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Food safety surveillance and response

Jenny Bishop[a] and Angelika Tritscher[b]

The food safety community is eagerly awaiting the first results of pilot studies from the World Health Organization's (WHO) *Initiative to Estimate the Global Burden of Foodborne Diseases*, which are due later this year. These studies were conducted in recognition of the growing threat posed by foodborne diseases worldwide to provide precise and comprehensive information on the magnitude of foodborne diseases to guide food safety policy, including the development and implementation of food safety standards in the context of the Codex Alimentarius Commission, and provide a baseline for monitoring and impact assessment of food safety measures. The Initiative operates through its advisory body, the Foodborne Disease Burden Epidemiology Reference Group (FERG) and comprises two main components:

(1) Track 1 at global level FERG (i) conducts epidemiological and toxicological reviews for mortality, morbidity and disability in each of the major foodborne diseases; (ii) assembles, appraises and reports on existing burden of foodborne disease estimates; (iii) provides models for the estimation of foodborne disease burden where data is lacking; (iv) develops source attribution models to estimate the proportion of disease that is foodborne; and (v) develops user-friendly tools for burden of foodborne diseases studies and policy situation analyses at country level.

(2) Track 2 focuses on burden of foodborne disease studies at country level which will provide first hand burden estimates and supplement FERG's epidemiological reviews.This will be supported by policy interventions to ensure that the burden data are meaningful to end-users and to foster research-up take.

As more burden of foodborne disease studies become available, the understanding of foodborne disease will transform from a limited diarrhoeal disease focus to one inclusive of a wide spectrum of foodborne illnesses, including chemical-related illnesses and relevant noncommunicable diseases. These studies also aim to address the problems posed by underreporting.[1] Surveillance systems are a key source of information to inform the burden of foodborne disease estimates.

It is accepted internationally that surveillance systems have a dual purpose; the first is to detect, control and prevent foodborne disease outbreaks. Most countries of the WHO Western Pacific Region have such surveillance and response systems in place, but the effectiveness and coverage of those systems vary widely from country to country. Norton *et al*[2] and Gunaratnam *et al*[3] outline such foodborne disease outbreak investigations, including their detection and control through food safety mechanisms. Johnston[4] discusses the food safety response to the 2010 and 2011 earthquakes in New Zealand, outlining the importance of developing emergency response plans for food safety and the use of risk analysis (risk assessment, risk management and risk communication) in emergency situations to prevent foodborne disease outbreaks.

The second purpose of surveillance systems is to inform longer-term issues, including: (1) identifying priorities and developing policy for the control and prevention of foodborne diseases; (2) estimating the burden of foodborne diseases and monitoring trends; and (3) evaluating foodborne disease prevention and control strategies.[5] The impact of using surveillance system data to address longer-term public health issues is successfully outlined by Campbell *et al* for foodborne *Campylobacter* in New Zealand. Here, surveillance data drove the development of interventions to successfully reduce the *Campylobacter* burden in New Zealand. The public health and financial benefits clearly display the power of such information. However, regrettably, across the Western Pacific Region, only a few countries have surveillance systems in place that can meet these objectives, severely impacting the efficiency of their food control systems.

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In 2011, health representatives from the Western Pacific Region endorsed the Western Pacific Regional Food Safety Strategy 2011–2015.[6] They urged Member States to use the Strategy as a framework for strengthening national food control systems to effectively protect public health, prevent fraud, avoid food adulteration and facilitate the sufficient availability of safe and healthy food.

The Strategy consists of the following seven themes:

(1) improved food control and coordination throughout the food-chain continuum and adequate funding;

(2) risk-based regulatory frameworks;

(3) improved availability of food safety data to better guide policy and risk analysis;

(4) inspection services;

(5) food safety training and education;

(6) capacity to detect, assess and manage food safety incidents and emergencies; and

(7) enhanced cooperative planning.

In terms of surveillance, theme 3 aims to introduce a systematic effort to collect, analyse and interpret data on food contaminants and food consumption and establish effective links with the public health system to improve the availability of attributable data on foodborne disease. Theme 6 aims to contribute to health security by enhancing capacities to detect, assess and manage food safety incidents and emergencies at national and international levels. This will be achieved by sharing relevant expertise, resources and information globally, regionally and subregionally.

For each of the themes, strategic actions have been developed in consultation with Member States and are currently being implemented. WHO also has several programmes, in addition to the *Initiative to Estimate the Global Burden of Foodborne Diseases*, which assist in the delivery of these strategic actions.

As discussed by Verger *et al*,[7] this includes the identification of chemicals in the food-chain and evaluation of their impact on human health through *Total Diet Studies* and the *Global Environment Monitoring System – Food Contamination Monitoring and Assessment Programme* (GEMS/Food). On the response side, institutes involved in GEMS/Food are increasingly assisting developing countries in the detection of hazards causing food safety emergencies. Such efforts are applauded by WHO and the international community.

The Global Foodborne Infections Network (GFN) aims to build capacity to detect, control and prevent foodborne and other enteric infections from farm to table by promoting integrated, laboratory-based surveillance and fostering intersectoral collaboration among human health, veterinary and food-related disciplines through training courses and activities around the world.

For both day-to-day food safety information sharing as well as food safety response activities, the International Food Safety Authorities Network (INFOSAN), a joint initiative between WHO and the Food and Agriculture Organization of the United Nations (FAO), was established in 2004. The network aims to: (1) promote the rapid exchange of information during food safety-related events; (2) share information on important food safety-related issues of global interest; (3) promote partnership and collaboration among countries; and (4) help countries strengthen their capacity to manage food safety risks. At present, a regionally-based strategy for enhancing participation in INFOSAN in Asia is under development and will be discussed later this year. Additionally, as part of efforts to strengthen INFOSAN and assist countries to detect, assess and manage food safety incidents and emergencies, and to assist in the building of core capacities defined by Annex 1 of the International Health Regulations (2005),[8] a series of guidance documents have been developed by FAO and WHO. Those documents provide a guidance on developing national food safety response systems, application of risk analysis principles and procedures during food safety emergencies, developing and improving national food recall systems (yet to be published) and investigation of foodborne disease outbreaks.

Foodborne disease continues to represent a serious threat to the health of millions of people in the world, global trade of food continues to increase and developing countries continue to struggle to find resources to address food safety challenges in a coordinated and long-term manner. It is imperative that we improve collaboration and partnerships to address surveillance and response challenges. This will help to ensure that the public health and financial impact of foodborne disease is limited in incidents and emergencies. It will also ensure that we are using our limited resources in the most effective manner to address public health concerns for the good of each country and for the good of global health security.

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Strengthening collaboration on chemical hazards in food among food safety authorities and the World Health Organization in the Western Pacific Region

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The World Health Organization (WHO), together with the Food and Agriculture Organization of the United Nations (FAO) is leading the scientific risk assessment of food at the international level. Within this process, dietary exposure is the only input that is country or region specific since consumption patterns, food composition and food contamination differ in various parts of the world.

The food consumption of populations in the Western Pacific Region belong to two of the 13 WHO food consumption cluster diets (Clusters G & L),[1] meaning that consumption patterns are relatively homogeneous within the region but significantly different from the rest of the world. Although there is wide consensus on risk analysis principles and methods, the challenge remains to obtain a strong commitment from individual countries to collect specific data to support the scientific evaluation. This is particularly true for the exposure assessment component of the risk assessment for chemical hazards in food, which are extremely data-driven and for which the need for collecting and sharing data is critical.

The objectives of this paper are to highlight the benefits of sharing information to Western Pacific Region Member States and to identify similarities at the regional level in terms of food safety issues and public health protection. In addition, it aims to propose an improved partnership among regional food safety authorities and WHO on targeted objectives.

During the last 10 to 20 years, the amount of data collected at the national level to measure various chemicals in food increased more in the Western Pacific Region than anywhere else in the world. This increase could be due to the increase of food trade (both import and export)[2] and the strengthening of surveillance and monitoring plans in reaction to several food crises (e.g. acrylamide, melamine, di(2-ethylhexyl)phthalate). In the field of chemical hazards, controls were traditionally based on conformity checks: a yes/no response against the regulatory limit, meaning that the results could not be quantified. Now, with more accurate methods used for risk assessment, results can be quantified. Several countries in the Western Pacific Region are conducting Total Diet Studies (TDS) on a regular basis, in addition to monitoring individual commodities, to obtain a global indicator of the average level of chemicals in commonly consumed foods.[3]

Similarly, many of the countries in the Western Pacific Region are conducting national food consumption surveys on individuals and implementing other monitoring of the population (e.g. body weight and other health parameters) to better characterize consumers and therefore to better protect them during the food standards setting and implementation process. However, the level of food monitoring is not homogeneous among countries and not all countries have the human and financial resources for implementing a full national system covering each component of the risk analysis process.

One of the main concerns is guaranteeing accurate data for each population and age group all around the world. Relying exclusively on per capita data may not always account for specific groups of consumers and in

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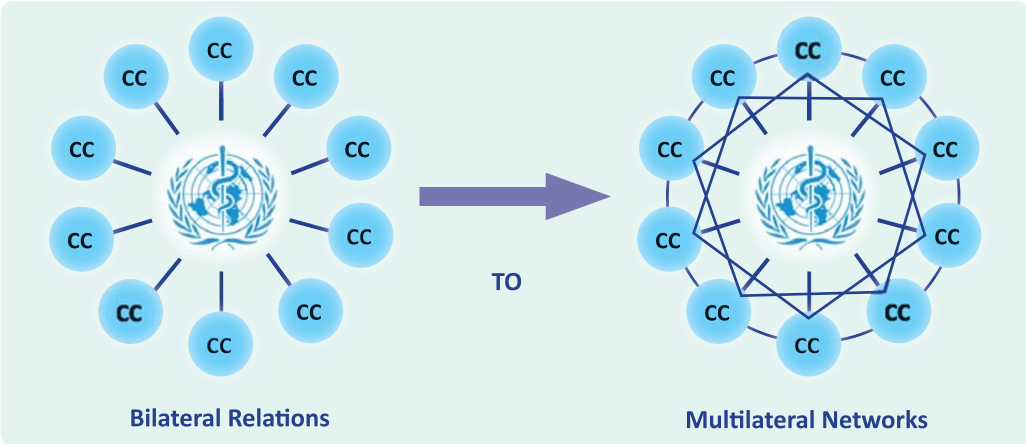
Figure 1. **Strengthening collaboration: moving from bilateral relations to multilateral networks**



CC = Collaborating Centre

particular for children.[4] A major step forward would be to create a harmonized database for populations by age group. This would allow children in the Western Pacific Region to be considered accurately in the exposure assessments to various chemicals. Such a database could collect available data on food consumption, portion sizes and body weights from various countries using a single format. It would increase the voice of the Western Pacific Region in the international arena and close the gap of countries without a monitoring system in place. A similar project has already been initiated in 2011 by the Association of Southeast Asian Nations.[5]

It is also important to establish priorities for food chemical monitoring. These priorities could be regional and based on a screening of chemicals more likely to occur in staple food and for which remediation measures could be needed. The example of inorganic arsenic in rice is a good one for a regional concern for public health.[6] Moreover, regional monitoring would also allow for the observation of chemical occurrence trends on a long-term basis, in particular when mitigation measures are implemented. To complement the national system of food monitoring, the TDS approach is recommended as the most cost-effective screening tool to estimate the average chemical exposure of the population. Such a methodology implemented at the regional level would allow for better identification of chemicals for which national monitoring and observation of regional trends for food chemical contamination should be recommended. It would also allow countries without a full system for food regulation to prioritize their objectives.

WHO is offering a global platform as well as a possible common format for data collection through the Global Environment Monitoring System - Food Contamination Monitoring and Assessment Programme (GEMS/Food).[7]

The Western Pacific Region is playing a leading role in GEMS/Food, with five WHO collaborating centres and eight national institutions participating in data collection. WHO has also developed, as a part of GEMS/Food, a web-based system called OPAL-web to facilitate the collection of food contamination data from TDS and other types of surveys under a unique format. This OPAL-web system should be expanded to include the collection of food consumption data and other physiological characteristics of consumer groups. Future developments should also facilitate accessibility to WHO data needed for risk assessment and emergency preparedness.

Consistent with the *Western Pacific Regional Food Safety Strategy 2011–2015*, all relevant institutions owning data and not yet participating in GEMS/Food and/or FOSCOLLAB[8] are invited to join and to share data, information and scientific expertise in the field of dietary exposure assessment. It is also proposed to initiate networking activities between WHO and collaborating institutions in the Western Pacific Region instead of maintaining the traditional bilateral relationship among WHO and each of the national institutions (**Figure 1**).

Conflicts of interests

None declared.

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Surveillance for action – managing foodborne *Campylobacter* in New Zealand

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Public health surveillance is the continuous, systematic collection, analysis and interpretation of health-related data needed for the planning, implementation and evaluation of public health practice.[1] It can serve as an early warning system for impending public health emergencies; document the impact of an intervention, or track progress towards specified goals; and monitor and clarify the epidemiology of health problems, to allow priorities to be set and to inform public health policy and strategies.

In New Zealand, information gathered by the human disease surveillance system has been used to inform its well-documented, science-based Food Safety Risk Management Framework and response to an increasing national public health problem–campylobacteriosis. This paper discusses the use of surveillance data in initial prioritization, goal setting, source attribution and monitoring and review for *Campylobacter* infection in New Zealand.

Disease notifications provide the basis for surveillance and hence disease control in New Zealand. Health professionals and laboratories are required to inform their local Medical Officer of Health of any notifiable disease that they suspect or diagnose. These data are collated nationally, with the Ministry of Health being the responsible agency for human disease investigation and the Ministry of Agriculture and Forestry (MAF), formerly New Zealand Food Safety Authority (NZFSA), for food safety. Campylobacteriosis was made a notifiable disease in New Zealand in 1980.

The New Zealand Food Safety Risk Management Framework ensures that all aspects of internationally recognized risk analysis practice, i.e. risk assessment, risk management, risk communication and the regulatory components of monitoring and review, are brought together in a logical manner to maximize the benefits available from a risk-based approach to food safety.[2] National human health surveillance activities are an important contributor to these MAF activities. To determine the effectiveness of food safety regulatory activities in consumer protection terms, food-chain monitoring and human health surveillance data are combined where possible. This may be carried out ahead of the implementation of risk management activities so as to establish baseline levels, or may follow their implementation. When setting outcomes related to consumer health, MAF wishes to be able, with a reasonable degree of certainty, to show that a change (or lack of) in disease incidence can be attributed to the organization's actions.

The successful control of foodborne disease requires knowledge about the most important sources or reservoirs as well as their principal routes. To identify and prioritize food safety interventions it is important to identify not only the fraction of incidence of human illness attributable to particular foods but also what is attributable to other sources such as environmental exposure, direct animal contact and human-to-human exchange.[3] Attribution of human foodborne diseases to source can be achieved using different methods but all depend on robust disease surveillance data. The ultimate goal is to partition the burden of disease caused by a pathogen to specific food commodities.

New Zealand has high population disease rates of several potentially foodborne diseases, especially campylobacteriosis.[4] The incidence rose steadily from the mid-1980s to a peak in 2006 with 15 873 cases notified (384 cases per 100 000 population), the highest reported rate internationally for this disease.[5] Sporadic and outbreak surveillance data, epidemiological studies, expert elicitation and microbiological (genotypic) source attribution approaches have been used to estimate

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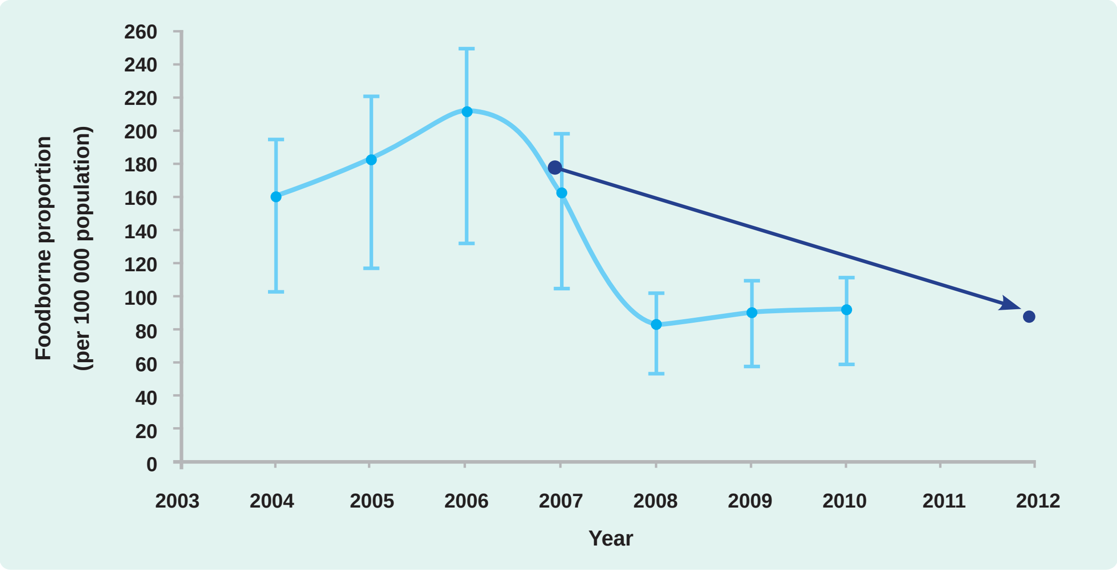
the contribution of food and environmental sources to the incidence of campylobacteriosis.[6–8] All have demonstrated that >50% of sporadic cases were attributable to poultry. Risk ranking, where different pathogens are graded against each other, has also shown that *Camplyocbacter* accounts for the greatest proportion of the overall burden of disease in New Zealand.[9] These findings gave direction to the implementation of the MAF *Campylobacter* Strategies.

