

Evaluation of the system of surveillance for enteric disease outbreaks, New South Wales, Australia, 2000 to 2005

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Abstract: Aim: To evaluate the NSW enteric disease outbreak surveillance system. **Evaluation methods:** We performed unstructured interviews with NSW Health Communicable Diseases Branch staff and analysed summary outbreak reports for July 2000 to June 2005. **Performance of the surveillance system:** The system provided a mechanism for meeting all of its objectives to some level. Limitations included difficulty in monitoring outbreaks, incomplete outbreak information, difficulty in linking and collating information, and the cumbersome and inflexible data management system. **Conclusions:** The NSW enteric disease outbreak surveillance system is serving a useful public health function, but could be improved through the use of more sophisticated electronic data management techniques.

Surveillance systems are designed to identify, investigate, control and report rapidly on outbreaks of disease, and to identify factors that can help prevent future outbreaks.¹ Enteric disease outbreaks have been notifiable in NSW since 1991, and surveillance has been progressively improved from 2000 onwards with the introduction of OzFoodNet, a collaborative national network for the surveillance of enteric disease.² This network aims to provide better understanding of the causes and incidence of food-borne disease in the community, and an evidence base for policy formulation.²

A description of the notification and reporting requirements for enteric disease outbreaks in NSW is provided in Table 1. In NSW, public health units (PHUs) are responsi-

ble for investigating notifications of enteric disease, and providing summary reports of enteric disease outbreaks to the NSW Department of Health using standard reporting forms. Outbreaks may also be detected through review of routinely collected notifiable diseases surveillance data, the NSW Food Authority complaints hotline, or reports from clinicians, institutions or laboratories, and members of the public (Figure 1).

The NSW enteric disease outbreak surveillance system collects data from all NSW public health units; it therefore covers the entire population of NSW. The specific objectives of the NSW enteric disease outbreak surveillance system as described in the NSW Health *Notifiable Diseases Manual* are to:

- identify the source of the outbreak
- prevent further cases
- monitor the epidemiology to inform the development of better prevention strategies
- monitor the development of unusual or emerging pathogens
- fulfil international reporting requirements.³

We undertook the first evaluation of the NSW enteric disease outbreak surveillance system, which aimed to:

- determine whether the objectives of the system are being met
- evaluate the specific attributes of the system
- identify areas for improvement.

Evaluation methods

The evaluation was based on the Centers for Disease Control and Prevention guidelines for evaluating surveillance systems (Table 2).^{4,5} The public health importance was derived from the results of the accompanying enteric disease outbreak review presented in this issue.⁶

The simplicity, flexibility and acceptability of the system were examined through unstructured interviews with key Communicable Diseases Branch (CDB) staff, and by detailing the flow of information through the system (Figure 1). Other system attributes were examined by analysing the summary reports from the two NSW enteric disease outbreak databases (the Gastroenteritis in Institutions Database and the OzFoodNet Outbreak Summary Database), where symptom onset for the first case occurred between 1 July 2000 and 30 June 2005.

Table 1. Notification and reporting requirements for enteric disease outbreaks in New South Wales

