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Health Statistics NSW: getting the right balance between privacy and small numbers in a web-based reporting system

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Abstract: Health Statistics NSW is a new web-based application developed by the Centre for Epidemiology and Research at the NSW Ministry of Health. The application is designed to be an efficient vehicle for the timely delivery of health statistics to a diverse audience including the general public, health planners, researchers, students and policy analysts. The development and implementation of this web application required the consideration of a series of competing demands such as: the public interest in providing health data while maintaining the privacy interests of the individuals whose health is being reported; reporting data at spatial scales of relevance to health planners while maintaining the statistical integrity of any inferences drawn; the use of hardware and software systems which are publicly accessible, scalable and robust, while ensuring high levels of security. These three competing demands and the relationships between them are discussed in the context of Health Statistics NSW.

Health Statistics NSW (HSNSW, www.healthstats.nsw.gov.au) is a new web-based reporting application

developed by the Centre for Epidemiology and Research, New South Wales (NSW) Ministry of Health. This application was developed to replace the electronic version of the report *Health of the people of NSW—Report of the Chief Health Officer* (known as the eCHO report) which has been published as a web-based report since 2000 and as a printed report since 1996. The main incentives for converting the eCHO report, which consisted of a series of around 1000 static web pages, into an interactive web-based application were:

- to assist users find specific information through improved search and navigation functions
- to assist users download data and reports through improved download and report compilation functions
- to expand the content, update data and maintain the report through the use of modern business intelligence software, infrastructure and technology.

Many Australian (Australian Institute of Health and Welfare, aihw.gov.au, Public Health Information Development Unit, www.publichealth.gov.au and the Australian Bureau of Statistics, www.abs.gov.au) and overseas health agencies (US Centers for Disease Control and Prevention www.cdc.gov/DataStatistics/ and the World Health Organization, www.who.int/research/en/) now incorporate some type of web-based data query system into their main agency website.¹ The rapid development of web-based technologies in the past 20 years has seen such sites evolve from simple tables of data to hosting complex web-based applications that allow significant user interaction including the production of dynamically generated graphs and maps. For example, new map-based reports using InstantAtlas™ (www.instantatlas.com) are used by the Victorian Department of Health (www.health.vic.gov.au/healthstatus/atlas/) and to report the Australian Early Development Index (maps.aedi.org.au/IA/2011/region/105/atlas.html).

This trend of improving the technologies that support these types of websites is likely to continue into the foreseeable future with significant investment into the Australian internet infrastructure by both private and public institutions (for example the Australian National Broadband Network, www.nbnco.com.au).

This article describes the three competing demands that were considered when designing the HSNSW application, configuring the content and then deploying a system which was suitable for release to the public. These demands were: consideration of the public versus the private interest when reporting health statistics; recognition of statistical signals versus noise when reporting at small spatial scales and on rare conditions; and building data systems that are secure but still highly accessible. An expanded consideration of these issues was presented in the report *Privacy issues and the reporting of small numbers*.²

1. Public versus private interest

The implementation of evidence-based policies and planning for health services requires the collection and management of data. Development of performance indicators from these data supports our understanding of whether particular policies and programs are achieving their goals; there is also significant public interest in performance reporting. Further, all levels of government require the use of timely data for the planning of clinical and public health services.^{3,4} In the field of health however, we must be particularly cognisant that these data are collected from individuals and that there are significant legal and ethical reasons why the privacy of these individuals cannot be compromised. Consequently the overarching challenge when presenting health statistics is to develop robust reporting strategies that ensure that both private and public interests are met.

Within the NSW health system, the key legislative instruments to protect the privacy of citizens are the *Privacy and Personal Information Protection Act 1998* (NSW) which regulates personal information in the public sector; and the *Health Records and Information Privacy Act 2002* (NSW) which regulates personal health information. The *Health Records and Information Privacy Act 2002* is supported by detailed statutory guidelines which cover particular applications of health data. All relevant laws and policies are explained in the *NSW Health Privacy Manual*.⁵

A critical aspect of privacy legislation when using health data is the de-identification of the data. De-identification in the context of public reporting must be interpreted more broadly than simply removing names and addresses from records because it is about the potential of re-identifying an individual from the final publication of that data. The steps required for effective de-identification in this context are not necessarily simple and require consideration of the

condition being reported and the population from which observations are drawn. Much emphasis in public reporting is usually placed on the number of people reported and simple threshold rules are defined. However, expert groups such as the Statistical Information Management Committee⁶ argue that the size of the underlying population (which may be defined as the population in one geographic area or a sub-group such as the Aboriginal population) becomes more important when the probability of re-identification is considered.

Consequently when HSNSW was configured, standard rules were used to guard against re-identification (such as designing tables to minimise the number of cells with denominators less than 1000 people and individual counts less than five people). Such steps are crucial to ensure that private interests are not compromised to achieve the public interests associated with statistical reporting.

2. Data signals versus noise

HSNSW includes partial functionality to drill down into increasing levels of data granularity (the fineness with which data fields are subdivided). For example, when looking at hospitalisation admissions, it is possible to examine the pattern of these admissions across Local Health Districts, or to develop a time series of admissions for a particular Local Health District. This functionality was included because many potential users of the system requested straightforward access to data about their Local Health District. This approach works well but it very rapidly becomes apparent that there are limitations to how far you can drill down into the data before the numbers of individuals being reported become too small to meet two important criteria: privacy and statistical interpretability. Firstly, as noted above, there are privacy issues that cannot be compromised. Secondly, as Steel and co-workers discuss,⁷ small numbers are subject to much larger relative variation over time or between groups, which makes any inferences drawn from these numbers less reliable. It is important to recall that the reason these statistics are being reported in the first place is the public interest associated with evidence-based policy and decision making. If the inferential value of these data is degraded, then the justification for their publication can become compromised.

Perhaps the most transparent approach to this issue is to estimate the variability of any published statistics (which may require additional statistical assumptions). If the relative variability exceeds some particular threshold, then such statistics should not be published. Where practical, this approach was used in HSNSW, but in other cases, simple techniques such as averaging or more sophisticated statistical methods such as Bayesian smoothing⁸ were used to ensure that patterns, and not observations from individuals, were being presented. Judgments based upon

threshold rules of sample size and relative variability, which were checked by subject matter experts, were used when configuring indicators for HSNSW to ensure that there were adequate data for any meaningful statistical inferences. Options to drill down into these data were not provided if such subsets of the data were subject to excessive variability (e.g. for mesothelioma deaths, which are very rare events). If analysts, planners or policy developers require such data then there are alternative options for accessing this information within secure, non-public environments (such as SAPHaRI).⁹

Note that technologies designed for data drill-down such as data-cubes (which can be thought of as a multi-dimensional extension to a spreadsheet table) have primarily been developed for commercial applications. For example, a sales manager may want to see patterns of sales across the nation, but he or she may also want to know what type of widget a particular salesperson sold yesterday. Such datasets and applications are not associated with the privacy and inferential issues that are so important to the health data being presented with HSNSW. Although HSNSW does use data-cubes to efficiently access large volumes of data, decisions about the level of data granularity available to the public are made well before the data are transformed into cubes.

