The Laboratory Virology and Serology Reporting Scheme, 1991 to 2000

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Abstract

Between 1991 and 2000, the Laboratory Virology and Serology Surveillance Scheme (LabVISE) received 340,730 laboratory reports of viral and non-viral pathogen identifications. In this report, data on 136 viruses and 31 non-viral pathogens is analysed. The age and sex distribution and seasonal fluctuations in infections are described. The major clinical diseases associated with LabVISE pathogens are reviewed together with a survey of recent activity reported in Australia. The contribution of LabVISE over the 10-year period to surveillance of poliomyelitis in Australia, up to and beyond the eradication goal, is described. The contribution of LabVISE to influenza surveillance and control in Australia is also described. Prospects for the continued role of LabVISE in the surveillance and control of viral meningitis, viral gastroenteritis and viral respiratory diseases are reviewed. *Commun Dis Intell* 2002;26:323-374.

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Abbreviations

CMV	Cytomegalovirus
CNS	Central Nervous System
DAD	Disseminated adenovirus disease
DNA	Deoxyribonucleic acid
EBV	Epstein-Barr virus
HEV	Hepatitis E virus
HPIV	Human parainfluenza viruses
HPV	Human papillomaviruses
HSV-2	Herpes simplex virus type 2
LabDOSS	Laboratory Database of Organisms from Sterile Sites
LabVISE	Laboratory Virology and Serology Reporting Scheme
MMR	Measles-mumps-rubella vaccine
NLV	Norwalk-like virus
NNDSS	National Notifiable Diseases Surveillance System
PHLN	Public Health Laboratory Network
RRV	Ross River virus
RSV	Respiratory syncytial virus
USA	United States of America
WHO	World Health Organization

Introduction

The Laboratory Virology and Serology (LabVISE) Reporting Scheme is a passive surveillance scheme based on voluntary reports of infectious agents contributed by virology and serology laboratories around Australia. LabVISE provides information on a number of viruses and other infectious agents and basic demographic information of persons they infect.

In 1959 a group of virologists met to exchange information on viruses circulating in Victoria. Between 1962 and 1968 the group, which expanded to include virologists from other states, reported their findings quarterly in the *Medical Journal of Australia*. In 1975, the Commonwealth Department of Health in collaboration with virology laboratories, established the 'Virus Reporting Scheme', which was replaced in 1977 by the 'National Pathogen Reporting Scheme'. This scheme, consisting of 6 laboratories, sent data to the Commonwealth, which published the data in a fortnightly bulletin called the *National Microbiological Laboratory Reporting Scheme*. This scheme was replaced in 1992 by two parallel reporting schemes: Laboratory Database of Organisms from Sterile Sites (LabDOSS) and LabVISE. While LabDOSS collected data on bacterial and fungal infections, LabVISE collected data on pathogens diagnosed by virology and serology laboratories.

Meanwhile, a national database of communicable diseases was established in 1991 in the form of National Notifiable Diseases Surveillance System (NNDSS). The NNDSS, operating under the auspices of the Communicable Diseases Network Australia, reported on 49 diseases in the period 1991 to 2000. Several of these diseases were also reported by sentinel laboratories in LabVISE in the same period. In 1995, the laboratory schemes were reviewed and LabDOSS was discontinued, while LabVISE was simplified. There was a reduction in the number of pathogens under surveillance by LabVISE, primarily by removal of reports of hepatitis B and C isolations, which were being reported through the NNDSS. In addition, there was a reduction in the details collected on each isolate to a minimal dataset.

The National Communicable Diseases Surveillance Strategy (1996) recommended the strengthening of laboratory networks and collaborations between laboratories and epidemiologists. LabVISE was evaluated in 1999 and three options were presented to the Public Health Laboratory Network (PHLN). Of the three options, PHLN endorsed the retention and development of LabVISE as a broad based surveillance scheme with clear objectives and a feasibility study to assess additional uses of laboratory generated data and the possibility of real-time data transfer to state public health units and the commonwealth.

This report is the first assessment of data collected by LabVISE since 1996. LabVISE data for 1999 and 2000 were reported as part of the Australia's Notifiable Diseases Status reports for those years.[1] In this report, we review data collected since 1991 using the current list of organisms and data fields and compare LabVISE data with other data sources such as NNDSS (where applicable).

Materials and methods

Data collection and reporting laboratories

The LabVISE database contains over 645,000 records of infectious disease collected since 1982. Records include those previously collected by the 'National Pathogens Reporting Scheme' (1982–1992).

Data are reported to LabVISE as paper reports or electronic format. Electronic reporting by diskettes has been replaced more recently by e-mail. Over time, almost all laboratories have changed to report by e-mail although a few still rely on paper reports.

In 1999, the database was changed from a 'Focus mainframe' database to a 'MS Access' format to comply with year 2000 requirements. The Department of Health and Ageing had previously developed an Epi Info based data entry system to allow laboratories to enter and send data to LabVISE. This data extraction package was provided free of charge to contributing laboratories on request. In 1999, this system was replaced by the MS Access based system, 'LabData'.

In 1997, the LabVISE database was simplified by the removal of 12 fields (containing information on risk factors, clinical outcome, sources of clinical sample, methodology details and serogroup results). The data fields collected in LabVISE throughout the study period are shown in Table 1. Four fields are designated as mandatory and must be completed for a record to be accepted into the database.

In 1997 the number of organisms under surveillance in LabVISE was reduced by the exclusion of organisms such as hepatitis B and C, *Neisseria gonorrhoea* and herpesvirus. The organisms currently under surveillance and the totals reported between 1991 and 2000 are shown in Appendix 2. Only reports of viral pathogens, *Chlamydia*, *Mycoplasma*, and *Rickettsia* are analysed in this report.

The Surveillance and Epidemiology Section of the Commonwealth Department of Health and Ageing publishes reports of data from LabVISE in *Communicable Diseases Intelligence* (*CDI*). This bulletin was produced fortnightly between 1978 and September 1997, four weekly between October 1997 and March 2000, monthly between April and December 2000, and quarterly from 2001. LabVISE annual reports were published in *CDI* for the years 1992 to 1995,[2,3,4,5] the last two of these reports are also available on the Communicable Diseases Australia Website at http://www.health.gov.au/pubhlth/cdi/labannrep.htm.

Notes on interpretation

LabVISE data are difficult to interpret for a number of reasons. The representativeness of the data is uncertain, since there are no denominator data available and the reporting by pathogen has not been consistent. Although some major reference laboratories have been reporting to LabVISE, not all are represented. Laboratories from the Northern Territory have not been contributing regularly, although data from the Northern Territory are available in LabVISE via reference laboratories in other states. While public laboratories are well represented in LabVISE, larger private laboratories are not. As more pathology testing is being done in the latter in recent years, the representativeness of LabVISE becomes more uncertain. Although LabVISE data are reported by state and territory of the patient, disease rates have not been calculated. Alternative measurements such as rates of positive tests in each laboratory may be possible in the future, however, total test figures have not been available to date.

Since the number of reporting laboratories and total reports have varied over the 10-year period, we have not been able to draw conclusions about rates or outbreaks, except where independently confirmed. The quality of LabVISE data has

Table 1. Data field names and descriptions used in LabVISE, 1991 to 2000

Field name	Field data	Status*
Lab code	Unique 3-digit identification code for the sending laboratory	Mandatory
Lab ID	Unique patient identifier	Mandatory
Collection date	Date specimen was collected	Mandatory
2x2 identifier	Identifier composed of first 2 letters of first and first two letters of family name	Not mandatory
Sex	Gender of patient [Male (M), Female (F) or Unknown (U)]	Not mandatory
Date of birth	Patient's date of birth	Not mandatory
Age	Patient's age at date of specimen collection	Not mandatory
Postcode	Postcode of patients residence	Not mandatory
Diagnosis	Primary diagnosis, coded according to Table (Appendix 1)	Not mandatory
Organism	Primary organism isolated or identified in specimen (codes, Appendix 2)	Mandatory

* Mandatory fields must be complete for acceptance of a record into the LabVISE database

declined over time with details of viral serotypes for example, being less complete in more recent years. This limits the ability to comment on changes in viral serotypes circulating in Australia.

Further limitations on the interpretation of LabVISE data are the lack of agreed reporting protocols for contributing laboratories and the absence of diagnostic definitions, which would standardise reporting between laboratories. Although duplicate reports are removed from LabVISE, repeat testing of the same individual for the same pathogen on different occasions are not excluded, nor are the testing of one patient for the same condition by more than one laboratory. The mix of laboratories reporting to LabVISE is heavily biased toward the reference laboratories or laboratories of major hospitals, which may bias toward the reporting of rare infections. Finally, the decision to remove data on diagnostic method data from LabVISE reporting in 1996 was regrettable as the impact of new rapid screening technologies on infections reported can not be measured. The analysis of diagnostic methods used in LabVISE reported here are representative only of the period 1991 to 1996.

Results

Part A: General results

LabVISE reports 1991 to 2000

Between 1991 and 2000, LabVISE received 340,730 reports from between 13 and 26 laboratories. The numbers of reports and reporting laboratories are shown in Table 2. There has been a decline in both the number of reports and the number of contributing laboratories to LabVISE over the period 1991 to 2000 (Figure 1).

Figure 1. Total annual number of reports and number of laboratories reporting to LabVISE, 1991 to 2000

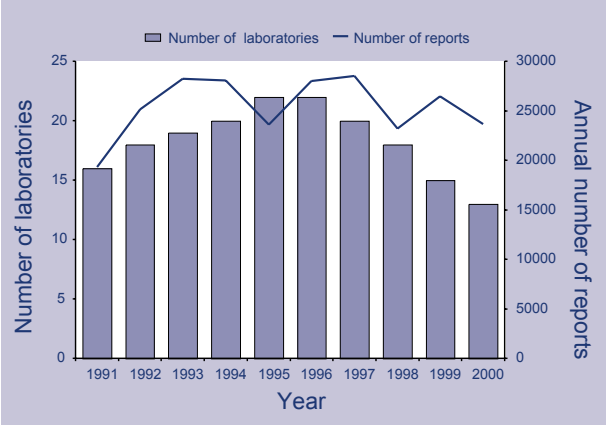


Table 2. Laboratory reports to LabVISE, 1991 to 2000, by laboratory

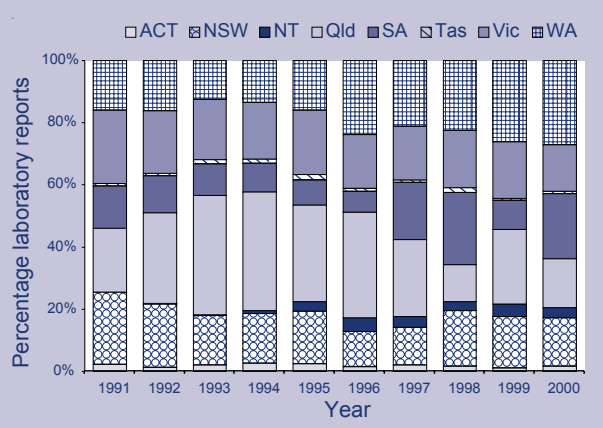
Jurisdiction	Laboratory name	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Australian Capital Territory	The Canberra Hospital	690	613	808	1,020	800	395	621	212	49	241
New South Wales	Institute of Clinical Pathology & Medical Research, Westmead	4,319	4,132	3,757	3,349	1,407	1,356	786	1,430	1,527	1,741
	Prince Henry/Prince of Wales Hospitals, Sydney	1,428	1,327	126	2,151	1,477	40	-	-	-	-
	New Children's Hospital, Westmead	892	845	779	764	677	499	975	1,101	1,253	924
	Royal Prince Alfred Hospital, Camperdown	-	-	-	136	371	288	259	483	573	542
	South West Area Pathology Service, Liverpool	-	792	1,268	1,695	1,713	1,203	997	1,206	1,001	346
	New England Pathology	126	151	160	-	-	-	-	-	-	-
	Royal North Shore Hospital	-	-	-	18	296	159	291	-	-	-
Northern Territory	Alice Springs Hospital	-	-	-	-	-	113	-	-	-	-
Queensland	Lynch Laboratory, Rockhampton	1,085	1,540	803	-	-	-	-	-	-	-
	Queensland Medical Laboratory, West End	-	3,750	8,751	10,012	10,793	7,953	5,219	2,944	7,669	4,403
	Townsville General Hospital	-	-	-	-	-	-	-	98	207	110
	State Health Laboratory, Brisbane	4,619	5,581	6,935	6,011	3,630	4,224	2,249	-	-	-
	Toowoomba Pathology Laboratory	129	17	-	-	-	-	-	-	-	-
	Nambour Hospital	-	-	4	99	52	-	-	-	-	-
South Australia	Institute of Medical and Veterinary Science, Adelaide	3,890	5,195	5,335	5,061	3,776	2,009	5,258	5,481	2,486	4,938

Table 2 (continued). Laboratory reports to LabVISE, 1991 to 2000, by laboratory

Jurisdiction	Laboratory name	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Tasmania	Northern Tasmanian Pathology Service, Launceston	-	76	222	161	184	95	110	156	105	128
	Royal Hobart Hospital, Hobart	231	273	306	472	596	293	109	234	24	-
	Hobart Pathology	19	-	-	-	-	-	-	-	-	-
Victoria	Monash Medical Centre, Melbourne	-	-	222	569	798	772	765	421	728	259
	Royal Children's Hospital, Melbourne	1,985	2,107	2,558	2,983	2,451	2,506	2,455	2,341	2,154	1,404
	Victorian Infectious Diseases Reference Laboratory, Fairfield	4,791	4,991	5,061	4,024	4,102	2,367	1,623	1,463	1,954	1,936
	Microbiological Diagnostic Unit, University of Melbourne	247	172	166	152	126	111	123	3	-	-
	Commonwealth Serum Laboratories, Melbourne	-	-	-	59	36	-	9	-	-	-
	Unipath Laboratories	-	-	-	-	436	251	-	-	-	-
Western Australia	PathCentre Virology, Perth	5,132	5,890	6,219	6,521	6,603	4,813	3,746	4,030	5,571	5,187
	Princess Margaret Hospital, Perth	990	1,386	1,266	1,785	1,252	1,687	1,387	885	1,314	1,398
	Western Diagnostic Pathology	-	-	-	-	900	2,951	1,691	1,086	173	107
	Royal Perth Hospital	-	-	-	-	-	185	85	-	-	-
Total*	**30,573 38,838 44,746 47,042 42,476 34,270**	**28,758**	**23,575**	**26,788**	**23,664**						

The number of organisms reported to LabVISE was reduced in 1995. This report will focus on the current list of organisms, most of which have been reported for the full study period (1991–2000). The number of reports for these organisms by year of collection and State or Territory of patient's residence is shown in Table 3. The proportion of reports from each Australian State and Territory has varied over the study period (Figure 2).

Figure 2. Laboratory reports to LabVISE, 1991 to 2000, by State or Territory



Completeness of data

Table 4 shows the completeness of data in four key (but not mandatory) fields common to LabVISE for the whole period from 1991 to 2000. While sex and diagnosis data were reported consistently over the years for the majority of LabVISE reports, in recent years important data such as age has been incomplete in more than half of all records. The completeness of data varied by laboratory, pathogen, and year.

Diagnosis

Data on diagnosis were available for 335,001 (98%) records from the study period. Of these 96,253 were coded as 'no clinical information available' and another 20,592 were coded as 'other diagnosis'. The 10 most common diagnoses (of 62 diagnostic categories accepted in LabVISE), which make up 201,959 or 90 per cent of the remaining 223,205 records are shown in Table 5.

Although samples submitted to LabVISE for investigations of genital (STI) disease make up the largest single category, the combined number of investigations of respiratory disease total 80,691 or 36 per cent of the total. It should be noted that the diagnostic descriptions are very broadly defined and the analysis that follows should be interpreted with caution.

The most frequently reported organisms in samples from patients with the 10 most common diagnoses are shown in Table 6.

Table 3. Laboratory reports to LabVISE, 1991 to 2000, by State or Territory

Year	ACT	NSW	NT	Qld	SA	Tas	Vic	WA	Australia
1991	436	4,498	0	3,969	2,596	145	4,568	3,076	**19,288**
1992	345	5,101	65	7,309	2,984	233	5,025	4,074	**25,136**
1993	621	4,475	57	10,851	2,833	380	5,473	3,529	**28,219**
1994	766	4,484	259	10,731	2,583	351	5,137	3,757	**28,068**
1995	596	3,958	749	7,318	1,897	436	4,857	3,777	**23,588**
1996	444	3,141	1,256	9,508	1,843	294	4,820	6,671	**27,977**
1997	592	3,437	1,030	7,032	5,249	229	4,939	6,011	**28,519**
1998	419	4,110	670	2,758	5,415	366	4,270	5,208	**23,216**
1999	283	4,386	1,092	6,337	2,505	158	4,822	6,894	**26,477**
2000	397	3,688	776	3,729	4,964	179	3,527	6,402	**23,662**
Total	**4,899**	**41,278**	**5,954**	**69,542**	**32,869**	**2,771**	**47,438**	**49,399**	**254,150**

Table 4. Completeness of data in key fields in LabVISE, 1991 to 2000

Year	Sex* % complete	Age % complete	Postcode % complete	Diagnosis % complete
1991	97.6	77.0	2.9	100.0
1992	98.6	80.7	13.5	100.0
1993	98.9	83.1	51.6	99.9
1994	98.6	84.6	66.8	100.0
1995	98.9	91.5	74.8	99.9
1996	99.1	81.6	62.9	100.0
1997	99.1	80.9	60.9	99.9
1998	99.2	79.3	50.6	99.2
1999	99.3	54.7	74.9	94.2
2000	99.2	31.2	70.0	87.0

* Proportion of records identified as male or female, all the remainder were marked 'U' for unknown.