Type of outbreak	Definition	Public health unit notification and reporting requirements	Responsibility for investigation
Suspected or confirmed foodborne outbreak, or person-to-food-to-person outbreak	Two or more people who are linked in time or place with acute onset of enteric or other symptoms caused by ingestion of infectious agents or toxins that may have been acquired by consuming contaminated food or drink	Within 1 working day of identifying an outbreak, notify CDB and NSW Food Authority. On the day epidemiological results are determined, send completed 'Initial Epi Report Form' and any other relevant data forms to the CDB and NSW Food Authority. Within 1 month of finalisation of an investigation send a completed OzFoodNet Outbreak Summary Form to the CDB	NSW Health is responsible for investigating the epidemiology of the outbreak and the NSW Food Authority is responsible for providing an environmental investigation and conducting trace-back investigation of the source of food products, and dealing with food industry partners
Non-foodborne outbreaks including: <ul style="list-style-type: none"> • waterborne • animal-to-person • environment to person • person-to-person transmission not in an institutional setting • outbreaks of unknown origin 	Two or more people who are linked in time or place report acute onset of enteric or other symptoms	Within 1 working day of identifying an outbreak notify CDB and NSW Food Authority. On the day epidemiological results are determined send completed 'Initial Epi Report Form' and any other relevant data forms to the CDB. Within 1 month of completion of an investigation send a completed OzFoodNet Outbreak Summary Form to the CDB	NSW Health
Gastroenteritis in an institutional setting (e.g. residential, educational, child care, or health care institutions)	A person within an institution with vomiting or diarrhoea thought to be infectious, at a time when at least one other person at the institution has vomiting or diarrhoea	Within 1 working day of identifying an outbreak notify CDB and NSW Food Authority. Within 1 month of completion of an investigation send a completed 'PHU Report Form for Investigation of a gastroenteritis outbreak in an institution' to the CDB	NSW Health as well as the institution and its infection control officer

CDB: Communicable Diseases Branch, NSW Department of Health.

To assess the completeness of enteric disease outbreak reporting by PHUs, we calculated the proportion of all outbreaks first reported in any form (including phone calls, emails and other initial reports) to the CDB from January to December 2005 that had a completed final outbreak summary report. Timeliness of reporting was evaluated by determining the period between the date of symptom onset for the first case and the date of the final summary outbreak report.

Completeness was assessed by examining the completeness of key data fields, including: onset date for the first case; summary report date; number of people at risk; number of people affected; number of hospitalisations; number of deaths; and number of clinical specimens collected.

The usefulness of the system was examined by reviewing the objectives of the surveillance system, interviewing key informants from the CDB enteric diseases team and reviewing the output of the system, including reports and policy interventions. Policy outputs for the period 1 July 2000 to 30 June 2005 were identified in past editions of the *NSW Public Health Bulletin* and through interviews with the CDB staff.

Performance of the surveillance system

Simplicity

Enteric disease outbreaks in NSW were identified and reported through several mechanisms (Figure 1). The maintenance and integration of the flow of outbreak information along these pathways was primarily a manual