3. Data security versus accessibility

The underlying technical architecture of HSNSW is complex and the details are beyond the scope of this article. There are, however, two major components of the system: indicator calculation; and reporting and analytics. The algorithms used for indicator calculation process unit-level or semi-aggregated data into defined health indicators on secure internal workstations. These processing steps are implemented using existing and well-tested processes within the Centre for Epidemiology and Research, NSW Ministry of Health. Any data with potential privacy issues are therefore subject to strict security protocols within the Ministry. None of these privacy-sensitive data are stored on publicly-facing servers.

In contrast, the web-based reporting and analytics solution imports the text output from the indicator calculation steps described above, builds data-cubes, handles user interaction and renders tables, charts, maps and portable document format (pdf) reports, spreadsheets and images. These functions are completed on other servers which are publicly facing and are isolated from any servers which contain privacy-sensitive data.

This system thus enables the delivery of population health indicators to the public without any privacy-sensitive data being stored on public web servers. This design required some duplication and inefficiencies (from a systems-design perspective), but these are justified to meet the dual

objectives of secure health data and accessible health indicators.

Conclusion

Web-applications such as HSNSW are complex systems which require consideration of a diverse range of issues in their design, implementation and configuration. Many of these issues require a trade-off between users' wishes and the responsibilities of the data reporting specialists. For example, people want access to data, but cannot be given access to all data because of very justifiable privacy issues. People need access to information about their area, but should not be provided with information that is not suitable for drawing valid statistical inferences. Computer systems need to be deployed that provide public access to the data, but these systems must be designed in a manner that cannot increase risks to personal privacy.

The authors contend that HSNSW strikes the right balance with these inter-related competing demands for the benefit of publishing a diverse range of population health indicators using a new web-based data query system. These issues are discussed in more detail in the report *Privacy issues and the reporting of small numbers*² that was prepared in conjunction with the initial release of HSNSW. Readers may also find the article by Lawlor and Stone¹⁰ of interest as these authors provided an overview of tensions between data protection and informing public health.

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Utilisation of the Medicare Teen Dental Plan in NSW, 2008–2010

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Abstract: Aim: To examine the use of the Medicare Teen Dental Plan in NSW, its uptake in the private and public dental sectors and to map the geographical pattern of program use. **Methods:** Data describing the use of the Medicare Teen Dental Plan were assembled from a variety of sources including Medicare, the NSW Oral Health Data Collection and the NSW Teen Dental Survey 2010. **Results:** In 2010, use of the Medicare Teen Dental Plan across the entire NSW eligible aged population ranged from 20 to 25.5%, with the average usage across all ages being 20.2%. For the period 2002 to 2010, the average utilisation rate for teenagers accessing public dental care was approximately 6.8%. **Conclusion:** As a single Dental Benefits Schedule item is used for service provided under the Plan, it is difficult to evaluate the mix of dental treatment items and the comparative value of the service provided unless these services are provided in a public dental service with a data collection that can flag care provided under a Medicare Teen Dental Plan voucher.

The Medicare Teen Dental Plan was introduced on 1 July 2008 after being announced as an election commitment by the Commonwealth Labor Government.¹ The Medicare Teen Dental Plan provides a \$163.05 voucher (indexed annually) that aims to promote life-long good oral health habits. Vouchers are sent to eligible teenagers in January and February each year, and must be redeemed within the calendar year of issue.

At a minimum, each voucher is to provide an oral examination and other necessary diagnostic or preventive dental items that can be provided within the dollar value of the

voucher.¹ Parents or teenagers may face out-of-pocket costs if private dentists charge above the voucher amount, or if additional treatment is required. To be eligible for a voucher, a teenager must, for at least some part of the calendar year, be aged between 12–17 years, and meet a means test. The means test involves the teenager or his or her family, caregiver, guardian or partner being eligible for one or more of a range of Australian Government benefits or allowances.² Approximately 1.3 million (65%) of the Australian population aged 12–17 years were eligible for a Medicare Teen Dental Plan voucher in 2008¹ reducing to 1.2 million in 2010.³ A similar proportion of teenagers were eligible in New South Wales (NSW).

The implementation of the Medicare Teen Dental Plan required a legislative framework for the payment of dental benefits to be established.⁴ After consultation with the State and Territory Dental Directors and Chief Dental Officers, the Medicare Teen Dental Plan implementation was amended so that vouchers could be claimed through public oral health services. This is a notable difference from the Medicare Chronic Disease Dental Scheme, which has not been available through public oral health services.

Each of the former Area Health Services (now Local Health Districts) in NSW has been providing services under the Medicare Teen Dental Plan since the program began, as all children and young people under 18 years of age are eligible for NSW Public Oral Health Services. Arrangements were made for the processing and claiming of the vouchers through a Representative Public Dentist's Medicare provider number⁵ in each of the former Area Health Services. The benefits claimed by the Representative Public Dentist are paid to an Area Health Service account.

We examined the use of the Medicare Teen Dental Plan in NSW and compared this with its use in other Australian jurisdictions. We also examined uptake in the private and public dental sectors in NSW and mapped the geographical pattern of program use.

Methods

All dental services data for children and adults accessing public dental care in NSW are captured in the Information System for Oral Health. Data were extracted monthly from each former Area Health Service's Information System for Oral Health database and reported to the NSW Oral Health Data Collection. Data on the use of public dental services

Table 1. Total benefits paid through Medicare Teen Dental Plan items (Dental Benefit Schedule Item No 88000) processed for three financial years 2008–2009 to 2010–2011 for each jurisdiction in Australia

Financial year	Jurisdiction								Total \$
	NSW \$	Vic. \$	Qld \$	SA \$	WA \$	Tas. \$	ACT \$	NT \$	
2008–2009	24 876 525	19 013 925	12 930 539	4 128 744	3 960 024	892 192	694 582	199 365	66 695 896
2009–2010	22 472 021	16 612 579	11 292 251	5 308 608	4 463 561	2 434 322	625 041	206 075	63 414 458
2010–2011	21 284 505	15 666 985	11 285 616	4 559 590	4 107 848	1 968 736	681 618	245 496	59 800 395
Total	68 633 052	51 293 489	35 508 406	13 996 942	12 531 433	5 295 249	2 001 242	650 936	189 910 749

Source: Medicare Australia. https://www.medicareaustralia.gov.au/statistics/mbs_item.shtml (Cited 8 September 2011).
NSW: New South Wales; Vic: Victoria; Qld: Queensland; SA: South Australia; WA: Western Australia; Tas: Tasmania; ACT: Australian Capital Territory; NT: Northern Territory.