Table 5. The 10 most common diagnoses for which samples were submitted for testing to LabVISE laboratories, 1991 to 2000

Code	Diagnosis description	n	%
59	Genital disease (including sexually transmitted infections)	39,860	17.9
06	Superficial skin or mucous membrane diseases	36,677	16.4
02	Lower respiratory tract infection	36,320	16.3
11	Respiratory tract infection — unspecified	23,590	10.6
07	Gastrointestinal disease	23,177	10.4
01	Upper respiratory tract infection	20,781	9.3
17	Hepatitis	7,045	3.6
29	Bone/joint disease	5,541	2.5
G8	Malaise — general and/or mild fever	4,537	2.0
08	High fever	4,431	2.0

Table 6. The 10 most frequently isolated organisms in the 10 most frequently reported clinical diagnoses, LabVISE, 1991 to 2000

Rank	Genital diseases (n= 39,860) Virus/organism	Reports	Rank	Skin/mucous membrane disease (n=36,677) Virus/organism	Reports
1	*Chlamydia trachomatis*	18,208	1	Herpes simplex type 1†	12,029
2	Herpes simplex type 2†	14,257	2	Herpes simplex type 2†	8,596
3	Herpes simplex type 1†	5,539	3	Varicella–zoster virus	7,702
4	Herpes simplex (not typed)†	743	4	Rubella	1,768
5	*Treponema pallidum*	517	5	Herpes (not typed)	1,338
6	*Neisseria gonorrhoeae*†	178	6	Ross River virus	1,324
7	Cytomegalovirus	89	7	Measles virus	1,253
8	Varicella–zoster virus	67	8	Parvovirus	601
9	*Chlamydia trachomatis* A–K	35	9	Enterovirus (untyped)	322
10	*Chlamydia* spp.	35	10	Epstein-Barr virus	173
Rank	**Lower respiratory tract infection (n=36,320) Virus/organism**	**Reports**	**Rank**	**Respiratory tract infection — unspecified (n=23,590) Virus/organism**	**Reports**
1	Respiratory syncytial virus	16,349	1	Respiratory syncytial virus	9,202
2	*Mycoplasma pneumoniae*	3,750	2	Influenza A	2,259
3	Influenza A	3,367	3	Adenovirus (untyped)	1,629
4	Parainfluenza virus type 3	2,255	4	Parainfluenza virus type 3	1,455
5	Rhinovirus	1,753	5	*Mycoplasma pneumoniae*	1,441
6	Cytomegalovirus	1,699	6	Rhinovirus	1,303
7	Adenovirus (untyped)	1,163	7	Enterovirus (untyped)	1,013
8	Influenza B	1,093	8	Cytomegalovirus	880
9	*Bordetella pertussis*	690	9	Influenza B	615
10	Parainfluenza virus type 1	478	10	*Bordetella pertussis*	563
Rank	**Gastrointestinal disease (n=23,177) Virus/organism**	**Reports**	**Rank**	**Upper respiratory tract infection (n=20,781) Virus/organism**	**Reports**
1	Rotavirus	15,887	1	Respiratory syncytial virus	5,358
2	Adenovirus (untyped)	3,033	2	*Bordetella pertussis*	2,913
3	Enterovirus (untyped)	1,865	3	Rhinovirus	1,898
4	Human calcivirus*	683	4	Epstein-Barr virus	1,720
5	Adenovirus type 40	188	5	Parainfluenza virus type 3	1,336
6	Cytomegalovirus	161	6	Influenza A	1,225
7	Adenovirus type 2	111	7	Cytomegalovirus	988
8	Poliovirus (untyped)	87	8	Adenovirus (untyped)	919
9	Adenovirus type 1	68	9	Enterovirus (untyped)	618
10	Coronavirus	59	10	Parainfluenza virus type 1	587

Table 6 (continued). The 10 most frequently isolated organisms in the 10 most frequently reported clinical diagnoses, LabVISE, 1991 to 2000

Rank	Hepatitis (n=7,045) Virus/organism	Reports	Rank	Bone/joint disease (n=5,541) Virus/organism	Reports
1	Hepatitis C†	2,805	1	Ross River virus	4,296
2	Hepatitis A	1,890	2	Barmah Forest virus	308
3	Hepatitis B antibody†	1,832	3	Parvovirus	176
4	Epstein-Barr virus	124	4	Rubella	123
5	Cytomegalovirus	124	5	*Streptococcus* A	119
6	Hepatitis D	103	6	Epstein-Barr virus	72
7	*Coxiella burnetii*	29	7	Influenza A	55
8	Hepatitis B antigen†	23	8	Cytomegalovirus	55
9	*Chlamydia trachomatis*	19	9	*Coxiella burnetii*	49
10	Hepatitis E	17	10	Dengue type 2	40
Rank	**Malaise (n=4,537) Virus/organism**	**Reports**	**Rank**	**High fever (n=4,431) Virus/organism**	**Reports**
1	Epstein-Barr virus	710	1	Ross River virus	1,270
2	Cytomegalovirus	699	2	Epstein-Barr virus	458
3	Ross River virus	602	3	Cytomegalovirus	380
4	Coxiella burnetii	236	4	Influenza A	280
5	Influenza A	192	5	Respiratory syncytial virus	2
6	Hepatitis C†	152	6	*Coxiella burnetii*	185
7	*Mycoplasma pneumoniae*	145	7	Adenovirus (untyped)	138
8	Rubella	143	8	*Mycoplasma pneumoniae*	138
9	Influenza B	141	9	Barmah Forest virus	127
10	Barmah Forest virus	125	10	Enterovirus (untyped)	99

* Combines Norwalk like virus, small round virus and human calcivirus.

† Data collected up to 1996 only.

The ranking of organisms identified in different diagnoses over a 10-year period includes a number of pathogens no longer under surveillance through LabVISE. Among samples submitted with a primary diagnosis of genital disease, herpes simplex viral identifications combined comprise 20,539 (51% of the total), although data on herpesvirus were not included in LabVISE after 1996. Since the late 1970s the prevalence of herpes simplex type 2 (HSV–2) infections increased by 30 per cent in the United States of America (USA) and HSV–2 infects an estimated 86 million people worldwide.[6]

Among respiratory infections, respiratory synctial virus was most frequently identified in cases of all kinds of respiratory infection, while rotavirus was the predominant organism identified in cases of gastroenteritis. Cases of hepatitis tested in LabVISE were predominantly hepatitis C, although reporting of this pathogen to the system ceased in 1996.

Specimens processed and methods used

Although data fields for type of specimen and methods used for the diagnosis were no longer required in LabVISE after 1996, many laboratories continued to send these data fields. The 10 most common specimens received by LabVISE and the 10 most common methods used in LabVISE laboratories for the detection of antigens and antibodies are shown in Tables 7, 8 and 9.

Table 7. The 10 most common specimens received by LabVISE, 1991 to 2000

Rank	Specimen	n	%
1	Blood	80,019	25.0
2	Nasopharyngeal swab or aspirate	54,657	17.1
3	Other	42,937	13.4
4	Genital swab	42,782	13.4
5	Serum	34,039	10.6
6	Skin	25,462	8.0
7	Faeces/rectal swab	23,572	7.4
8	Urine	6,367	2.0
9	Eye	3,457	1.1
10	Cerebrospinal fluid	2,196	0.7

Table 8. The 10 most common methods used to detect microbial antigens in LabVISE laboratories, 1991 to 2000

Rank	Antigen description	n	%
1	Immunofluorescence	69,646	29.5
2	Enzyme-linked immunosorbent assay	38,221	16.2
3	Light microscopy	36,955	15.7
4	Immunoenzymatic techniques	33,138	14.0
5	Nucleic acid detection	18,354	7.8
6	Radio-immunoassay	17,547	7.4
7	Electronic microscopy	8,487	3.6
8	Other	3,862	1.6
9	Growth characteristics	2,935	1.2
10	Latex agglutination	2,899	1.2

Table 9. The 10 most common methods used to detect antibodies in LabVISE, 1991 to 2000

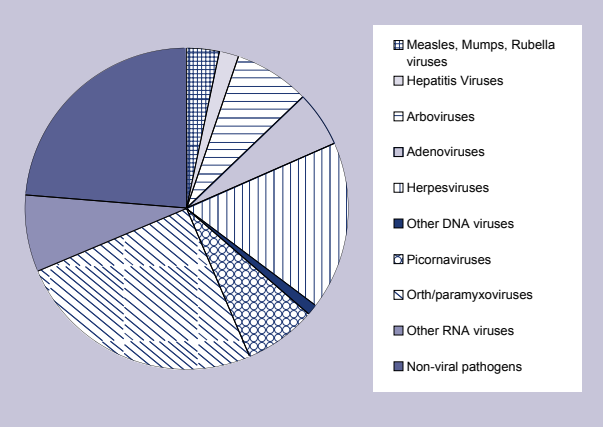
Rank	Antibody description	n	%
1	Enzyme-linked immunosorbent assay	71,611	42.3
2	Complement fixation	31,598	18.7
3	Immunofluorescence	26,001	15.3
4	Immunoenzymatic techniques	15,591	9.2
5	Other	9,165	5.4
6	Haemagglutination	3,230	1.9
7	Haemagglutination inhibition	3,169	1.9
8	Slide/tube agglutination	2,473	1.5
9	Radioimmunoassay	2,308	1.4
10	Latex agglutination	2,156	1.3

Pathogens under surveillance in LabVISE, 1991 to 2000

A complete list of pathogens under surveillance for this report is shown in Appendix 3 and is summarised in Table 10.

The totals for each year for each pathogen group are shown in Table 11. Figure 3 shows the relative proportions of each pathogen group in the total dataset.

Figure 3. Laboratory reports to LabVISE, 1991 to 2000, by pathogen group



In the study period, reports of non-viral pathogens increased from 17.9 per cent to 27 per cent of the annual reports to LabVISE. Among viral pathogens, ortho/paramyxoviruses made up on average 25 per cent of the annual reports, herpesviruses 17 per cent and other RNA viruses 8 per cent.

Part B: Analysis of data by pathogen

Measles, mumps and rubella viruses

LabVISE reports of measles, mumps and rubella during the study period have declined since 1994, when the last epidemic of measles occurred in Australia. As part of Australia's measles elimination strategy, the Measles Control Campaign in 1998 vaccinated 1.7 million Australian children regardless of their vaccination status, with the measles-mumps-rubella vaccine (MMR) . As a result of this campaign and continuing high vaccination coverage, measles activity in Australia is at an historic low.[7]

Measles, mumps and rubella are notifiable diseases that have been collected since 1991 from all Australian states and territories in the National Notifiable Diseases Surveillance System. A comparison of notifications for these diseases recorded in the NNDSS with LabVISE laboratory reports is shown in Table 12.

Table 10. Summary of pathogens under surveillance in LabVISE, 1991 to 2000

Pathogen group	Specific pathogens
Measles, mumps, rubella	Measles, mumps and rubella viruses
Hepatitis viruses	Hepatitis A, D and E
Arboviruses	Ross River virus, Barmah Forest virus, dengue (type 1 to 4), Murray Valley encephalitis virus, Kunjin virus, Japanese encephalitis virus, Kokabera virus, Stratford virus and flavivirus (unspecified)
Adenovirus	Types 1–17, 19, 21–22, 24, 26–32, 34, 35, 37, 40–47
Herpesviruses	Herpesvirus type 6, cytomegalovirus, varicella-zoster virus, Epstein-Barr virus
Other DNA viruses	Parvovirus, papovavirus, molluscum contagiosum, orf virus, poxvirus
Picornavirus	Coxsackievirus, echovirus, poliovirus, rhinovirus, enterovirus
Ortho/paramyxovirus	Influenza, parainfluenza, respiratory synctial virus
Other RNA virus	Rotavirus, astrovirus, reovirus (unspecified), calcivirus/Norwalk agent, coronavirus, small virus-like particles
Other non-viral pathogens	*Chlamydia, Mycoplasma, Rickettsia, Streptococcus, Yersinia, Brucella, Bordetella, Legionella, Leptospira, Cryptococcus, Treponema, Entamoeba, Toxoplasma, Echinococcus*

Table 11. Total number of reports to LabVISE, 1991 to 2000, by pathogen group and year and percentage of each year's total

Pathogen group		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Total
Measles, mumps, rubella	n	534	1,005	1,856	2,464	957	810	469	196	375	144	**8,810**
	%	*2.7*	*4.0*	*6.6*	*8.8*	*4.1*	*2.9*	*1.6*	*0.8*	*1.4*	*0.6*	***3***
Hepatitis viruses	n	482	417	510	393	455	426	643	392	384	159	**4,261**
	%	*2.5*	*1.6*	*1.8*	*1.4*	*1.9*	*1.5*	*2.3*	*1.7*	*1.5*	*0.6*	***2***
Arboviruses	n	955	2,013	2,744	2,577	1,271	3,570	2,311	872	1,726	1,682	**19,721**
	%	*5.0*	*8.0*	*9.7*	*9.2*	*5.4*	*12.8*	*8.1*	*3.7*	*6.5*	*7.1*	***8***
Adenovirus	n	1,518	1,722	1,885	1,542	1,182	1,382	1,017	1,162	1,309	1,205	**13,924**
	%	*7.9*	*6.9*	*6.7*	*5.5*	*5.0*	*4.9*	*3.6*	*5.0*	*5.0*	*5.1*	***5***
Herpesviruses	n	3,706	4,039	4,059	4,311	4,367	4,589	4,426	3,923	5,090	4,738	**43,248**
	%	*19.2*	*16.1*	*14.4*	*15.4*	*18.5*	*16.4*	*15.5*	*16.9*	*19.2*	*20.0*	***17***
Other DNA viruses	n	67	206	109	121	121	282	310	272	474	414	**2,376**
	%	*0.3*	*0.8*	*0.4*	*0.4*	*0.5*	*1.0*	*1.1*	*1.2*	*1.8*	*1.7*	***1***
Picornavirus	n	1,902	2,341	2,630	2,678	1,885	1,559	1,119	1,190	1,631	1,527	**18,462**
	%	*9.9*	*9.3*	*9.3*	*9.5*	*8.0*	*5.6*	*3.9*	*5.1*	*6.2*	*6.4*	***7***
Ortho/paramyxovirus	n	3,833	5,981	5,432	6,244	6,129	6,992	8,782	8,261	6,238	5,604	**63,496**
	%	*19.9*	*23.8*	*19.2*	*22.2*	*26.0*	*25.0*	*30.8*	*35.5*	*23.6*	*23.6*	***25***
Other RNA virus	n	2,832	2,277	2,090	2,332	1,693	1,582	1,522	1,444	2,322	1,864	**19,958**
	%	*14.7*	*9.1*	*7.4*	*8.3*	*7.2*	*5.7*	*5.3*	*6.2*	*8.8*	*7.9*	***8***
Other non-viral pathogens	n	3,458	5,135	6,904	5,406	5,528	6,798	7,919	5,547	6,928	6,374	***59,997***
	%	*17.9*	*20.4*	*19.3*	*24.5*	*23.4*	*24.2*	*27.8*	*23.1*	*26.2*	*27.0*	***24***

Table 12. Laboratory reports to LabVISE and notifications to NNDSS of measles, mumps and rubella, 1991 to 2000

Virus	Surveillance system	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Measles	LabVISE	256	204	853	1,199	153	57	67	49	172	44
	NNDSS	1,380	1,425	4,536	4,825	1,194	481	858	290	230	107
Mumps	LabVISE	32	48	77	87	69	37	40	44	58	49
	NNDSS	NN	23	28	90	157	126	191	182	184	212
Rubella	LabVISE	246	753	926	1,178	735	716	362	103	145	51
	NNDSS	620	3,810	3,812	3,374	4,590	2,556	1,389	745	376	321

NN Not notifiable

Measles reports in LabVISE included both viral isolations and seroconversions, whereas the NNDSS included cases of measles diagnosed on the basis of clinical findings or epidemiological links to another case. NNDSS notifications were 4–8 times higher than LabVISE reports. Laboratory confirmation of measles infection becomes increasingly important as Australia plans the elimination of the disease over the next few years. LabVISE laboratories could provide important information to supplement that of the NNDSS if a representative sample of all diagnostic laboratories was included. Despite these limitations, laboratories can provide important information on circulating measles virus genotypes in Australia. Genotyping data suggests that in some jurisdictions there are now no endemic measles strains circulating and that small outbreaks are frequently linked to imported cases (Lambert, Communicable Disease Conference 2001, abstract 60).

