

Epidemiology of chronic hepatitis B and C in Victoria, Australia: insights and impacts from enhanced surveillance

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Chronic viral hepatitis is one of the major causes of morbidity and mortality worldwide, affecting more than 350 million people¹⁻³ and ranking seventh of all causes of death.⁴ Although Australia is considered a low prevalence country for hepatitis B and C viruses (HBV and HCV), which together affected approximately 2% of the population in 2016,¹ chronic viral hepatitis remains a significant cause of preventable morbidity and mortality.⁵ Liver cancer, predominantly attributable to viral hepatitis infection, is Australia's fastest increasing cause of cancer death.⁶

Despite the availability of effective testing and treatment, significant improvements are needed in access to diagnosis and care in order to prevent adverse outcomes in those affected by HBV,^{7,8} while the recent availability of highly effective new treatments for HCV has raised the possibility of elimination of infection in Australia.⁹ High-quality, up-to-date information regarding the epidemiological characteristics of those most affected is crucial for enhancing both public health and clinical responses.¹⁰ Along with survey-based and modelling studies, a key source of this information is surveillance for notifiable diseases, which records information on selected infectious diseases legislated as being of public health importance, including viral hepatitis, to guide public health interventions. These systems, however, rely on administrative data sources and compliance with public health regulations, and as such are often subject to gaps in quality and completeness.^{11,12}

Abstract

Objective: To assess the impact of an enhanced viral hepatitis surveillance program on data completeness and on epidemiological assessment of affected populations.

Methods: Notified cases of non-acute hepatitis B and C were analysed to determine demographic characteristics and risk factors during the period prior to July 2015–June 2016, and during enhanced surveillance of the period July 2016–June 2017, during which time doctors were contacted for information about new diagnoses.

Results: During the enhanced period, completeness for country of birth and Indigenous status doubled for both hepatitis B and hepatitis C, from 18–37% to 48–65%. The incidence ratio of hepatitis C among Aboriginal and Torres Strait Islander people increased from eight-fold to 11.4-fold, and the proportion of hepatitis B cases reported as born in China and Vietnam relative to other countries increased. New data fields identified that 12% of hepatitis C diagnoses occurred in a correctional facility, and 2% of hepatitis B cases were healthcare workers.

Conclusions: Improved data completeness highlighted the underlying epidemiology of chronic viral hepatitis, demonstrating the increased burden of infection among specific priority populations.

Implications for public health: Enhanced surveillance provides greater insight into the epidemiology of chronic viral hepatitis, identifying groups at risk and opportunities for public health action.

Key words: surveillance, epidemiology, viral hepatitis, migrant health

All diagnoses of hepatitis B and hepatitis C are required by jurisdictional public health legislation to be notified to health authorities by the pathology laboratory conducting the test (in all jurisdictions) and by the diagnosing doctor (in most jurisdictions).¹³ Notifications are classified as newly acquired, where there is laboratory or clinical evidence that infection was acquired in the past two years, or otherwise as unspecified, in accordance with national case definitions.¹⁴ Those cases categorised as unspecified overwhelmingly represent chronic cases of HBV and HCV.⁵

While compliance with notification requirements is high among laboratories, historically only a minority of health practitioners complied with these regulations in relation to unspecified HBV and HCV.¹⁵ Previous research has identified that diagnosing doctors appreciate the value of public health responses to hepatitis B diagnosis; however, time constraints and clinical system limitations were barriers.¹⁶

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Submitted: April 2019; Revision requested: June 2019; Accepted: July 2019

The authors have stated they have no conflict of interest.

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Although laboratory notifications can provide case counts and core demographic information such as age, sex and area of residence, variables such as Aboriginal and Torres Strait Islander status, country of birth, occupation and risk factors for infection can only be provided by the diagnosing doctor. These are particularly important in assessing the epidemiological trends relating to chronic viral hepatitis, which disproportionately affects those born overseas, Aboriginal and Torres Strait Islander people and people who have injected drugs.^{5,17} Other information obtained from clinical data, such as whether the diagnosed person is a healthcare worker or resides in a correctional facility, facilitate a more thorough public health response.

