Evaluation of *Campylobacter* infection surveillance in Victoria

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Abstract

Campylobacter infection is a notifiable infectious disease in Victoria and with more than 6,000 cases notified annually, it is the second most commonly notified disease after chlamydia. The objectives of *Campylobacter* infection surveillance in Victoria are to monitor the epidemiology of *Campylobacter* infection, identify outbreaks, initiate control and prevention actions, educate the public in disease prevention, evaluate control and prevention measures, and plan services and priority setting. An evaluation of the system was undertaken to assess performance against its objectives, identify areas requiring improvement and inform a decision of whether *Campylobacter* infection should remain a notifiable infectious disease. The surveillance system was assessed on the attributes of data quality, timeliness, simplicity and acceptability using notifiable infectious diseases data and interviews with doctors who had failed to notify, and laboratory and public health staff. The evaluation found that the system collects core demographic data with high completeness that are appropriately reviewed, analysed and reported. In 2007, 12% of *Campylobacter* isolates were subtyped and only one to 3 outbreaks were identified annually from 2002 to 2007. Fifty-four per cent of cases were notified by doctors and 96% by laboratories, although nearly half of laboratory notifications were not received within the prescribed timeframe. Half of the surveyed non-notifying doctors thought that *Campylobacter* infection was not serious enough to warrant notification. The *Campylobacter* surveillance system is not fully satisfying its objectives. Investment in the further development of analytical methods, electronic notification and *Campylobacter* subtyping is required to improve simplicity, acceptability, timeliness and sensitivity. *Commun Dis Intell* 2010;34(2):110–115.

Keywords: *Campylobacter*, population surveillance, disease notification

Introduction

Infection with *Campylobacter* causes acute enteritis of mucopurulent and sometimes bloody diarrhoea, abdominal pain, fever, nausea, myalgia and headache.[1] Symptoms typically last for two to 5 days, but may continue for up to a week or longer. *Campylobacter* infection may be complicated by generalised sepsis, reactive arthritis and Guillian-Barré syndrome but is rarely fatal. *Campylobacter* infections are a common and significant public health issue in Australia. The notification rate of *Campylobacter* infections consistently exceeds 100 per 100,000 population,[2] and was estimated to have caused around 225,000 gastroenteritis cases annually between 2000 and 2004.[3] The morbidity and costs associated with *Campylobacter* infection are significant despite infections generally being self-limited, and it was associated with more than 3,000 hospitalisations in Australia in 2000.[4]

Campylobacter infection is notifiable in all Australian jurisdictions except New South Wales.[5] Under the *Victorian Health (Infectious Diseases) Regulations 2001,* medical practitioners and pathology services in Victoria are required to notify cases to the Victorian Department of Health within 5 days of diagnosis. The regulations also require pathology services to immediately notify the department of *Campylobacter* isolated or detected in food or water supplies. Furthermore, two or more related cases of suspected food or water-borne illness must be notified within 24 hours of diagnosis. A notified case is investigated if it meets any of the following criteria: is a food handler, health care worker or child care worker; is a child in a child care centre; is associated with one or more other cases; is a resident of a special care facility or institution; or if a suspected source of the case's illness has been reported.[6]

The objectives of *Campylobacter* surveillance in Victoria are: to monitor epidemiological trends of *Campylobacter* infection in the population; identify outbreaks and their possible or probable cause; initiate action to prevent, contain or minimise outbreaks and illness; take the opportunity to educate the public in disease prevention; evaluate control and prevention measures; and plan services and priority setting in the allocation of health resources.