From 2007, the then NZFSA and the poultry industry introduced a range of regulatory and voluntary measures aimed at reducing levels of *Campylobacter* on fresh chicken meat. From April 2007, poultry processors were required to report *Campylobacter* contamination levels at the end of primary processing to the MAF-managed National Microbiological Database (NMD); in April 2008, mandatory *Campylobacter* performance targets based on enumerated levels commenced; not more than six samples from 45 collected will have >6000 colony forming units per carcass.[10] If processing plants exceed the six-sample limit, progressively greater sanctions are applied that can ultimately result in plant closure. Following the introduction of these controls, there were 9000 fewer notified cases of campylobacteriosis with 500 fewer hospitalizations in 2008 compared to 2006.[4]

One of the public health goals set by MAF for the five-year period 2008–2012 was a 50% reduction in the domestically acquired foodborne component of campylobacteriosis. To deliver this challenging target, a thermotolerant *Campylobacer* control strategy was developed. To scrutinize success of the strategy and progress against the public health goals, a monitoring system using surveillance data was developed.[4] The statistics used are the annual (calendar year) number (per 100 000 mid-year population estimate) of notified cases with the baseline year being the average of 2004–2007. The measurements are adjusted for the proportion of cases reported as having travelled overseas during likely incubation period and for the proportion of disease estimated to be due to foodborne transmission based on expert elicitation. In 2010, the rate of foodborne camplylobacteriosis had decreased to 90.6 per 100 000 (most likely estimates 58.5–109.7)[4] (**Figure 1**).

When using human surveillance data, uncertainties arise due to underreporting of the true incidence of disease. Notified cases of illness and reported outbreaks represent a subset of all cases and outbreaks that occur. By using these data as indicators, it is assumed that they are representative of all the cases and outbreaks that occur in New Zealand. However, many cases do not visit a general medical practitioner or otherwise come to the attention of the medical system. It has been estimated that for every one notified case of gastrointestinal disease of infectious etilogy, there are 222 (5th and 95th percentiles 199–247) occuring in the community.[11]

Figure 1. **Annual trend in estimated foodborne campylobacteriosis against five-year (2008–2012) goal, New Zealand[4]**



Note: The blue arrowed line represents the trend line from the baseline year (average of 2004–2007) to the five-year target (blue dot).

In recent United States of America and United Kingdom studies the under-ascertainment for campylobacteriosis is estimated to be by factors of 30.3 and 9.5.[12,13] In addition, the estimates of the proportion of a disease that is foodborne have variable, wide confidence limits.[9] These issues are not surprising as human disease surveillance systems are, in the main, control rather than strategy focused.

MAF has been fortunate to be able to integrate disease surveillance data with the poultry primary processing microbiological findings recorded in NMD. An association has been demonstrated between the decrease in *Campylobacter* carcass counts and the decline in human campylobacteriosis. This allowed the validation by statistical risk modelling of its *Campylobacter*-reduction initiatives. It is rare to be able to substantiate such approaches in the real food safety world.

Surveillance of diseases that could be acquired from food has a pivotal role in informing all parts of MAF activities, from the development of its strategic priorities through to measurement of its agreed outputs and outcomes. The campylobacteriosis decline has been maintained, with there now being an estimated 70 000 fewer cases each year overall in the community.[4,11] There is good evidence that the *Campylobacter* Strategy has been responsible for a reduction in the annual number of cases of campylobacteriosis between 2006 and 2009 of some 53%, with a saving of the order of US$ 40 million annually.[14]

New Zealand is on course to meet its five-year campylobacteriosis reduction goal. However, the notified disease rate remains unacceptably high. Further work, such as a re-evaluation of the present *Campylobacter* poultry performance target, is ongoing, but initiatives to reduce the burden from non-foodborne sources are required also.

Conflicts of interest

None declared.

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Use of a prohibition order after a large outbreak of gastroenteritis caused by norovirus among function attendees

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Introduction: In May 2011, an outbreak of acute gastroenteritis occurred among guests attending two functions (Function A and B) at a local function centre in Sydney, Australia. The Sydney South West Public Health Unit and the New South Wales (NSW) Food Authority sought to determine the cause of the outbreak and implement control measures.

Methods: A retrospective cohort study was planned. A complete guest list was unavailable, so guests who could be contacted were asked to provide details of other guests. Attendee demographics, symptom profile and food histories were obtained using a standard response questionnaire. Stool samples were requested from symptomatic guests. The NSW Food Authority conducted a site inspection.

Results: Of those interviewed, 73% of Function A guests and 62% of Function B guests were ill, with mean incubation times of 27 and 23 hours respectively. Diarrhoea was the most common symptom. Three stool samples and four environmental swabs were positive for norovirus. One food handler reported feeling ill before and during the functions. A prohibition order was used to stop food handlers implicated in the outbreak from preparing food.

Discussion: This outbreak strongly suggests transmission of norovirus, possibly caused by an infected food handler. Regulatory measures such as prohibition orders can be effective in enforcing infection control standards and minimising ongoing public health risk.

Norovirus is well recognized as the leading cause of acute gastroenteritis worldwide, and in Australia alone there are an estimated 1.8 million cases every year.[1] Outbreaks are most common in settings such as aged care facilities, hospitals and restaurants where people are in close proximity to one another.[2] Food handlers have been identified as the route of transmission in numerous norovirus outbreaks, with uncooked foods, such as salads, most likely to be contaminated.[3–9] Infected people can continue to shed norovirus after cessation of symptoms, with one study finding that stool samples were positive by polymerase chain reaction (PCR) for norovirus up to three weeks after the onset of illness.[10]

In New South Wales (NSW), the responsibility for investigating suspected outbreaks of foodborne illness and implementing control measures is shared between the local public health unit, which conducts the epidemiological investigation, and the NSW Food Authority, which conducts the environmental investigations. Investigations are conducted in line with national and state guidelines. [11,12]

The NSW Food Act 2003 allows the NSW Food Authority to sanction establishments that are not complying with food safety standards. In more serious circumstances, where food safety standards are breached and the NSW Food Authority believes action is needed to prevent or mitigate risk to public health, a prohibition order may be served.[13] Food legislation in most Australian jurisdictions contain similar provisions.

A prohibition order prevents the use of specific equipment and/or the sale of particular or all foods from a premise. A prohibition order remains in place until a Certificate of Clearance is issued by the NSW Food Authority stating that the business is fit

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to handle food. Conditions for issuing a Certificate of Clearance can include sufficient cleaning and disinfection of the premises, food safety training for staff and documentation confirming that food handlers employed at the premises are not having, or carrying, a foodborne disease.[13]

In May 2011, the NSW Food Authority notified Sydney South West Public Health Unit of three separate groups totalling 31 people who had become ill with gastrointestinal symptoms following attendance at a dinner two days earlier at a local function centre (Function A). On that same day, a local Emergency Department reported two additional unwell people, unknown to each other, who reported attending Function A with family and friends. This paper describes the investigation of the outbreak and control measures taken to minimize ongoing public health risk.

METHODS

Epidemiological Investigation

A retrospective cohort study was planned to help determine the causative agent and its transmission route i.e. person-to-person or foodborne.

Preliminary information from the NSW Food Authority indicated a lunch was also held the following day at the same venue (Function B). Contact details for event organizers and a small number of the guests attending one or both functions were obtained through the NSW Food Authority. A complete guest list was unavailable from event organizers, only details of the person who purchased the tickets for their group. Guests interviewed were asked to provide names and contact details of other attendees, thus generating a list of 105/260 (40.3%) guests attending Function A and 46/150 (30.6%) attending Function B.

Demographics, symptom profile and detailed food histories were obtained using a standard initial response questionnaire. The food history section was updated to include: foods consumed at the function; illness or contact with ill people before the function; and to determine if ill persons were more likely to sit together, seating placement of persons within the function room.

The NSW Food Authority also provided contact details for six food handlers who had worked at the function centre over the two days. Staff demographics, symptom profile, food histories and hours of work were obtained using a standardized questionnaire.

Interviews were administered by telephone by public health officers at Sydney South West Public Health Unit over the six days following notification. Where contact was not possible on the first phone call, the public health officer would attempt up to three repeat phone calls at different times and on different days to reach the guest.

A case was defined as a person who has vomiting or diarrhoea with nausea or abdominal pain and attended either Function A or B. A secondary case was defined as a contact of a confirmed case who developed vomiting or diarrhoea with nausea or abdominal pain more than 72 hours after the function occurred.

Statistical analysis of interview data was carried out using Statistical Analysis Software (SAS) version 9.2. The detailed cohort analysis is not presented due to low response rate.

Environmental Investigation

A food premises inspection was conducted by the NSW Food Authority the day following notification. Managers and food handlers were interviewed regarding infection control, preparation techniques and food storage. During the inspection the menu was reviewed and swabs were taken from around the premises. Samples were not available for all foods consumed, but residual samples of the octopus, black olives, feta cheese and tzatziki were taken to test for viral particles and bacterial contamination.

Microbiological Investigation

Stool samples were requested from symptomatic guests and food handlers. Specimens were tested for viruses (norovirus, rotavirus and adenovirus) by enzyme immunoassay (EIA) at two public hospital laboratories, using the RIDASCREEN norovirus EIA kit (R-Biopharm AG, Darmstadt, Germany), which tests for the norovirus genogroups I and II. Specimens were also tested for bacterial pathogens (*Salmonella*, *Shigella* and *Campylobacter*) using PCR or culture, for *Clostridium difficile* by EIA and for ova, cysts and parasites by microscopy.

Norovirus genogrouping and phylogenetic analysis was conducted at the University of NSW using real-time reverse transcription PCR. This analysis compared two of the positive stool samples with the environmental norovirus isolates found at the premises. The RNA was extracted from the stool samples using the Viral RNA Mini kit (Qiagen Inc., Valencia, CA, USA) and DNA synthesized using the SuperScript VILO cDNA Synthesis kit (Invitrogen, Grand Island, NY, USA). RNA extraction and DNA synthesis from the environmental samples was done at the Molecular Microbiology Laboratory at the Division of Analytical Laboratories using an in-house kit for RNA extraction and the cDNA Synthesis kit (Bioline, Tauton, MA, USA).

RESULTS

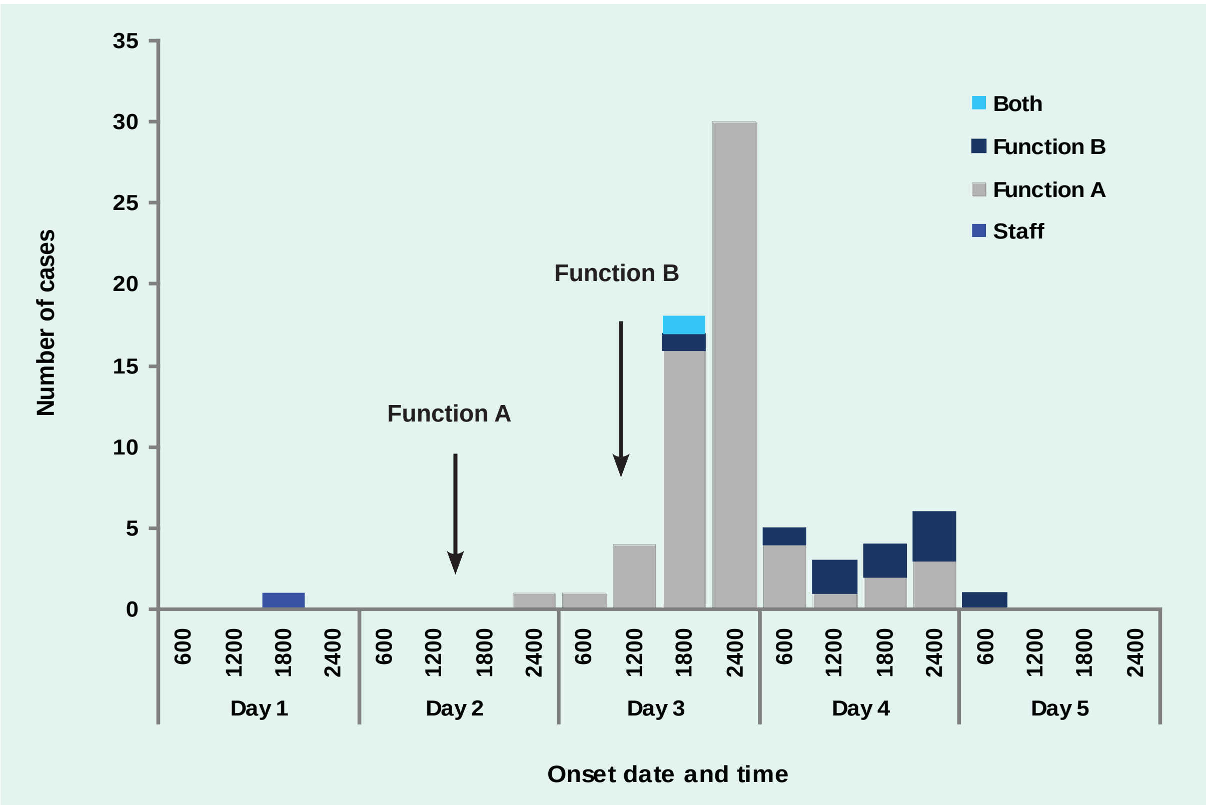
Epidemiological Investigation

Of the 151 guests whose contact details were obtained, 109 (72%) were interviewed. Of the 109, 88 attended Function A and 21 attended Function B. Two people interviewed attended both functions. Two people declined to be interviewed and the remaining 40 could not be contacted by phone because a wrong number was provided or there was no answer after repeated calls. Of the people interviewed, 64 (73%) Function A guests and 13 (62%) Function B guests were ill following their respective function.

Most cases interviewed were between the ages of 60 and 79. The median age of cases was 68 years (range 6 to 84). Diarrhoea was the most common symptom among cases (92% at Function A, 77% at Function B), followed by nausea (84% and 69%) and vomiting (84% and 69%). Twenty-two (34%) of the Function A cases and seven (54%) of the Function B cases visited their doctor or an emergency department.

The time between attendance and onset of symptoms ranged from 7 to 53 hours (mean 27 hours) for Function A cases and from 3 to 30 hours (mean 23 hours) for Function B cases. One guest had an incubation time of over four days and was classified as a secondary case. No guests reported developing symptoms at the function, though two guests attending Function A had short onset times of seven and eight hours after the event. One Function B guest who also attended Function A reported onset of symptoms three hours after Function B (**Figure 1**).

Figure 1. **Onset of symptoms among cases in a gastroenteritis outbreak in Sydney, May 2011**



One food handler reported feeling ill 24 hours before the start of Function A, with diarrhoea and vomiting starting on the morning of Function A and continuing for four days. Prior to Function A the food handler vomited once at work, though precise location was not reported. The food handler prepared food for both functions while unwell. No other food handler reported illness. Information about staff food consumption and symptoms was not included in the analysis due to small numbers.

The mean duration of illness for Function A cases was 48 hours (range 2–144 hours) with nine guests still unwell at the time of interview. The mean duration for Function B cases was also 48 hours (range 9–96 hours) with one guest still unwell at the time of interview.

Exposure information was collected for possible food exposures and person-to-person transmission, with the intention of calculating relative risks for each of the 20 foods available at either one or both functions. However, due to the low response rate, it was not possible to undertake valid analysis of the food exposure data. Information on seating arrangements revealed ill persons were no more likely to be seated in any particular area of the function room compared to those not reporting illness and was also not analysed further.

Environmental Investigation

Food hygiene inspection

Catering at both events consisted of mostly processed and fried foods. Items made on site included Greek salad and tzatziki. The ill food handler was involved in making the tzatziki and preparing and placing processed foods onto individual plates. Assessment of food handlers identified a lack of skills and knowledge around food safety and deficiencies in cleaning and sanitizing of food contact surfaces of equipment and utensils. The premises had no documented policy prohibiting food handlers from working while having a suspected foodborne illness. There was only one set of male and female toilets on the premises, with staff and guests using the same facilities.

Public health intervention

Three days following notification, the NSW Food Authority supervised a thorough cleaning of the premises and issued a prohibition order. No food preparation was undertaken by the business during the three days between notification of the incident and service of the prohibition order. This was the first time a prohibition order was issued in the absence of microbiological confirmation.

The order was issued on the basis that, given the number of ill attendees, lack of food safety skills and knowledge and potential for further infection of food handlers, there was a high risk of ongoing illness associated with the premises. The apparent inability to grasp the seriousness of an ill food handler working while infectious made non-compliance possible and the order necessary.

The prohibition order required the premise operators to undertake and provide details to the NSW Food Authority of measures to ensure all food handlers working were not having symptoms of foodborne illness, that all food handlers had skills and knowledge of food safety and hygiene appropriate to their work activities as per the Food Standards Code and that all utensils and surfaces were adequately cleaned and sanitized.[14] The operators were also required to provide a list of staff cleared to work in food handling. Any person excluded from work was allowed to return only after being examined by a medical practitioner and cleared of any gastrointestinal illness.

Under the prohibition order, the business remained closed for two weeks while staff training was completed, the premises sanitized and re-inspected and documentation provided to show food handlers were no longer ill and were aware of health and hygiene requirements. Following this, a Certificate of Clearance was issued.

Microbiological Investigation

Stool samples were collected from eight guests and one food handler. Three stool specimens were positive for norovirus, five stool specimens (including the specimen from the food handler) were negative.

Four of the 22 environmental swabs – from the metal handle of a ladle from the kitchen, a tap in the ladies toilet, a microwave metal door and an oven handle – were positive for norovirus. Only one environmental swab (oven door handle) and stool samples from two guests could be genotyped, with all samples identified as a norovirus GII.4 variant and identical to each other.

DISCUSSION

This investigation confirmed an outbreak of norovirus, with a possible cause being an infected food handler. The investigation highlights the role of timely and definitive regulatory action in minimizing public health risk where infection control breaches are suspected based on preliminary information, even before microbiological evidence is available.

Evidence of microbiological or chemical contamination and/or critical hygiene defects is usually required before a prohibition order can be issued. In this instance the initial outbreak investigation – and in particular indication of a sick food handler – provided sufficient evidence of ongoing risk to the public for the NSW Food Authority to issue a prohibition order while microbiological confirmation was being sought. As it was unknown if secondary transmission to other food handlers had occurred, the prohibition order prevented these staff from working until well after the period of exposure to norovirus (14 days) and required the function premises to remain closed until breaches of food safety (i.e. food handling practices by staff) were rectified.