Table 2. Number of services claimed through Medicare Teen Dental Plan items (Dental Benefit Schedule Item No 88000) for the financial years 2008–9 to 2010–2011 for each jurisdiction in Australia

Financial year	Jurisdiction								Total N
	NSW n	Vic. n	Qld n	SA n	WA n	Tas. n	ACT n	NT n	
2008–2009	168 580	134 999	88 180	27 979	27 267	6 286	4982	1418	459 691
2009–2010	147 986	113 816	74 775	34 723	29 693	16 079	4304	1410	422 786
2010–2011	136 572	104 023	72 676	29 210	26 650	12 672	4529	1600	387 932
Total	453 138	352 838	235 631	91 912	83 610	35 037	13 815	4428	1 270 409

Source: Medicare Australia. https://www.medicareaustralia.gov.au/statistics/mbs_item.shtml (Cited 8 September 2011).
NSW: New South Wales; Vic: Victoria; Qld: Queensland; SA: South Australia; WA: Western Australia; Tas: Tasmania; ACT: Australian Capital Territory; NT: Northern Territory.

were extracted for the 9 years from 2002 to 2010 for all young people aged 12 to 17 years at the time of service delivery. Data for each teenager presenting with a Medicare Teen Dental Plan voucher or referral indicator were also extracted from the demographics table in the Information System for Oral Health. Where possible, these data were matched to a unique treatment visit that occurred in the same year as the use of the voucher.

For the last 3 years of the period 2002 to 2010, the Medicare Teen Dental Plan was in place and each of the former Area Health Services accepted Medicare Teen Dental Plan vouchers. A NSW Health Policy Directive mandates the use of a Medicare Teen Dental Plan indicator for each year that the teenager uses their voucher in the public dental system.⁶ The use of this indicator has only been fully implemented recently in some parts of the state which means that the available data underestimate the true number of teens attending dental clinics with vouchers.

In 2010 a randomised, statewide Teen Dental Survey (unpublished) examined the oral health of a random representative sample of Year 9 students aged 14–15 years in NSW. This survey included a questionnaire completed by the teenager and his or her parents about the teenager’s

oral health-related behaviours and use of dental services, including the Medicare Teen Dental Plan. The data from these questionnaire responses were analysed.

Data on the number of services provided and the value of vouchers claimed under the Medicare Teen Dental Plan by all Statistical Local Areas in NSW were obtained for the period 2008 to 2011 from the Department of Human Services National Office by formal request. In addition voucher claims data for all Australian jurisdictions was obtained from the Medicare Statistics website for the period 2008 to 2011. All datasets were analysed using SAS 9.2.⁷ The Medicare data were also mapped for each NSW Statistical Local Area using the Geographical Information System software, MapInfo version 11.⁸

Results

At the end of June 2011, \$189.9 million in benefits had been claimed in Australia under the Medicare Teen Dental Plan since July 2008 with \$68.6 million of benefits claimed for NSW teenagers (Table 1). Since the scheme commenced in July 2008, 1 270 409 services have been claimed in Australia with 453 138 services in NSW (Table 2). In the first financial year in NSW (2008–9), 168 580 services

Table 3. Percentage of the NSW teenage population aged 11–18 years claiming Medicare Teen Dental Plan vouchers in 2010

Age at date of service Years	Medicare Teen Dental Plan services claimed*			Total NSW population**			Medicare Teen Dental Plan usage		
	Female <i>n</i>	Male <i>n</i>	Total <i>N</i>	Female <i>n</i>	Male <i>n</i>	Total <i>N</i>	Female %	Male %	Total %
11	4689	4829	9518	43 868	45 784	89 652	10.7	10.6	10.6
12	11 080	11 234	22 315	43 590	45 912	89 502	25.4	24.5	24.9
13	11 419	11 514	22 933	43 818	46 154	89 972	26.1	25.0	25.5
14	10 991	11 180	22 171	43 420	46 592	90 012	25.3	24.0	24.6
15	10 716	10 760	21 476	44 219	46 620	90 839	24.2	23.1	23.6
16	9746	9607	19 354	43 877	46 852	90 729	22.2	20.5	21.3
17	9237	8471	17 707	43 233	45 461	88 694	21.4	18.6	20.0
18	4599	4301	8900	41 252	43 435	84 687	11.2	9.9	10.5
Total	72 478	71 896	144 374	347 277	366 810	714 087	20.9	19.6	20.2

Sources: *Medicare Data, Department of Human Services and Health; **ABS Census Data (2006).

were claimed in NSW declining to 136 572 services claimed in the financial year 2010–11.

In the 2010 calendar year, use of the Medicare Teen Dental Plan was slightly higher in younger age groups, and rates of use declined in older teenagers (Table 3). Use of the scheme in the NSW population aged 12–17 years ranged from 20% among 17 year olds to 25.5% among 13 year olds. As the age requirements of the Medicare Teen Dental Plan includes teenagers who are aged between 12–17 years for only part of the calendar year, there was also some use of vouchers by teenagers who were younger than the scheme's target group (10.6% of 11 year olds used a voucher) and those older (10.5% of 18 year olds). The average use across all ages 11–18 years was 20.2%.

The distribution of Medicare Teen Dental Plan services claimed for NSW for the period July 2008 to June 2011 (Figure 1), and the distribution of Medicare Teen Dental Plan services for the Sydney Metropolitan area for the same time period (Figure 2) show that, while services are largely concentrated in the highly populated coastal areas of NSW, there has been uptake of the Plan in regional and rural areas west of the Great Dividing Range.

Table 4 describes the use of public dental system in each of the former Area Health Services by all young people aged 12–17 years at the time of service for the period 2002 to 2010. This represents an average utilisation rate of approximately 6.8% of public dental services for the period 2002 to 2010.

Despite the limitations of the Medicare Teen Dental Plan indicator, there appears to be a slight increase in the number of teenagers accessing the public dental system between 2008 and 2010 compared to the overall period of 2002 to 2010 (Table 4).

Of the 16 365 teenagers with a Medicare Teen Dental Plan voucher indicator between 2008 and 2010 (Table 5),

12 789 (78.1%) were able to be matched with a unique visit identifier in the same year as the voucher indicator (Table 6).

In 2010, 901 (80%) of parent respondents in the NSW Teen Dental Survey reported receiving a Medicare Teen Dental Plan voucher. Of these, 528 teenagers had used the voucher, with 477 (90.3%) having used it at a private dentist and 9.7% reported using it in the public sector. However, a comparison of data from the Information System for Oral Health with Medicare data on total vouchers claimed in NSW indicates that only 3.7% were through the public oral health service in 2010 and 3.6% in 2009 (Table 5).

Referral pathways between private and public sectors have also been developed to ensure continuity of care for those patients who have redeemed their voucher privately, but require further care in the public sector. Between 2008 and 2011 in NSW, 600 teenagers were recorded as presenting to the public dental service for follow-up dental care after claiming their vouchers at a private dental practitioner (Table 5). Unlike vouchers, referrals are not differentiated by a new indicator each year and so it is not possible to examine these data by year from the Information System for Oral Health.