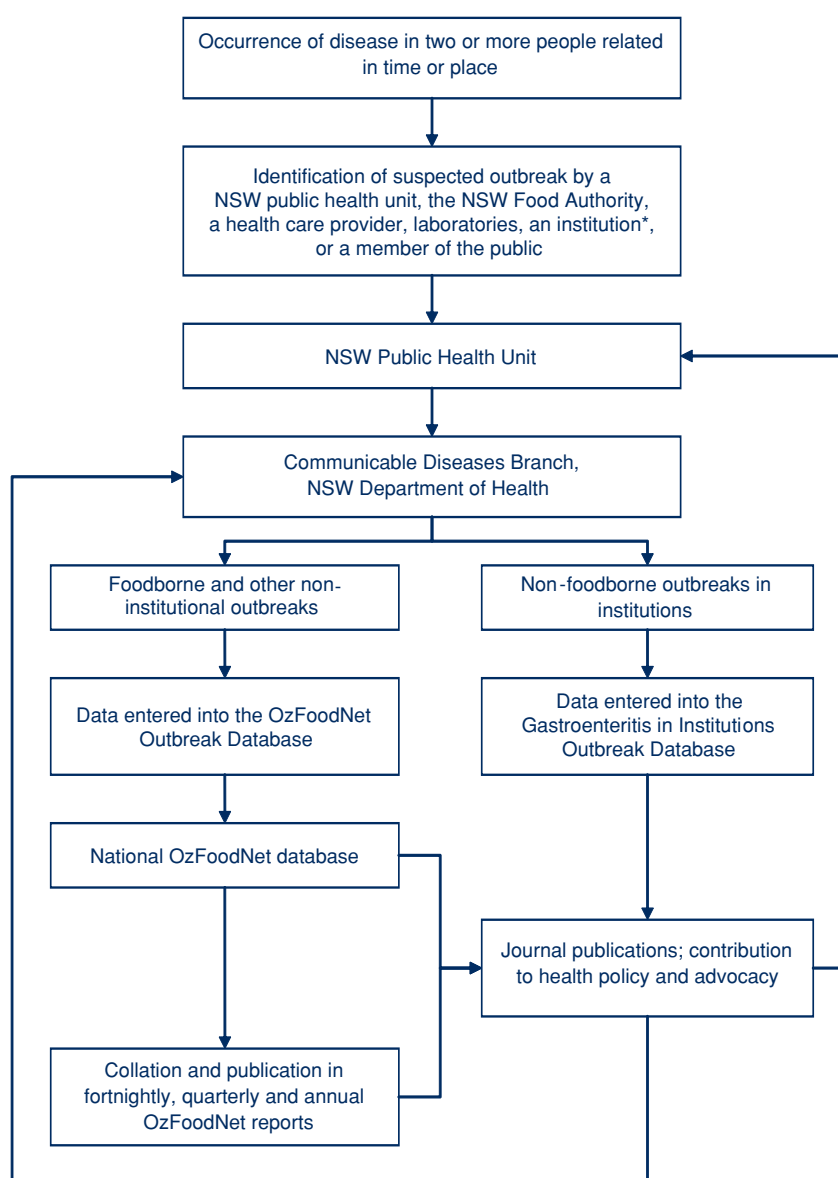


Figure 1. The flow of information relating to suspected or confirmed enteric disease outbreaks in New South Wales.

*An institution includes residential, educational, health care, childcare and correctional facilities.

Table 2. Tasks for the evaluation of a surveillance system

Task	Components
Assess the public health importance of the health event	Total number of cases, incidence and prevalence Indicators of severity, such as the mortality rate and the case-fatality ratio Preventability
Describe the components and operation of the surveillance system	What are the system objectives? What is the population under surveillance? What is the period of time of the data collection? What information is collected? Who provides the surveillance information? How is the information transferred? How is the information stored? Who analyses the data? How are the data analysed and how often? How often are reports disseminated and to whom? How are the reports distributed?
Evaluate the surveillance system attributes	Simplicity, flexibility, level of integration with other information systems, acceptability, data confidentiality and security, representativeness, completeness, sensitivity, positive predictive value, timeliness, stability
Assess the level of usefulness of the system	What actions are taken as a result of the data from the surveillance system? Who has used the data to make decisions and take action? Are there any other anticipated uses of the data?
Describe the resources used to operate the system	Direct cost of the surveillance system
Provide conclusions and recommendations	Are the system objectives met, and to what extent? What modifications or improvements could be made? Should the surveillance system continue?
Adapted from the Centers for Diseases Control and Prevention guidelines. ^{4,5}	

process involving considerable work by staff from notifying laboratories, PHUs, CDB and the NSW Food Authority. There were few automated components to this process. The CDB enteric diseases team entered all data from outbreak summary forms received from PHUs into the relevant enteric disease outbreak database – either the OzFoodNet Outbreak Summary Database or the Gastroenteritis in Institutions Database – as there was no mechanism for PHUs to enter their own data.

Flexibility

Key informants reported that these databases only captured final summary outbreak information and provided no mechanism to track the course of outbreaks from initial identification through to completion. Some outbreaks were incompletely reported and others were not entered into the database. The system could not readily capture and organise the large amount of information generated throughout the course of an outbreak investigation in a timely fashion. The outbreaks reported ranged in size and scope. The surveillance system catered for this; however, the databases were not flexible enough to incorporate additional information where required, and data from other Australian states could not be readily accessed.

Level of integration with other surveillance and health information systems

It was not possible to determine the potential relationships between individual disease notifications in the NSW Notifiable Diseases Database and enteric disease outbreaks recorded in the enteric disease outbreak databases. In addition, cross-checking whether cases identified in outbreaks had also been entered into the

NSW Notifiable Diseases Database was not possible, as information on individuals was not captured as part of the outbreak summary reporting process.