Surveillance of mumps in LabVISE preceded that in the NNDSS. Mumps notifications to the NNDSS began in 1992 and for some years, mumps was not reported from all jurisdictions. Thus from 1991 to 1993, LabVISE recorded more cases of mumps than the NNDSS. Notifications to the NNDSS include clinically diagnosed cases without laboratory confirmation, although some jurisdictions such as New South Wales require laboratory confirmation. Mumps is a rare disease in Australia. Although vaccination of Australian children with the MMR vaccine is expected to reduce mumps incidence in Australia, the impact has been less evident on the rate of mumps compared with the rate of measles (Gidding, Communicable Disease Conference, 2001, abstract 57). In a similar manner to measles, the laboratory diagnosis of mumps increases in importance, as the disease becomes rarer.

The incidence of rubella in Australia has been dramatically reduced as a result of widespread vaccination with MMR. Both NNDSS and LabVISE data show the impact of increased vaccination in Australia during the 1990s. Up to 2000, notifications of rubella to the NNDSS were clinically defined and did not require laboratory confirmation.

Hepatitis viruses

Up to 1996, hepatitis B and C were the predominant reports of hepatitis in LabVISE (Table 5). These reports were excluded from LabVISE from 1997 and were not analysed in this report. Hepatitis A and D were reported for the whole study period and hepatitis E has been reported since 1992. LabVISE reporting of hepatitis D and E predated reporting through the NNDSS by some years (Table 13) and reports from all states and territories to the NNDSS was not achieved for hepatitis D and hepatitis E until 2000.

Since the peak of notifications to NNDSS in 1997, the number of cases of hepatitis A has fallen significantly as a result of vaccination of high-risk groups. The trends in the NNDSS data have been reflected in the trends in LabVISE data. Hepatitis notifications to NNDSS include clinical cases of hepatitis and cases epidemiologically linked to a serologically confirmed case, and thus are expected to outnumber the laboratory-confirmed cases reported by LabVISE.

Since hepatitis D is diagnosed only by laboratory methods, LabVISE data should be close to that in NNDSS, subject to the limited number of laboratories contributing to LabVISE. In some jurisdictions (New South Wales and the Northern Territory), cases of hepatitis E (HEV) may be clinically defined as a hepatitis-like illness in the absence of other causes of hepatitis with a history of travel to HEV-endemic areas.

Table 13. Laboratory reports to LabVISE and notifications to NNDSS of hepatitis A, D and E, 1991 to 2000

Virus	Surveillance system	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Hepatitis A virus	LabVISE	445	371	451	363	424	407	624	384	375	146
	NNDSS	2,195	2,109	2,006	1,919	1,645	2,112	3,069	2,443	1,557	807
Hepatitis D virus	LabVISE	37	45	47	24	23	17	15	7	8	9
	NNDSS	NN	NN	NN	5	37	14	17	10	21	27
Hepatitis E virus	LabVISE	-	1	12	6	8	2	4	1	1	4
	NNDSS	NN	NN	NN	1	5	4	7	1	2	10

NN Not notifiable

Arboviruses

The numbers of arthropod-borne ('arboviruses') diseases reported in LabVISE between 1991 and 2000 are shown in Table 14.

Of the 8 arboviruses that were reported to LabVISE, three (Ross River virus, Barmah Forest virus and dengue) were also notifiable diseases reported to the NNDSS during the same period. Another 3 viruses (Murray Valley encephalitis virus, Kunjin virus and Japanese encephalitis virus) had been notifiable to NNDSS under the collective group Australian encephalitis but from 2001 became notifiable separately. The NNDSS also recorded 'Arbovirus unspecified' as a disease category in the period 1991 to 2000, which would have captured data on all other viruses listed here.

A month by month comparison of notifications of Ross River virus (RRV) to NNDSS and laboratory reports of RRV to LabVISE is shown in Figure 4. LabVISE reports show a seasonal variation matching that seen in the NNDSS notifications, with annual peaks in the first and second quarters (i.e. the summer months) of the year. RRV infection is diagnosed by virological or serological methods. The smaller numbers reported to LabVISE in the same time period, reflects the small number of laboratories contributing to LabVISE. The number of LabVISE reports were similar to the number of NNDSS notifications out of epidemic seasons (Figure 4).

Table 14. Laboratory reports to LabVISE of arboviruses, 1991 to 2000

Virus	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Total
Ross River virus	833	1,319	1,895	2,240	988	3,249	2,016	676	1,423	1,268	**15,907**
Barmah Forest virus	36	251	208	273	202	232	201	44	180	169	**1,796**
Dengue total	29	385	528	35	25	62	64	70	88	181	**1,467**
Flavivirus (unspecified)	29	47	104	23	45	21	21	73	27	40	**430**
Kunjin virus	14	10	-	2	5	5	6	5	5	4	**57**
Murray Valley encephalitis virus	10	1	9	3	-	-	3	2	2	20	**50**
Japanese encephalitis virus	-	-	-	1	6	-	-	1	1	-	**9**
Stratford virus	3	-	-	-	-	1	-	1	-	-	**5**
Kokobera virus	1	-	-	-	-	-	-	-	-	-	**1**

Figure 4. Laboratory reports to LabVISE and notifications to NNDSS of Ross River virus infection, 1991 to 2000, by month of specimen collection

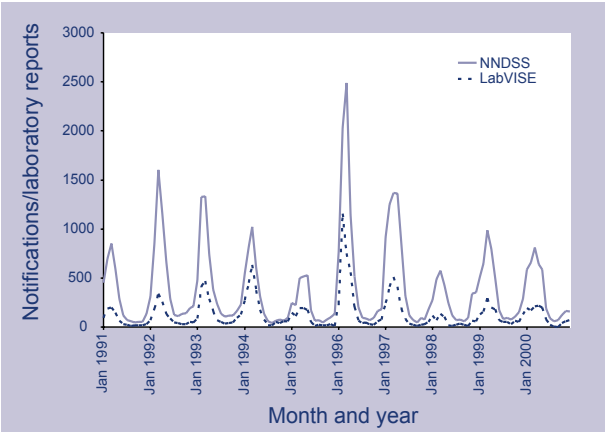
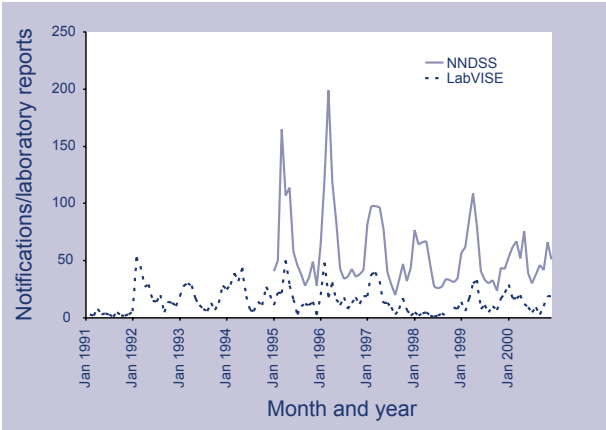


Figure 5. Laboratory reports to LabVISE and notifications to NNDSS of Barmah Forest virus infection, 1991 to 2000, by month of specimen collection



Barmah Forest virus laboratory reports have been recorded in LabVISE since 1991, 4 years before notifications were included in the NNDSS. A comparison of LabVISE reports and NNDSS notifications by month between 1991 and 2000 is shown in Figure 5. As for RRV, LabVISE laboratory reports and NNDSS notifications show an annual peak in the summer months. LabVISE reports were a larger proportion of NNDSS notifications out of epidemic seasons (Figure 5).

LabVISE reports of dengue virus include some data on the serotypes of dengue virus isolated (Table 5). However, the proportion of dengue virus among each year's reports that were serotyped has declined, particularly in recent years (Table 5) and there is no way to tell from LabVISE data whether the dengue infection was acquired overseas. The movement of new serotypes of dengue virus into Australia has important implications. The frequency of dengue haemorrhagic fever, a serious complication of dengue virus infection, increases when previously infected populations are exposed to different serotypes of the dengue virus. Since dengue is a major public health problem in areas to the north of Australia, and is occasionally a significant problem in Far North Queensland, surveillance of dengue and circulating dengue viral serotypes is essential.

Table 15. Laboratory reports to LabVISE of arboviruses, 1991 to 2000

Virus	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Dengue type 1	13	9	1	-	3	-	-	-	-	-
Dengue type 2	3	297	422	4	1	29	20	-	-	2
Dengue type 3	-	5	2	4	2	2	1	27	3	4
Dengue type 4	1	-	-	1	-	1	-	-	-	-
Dengue not typed	12	74	103	26	19	30	43	43	85	175
Dengue total	**29**	**385**	**528**	**35**	**25**	**62**	**64**	**70**	**88**	**181**

LabVISE reports of Murray Valley encephalitis virus infections are an important but partial record of this significant pathogen. Murray Valley encephalitis became a separately nationally notifiable disease from January 2001 along with Kunjin. Other arboviruses are also reported to the NNDSS as Arbovirus (not elsewhere classified).

Adenoviruses

Adenoviruses are DNA viruses which are clinically important because of their ability to cause acute respiratory infections and infections of the conjunctiva in humans. There are more than 47 serotypes of human adenoviruses. While human adenoviruses are ubiquitous with primary infection in the first year of life, there are geographical variations in the distributions of serotypes and associations of serotypes with different age groups. Broadly speaking, serotypes 1, 2, 5 and 6 are found in tonsils of young children, serotypes 3, 4 and 7 are found in young adults with upper respiratory tract infections, serotypes 8 and 19 are associated with adult eye infections and serotypes 11 and 21 are found in children with urinary tract infections.[8] The adenovirus serotypes associated with clinical syndromes in different age groups are shown in Table 16.

LabVISE laboratory reports of adenoviruses by year and serotype are shown in Table 17. Of the 13,924 reports, 10,826 were not further typed. Of the 2,468 serotypes identified, the most frequent serotypes identified in the period 1991 to 2000 were serotype 3 (687 reports, 28% of total), serotype 2 (591, 24%) and serotype 1 (513, 21%). In general, the proportion of untyped adenovirus reports increased from 63 per cent in 1991 to 86 per cent in 2000. The proportion of untyped adenovirus may reflect laboratory practices of batching samples for serotyping and the inability for LabVISE records to be updated with later serotyping information.

The age and sex distribution of adenovirus reports for the period 1991 to 2000 is shown in Figure 6. The male to female ratio was 1.3:1 and 58 per cent of the reports were from children aged less than 5 years.

Figure 6. Laboratory reports to LabVISE of adenovirus infection, 1991 to 2000, by age and sex

Table 16. Adenovirus serotypes associated with clinical syndromes in different age groups*

Group affected	Syndromes	Adenovirus serotypes
Neonates	Fatal disseminated infection	3,7,21,30
Infants	Coryza, pharyngitis (most asymptomatic)	1,2,5
Children	Upper respiratory disease	1,2,4–6
	Pharyngoconjunctival fever	3,7
	Haemorrhagic cystitis	11,21
	Diarrhoea	2,3,5,40,41
	Intussuception	1,2,4,5
	Meningoencephalitis	2,6,7,12
Young adults	Acute respiratory disease and pneumonia	3,4,7
Adults	Epidemic keritoconjunctivitis	8,19,37
Immunocompromised	Pneumonia with dissemination, urinary tract infection	5,31,34,35,39,42–47
	CNS disease including encephalitis	7,12,32

*Adapted from reference 8

Table 17. Laboratory reports to LabVISE of adenovirus, 1991 to 2000, by year of report and serotype

Viruses	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Total
Adenovirus type 3	88	96	203	57	66	45	22	57	35	18	**687**
Adenovirus type 2	142	129	128	45	37	29	39	22	13	7	**591**
Adenovirus type 1	91	111	85	48	32	21	29	74	14	8	**513**
Adenovirus type 40	4	6	9	-	-	34	12	21	74	86	**246**
Adenovirus type 8	38	33	55	55	22	13	3	3	1	3	**226**
Adenovirus type 4	23	103	40	2	2	-	7	4	15	5	**201**
Adenovirus type 5	31	38	28	12	14	9	8	1	6	8	**155**
Adenovirus type 7	8	4	11	16	26	17	8	17	7	8	**122**
Adenovirus type 11	29	12	4	1	3	1	-	1	-	-	**51**
Adenovirus type 37	7	3	1	2	2	5	3	5	11	11	**50**
Adenovirus type 19	6	20	3	-	3	7	-	2	1	7	**49**
Adenovirus type 6	9	7	3	1	2	3	-	20	-	3	**48**
Adenovirus type 9	11	7	5	3	2	1	-	-	-	-	**29**
Adenovirus type 26	11	-	2	2	2	1	-	-	-	-	**18**
Adenovirus type 28	12	1	1	-	-	1	-	-	-	-	**15**
Adenovirus type 30	7	2	-	1	2	-	-	-	-	-	**12**
Adenovirus type 35	4	1	1	1	1	3	-	-	-	-	**11**
Adenovirus type 10	4	2	1	-	1	-	1	1	-	-	**10**
Adenovirus type 22	3	1	1	3	-	-	-	2	-	-	**10**
Adenovirus type 46	1	3	1	2	2	-	-	-	-	-	**9**
Adenovirus type 41	-	-	-	-	-	4	3	-	-	1	**8**
Adenovirus type 12	-	3	3	-	-	-	-	-	-	-	**6**
Adenovirus type 29	5	-	-	-	-	-	-	-	-	-	**5**
Adenovirus type 24	3	-	-	-	-	-	-	-	-	-	**3**
Adenovirus type 31	3	-	-	-	-	-	-	-	-	-	**3**
Adenovirus type 47	1	2	-	-	-	-	-	-	-	-	**3**
Adenovirus type 16	2	-	-	-	-	-	-	-	-	-	**2**
Adenovirus type 34	-	2	-	-	-	-	-	-	-	-	**2**
Adenovirus type 42	-	-	-	-	1	1	-	-	-	-	**2**
Adenovirus type 13	1	-	-	-	-	-	-	-	-	-	**1**
Adenovirus type 14	1	-	-	-	-	-	-	-	-	-	**1**
Adenovirus type 15	-	-	-	-	-	-	-	-	-	1	**1**
Adenovirus type 18	1	-	-	-	-	-	-	-	-	-	**1**
Adenovirus type 21	1	-	-	-	-	-	-	-	-	-	**1**
Adenovirus type 27	1	-	-	-	-	-	-	-	-	-	**1**
Adenovirus type 32	1	-	-	-	-	-	-	-	-	-	**1**
Adenovirus type 43	-	-	-	-	-	1	-	-	-	-	**1**
Adenovirus type 44	1	-	-	-	-	-	-	-	-	-	**1**
Adenovirus type 45	2	-	-	-	-	-	-	-	-	-	**2**
Adenovirus not typed/pending	966	1,136	1,300	1,291	962	1,186	882	932	1,132	1,039	**10,826**
Total	**1,518**	**1,722**	**1,885**	**1,542**	**1,182**	**1,382**	**1,017**	**1,162**	**1,309**	**1,205**	**13,924**

LabVISE reports of adenoviruses in which diagnosis details were available were analysed. The majority of adenovirus reports came from patients with respiratory, gastrointestinal or eye disease (45% respiratory, 33% gastrointestinal and 11% eye disease).

It is estimated that adenoviruses account for between 2–4 per cent of acute respiratory infections, which cause 4.5 million deaths annually in children, mostly in the developing world.[9] Adenoviruses also cause diarrhoea in children in developed countries. A prospective study in Canada has estimated that adenoviruses are responsible for around 4 per cent of community-acquired paediatric diarrhoea.[10] Adenoviruses were identified in between 3.4 and 4.9 per cent of stools from children hospitalised with acute gastroenteritis in Melbourne between 1995 and 1998.[11]

Adenovirus types vary in their geographic distribution and over time. Adenovirus type 41 infections increased in the Netherlands from 30 per cent to 95 per cent of all adenovirus infections between 1981 and 1986.[12] Adenovirus type 7 has been recorded as causing community and hospital outbreaks as well as sporadic cases in Australia.[13] Seven genome types of adenovirus 7 have been identified and a shift from Ad7c to Ad7c genome types was observed to occur in the late 1960s in Europe and in the mid-1970s in Australia.[14]

Adenovirus infections are significant in the immunocompromised. Disseminated adenovirus disease (DAD) in neonates has been reported in recent years. A review of 11 DAD cases in Texas (6 of whom were immunocompromised and 5 who were immunocompetent) showed a high mortality rate (83%). Mortality was reduced by treatment with antiviral agents and immunoglobulin.[15]

In HIV-positive patients, adenovirus infection risk was estimated at 28 per cent per year and increased with declining CD4+ T-cell counts. Infection was most commonly gastrointestinal or urinary and prolonged viral shedding in severely immunocompromised has been noted.[16]

Respiratory infections with cytomegalovirus (CMV) and community respiratory viruses including adenoviruses are important causes of infection and morbidity and mortality among lung transplant recipients.[17]

Herpesviruses

Viruses from the Herpesviridae family of DNA viruses, under surveillance through LabVISE, are herpesvirus type 6, cytomegalovirus (human herpesvirus 5), varicella-zoster virus (human herpesvirus 3) and Epstein-Barr virus (human herpesvirus 4). Total reports for these viruses to LabVISE between 1991 and 2000 are shown in Table 18. The major clinical syndromes associated with herpesviruses are summarised in Table 19.