Discussion

When compared nationally, the use of the Medicare Teen Dental Plan in NSW is largely proportional to population. Use of the Medicare Teen Dental Plan as a percentage of the total NSW teenage population (11–18-year olds) shows differences between age groups with use declining in older teenagers. The decline in usage across the ages may be a result of declining interest in the program as older teenagers may already have had two previous preventive visits under the Plan or it may represent changing circumstances, such as increasing independence from parents or

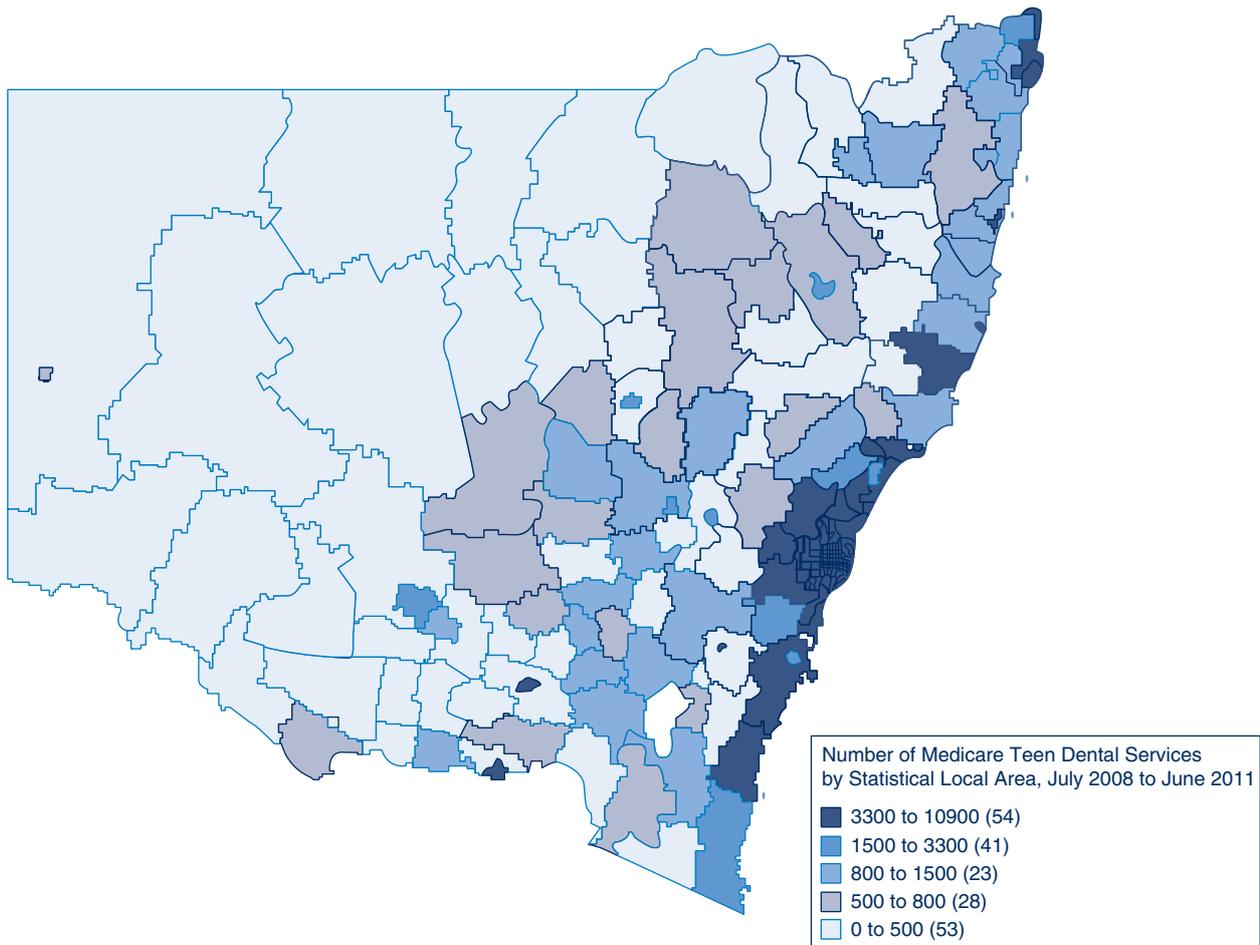


Figure 1. The geographical distribution of Medicare Teen Dental Plan services for each Statistical Local Area in NSW, for the period July 2008 to June 2011.
 Source: Department of Human Services National Office, Canberra, Australia.

caregivers who previously encouraged them to use their Medicare Teen Dental Plan voucher.

There has been a notable decline in the number of vouchers claimed since 2008. This may be due to changes in the number of teenagers eligible for the Plan, or represent a waning awareness of the program following the initial implementation phase. Other factors that might contribute to the decline are that some teenagers used a voucher and were assessed as having no disease, or required treatment beyond the scope of the items offered under the voucher or beyond their ability to pay for these additional services.

Uptake of the Medicare Teen Dental Plan in the NSW public dental service has varied, both across the former Area Health Services, and over the years of operation. This is likely due to a range of factors including existing high demand for services and concerns during the first 12 months of implementation about taxation liability for the Representative Public Dentist. This taxation liability issue was resolved in 2010 with a ruling from the Australian Taxation Office.⁴

Recent declines in the number of vouchers claimed in some areas may represent a failure to maintain accurate data entry in the Information System for Oral Health through use of the Medicare Teen Dental Plan voucher indicators. It was not possible to match all Medicare Teen Dental Plan voucher indicators with visit data from the Information System for Oral Health in a way that could be reliably used to investigate treatment provided to teenagers in NSW public dental services.

There was a notable difference in the reported use of Medicare Teen Dental Plan vouchers in the public sector from the 2010 NSW Teen Dental Survey (9.7%) and the data from Medicare and the Information System for Oral Health (3.7%). While this difference may be due to sampling factors, an alternative explanation is that the NSW Teen Dental Survey only collected data regarding those people who were eligible by way of the Family Tax Benefit A, whereas the eligibility for the Plan includes a wider range of benefits. If this was the primary cause of the differences, it would suggest that those teenagers who were eligible via the Family Tax Benefit A were more likely to use their vouchers