Testing of all food handlers was considered but not pursued. People can continue to shed norovirus after symptoms cease and a positive norovirus result does not necessarily indicate a person is still infectious. There is no evidence that infected food handlers should be excluded from the workplace for longer than 48 hours after cessation of symptoms.[11] Training food handlers and ensuring standard infection control procedures are followed at all times was believed to be the best way of minimizing the risk of future outbreaks at the premises.

Norovirus was isolated in three stool specimens and in four environmental swabs; the symptom profile and incubation period for cases is consistent with norovirus. The variant GII.4 is predominant in norovirus outbreaks globally.[3] This strain was first identified in NSW in 2009 and has been the dominant GII.4 variant in the state since then (personal communication, Peter White, 24 April 2012). The cohort was elderly and norovirus infection is more frequent in adults over 65 years.[3] Symptoms reported by guests were slightly unusual as diarrhoea was the most common symptom, rather than nausea or vomiting.

The investigation indicated a possible source of infection was an ill food handler: there was a clear description of a foodhandler who became ill before the event and was ill while working. Also, food preparation areas were found to be positive for norovirus. This indicates the virus spread from the kitchen to the function room. Two stool samples from ill patrons were also positive for norovirus with the same genotype as the environmental swab.

Transmission between guests, or as a result of environmental contamination in areas shared by guests and food handlers, such as the toilets, is also possible given the high prevalence of norovirus in the community.[11] Two guests at Function A reported onset of illness only seven and eight hours afterward, indicating they may have been infected but asymptomatic at the function. Similarly, a guest who attended both Function A and Function B developed symptoms three hours after Function B. These guests are unlikely to be the sole cause of the outbreak given the unclear role of asymptomatic infection in transmission of norovirus.[3,11]

This epidemiological investigation was limited due to a full guest list not being available and only a subset of the total number of guests attending being interviewed. This resulted in incomplete information about the symptoms and food histories of all guests who attended the two functions. Relative risks for food exposures could not be reliably calculated, so foodborne transmission cannot be excluded. Ascertainment bias may have been introduced by asking for referrals from guests who had been ill, leading to overrepresentation of ill patrons in the sample.

The investigation team was also not able to obtain a full list of food handlers working over the weekend. Of the eight people for whom contact details were obtained, two refused to be interviewed or give personal information and one person could not be contacted. This may have resulted in under-ascertainment of cases among food handlers.

Norovirus was not detected in five specimens, including the specimen from the ill food handler despite symptoms consistent with norovirus infection. There are two potential reasons for the failure to detect norovirus in the specimens. One, the reported sensitivity and specificity of the RIDASCREEN norovirus kit varies widely from 71%–80.3% to 47%–100% respectively.[15,16] The second reason relates to the quality and timeliness of stool samples. Samples must be collected as soon as possible after the onset of symptoms and ideally within three days for optimal results for testing with the RIDASCREEN norovirus EIA kit. The fact that the specimen from the food handler was collected at least one week after the onset of symptoms may have contributed to the negative result.[17]

This investigation highlights the importance of maintaining infection control in premises where food is served. Regular hand washing and cleaning and disinfection of premises should be promoted and food handlers exempted from work while they have symptoms of gastroenteritis. In cases with a demonstrable ongoing risk to public health, prohibition orders are effective measures in preventing further outbreaks while the premise is instituting infection control measures.

Conflicts of interest

None declared.

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A large point-source outbreak of *Salmonella* Typhimurium linked to chicken, pork and salad rolls from a Vietnamese bakery in Sydney

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Introduction: In January 2011, Sydney South West Public Health Unit was notified of a large number of people presenting with gastroenteritis over two days at a local hospital emergency department (ED).

Methods: Case-finding was conducted through hospital EDs and general practitioners, which resulted in the notification of 154 possible cases, from which 83 outbreak cases were identified. Fifty-eight cases were interviewed about demographics, symptom profile and food histories. Stool samples were collected and submitted for analysis. An inspection was conducted at a Vietnamese bakery and food samples were collected and submitted for analysis. Further case ascertainment occurred to ensure control measures were successful.

Results: Of the 58 interviewed cases, the symptom profile included diarrhoea (100%), fever (79.3%) and vomiting (89.7%). *Salmonella* Typhimurium multiple-locus-variable number tandem repeats analysis (MLVA) type 3-10-8-9-523 was identified in 95.9% (47/49) of stool samples. Cases reported consuming chicken, pork or salad rolls from a single Vietnamese bakery. Environmental swabs detected widespread contamination with *Salmonella* at the premises.

Discussion: This was a large point-source outbreak associated with the consumption of Vietnamese-style pork, chicken and salad rolls. These foods have been responsible for significant outbreaks in the past. The typical ingredients of raw egg butter or mayonnaise and pate are often implicated, as are the food-handling practices in food outlets. This indicates the need for education in better food-handling practices, including the benefits of using safer products. Ongoing surveillance will monitor the success of new food regulations introduced in New South Wales during 2011 for improving food-handling practices and reducing foodborne illness.

In Australia, it is estimated that there are 5.4 million cases of gastroenteritis caused by contaminated food each year, accounting for approximately one third of all gastroenteritis cases in the country. Consequently there are 1.2 million visits to doctors, 18 000 hospital admissions and approximately 120 deaths annually due to foodborne illness.[1] Various types of *Salmonella* are commonly identified as the etiological agent and *Salmonella* Typhimurium (STM) is the most commonly notified serovar in Australia.[2]

On 4 January 2011, a hospital emergency department (ED) in Sydney, Australia notified the Sydney South West Public Health Unit (SSWPHU) of an increased number of gastroenteritis presentations during the previous evening. On the same afternoon three cases were interviewed; however, no common exposures were identified.

The next day, the hospital notified SSWPHU of additional gastroenteritis cases presenting overnight, with all patients reporting consumption of pork or chicken rolls from a bakery in the area. An outbreak investigation was initiated incorporating epidemiological, environmental and laboratory elements. This paper describes the public health investigation and response to a foodborne outbreak caused by STM from a commercial food outlet.

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METHODS

Epidemiological Investigation

Case-finding was conducted by requesting daily reports from five EDs closest to the bakery premises. General Practitioners (GP) in the local area and other Public Health Units in New South Wales (NSW) were alerted to the outbreak and asked to report possible cases. EDs and GPs were also asked to take stool samples from possible cases. A possible case was defined as: an individual with diarrhoea and either vomiting or fever, with an illness onset after 1 January 2011 and who attended a hospital ED or a GP practice.

To confirm that food from the bakery was the only common exposure, detailed food histories for the three days preceding illness onset were obtained for the first 26 cases notified to SSWPHU. Other possible cases were interviewed using a shorter standardized questionnaire to confirm exposure, onset date, symptoms, date of exposure and details of foods consumed from the bakery. Where a person was unable to be contacted directly, a cases linkage to the bakery was verified by clinician documentation in electronic hospital notes, direct discussion with the treating clinician or a relative.

Subsequently, after an association with food consumed from the bakery was established, a bakery-linked case was defined as an individual with diarrhoea and/or vomiting or fever with illness onset after 1 January 2011 and who ate food prepared at the bakery between 30 December 2010 and 5 January 2011.

Bakery staff were also interviewed using the standardized questionnaire to identify illness and exposure details.

Data were entered in Microsoft Excel 2007 and analysed using Statistical Analysis Software (SAS) System version 9.2.

Environmental Investigation

The NSW Food Authority, the regulatory body responsible for food safety in NSW, was notified of the outbreak on the morning of 5 January 2011. An inspection of the suspect premises was conducted on the afternoon of 5 January 2011, by which time SSWPHU had conducted approximately 10 of 26 hypothesis-generating long interviews, all identifying a Vietnamese bakery at a particular street location where pork/chicken/salad rolls had been purchased in the 48 hours before illness onset.

Food-handling and cleaning practices were reviewed by the NSW Food Authority. Environmental swabs and food samples were collected from the bakery for microbial testing. Food samples included chicken, pork, ham, egg butter, mayonnaise, pate and a variety of other foods stored in the chilled food display cabinet. A trace-back of suspect foods served at the premises was initiated.

Laboratory Investigation

Faecal specimens were cultured at laboratories throughout Sydney. Clinical *Salmonella* isolates were sent to the Centre for Infectious Disease and Microbiology Laboratory Service (CIDMLS) in Sydney for typing. Food and environmental samples were tested by the Division of Analytical Laboratories. Multiple-locus-variable number tandem repeats analysis (MLVA)[3,4] was performed on the clinical, food and environmental isolates by CIDMLS. Food and environmental specimens were phage typed at the Institute of Medical and Veterinary Science in Adelaide, South Australia. All results were then collated by SSWPHU. Phage typing is not routinely carried out on clinical specimens in NSW.

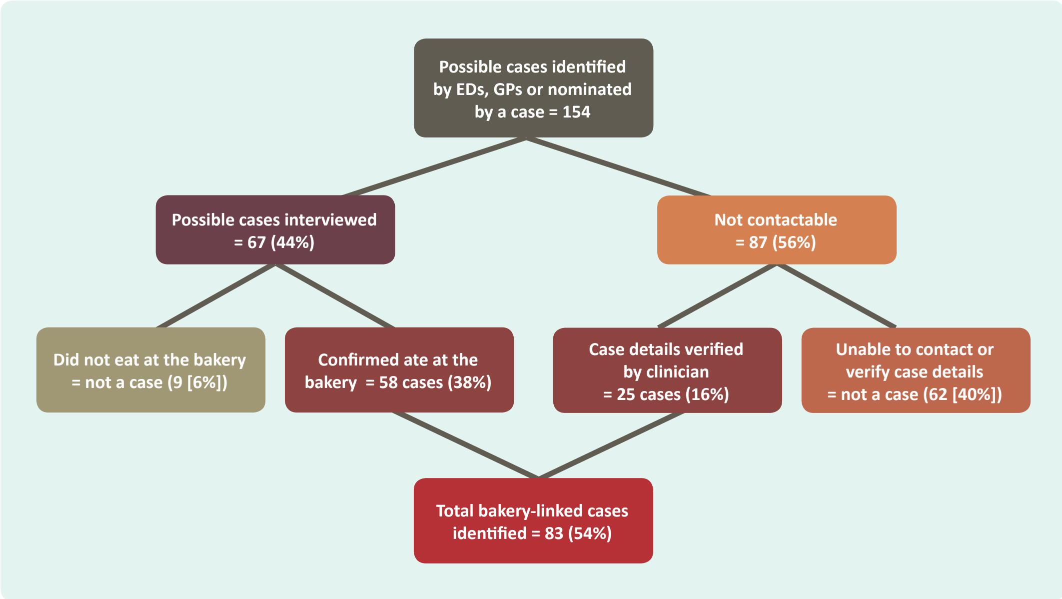
All *Salmonella* isolates within NSW are referred to CIDMLS for serotyping and MLVA typing if appropriate. STM MLVA data from the outbreak period were obtained from NSW Ministry of Health to assess whether there were other cases of the outbreak strain occurring at this time. Data with an MLVA type consistent with the investigation were compared with background rates of the same type. No extra interviews were conducted as there was a delay in reporting of MLVA data and extra interviews would not have contributed to control efforts at that point.

RESULTS

Epidemiological Investigation

The SSWPHU was notified of 154 possible cases by EDs and GPs. Of these, 83 cases were identified as being linked to the bakery. Sixty-two cases were reported by EDs and GPs but were not interviewed and

Figure 1. **Verification process for linking reported cases to the outbreak, Sydney, January 2011**



no information was available on place of exposure and foods consumed. Nine possible cases were interviewed and subsequently excluded. Fifty-eight of the 83 bakery-linked cases were interviewed directly, while the remaining 25 were confirmed through documentation by the clinician in electronic hospital notes accessible to SSWPHU or through discussions with the treating clinician or a relative (**Figure 1**).

Of the first 26 cases notified to SSWPHU, 21 (81%) had consumed food from a single Vietnamese bakery in the three days before onset of illness.

The median age of interviewed bakery-linked cases was 27.5 years (range, 1 to 75 years) and most cases were female (**Table 1**). The peak of the outbreak occurred between 3 and 5 January 2011, with 86% (50/58) of cases reporting disease onset on these three dates (**Figure 2**). The median incubation period reported was one day (ranging from less than one day to three days) with 40% (23/58) of cases reporting an incubation period of less than one day. Demographic and clinical characteristics of interviewed bakery-linked cases are contained in **Table 1**.

Of the 83 known bakery-linked cases, 64 (77%) sought medical attention: six (7%) cases visited a GP, 38 (46%) cases were reviewed in an ED and 20 (24%) cases were admitted to hospital.

Table 1. **Demographic and clinical characteristics for interviewed bakery-linked cases, *Salmonella* Typhimurium outbreak, Sydney, January 2011 (*n* = 58)**

Characteristic	n	%
Sex		
Female	43	74.1
Male	15	25.9
Age group		
0–9	4	6.9
10–19	3	5.2
20–29	20	34.5
30–39	10	17.2
40–49	6	10.3
50–59	6	10.3
60+	1	1.7
Unknown	8	13.8
Symptoms		
Diarrhoea	58	100.0
Vomiting	52	89.7
Fever	46	79.3

All but one case purchased food from the bakery over a four-day period (2 to 5 January 2011). This case reported purchasing food on 30 December 2010 and became unwell on 2 January 2011, but no stool specimen was taken. No further cases were identified after

Figure 2. **Number of interviewed bakery-linked cases by date of onset and date of purchase, *Salmonella* Typhimurium outbreak, Sydney, January 2011 (*n*=58)**

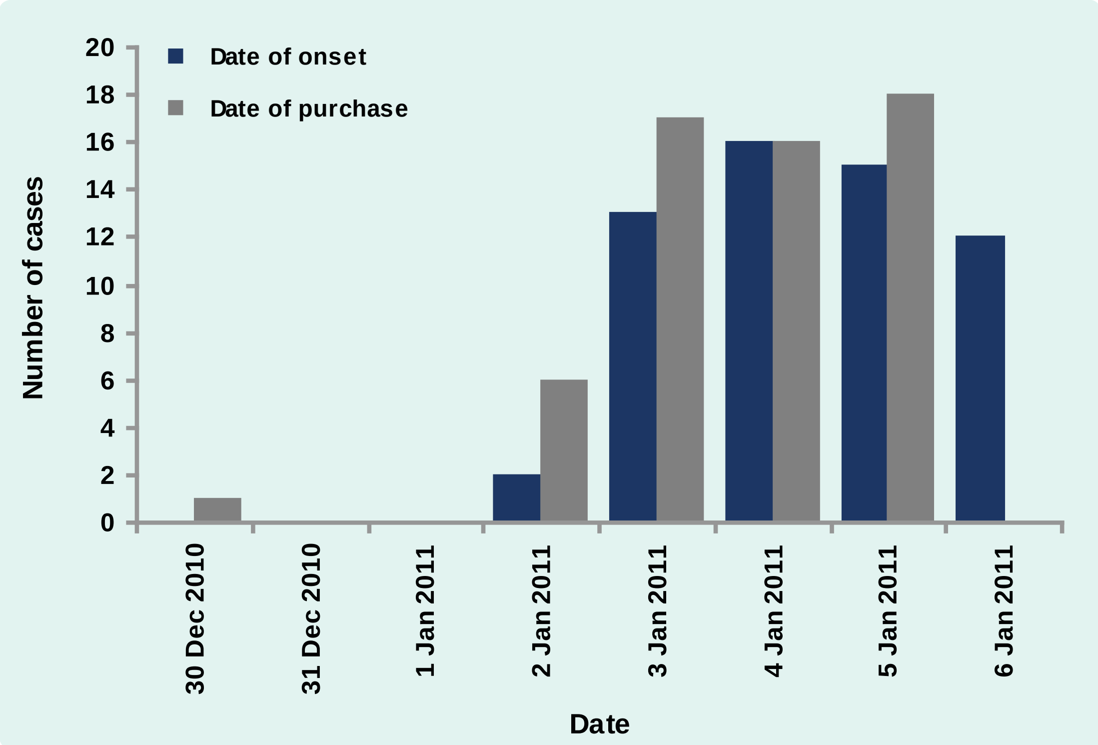


Table 2. **Ingredients consumed by cases, *Salmonella* Typhimurium outbreak, Sydney, January 2011 (*n*=58)**

Food exposure	*n*	%
Chicken	26	44.8
Raw egg butter*	25	43.1
Pork	22	37.9
Pate*	20	34.5
Mayonnaise*	10	17.2
Ham	5	8.6
Salad	5	8.6

* 18 cases replied "unknown" to these food exposures

the NSW Food Authority inspection on the afternoon of 5 January 2011 (**Figure 2**).

All 58 interviewed cases reported that they ate a roll of some type from the bakery before illness onset. Information regarding individual roll ingredients consumed by these 58 cases was collected and results are outlined in **Table 2**.

Only one staff member from the bakery reported becoming unwell during the outbreak, with an onset date of 5 January 2011. This food handler reported eating a salad roll with mayonnaise from the bakery on 4 January and a salad roll with raw egg butter on 5 January before becoming unwell. All other staff stated that they consumed food from the bakery but did not become unwell.

Laboratory Investigation

A total of 49 stool specimens were obtained from the bakery-linked cases. *Salmonella* Typhimurium MLVA type 3-10-8-9-523 was identified in 47 samples. Two cases' specimens were negative for bacterial pathogens.