Victoria implemented a program to enhance the collection of these surveillance data in July 2016. This was achieved by incorporating extra questions into the standard notification form, contacting diagnosing doctors by mail to emphasise the importance of notifying, and facilitating ease of reporting by providing simplified pre-filled forms. Prior to the commencement of this program, follow-up was concentrated upon only those cases where the notifying doctor or laboratory indicated that the case may be newly acquired or where a potential public health risk existed (for example, recent surgery, or a case being a healthcare worker) and complete information was predominately limited to those cases.

The aim of this analysis is to generate an overview of the current epidemiology of unspecified (chronic) HBV and HCV in Victoria, and examine the impact of improved reporting on the demography of infection and identification of priority populations and the incidence of risk factors. It also examines changes in the reporting of risk factors before and after the implementation of enhanced surveillance, assessing the impact of previous under-reporting on the ability to accurately assess information derived from a surveillance system.

Methods

Data source

We analysed all cases of unspecified HBV and HCV infections notified to the Public Health Events Surveillance System (PHESS) of the Victorian Department of Health and Human Services (DHHS) from 1 July 2015 until 30 June 2017. This includes the one-year periods before (baseline) and after

(enhanced) implementation of the enhanced surveillance project, which began on 1 July 2016. Unspecified cases are those with no laboratory or clinical evidence to indicate infection having been newly acquired, in accordance with national case definitions¹⁴ and represent the vast majority of cases.

Variables

Extracted data included age at diagnosis, sex, Aboriginal and Torres Strait Islander status, country of birth, occupation, area of residence (metropolitan or rural/regional), history of injecting drug use, whether the case was in a correctional facility at the time of diagnosis (based on both a specific variable and where this was missing, imputed from residential address and clinic information) and whether the case had ever been a healthcare worker. These latter three variables were added to a standard data collection form as part of the enhanced surveillance program and were not able to be assessed for the baseline period. Although data were collected for a small proportion of cases prior to the pilot (<10%), reporting was not systematic and these fields were likely to be preferentially recorded for cases with these demographic or risk factors present, due to the practice of following up suspected newly acquired cases.

Analysis

Data completeness was assessed for the baseline and enhanced surveillance periods. Rates and rate ratios of unspecified HBV and HCV notifications were generated for each time period according to sex, Aboriginal and Torres Strait Islander status, region of birth (overseas or Australia) and area of residence (metropolitan or non-metropolitan). Due to the over-representation of overseas-born individuals among non-Indigenous Australians with HBV, the rate ratio comparing Aboriginal and Torres Strait Islander and Australian-born non-Indigenous individuals was also calculated, and is presented in Table 1.

The proportion of all cases reported as Aboriginal and Torres Strait Islander and born overseas was assessed, as well as specific country of birth for the most common countries. Median and interquartile ranges were calculated to assess age distribution. The proportion of cases reporting a history of injecting drug use, occupation as a healthcare worker, or being in a correctional facility at the time of diagnosis was calculated for the enhanced period only.

Population denominator data, according to age, sex, area of residence, Aboriginal and Torres Strait Islander status and region of birth were sourced from the 2016 Australian Census,^{18,19} with adjustments made for the period 2015–16 in accordance with the change in Estimated Resident Population during that time.²⁰

Results

Summary and data completeness

Between 1 July 2015 and 30 June 2017, a total of 8,149 cases of unspecified HBV and HCV were notified in Victoria. The number of notifications decreased during 2016–2017 for both HBV (1,917 during baseline and 1,708 during enhanced) and HCV (2,438 and 2,086), see Table 1.

Data completeness for these notifications varied substantially according to variable and time period. Characteristics such as sex, age and postcode of residence, available from either laboratory or doctor notification information were complete in at least 95% of cases, with little difference between the baseline and enhanced surveillance periods (Table 1).

Large increases in completeness occurred for all remaining variables during the enhanced surveillance period. The proportion of cases with Aboriginal and Torres Strait Islander status missing fell from 63.0% to 34.7% for HBV and 77.9% to 45.9% for HCV (Table 1). Country of birth reporting also substantially improved, with the proportion incomplete reducing from 70.9% to 40.7% for HBV and 81.9% to 51.2% for HCV. Reporting for variables not routinely collected in the pre-pilot period was understandably low, with fewer than 10% of notifications having any information available on injecting drug use status, correctional facility status and healthcare worker status. In the enhanced surveillance period, completeness for these variables reached 45–55% (Table 1).