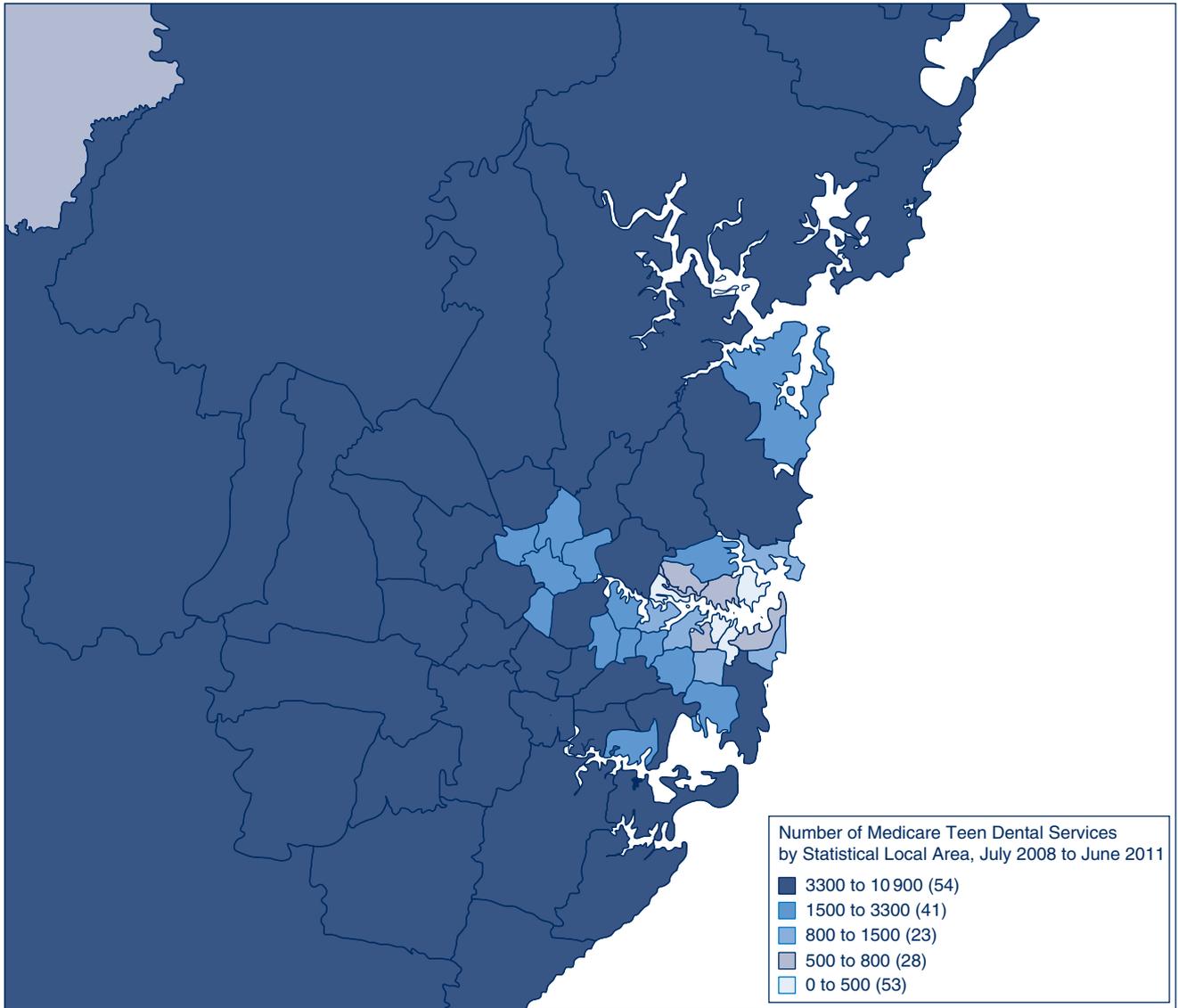


Figure 2. The geographical distribution of Medicare Teen Dental Plan services for each Statistical Local Area in the Sydney Metropolitan Area for the period, July 2008 to June 2011.

Source: Department of Human Services National Office, Canberra, Australia.

in the public dental service than those teenagers who were eligible under other benefits and allowances.

There are several observations made by the report of the review of the Dental Benefits Act 2008 related to changes to the program that would assist with evaluation. A key issue noted in the report was that data should be provided for each voucher claimed on which of the dental items included under the scheme had been provided rather than the single Dental Benefits Schedule (DBS) item 88000.¹ The report noted that this could be achieved by adding an 88 prefix to the existing Australian Dental Association (ADA) treatment item code set in a similar way to the coding of treatment provided under the Medicare Chronic Disease Dental Scheme. This additional coding would allow for quantification of anecdotal evidence of substantial variation in value of services provided under a voucher.¹

The review also noted that public feedback on the Medicare Teen Dental Plan included concerns about access to follow-up treatment of oral health issues identified by the preventive dental check, and the potential difficulties experienced by eligible teenagers moving between the private and public dental sectors for follow-up treatment.¹ When vouchers are redeemed in the public sector, treatment identified in the oral examination can be provided to the teenager free of charge and with continuity of care.

Conclusion

The Medicare Teen Dental Plan provides an important opportunity to provide preventive dental care to teenagers, particular to those who may not otherwise seek it. It remains unclear, however, whether the Plan will meet the long-term objective to encourage teenagers to have a

Table 4. Use of public dental services by teenagers aged 12–17 years for each former Area Health Service in NSW for each year 2002 to 2010

Year	Former Area Health Service									Total N
	JH n	SSW n	GS n	HNE n	SESI n	GW n	NC n	NSCC n	SW n	
2002	0	5455	2565	6109	3128	2719	3716	2970	5636	32 298
2003	0	5528	2744	7575	3421	2579	4214	3308	6239	35 608
2004	118	5696	3154	7710	3725	2395	4258	3472	6688	37 216
2005	176	5273	3026	8127	4055	2385	4598	3605	7024	38 269
2006	268	5152	3176	6214	4010	2758	4126	3457	7036	36 197
2007	333	5452	2678	6148	4210	2319	4091	3412	7046	35 689
2008	300	6778	3749	6961	5102	2873	4394	3383	8325	41 865
2009	215	6053	3484	6548	4492	2540	4014	3204	7287	37 837
2010	313	6270	3459	6257	4410	2533	3830	3284	7100	37 456
Total	1723	51 657	28 035	61 649	36 553	23 101	37 241	30 095	62 381	332 435

JH: Justice Health; SSW: Sydney South West; GS: Greater Southern; HNE: Hunter New England; SESI: South Eastern Sydney Illawarra; GW: Greater Western; NC: North Coast; NSCC: North Sydney Central Coast; SW: Sydney West.
Source: NSW Oral Health Data Collection.

Table 5. Number of Medicare Teen Dental Plan vouchers and referrals for 2008 to 2010, for each former Area Health Service,* NSW

Former Area Health Services	Medicare Teen Dental Plan				
	2008 n	2009 n	2010 n	Vouchers Total N	Referrals N
NC	746	717	834	2297	84
NSCC	374	585	254	1213	2
HNE	1112	990	274	2376	101
SSW	910	437	147	1494	1
SESI	810	1039	709	2558	389
SW	80	5	764	849	2
GW	403	513	454	1370	14
GS	996	1352	1860	4208	7
Total claimed in NSW	97 131	158 158	144 397	374 853	
Total NSW public dental service	5431	5638	5296	16 365	600
Percentage claimed in public dental service	5.57%	3.56%	3.67%	4.37%	

SSW: Sydney South West; GS: Greater Southern; HNE: Hunter New England; SESI: South Eastern Sydney Illawarra; GW: Greater Western; NC: North Coast; NSCC: North Sydney Central Coast; SW: Sydney West.
Source: NSW Oral Health Data Collection.

Table 6. Number of Medicare Teen Dental Plan Voucher indicators matched to treatment data for the period 2008 to 2010 for each former Area Health Services in NSW

Year	Former Area Health Service								Total N
	NC n	NSCC n	HNE n	SSW n	SESI n	SW n	GW n	GS n	
2008	451	354	805	602	591	19	320	776	3918
2009	550	579	780	239	866	3	397	1107	4521
2010	678	253	185	103	621	614	361	1535	4350
Total	1679	1186	1770	944	2078	636	1078	3418	12 789

JH: Justice Health; SSW: Sydney South West; GS: Greater Southern; HNE: Hunter New England; SESI: South Eastern Sydney Illawarra; GW: Greater Western; NC: North Coast; NSCC: North Sydney Central Coast; SW: Sydney West.
Source: NSW Oral Health Data Collection.

regular preventive dental check as they become independent adults, and therefore ongoing monitoring of these teenagers beyond the target age groups of the Plan is required. The decline in use of vouchers as teenagers get older may be of particular concern in this respect, and would suggest that further effort is required to sustain usage as teenagers get older and become more independent.