Acceptability

The CDB staff who managed and maintained the surveillance system for enteric disease outbreaks reported that it was cumbersome and labour intensive. The system for reporting enteric disease outbreaks created a large paper trail and involved many hours of data entry work, particularly during epidemic winter seasons of viral gastroenteritis. The outbreak summary forms provided by PHU staff often required interpretation by the CDB enteric diseases team, and required additional work to gather missing information where forms were incomplete.

Data confidentiality and security

Completed outbreak summary forms were mailed, sent by secure fax or emailed to the CDB. Individual case identifiers were not included in the data forms; information was reported in summary form only. Information on individual institutions and businesses with suspected or confirmed outbreaks was included, highlighting the need to ensure security of data at all times. With no system for tracking outbreaks, and the large paper, email and fax trails generated by the outbreak reporting system along the numerous reporting pathways, there was considerable potential for information to be misplaced or lost.

Representativeness

The true representativeness of the surveillance system could not be evaluated because this can only be measured through comparison to the true rate of enteric disease

Table 3. Completeness of enteric disease outbreak data field by reporting unit, New South Wales, 2000–2005

Reporting unit	Hospitalisation recorded n (%)	Deaths recorded n (%)	Onset date recorded n (%)	At least one stool sample collected n (%)
Communicable disease branch	7 (88)	7 (88)	8 (100)	5 (63)
Rural public health units				
A	26 (55)	24 (51)	45 (96)	26 (55)
B	34 (77)	34 (77)	42 (95)	29 (66)
C	19 (58)	14 (42)	33 (100)	14 (42)
D	4 (100)	4 (100)	4 (100)	3 (75)
E	12 (55)	10 (45)	22 (100)	6 (27)
F	5 (83)	6 (100)	6 (100)	4 (67)
G	8 (80)	7 (70)	10 (100)	4 (40)
H	4 (67)	4 (67)	6 (100)	3 (50)
Regional public health units				
I	101 (49)	100 (49)	201 (98)	102 (50)
J	33 (80)	32 (78)	41 (100)	5 (12)
K	13 (29)	12 (27)	45 (100)	22 (49)
Metropolitan public health units				
L	46 (52)	39 (44)	87 (98)	21 (24)
M	52 (39)	36 (27)	133 (100)	61 (46)
N	40 (82)	36 (73)	42 (86)	14 (29)
O	75 (74)	68 (67)	94 (92)	57 (56)
P	51 (50)	49 (48)	95 (92)	56 (54)
Q	25 (68)	24 (65)	34 (92)	11 (30)
Total	556 (56)	507 (51)	951 (95)	445 (45)

Pre 2005 Area Health Service boundaries.
Source: Gastroenteritis in Institutions Database; OzFoodNet Outbreak Summary Database.

outbreaks in NSW, which is not known. An approximate assessment of representativeness can be made by comparing the rates of enteric disease outbreaks across different areas of NSW, assuming that the occurrence of enteric disease outbreaks do not vary by location. The population-adjusted public health unit total rate of reporting of enteric disease outbreaks was highly variable, ranging from 0.5 to 7.4 per 100 000 population.⁶

Completeness

The completeness of the surveillance system was judged by assessing the proportion of critical data fields that were completely collected for all outbreaks during the period of the evaluation. The outbreak data were almost 100% complete for the date of onset of the first case and the number of people affected. Completeness for other important fields, such as the number at risk, the number hospitalised, the number of deaths, the number of stool specimens and the summary report date, was variable both over time and between public health units (Table 3). In addition, CDB staff reported that it was common for data on the environmental component of foodborne disease investigations to be incomplete, and that they were unable to monitor the completeness of outbreak reporting or be sure that they had received all essential outbreak data.