Demographics and risk factors

During both time periods, the notification rate was higher for males than females, particularly for HCV (Table 1). The median age was higher for HCV (41 and 42 years during baseline and enhanced, respectively) than for HBV (36 and 37 years). The rate of HCV notification was higher in non-metropolitan areas of Victoria during both time periods; whereas, for HBV it was more than four times higher in metropolitan regions (Table 1).

The rate of HBV among people identified as Aboriginal and/or Torres Strait Islander (6.4 per 100,000) was lower than all non-Indigenous people (13.1) during the first time period; however, this may be limited by the low number of cases (<5 in Aboriginal and Torres Strait Islander people). During the enhanced surveillance period, during which data completeness reached 65%, rates were very similar (18.8 in Aboriginal and Torres Strait Islander and 20.0 in all non-Indigenous people). However, the rate among Australian-born non-Indigenous individuals was much lower (0.76 per 100,000 during 2015–2016 and 1.53 per 100,000 during 2016–17), leading to rate ratios for Aboriginal and Torres Strait Islander compared to other Australian-born non-Indigenous people of 8.51 and 12.3, respectively. The notification rate for HCV was higher for Aboriginal and Torres Strait Islander people during both time periods, with the disparity increasing from eight-fold higher during baseline to 11.4-fold higher during enhanced, as Aboriginal and Torres Strait Islander status completeness increased from 22% to 55% (Table 1).

The majority of people diagnosed with HBV were born overseas. During both time periods the notification rate was more than 30 times higher in this population and data completeness nearly doubled with enhanced surveillance, from 29% to 59%. For HCV, rates were slightly lower among overseas-born residents than Australian-born residents in both time periods and data completeness improved from 19% to 50% (Table 1).

The proportion of notification forms distributed that were returned by the notifying doctor (response proportion) during the enhanced surveillance was 59.7%. This was lowest in the first month (47.1% in July 2016); however, remained above 55% for the remaining months with the exception of January 2017 (50.0%), with no evidence seen of declining response proportion over time.

The distribution of cases according to country of birth within those born overseas also shifted between the two time periods (Figures 1 and 2). Although China was the most common country of birth for HBV cases, the proportion increased during the enhanced period (19.6% during baseline and 31.5% during enhanced), making up nearly one-third of those with a country of birth reported during 2016–2017 (Figure 1). The proportion born in most other countries remained relatively stable; however, there was also an increase in the proportion of

Table 1: Demographic characteristics and risk factors for unspecified hepatitis B and hepatitis C cases, Victoria, Australia, 2015–2017, by time period.