MLVA results from CIDMLS identified 89 stool samples from residents in south-western Sydney between 4 and 24 January 2011 where STM MLVA 3-10-8-9-523 was identified. Seventy-three (82%) of the samples were collected between 4 and 9 January 2011. The number of positive samples peaked on 6 January 2011, at 24 samples. Sydney West area (the neighbouring area health service that is geographically

Table 3. **Bakery breaches to the Australia New Zealand Food Standards Code, *Salmonella* Typhimurium outbreak, Sydney, January 2011**

Breaches practised by the bakery	Food Standards Code breaches by bakery
Cooked pate cooled at room temperature for up to four hours	Division 3, clause 7 (3a)
Inadequate temperature monitoring of pork belly during cooking	Division 3, clause 7 (1b[ii])
No doors on chilled food display cabinet (no temperature monitoring or control)	Division 3, clauses 6 (1b), 6 (2a), 8(5a)
Eggs stored at room temperature	Division 3, clause 6 (2a)
Food equipment not adequately cleaned or sanitized	Division 5, clause 20 (2a & b)
Food mixer whisks stored on floor	Division 5, clause 20 (1b)
Inadequate kitchen hand-washing facilities	Division 4, subdivision 2, clause 17 (1)
Poor hand-washing practices by staff before food handling	Division 4, subdivision 1, clause 15 (3a)

closest to the premises) saw a simultaneous increase in the same MLVA type with 14 positive stool specimens in this time period. Excluding the 47 known bakery-linked cases from the total of 105 cases in the two health areas with the same MLVA type, an additional 56 people may have been affected by this outbreak. NSW data from the same period in 2010 identified only 12 stool samples positive for STM MLVA 3-10-8-9-523.

Environmental Investigation

The bakery was located within a busy shopping centre in Sydney, NSW. The NSW Food Authority inspection of the premises on 5 January 2011 revealed that there were multiple breaches of food safety standards of the *Australia New Zealand Food Standards Code* (**Table 3**).[5]

Raw egg butter was made approximately every three days by the premises. The raw egg butter batch made on 2 January 2011 was mixed with the new batch made on 5 January 2011. Raw egg butter is produced by hand by shifting egg contents back and forth between half shells to separate yolks, which are then mixed with vegetable oil and salt using metal whisks. The egg butter was not subject to a processing step such as pasteurization, adequate heating or acidifying the product.

The chicken liver pate was prepared on 2 January 2011. The same batch of each of the following ingredients was served from 2 to 5 January 2011: the pork belly which purchased and cooked on 23 December 2010, the white ham purchased on 30 December 2010 and the prager ham purchased on 23 December 2010. The chicken served to customers in the same time period was purchased and cooked on 31 December 2010, 3 January 2011 or 5 January 2011.

The bakery owner voluntarily removed and disposed of all roll fillings from the chilled food cabinet and all prepared sandwich ingredients. The bakery was asked to cease production of raw egg butter and pate until the NSW Food Authority had finalized their investigation.

On 10 January the NSW Food Authority served a prohibition order to the premises based on food sample and swab results that confirmed widespread *Salmonella* contamination in the store. The order closed the business until the following conditions were met: all equipment cleaned and sanitized, fixtures and fittings verified free from *Salmonella* by the NSW Food Authority and food handlers demonstrating adequate skills and knowledge in food safety and hygiene. The business agreed to permanently cease production of raw egg butter in accordance with the NSW Food Authority's recommendation.

Sixty-two per cent (13/21) of the food samples were positive for STM phage type 44, MLVA type 3-10-8-9-523. These included the raw egg butter, chicken liver pate, chicken, pork and various salad ingredients. The mayonnaise was a commercial brand that was used before its expiration date. Only cooked chicken and pork were available for sampling at the time of inspection. Forty-five per cent (5/11) of the environmental swabs were also positive for STM phage type 44, MLVA type 3-10-8-9-523.

Eleven eggs left over from the batch used to produce the raw egg butter made on 2 January and 5 January 2011 were submitted for testing. No *Salmonella* or other organisms were isolated. The eggs used by the bakery during the outbreak were purchased on 1 January 2011 from a growers' market in Sydney that was not the usual supplier. The egg supplier to the market stall sourced the eggs from 10 farms in NSW and occasionally from a farm in Victoria. The NSW Food Authority was unable to trace the farm of origin of the eggs used by the bakery during the outbreak due to missing labels on the egg cartons.

DISCUSSION

This was a large point-source outbreak of *Salmonella* Typhimurium MLVA 3-10-8-9-523 in which the majority of identified cases (77%) sought medical attention. The outbreak was probably larger than demonstrated by this investigation as indicated by the retrospective MLVA data provided by NSW Ministry of Health, which showed a clear increase at the time of the outbreak in this MLVA type compared to the usual background rate.

A major concern demonstrated by this outbreak was a clear lack of knowledge of safe food handling practices. Various forms of temperature abuse were involved in storage and display and also production of foods, such as inadequate monitoring of temperatures during cooking and inadequate cooling of food items after cooking. The business used the undesirable practices of producing raw egg butter with no pathogen control step[6] and mixing ready-to-eat foods with existing batches. Several mechanisms for cross-contamination were also evidenced: the type of *Salmonella* responsible for the outbreak was isolated from 62% of the samples of food sold on the premises and from 45% of environmental swabs taken from utensils and surfaces used for food processing and from objects and surfaces not directly involved in food preparation.

This investigation was unable to identify the food source that introduced *Salmonella* onto the premises. Eggs, chicken, pork, ham and salad items have all previously been implicated in foodborne outbreaks.[7–12] In this outbreak, all of these food items grew the same type of *Salmonella* that was identified as the cause of clinical illness, potentially implicating any of these items as the original source of *Salmonella.*

Nevertheless, eggs were considered the most likely potential source as the eggs used to make the raw egg butter were not bought from the usual supplier; they were stored inadequately then served raw in the form of raw egg butter; and there was no pathogen control step. Also, during the raw egg butter production, the practice of moving the contents of the egg back and forth between the two shell halves to separate the yolk allowed a route for the outer shell to potentially contaminate the contents.

Foods commonly known to contain raw egg have been identified as the cause of large point-source outbreaks, especially in commercial food outlets.[2,13] *Salmonella* Typhimurium phage type 44 has previously been associated with consumption of raw eggs or prepared dishes containing raw eggs.[14] OzFoodNet, an Australian national network set up to improve foodborne disease surveillance, management and prevention,[15] reported at least 40 *Salmonella* outbreaks across Australia between 2009 and 2010,[13,16–21] in which ready-to-eat foods containing raw egg were identified as the probable vehicle.

Pork and chicken have also been implicated as a vector of *Salmonella*, including outbreaks specifically implicating Vietnamese pork rolls.[13,16–21] This evidence, combined with inadequate temperature checking of the pork belly during cooking and the prolonged cooling time of the chicken liver pate, suggests pork or chicken could also be the suspect food source in this outbreak. However, due to lack of epidemiological evidence pinpointing a particular food item, the fact that no STM 44 was isolated from any of the eggs tested and the inability to trace back a source farm for the eggs, confirmation of eggs or any other food as the pathogen vector in this outbreak was not successful.

Multiple factors have often contributed to large *Salmonella* outbreaks. These include issues related to storage and refrigeration, substandard labelling of preparation dates, mixing old with new batches of foods, using broken shells to separate egg yolk and the use of second grade eggs.[14,22–25] Often there are also issues with general hygiene and cleaning practices leading to cross-contamination.[15,23,26] This all suggests that food safety regulations should remain focused on these aspects of control.

Strategies to minimize the risk of *Salmonella* transmission to the public are taken at every level–from industry involved in food production to food services and consumers.[16] The egg production industry has quality assurance standards such as egg labelling, food safety, animal health and welfare, biosecurity and environmental management.[27] In June 2010 a new regulation was introduced in NSW requiring egg producers to implement a food safety programme. Voluntary industry measures coupled with government mandated measures mitigate the risk of *Salmonella* reaching the food services industry but will not always prevent this from occurring.[23]

To address issues surrounding food handling, the NSW government has introduced new regulations under the Food Amendment (Food Safety Supervisors) Bill 2009. This initiative, introduced in October 2010, required food businesses such as hospitality and food retailers to have at least one trained Food Safety Supervisor (FSS) appointed in the business by 1 October 2011. Training occurs through registered accredited training organizations. It remains mandatory for all food handlers to have general knowledge and skills appropriate to their role, as outlined in the Food Standards Code.[28–30]

Limitations

It was not possible to present an association between foods consumed and illness because we did not recruit controls. We felt it would have been difficult to find a comparison group and unnecessary given that we already had strong evidence pointing to the bakery. This investigation was only capable of capturing the more severe cases and therefore does not reflect the true magnitude of the outbreak. Many interviewed cases did not supply more detailed information regarding condiments contained on their rolls because they did not know or could not remember. Finally, an analytic study would have been difficult to justify in these circumstances because the premises was the point of control, and control was achieved through closure without having to identify the exact source.

Two of the seven food handlers were unable to be interviewed. They were both family members of the business owner and only anecdotal information on the absence of illness was able to be obtained. Also, a detailed history of foods eaten in the specified time period was not obtained from these two food handlers.

CONCLUSION

This large outbreak was associated with a single Vietnamese bakery and significantly affected the health of individuals and put stress on the health system. Foodborne disease is a great public health concern as the effects of outbreaks cause considerable morbidity and consume public health effort and resources.[31] These outbreaks are essentially avoidable. Poor understanding of food handling practices, leading to extensive cross-contamination throughout the bakery, played a major role in this outbreak. This issue has contributed to other large point-source outbreaks in the past. The introduction of new regulations such as the FSS Programme could contribute, through improved hygiene education, to minimize the extent of contamination and therefore the size and severity of outbreaks in many instances in the future. The role of NSW Ministry of Health and the NSW Food Authority in reacting promptly to food complaints and laboratory information that indicate a possible common exposure to *Salmonella* that continue to be crucial in future regulatory changes.

Conflicts of interest

None declared.

Funding

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"Shake, Rattle and Roll": risk assessment and management for food safety during two Christchurch earthquakes

Sally Johnston[a]

Problem: Two earthquakes recently struck the Christchurch region. The 2010 earthquake in Canterbury was strong yet sustained less damage than the 2011 earthquake in Christchurch, which although not as strong, was more damaging and resulted in 185 deaths. Both required activation of a food safety response.

Context: The food safety response for both earthquakes was focused on reducing the risk of gastroenteritis by limiting the use of contaminated water and food, both in households and food businesses. Additional food safety risks were identified in the 2011 Christchurch earthquake due to the use of large-scale catering for rescue workers, volunteers and residents unable to return home.

Action: Using a risk assessment framework, the food safety response involved providing water and food safety advice, issuing a boil water notice for the region and initiating water testing on reticulation systems. Food businesses were contacted to ensure the necessary measures were being taken. Additional action during the 2011 Christchurch earthquake response included making contact with food businesses using checklists and principles developed in the first response and having regular contact with those providing catering for large numbers.

Outcome: In the 2010 earthquake in Canterbury, several cases of gastroenteritis were reported, although most resulted from person-to-person contact rather than contamination of food. There was a small increase in gastroenteritis cases following the 2011 Christchurch earthquake.

Discussion: The food safety response for both earthquakes was successful in meeting the goal of ensuring that foodborne illness did not put additional pressure on hospitals or affect search and rescue efforts.

Christchurch, New Zealand, is now best known to many people for the earthquakes that occurred in September 2010 and February 2011 – the latter killing 185 people. This article outlines some of the lessons learnt from the food safety response for each of the two earthquake events.

THE 2010 CANTERBURY EARTHQUAKE

Problem

The 2010 Canterbury earthquake was a 7.1 magnitude earthquake that struck at 04:35 on 4 September 2010. While the quake caused widespread damage and several power outages, there were low numbers of serious injuries and no fatalities – probably because the quake occurred during the night when most people were off the street. However, the damage was of such significance that the National Crisis Management Centre[1] was activated and Civil Defence personnel in the relevant councils declared local states of emergency for Christchurch, the Selwyn District and the Waimakariri District (**Figure 1**). Power was disrupted in up to 75% of Christchurch, as well as many towns in the Canterbury region. Sewers were damaged and water lines were broken. A feature of the quake was significant soil liquefaction, which can cause buried pipes to float up to the surface. Some houses were damaged to the point that they were unsafe for residents. Welfare centres were set up in several locations, where more than 244 people slept on the night after the quake.

Context

The risk assessment process in the 2010 earthquake response involved a range of food safety experts gathering in Wellington to discuss likely effects of the earthquake for consumers and food businesses. The discussions included identifying regulatory requirements unable to be met in the affected areas and the effects

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Figure 1. **Districts for which a state of emergency was declared, 2010 Canterbury earthquake**

of damage and possible consequences on food safety (risks). Assumptions about levels and effects of damages were tested with field staff in the Canterbury region. Potential risks were prioritized and risk management options identified. Risk assessors and risk managers worked collaboratively in identifying risks, assessing likely impacts and deciding which risk management options to apply.

The primary food safety risks included:

(1) The use of contaminated water in food preparation and processing. There was a high likelihood that the earthquake and resulting liquefaction had damaged the water reticulation system through damage to buried pipes, which may have allowed sewage to contaminate the residential water supply.

(2) The use of contaminated foods due to property damage, unsafe water supplies and storage outside safe temperatures (due to power cuts).

Action

Water testing for indicators of faecal contamination (e.g. *Escherichia coli*) on reticulation systems was initiated immediately.

Key actions aimed at the public included:

(1) Providing water safety advice regarding water used for drinking and general hygiene (e.g. brushing teeth, handwashing);

(2) Issuing a boil water notice for the region; and

(3) Issuing food safety advice, including management of food in refrigerators and freezers in areas without power.

The key action aimed at food businesses was:

Having food safety officers and auditors circulate throughout the region to ensure food businesses were taking the necessary measures. This included:

(a) Ensuring that such businesses were able to render water for safe use with food. Many of these businesses use substantial amounts of water in processing and were keen to re-open as soon as possible.

(b) Conducting assessments for those businesses that had sustained moderate damage to ensure food had not become contaminated with physical hazards and that subsequent manufacturing of food would be protected from contamination by physical, chemical and microbiological hazards.

(c) Suspending the issuing of export certificates for export food businesses until adequate food safety measures were implemented and were effective.

Outcome

(1) About 90% of the electricity in Christchurch was restored by 18:00 the day of the earthquake. The repair of electricity was more difficult in the rural areas; however power was restored to almost all areas within two days.

(2) The boil water notice for Christchurch and Banks Peninsula was lifted late on 8 September 2010 after more than 500 tests conducted over three days found no contamination. A boil water

notice for most of Selwyn District was lifted on 9 September. The boil water notice remained in effect for parts of Waimakariri District until 19 September because *Escherichia coli* was found in a water sample from Kaiapoi (a town in the District).

(3) Most food safety officers generally found proprietors making sensible food safety decisions and using good practice around water management and food preparation.

(4) Several cases of gastroenteritis were reported. By 7 September, 28 cases had been observed at the city's welfare centres. Public health officers reported that the majority of these cases resulted from person to person contact rather than contamination of food.

THE FEBRUARY 2011 CHRISTCHURCH EARTHQUAKE

Problem

The February 2011 Christchurch earthquake, although smaller in magnitude than the 2010 earthquake, was more damaging and deadly for several reasons. The epicentre was closer to Christchurch, and shallower. The earthquake occurred during lunchtime on a weekday when the Central Business District (CBD) was busy and many buildings were already weakened from the previous quake and ongoing aftershocks. Liquefaction was significantly greater than that of the 2010 earthquake, causing significant ground movement, undermining many foundations and destroying infrastructures. Although communication was initially difficult, and it took many hours for a full picture of the devastation to be obtained, a full emergency management structure was in place within two hours, with national coordination again operated from the National Crisis Management Centre. On 23 February, the Minister of Civil Defence declared the situation a state of national emergency, the country's first for a civil defence emergency.

Context

In this response, risk assessment (using processes as for the 2010 earthquake) identified several risks for food safety and security, including:

(1) Water safety – 80% of water and sewerage systems were severely damaged with many reticulation systems failing completely. People relied on alternative water sources such as rainwater, emergency water tanks (untreated water) and swimming pools. Water available via reticulation systems had a high likelihood of water contamination.

(2) Poor hygiene and limited access to water due to significant damage in several suburbs including inoperable sewerage systems, no power and no or severely restricted road access. Many residents were choosing to remain at home in these suburbs.

(3) Food businesses re-opening with limited water availability and non-functioning sewerage systems.

(4) Large-scale catering at welfare centres for residents unable or unwilling to return home and at several reporting or gathering sites for rescue workers and volunteers in places that lacked power, water and sewerage systems.

(5) Catering at welfare centres being conducted by people not usually involved in the food industry and therefore not aware of food safety requirements.

(6) Volunteers within and outside the region were very keen to help with donations of food and other assistance. For example the "Rangiora Earthquake Express" provided water, medical supplies and food, including hot meals, from nearby Rangiora by helicopter and truck.

Action

The key actions for this response were similar to the 2010 earthquake with respect to issuing water and food safety advice, issuing a boil water notice for the region and initiating water testing on reticulation systems. Some changes and additions to this included:

(1) Printing flyers with water and food safety advice and distributing these via supermarkets, but as we had learnt from the 2010 earthquake response that many residents were unable to get this advice easily from web sites (due to power outages).

(2) Making contact with food businesses using information, checklists and principles developed in the first response.[2–6] The approach used by food safety officers was:

(a) Advisory – focusing on boil water management for appliances (e.g. ice-machines, slushies, snow freeze, post-mix and coffee machines – all of which needed to be supplied with pre-boiled water if they were going to be used) and general hygiene.

(b) Relaxed regulation – sort the operators demonstrating good food safety behaviours (allow them to operate) from those that are trying to make good food safety decisions but need help or advice (provide as needed) from the operators disregarding or not following good food safety practices (revisit often, or as a last resort apply food safety sanctions).

(c) Apply a hierarchy of:

(i) Food Security – ensure residents can get enough to eat. This might mean accepting higher than usual food safety risks in some circumstances (within reason, remembering that in this situation food shortages are likely to be very temporary).

(ii) Food Safety – preventing foodborne illness from placing additional pressure on hospitals or affecting search and rescue and earthquake recovery efforts (by taking people out of the workforce).

(iii) Food Suitability – food supplied/donated to the response and recovery efforts should still meet basic requirements for information and labelling (e.g. allergen identification).

(iv) Food Quality – a low priority issue, as consumers will be able to make their own choices about whether to consume these products.

(3) Communicating regularly and clearly with stakeholders (public, food businesses, other government agencies, welfare and community organizations); communicating face to face whenever possible and without assuming prior knowledge or understanding.