Campylobacter infection is the second most commonly notified disease in Victoria (accounting for about 20% of the 2007 total) after chlamydia. There has been a generalised increase in the number of notified cases in the last 15 years from an average of approximately 2,220 cases annually between 1991 and 1993 to approximately 6,130 annually notified cases between 2004 and 2007.[6,7] Annual notification rates have increased by a similar magnitude over the same period.[2]

An evaluation of Victoria's *Campylobacter* infection surveillance was undertaken prior to a review of Victoria's public health regulations to: determine whether it was achieving its stated objectives; identify redundancies or specific areas requiring improvement; and potentially identify alternative methods for *Campylobacter* infection surveillance (such as in New South Wales for which it is only notifiable when implicated as the source of foodborne disease or gastroenteritis in an institution).[5]

Methods

The evaluation was conducted using the US Centers for Disease Control and Prevention's *Updated guidelines for evaluating public health surveillance systems*.[8] Here we report on the specific attributes of: data quality (assessed by completeness of core data fields and proportion of case isolates that are subtyped); timeliness (for laboratory notifications assessed by time in days between specimen collection date, date of result and notification receive date at the department and for doctor notifications assessed by time in days between the date of signature by the doctor and notification receive date); simplicity (assessed by method of notification); sensitivity (assessed by number of outbreaks identified from case investigation or epidemiological analysis); and acceptability (assessed by proportion of cases notified by doctors and survey of non-notifying doctors).

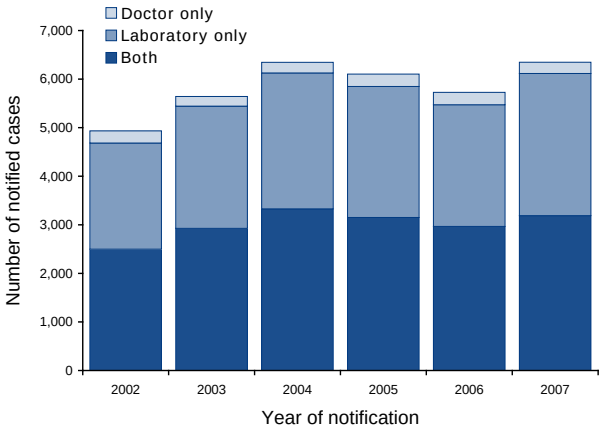
Semi-structured interviews about the system's performance against the attributes and perceptions about its usefulness were conducted with 20 key system users including laboratory staff, and head office and regional departmental public health staff that contribute to and operate the system. Records of all confirmed cases of *Campylobacter* infection with a notification receive date between 1 January 2002 and 31 December 2007 inclusive were extracted from the Victorian Government Department of Health Notifiable Infectious Diseases Surveillance database for descriptive analysis. For clarity and brevity, most figures in this paper present the most recent (2007) annual data. Using a telephone-administered survey, a sample of 30 doctors chosen randomly from a population of 270 doctors who failed to notify at least 1 case of *Campylobacter* infection in February 2008 (but were identified from a laboratory notification of the case) were asked about their awareness of *Campylobacter* infection as a notifiable disease, reasons for their failure to notify and the level of importance they would ascribe to various doctor notification improvement strategies. Survey responses were descriptively analysed using frequency tables.

EpiData software was used to collate and analyse doctors' survey data. Other descriptive analyses were conducted with Stata/IC version 10 and Microsoft Excel.

Results

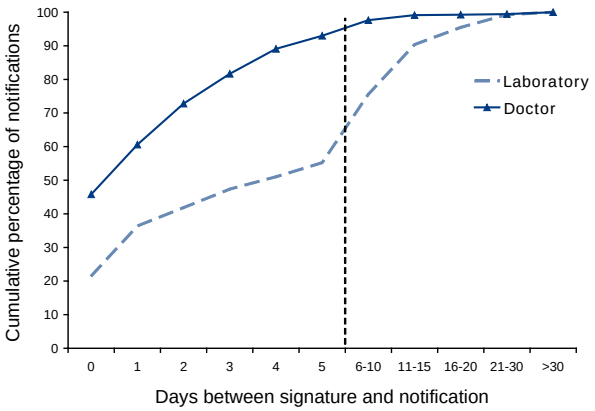
Completeness of the core data fields of date of birth, sex and residential postcode was in excess of 98% in each year from 2002–2007. However, two of the prescribed fields for medical practitioner notifications, indigenous status and occupation (which are not prescribed for laboratory notifications), were only completed for 40%–46% and 5%–14% of total cases respectively over the same time period. Of the total notified cases of *Campylobacter* infection, doctors failed to notify 44%–46% annually (Figure 1). Generally, 50%–52% of cases were notified by both a doctor and laboratory and 3%–5% by a doctor only.