During 2005, final summary outbreak forms were received for 132 (63 per cent) of 209 provisionally reported outbreaks, including summary reports for 49/116 (42 per cent) of foodborne outbreaks and 83/93 (89 per cent) of institutional outbreaks. Some of the outbreaks provisionally reported may not have been considered to warrant further investigation or summary reporting by the PHU.

Sensitivity and positive predictive value

Sensitivity could not be evaluated, as data on the true total number of enteric disease outbreaks in NSW is not available. Positive predictive value could also not be formally evaluated, but all of the outbreaks reported using the final summary reporting form appeared to be true enteric disease outbreaks, as no non-enteric pathogens were identified.

Timeliness

There was inevitably a delay between the date of onset of symptoms in the first case and the final date of the outbreak summary report. The median time to summary reporting of all enteric outbreaks over the 5-year period was 20 days (inter-quartile range 6–52 days). For foodborne outbreaks, the median time to a summary report was 32 days (inter-quartile range 10–105 days), and for non-foodborne outbreaks 19 days (inter-quartile range 6–47 days). The time to

summary reporting of foodborne outbreaks was significantly longer than for non-foodborne outbreaks ($p < 0.001$, Kruskal–Wallis test), although the median time to summary reporting for all outbreaks was well within the required 30 days since the last outbreak case was identified.

Stability

As the period of evaluation covered the introduction of two outbreak databases, one during early 2000 and another in 2003, the methods for surveillance and reporting of enteric disease outbreaks changed over the five-year time period investigated, both in terms of the reporting forms used, data fields collected and databases used. This meant that some data were incomplete or not completely comparable, even over this relatively short time period.

Cost of the surveillance system

The cost of the surveillance system was not assessed due to time constraints.

Public health importance of the surveillance system

Between 2000 and 2005, 998 enteric disease outbreaks were reported (148 foodborne and 850 non-foodborne), affecting 24 260 people, and associated with 771 hospitalisations and 21 deaths. The outbreaks reported during the evaluation period are described in more detail in 'Enteric disease outbreak reporting, New South Wales, Australia, 2000 to 2005' in this issue.⁶

Usefulness of the surveillance system

Despite the limitations of the surveillance system, the key informants indicated that they were able to use the enteric disease outbreak surveillance system data to produce

useful information, such as: the incidence of outbreaks in NSW; assessment of the success of outbreak control efforts; identification of the probable cause of an outbreak; and identification of measures that could contribute to more effective prevention of enteric disease outbreaks.⁶

The CDB users of the system, and the results of an analysis of the information available from the enteric disease outbreak databases, indicated that the surveillance system did provide a mechanism for meeting all the objectives of the surveillance system at some level.

System products

Policy outputs of the NSW enteric disease outbreak surveillance system were difficult to identify due to an absence of a system for identifying, organising and recording policy outcomes of outbreak investigations. Products of the surveillance system that were identified through document review and interviews with key informants included:

- fortnightly, quarterly and annual NSW Health and OzFoodNet reports (published as part of the national OzFoodNet reports in *Communicable Diseases Intelligence*)
- summary institutional outbreak data published in each issue of the *NSW Public Health Bulletin* and available from the NSW Health website (www.health.nsw.gov.au)
- *ad hoc* provision of outbreak data as requested by other jurisdictions, government agencies, research institutions and industry
- information that contributed to policy development within the NSW Department of Health and the NSW

Table 4. Examples of policy outputs from enteric disease outbreak investigations, New South Wales, 2000 to 2005