(4) Making decisions quickly when faced with new information or situations – do or delegate (required action), defer (decisions to a higher authority if in doubt), dump (unsafe food).

(5) Making contact with welfare, church and community groups to provide food safety advice for catering for large numbers of people.

(6) Recommending that professional caterers be used in key areas where mass gatherings were regularly occurring (e.g. welfare centres, worker/volunteer coordination sites), or (as time went on) at funerals.

(7) Providing specific advice for donated food.

(8) Visiting key community initiatives to support the provision of safe food and ensuring the general food safety steps (clean, cook, cover, chill) were being followed.

(9) Printing food safety advice in several languages and deploying a Cantonese/Mandarin-speaking Food Safety Officer to get better compliance with food safety principles where language barriers had been shown to be an issue.

(10) Working with the insurance council as food businesses were not disposing of spoilt food because insurance assessments were required and insurance agencies wanted to see the extent of the damage.

Outcome

The national Food Safety response to the earthquake lasted less than three weeks. During this time, all of the approximately 2400 food businesses in Christchurch were visited (except the 500 odd in the red zone – cordoned-off CBD areas [**Figure 2**]), hundreds of enquiries were answered and plans were made for actions to be undertaken as closed food businesses re-opened. The local council and food safety officers resumed business-as-usual food safety management in the region from Monday 14 March 2011. Specific outcomes included:

Figure 2. **Christchurch area map showing approximate red zone area, 2011 Christchurch earthquake***

* Reproduced with permissions from Canterbury Earthquake Recovery Authority.

(1) Power was restored to 82% households within five days and to 95% within two weeks. Generators were donated, and telephone companies established emergency communications and free calls.

(2) Water was supplied in several ways – a major dairy company provided milk tankers to bring in water, the Army provided desalination plants, and bottled supplies were sent by volunteers and companies. Main water supply was re-established to 70% of households within one week.

(3) Over 2000 portable toilets and 5000 chemical toilets from throughout New Zealand and overseas were brought in, and 20 000 more chemical toilets were placed on order from the manufacturers. Households also had to establish emergency latrines.

(4) Over 2000 water samples were taken and tested and over 80 *Escherichia coli* contaminations were identified.

(5) The boil water notice remained in effect until 8 April 2011. Chlorination of water was introduced to help ensure that the water remained safe while the water supply infrastructure remained vulnerable and susceptible to new damage (from ongoing aftershocks).

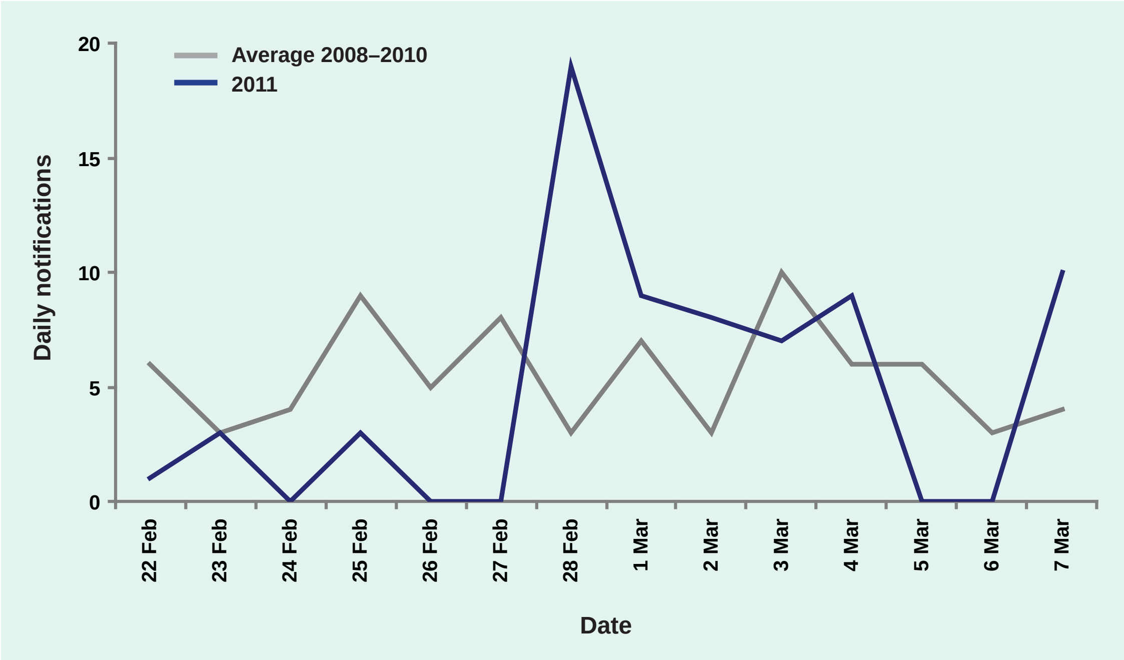
(6) Insurance requirements had to be clarified to ensure both food safety and insurance assessment requirements could be met.

(7) There was a small increase in gastroenteritis cases in the first week following the earthquake (**Figure 3**); the number of reported cases to 22 March 2011 was 18 more than the average for the same period over the previous three years.

DISCUSSION

Food safety is not always immediately recognized as an important factor in response to natural disasters. People tend to focus initially on treating the injured, looking for survivors and repairing damage (e.g. restoring power, water supplies, opening transport routes). But in the background, food safety professionals are working hard, often from the minute of hearing about a natural disaster, to ensure that, among other things, hospitals are not put under further pressure with increasing numbers of cases of foodborne illness.

Figure 3. **Number of Enteric notifications from 22 February to 7 March, Canterbury, 2011 and 2008–2010 average[7]**



There were significant lessons learnt from the food safety response to both earthquakes in Christchurch. The response to the February 2011 Christchurch earthquake was both helped and hindered by the experience of the 2010 Canterbury earthquake. It was helped because all response agencies had learnt valuable lessons from the first event. It was hindered because many Christchurch residents had an expectation that water would be safe (because it had proven safe in the first event). This reinforces the view that while response preparedness is important, it is also important to be flexible and adapt to the specific needs of each response (no matter how similar, no two events are the same).

As there were only small numbers of gastroenteritis cases reported after each earthquake, we consider that the food safety response for both the 2010 Canterbury earthquake and the 2011 Christchurch earthquake was successful in meeting the goal of ensuring that foodborne illness did not put additional pressure on hospitals or affect search and rescue and earthquake recovery efforts.

Conflicts of interest

None declared.

Funding

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Improved laboratory capacity is required to respond better to future cholera outbreaks in Papua New Guinea

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Cholera was first detected in Papua New Guinea in July 2009, caused by *Vibrio cholerae* O1 El Tor serotype Ogawa.[1] By late 2011, 15 500 cases had been reported throughout lowland Papua New Guinea with a case fatality rate of 3.2%.[2] The epidemic has since slowed, with only sporadic cases reported in Western Province and the Autonomous Region of Bougainville (ARB). Accurate and timely diagnosis is a critical element of the public health response to cholera, yet in low-income countries where the burden of cholera is the greatest, diagnostic services are often limited. Here we report on the diagnostic challenges and the logistical factors that impacted on diagnosis during the first reported outbreak of cholera in Papua New Guinea.

The Port Moresby General Hospital (PMGH) laboratory is the only laboratory in Papua New Guinea that routinely conducts bacterial culture for diagnostic purposes. When cholera spread from the remote outbreak epicentre in rural Morobe Province to the provincial capital (Lae), bacterial culture was re-established at the provincial hospital in Lae (culture had not been conducted for many years due to limited funding and declining infrastructure). The disease spread to six other lowland provinces of Papua New Guinea and ARB where it was not feasible to re-establish culture facilities in a time frame that could have assisted with cholera diagnosis. Instead, specimens were sent by plane to the PMGH laboratory. Rapid diagnostic tests (RDTs) were not recommended by the National Department of Health; however, some Provincial Health Offices used RDTs locally during the outbreak.

Swabs were prepared from stool samples of patients older than five years of age with acute watery diarrhoea (AWD) (with no documented recent exposure to antibiotics) and placed in Cary-Blair transport medium. Culture was conducted following standard bacterial methods.[3] In brief, enrichment was conducted using alkaline peptone water (6–12 hours at 37°C) then plated onto TCBS agar (37°C for 24 hours). Direct inoculation of samples onto TCBS agar was also conducted. Confirmation was done by biochemical profiling (API 20E, bioMerieux, Marcy-l'Étoile France) and serology to determine biotype and serotype. In total, 678 samples were analysed at PMGH from 17 of Papua New Guinea's 20 provinces, with 331 (49%) being culture positive. Data are not available regarding the number of samples tested in Lae and bacterial culture has not been sustained at that site.

It is accepted that "prompt and accurate diagnosis of *Vibrio cholerae* is a key step in cholera outbreak surveillance that can greatly influence rapid intervention and prevention to minimize disease spread and mortality."[4] However, tracking the spread of cholera throughout Papua New Guinea and confirming cases in cholera-naïve regions was a long process. The remote location of some outbreak sites, the lack of roads linking with Port Moresby and the inability to conduct culture at nearby hospital laboratories delayed the confirmation time of cases. It often took three to four days to collect samples from the outbreak area and deliver them to PMGH. At least two days were required for confirmation of a culture-

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positive result, resulting in delays of up to one week from the time when cholera was first suspected in a previously unaffected area of the country to confirmation. Patients with suspected cholera were treated empirically, following standardized rehydration algorithms, so delayed diagnosis did not impact on treatment. However, the time to diagnosis may have delayed public health responses aimed at reducing the spread of cholera within an outbreak area.

The World Health Organization (WHO) recommends laboratory confirmation (by culture) for the first 10–20 cases of suspected cholera. WHO also recommends that a few samples be taken during an outbreak to monitor antimicrobial sensitivity and about 20 stool samples tested to confirm the end of the outbreak (all should be culture negative).[5] In Papua New Guinea, samples were collected and cultured sporadically during an outbreak in a new district, and no outbreaks were confirmed to have ended through culture. This opportunity was largely missed, as the added demands created by the cholera outbreak in Papua New Guinea stretched laboratory capacity to the limit. Confirming the end of the outbreaks would have enabled provincial governments to close cholera treatment centres in a timely manner, thus saving money and resources.

Although culture remains the mainstay of laboratory diagnosis for cholera, it may fail to detect many true cases. In a recent study of cholera in Bangladesh, 131/135 (97%) stool samples were deemed to be *Vibrio cholerae* positive using a combination of culture, RDTs, direct fluorescent antibody detection, polymerase chain reaction or detection of lytic phage using a plaque assay; however, only 86 (64%) of positive samples were culture positive.[4] The inability of culture to detect all cases of cholera may be a contributing factor to the <50% isolation rate of *Vibrio cholerae* in Papua New Guinea. Moreover, it is difficult to ascertain the impact of storage and transportation of samples on the viability of *Vibrio cholerae* during the outbreak. Improved laboratory capacity in major regional centres would ensure Papua New Guinea is better prepared to manage future epidemics while also aiding diagnosis of high-burden endemic infectious diseases.

The 49% culture-positive rate in samples sent to PMGH is comparable to rates of detection previously reported.[4,6] The remaining 51% of AWD cases fulfilled the case-definition for cholera (in the context of a cholera outbreak) but did not have a definitive culture result. As the burden of other enteric infections is high in Papua New Guinea, it is possible that people with different diarrhoeal illnesses presented to health care facilities out of fear of having cholera.[7,8] In the future, full etiological studies using culture and molecular techniques should be considered on a subset of samples to better understand the spectrum of pathogens associated with outbreaks of AWD in Papua New Guinea.

Improved diagnostic tools are required for the diagnosis of *Vibrio cholerae* in low-income countries. At least two different RDTs were used during the Papua New Guinea outbreak (Cholera Ag O1, Standard Diagnostics Inc. Kyonggi province, Republic of Korea and SMART II, New Horizons Diagnostic, Corp., Columbia, Maryland, USA), but their use was neither widespread nor systematic. While RDTs are generally considered easy to use,[9,10] during the early stages of the outbreak, junior clinical and laboratory staff (who were not trained to perform RDTs) falsely interpreted the first 20 test kits as negative and did not collect stool samples for culture. Although a rapid clinical outbreak response was initiated early and appropriately, the misinterpretation of cholera RDTs may have delayed its laboratory confirmation and highlights the need for adequate training when using RDTs before their introduction into the country.

Although RDTs may be useful, the role of bacterial culture should not be overlooked in low-income countries. Culture remains the gold standard for diagnosis of many bacterial infections. The isolation and preservation of clinical isolates can enable important public health data to be obtained, e.g. surveillance of antimicrobial drug resistance in bacteria. In a country of approximately 7 million people, with a high burden of infectious diseases and lack of transport infrastructure, one laboratory equipped to conduct bacterial culture is insufficient. The core function of the PMGH laboratory is routine diagnosis; the need to respond to the cholera epidemic was a strain on the capacity of the laboratory. Outbreak response and ongoing surveillance might be better suited to the central public health laboratory in Papua New Guinea. Large regional hospitals in Papua New Guinea should be equipped with culture facilities.

Increased capacity in bacterial culture is unlikely to occur in Papua New Guinea in the foreseeable future; thus complementary tests should be considered to aid diagnosis. The currently available cholera RDTs have not gained widespread acceptance, but despite their shortcomings, they may have a role to play in cholera diagnosis. RDTs should not be considered as a replacement for culture but may be a useful adjunct to diagnosis by culture.[3,11] Timely and accurate diagnosis leads to better patient outcomes, better public health responses and better epidemiological data; all of these were suboptimal in the Papua New Guinea cholera outbreak. Adequate planning and investment in resources at the national level would ensure Papua New Guinea and other countries in the Western Pacific Region are better situated to respond to future cholera outbreaks.

Conflicts of interest

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Changes in invasive pneumococcal disease serotypes in a regional area of Australia following three years of 7vPCV introduction

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Background: Invasive pneumococcal disease (IPD) is a serious bacterial disease. Vaccination can prevent disease for many of the current serotypes. The aim of this investigation was to describe the notification rates of IPD in a regional area of Australia, explore changes in rates since the introduction of the population vaccine programmes in 2005 and to describe changes in the distribution of serotypes in relation to the available vaccines after three years.

Methods: Annualized IPD notification rates were calculated for residents of a regional area in northern New South Wales. Rates were analysed according to serotypes covered by available vaccines. Changes in serotypes were compared for the periods 2002–2004 and 2008–2010.

Results: The annualized notification rate of IPD in all ages for the period 2002–2004 was 13.7 per 100 000 population, and 8.3 per 100 000 population for the period 2008–2010 (rate ratio [RR], 0.61, confidence interval [CI]: 0.51–0.72). The largest decline was observed in 7-valent pneumococcal conjugate vaccine (7vPCV) types across all age groups (RR, 0.17, CI: 0.12–0.24) and in the zero to four year age group (RR, 0.03, CI: 0.01–0.11). The six serotypes included in the new 13-valent pneumococcal conjugate vaccine, but not in the 7vPCV, accounted for 40.6% of IPD cases in the zero to four year age group during the period of 2008–2010.

Discussion: The introduction of 7vPCV significantly reduced the overall notification rate of IPD caused by the serotypes contained in this vaccine. This decline in IPD rates in children can be directly attributed to the use of 7vPCV, and in adults it is most likely an indirect effect of the 7vPCV programme in children.

Invasive pneumococcal disease (IPD) is a serious bacterial infection caused by the bacteria *Streptococcus pneumoniae* and can result in bacteraemia, meningitis and pneumonia. Higher rates of the disease are seen in children less than two years of age, in older adults and in people who are immunosuppressed or have a chronic illness.[1]

There are 90 known capsular antigenic types of *Streptococcus pneumoniae*. Some serotypes are carried in the upper respiratory tract and others are more associated with the invasive disease. Prior to the introduction of pneumococcal vaccines into the Australian immunization schedule, 83%–85% of IPD cases in children aged less than 14 years and 69% of IPD cases in adults aged more than 65 years in the state of New South Wales (NSW) could be attributed to the seven serotypes found in the 7-valent pneumococcal conjugate vaccine (7vPCV) (**Box 1**).[2]

Box 1. **Serotypes contained in 7vPCV, 13vPCV and 23PPV, Australia**

	Serotypes
23vPPV	1 2 3 4 5 6B 7F 8 9N 9V 10A 11A 12F 14 15B 17F 18C 19A 19F 20 22F 23F 33F
7vPCV	4 6B 9V 14 18C 19F 23F
13vPCV	1 3 4 5 6A 6B 7F 9V 14 18C 19A 19F 23F

A vaccine programme has been in place in Australia for pneumococcal disease since 1999 when the 23-valent polysaccharide pneumococcal vaccine (23vPPV) was introduced for Aboriginal and Torres Strait Islander adults aged 50 years and over (**Box 2**).[1] This was extended to non-Aboriginal people from 2005 for those aged 65 years and over. The vaccine is also recommended for people less than 65 years of age who have conditions that predispose them to IPD.[1]

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Box 2. **Summary of funded Pneumococcal Immunization Programme, Australia**

Year	Vaccine
1999	Pneumovax 23™ introduced for Aboriginal and Torres Strait Islander adults >50 years of age
2001	Prevenar 7™ introduced for Aboriginal and Torres Strait Islander children in Central Australia only
2003	Prevenar 7™ introduced for all children less than five years of age with medical risks
2005	Prevenar 7™ introduced for all children at two, four and six months of age with catch-up for children born between 1 January 2003 to 31 December 2004
	Pneumovax 23™ introduced for all adults >65 years of age
2011	Prevenar 13™ introduced for all children at two, four and six months of age

The 7vPCV, which comprises seven of the serotypes found in the 23vPPV, was introduced into the Australian immunization schedule for medically at-risk and Aboriginal and Torres Strait Islander children in 2001.[1] In 2005, the schedule for 7vPCV was extended to include all children up to two years of age, including a catch-up programme. A new 13-valent vaccine (13vPCV) was introduced into the Australian immunization schedule in June 2011, comprising an additional five serotypes also found in 23vPPV, as well as one unique serotype (**Box 1**).