Figure 1: Number of notified *Campylobacter* infection cases notified by doctors, laboratories or both, Victoria, 2002 to 2007



In 2007, 89% of laboratory notifications of *Campylobacter* infection were diagnosed within 5 days of specimen collection (median = 3 days); 55% of these notifications were received by the department within the prescribed 5 days from when the diagnosis was confirmed by the laboratory (Figure 2). However, there was significant inter-laboratory variation; 1 laboratory notified 98% of its diagnosed cases within 5 days but another only notified 3%. In comparison, nearly 93% of the *Campylobacter* infection notifications made by doctors in 2007 were within 5 days of the signature (diagnosis) date (Figure 2). The distribution of notification methods amongst laboratories and doctors reflected the time elapsed between diagnosis and notification, with nearly ¾ of laboratory notifications made by post compared with more than half of doctor notifications being made by the faster methods of fax or telephone (Table 1).

Figure 2: Days difference between diagnosis and notification of *Campylobacter* infection by laboratories and doctors, Victoria, 2007



One-third of the surveyed non-notifying doctors indicated the most important reason for not notifying cases of *Campylobacter* infection was that it was unnecessary because laboratories notify anyway (Table 2). A further 17% of doctors surveyed indicated their primary reason as being that *Campylobacter* infection is not important enough to warrant notification. Overall, half of the surveyed doctors indicated this as a reason for not notifying.

Table 1: Percentage of laboratory or doctor *Campylobacter* infection notifications, Victoria, 2007, by method

Notification method	Laboratories	Doctors
Post	72	44
Fax	26	48
Telephone	0	4
Web	0	3
Indirectly	2	1

Table 2: Most important reason reported by doctors for not notifying *Campylobacter* infection

Reason	Number	Per cent
Laboratory notifies anyway	10	33
Don't know	7	23
Not important	5	17
Too busy	4	13
System broke down	2	7
Other	2	7
Total	30	

Of factors that would encourage notification of *Campylobacter* infections, 23 of the 30 respondents noted 'a more simplified process' would encourage notification; 11 of these believed it the most important factor in increasing notifications. Cost and resource implications were acceptable to doctors, with 83% responding that 'lack of administrative and staffing support' was of little or no importance in their failure to notify.

Notifications of *Campylobacter* infection between 2002 and 2007 resulted in the identification of between one and 3 outbreaks or clusters of infection annually. In 2007, the 3 *Campylobacter* outbreaks identified were not identified from the analysis of *Campylobacter* infection notifications but through investigation of directly reported outbreaks of unspecified gastroenteritis that were subsequently found to be caused by *Campylobacter*. Although the incident case investigation system did allow some prevention and education activities in 2007 (Table 3), in general little prevention, containment or treatment activity results from notification data because the incident case is contacted subsequent to the period of *Campylobacter* infectivity.

