EVALUATION OF CAMPYLOBACTER INFECTION SURVEILLANCE IN VICTORIA
Nathan J Grills, Stacey L Rowe, Joy E Gregory, Rosemary A Lester, James E Fielding

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. 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, and was estimated to have caused around 225,000 gastroenteritis cases annually between 2000 and 2004. 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.

Campylobacter infection is notifiable in all Australian jurisdictions except New South Wales. 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.

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. Annual notification rates have increased by a similar magnitude over the same period.
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).

**Methods**

The evaluation was conducted using the US Centers for Disease Control and Prevention’s *Updated guidelines for evaluating public health surveillance systems*. 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.

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).
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.

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

<table>
<thead>
<tr>
<th>Notification method</th>
<th>Laboratories</th>
<th>Doctors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post</td>
<td>72</td>
<td>44</td>
</tr>
<tr>
<td>Fax</td>
<td>26</td>
<td>48</td>
</tr>
<tr>
<td>Telephone</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Web</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Indirectly</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Reason</th>
<th>Number</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory notifies anyway</td>
<td>10</td>
<td>33</td>
</tr>
<tr>
<td>Don’t know</td>
<td>7</td>
<td>23</td>
</tr>
<tr>
<td>Not important</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>Too busy</td>
<td>4</td>
<td>13</td>
</tr>
<tr>
<td>System broke down</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>

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

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

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

<table>
<thead>
<tr>
<th>Species</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Campylobacter</em> not further specified</td>
<td>5,561</td>
<td>88</td>
</tr>
<tr>
<td><em>C. jejuni</em></td>
<td>498</td>
<td>8</td>
</tr>
<tr>
<td><em>C. jejuni jejuni</em></td>
<td>146</td>
<td>2</td>
</tr>
<tr>
<td><em>C. coli/jejuni</em></td>
<td>82</td>
<td>1</td>
</tr>
<tr>
<td><em>C. coli</em></td>
<td>41</td>
<td>&lt;1</td>
</tr>
<tr>
<td><em>C. upsaliensis</em></td>
<td>16</td>
<td>&lt;1</td>
</tr>
<tr>
<td><em>C. lari</em></td>
<td>6</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Total</td>
<td>6,350</td>
<td></td>
</tr>
</tbody>
</table>

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. 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. 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. 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 and 55% of 183 isolates into 29 clusters in Canada. In Australia, genotyping has been used periodically to identify genotype-specific risk factors for *Campylobacter* infection and identify outbreaks or clusters of
However, the high volume of Campylobacter infection noti-
fications means that subtyping all—or even a sub-
stantial 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 esti-
ated that notifiable diseases surveillance detects
approximately 10% of all community cases of
Campylobacter infection.\textsuperscript{1,15} Although this is a low pro-
portion 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 uniden-
tified cases are generally consistent over time, then
comparisons in Campylobacter infection notifica-
tions 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 associ-
ated).\textsuperscript{11} It therefore follows that enhancement of
Campylobacter subtyping would improve the sys-
tem’s sensitivity to detect outbreaks.

In the interests of relevance to other jurisdictions,
this paper has generally focused on the notifica-
tion elements that feed into the Campylobacter
infection surveillance system, rather than the
subsequent investigation processes that are spec-
cific 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 technol-
ogy could automatically check for associations of
Campylobacter infections with, for example, popu-
lation density, occupation, proximity to waterways
and industry. Specific areas of improvement for the
system were identified, particularly the timeliness
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 noti-
fication technology will dramatically improve this.

In summary, the Campylobacter infection surveil-
ance 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 complex-
ity, 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 notifica-
tion 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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References