IPD has been notifiable by laboratories in NSW, Australia, since December 2000 under the NSW Public Health Act 2010. Notification and surveillance data are entered into the NSW Notifiable Conditions Information Management System by Public Health Units and include data on serotype when testing is completed.

There have been some reports of the impact of the pneumococcal vaccine since its introduction into the Australian immunization schedule and the potential benefits that may be offered by the 13vPVC. A national study of IPD in children less than two years old reported a 74% decline in incidence of IPD post introduction of the pneumococcal vaccine in 2005 with a 97% decline in cases caused by 7vPCV types.[3] At that time, 50% of IPD cases were caused by serotypes contained in 13vPCV.

In the regional area of North Queensland, IPD rates have declined by 34% across all age groups after introduction of 7vPVC. Declines in the number of IPD cases caused by serotypes contained in 7vPCV across age groups not targeted for vaccination demonstrated that 7vPCV had a population effect.[4] The authors of this study estimated that a further 64% of IPD cases could be prevented by the introduction of 13vPCV through direct and indirect effects. Different areas across Australia likely have different IPD epidemiology.

The Hunter New England Local Health District has a population of approximately 840 000 and consists of both rural and urban landscapes over 130 000 km^2. Approximately 22% of the NSW Aboriginal and Torres Strait Islander population reside in this area. The proportion of the population aged 65 years and over is approximately 17% and is projected to increase to 25% by 2030.[5]

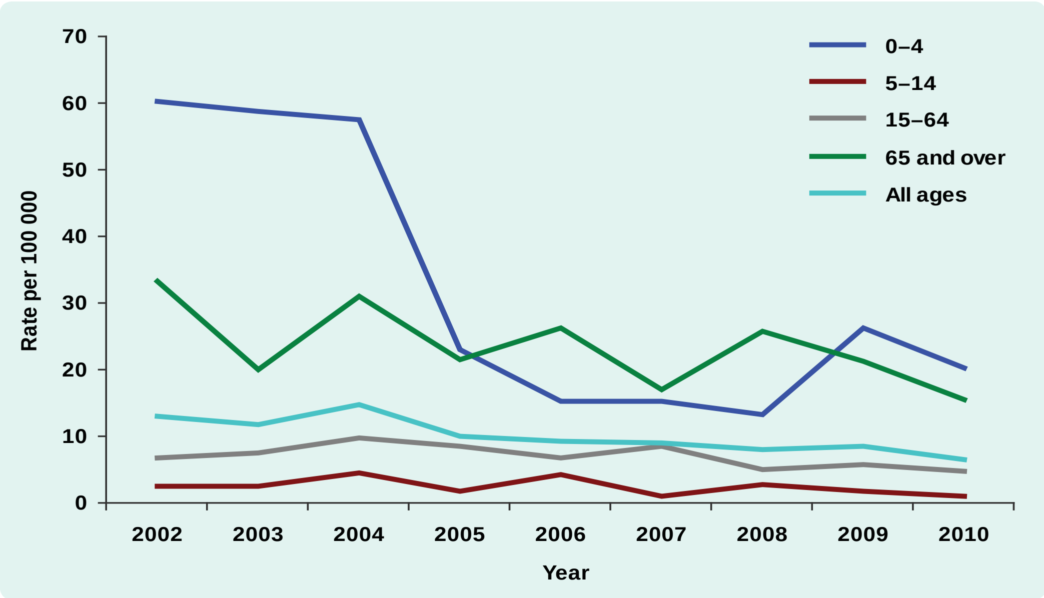
The aim of this investigation was to describe the notification rates of IPD before and after the introduction of the vaccine programmes, in a regional area in the state of New South Wales, Australia. An additional aim was to explore changes in the distribution of serotypes of the notified cases in relation to the available vaccines.

METHODS

IPD notification data for the period 2002–2010 in the regional area of Hunter New England (HNE) in northern NSW were sourced from the Health Outcomes Information and Statistical Toolkit, NSW Ministry of Health. Analysis was performed using Statistical Analysis Software (SAS) version 9.2. IPD notification rates were calculated using mid-year Estimated Residential Population figures from the Australian Bureau of Statistics from 2002 to 2010.

Annualized notification rates by serotype were calculated for two comparison periods, 2002–2004 and 2008–2010. These correspond with the period before the introduction of the free pneumococcal vaccine to

Figure 1. **IPD notifications by age group, Hunter New England, NSW, 2002 to 2010**



the Australian immunization schedule in 2005 and the period after. Rate ratios (RR) were calculated comparing the notification rates of the period 2008–2010 to the period of 2002–2004 notification rate baseline with their 95% confidence interval (CI).

Serotypes were grouped into 7vPCV, 23vPPV, 23PPV-only (16 serotypes) and non-vaccine types. Serotypes not contained in any pneumococcal vaccine were termed non-vaccine types. The additional six serotypes found in 13vPCV are also described (referred to as 6v [13v-7v]).

This project was deemed a quality improvement exercise by the HNE Human Research Ethics Committee and did not require ethics approval.

RESULTS

The total number of laboratory-confirmed IPD cases for the period 2002–2004 was 339, and for the period 2008–2010 there were 218 notified cases. The proportion of untyped specimens was 16% (54/339 between 2002 and 2004 and 6% (13/218) in the period 2008–2010. The annualized notification rate of IPD for all ages for the period 2002–2004 was 13.7 per 100 000 population and 8.3 per 100 000 population for the period 2008–2010 – a RR of 0.61 (95% CI:0.51–0.72). Across the age groups the notification rate of IPD in the zero to four years age group has shown the largest reduction (**Figure 1**).

The overall notification rate in males was greater than females at 16.6 per 100 000 and 9.3 per 100 000, respectively, in the period 2002–2004 and 10.0 per 100 000 in males and 6.2 per 100 000 in females in the period 2008–2010. The largest decline was observed in notifications of IPD cases caused by 7vPCV serotypes with a rate ratio of 0.17 (95% CI: 0.12–0.24). A decline was also observed in the notification rate of IPD caused by 23PPV types (RR, 0.55, 95% CI: 0.45–0.67).

An increase was observed in the notification rate of IPD cases with 23PPV only types (RR, 1.99, 95% CI: 1.43–2.73). The notification rate of IPD with non-vaccine types also increased with a RR of 3.18 (95% CI: 1.84–5.49). An increase was noted in IPD cases caused by 6v (13v-7v) types (RR, 2.43, 95% CI: 1.61–3.66). In fact, 40.6% of cases in the zero to four years age group were caused by 6v (13v-7v) types (**Table 1**).

Significant increases were recorded for 23PPV only, non-7vPCV and 6V(13v-7v) types in the 0–4, 15–64 and 65+ years age groups. Additionally, there was also a significant increase for non-vaccine types in the 15–64 and 65+ years age groups. Significant decreases were seen in the total, 23PPV and 7vPCV types for these age groups. There was no significant difference between the notification rates of IPD for 5 to 14-year-olds between the periods 2002–2004 and 2008–2010 (**Table 1**).

Table 1. **Changes in IPD notification rates by age group and serotype, Hunter New England, 2002–2004 and 2008–2010**

Vaccine	2002–2004			2008–2010			Rate ratio	95% CI
	Number	%	Rate per 100 000	Number	%	Rate per 100 000		
All ages								
Total	**339**	**100.0**	**13.7**	**218**	**100.0**	**8.3**	**0.61**	**0.51–0.72**
23vPPV	271	79.9	10.9	157	72.0	6.0	0.55	0.45–0.67
7vPCV	215	63.4	8.7	39	17.9	1.5	0.17	0.12–0.24
23vPPV only	56	16.5	2.3	118	54.1	4.5	1.99	1.43–2.73
Non-7vPCV	70	20.6	2.8	165	75.7	6.3	2.23	1.69–2.95
Non-vaccine	14	4.1	0.6	47	21.6	1.8	3.18	1.84–5.49
6v (13v-7v)	32	9.4	1.3	82	37.6	3.1	2.43	1.61–3.66
0–4 years old								
Total	**92**	**100.0**	**58.2**	**32**	**100.0**	**20.0**	**0.34**	**0.23–0.51**
23vPPV	74	80.4	46.8	23	71.9	14.3	0.31	0.19–0.49
7vPCV	72	78.3	45.6	2	6.3	1.2	0.03	0.01–0.11
23vPPV only	2	2.2	1.3	21	65.6	13.1	10.35	2.42–44.12
Non-7vPCV	5	5.4	3.2	29	90.6	18.1	5.72	2.21–14.76
Non-vaccine	3	3.3	1.9	8	25.0	5.0	2.63	0.70–9.90
6v (13v-7v)	2	2.2	1.3	13	40.6	8.1	6.40	1.44–28.38
5–14 years old								
Total	**11**	**100.0**	**3.1**	**6**	**100.0**	**1.8**	**0.56**	**0.21–1.52**
23vPPV	10	90.9	2.8	3	50.0	0.9	0.31	0.08–1.12
7vPCV	8	72.7	2.3	2	33.3	0.6	0.26	0.05–1.21
23vPPV only	2	18.2	0.6	1	16.7	0.3	0.51	0.05–5.68
Non-7vPCV	2	18.2	0.6	4	66.7	1.2	2.06	0.38–11.24
Non-vaccine	0	0.0	0.0	3	50.0	0.9	–	–
6v (13v-7v)	2	18.2	0.6	1	16.7	0.3	0.51	0.05–5.68
15–64 years old								
Total	**131**	**100.0**	**8.2**	**91**	**100.0**	**5.4**	**0.65**	**0.50–0.85**
23vPPV	107	81.7	6.7	73	80.2	4.3	0.64	0.48–0.86
7vPCV	75	57.3	4.7	20	22.0	1.2	0.25	0.15–0.41
23vPPV only	32	24.4	2.0	53	58.2	3.1	1.56	1.00–2.42
Non-7vPCV	35	26.7	2.2	65	71.4	3.8	1.75	1.16–2.64
Non-vaccine	3	2.3	0.2	12	13.2	0.7	3.77	1.06–13.35
6v (13v-7v)	16	12.2	1.0	35	38.5	2.1	2.06	1.14–3.72
65 years old and above								
Total	**105**	**100.0**	**28.0**	**89**	**100.0**	**20.9**	**0.75**	**0.56–0.99**
23vPPV	80	76.2	21.3	58	65.2	13.6	0.64	0.46–0.90
7vPCV	60	57.1	16.0	15	16.9	3.5	0.22	0.12–0.39
23vPPV only	20	19.0	5.3	43	48.3	10.1	1.90	1.12–3.22
Non-7vPCV	28	26.7	7.5	67	75.3	15.7	2.11	1.36–3.28
Non-vaccine	8	7.6	2.1	24	27.0	5.6	2.65	1.19–5.90
6v (13v-7v)	12	11.4	3.2	33	37.6	7.8	2.43	1.25–4.70

Note: 23vPPV only = 23vPPV - 7vPCV; non-7vPCV = total - (7vPCV + untyped); and non-vaccine = total - (23PPV + untyped).

DISCUSSION

This investigation supports other reports that show the decline in the notification rate of IPD in children can be directly attributed to the use of 7vPCV.[6] The decline in notification rates in adults is most likely an indirect effect of 7vPCV programme in children.[7] This is supported by the recorded increase in the notification rate of IPD caused by 23vPPV-only types across most age groups. A similar effect has been described in another regional area of Australia[4] and internationally.[7]

The increase in incidence of 23vPPV-only types across all age groups and less than

60% immunization coverage in the greater than 65 years age group suggests that 23vPPV has provided individual protection rather than a population effect.[8] Increased nasopharyngeal carriage of 23vPPV-only types in vaccinated children may have had a negative effect on the impact of 23vPPV.[4] Varied immunogenicity in the greater than 65 years age group due to comorbidities may have also had a negative impact on the efficacy of 23PPV.[9]

The increase in non-vaccine serotypes across all age groups is consistent with the phenomenon of serotype replacement that has been described elsewhere.[10] Serotype 19A has emerged as a potent disease-causing organism, with its capsular switching and increasing antibiotic resistance, it has been able to evade vaccine selection pressure.[11] Serotype 19A is one of the serotypes contained in the newly introduced 13vPCV. If the distribution of serotypes remains the same, there is potential for a further 21% decline in the incidence of IPD caused by 19A in adults in the study population through a population effect.

The 13vPCV also presents an opportunity to further reduce the burden of IPD in children. In the zero to four year age group, 40.6% of all notified IPD cases during the 2008–2010 period were caused by 6v (13v-7v) types. This result is similar to the findings of a national study in 2007.[3]

IPD rates in males were observed to be higher than that of females. This phenomenon was observed across all age groups in both comparison periods and has been documented elsewhere.[12] Continued surveillance of IPD is essential in monitoring the impacts of the pneumococcal vaccines and trends in serotypes.

There are limitations to this study. The decline in 6v(13v-7v) types in the 5–14 years age group differs to trends in other age groups and may represent lack of precision with relatively small numbers. However, our findings of a population effect due to the 7vPCV are consistent with findings from another regional area of Australia, in North Queensland.[3,4]

The 35% decline in IPD notification rates in the 15–64 year age group is markedly different to the 2.6% decline found in North Queensland. This may be explained by the difference in study periods. The study period 2008–2010 is later than the 2006–2009 study period in north Queensland, which may have given 7vPCV more time to impact the population. Regional differences in serotypes and immunization rates may also have an impact and limit the ability of this study to be extrapolated to other regional areas of Australia.[10] Pneumococcal vaccine coverage in the Hunter New England Local Health District before the introduction of the funded programmes in 2005 is unknown. Over 95% of children aged 24–27 months in HNE were immunized in the 2008–2010 study period.[13] High immunization coverage are associated with increases in non-vaccine types.[10]

No changes were made to surveillance or to IPD treatment protocols during the study periods. This study is also limited by the quality of the current surveillance system where several factors affect the notifiable fraction for communicable diseases in rural and regional areas in Australia, such as decreased seeking of medical care and decreased collection and submission of specimens.[14] No outbreaks of IPD were recorded during this time.

CONCLUSION

The 7vPCV has proven to be an effective health intervention in reducing the pneumococcal disease burden in a regional area of Australia despite some level of serotype replacement. There is a potential for continuous serotype replacement after the introduction of 13vPCV as has happened with 7vPCV, but as with 7vPCV, the gains made with 13vPCV are likely to improve health outcomes for both children and adults. The increase in cases due to serotypes in 13vPCV implies that 13vPCV presents an opportunity to further reduce the burden of IPD in the Hunter New England Local Health District.

Conflicts of interest

None declared.

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Incidence of dengue virus infection among Japanese travellers, 2006 to 2010

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Introduction: Dengue continues to be a global public health concern. In Japan, although dengue cases are currently seen only among travellers returning from endemic areas, the number of reported cases is rising according to the national case-based surveillance system. We evaluated the characteristics of dengue cases imported into Japan and the relationship between the incidence of infection and season of travel to popular destinations.

Methods: Dengue cases reported to the national surveillance system were retrospectively examined. The number of reported cases per number of Japanese travellers to a dengue-endemic country was calculated to estimate the country-specific incidence of imported dengue virus infection. The incidence of dengue infection among Japanese travellers was compared between dengue high season and low season in each country using relative risk (RR) and associated 95% confidence intervals (CI).

Results: Among 540 Japanese residents who were reported as dengue cases from 2006 to 2010, the majority had travelled to Indonesia, India, the Philippines and Thailand. The RR of dengue infection among Japanese travellers during dengue high season versus low season was 4.92 (95% CI: 3.01–8.04) for the Philippines, 2.76 (95% CI: 1.67–4.54) for Thailand and 0.37 (95% CI: 0.15–0.92) for Indonesia.

Discussion: Overall, higher incidence of imported cases appeared to be related to historic dengue high seasons. Travellers planning to visit dengue-endemic countries should be aware of historic dengue seasonality and the current dengue situation.

Dengue fever (DF) has rapidly spread over the last few decades and is currently found in most tropical and subtropical areas throughout the world.[1] In Japan, according to the national case-based surveillance system, the number of reported DF cases has been steadily increasing, from fewer than 50 cases in 2006 to more than 200 cases in 2010. It is thought that there is no dengue transmission in Japan and that all reported cases are among those who returned from endemic countries. However, one of the mosquito vectors for dengue, *Aedes albopictous*, inhabits Japan and a major outbreak in western Japan occurred between 1942 and 1945.[2] As rapid globalization has accelerated international travel and trade, there is a growing fear that secondary transmission will cause a dengue outbreak in Japan, as documented in Australia[3,4] and France.[5]

In Japan, DF and dengue haemorrhagic fever (DHF) have been notifiable diseases regulated by the Infectious Disease Control Law since April 1999. Physicians in all clinics and hospitals are required to report demographic information and clinical and exposure history about every patient meeting the DF/DHF case definitions (**Box 1**) to the nearby public health centre. The data are reported by local governments to the Ministry of Health, Labour and Welfare and the Infectious Disease Surveillance Center (IDSC), National Institute of Infectious Diseases (NIID).

To estimate the incidence of dengue virus infection among Japanese travellers, we described the characteristics of dengue cases reported to the national case-based surveillance system and the relationship between the incidence of dengue infection and season of travel.

METHODS

Using the Japanese reportable disease surveillance data, the epidemiological characteristics of reported DF and DHF from 2006 to 2010 were described.[6]

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Box 1. **Case definitions for DF and DHF**

DF cases require laboratory confirmation, defined as:
- virus isolation;
- virus-specific nucleic acid sequences by polymerase chain reaction (PCR);
- positive IgM antibody in serum; or
- seroconversion or significant rise in IgG or IgM antibody titers in paired serum samples in neutralization test or hemagglutination inhibition test.

DHF is defined as DF that has all of the following symptoms:
- fever of 2–7 days duration;
- increased vascular permeability;
- thrombocytopenia; and
- haemorrhagic tendencies.

To estimate the country-specific annual incidence of imported dengue virus infection among Japanese travellers, the number of reported cases returning from an endemic country for a given year was divided by the number of travellers that visited that country in that year. Countries were included if there were more than 50 reported cases from that country over the study period; cases were excluded if they had a home address outside of Japan or they had reported visiting multiple destinations (i.e. more than one country). International traveller data among the Japanese population were obtained for the Philippines and Thailand from the Japan Tourism Marketing Company,[7] and for Indonesia and India from the relevant ministries of receiving countries.[8,9] For Indonesia, international traveller data were only available from 2007 to 2010. Travellers from Japan were based on nationality, except for the Philippines, which were based on residency. Information on visit duration and areas visited in the destination countries was not available.