Table 18. Laboratory reports to LabVISE of herpesviruses, 1991 to 2000

Virus	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Total
Cytomegalovirus	1,820	1,728	1,561	1,727	1,404	1,373	1,017	766	1,220	1,312	**13,928**
Varicella-zoster virus	522	684	924	1,062	1,073	1,132	1,252	1,252	1,658	1,494	**11,053**
Epstein-Barr virus	1,361	1,625	1,570	1,516	1,887	2,084	2,151	1,903	2,196	1,926	**18,219**
Herpesvirus type 6	3	2	4	6	3	-	6	2	16	6	**48**

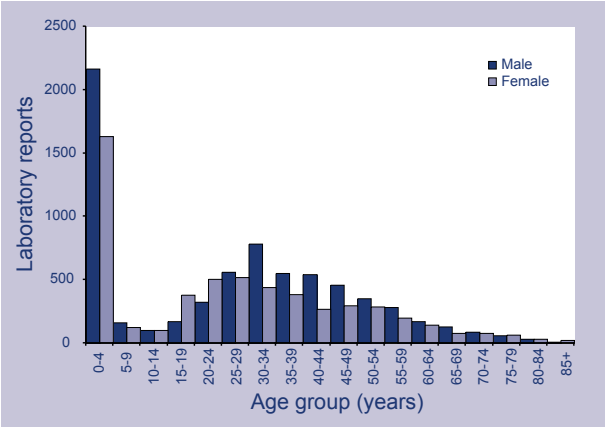
Table 19. Major clinical syndromes associated with herpesviruses under surveillance in LabVISE, 1991 to 2000

Virus	Clinical syndrome(s)
Cytomegalovirus	Cytomegalic inclusion disease, CMV mononucleosis, significant infection in AIDS patients
Varicella-zoster virus	Chickenpox, shingles
Epstein-Barr virus	Infectious mononucleosis
Herpesvirus type 6	Roseola infantum, fever, otitis media, encephalitis

Cytomegalovirus

Cytomegalovirus laboratory reports were reported more frequently from males than females (male to female ratio 1.3:1). The largest numbers of notifications were found in children aged less than 5 years (27% of total reports, Figure 7).

Figure 7. Laboratory reports to LabVISE of cytomegalovirus infection, 1991 to 2000, by age and sex



Cytomegalovirus was identified in patients presenting with a wide range of diagnoses during the study period. Respiratory infections accounted for 48 per cent of diagnoses in which CMV were found. CMV was also isolated from blood (32%), nasopharyngeal swabs (25%), urine (14%) or diagnosed from serum (12%).

CMV infection in humans is common and life-long although disease is rare. Secondary activation of latent infections is common although disease caused by primary infection is more serious. There are two periods of increased transmission — during the perinatal period and in the reproductive years. Transmission may occur during birth, during breast-feeding and between infants in nurseries. Sexual transmission is also common. Congenital CMV infections occur in 0.5–2.2 per cent of all live births, mainly in primiparous mothers who were infected for the first time with CMV during pregnancy.[18] Demographic and occupational factors also influence the risk of giving birth to an infant with congenital CMV infection.[19] Symptoms occur in less than a quarter of infected children; however, those that are infected demonstrate cytomegalic inclusion disease, characterised by jaundice and multiple organ involvement. Congenital CMV infections are the leading cause of congenital malformations in the developed world. Clinical trials of treatment regimens for congenital CMV infections are under way.[20]

There have been some profound changes in the epidemiology of CMV infections in children as a result of changes in breast-feeding and child rearing practices in Western countries over the past 15 years. In the USA, this has changed the prevalence of CMV among mothers and children in different socioeconomic classes. In middle and upper class households, which utilise child-care facilities, the exposure of mothers to CMV infection via their children will increase. In lower socioeconomic classes the relative decline in breast-feeding and the lower use of child-care facilities may increase the proportion of uninfected mothers.[21]

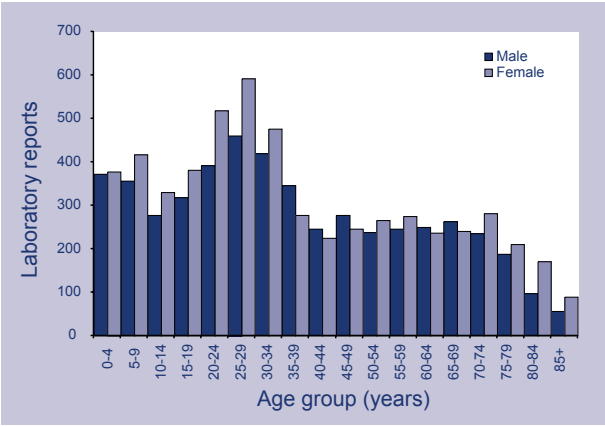
CMV infection by blood transfusion is common causing approximately 2.4 seroconversions per 100 units transfused.[18] Organ transplant recipients are also susceptible to infection with CMV.

CMV infections are significant in HIV/AIDS particularly as a cause of retinitis. In advanced AIDS, CMV infection may cause mononeuropathy multiplex.[22] Karposi's sarcoma in HIV positive patients was initially associated with CMV infection.[23] However, more recent work has identified a herpesvirus (human herpesvirus 8, Karposi's sarcoma associated herpesvirus, KSHV) as the etiologic agent of Karposi's sarcoma.[24]

Varicella-zoster virus

Reports of varicella-zoster virus (VZV) to LabVISE increased over the study period and comprised 4 per cent of the total reports. In 2000, LabVISE reports of VZV totalled 1,494. There were slightly more reports from females than males (male to female ratio 0.9:1). Laboratory reports were from all age groups with the largest numbers of notifications found in the 25–29 year age group (9% of total, Figure 8).

Figure 8. Laboratory reports to LabVISE of varicella zoster-virus infection, 1991 to 2000, by age and sex



The great majority of diagnoses associated with identification of VZV were skin/mucous membrane disease (89.5%) and the virus was most commonly isolated from skin (69%) or blood (19%).

VZV causes an acute generalised viral disease in children commonly termed 'chickenpox', while reactivation of the virus in adults and the elderly causes shingles. More than 90 per cent of people are infected with VZV by adolescence. While most VZV infections cause mild disease in children, disease severity is greater in adults and case fatality rates can be 20 times higher (in the 5–9 year age group 1 death per 100,000 population compared with adults 1 death per 5,000 population).[24]

While immunity is long lived, reactivation of the latent varicella infection is common in the elderly and up to 30 per cent of patients with shingles may suffer a post-shingles neuralgia.[24]

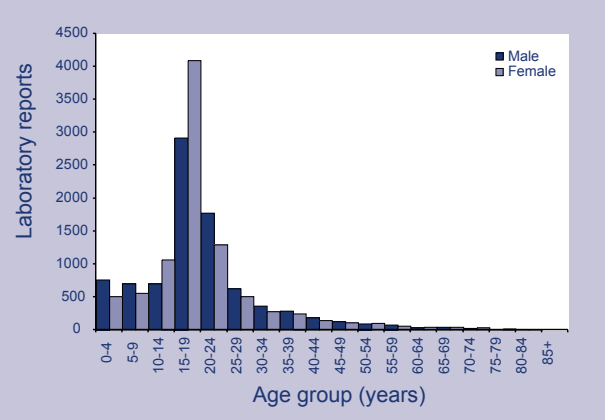
A varicella vaccine has been available in the USA since 1995. This vaccine has an efficacy among children of between 70 and 90 per cent. In 2002, the Australian Technical Advisory Group on Immunisation (ATAGI) is considering this vaccine for inclusion in the childhood immunisation schedule.

Epstein-Barr virus

Reports of Epstein-Barr virus (EBV) infection to LabVISE averaged 1,800 reports per year over the study period, about 7 per cent of total LabVISE reports between 1991 and 2000.

There were slightly more reports in females than males (male to female ratio 0.9:1). The largest numbers of notifications were in the 15 to 19 year age group (39% of the total, Figure 9).

Figure 9. Laboratory notifications of Epstein-Barr virus infection, 1991 to 2000, by age and sex



Over the study period, EBV was most often identified in patients presenting with reticuloendothelial disease (35%), and was most commonly isolated from blood (67%).

EBV causes an acute viral syndrome with fever, sore throat and lymphadenopathy accompanied by characteristic increases in the percentages of monocytes and lymphocytes (mononucleosis and lymphocytosis). The virus infects and transforms human B cells, although only 50 per cent of people infected will develop clinical infectious mononucleosis. While EBV infection is distributed worldwide, the peak of infection occurs in different age groups. Infection is more common among children in developing countries and more common among adolescents in developed countries. EBV is associated with the pathogenesis of Burkitt's lymphoma and nasopharyngeal carcinomas. Infection with EBV is possibly associated with Hodgkin's disease and non-Hodgkin's lymphomas particularly in HIV positive patients. Reactivation of latent EBV infection in HIV positive patients may cause interstitial pneumonia in infants and hairy leucoplakia and B-cell tumours in adults.[24]

Herpesvirus type 6

Only 48 reports of herpesvirus type 6 (HHV–6) were made to LabVISE during the study period. HHV–6 is the cause of 'sixth disease', Roseola infantum, an acute febrile rash occurring in children aged under 4 years. HHV–6 can be an opportunistic infection in transplant recipients. A meta-analysis of studies between 1986 and 1996[25] concluded that between 38 and 60 per cent of bone marrow transplant recipients and 31–55 per cent of solid organ transplant recipients were infected with HHV–6 two to four weeks after transplantation. Bone marrow suppression, interstitial pneumonia and encephalitis were the most commonly reported clinical diseases associated with HHV–6 infection.

Other DNA viruses

A number of other DNA viruses, reported to LabVISE in small numbers during the period 1991 to 2000, are shown in Table 20.

Table 20. Laboratory reports to LabVISE of other DNA viruses, 1991 to 2000

Virus	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Total
Parvovirus	29	178	86	109	102	268	291	261	437	389	**2,150**
Papovavirus group	9	11	1	4	11	1	2	3	12	7	**61**
Molluscipox virus	21	10	8	4	3	7	5	2	15	11	**86**
Orf virus	5	7	4	2	1	1	9	6	8	7	**50**
Poxvirus group (not typed)	3	-	10	2	4	5	3	-	2	-	**28**

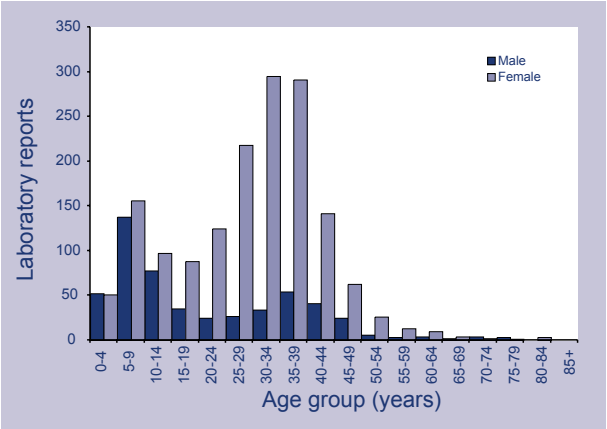
Among the parvoviruses, only parvovirus B19 is a known human pathogen.[26] Parvovirus causes prolonged epidemics of erythema infectiosum ('Fifth disease') among primary school aged children.[27] Fifth disease is a mild non-febrile illness characterised by a biphasic rash ('slapped cheek syndrome').[24] In Australia approximately 40 per cent of women are susceptible and around half of these are exposed to infection at home, typically via their school-aged children. Infection with parvovirus B19 in first half of pregnancy is associated with a 10 per cent excess foetal loss, anaemia and hydrops fetalis in 3 per cent. The overall risks of adverse events after occupational exposure to parvovirus B19 during pregnancy is low (excess foetal loss 2–6 per 1,000 pregnancies and foetal death from hydrops in 2–5/10,000 pregnancies.[27] It is recommended that susceptible pregnant women should be excluded from working with children during epidemics of parvovirus, which occur every 2 years and last for up to 2 years.[27]

Parvovirus infections may cause severe chronic anaemia in the immunosuppressed.[24]

Among reports of parvovirus to LabVISE, parvovirus was more commonly identified in women of childbearing age, possibly because of antenatal screening (Figure 10). The male to female ratio was 0.3:1, and 53 per cent of reports were in women aged between 15 and 45 years.

The papovavirus group includes human papillomaviruses and polyomaviruses. Human papillomaviruses (HPV) are the causative organism of human warts. At least three types of cutaneous HPV are recognised — cutaneous, plantar and anogenital. Diagnoses of the latter have been increasing since the 1980s.[28] Polyomaviruses JC viruses cause a rare demylinating disease in the immunocompromised (progressive multifocal leukoencephalopathy). Polyomaviruses JC and BK virus infections are common in childhood and the virus persists in the kidney.

Figure 10. Laboratory reports to LabVISE of parvovirus infections, 1991 to 2000, by age and sex



The poxvirus, molluscipoxvirus is the causative organism of the skin disease, molluscum contagiosum. Molluscum contagiosum skin papules occur on the abdomen, pubis, genitalia and inner thighs and persist without treatment for between 6 months and 2 years. The virus has not been isolated and serology is poorly defined. Transmission is by direct contact, including sexual, fomites and autoinoculation. Lesions may disseminate in HIV-infected persons.[29]

The orf virus is another poxvirus and the cause of contagious pustular dermatitis, a proliferative cutaneous disease. The virus is transmitted to humans by contact with infected sheep and goats. The disease is worldwide in distribution, especially among farm workers, and has been reported as an important occupational disease in New Zealand.[24]

Picornaviruses

The family *Picornaviridae* consists of two groups: the rhinoviruses and enteroviruses. Enteroviruses consist of five subgroups and these comprise a total of 67 serotypes: 31 echoviruses, 23 coxsackie A viruses, 6 coxsackie B viruses, 3 polioviruses and 4 'new' enteroviruses 68–71 (identified since 1970).[31] Reports of *Picornaviridae* to LabVISE are shown in Table 21.

Enteroviruses (general)

Picornavirus reports averaged 7.5 per cent of the annual reports to LabVISE throughout the study period. Enteroviruses made up nearly two-thirds of the total picornavirus reports (12,148, 65%) and 4.7 per cent of the total LabVISE reports.

Of enteroviruses with typing information, echovirus comprised 56 per cent, poliovirus 19.7 per cent, coxsackie B virus 14.9 per cent and coxsackie A virus 7.2 per cent.

Coxsackie A viruses

Coxsackie A viruses reported to LabVISE between 1991 and 2000 are shown in Table 22.

Table 21. Laboratory reports to LabVISE of Picornaviridae, 1991 to 2000

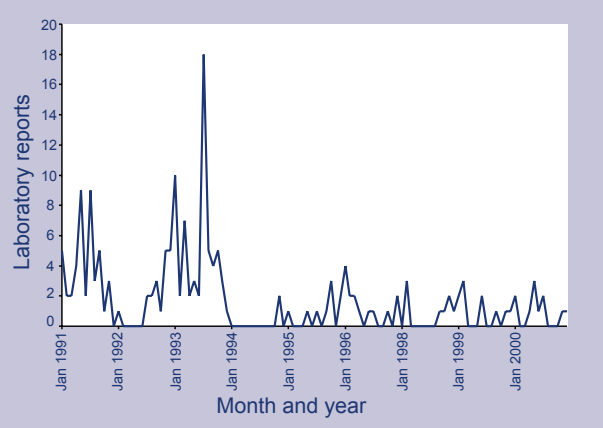
Virus	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Total
Enterovirus not typed	673	781	943	1,101	891	742	484	538	753	815	**7,721**
Rhinovirus (all types)	653	683	868	905	650	662	549	420	501	420	**6,311**
Echovirus	155	497	502	443	206	49	25	149	264	193	**2,483**
Poliovirus	194	186	121	106	71	35	24	44	52	40	**873**
Coxsackie B virus	155	136	113	87	21	49	27	18	21	32	**659**
Coxsackie A virus	58	43	82	36	12	22	10	12	25	19	**319**
Enterovirus 71	13	15	1	-	34	-	-	9	15	6	**93**

Table 22. Laboratory reports to LabVISE of coxsackie A virus, 1991 to 2000, by serotype

Virus	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Total
Coxsackie virus A9	45	19	62	2	9	9	5	8	10	11	**180**
Coxsackie virus A16	9	21	18	34	1	12	5	3	15	8	**126**
Coxsackie virus A2	2	-	-	-	-	-	-	-	-	-	**2**
Coxsackie virus A10	-	-	-	-	1	-	-	1	-	-	**2**
Coxsackie virus A7	-	-	-	-	-	1	-	-	-	-	**1**
Coxsackie virus A21	-	-	1	-	-	-	-	-	-	-	**1**
Coxsackie virus A (untyped)	2	3	1	-	1	-	-	-	-	-	**7**
Total	**58**	**43**	**82**	**36**	**12**	**22**	**10**	**12**	**25**	**19**	**319**

Diagnoses in which coxsackie A viruses were identified were most commonly in patients with skin or mucous membrane disease (38%) and meningitis (21%), and most often identified in specimens of nasopharyngeal swabs (25%). Most coxsackie A viruses are not readily isolated by cell culture except serotypes A9 and A16. As a result these were the most commonly isolated serotypes reported by LabVISE. Coxsackie A9 infections have occurred in outbreaks in 1985, 1988 and 1993 (Figure 11).[30]

Figure 11. Laboratory reports to LabVISE of coxsackie A9 infections, 1991 to 2000, by month of specimen collection



This virus is associated with aseptic meningitis in adults and children. Coxsackie virus A16 is the etiologic agent of hand, foot and mouth disease. In Western countries, cases of this disease among children in the same family are often seen. The infection is typified by fever followed by the appearance of oral vesicles and peripheral exantham on the skin of the hands and feet.[31] The clinical syndromes associated with coxsackie A viral infections are summarised in Table 23.