This examination of the utilisation of the Plan in NSW raised concerns with respect to the lack of uptake, the equity of uptake of vouchers and the number of providers available or willing to accept vouchers in certain rural and regional areas of NSW. A lack of support for the provision of follow-up care in the private sector is also of concern, and could contribute to additional pressures being placed on the NSW public oral health service which are not offset by revenue from the Plan.

With only a single Dental Benefits Schedule item used for services provided under the Plan, it is difficult to evaluate the mix of dental treatment provided and the comparative value of the services delivered. Better capture of the full range of dental care provided under each voucher is needed for more effective monitoring and evaluation of the Plan and its goals.

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Development of a maternity hospital classification for use in perinatal research

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Abstract: We aimed to develop a maternity hospital classification, using stable and easily available criteria, that would have wide application in maternity services research and allow comparison across state, national and international jurisdictions. A classification with 13 obstetric groupings (12 hospital groups and home births) was based on neonatal care capability, urban and rural location, annual average number of births and public/private hospital status. In a case study of early elective birth we demonstrate that neonatal morbidity differs according to the maternity hospital classification, and also that the 13 groups can be collapsed in ways that are pragmatic from a clinical and policy decision-making perspective, and are manageable for analysis.

A hospital's role and level of service delivery depends on various factors, including its size, geographical location, public or private sector status and the place of the hospital within a wider health system network. Measures of service delivery (e.g. facilities, volume of procedures) have been used to assess the quality of care,¹ as predictors of health outcomes^{2,3} and to inform hospital role delineation.⁴ The delineated role of a service in maternity care has traditionally been determined by the availability of paediatric support services. For example, the National Health and Medical Research Council (NHMRC) recommended that

pregnancies less than 33 weeks gestation be delivered at hospitals with neonatal intensive care units to ensure babies are born under the best conditions possible to reduce morbidity and mortality of the newborn.⁵

In New South Wales (NSW), information about all births is collected in the NSW Perinatal Data Collection (PDC), a population-based statutory surveillance system which includes information on maternal characteristics, pregnancy, birth and infant outcomes. An obstetric service level is assigned to each hospital where women give birth. These levels are based on a complex array of maternity and neonatal staffing, expertise, pathology and surgical and anaesthetic capability, and range from Level 6 (providing both obstetric and neonatal tertiary care) to Level 1 (no birthing services, may provide postnatal care).⁶ Although the components of the level can change throughout the course of a year (e.g. in rural hospitals the departure of the only obstetrician would change the level), the level that has prevailed for the majority of the year is assigned as the level for the entire year.

When using these levels for research, other limitations emerge. Firstly, there is no geographical differentiation, although the provision and outcome of maternity services needs to take geography into account. Secondly, no service levels are assigned to private hospitals as no information on maternity or neonatal services capability in private hospitals in NSW is routinely available; they form one group regardless of the level of obstetric and neonatal services available. Thirdly, there is no evidence that the level designations are better predictors of birth outcome than the annual number of births at each hospital.⁷ Therefore we aimed to develop a service level descriptor that was suitable for research with stable and easily available components that would have wide application and allow comparison across state, national and international jurisdictions. We wanted groupings of hospitals that were sufficiently large that would allow us to exclude or collapse the groups across dimensions relevant to a research question. Here we report the development of such a classification of maternity hospitals and provide a case study of its use.

Methods – construction of a new maternity hospital classification

We classified maternity hospitals in NSW according to the following dimensions of service level: neonatal care

Table 1. Classification of maternity hospitals in NSW by 13 obstetric groups including home births, 2001 and 2008

Hospital obstetric group	Grouping criteria			Hospitals	
	Resources	Geographic area	Annual birth volume <i>n</i>	2001 <i>n</i>	2008 <i>n</i>
NICU	Tertiary public	Any region	≥1000	7	7
CPAP (2001+)	CPAP facilities public	Any region	≥1000	5	5
Large urban	Non tertiary public	Urban	≥1000	4	6
Medium urban	Non tertiary public	Urban	500–999	7	3
Small urban	Non tertiary public	Urban	20–499	2	3
Large regional	Non tertiary public	Regional	≥1000	3	5
Medium regional	Non tertiary public	Regional	500–999	10	8
Small regional	Non tertiary public	Regional	20–499	48	39
Large private	Private hospital	Any region	≥1000	9	9
Medium private	Private hospital	Any region	500–999	6	6
Small private	Private hospital	Any region	20–499	9	4
Other/postnatal	Non tertiary public	Any region	<20	26	20
Home births	–	Any region	N/A	N/A	N/A

CPAP: continuous positive airways pressure.
NICU: neonatal intensive care unit.
Source: Population Health Research Network.

capability (tertiary neonatal intensive care unit (NICU); continuous positive airways pressure (CPAP) facilities and trained staff⁸ or other); geography (urban or rural location); annual average number of births (>1000, 500–999, 20–499 and <20 births); and hospital status (public or private). Women birthing outside a hospital were classified as a separate group. These criteria were used to create a set of 13 obstetric groups (12 hospital groups plus home births) (Table 1). Although a classification with 13 levels is unwieldy for most research purposes, the hospital groups can easily be collapsed along dimensions that are appropriate to the study objectives. Groupings can be allocated on the basis of *a priori* research questions and/or similarity of clinical characteristics prior to the assessment of outcomes, as in the following case study. SAS program coding for the maternity hospitals classification is available on the Population Health Research Network website at www.phrn.org.au.

Results – case study

Two objectives of a recent study of early elective births (induction of labour or pre-labour caesarean section) in NSW were to determine the risk of severe neonatal morbidity following elective births (33–39 weeks gestation), and the extent to which the morbidity differs according to the gestational age at which the infant was born.⁹ While much is known about the pattern of morbidity by gestational age in tertiary hospitals,¹⁰ less is known about the patterns of, and outcomes following, elective deliveries in a range of non-tertiary hospitals. Thus, a secondary aim of the study was to assess patterns of

morbidity across non-tertiary hospitals, where there may not be the service capability to care for sick and preterm infants.

Data on births were obtained from the NSW Perinatal Data Collection. To assess patterns of morbidity, birth data were linked with hospital data in the NSW Admitted Patient Data Collection. Neonatal and maternal outcomes were assessed using composite indicators of morbidity which include both diagnoses and procedures, and are able to overcome problems of under-ascertainment of individual adverse events.^{11,12} For the purposes of this study, home births and hospitals offering postnatal or midwifery-led care were excluded as elective births do not occur in these settings.

Hospitals were initially stratified into the 12 maternity hospital groups. Rates of elective births (by method) were compared across hospital strata and by gestational age, and strata were combined when the pattern of rates were similar across gestational ages. For example, the elective birth rates for the three levels of private hospitals were grouped based on similar rates across gestational ages (Figure 1). This resulted in six hospital groups: tertiary hospitals, hospitals with continuous positive airways pressure facilities, all other urban hospitals, large regional hospitals (delivery volume ≥1000), all other regional hospitals (delivery volume <1000), and private hospitals.