Variable	Baseline	Enhanced	Baseline	Enhanced
	(2015–2016)	(2016–2017)	(2015–2016)	(2016–2017)
	HBV		HCV	
Total cases	1,917	1,708	2,438	2,086
Rate per 100,000	33.1	28.8	42.1	35.1
Age (years)				
Median (IQR)	36 (29–48)	37 (29–50)	41 (33–51)	42 (34–53)
Range	0–92	0–93	9–93	3–93
Sex				
Male	1,030 (53.7%)	868 (50.8%)	1,575 (64.4%)	1,342 (64.3%)
Rate per 100,000	36.3	29.8	55.5	46.1
Female	859 (44.8%)	830 (48.6%)	826 (33.9%)	728 (34.9%)
Rate per 100,000	29.1	27.5	28.0	24.1
Not stated	28 (1.5%)	10 (0.6%)	37 (1.5%)	13 (0.6%) ^a
Aboriginal and Torres Strait Islander status				
Aboriginal and/or Torres Strait Islander	3 (0.2%)	9 (0.5%)	35 (1.4%)	101 (4.8%)
Rate per 100,000	6.4	18.8	75.0	211.4
Non-Indigenous	707 (36.9%)	1,107 (64.8%)	505 (20.7%)	1,027 (49.2%)
Rate per 100,000	13.1	20.0	9.4	18.5
Australian-born non-Indigenous ^b	28 (1.5%)	58 (3.4%)	282 (11.6%)	664 (31.8%)
Rate per 100,000	0.76	1.53	7.60	17.48
Not stated	1,207 (63.0%)	592 (34.7%)	1,898 (77.9%)	958 (45.9%)
Area of residence				
Metropolitan	1,766 (92.1%)	1,544 (90.4%)	1,655 (67.9%)	1,343 (64.4%)
Rate per 100,000	40.3	34.4	37.8	30.0
Rural and regional	128 (6.7%)	112 (6.6%)	683 (28.0%)	635 (30.4%)
Rate per 100,000	9.3	7.9	49.4	44.8
Not stated	23 (1.2%)	52 (3.0%)	100 (4.1%)	108 (5.2%)
Region of birth				
Australia	31 (1.6%)	67 (3.9%)	317 (13.0%)	765 (36.7%)
Rate per 100,000	0.8	1.7	8.4	19.9
Overseas	526 (27.4%)	946 (55.4%)	125 (5.1%)	252 (12.1%)
Rate per 100,000	32.1	56.3	7.3	15.0
Not stated	1,360 (70.9%)	659 (40.7%)	1,996 (81.9%)	1,069 (51.2%)
History of injecting drug use				
Yes	*	24 (1.4%)	*	622 (29.8%)
No	*	613 (35.9%)	*	260 (12.5%)
Unknown	*	158 (9.3%)	*	191 (9.2%)
Not stated	1,870 (97.5%)	913 (53.5%)	2,302 (94.4%)	1,013 (48.9%)
In Correctional Facility				
Yes	*	34 (2.0%)	*	244 (11.7%)
No	*	728 (42.6%)	*	778 (37.3%)
Not stated	1,870 (97.5%)	946 (55.4%)	2,274 (93.3%)	1,064 (51.0%)
Health care worker				
Yes	*	33 (1.9%)	*	35 (1.7%)
No	*	596 (34.9%)	*	705 (33.8%)
Unknown	*	147 (8.6%)	*	260 (12.5%)
Not stated	1,897 (99.0%)	932 (54.6%)	2,420 (99.3%)	1,086 (52.1%)

Notes:

Not stated = clinician did not respond to this question; Unknown = clinician responded to this question but stated that status was unknown.

a: Three additional individuals had sex recorded as 'other'.

b: The non-Indigenous Australian-born group was used as the comparator for HBV cases due to the very high representation of overseas-born among the non-Indigenous group; see Methods.

IQR, interquartile range.

**Data suppressed as completeness was below 10%.*

cases born in Vietnam and Thailand, and a relative decrease in those born in Myanmar, the Philippines, India and Afghanistan (Figure 1). Of those HCV cases born overseas, there were increases seen for Vietnam and New Zealand, and a decrease for Pakistan (Figure 2). Both HBV and HCV had a reduction in the proportion of cases with country of birth categorised as 'overseas not further defined' (18.1% to 4.0% for HBV and 5.2% to 0.5% for HCV).

During the baseline period, only a small minority of cases had IDU status complete (2.5% for HBV and 6.5% for HCV). Of those with reporting, history of IDU was reported for the majority of HCV cases (89.5%) and a small proportion of HBV cases (9%). In the enhanced period, when completeness increased (to 46.4% for HBV and 51.1% for HCV), the proportion with a history of IDU was 3.8% for HBV and 70.5% for HCV. There was also an additional 9.3% of cases for HBV and 9.2% for HCV who had IDU status reported as unknown (as stated by the notifying doctor, Table 1).

Increased reporting of healthcare worker and correctional facility status from a previously very low level was also observed for both HBV and HCV (Table 1). For HBV, completeness of correctional facility status increased from 2.5% to 44.6%, while completeness of healthcare worker status increased from 1.0% to 45.4%. Of those with reporting, the proportion of cases during the enhanced period who were in a correctional facility was 4.5%, while healthcare workers represented 5.2% of cases with status reported (Figure 1). For HCV, correctional facility status completeness rose from 6.7% to 49.0%, while healthcare worker status completeness rose from 0.7% to 47.9%. The proportion identified as diagnosed in a correctional facility of those with reporting was 23.9%, while healthcare workers represented 4.7% of those with reporting. During the enhanced period, 8.5% of HBV cases and 12.5% of HCV cases reported 'unknown' for healthcare worker status (Table 1).