Country-specific aggregated monthly incidence was calculated in the same manner but over a period of one calendar month, and the data for each month were aggregated over the period 2006–2010. Monthly data were summed over these years as the number of cases reported for each month was small and the monthly pattern remained consistent. Monthly data for Japanese travellers were unavailable for India[9] and only available for 2010 for Indonesia.[8]

Historical dengue seasons are from January to February in Indonesia, June to August in Thailand, August to November in India[10] and July to October in the Philippines.[11] The incidence of infection among Japanese travellers was compared between dengue high season and low season months. This comparison was calculated as a relative risk (RR) and associated 95% confidence intervals (CI).

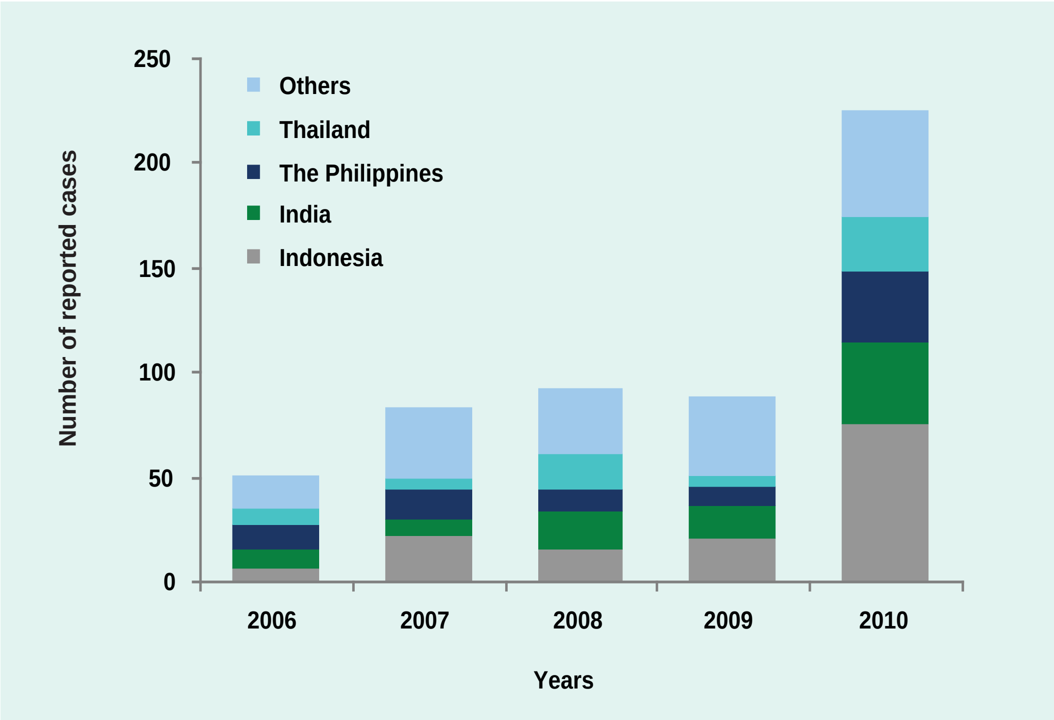
RESULTS

There were a total of 589 reported cases between 2006 and 2010 - 565 of DF and 24 of DHF. Three hundred eighty-two cases (64.9%) were male and the median age was 29 years (range: eight months to 90 years). The largest proportion of cases were among those aged 20–29 years (239/589 [40.6%]) and 30–39 years (126/589 [21.4%]). Of the 24 cases classified as DHF, 17 cases were male and the median age was 32 years (range: one to 64 years); information on previous history of DF was unknown.

Laboratory confirmation was made by the following methods: virus isolation (60/589 [10.2%]), virus-specific nucleic acid sequences by PCR (295/589 [50.1%]) and positive IgM antibody in serum (346/589 [58.7%]); 49/589 [8.3%] tested positive by multiple methods. Information regarding clinical symptoms was available for 581 cases (557 DF and 24 DHF). Among DF cases, the following were reported: fever (551/557 [98.9%]), thrombocytopenia (369/557 [66.2%]), headache (320/557 [57.5%]), leukocytopenia (308/557 [55.3%]) and rash (293/557 [52.6%]). All 24 cases of DHF reported all four symptoms as per the case definition.

Among the 589 cases, 15 had home addresses outside of Japan and 34 had visited multiple destinations. Of the remaining 540 cases, 491 (90.9%) were associated with travel within Asia. Twenty-seven (5.0%), 14 (2.6%), seven (1.3%) and one (0.2%) were associated with travel to Latin America and the Caribbean, Australia and Oceania, Africa and the Middle East, respectively. The countries with the largest number of reported Japanese dengue cases were Indonesia (141 cases [26.1%]), India (89 cases [16.5%]), the Philippines (79 cases [14.6%]) and Thailand (62 cases [11.5%]) (**Figure 1**). In terms of estimated incidence of imported dengue virus infection among Japanese travellers, India was highest, followed by Indonesia, the Philippines and Thailand (**Table 1**).

Figure 1. **Number of reported dengue cases by year and country visited, Japan, 2006–2010 (*n* = 540)**



The aggregated number of cases by month from 2006 to 2010 showed that travel among the reported cases was most common during August through October (**Figure 2**). Among the reported cases, travel to Indonesia, Thailand and the Philippines was highest in August, while travel to India was highest in September. The annual country-specific incidence of imported cases per 100 000 Japanese travellers indicated a considerably higher incidence in 2010 relative to previous years (**Figure 3**).

Table 1. **Number of Japanese dengue cases, Japanese travellers,[7-9] incidence and relative risk comparing dengue in high versus low season by country visited, Japan, 2006–2010**

	Number of Japanese dengue cases, 2006–2010	Number of Japanese travellers, 2006–2010	Incidence per 100 000 travellers	Relative risk (95% confidence intervals)	
The Philippines	**79**	**1 859 850**	**4.25**		
High season (Jul–Oct)	57	641 905	8.88	4.92	(3.01–8.04)
Low season (Nov–Jun)	22	1 217 945	1.81	1.00	
Thailand	**62**	**5 732 619**	**1.08**		
High season (Jun–Aug)	29	1 389 345	2.09	2.75	(1.67–4.52)
Low season (Sep–May)	33	4 343 274	0.76	1.00	
Indonesia	**134***	**1 753 481***	**7.64***		
High season (Jan–Feb)	5†	64 668†	7.73†	0.37	(0.15–0.92)
Low season (Mar–Dec)	71†	341 343†	20.80†	1.00	
India‡	**89**	**702 957**	**12.66**		

* For Indonesia, the number of Japanese dengue cases, number of Japanese travellers and the corresponding incidence refer to data from 2007 to 2010 as the Japanese traveller data were not available for 2006.

† For Indonesia, the figures for high season and low season refer to 2010 as the monthly data for Japanese travellers were only available for 2010.

‡ For India, monthly data for Japanese travellers were not available.

Figure 2. **Number of reported dengue cases by aggregated month and country visited, Japan, 2006–2010 (*n* = 540)**

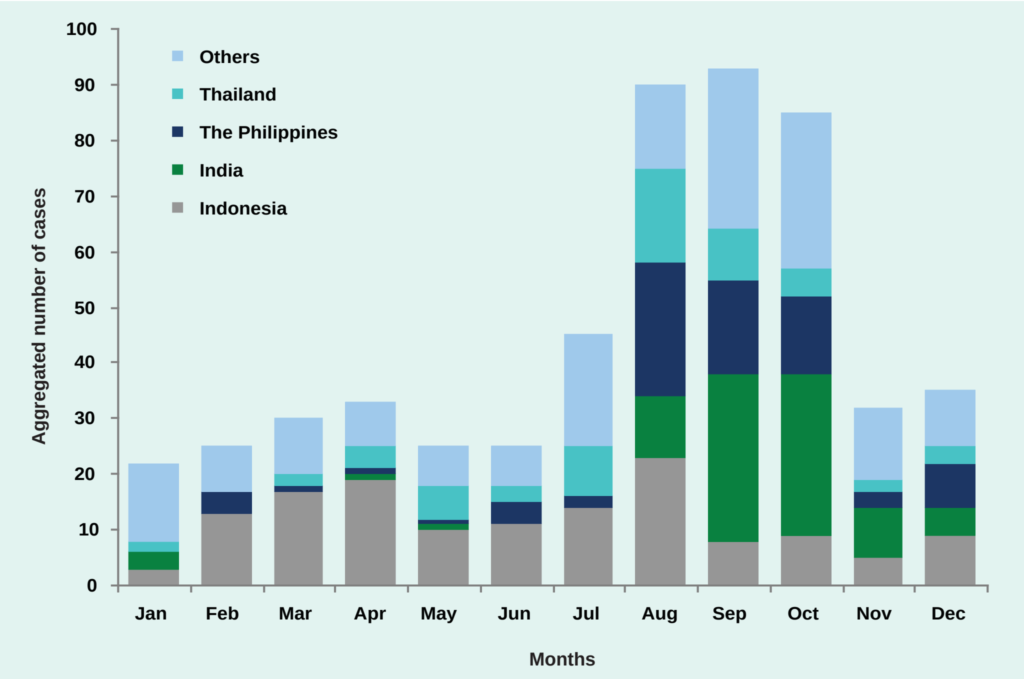
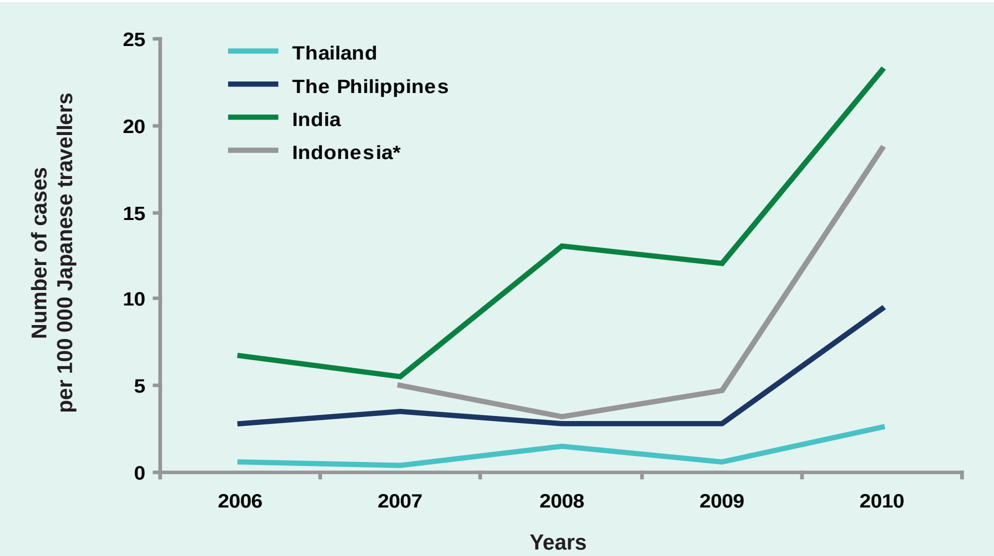


Figure 3. **Rate of reported dengue cases per 100 000 travellers by year and country visited, Japan, 2006–2010**



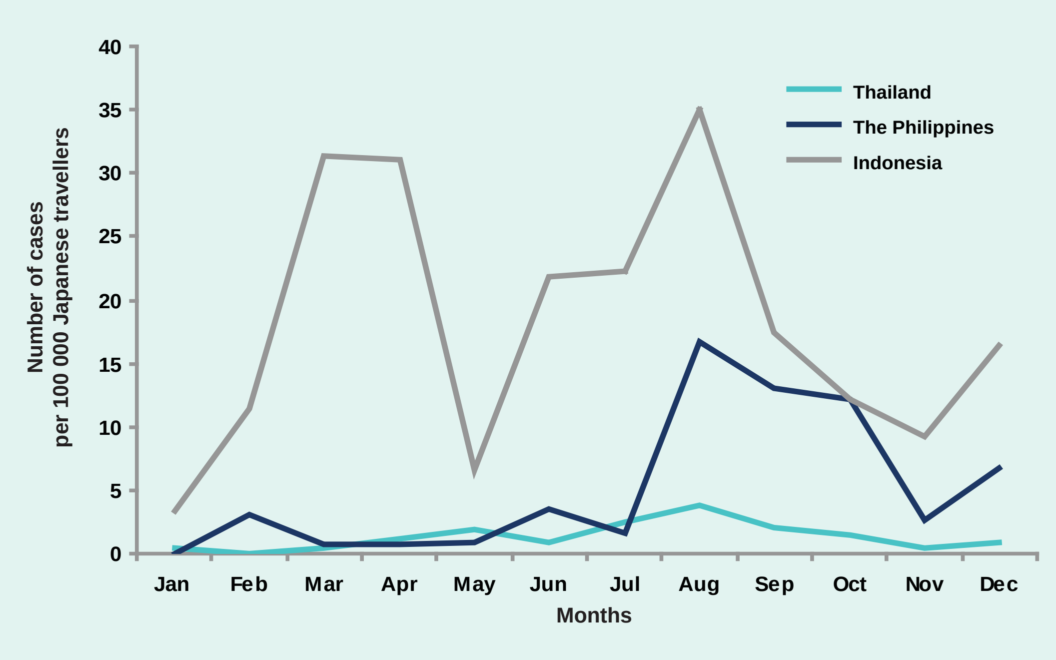
* Japanese traveller data were not available for Indonesia in 2006.

The aggregated monthly data from 2006 to 2010 showed that the monthly incidence of dengue infection among Japanese travellers to the Philippines, Indonesia and Thailand were highest in August (**Figure 4**). The incidence of dengue infection among Japanese travellers during high versus low season was significantly higher for the Philippines and Thailand but significantly lower for Indonesia (**Table 1**).

DISCUSSION

The global incidence of dengue has grown dramatically in recent decades.[1] In the World Health Organization (WHO) South-East Asian Region and WHO Western Pacific Region, the incidence has also been increasing.[10,11] While the number of overseas Japanese travellers has recently been slightly declining,[12] the number of

Figure 4. **Rate of reported dengue cases per 100 000 travellers by month and country visited,* Japan, 2006–2010**



* Data for Japanese travellers visiting Indonesia by month only available for 2010. Monthly Japanese traveller data were not available for India.

reported dengue cases in Japan has been increasing overall. This study shows the majority of dengue cases notified in Japan were imported from Asia, especially Indonesia, India, the Philippines and Thailand; both the number of reported cases from those countries and the incidence among Japanese travellers from those countries increased in 2010.

Most of the cases were reported from August to October, which corresponds with late summer vacation season in Japan. Moreover, the incidences of imported cases from the Philippines and Thailand were significantly higher during the historic dengue high season relative to the low season. Peak incidence among travellers to Indonesia in 2010 (i.e. August) was not associated with travel during the historic high season (i.e. January and February). However, analysis for Indonesia was limited as monthly data were available only for 2010 and the high incidence also observed in March is temporally close to the historic peak season during January and February.[10] In addition, a recent study of reported dengue cases in Bali from 2005 to August 2010 indicated a particularly high number of cases from March to July 2010.[13] As Bali is one of the most popular Japanese travel destinations in Indonesia, with 61% of Japanese travellers to Indonesia visiting Bali in 2010, it is possible that the second peak in August 2010 may have been associated with the high activity observed in Bali from March to July 2010. Therefore, it is important that travellers planning to visit dengue-endemic countries be aware of the historic dengue high seasons and the current local dengue situation.

Surveillance data from exported traveller cases should be reported not only to the local populations in the endemic countries but also to the international community. While there are various studies of travel-related dengue infection, several studies of imported cases have been useful in suggesting the existence of local DF outbreaks in endemic areas.[14,15] In 2008, for example, a dengue case was imported from Côte d'Ivoire to Japan and tested DENV-3 positive. Following this case and another case in France, an international alert was issued because DENV-3 had never been reported in West Africa before.[16] The practice of timely information sharing of the dengue situation among endemic countries has recently been facilitated through the WHO Western Pacific Regional Office.[17]

There are several important limitations in our study. There is concern whether the reported cases truly arose from the traveller population. While we excluded cases reported to the national surveillance system that had home addresses outside of Japan, their nationalities were not identified. As the population that travelled from Japan to the destination countries was based on nationality (except for the Philippines, which was based on residency), there is a possibility that some of the cases captured by the Japanese national surveillance system did not arise from the traveller population considered at risk.

Our study might be underestimating the risk of dengue infection for Japanese travellers. Dengue infection has a broad spectrum of presentation, and dengue patients with only mild symptoms might not seek medical attention. In addition, while the national surveillance system requires reporting of all dengue cases from all medical doctors in Japan, as dengue is not endemic, the disease might be misdiagnosed and not reported.

Specific information on the travellers' behaviours, detailed information on locations visited and duration of visit, which may influence the risk of dengue infection, were not available. For example, specific activities of the visitors, such as exploration/adventure-themed travel, may have accounted for some of the recent increase in reported dengue cases. In addition, while there were nearly twice as many male than female cases during the period 2006–2010, the lack of sex-stratified traveller information limited our ability to assess differential risk due to sex.

However, despite these limitations, the higher incidence of infection associated with travel to dengue-endemic countries during historic epidemic seasons is an important public health finding from this study. Although imported dengue cases may not be representative of local cases in endemic countries (among overseas Japanese travellers, tour groups are popular and such groups may stay and visit specific tourist locations not frequented by the local population), this study nevertheless suggests that travellers are more likely to contract dengue during historic dengue high seasons in endemic countries. Travellers should thus be advised to be aware of dengue, especially during historic peak seasons. Communicating such seasonality to medical practitioners could also be beneficial in enhancing their awareness for appropriate diagnosis and treatment. In addition, travellers and medical practitioners should also both be aware of the current dengue situation.

Given the continued increase in both global dengue incidence and global travel, sustained dengue surveillance for both endemic and exported dengue cases, enhanced awareness among travellers and clinicians and international information sharing are essential for combating the global dengue threat.