Figure 2 (a and b) presents the absolute risk of severe neonatal morbidity by gestational age and hospital classification. There is a stepwise decline in neonatal morbidity

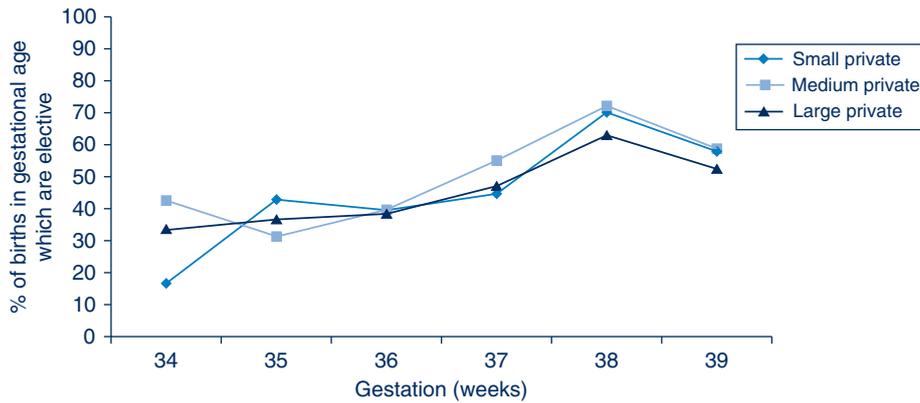


Figure 1. Gestation-specific rates of elective births at private hospitals, NSW, 2001–2007. Source: NSW Perinatal Data Collection.

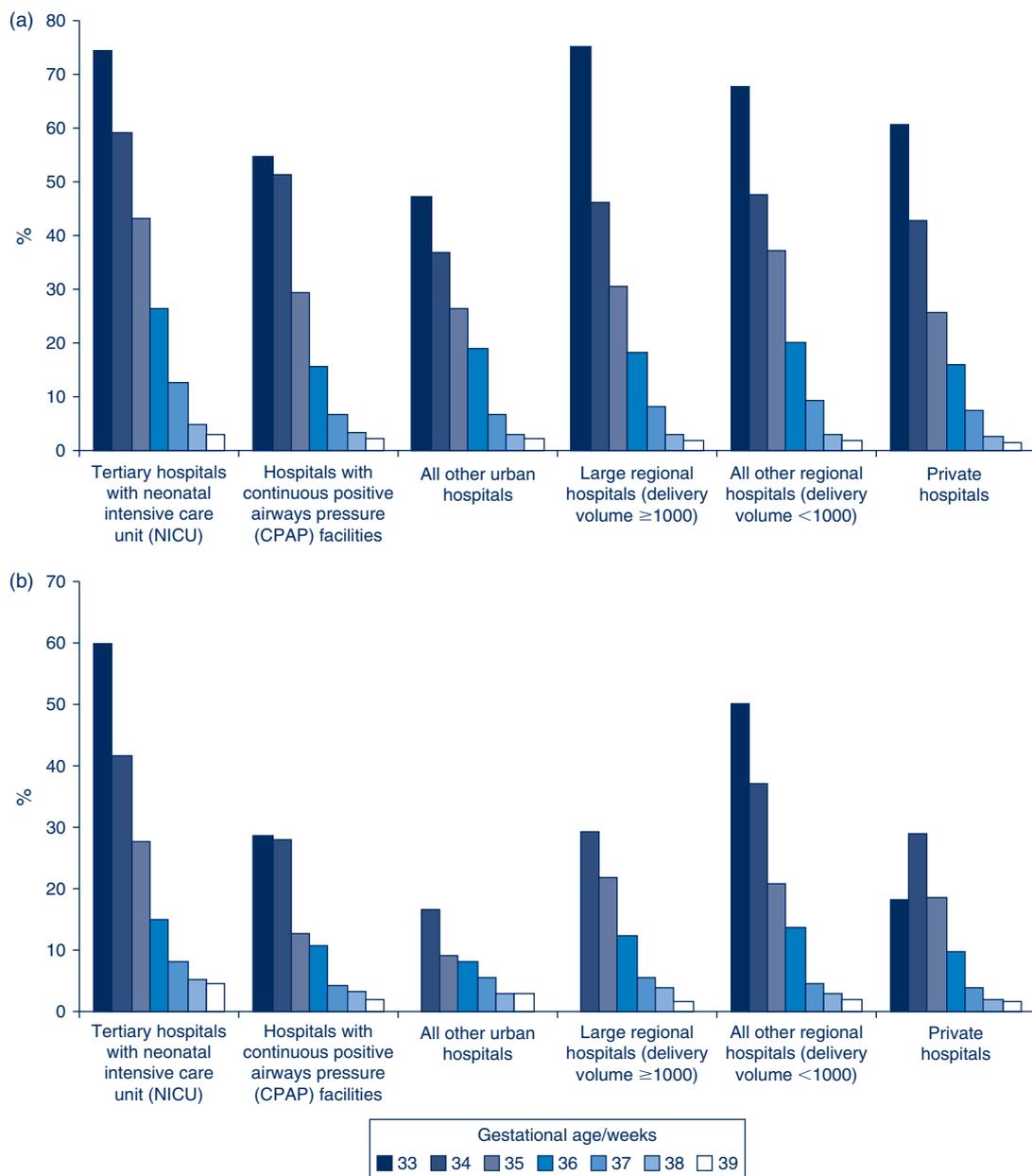


Figure 2. Absolute risk of neonatal morbidity at seven gestational ages following elective birth, by hospital classification, using six maternity hospital groups, NSW, 2001–2007. (a) Following pre-labour caesarean. (b) Following induction. Source: Linked NSW Perinatal Data Collection and NSW Admitted Patient Data Collection.

with each week of advancing gestation irrespective of the mode of elective birth, and this stepwise pattern was present in all of the hospital groups. The highest gestation-specific morbidity rates were at hospitals with a neonatal intensive care unit, which is consistent with birth of high-risk infants in tertiary centres. The rates of morbidity were higher following pre-labour caesarean section than induction at every gestation until 39 weeks. The pattern of stepwise improvement in outcomes associated with increasing gestation was also observed for maternal morbidity, and rates of transfer to a neonatal intensive care unit for infants born in non-tertiary hospitals (data not shown).

Discussion

Classifying hospitals into service levels is important for health services research. However, the classification of hospitals into similar groups may vary depending on the research question. In the case study presented, a key focus of the study was access to neonatal care and therefore geographical and resources dimensions were important.

Our case study found higher rates of severe adverse outcomes at shorter gestations with a stepwise decline as gestation increases, especially following pre-labour caesarean section. This pattern was found across all hospital classifications, including a range of non-tertiary hospitals that may not have the facilities to care for sick and preterm infants, reaffirming the importance of birth in risk-appropriate settings. Such results highlight the need for health policy to address the accessibility of obstetric and neonatal support services. Role delineation guidelines need to incorporate criteria on elective birth (pre-labour caesarean and induction of labour) and resourcing of regional hospitals needs to be reviewed if elective births are to be sanctioned in such settings.