Table 3: Outcomes of *Campylobacter* infection single incident investigations, Victoria, 2007

Outcome(s) of investigation	Number	Per cent
Exclusion from school/childcare/ work	133	10
Other cases identified	118	9
Possible source identified	285	21
Source confirmed	6	<1
Education completed	685	56
Outbreak identified	0	0
Total	1,227	

Interviews with surveillance system stakeholders quickly achieved methodological data saturation as similar issues were repeatedly identified, the most common of which were a cumbersome system for case referral and investigation, and the need for more effective feedback and dissemination to encourage more notification and better influence practice and policy. The *Campylobacter* surveillance system generates significant data that are disseminated through: regular descriptive surveillance reports to national, state and local government stakeholders; automatically (daily) generated summary data reports, and descriptive annual and quarterly reports that are posted on the web; and relevant

stakeholders being informed of an outbreak within 24 hours of its detection. However, interviews with users of the outputs of the system suggested that it is not being used to its potential for the evaluation of control and prevention measures or to influence planning, priority setting, policy, practice, research and public education.

The quality of the microbiological data available in surveillance was limited at the laboratory level. In 2007 only 12% of 6,350 *Campylobacter* isolates were speciated, of which approximately 10% were *C. jejuni* and 3 other *Campylobacter* spp. comprised the remainder (Table 4).

Table 4: Notified cases of *Campylobacter* infection, Victoria, 2007, by reported species

Species	Number	Per cent
Campylobacter not further specified	5,561	88
C. jejuni	498	8
C. jejuni jejuni	146	2
C. coli/jejuni	82	1
C. coli	41	<1
C. upsaliensis	16	<1
C. lari	6	<1
Total	6,350	

Discussion

This evaluation has found that Victoria's notifiable infectious diseases surveillance system for *Campylobacter* infection is only partially achieving its objectives. Whilst the system has a number of strengths, there are a number of improvements that could be made so that it is more effective.

Approximately half of notified cases of *Campylobacter* infection have a doctor notification. This, and results of the survey of doctors who failed to notify cases of *Campylobacter* infection, suggest that acceptability is an important weakness of the system although it should be noted that acceptability among notifying doctors was not assessed in the evaluation. Amongst the non-notifying practitioners surveyed, improved simplicity was identified as the single most important factor that would increase notification rates. Integration of electronic notification systems with practice software would improve simplicity, timeliness and quantity of doctor notifications of *Campylobacter* infection, as well as all other notifiable diseases. This is especially pertinent given the high volume of cases and that more than 90% of general practices in Australia use a clinical software package.[9] Doctors from the sample also commented that improving feedback would encourage a higher notification rate, although these need to go beyond automatically generated summary reports currently published. Other potential avenues for feedback and comparison of notification indicators include formal education sessions, information distribution through peak body organisations and other medical publications, as well as utilising improved technology to generate automatic reports to the practitioner about outcomes and investigations arising from—and thus the importance of—their notifications. Doctors should also be reminded that their notifications contain important information not provided by laboratories, such as indigenous status and risk factor data.

Results from the survey of doctors in this evaluation have informed the development of a strategy to improve medical practitioner notification rates of infectious diseases. With the support of General Practice Victoria, the strategy is focussing on: improving technology to enable notification, and; educational activities and resources that support notification.[10] A project for electronic notification of notifiable infectious diseases from pathology laboratories in Victoria to improve completeness, timeliness and overcome the practice of batching is also being developed. Imposing fines for failing to notify is an alternative method to improve notification rates and although the legislative framework allows for this, there is general agreement that this would be counterproductive in a cooperative surveillance system.

The *Campylobacter* infection surveillance system is not optimally achieving its objective of identifying outbreaks. Despite generally high completeness of core demographic data, a key barrier to achieving this objective is the low proportion of case isolates that are differentiated to species and subspecies level. This is in contrast to outbreaks of *Salmonella* infection that are identified and traced to sources through comprehensive laboratory sub-typing. If identifying outbreaks and their causes from *Campylobacter* infection surveillance is to remain an objective, then more systematic utilisation of existing and emerging technologies to subtype *Campylobacter* will be important.[11] Systematic serotyping, ribotyping and genotyping of case isolates identified from notifiable infectious diseases surveillance were used to differentiate 28% of 975 patient isolates of *Campylobacter* into 43 different clusters in Denmark[12] and 55% of 183 isolates into 29 clusters in Canada.[13] In Australia, genotyping has been used periodically to identify genotype-specific risk factors for *Campylobacter* infection and identify outbreaks or clusters of