Coxsackie B viruses

Coxsackie B viruses were most often identified in patients presenting with meningitis (31%), lower respiratory tract illness (18%) and gastroenteritis (11%). Specimens of nasopharyngeal swabs (32%), faeces (26%) or cerebrospinal fluid (23%) were the most common sources.

Coxsackie B4 and B5 were the most common serotypes of coxsackie B viruses identified in LabVISE. Coxsackie B4 is associated with respiratory disease (summer gripe) mostly in children under 5 years of age. Coxsackie B5 is associated with meningitis and occurs in children and adults.[31]

Coxsackie B serotypes identified in LabVISE reports between 1991 and 2000 are shown in Table 24.

There were a number of outbreaks of coxsackie B4 viruses in 1991, 1993–1994, 1996 and 2000. Coxsackie B5 outbreaks occurred in 1991–1992, 1993 and 1996 (Figure 12).

The clinical syndromes associated with coxsackie B viral infection are summarised in Table 25.

Figure 12. Laboratory reports to LabVISE of coxsackie B4 and B5 viruses, 1991 to 2000, by month of specimen collection

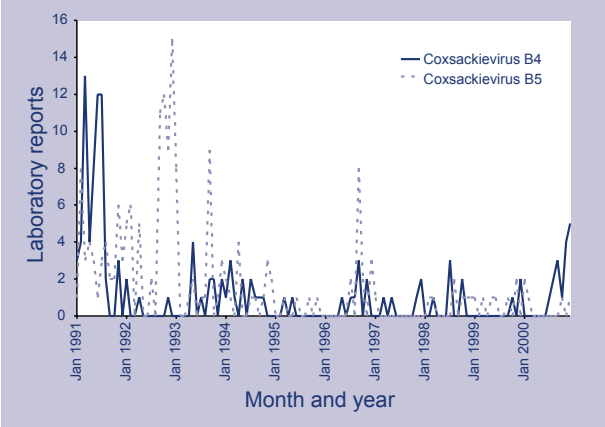


Table 23. Clinical syndromes associated with coxsackie A viral infection*

	Clinical syndrome	Coxsackie A serotypes
Illnesses associated with many enteroviruses in addition to coxsackie A	Aseptic meningitis	1–11,14, 16–18, 22, 24
	Encephalitis	2,5,6,7,9
	Paralysis	4,6,7,9,11,14,21
Illnesses more characteristic of particular groups or serotypes of coxsackie A	Herpangina	2–6, 8, 10, 22
	Hand, foot and mouth syndrome	5,7,9,10,16
	Exanthem	2,4,5,9,16
	Epidemic conjunctivitis	24
Undefined/uncertain etiologic role of coxsackie A viruses	Haemolytic uraemic syndrome	4
	Myositis	9
	Guillain-Barré syndrome	2,5,9
	Mononucleosis	5,6

* Modified from reference 31

Table 24. Laboratory reports to LabVISE of coxsackie B viruses, 1991 to 2000, by year and serotype

Virus	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Total
Coxsackie virus B5	40	65	26	15	4	15	1	7	7	5	**185**
Coxsackie virus B4	61	4	11	12	2	8	5	6	3	16	**128**
Coxsackie virus B1	6	57	51	4	-	-	1	-	1	4	**124**
Coxsackie virus B2	34	2	8	23	4	20	6	1	10	6	**114**
Coxsackie virus B3	13	6	15	31	11	3	14	2	-	-	**95**
Coxsackie virus B6	-	1	1	2	-	-	-	1	-	-	**5**
Coxsackie virus B untyped	1	1	1	-	-	3	-	1	-	1	**8**
Total	**155**	**136**	**113**	**87**	**21**	**49**	**27**	**18**	**21**	**32**	**659**

Table 25. Clinical syndromes associated with coxsackie B viral infection*

	Clinical syndrome	Coxsackie B serotypes
Illnesses associated with many enteroviruses in addition to coxsackie B viruses	Aseptic meningitis	1–6
	Encephalitis	1–3,5,6
	Paralysis	1–6
Illnesses more characteristic of particular groups or serotypes of coxsackie B viruses	Exanthem	1,3,4,5
	Pleurodynia	1–5
	Pericarditis	1–5
	Myocarditis	1–5
	Generalised disease of the newborn	1–5
Undefined/uncertain etiologic role of coxsackie B viruses	Haemolytic uraemic syndrome	2,4
	Mononucleosis-like syndrome	5

* Modified from reference 31

Echoviruses

Echoviruses identified in LabVISE reports between 1991 and 2000 are shown in Table 26.

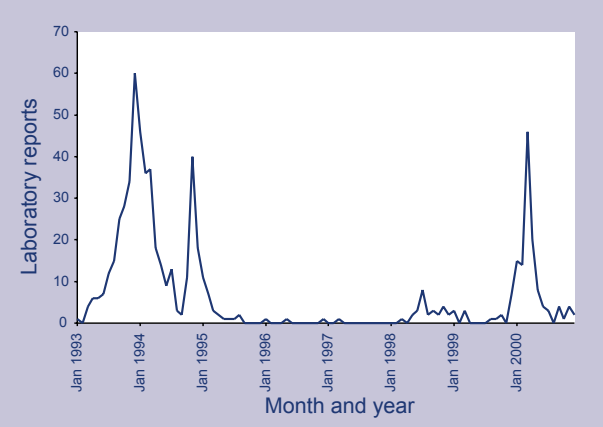
Table 26. Laboratory reports to LabVISE of echovirus, 1991 to 2000, by serotype

Virus	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Total
Echovirus type 30	1	3	198	247	28	3	1	26	17	121	**645**
Echovirus type 11	10	13	141	26	4	1	5	50	166	7	**423**
Echovirus type 9	5	216	22	7	41	4	1	22	32	5	**355**
Echovirus type 6	9	85	10	107	12	1	1	5	16	1	**247**
Echovirus type 7	4	39	74	-	2	24	4	-	1	33	**181**
Echovirus type 17	59	38	4	-	-	-	-	2	-	-	**103**
Echovirus type 22	19	13	9	9	13	1	1	14	12	8	**99**
Echovirus type 14	7	15	23	12	35	4	-	1	-	1	**98**
Echovirus type 3	-	-	-	27	16	-	-	-	5	2	**50**
Echovirus type 25	2	31	5	1	3	-	-	-	3	-	**45**
Echovirus type 18	3	3	1	2	2	1	-	15	-	1	**28**
Echovirus type 4	2	14	-	-	1	1	1	5	1	-	**25**
Echovirus type 5	3	2	5	1	-	4	4	5	1	-	**25**
Echovirus type 16	14	9	-	-	-	-	-	-	-	-	**23**
Echovirus type 1	4	1	-	-	3	-	-	1	-	3	**12**
Echovirus type 33	1	-	-	-	1	1	1	-	4	4	**12**
Echovirus type 21	2	4	4	-	-	-	-	-	-	-	**10**
Echovirus type 31	1	1	-	-	1	-	1	-	1	2	**7**
Echovirus type 15	1	-	3	-	1	1	-	-	-	-	**6**
Echovirus type 24	2	1	-	-	3	-	-	-	-	-	**6**
Echovirus type 19	-	2	1	-	-	-	-	-	1	-	**4**
Echovirus type 2	-	1	-	-	-	-	1	1	1	-	**4**
Echovirus type 20	-	3	-	-	-	-	-	-	-	-	**3**
Echovirus type 23	-	-	-	1	1	-	-	-	-	-	**2**
Echovirus type 32	2	-	-	-	-	-	-	-	-	-	**2**
Echovirus type 8	-	2	-	-	-	-	-	-	-	-	**2**
Echovirus type 34	1	-	-	-	-	-	1	-	-	-	**2**
Echovirus type 12	-	-	1	-	-	-	-	-	-	-	**1**
Echovirus type 13	-	-	-	-	1	-	-	-	-	-	**1**
Echovirus not typed/ pending	3	1	1	3	38	3	3	2	3	5	**62**
Total	**155**	**497**	**502**	**443**	**206**	**49**	**25**	**149**	**264**	**193**	**2,483**

The most commonly identified echovirus serotypes during the study period were echovirus types 30, 11 and 9. Diagnoses in which echoviruses were identified were predominantly in cases of meningitis (41%) and were often isolated from cerebrospinal fluid.

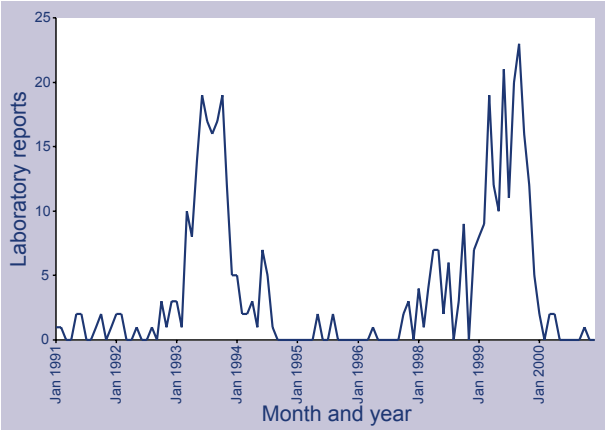
Echovirus 30 was the most common echovirus serotype identified in LabVISE during the study period. Echovirus 30 has caused large outbreaks of aseptic meningitis in many regions of the world during the last 40 years. Periods of increased reporting of echovirus 30 were evident in 1993 to 1994 and again in 2000 (Figure 13).

Figure 13. Laboratory reports to LabVISE of echovirus 30, 1991 to 2000, by month of specimen collection



Periods of increased activity of echovirus 11 associated with aseptic meningitis occurred at intervals of 2–4 years with major peaks in 1993 and 1999. More than half the cases were in children under 5 years (Figure 14).

Figure 14. Laboratory reports to LabVISE of echovirus 11, 1991 to 2000, by month of specimen collection



The clinical syndromes associated with infection with echovirus are shown in Table 27.

Table 27. Clinical syndromes associated with echoviruses*

	Clinical syndrome	Associated echovirus serotypes
Illnesses associated with many enteroviruses in addition to echoviruses	Aseptic meningitis	All except 24,26,29,32
	Encephalitis	2–4,6,7,9,11,14,17–19,25
	Paralysis	1–4,6,7,9,11,14,16,18,19,30
Illnesses more characteristic of particular groups or serotypes of echovirus	Exanthem	9,16 also 1–8,11,14,18,19,25,30,32,33
	Generalised disease of the newborn	4,6,7,9,11,12,14,19,21,51
	Neonatal diarrhoea	11,14,18
	Chronic meningoencephalitis in agammaglobulinemics	2,3,5,9,11,19,24,25,30,33
Undefined/uncertain etiologic role for echovirus	Myositis	9,11
	Haemolytic uraemic syndrome	22
	Guillan-Barré syndrome	6,22
	Infectious lymphocytosis	25

* Modified from reference 31

Polioviruses

Polioviruses are the cause of poliomyelitis, an infection of the central nervous system, which may result in acute flaccid paralysis. Poliovirus infection occurs via the gastrointestinal tract and in more than 90 per cent of cases, causes an inapparent infection.[24] Acute flaccid paralysis occurs in less than one per cent of infections. Three serotypes are recognised and immunity is serotype specific.[31] The oral polio vaccine, which has been in widespread use in Australia and throughout the world for the last 50 years, is a mixture of the three serotypes. Naturally occurring ('wild type') or live attenuated vaccine polioviruses circulate to a varying extent, depending on the impact of polio vaccine on transmission.[31]

Oral polio vaccination has placed the global eradication of poliomyelitis within reach. Numerous regions of the world, including the Western Pacific Region (which includes Australia) have been declared polio-free. The last case of poliomyelitis in Australia occurred in 1972 and the Western Pacific Region was declared polio-free in October 2000. However, continued surveillance is required since there is a continuing possibility of importation of cases of poliovirus from endemic areas.

Surveillance for poliovirus in Australia comprises reporting of poliomyelitis as a notifiable disease to the NNDSS, surveillance of all cases of acute flaccid paralysis, surveillance of vaccine associated paralytic polio cases, surveillance of enteroviruses and intratypic differentiation of all polioviruses isolated in Australia.

Poliovirus laboratory reports to LabVISE between 1991 and 2000 are shown in Table 28.

Thirty-seven per cent of poliovirus diagnoses were associated with a diagnosis of gastrointestinal disease and 50 per cent of the specimens in which poliovirus was identified were stool samples. No wild-type poliovirus has been isolated from any case of acute flaccid paralysis.[32] Continued surveillance of poliovirus will be required until the circulation of wild-type polio can be shown to have ceased. There is concern over the potential for live attenuated virus from the oral polio vaccine persisting in water supplies and possibly reverting toward wild-type neurovirulent phenotypes. This is one reason some countries such as the USA have changed to using an inactivated polio vaccine.[33]

Table 28. Laboratory reports to LabVISE of poliovirus, 1991 to 2000, by type

Virus	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Total
Poliovirus type 1 (uncharacterised)	40	71	43	41	27	15	9	12	26	22	**306**
Poliovirus type 2 (uncharacterised)	54	45	35	41	29	14	9	25	16	8	**276**
Poliovirus type 3 (uncharacterised)	26	32	31	14	13	1	4	6	8	8	**143**
Poliovirus type 1 (vaccine strain)	-	-	-	-	-	1	-	1	-	-	**2**
Poliovirus type 2 (vaccine strain)	-	-	-	-	-	2	2	-	1	-	**5**
Poliovirus type 3 (vaccine strain)	-	-	-	-	-	-	-	-	-	1	**1**
Poliovirus not typed/ pending	74	38	12	10	2	2	-	-	1	1	**144**

Enteroviruses 71 and enterovirus (not typed)

Since the revision of the classification system of the taxonomic scheme for picornaviruses in 1970, four new serotypes have been discovered. These are enteroviruses 68–71. These 'new' enteroviruses are associated with distinct clinical symptoms and show a defined geographical distribution. In Australia, only enteroviruses 70 and 71 have been reported. Infections with enterovirus 70 occurred in a cluster in New South Wales in 1990, but since then, there have been no more reports of this virus to LabVISE.[30]

Enterovirus 71, the most recently discovered enterovirus has been recognised as a cause of cutaneous and central nervous system disease since 1969. Enterovirus 71 is the only non-poliovirus enterovirus known to have the potential to cause epidemic paralytic disease.

The relatively large number of untyped enteroviruses may reflect laboratory practices whereby reports to LabVISE are made only on initial identification or after exclusion of polioviruses, and further identification data are not sent.

Report to LabVISE of enterovirus 71 and enterovirus (untyped) are shown in Table 29.

Enterovirus 71 was first reported in Australia in 1972. A major outbreak of enterovirus 71 occurred in south-east Australia in 1986. Clinical diagnosis during this outbreak was largely skin and mucous membrane disease, meningitis (23%) and respiratory disease (20%).[30] An outbreak of hand, foot, and mouth disease caused by an enterovirus was reported in Western Australia in 1999.[34] In this outbreak, nine of 14 (64%) children developed neurological disease and four of these had long-term sequelae.

Rhinovirus

Rhinoviruses are a cause of the common cold with a worldwide distribution.[35] Rhinoviruses infect humans from early childhood with recurrent infection throughout life. In temperate regions, there are annual seasonal peaks in incidence.

Rhinovirus laboratory reports to LabVISE between 1991 and 2000 are shown in Table 30.

LabVISE reports of rhinovirus show an annual peak in late winter and early spring (Figure 15).