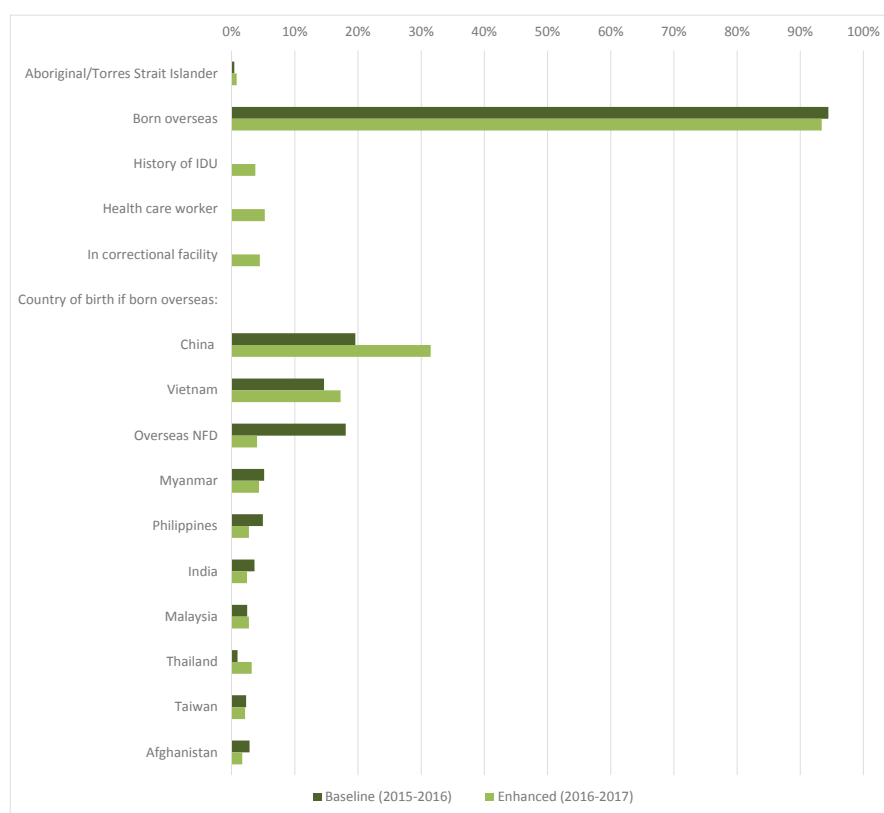
Discussion

This study assesses the current epidemiology of chronic HBV and HCV in Victoria and the impact of enhanced surveillance on the accurate measurement of demographic and risk factor data for newly diagnosed infections. It establishes that chronic HBV predominates among those born overseas and those living in metropolitan areas, while chronic HCV disproportionately affects Australian-born residents, those living in non-metropolitan regions, Aboriginal and Torres Strait Islander people, those with a history of injecting drug use and those in correctional facilities. Accurate assessment of these variables was greatly facilitated during the period following the implementation of enhanced surveillance, emphasising the importance of data completeness in routine surveillance systems.

The improved data collection during the enhanced surveillance period showed that the disparity between Aboriginal and Torres Strait Islander and non-Indigenous Victorians in chronic HCV was even greater than previously estimated. This suggests that the lack of collection of Aboriginal and Torres Strait Islander status data was disproportionately occurring for Aboriginal and Torres Strait Islander people, which may also be the case for other datasets in which completeness is limited. This has also been identified for other conditions in linkage studies that combine multiple datasets to improve completeness²¹ and highlights a potential concern where those without data are categorised as non-Indigenous.⁵ The data also demonstrate that crude comparison of rates for Aboriginal and Torres Strait Islander people with non-Indigenous people, without accounting for the very high rates among non-Indigenous overseas-born individuals, obscures the much greater notification rate of HBV among Aboriginal and Torres Strait Islander Victorians compared to Australian-born non-Indigenous people. The disparity in HBV prevalence among Aboriginal and Torres Strait Islander Australians has been previously established in other states²²; however, data from Victoria are limited, highlighting the impact of enhanced surveillance in filling gaps in epidemiological information.

The relatively higher number of cases of chronic HCV during the baseline period resulted from the subsidy of new highly effective antiviral treatment through Medicare from March 2016,⁹ likely leading

Figure 1: Proportion of unspecified hepatitis B cases in Victoria, Australia with specific risk or demographic factors, of those with reporting, by time period 2015-2017.



Notes:

Countries reported represent top 10 most commonly reported countries for hepatitis B.

*Data suppressed as completeness was below 10%.