infection.[14,15] Improved and systematic subtyping for *Campylobacter* will also make the surveillance much more effective in achieving its objectives of evaluating control and prevention measures, and planning services and priority setting in the allocation of health resources. For example, it could potentially be utilised to track the impact and effectiveness of the new Primary Production and Processing Standard for Poultry Meat, given that contaminated poultry meat is the greatest risk factor for *Campylobacter* infection in Australia.[15–17] However, the high volume of *Campylobacter* notifications means that subtyping all—or even a substantial proportion of—specimens would require significant finance and resource investment.

Sensitivity (at case level), representativeness and positive predictive value were not assessed in this evaluation. However, in Australia it has been estimated that notifiable diseases surveillance detects approximately 10% of all community cases of *Campylobacter* infection.[3] Although this is a low proportion of cases, it is difficult to determine whether or not it is representative of all cases. However, high sensitivity is not essential for a surveillance system to be representative, particularly if there are high volumes already notified. If biases amongst unidentified cases are generally consistent over time, then comparisons in *Campylobacter* infection notifications over time, person and place can still be made to monitor trends.

The low number of outbreaks detected suggests that the sensitivity of the system to detect outbreaks is poor. However, when compared with *Salmonella*, a much lower proportion of notified *Campylobacter* infection cases in Australia and the United Kingdom are associated with outbreaks. It has been suggested that the low frequency of reported *Campylobacter* outbreaks may be due to the wide distribution of source foods such as poultry and beef manifesting as disseminated community outbreaks, which are more difficult to detect than point source outbreaks (with which *Salmonella* spp. are commonly associated).[11] It therefore follows that enhancement of *Campylobacter* subtyping would improve the system's sensitivity to detect outbreaks.

In the interests of relevance to other jurisdictions, this paper has generally focused on the notification elements that feed into the *Campylobacter* infection surveillance system, rather than the subsequent investigation processes that are specific to the Victorian Government Department of Health. Briefly though, the evaluation noted that the system collects high quality data that are appropriately reviewed, analysed and reported. For example, in 2006 increased notifications of *Campylobacter* infection in the Barwon–South Western Region resulted in an investigation that linked the increase to changes in laboratory culturing methods. However, opportunities exist to make better use of algorithms and mapping technologies for geospatial analysis. Such technology could automatically check for associations of *Campylobacter* infections with, for example, population density, occupation, proximity to waterways and industry. Specific areas of improvement for the system were identified, particularly the timeliness and effectiveness of the referral process for case investigation and outbreak identification which have already been modified. The high volume of cases also periodically impacts the timeliness of data entry and thus the identification of outbreaks and emerging trends; adoption of electronic notification technology will dramatically improve this.

In summary, the *Campylobacter* infection surveillance system was found to be generating quality data for monitoring trends, and case investigation likely raises public awareness about *Campylobacter* to a limited extent. However, the system is threatened by a perceived lack of usefulness, unnecessary complexity, suboptimal timeliness, and a lack of acceptance of *Campylobacter* infection as a significant public health threat among a subset of doctors. Rectification of these issues for the system to meet its objectives requires investment in laboratory testing, more advanced analytical software and electronic notification technologies, the latter of which is in progress. The Victorian Department of Health regards *Campylobacter* infection as an infectious disease of public health importance, and improving the current system is preferred to another model such as that in New South Wales, where *Campylobacter* infection is not notifiable but which relies on direct reporting of gastroenteritis outbreaks to identify those caused by *Campylobacter*. Whilst the recommendations relate to *Campylobacter* infection surveillance, they have some cross-validity in terms of informing, more broadly, the approach to single incident investigations for other enteric diseases and surveillance for notifiable diseases in general.

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