Conflicts of interest

None declared.

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Coordination by registered dieticians for nutritional and dietary support in disaster in Japan

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Problem: Yamada, a town of Iwate Prefecture in north-eastern Japan, was struck by the tsunami from the Great East Japan Earthquake. In Yamada, it was challenging to manage nutritional and diet support for food aid because these services were unavoidably drawn out for several months in evacuation shelters.

Context: In Japan, food aid in disasters is often provided, divided and distributed erratically due to poor efforts made with regards to dietary support from the perspective of nutrition. The need for nationally registered dieticians to coordinate nutritional and dietary support in evacuation shelters was considered in this disaster.

Action: A dietary support team was formed of nationally registered dieticians to study the dietary conditions of evacuees in shelters in Yamada and to develop a system to ensure the nutritional and balanced dietary needs of the evacuees.

Outcome: In this disaster response, model menus were prepared and a menu–food matching system was put in place to order and distribute foods required for balanced meals. Every effort was made to avoid excesses and deficiencies in nutrition; the meals consisted of a staple, main dish, side dish and soup. Along with that, food sanitation and stock management were improved.

Discussion: The menu–food matching system put together by the nationally registered dieticians was useful for nutritional and dietary support in this particular disaster. It is recommended that similar nutritional and dietary support coordinated by nationally registered dieticians be considered for disaster management plans where appropriate.

PROBLEM

Yamada is a farming, fishing and lumber town of 18 957 people with an area of 26 345 km^2 located roughly in the middle of the Rikuchu Coast of Iwate Prefecture in north-eastern Japan (**Figure 1**). On 11 March 2011, the Tohoku area of Japan was hit by a massive 9.0-earthquake and ensuing tsunami. In Yamada, the death and missing person toll from the earthquake and tsunami reached 779 as of 4 November 2011. As of 14 March 2011 some 6000 persons were still living in a total of 35 evacuation shelters.

In Yamada, the distribution of goods was hampered by collapsed buildings, severed utilities such as electricity, water and gas and disrupted road networks. Until services were restored and living in shelters was brought to an end, evacuees depended greatly on the government to prepare them food or provide them with food and cooking equipment. Yamada officials provided these services by procuring emergency stores and relief supplies, but it was challenging to manage nutrition and diet support for food aid because these services were unavoidably drawn out for several months.

CONTEXT

If a large-scale natural disaster or other major emergency strikes Japan, the nation, prefectures and municipalities are assigned roles within the disaster management plans formulated under the Disaster Countermeasures Basic Act. As a part of disaster response efforts, municipalities are responsible for procuring and supplying food as dietary support for evacuees. When needed, municipalities request prefectures to procure, transport, store, supply, regulate supply and demand of and prepare food provisions. Because the supply, division and distribution of food to evacuees are erratic and disaster management departments are overburdened with assignments in municipal disaster management plans, dietary support has not been addressed from a nutritional

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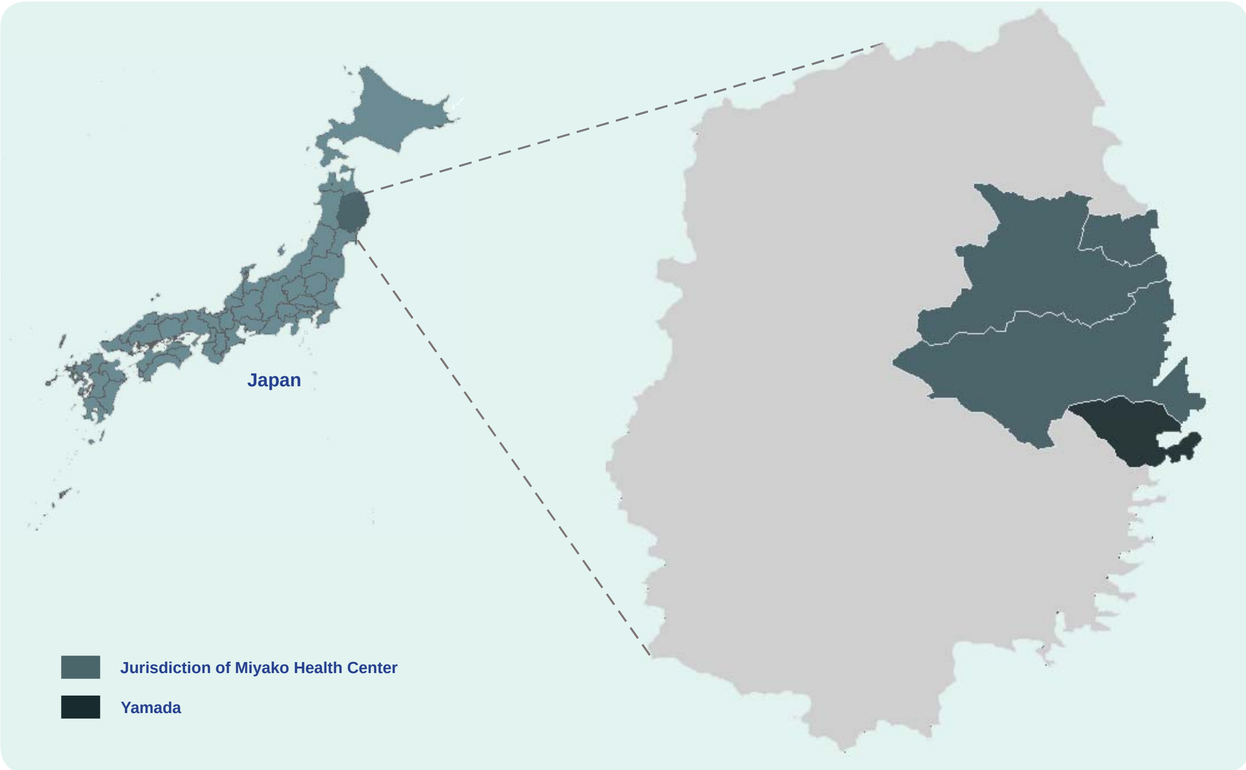
Figure 1. **Miyako Public Health Center area of jurisdiction and Yamada, Iwate Prefecture, Japan**



perspective. For these reasons, the need for registered dieticians to be proactively involved in dietary planning and support in disasters and to coordinate nutritional and dietary support has been indicated in recent years in Japan.[1]

Nationally registered dieticians provided nutritional and dietary support to people in evacuation shelters for about four months after the event in Yamada. These dieticians were hired either as temporary staff or seconded from other local governments. This paper discusses the lessons learnt from their role in the disaster response in Yamada, focusing on the general response only.

ACTION

From April to August 2011, the Yamada Nutrition Management Support Team (hereinafter "support team") was deployed to the Yamada and Miyako Public Health Center (hereinafter "public health centre") and tasked with nutritional and dietary support for evacuation shelters in Yamada, Iwate Prefecture, which was heavily damaged by the earthquake and tsunami. The support team studied the dietary conditions in shelters that prepared food and based on these studies, designed a system to meet the nutritional and balanced dietary needs of evacuees in shelters.

Studies

1. Preliminary survey

The public health centre received information on dietary issues of evacuation shelters in late March 2011 from nationally registered dieticians attached to public health teams dispatched from other prefectures. The nationally registered dieticians and food sanitation inspectors from the public health centre worked with the nationally registered dieticians in Yamada to survey the situation at eight selected shelters housing over 100 persons. They identified problems in food supply and management, menus and cooking equipment.

2. Formation of support teams and study of dietary conditions

After hearing the results of the preliminary survey, operations for food procurement, supply, management and coordination for evacuation shelters was moved from the Planning and General Affairs Department to the

Health and Welfare Department in early April in Yamada. At the same time, with the support of the public health centre, a support team was formed of the nationally registered dieticians and others from Yamada, the public health centre, other local government and Dietetic Associations to coordinate nutritional and dietary support for all evacuation shelters. The support team consisted of seven to 11 staff depending on availability.

The support team assessed the dietary conditions of all evacuation shelters where some 4000 persons were living and identified the following problems from the perspective of nutritional and dietary support:

(1) distributed and supplied foods did not meet the nutritional and balanced dietary needs of evacuees;

(2) imbalance between distribution, delivery and ordering of food and burdens placed on cooks;

(3) lack of equipment adequate for preparing large quantities of food;

(4) unmanaged food stocks;

(5) inadequate consideration for sanitation in food storage; and

(6) event-cooking, where nongovernmental organizations (NGOs) and private companies provided a light meal on a one-off basis, occurred more often at larger shelters than smaller ones.

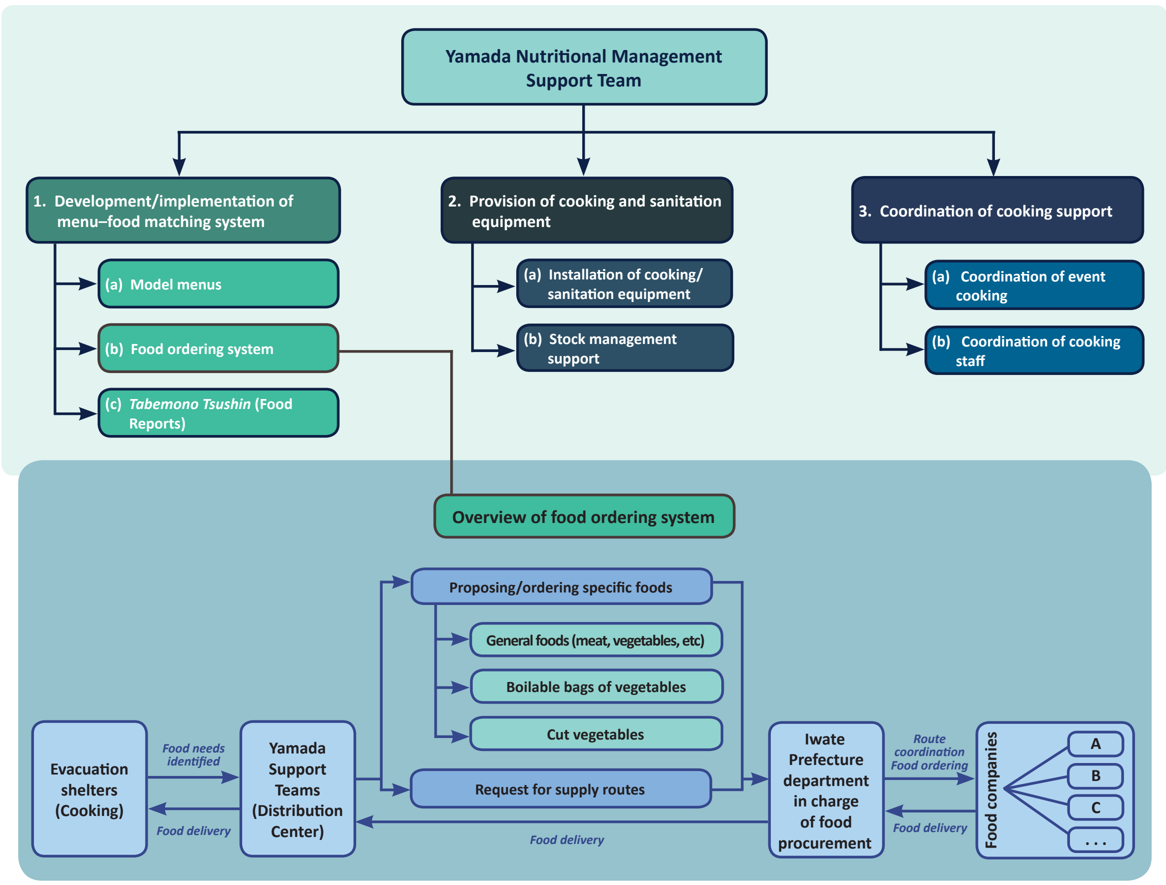
Response

From the findings of their studies of dietary conditions, the support team took the following three actions (**Figure 2**):

(1) Development and implementation of a menu–food matching system that was designed to meet the nutritional and balanced dietary needs of evacuees. This system consisted of three parts:

(a) Model menus

Figure 2. **Efforts of Yamada Nutritional Management Support Team, Yamada, Japan, April to August 2011**



- Prepared weekly menus of meals anyone could easily prepare.

(b) Food ordering system

- Developed and put into use a sheet for calculating the amount of food required and tracking the amount of food distributed to evacuation shelters.
- Opened new routes (merchants) for boilable plastic bags of dishes and cut vegetables.
- Repeated a series of ordering of foods for a next week menu before delivering, distributing, cooking and serving.

(c) *Tabemono Tsushin* (Food Report)

- Provided information on alternative menus when foods for model menus were not delivered.

(2) Provision of cooking and sanitation equipment

(a) Installation of cooking and sanitation equipment

- Provided equipment necessary for cooking large quantities and managing food stocks.
- Installed cooking equipment in proportion to the number of persons living and working at evacuation shelters.
- Installed large refrigerator-freezers at food distribution centres and refrigerator-freezers at evacuation shelters.

(b) Stock management support

- Nationally registered dieticians managed food sanitation and food stocks for distribution to evacuation shelters.
- Dieticians made periodic rounds to check food stores.

(3) Coordination of cooking support

(a) Coordination of event-cooking

- Coordinated event-cooking to ensure distribution to all evacuation shelters rather than just large shelters.

(b) Coordination of cooking staff

- Matched volunteers from NGOs and elsewhere to cooking needs of evacuation shelters.

OUTCOME

During the long course of implementing the three actions above, the support teams noted the following benefits and challenges:

Benefits

(1) Menu–food matching system

(a) A food supply system that matched food ordering to food supply was run for 19 weeks (between 11 April and approximately 29 August). It provided a good balance of staples, main dishes, side dishes and soups.

(b) The menu repertoire expanded as boilable bags of dishes (**Table 1**) and *Tabemono Tsushin* (11 editions) were used in cooking.

(c) Cooking efficiency was improved and the burden placed on cooks was lessened by using model menus, boilable bags of food and packed lunches.

(2) Provision of large refrigerators and other equipment and stocks management support

(a) The menu repertoire expanded due to increased ability to handle raw meat and refrigerated foods.

(b) Sanitary management was improved by discarding foods beyond the expiration date and using refrigerator-freezers for foods.

Table 1. **Deliverable food items at evacuation shelters, Yamada, Japan, April to August 2011**

Food	Main items
Boilable bags of food (dishes)	Precooked foods in vacuum packs whether frozen, refrigerated or preserved at room temperature Can be warmed as is or naturally thawed in the bag before eating. Examples: Potato salad, scrambled eggs, grilled fish, boiled fish, steamed vegetables
Cut vegetables	Vegetables precut according to cooking purpose Examples: Onions, carrots, potatoes (for curry sauce)

(c) Food oversupplies and undersupplies were managed by checking stocks.

(3) Total coordination by dieticians proved useful to food supply, procurement, storage, supply and demand adjustments and cooking.

Challenges

(1) Because the menu–food matching system was run on a weekly basis, it was difficult to respond to the changes in evacuation shelter cooking needs in realtime.

(2) Cooking over a long period of time inevitably reduces taste quality of food.

(3) Food management at evacuation shelters has physical space limitations.

DISCUSSION

Given the recent history of large-scale natural disasters, Japan has compiled guidelines on nutritional and dietary support for evacuees in disaster in which the roles and functions of nationally registered dieticians are cited because of the skills they can provide.[2] However, the disaster management plans of local governments, who are tasked with spearheading evacuee support, do not specify nutritional and dietary support to a significant degree, although they do specify the stockpiling and procurement of food. It is important that a system of coordination between disaster and risk management departments and health departments be created and maintained to provide nutritional and dietary support in disasters.[1]

The actions taken by the nationally registered dieticians in Yamada are a good example of how to address and respond to the aforementioned problems. Actions included logistical supply chain management that other departments normally handle in disaster management plans; distributing and cooking food; identifying food needs; and providing counselling and guidance on nutrition. The menu–food matching system made it possible to systematically and efficiently supply, divide and distribute food and provide well-balanced meals over several months. Moreover, the use of boilable bags of dishes and cut vegetables and efforts to coordinate supply routes ensured menu variety and effectively lessened the work for cooks.

However, in Yamada, food supplies managed in the menu–food matching system came erratically from various sources and routes. This augmented the burden placed on food management at evacuation shelters and resulted in considerable mismatching with the menus. In disasters, food and relief supplies are supplied by NGOs and private companies, not solely by the government. Fundamentally it is the affected government's role to coordinate disaster responses of assisting organizations, working together for maximum efficiency, coverage and effectiveness.[3] Therefore, local governments should not only improve nutritional and dietary support but also provide coordination for disaster responses as a whole.

This report highlights the effectiveness and importance of having nationally registered dieticians coordinate the full process of nutritional and dietary support in this particular disaster response. In the interest of strengthening the disaster management systems of local governments, it is suggested that nutritional and dietary support and the roles of nationally registered dieticians be included in disaster management and preparedness plans.

Conflicts of interests

None declared.

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Western Pacific Surveillance and Response Instructions to Authors

Aim of Western Pacific Surveillance and Response

To create a platform for sharing information to improve surveillance of and response to public health events in the Western Pacific Region.

Objectives

- To produce a web-based publication on surveillance and response activities in the region that has high exposure and is freely accessible.
- To promote information sharing on experiences and lessons learnt in surveillance and response for public health events in the Western Pacific Region and globally.
- To build capacity in communicating epidemiological findings in the Western Pacific Region.
- To highlight new and relevant technical or guidance documents and meeting reports published by the World Health Organization, Western Pacific Regional Office.

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Western Pacific Surveillance and Response (WPSAR) is aimed at people studying, conducting research or working in surveillance of and response to public health events both within the region and globally.

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WPSAR covers all activities related to the surveillance of and response to public health events. Such activities may be implementation or evaluation of surveillance systems, investigations of public health events, risk assessments both in rapid responses and policy development, outbreak investigations and research on routine public health activities. Public health events may be in any of the following areas: communicable diseases, natural disasters, bioterrorism and chemical and radiological events.

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- Data interpretation
- Writing the article

B

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- Final approval of the manuscript for submission

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Acknowledgements

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