IDU = Injecting drug use

to an increase in the number of individuals being tested for HCV. However, the stability of demographic characteristics not related to enhanced surveillance – such as age, sex and area of residence – suggests that the changes in other variables among the cohorts of individuals diagnosed between the time periods relates to improved completeness, rather than any changing epidemiology.

People born overseas constitute approximately 30% of the Victorian population but more than 90% of those diagnosed with HBV, confirming previous model-based estimates of burden in this community¹⁷ and highlighting the need for culturally and linguistically appropriate information and care. The relative changes in country of birth for chronic HBV cases may in part relate to the characteristics of notifiers. Prior to project implementation, a high proportion of notifications were received from immigration authority health services that have a substantial refugee caseload. This may have biased the countries of birth recorded in notifications towards those countries where a high proportion of migration occurred through refugee and humanitarian streams, including Myanmar and Afghanistan. This could explain previous findings of over-representation of these refugee communities in surveillance data when compared to estimated prevalence²³ as being driven not only by increased testing, as previously hypothesised, but also by higher compliance with notification procedures among clinicians serving these groups.

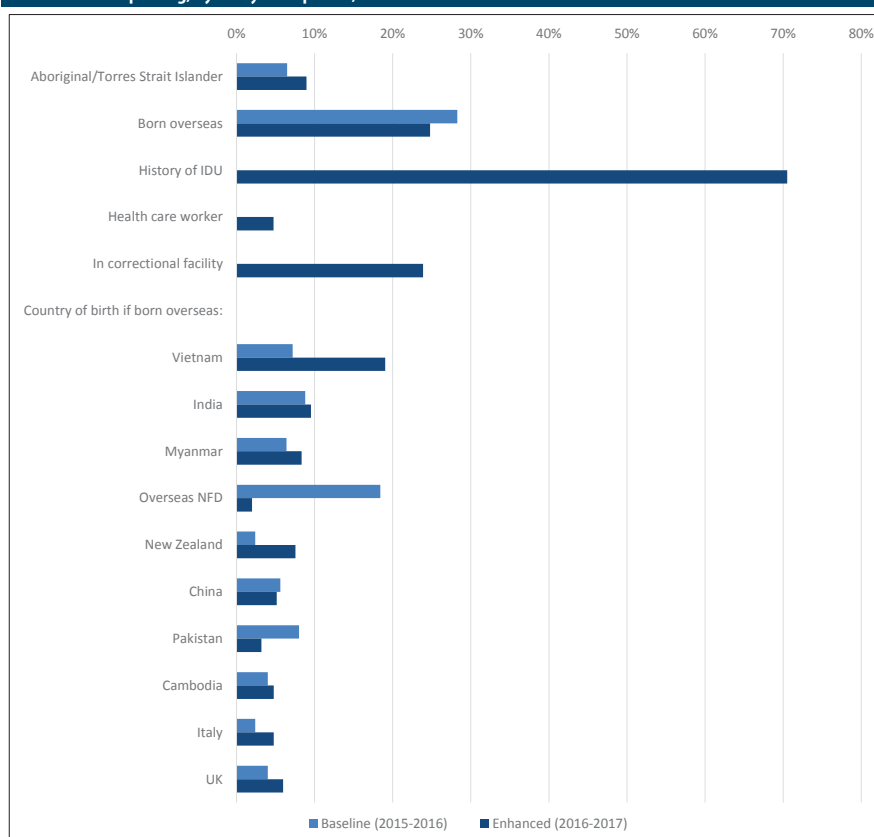
Chronic HCV occurred at a greater rate in those currently incarcerated, with residents of correctional facilities constituting 10% of notifications in the enhanced period, despite representing 0.2% of the Victorian population.^{18,24} These data emphasise the need for prevention and treatment programs for this population. This disparity likely relates to the increased prevalence of HCV among incarcerated individuals,²⁵ but also the high level of screening that occurs for prison entrants, which may be much higher than the level of diagnosis in the general population. This selection bias is an important consideration for the use of notifications data, which are used as an input for mathematical models of prevalence, diagnosis, and treatment,^{26,27} given these individuals may not be representative of the overall population living with HCV. The improved information flow from Victorian correctional facilities will now allow ongoing

measurement of variations between these populations.