Outbreak type	Policy or practice intervention
Hepatitis A in a food handler	Guidelines for operating mass post-exposure prophylaxis clinic developed by Central Sydney Public Health Unit. Tool developed by Communicable Diseases Branch to assess risk of exposure to hepatitis A or other gastrointestinal infection arising from a sick food handler.
<i>Salmonella</i> Typhimurium 9 and <i>S. Typhimurium</i> 126 outbreaks linked to eggs	NSW outbreak investigations contributed to an OzFoodNet report that will inform the development of the Food Standards Australia and New Zealand Primary Production and Processing Standards for the egg industry.
<i>Salmonella montevideo</i> outbreak linked to Egyptian tahini	Product recall, increased sampling of imports, Australian Quarantine and Inspection Service placed tahini on their risk list, international alert.
Various <i>Salmonella</i> outbreaks linked to chicken consumption	Used to inform the Food Standards Australia New Zealand Primary Production and Processing Standards for the poultry industry and industry risk assessments; increased attention from regulators; used to inform NSW Food Authority work with the poultry industry.
<i>S. Paratyphi</i> B bv java linked to contact with tropical fish and fish tanks	OzFoodNet developed fact sheets for the pet industry and purchasers of fish about the health risks and how to prevent infection.
<i>S. Typhimurium</i> 197 linked to lambs liver	Consumer education material produced by the NSW Food Authority.
Viral gastroenteritis epidemics in institutions	Development of the GASTRO PACK, formation of Aged Care Facility Outbreak Response Working Group, development of a new Viral Gastroenteritis in Institutions Reporting Form, regular media releases throughout winter viral gastroenteritis seasons.

Food Authority, and also to national foodborne illness and health policies

- information that contributed to advocacy measures, including media releases (Table 4).

Discussion

This evaluation determined that the surveillance system was performing a useful function, and was able to meet all of its pre-defined objectives to some extent. A principal limitation of the system was the inability to track the course of outbreaks efficiently and comprehensively, making central monitoring of the extent of outbreaks and the impact of control efforts difficult. In addition, the fact that enteric disease data was not linked with the NSW Notifiable Diseases Database delayed the sharing and reporting of outbreak information. A final limitation was the complicated, cumbersome and time-consuming nature of the enteric disease outbreak surveillance databases and information collation techniques, and the lack of flexibility of the data management system.

Given the absence of a system for tracking outbreaks and resultant policy outcomes, the findings presented here are likely to be incomplete. Nevertheless the system did appear to perform reasonably well with respect to prevention efforts and policy outputs. This report provides an imprecise indication of the comprehensiveness and timeliness of reporting due to the absence of a method for systematically tracking the course of an outbreak, and the absence of critical data fields, such as onset date of last case.

The sensitivity and specificity of the system could not be evaluated. Due to enhanced surveillance in the one site with the highest rates of reporting, the surveillance system is unlikely to be representative of the true distribution of enteric disease outbreaks. Furthermore, approximately 17.2 million cases of gastroenteritis occur in Australia annually, but only a minority of people with gastroenteritis go to a doctor, and only a minority of these provide a stool sample.⁷ Hence, the reported rates of enteric disease outbreaks are likely to be a substantial underrepresentation of the true rates of enteric disease outbreaks in the community. The rates of enteric outbreaks reported from this evaluation were comparable with previous estimates of reported rates of enteric disease outbreaks in NSW, indicating some system stability.⁸

The evaluation itself was limited: it was not independent of the health system, and only a limited number of key informants within the NSW Department of Health were interviewed. Local PHU staff were not interviewed, and may have been able to provide important insights into the performance and usefulness of the enteric disease surveillance system. This evaluation focussed mainly on the surveillance processes within the Department, and not on the notifications to PHUs, or the PHU investigations them-

selves. In addition, the cost-effectiveness of the system was not evaluated.

This evaluation produced some recommendations to improve the efficiency and effectiveness of the surveillance system. Recommendations from the review, together with the development of a tender for a new notifiable diseases surveillance database system, have resulted in agreement to the following improvements to the system:

- consolidation of all disease outbreak information into one database
- linkage of enteric disease outbreak data with enteric disease data in the redeveloped state and national notifiable disease databases
- development of a mechanism to monitor the course of outbreaks and assist in comprehensive outbreak data collection.

Once the new database has been constructed and implemented, simplification and consolidation of the data collection forms will be undertaken as a matter of priority.

Conclusion

The NSW enteric disease outbreak surveillance system is serving a useful public health function and should be continued. The system could be improved through the use of more sophisticated electronic data management techniques.

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