Figure 15. Laboratory reports to LabVISE of rhinovirus infections, 1991 to 2000, by month of specimen collection

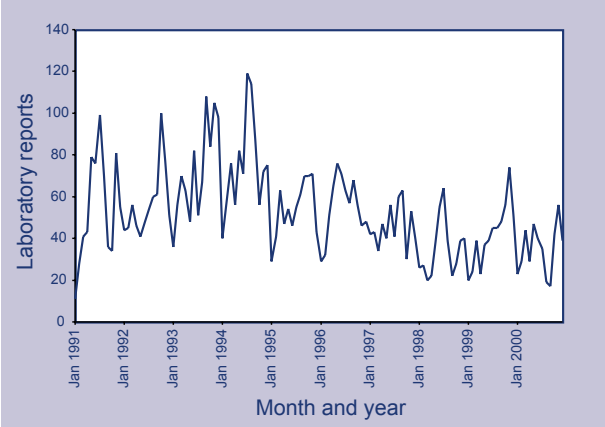


Table 29. Laboratory reports to LabVISE of enterovirus 71 and enterovirus (untyped), 1991 to 2000

Virus	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Total
Enterovirus type 71	13	15	1	-	34	-	-	9	15	6	**93**
Enterovirus not typed/pending	673	781	943	1,101	891	742	484	538	753	815	**7,721**

Table 30. Laboratory reports to LabVISE of rhinovirus, 1991 to 2000

Virus	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Total
Rhinovirus (all types)	653	683	868	905	650	662	549	420	501	420	**6,311**

Ortho/paramyxoviruses

Influenza virus

Influenza is a highly contagious acute respiratory disease which has caused epidemics and pandemics throughout the world for centuries. While most influenza infections are self-limiting, lower respiratory tract and cardiac complications, particularly in the elderly can lead to increased hospitalisations and deaths, particularly during the epidemic months.[36]

Up until 2001, LabVISE has been the only source of laboratory-confirmed influenza data for national influenza surveillance. Viral isolates are forwarded to the World Health Organization Centre for Reference and Research on Influenza for subtype and antigenic analysis. These data have been used to monitor circulating influenza viral strains and to determine the composition of the annual influenza vaccine for Australia.

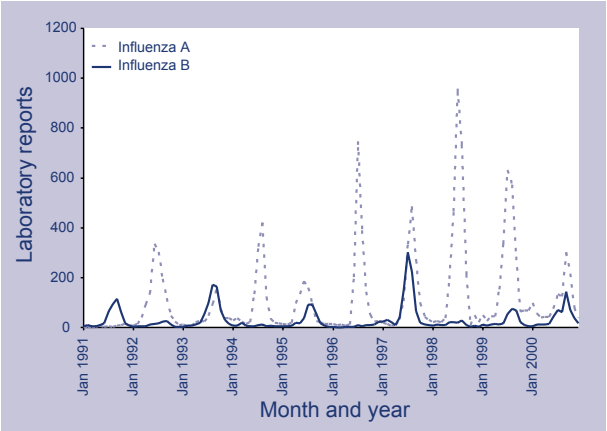
Influenza reports to LabVISE for 1991 to 2000 are shown in Table 31.

The monthly reports to LabVISE of influenza A and B, between 1991 and 2000 are shown in Figure 16. Typically, influenza A is predominant with outbreaks of influenza B every alternate year. Laboratory reports of influenza are largely from young children aged under 5 years.

Parainfluenza virus

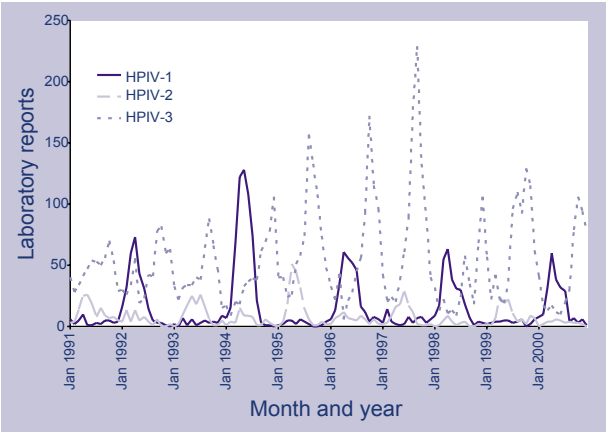
Human parainfluenza viruses (HPIV) are an important cause of acute respiratory infection in infants and children and are especially associated with laryngotracheobronchitis (croup). In the USA, the parainfluenza viruses are responsible for one-third of the estimated 5 million cases of lower respiratory infections occurring annually in children under 5 years of age.[37] Infections also occur in older age groups. Four serotypes are recognised. Biennial epidemics of HPIV–1 and HPIV–2 occur in autumn, while HPIV–3 causes annual epidemics, particularly among young infants aged less than 6 months. LabVISE reports of parainfluenza virus are shown in Table 32.

Figure 16. Laboratory reports to LabVISE of influenza A and influenza B infections, 1991 to 2000, by month of specimen collection



Laboratory reports of parainfluenza by serotype and month between 1991 and 2000 are shown in Figure 17. There are annual epidemics of parainfluenza type 3, while parainfluenza types 1 and 2 occur in biennial epidemics in alternate years in Australia. Laboratory reports to LabVISE for parainfluenza were predominantly for children aged 0–4 years. In 2000, 68 per cent of HPIV–1, 53 per cent of HPIV–2 and 68 per cent of HPIV–3 occurred in children aged 0–4 years.

Figure 17. Laboratory reports to LabVISE of human parainfluenza serotypes 1, 2 and 3, 1991 to 2000, by month of specimen collection



HPIV-1 human parainfluenza serotype 1
HPIV-2 human parainfluenza serotype 2
HPIV-3 human parainfluenza serotype 3

Table 31: Laboratory reports to LabVISE of influenza, 1991 to 2000, by strain type and annual influenza A:B ratio

Virus	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Total
Influenza A	60	1,322	544	1,196	797	1,641	1,447	2,746	1,932	1,506	**13,191**
Influenza B	408	126	648	87	355	79	903	149	279	580	**3,614**
Ratio influenza A:B	0.1	10.5	0.8	13.7	2.2	20.8	1.6	18.4	6.9	2.6	

Table 32. Laboratory reports to LabVISE of parainfluenza virus, 1991 to 2000, by serotype

Virus	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Total
Parainfluenza virus type 1	47	281	44	548	32	315	61	276	44	230	**1,878**
Parainfluenza virus type 2	143	60	127	61	178	73	112	30	114	36	**934**
Parainfluenza virus type 3	556	554	513	526	833	730	962	409	803	516	**6,402**
Parainfluenza virus type 4	-	-	-	-	2	7	-	3	2	-	**14**
Parainfluenza virus typing pending	59	80	46	68	36	32	239	5	1	1	**567**
Total	**805**	**975**	**730**	**1,203**	**1,081**	**1,157**	**1,374**	**723**	**964**	**783**	**9,795**

Table 33. Laboratory reports to LabVISE of respiratory syncytial virus, 1991 to 2000

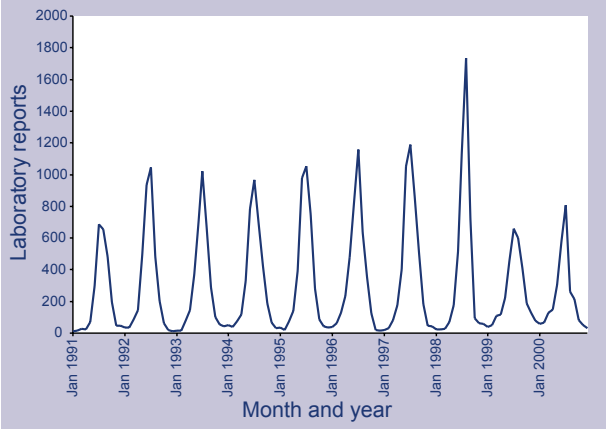
Virus	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Total
Respiratory syncytial virus	2,555	3,556	3,506	3,749	3,889	4,068	4,588	4,641	3,059	2,735	**36,346**

Respiratory syncytial virus

Respiratory syncytial virus (RSV) infects almost all people in all regions of the world within the first years of life and is the major cause of lower respiratory illness in young children. RSV is an important cause of community-acquired pneumonia.[38] A recent study from the United Kingdom suggests that RSV infection may be confused with influenza-like illness.[39] RSV identifications were the single most common virus reported in LabVISE (14.3% of total between 1991 and 2000). LabVISE reports of RSV are shown in Table 33.

RSV epidemics occur annually in the winter months (Figure 18) and most patients are aged between 0–4 years. Thus of 2,735 reports in 2000, 2,446 (89.4%) were in children aged less than 5 years.

Figure 18. Laboratory reports to LabVISE of respiratory syncytial virus infection, 1991 to 2000, by month of specimen collection



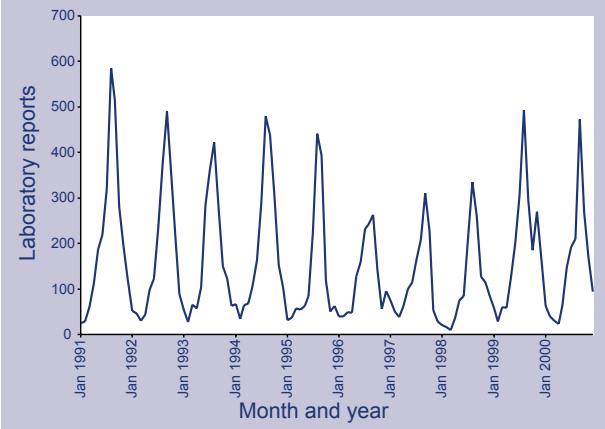
Other respiratory RNA viruses

Reports grouped under the LabVISE category 'other RNA viruses' are largely agents of viral gastrointestinal illness. LabVISE reports of these viruses are shown in Table 34.

Rotavirus

Reports of rotavirus infection were among the largest for any single virus in LabVISE (7.5% of total reports) between 1991 and 2000. Rotavirus infections are a common cause of diarrhoea in children and in Australia cause annual epidemics in the winter months (Figure 19).

Figure 19. Laboratory reports to LabVISE of rotavirus infection, 1991 to 2000, by month of specimen collection



Of the 1,771 reports of rotavirus in 2000, 1,556 (88%) were in children aged less than 5 years. From June 1999, a rotavirus surveillance program has been undertaken by the National Rotavirus Reference Centre, Royal Children's Hospital, Parkville, Victoria. Samples that test positive for rotaviruses by enzyme immunoassay or latex agglutination in collaborating laboratories are sent to the centre for serotyping. The Centre reports annually on circulating serotypes and outbreaks of rotavirus.[40]

Norwalk-like virus

For the purposes of this analysis, Norwalk-like virus includes reports of 'Norwalk agent', 'calicivirus' and 'small virus-like particles. Norwalk-like virus (NLV) is the leading cause of outbreaks of diarrhoea and vomiting in the United Kingdom.[41] These viruses are spread through contaminated food, aerosols, direct contact and environmental contamination. A recent report from the USA of a multi-state outbreak of NLV gastroenteritis associated with a common caterer, underlines the importance of this pathogen as food preparation becomes more centralised and distribution of products become more widespread.[42]

Astrovirus, and reovirus (unspecified)

Small numbers of astroviruses and reoviruses were reported to LabVISE during the study period (Table 34).

Astroviruses are a common cause of infantile gastroenteritis worldwide both as sporadic cases and as outbreaks. A study of children aged less than 5 years in Melbourne between 1995 and 1998, confirmed astrovirus as the cause of acute gastroenteritis in 3 per cent of cases.[11]

Reoviruses (unspecified) may include rotavirus. While reoviruses may cause human disease, infection is uncommon. Enteritis in infants and children and upper respiratory tract infections caused by reoviruses have been reported.[43]

Other non-viral pathogens

Chlamydial infections

Chlamydiae are a unique class of bacteria that are obligate intracellular parasites. Three *Chlamydia* species are recognised, all of which are human pathogens: *C. trachomatis, C. pneumoniae and C. psittaci*. The associated diseases, strains, mode of infection and host species are shown in Table 35.

Reports of chlamydial infections to LabVISE are shown in Table 36.

Table 34. Laboratory reports to LabVISE of 'other RNA viruses', 1991 to 2000

Virus	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Total
Rotavirus	2,642	2,134	1,989	2,275	1,617	1,492	1,431	1,372	2,245	1,771	**18,968**
Norwalk-like virus	117	89	66	50	65	77	70	47	60	82	**723**
Astrovirus	21	14	4	1	6	3	4	10	3	-	**66**
Reovirus (unspecified)	8	12	7	3	-	-	-	-	2	2	**34**

Table 35. Characteristics of *Chlamydia* spp. and strains, modes of transmission and associated human diseases*

Species	Strains	Mode of transmission	Host species	Associated human diseases
C. trachomatis	LGV (L1, L2, L3)	Sexual	Humans	Lymphogranuloma venereum
	Trachoma (A,B,Ba,C)	Hand to eye, fomites, flies	Humans	Ocular trachoma
	Trachoma (B,Ba,D–K)	Sexual, hand to eye, neonatal	Humans	Ocular and genital disease, infant pneumonia
C. psittaci	Many	Aerosol	Birds, sheep, cats etc	Ornithosis (psittacosis)
C. pneumoniae	'TWAR'	Not defined aerosol?	Humans	Bronchitis, pneumonia

* Adapted from reference 44

Table 36. Laboratory reports of to LabVISE chlamydial infections, 1991 to 2000

Organism	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Total
Chlamydia trachomatis A–K	59	11	-	1	1	1	1	-	1	-	**75**
Chlamydia trachomatis L1–L3	18	-	-	-	-	-	1	-	-	-	**19**
Chlamydia trachomatis not typed	2,615	2,563	2,835	2,178	2,579	3,803	3,980	3,158	3,295	3,154	**30,160**
Chlamydia pneumoniae	2	14	1	-	2	1	3	-	2	36	**61**
Chlamydia psittaci	139	97	74	114	176	62	51	70	78	102	**963**
Chlamydia spp. typing pending	1	10	9	10	6	1	7	-	1	-	**45**
Chlamydia species not typed	-	6	18	62	75	54	28	57	21	8	**329**
Total	**2,834**	**2,701**	**2,937**	**2,365**	**2,839**	**3,922**	**4,071**	**3,285**	**3,398**	**3,300**	**31,652**

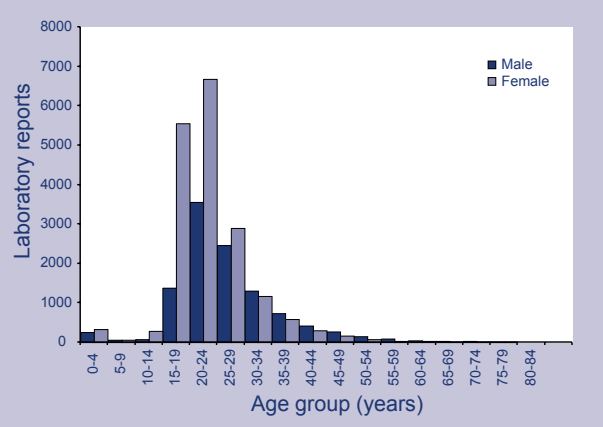
Chlamydia trachomatis

Notifications of *Chlamydial trachomatis* infection between 1991 and 2000 to the NNDSS and laboratory reports to LabVISE are shown in Table 37.

The NNDSS case definition for chlamydial infections requires the isolation of *Chlamydia trachomatis* or demonstration of chlamydial antigens in clinical specimens. For most of the study period and from most jurisdictions, notifications to the NNDSS of chlamydial infections were restricted to genital chlamydial infections. New South Wales did not start reporting chlamydial infections to the NNDSS until 1998. LabVISE laboratory reports have fallen from representing two-thirds of the NNDSS reports in 1991 to just 19 per cent in 2000. Whether laboratory reports in LabVISE were from clinical samples only from genital sites or whether they include samples from other infected sites cannot be determined.

The distribution of chlamydial infections by age and sex, reported to LabVISE are shown in Figure 20. The distribution is very similar to that seen in NNDSS notifications, with a female predominance (male to female ratio of 1:1.6) and the largest number of reports (57%) from young adults aged 15–24 years.

Figure 20. Laboratory reports to LabVISE of *Chlamydia trachomatis* infection, 1991 to 2000, by age and sex



Chlamydia psittaci

Notifications of *Chlamydia psittaci* infection between 1991 and 2000 to the NNDSS and laboratory reports to LabVISE are shown in Table 38.

Ornithosis has not been a notifiable disease in all Australian jurisdictions during the period 1991 to 2000 and consequently cases reported to the NNDSS do not represent national figures. While no agreed national NNDSS definition for ornithosis was used in this period, probable cases diagnosed based on an acute clinical illness compatible with ornithosis, were included. Laboratory diagnosis is based on increases in specific antibody titres, or more recently, detection of *C. psitttaci* by nucleic acid tests.

For a number of years, LabVISE reported more cases of ornithosis than the NNDSS. LabVISE reports showed a male predominance (male to female ratio 1.7:1) and a peak of reports from adult men aged 50–54 years. Figure 21 shows the age and sex distribution of laboratory reports of ornithosis to LabVISE. This age and sex distribution is similar to that found in notifications of ornithosis to NNDSS.