The overall epidemiological patterns identified in the priority populations – chronic HBV predominating among those born overseas and in metropolitan Melbourne, and chronic HCV among people who inject drugs and people living in non-metropolitan Victoria – reflect established modelled estimates, suggesting that complete notifications data reflect true patterns of disease, and could be further used to examine trends over time and changes in response to public health initiatives. They support the validity of modelled estimates in the absence of population-level seroprevalence studies and also highlight the need for tailored healthcare service delivery to the highly heterogeneous populations living with chronic HBV and with chronic HCV. The ability to follow up those cases where there is a transmission risk, such as healthcare workers conducting exposure prone procedures, provides a clear example of the public health benefit of improved data collection.

Surveillance data are a vital source of information regarding a range of communicable diseases, and assessing the underlying biases and inherent limitations can help explain the findings of analyses of these types of data in context and identify priorities for improving these systems. European research has highlighted the limitations of low levels of surveillance data completeness,²⁸ with only one-third of cases overall having information reporting whether the case originated outside the country of diagnosis and very low reporting of specific country of birth.¹¹ This was also reflected in HCV data, where only one-quarter of cases had information about transmission risks.¹² The enhanced surveillance described in the current study is implementable with a modest investment of resources and staff time and could provide a similar improvement in data completeness in other jurisdictions. The stable response proportion during the first year of the project suggests this approach is sustainable over time with regard to clinicians. Further analysis of the

Figure 2: Proportion of unspecified hepatitis C cases in Victoria, Australia with specific risk or demographic factors, of those with reporting, by study time period, 2015–2017.



Notes:

Countries reported represent top 10 most commonly reported countries for hepatitis C.

*Data suppressed as completeness was below 10%.

IDU = Injecting drug use

ongoing response proportion over time, and of potential variations in response according to health provider type, will help to further assess the representativeness of this enhanced surveillance data.

The Victorian DHHS has now embedded the enhanced data collection into surveillance activities regarding unspecified HBV and HCV. Ongoing work to increase data completeness will aim to further enhance the accuracy and information provided regarding the epidemiology of viral hepatitis in Victoria. Despite the large gains in information achieved, the conclusions drawn may still be limited by biases in reporting for those variables where completeness remained below 50%. The ability of health departments to provide notifying clinicians with feedback and clinically-relevant information obtained through enhanced surveillance systems may increase the willingness of clinicians to participate and contribute to their ongoing improvement.

As with all surveillance data, these results represent only notified cases, which exclude those people living with HBV or HCV who have not presented to healthcare facilities and been offered testing. These limitations are of particular importance given that the estimated proportion diagnosed in Australia is 62% for HBV⁷ and 75% for HCV.²⁹ Another key drawback in surveillance data is the reliance on clinician knowledge – and systematic recording – of patient characteristics, which may not always be complete. This is demonstrated in this study by the significant proportion of cases with a healthcare worker or injecting drug use variable response of ‘unknown’, indicating the clinician did not have the information available. This could be improved by clinical management systems that promote the collection of patient information at the time of consultation, rather than through contact that occurs after the diagnosis has been notified by the laboratory. This enhanced surveillance has the potential to improve clinicians’ collection of this information prospectively, with increasing awareness of the importance of surveillance information. This analysis represents a comprehensive assessment of chronic viral hepatitis epidemiology in Victoria. It is the first analysis to occur since the implementation of enhanced surveillance that allowed assessment of variables not previously available or sufficiently complete, and highlights priority populations for

enhanced access to care and treatment. It also demonstrates the broader impacts of improving surveillance data and the potential biases inherent in incomplete information. Notifications data can be crucial in informing the epidemiology of infections in all settings and systematic changes, including enhancing data completeness, can greatly improve their utility in informing public health action.

Acknowledgements

We would like to acknowledge Michelle Beckerman, Jennifer Ejlak, Trevor Lauer, Camilla Preston, Lauren Richardson, Jessica Rotty, Tara Shackell, Kim White, and the public health officers, surveillance officers, and information officers of the Victorian Government Department of Health and Human Services, and Nicole Allard of the WHO Collaborating Centre for Viral Hepatitis, for their valuable feedback and assistance with the implementation of the enhanced surveillance program.

This work was supported by funding from the Victorian Government Department of Health and Human Services and the Department of Justice and Regulation Victoria. We are grateful to all the notifying doctors who provided essential surveillance data.

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