Figure 21. Laboratory reports to LabVISE of *Chlamydia psittaci* infections, 1991 to 2000, by age and sex

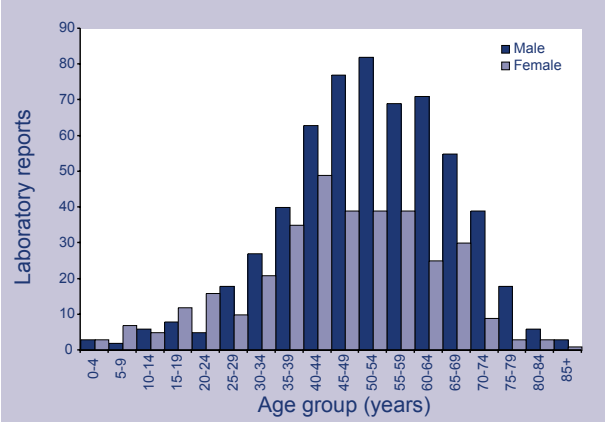


Table 37. Laboratory reports to LabVISE and notifications to NNDSS of *Chlamydia trachomatis* infections, 1991 to 2000

Surveillance system	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
LabVISE	2,692	2,574	2,835	2,179	2,580	3,804	3,982	3,158	3,296	3,154
NNDSS	4,044	6,293	6,500	6,450	6,398	8,445	9,242	11,339	14,082	16,853

Table 38. Laboratory reports to LabVISE and notifications to NNDSS of *Chlamydia psittaci* infections (ornithosis), 1991 to 2000

Surveillance system	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
LabVISE	139	97	74	114	176	62	51	70	78	102
NNDSS	136	98	94	86	186	86	35	64	84	100

Table 39. Laboratory reports to LabVISE, of *Mycoplasma* infections, 1991 to 2000

Organism	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Total
Mycoplasma pneumoniae	381	1,580	1,760	820	334	1,009	1,640	1,285	1,125	686	**10,620**
Mycoplasma hominis	2	4	-	2	-	2	-	2	5	8	**25**
Total	**383**	**1,584**	**1,760**	**822**	**334**	**1,011**	**1,640**	**1,287**	**1,130**	**694**	**10,645**

Chlamydia pneumoniae

Chlamydia pneumoniae causes an acute respiratory disease similar to that caused by *Mycoplasma*. Infection is widespread and antibody prevalence is low in children, around 50 per cent in young adults and continues to be high into old age. Clinical disease is seen in all ages but most frequently in young adults.[24]

Mycoplasma pneumoniae

Mycoplasma pneumoniae is the cause of mycoplasma pneumonia (or primary atypical pneumonia), that presents predominantly as a febrile lower respiratory infection or occasionally as a pharyngitis, bronchitis or pneumonia.[24] The disease is worldwide in distribution and may occur in all age groups with occasional epidemics in institutions and military recruits.

Laboratory reports to LabVISE of *Mycoplasma* between 1991 and 2000 are shown in Table 39.

Mycoplasma pneumoniae infections reported to LabVISE were most commonly reported in female children aged 5–9 years (male to female ratio 0.9:1, Figure 22).

Mycoplasma pneumoniae reports show variation from year to year without a distinct seasonal peak (Figure 23).

Mycoplasma hominis is commonly isolated from the genitourinary tract (more commonly from women than men), the neonatal conjunctiva and peripartum blood. The organism is associated with cervicitis, vaginitis, conjunctivitis and peripartum sepsis.[45]

Figure 22. Laboratory reports to LabVISE of *Mycoplasma pneumoniae* infections, 1991 to 2000, by age and sex

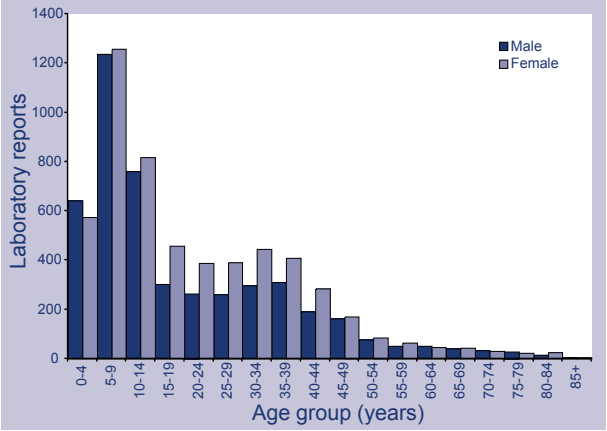


Figure 23. Laboratory reports to LabVISE of *Mycoplasma pneumoniae* infections, 1991 to 2000, by month of report

Rickettsia

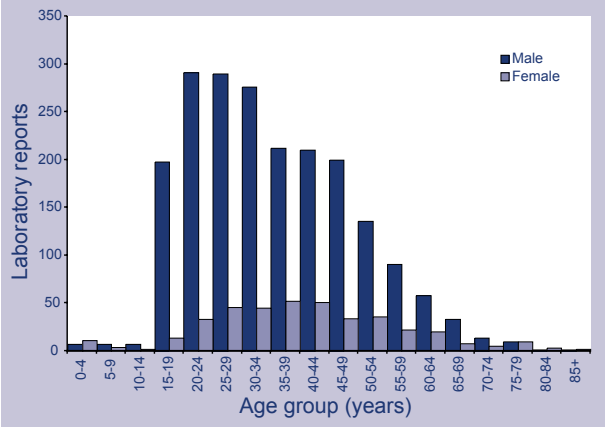
Coxiella burnetii

The rickettsial pathogen *Coxiella burnetii* is the cause of an acute febrile disease with a variety of clinical presentations of variable severity and duration (Q fever). The disease is particularly associated with livestock workers. Notifications of Q fever to the NNDSS and laboratory reports of *Coxiella burnetii* to LabVISE between 1991 and 2000 are shown in Table 40.

The NNDSS case definition for Q fever[46] is based on serology or isolation of the organism from a clinical sample. The trends in laboratory reports to LabVISE are similar to trends in NNDSS data, with a peak in reports in 1993 and lower reports in more recent years as a result of Q fever vaccine initiatives among abattoir workers, who are at high risk of contracting the disease.

An age, sex analysis of *Coxiella burnetii* infections shows a large male predominance (male:female ratio 5.2:1), similar to that shown in NNDSS data. The largest numbers of laboratory reports to LabVISE were from men aged 25–29 years (Figure 24).

Figure 24. Laboratory reports to LabVISE of *Coxiella burnetii* infections, 1991 to 2000, by age and sex



Small numbers of laboratory reports of other *Rickettsia* were sent to LabVISE during the period as shown in Appendix 3.

Other pathogens

From 1992 to 1996 and in 1999 and 2000, several hundred reports were made to LabVISE of group A streptococci. While streptococcal group A infections have declined dramatically in Australia, Indigenous Australians in northern Australia continue to suffer endemic infection with corresponding high rates of rheumatic fever,[47] acute post-streptococcal glomerulonephritis,[48] streptococcal pyoderma[49] and resulting chronic renal disease and rheumatic heart disease.

A significant number of reports to LabVISE during the period 1991 to 2000 were received for other pathogens under surveillance in the NNDSS (Appendix 2). These include isolations of *Yersinia, Brucella, Bordetella, Legionella, Leptospira, Treponema* and *Echinococcus*. Since data on these pathogens was collected sporadically over the period and represent only a small fraction of notified cases reported to NNDSS, no analysis has been attempted here. Similarly for small numbers of reports of *Cryptococcus, Entamoeba histolytica* and *Toxoplasmosis gondii* no meaningful comments can be offered.

The reader is referred to NNDSS annual reports published in *Communicable Diseases Intelligence* for detailed analysis of the epidemiology of these and other pathogens in Australia.

Table 40. Laboratory reports to LabVISE and notifications to NNDSS of *Coxiella burnetii* infection (Q fever), 1991 to 2000

Surveillance system	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
LabVISE	240	270	552	345	167	208	259	137	221	101
NNDSS	595	543	889	664	466	554	580	560	518	573

Discussion

This review of LabVISE data for the last 10 years has shown that this reporting scheme contains valuable data potentially important to public health in Australia. LabVISE collects important data on the viral diseases, particularly those of children that are not reported in other surveillance systems. These data supplement diseases under surveillance through the National Notifiable Diseases Surveillance System.

LabVISE has had a uniquely important role in the control of two diseases in the last 10 years, influenza and poliomyelitis.

Influenza epidemics occur in Australia annually in winter. Admissions to hospitals in Australia for influenza and pneumonia exceed 250,000 annually.[50] Pneumonia secondary to influenza infection in the elderly is an important cause of mortality.[36,50] For this reason, the Australian Government has provided influenza vaccination free of charge to Australians aged 65 years and above since 1999. Surveys of elderly Australians in 2000 and 2001 show that 77 per cent of this age group are taking annual influenza vaccination.[51] Each year, the composition of the Australian influenza vaccine is reviewed and altered to reflect the virus strains circulating in the previous influenza season. This information is derived in a large part from isolates collected through LabVISE laboratories.

Laboratory reports of influenza are reported throughout the year and allow surveillance of the annual epidemics. These data, combined with reports of influenza-like illness in sentinel general practices, are reported annually in the report of the National Influenza Surveillance Scheme.[52]

Since June 2001, influenza data are published fortnightly throughout the year on the Communicable Diseases Australia Website at http://www.health.gov.au/pubhlth/cdi/ozflu/flucurr.htm. It is essential for influenza surveillance and for vaccine production that LabVISE laboratories continue to isolate and characterise influenza viruses. It is only a matter of time until genetic mutations in the influenza virus trigger an influenza pandemic. Laboratory surveillance will be critical in the early stages of a pandemic to characterise the new virus and to monitor the geographical spread.

The last case of poliomyelitis in Australia was reported in 1972 and the Western Pacific Region was declared polio-free in October 2000. The WHO recommends continued surveillance of poliovirus in Australia, including laboratory investigations of all cases of acute flaccid paralysis and vaccine-associated paralytic polio and the monitoring of circulating enteroviruses in the community and intratypic differentiation of all polioviruses.[32] LabVISE contributes significantly to these aspects of polio surveillance. Such surveillance is still not reaching the targets set by WHO[32] and surveillance needs to continue until the global eradication of poliomyelitis is achieved. Recent outbreaks of polio in Bulgaria,[53] show that countries that have eliminated endemic polio are at risk from imported polio cases.

LabVISE has accumulated important information on viral pathogens of public health importance, particularly causative organisms of viral meningitis, viral gastroenteritis and viral respiratory diseases.

Viral meningitis surveillance is recommended by the WHO.[54] The rationale for this surveillance is that viral meningitis can occur in epidemics as well as sporadically and that although mortality is generally low, the associated morbidity and risk of long term sequelae in children are high. Laboratory identification of the causative virus and measurement of incidence by time, geographical area and age group are important to the identification and control of epidemics. There is no other national surveillance system in Australia, other than LabVISE, in a position to undertake this surveillance.

Outbreaks of viral meningitis associated with echovirus 11 and 30, enterovirus 71, and coxsackie A9 and B5, have been detected in Australia in recent years. However, there has been no nationally coordinated approach to these important public health problems.

Viral agents are responsible for the largest proportion of gastroenteritis in developed countries.[55] Rotavirus is a major cause of diarrhoea and may be an important cause of gastroenteritis in the elderly. In Australia, there are annual epidemics in the winter months and large outbreaks have occurred biennially in the Northern Territory.[56] During these epidemics, hospital consultations and admissions are greatly increased. Although deaths are rare in industrialised countries, rotavirus causes 800,000 childhood deaths annually in the developing countries.[57] The introduction of a rotavirus vaccine in 1998 was to be an important milestone in the control of this disease. The vaccine was subsequently withdrawn after cases of intestinal intussusception. Despite this, vaccination for rotavirus, particularly as part of the childhood immunisation program in developing

countries, remains a priority. Since 1999, the National Rotavirus Surveillance Program has serotyped rotaviruses isolated in laboratories, measured the emergence of new serotypes, and tracked their geographical spread in Australia.[40] Continued laboratory surveillance of rotavirus is important to monitor epidemics, to monitor circulating serotypes and to measure the impact of future vaccines.

Norwalk-like virus has emerged as a major cause of gastroenteritis in adults. The control of this agent is difficult, as transmission has been shown to be by aerosols and environmental contamination[58] as well as by contaminated food.[42] The epidemiology of the virus continues to be elucidated and surveillance of this agent is important for the control of community gastroenteritis.

Viral respiratory diseases include influenza, parainfluenza, respiratory syncytial virus and various adenoviruses. These viruses are important childhood pathogens. The importance of LabVISE to surveillance of influenza in Australia has been noted above. More common childhood infections with parainfluenza and RSV have been reported consistently to LabVISE over the years. Both viruses cause annual epidemics, with parainfluenza serotype 1 showing annual epidemics while serotypes 2 and 3 show biennial epidemics.

Since HPIV–3 causes more severe disease, monitoring of parainfluenza serotypes is important. Adenoviruses play a role in acute respiratory infections and monitoring of circulating serotypes will be an important activity to predict disease patterns in the Australian community.

The LabVISE scheme has been evaluated elsewhere[30] and a full discussion of the schemes strengths and weaknesses belong to another paper. However, it is obvious from the analysis performed here that there are limitations to the value of LabVISE data. As has been noted earlier the representativeness of the data in LabVISE is uncertain since there has been no measure from what population these results are drawn. The large number of reports from children in LabVISE reflects both the nature of the pathogens reported but also the inclusion of reports from major children's hospitals in Australia. By contrast, other age groups may be under-represented. The large proportion of tertiary hospital laboratories in LabVISE also biases the system to report less common pathogens or those more difficult to diagnose, seen perhaps more often in sicker individuals and not typical of the community at large. It is unclear what populations these large reference laboratories serve and laboratories have only reported positive results without reporting on the total number of tests performed. Thus, there are no denominators in the data to calculate rates. The National Respiratory and Enteric Virus Surveillance System of the Centers for Disease Control and Prevention in the USA, collect data as the percentage of positive isolates from laboratories, which allows monitoring of virus activity throughout the year. (www.cdc.gov/ncidod/dvrd/revb/nrcvss/index. Accessed, January 2002).

Another criticism of LabVISE has been the lack of focus, in that the surveillance system covers a large range of pathogens of varying public health significance. A focus on viral agents of meningitis, gastroenteritis and respiratory disease prioritised by public health importance may be an important option for the future of LabVISE. Changes to the pathogens under surveillance and the data collected on each notification in NNDSS impact on the usefulness of data collected by LabVISE. Notifications of measles, mumps, rubella, hepatitis, arboviral infections and chlamydial infection to NNDSS greatly exceed reports to LabVISE. Now that more microbiological data are collected on each NNDSS notification, the data collected by LabVISE has lost its value. Inclusion of these organisms in LabVISE may therefore be redundant and this supports the option that LabVISE should focus on a supplementary set of pathogens.

Reporting of LabVISE data has been poor for many years. This is the first full analysis of LabVISE data since 1996. The timeliness of reports through *Communicable Diseases Intelligence* is also poor as the publication schedule has changed to quarterly. Publication of reports on the Internet would be important in giving timely information.

The quality of data has declined over time with less complete identification of pathogens. A data collection system for NNDSS, which allows the updating of reports with additional detail, is being implemented. This allows the timely notification of a case and the subsequent completion of details including laboratory results. A similar system for LabVISE would allow timely reporting and complete characterisation of the pathogen.

This review of the last 10 years of LabVISE data shows that much valuable data has been accumulated and lessons learnt. With a new focus and commitment, LabVISE will continue to have an important role in public health in Australia.

Appendices

Appendix 1. Classifications of diagnoses for specimens reported to LabVISE, 1991 to 2000

Code	Diagnosis
00	Healthy — no illness
01	Respiratory tract infection — upper
02	Respiratory tract infection — lower
04	Central nervous system (CNS) — paralytic disease
05	CNS diseases — other (e.g. convulsions)
06	Superficial skin/mucous membrane diseases (rash, ulcer etc)
07	Gastrointestinal disease
08	High fever
09	Other than this list
10	Eye disease (e.g. conjunctivitis, keratitis, endophthalmitis)
11	Respiratory tract infection unspecified
12	Otitis media
13	Nervous system disease (unspecified)
14	Endocarditis
15	Trauma
16	Deep skin infection (wound, abscess, cellulitis, cyst)
17	Hepatitis
18	Septicaemia
19	Cardiovascular disease, unspecified
20	Endocarditis (native valve)
21	Endocarditis (prosthetic valve)
22	Otitis externa
23	Septic shock
24	Intra-abdominal infections (e.g. peritonitis, cholecystitis)
29	Bone and/or joint disease (including Bornholm disease)
30	Septic arthritis
31	Osteomyelitis
32	Otitis, unspecified
34	Myocarditis
35	Pericarditis
38	Reticulo-endothelial system disease
39	Glandular disease (salivary, endocrinous glands)
40	Epiglottitis
47	Hepatic disease — other (including jaundice)
48	Colitis
49	Intussusception
50	HIV/AIDS
51	Neutropenia

Appendix 1 (continued). Classifications of diagnoses for specimens reported to LabVISE, 1991 to 2000

Code	Diagnosis
52	Diabetes
53	Injecting drug use
54	Renal failure/haemodialysis
55	Transplant
56	Transplant
57	Immunosuppressed
58	Malignancy
59	Genital disease (including sexually transmitted infections)
60	Infection of female pelvis
61	Pregnant
62	Postnatal
63	Hospitalisation
64	Travel overseas
65	Animal exposure
66	Occupational
68	Pre-term neonate
69	Congenital disease
70	Recent surgery — gastrointestinal
71	Recent surgery — orthopaedic
72	Recent surgery — urinary tract
73	Recent surgery — thoracic
74	Recent surgery — vascular
75	Recent surgery — neurology
79	Recent surgery — other
80	Intravascular device — peripheral IV line
81	Intravascular device — central IV line
83	Intravascular device — artificial heart valve
84	Other prosthetic device
85	Phlebitis
88	Urinary tract infection (instrumentation/catheterisation)
89	Urinary tract disease
90	Blood transfusion
95	Probable contaminant
96	Hospital acquired
97	No data available
99	No clinical information available
A1	Sudden infant death syndrome
AA	Concomitant, but unrelated disease
E3	Encephalitis
G8	Malaise — general and/or mild fever
M3	Meningitis
P8	Pyrexia of unknown origin or severe prolonged fever

Appendix 2. Laboratory reports to LabVISE, 1991 to 2000, by year and organism type

Organism	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Measles, mumps, rubella										
Measles virus	256	204	853	1,199	153	57	67	49	172	44
Mumps virus	32	48	77	87	69	37	40	44	58	49
Rubella virus	246	753	926	1,178	735	716	362	103	145	51
Hepatitis										
Hepatitis A virus	445	371	451	363	424	407	624	384	375	146
Hepatitis D virus	37	45	47	24	23	17	15	7	8	9
Hepatitis E virus	-	1	12	6	8	2	4	1	1	4
Arboviruses										
Ross River virus	833	1,319	1,895	2,240	988	3,249	2,016	676	1,423	1,268
Barmah Forest virus	36	251	208	273	202	232	201	44	180	169
Dengue type 1	13	9	1	-	3	-	-	-	-	-
Dengue type 2	3	297	422	4	1	29	20	-	-	2
Dengue type 3	-	5	2	4	2	2	1	27	3	4
Dengue type 4	1	-	-	1	-	1	-	-	-	-
Dengue not typed	12	74	103	26	19	30	43	43	85	175
Murray Valley encephalitis virus	10	1	9	3	-	-	3	2	2	20
Kunjin virus	14	10	-	2	5	5	6	5	5	4
Japanese encephalitis virus	-	-	-	1	6	-	-	1	1	-
Kokobera virus	1	-	-	-	-	-	-	-	-	-
Stratford virus	3	-	-	-	-	1	-	1	-	-
Flavivirus (unspecified)	29	47	104	23	45	21	21	73	27	40
Adenoviruses										
Adenovirus type 1	91	111	85	48	32	21	29	74	14	8
Adenovirus type 2	142	129	128	45	37	29	39	22	13	7
Adenovirus type 3	88	96	203	57	66	45	22	57	35	18
Adenovirus type 4	23	103	40	2	2	-	7	4	15	5
Adenovirus type 5	31	38	28	12	14	9	8	1	6	8
Adenovirus type 6	9	7	3	1	2	3	-	20	-	3
Adenovirus type 7	8	4	11	16	26	17	8	17	7	8
Adenovirus type 8	38	33	55	55	22	13	3	3	1	3
Adenovirus type 9	11	7	5	3	2	1	-	-	-	-
Adenovirus type 10	4	2	1	-	1	-	1	1	-	-
Adenovirus type 11	29	12	4	1	3	1	-	1	-	-
Adenovirus type 12	-	3	3	-	-	-	-	-	-	-
Adenovirus type 13	1	-	-	-	-	-	-	-	-	-
Adenovirus type 14	1	-	-	-	-	-	-	-	-	-
Adenovirus type 15	-	-	-	-	-	-	-	-	-	1
Adenovirus type 16	2	-	-	-	-	-	-	-	-	-
Adenovirus type 18	1	-	-	-	-	-	-	-	-	-
Adenovirus type 19	6	20	3	-	3	7	-	2	1	7
Adenovirus type 21	1	-	-	-	-	-	-	-	-	-

Appendix 2 (continued). Laboratory reports to LabVISE, 1991 to 2000, by year and organism type

Organism	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Adenoviruses, cont.										
Adenovirus type 22	3	1	1	3	-	-	-	2	-	-
Adenovirus type 24	3	-	-	-	-	-	-	-	-	-
Adenovirus type 26	11	-	2	2	2	1	-	-	-	-
Adenovirus type 27	1	-	-	-	-	-	-	-	-	
Adenovirus type 28	12	1	1	-	-	1	-	-	-	-
Adenovirus type 29	5	-	-	-	-	-	-	-	-	-
Adenovirus type 30	7	2	-	1	2	-	-	-	-	-
Adenovirus type 31	3	-	-	-	-	-	-	-	-	-
Adenovirus type 32	1	-	-	-	-	-	-	-	-	-
Adenovirus type 34	-	2	-	-	-	-	-	-	-	-
Adenovirus type 35	4	1	1	1	1	3	-	-	-	-
Adenovirus type 37	7	3	1	2	2	5	3	5	11	11
Adenovirus type 40	4	6	9	-	-	34	12	21	74	86
Adenovirus type 41	-	-	-	-	-	4	3	-	-	1
Adenovirus type 42	-	-	-	-	1	1	-	-	-	-
Adenovirus type 43	-	-	-	-	-	1	-	-	-	-
Adenovirus type 44	1	-	-	-	-	-	-	-	-	-
Adenovirus type 45	2	-	-	-	-	-	-	-	-	-
Adenovirus type 46	1	3	1	2	2	-	-	-	-	-
Adenovirus type 47	1	2	-	-	-	-	-	-	-	-
Adenovirus not typed/ pending	966	1,136	1,300	1,291	962	1,186	882	932	1,132	1,039
Herpesviruses										
Herpesvirus type 6	3	2	4	6	3	-	6	2	16	6
Cytomegalovirus	1,820	1,728	1,561	1,727	1,404	1,373	1,017	766	1,220	1,312
Varicella-zoster virus	522	684	924	1,062	1,073	1,132	1,252	1,252	1,658	1,494
Epstein-Barr virus	1,361	1,625	1,570	1,516	1,887	2,084	2,151	1,903	2,196	1,926
Other DNA viruses										
Papovavirus group	9	11	1	4	11	1	2	3	12	7
Cowpox virus	1	-	-	-	-	-	-	-	-	-
Molluscum contagiosum	21	10	8	4	3	7	5	2	15	11
Contagious pustular dermatitis (Orf virus)	5	7	4	2	1	1	9	6	8	7
Poxvirus group not typed	2	-	10	2	4	5	3	-	2	-
Parvovirus	29	178	86	109	102	268	291	261	437	389
Picornaviruses										
Coxsackie A										
Coxsackievirus A2	2	-	-	-	-	-	-	-	-	-
Coxsackievirus A7	-	-	-	-	-	1	-	-	-	-
Coxsackievirus A9	45	19	62	2	9	9	5	8	10	11
Coxsackievirus A10	-	-	-	-	1	-	-	1	-	-
Coxsackievirus A16	9	21	18	34	1	12	5	3	15	8
Coxsackievirus A21	-	-	1	-	-	-	-	-	-	-
Coxsackievirus A untyped/pending	2	3	1	-	1	-	-	-	-	-

Appendix 2 (continued). Laboratory reports to LabVISE, 1991 to 2000, by year and organism type

Organism	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Picornaviruses, cont.										
Coxsackie B										
Coxsackievirus B1	6	57	51	4	-	-	1		1	4
Coxsackievirus B2	34	2	8	23	4	20	6	1	10	6
Coxsackievirus B3	13	6	15	31	11	3	14	2	-	-
Coxsackievirus B4	61	4	11	12	2	8	5	6	3	16
Coxsackievirus B5	40	65	26	15	4	15	1	7	7	5
Coxsackievirus B6	-	1	1	2	-	-	-	1	-	-
Coxsackievirus B untyped/pending	1	1	1	-	-	3	-	1	-	1
Echoviruses										
Echovirus type 1	4	1	-	-	3	-	-	1	-	3
Echovirus type 2	-	1	-	-	-	-	1	1	1	-
Echovirus type 3	-	-	-	27	16	-	-	-	5	2
Echovirus type 4	2	14	-	-	1	1	1	5	1	-
Echovirus type 5	3	2	5	1	-	4	4	5	1	-
Echovirus type 6	9	85	10	107	12	1	1	5	16	1
Echovirus type 7	4	39	74	-	2	24	4	-	1	33
Echovirus type 8	-	2	-	-	-	-	-	-	-	-
Echovirus type 9	5	216	22	7	41	4	1	22	32	5
Echovirus type 11	10	13	141	26	4	1	5	50	166	7
Echovirus type 12	-	-	1	-	-	-	-	-	-	-
Echovirus type 13	-	-	-	-	1	-	-	-	-	-
Echovirus type 14	7	15	23	12	35	4	-	1	-	1
Echovirus type 15	1	-	3	-	1	1	-	-	-	-
Echovirus type 16	14	9	-	-	-	-	-	-	-	-
Echovirus type 17	59	38	4	-	-	-	-	2	-	-
Echovirus type 18	3	3	1	2	2	1	-	15	-	1
Echovirus type 19	-	2	1	-	-	-	-	-	1	-
Echovirus type 20	-	3	-	-	-	-	-	-	-	-
Echovirus type 21	2	4	4	-	-	-	-	-	-	-
Echovirus type 22	19	13	9	9	13	1	1	14	12	8
Echovirus type 23	-	-	-	1	1	-	-	-	-	-
Echovirus type 24	2	1	-	-	3	-	-	-	-	-
Echovirus type 25	2	31	5	1	3	-	-	-	3	-
Echovirus type 30	1	3	198	247	28	3	1	26	17	121
Echovirus type 31	1	1	-	-	1	-	1	-	1	2
Echovirus type 32	2	-	-	-	-	-	-	-	-	-
Echovirus type 33	1	-	-	-	1	1	1	-	4	4
Echovirus type 34	1	-	-	-	-	-	1	-	-	-
Echovirus not typed/ pending	3	1	1	3	38	3	3	2	3	5

Appendix 2 (continued). Laboratory reports to LabVISE, 1991 to 2000, by year and organism type

Organism	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Picornaviruses, cont.										
Polioviruses										
Poliovirus type 1 (uncharacterised)	40	71	43	41	27	15	9	12	26	22
Poliovirus type 2 (uncharacterised)	54	45	35	41	29	14	9	25	16	8
Poliovirus type 3 (uncharacterised)	26	32	31	14	13	1	4	6	8	8
Poliovirus type 1 (vaccine strain)	-	-	-	-	-	1	-	1	-	-
Poliovirus type 2 (vaccine strain)	-	-	-	-	-	2	2	-	1	-
Poliovirus type 3 (vaccine strain)	-	-	-	-	-	-	-	-	-	1
Poliovirus not typed/ pending	74	38	12	10	2	2	-	-	1	1
Rhinovirus (all types)	653	683	868	905	650	662	549	420	501	420
Other enteroviruses										
Enterovirus type 71 (BCR)	13	15	1	-	34	-	-	9	15	6
Enterovirus not typed/ pending	673	781	943	1,101	891	742	484	538	753	815
Picorna virus not typed	1	-	-	-	-	-	-	-	-	2
Ortho/paramyxoviruses										
Influenza										
Influenza A virus	54	1,144	512	1,122	696	1,571	1,350	2,744	1,898	1,499
Influenza A virus H1N1	5	8	-	-	92	-	1	-	1	-
Influenza A virus H3N2	1	170	32	74	9	70	96	2	33	7
Influenza B virus	408	126	648	87	355	79	903	149	279	580
Influenza C virus	1	-	-	-	-	-	-	-	-	-
Influenza virus — typing pending	2	1	4	8	2	19	448	2	-	-
Parainfluenza										
Parainfluenza virus type 1	47	281	44	548	32	315	61	276	44	230
Parainfluenza virus type 2	143	60	127	61	178	73	112	30	114	36
Parainfluenza virus type 3	556	554	513	526	833	730	962	409	803	516
Parainfluenza virus type 4	-	-	-	-	2	7	-	3	2	-
Parainfluenza virus typing pending	59	80	46	68	36	32	239	5	1	1
Respiratory syncytial virus	2,555	3,556	3,506	3,749	3,889	4,068	4,588	4,641	3,059	2,735
Other RNA viruses										
Paramyxovirus (unspecified)	3	1		1	5	28	22	-	4	-
HTLV–1	8	2	13	1	4	10	17	15	12	9
Rotavirus	2,642	2,134	1,989	2,275	1,617	1,492	1,431	1,372	2,245	1,771
Astrovirus	21	14	4	1	6	3	4	10	3	-
Reovirus (unspecified)	8	12	7	3	-	-	-	-	2	2
Calicivirus	37	19	12	6	1	6	-	1	1	-
Norwalk agent	21	6	21	11	48	59	67	44	59	82
Coronavirus	36	26	11	2	1	-	-	-	-	-
Small virus (like) particle	59	64	33	33	16	12	3	2	-	-

Appendix 2 (continued). Laboratory reports to LabVISE, 1991 to 2000, by year and organism type

Organism	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Non-viral pathogens										
Chlamydia										
Chlamydia trachomatis – A–K	59	11	-	1	1	1	1	-	1	-
Chlamydia trachomatis — L1–L3	18	-	-	-	-	-	1	-	-	-
Chlamydia trachomatis (not typed)	2,615	2,563	2,835	2,178	2,579	3,803	3,980	3,158	3,295	3,154
Chlamydia pneumoniae	2	14	1	-	2	1	3	-	2	36
Chlamydia psittaci	139	97	74	114	176	62	51	70	78	102
Chlamydia spp. (typing pending)	1	10	9	10	6	1	7	-	1	-
Chlamydia species	-	6	18	62	75	54	28	57	21	8
Mycoplasma										
Mycoplasma pneumoniae	381	1,580	1,760	820	334	1,009	1,640	1,285	1,125	686
Mycoplasma hominis	2	4	-	2	-	2	-	2	5	8
Rickettsia										
Coxiella burnetii (Q fever)	240	270	552	345	167	208	259	137	221	101
Rickettsia prowazeki	-	-	1	-	-	-	-	-	-	2
Rickettsia australis	-	8	3	3	24	18	10	2	2	2
Rickettsia tsutsugamushi	-	-	-	-	6	13	26	-	2	11
Rickettsia — spotted fever group	-	21	-	-	2	-	-	-	1	44
Rickettsia species — other	1	2	11	6	7	5	7	8	13	12
Gram positive bacteria										
Streptococcus group A	-	73	292	340	553	154	-	-	368	348
Streptococcus group B	-	5	-	-	-	-	-	-	-	-
Gram negative bacteria										
Yersinia enterocolitica	-	5	5	34	31	-	-	1	10	15
Brucella abortus	-	-	-	13	1	-	-	-	-	1
Brucella species	-	15	3	8	7	3	-	-	11	5
Bordetella pertussis	-	20	348	620	608	943	1,801	770	845	689
Bordetella parapertussis	-	-	1	3	-	-	-	-	-	1
Bordetella species	-	73	264	159	261	244	2	-	-	-
Legionella pneumophila	-	1	-	3	5	5	18	8	17	44
Legionella longbeachae	-	1	3	5	22	20	31	37	51	59
Legionella species	-	3	8	27	11	14	10	-	-	5
Cryptococcus										
Cryptococcus species	-	13	30	22	18	13	20	7	9	18
Spirochetes										
Leptospira interrogans	-	-	-	-	-	2	-	-	-	-
Leptospira canicola	-	1	2	1	-	2	1	-	-	-
Leptospira icterohaemorrhagiae	-	2	4	2	-	-	-	-	-	-
Leptospira pomona	-	5	7	6	4	10	7	-	-	-

Appendix 2 (continued). Laboratory reports to LabVISE, 1991 to 2000, by year and organism type

Organism	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Spirochetes, continued										
Leptospira autumnalis	-	-	-	1	-	-	-	-	-	-
Leptospira grippotyphosa	-	-	-	1	-	2	-	-	-	-
Leptospira hardjo	-	8	20	25	9	25	8	3	1	-
Leptospira australis	-	2	4	5	3	7	5	-	-	-
Leptospira species	-	10	22	45	26	58	1	-	55	63
Treponema pallidum	-	267	547	431	452	102	1	1	774	909
Protozoa										
Entamoeba histolytica	-	3	9	7	20	8	-	-	7	17
Toxoplasma gondii	-	35	48	84	107	7	1	1	9	16
Helminths										
Echinococcus granulosus	-	7	23	23	11	2	-	-	4	18

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