The groupings in the case study are pragmatic from a clinical and policy decision-making perspective, and appear to have validity in the expected pattern of morbidity. The collapsed set of six groups was manageable for analysis, and was easily interpretable in the context of the study purposes. In the case study, rates of elective delivery were more similar between private hospitals, than between private and public hospitals of similar geography and volume, and so private hospitals were grouped together.

A limitation of the hospital groups may be the immediate application to jurisdictions outside of NSW, although the classification is easily adapted. For example, there may be private hospitals with neonatal intensive care unit facilities in other jurisdictions, and so an additional category may be needed. Further identification of specialised services, such as hospitals that now offer midwifery care only, is also possible. The proposed classification increases the potential for comparability, through greater flexibility and transparency in the classification of groups. Furthermore,

in the absence of available perinatal data, the groups may be replicated using alternate data sources such as hospitalisation data.

Conclusion

We have developed and used a classification of maternity hospitals that is based on readily available information, that may be adapted to different research questions and could be used at an area, state, national or international level. Hospitals will change groups if there are significant changes to the annual birth volume, avoiding reliance on facilities and staffing change which are hard to monitor in over 100 hospitals. This approach may be adaptable to other service delivery areas.

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Reporting of Aboriginal and Torres Strait Islander peoples on the NSW Admitted Patient Data Collection: the 2010 Data Quality Survey

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Abstract: The reporting of Aboriginal and Torres Strait Islander peoples on the NSW Admitted Patient Data Collection was ascertained using a stratified purposive sample of NSW public hospital patients in 2010. Information was collected by interviewing patients and compared with patient information obtained on admission. The study used the methods used in the national survey by the AIHW in 2007 and the study results were compared to the AIHW survey results. The level of correct reporting was 90.7% (95% CI 84.6–94.2). These results, while indicative, should be interpreted with caution as some people may not have identified themselves as Aboriginal or Torres Strait Islander either on hospital admission or in the survey, and non-random sampling can produce non-representative samples.

Improving the health of Aboriginal and Torres Strait Islander peoples is a priority under the National Partnership Agreement on Closing the Gap on Indigenous Health Outcomes.¹ This Agreement aims to reduce the disadvantage experienced by Aboriginal and Torres Strait Islander peoples with respect to life expectancy, child mortality, access to early childhood education, educational achievement and employment outcomes.¹ The correct reporting of Aboriginal and Torres Strait Islander peoples on health data collections is essential to measure the effectiveness of

policies and programs at reducing the health disadvantage that they experience.

The *National best practice guidelines for collecting Indigenous status in health data sets* note that there are continuing problems with the under-reporting of Aboriginal and Torres Strait peoples on many health-related data collections, and encourages states and territories to ‘establish mechanisms for monitoring, improving and maintaining the quality of Aboriginal and Torres Strait Islander data...’.²

A national survey coordinated by the Australian Institute of Health and Welfare (AIHW) estimated the level of correct reporting of Aboriginal and Torres Strait Islander peoples on New South Wales (NSW) public hospital admitted patient data in 2007 to be 88%. The level of correct reporting ranged from 48% to 97% across Australian states and territories.³

Inpatient information collected by hospitals in NSW is compiled into the NSW Admitted Patient Data Collection (APDC). The APDC covers demographic and episode-related data for every inpatient separated from any public and repatriation hospital, and public same day procedure centre. Similar data are collected on patients admitted to private hospitals. Separation can result from discharge, transfer, death or change in care type. The APDC is maintained by the Data Collections and Reporting Unit in the Demand and Performance Evaluation Branch of the NSW Ministry of Health. The APDC is a major source of information on indicators of serious morbidity in the population.

To monitor the quality of reporting of Aboriginal and Torres Strait Islander peoples in the APDC, we carried out an audit using survey methods, estimated the level of correct reporting in 2010 and compared the results with those of the 2007 survey conducted by the AIHW.

Methods

This study used the methods of the national survey conducted by the AIHW in 2007. The methods have been described in detail elsewhere,² however a summary is provided here.

Hospital selection

As for the 2007 survey, the aim of the 2010 survey was to achieve a sample size of approximately 2800 people drawn from NSW public hospitals. Hospitals were stratified by their geographic remoteness using the Accessibility/Remoteness Index of Australia (ARIA+) categories.⁴ A proportion of the total sample of people was assigned to each geographic area based on the proportion of the NSW Aboriginal and Torres Strait Islander population resident in each remoteness area. Within each ARIA category, a purposive sample of public hospitals was selected, based on high throughput and/or a relatively high number of separations of Aboriginal or Torres Strait Islander people. Within each hospital, people were selected from medical and surgical wards and renal units. Certain groups of patients were excluded, such as those: aged less than 18 years, too ill to speak, in intensive care or where clinical staff advised at the time that it was not appropriate to interview a patient. To allow comparison, hospitals selected for the 2007 survey were selected again in 2010. Three hospitals that were sampled in 2007 did not participate, reducing the number of participating hospitals from 20 to 17. Of the 17 hospitals sampled: five were selected from 61 hospitals located in major cities, six were selected from 71 hospitals in inner-regional areas, two were selected from 117 hospitals in outer-regional areas, and four were selected from 29 hospitals in remote and very remote areas.

Patient interviews

Patients were interviewed in June 2010 by hospital staff members who, where possible, were Aboriginal and Torres Strait Islander liaison officers and not involved in maintaining personal information on the hospital Patient Administration System. The questionnaire included a script for each question so that questions were asked in a standard way and order. Patients were eligible to be interviewed if they were aged 18 years or over and well enough to be interviewed when the interviewer was present. Patients were provided with an information sheet about the survey and informed consent was obtained. Patients were asked a series of questions concerning their sex, place of birth in Australia (yes/no), date of birth, whether they were Aboriginal or Torres Strait Islander and usual place of residence. Information on whether each survey participant was reported as Aboriginal or Torres Strait Islander was also obtained from the hospital Patient Administration System. De-identified data were provided to the Ministry of Health for analysis.

Analysis

The analysis followed the same method used for the 2007 survey. The proportion of Aboriginal or Torres Strait Islander people correctly reported on the Patient Administration System was calculated for each hospital stratum, and correction factors derived. These correction factors

were then applied to the number of reported separations for Aboriginal and Torres Strait Islander peoples for each hospital remoteness category for June 2010, to give a number of expected separations for Aboriginal and Torres Strait Islander peoples for each remoteness category, which were then summed to give the total number of expected separations for Aboriginal and Torres Strait Islander peoples for NSW. The numbers of observed and expected separations for Aboriginal and Torres Strait Islander peoples for NSW were then compared to give the estimated proportion of Aboriginal and Torres Strait Islander peoples in NSW who were correctly reported on the Patient Administration System. Binomial confidence intervals for the remoteness category and total state level completeness were calculated.

Trends in monthly counts of reported separations among Aboriginal and Torres Strait Islander peoples for survey hospitals were obtained from the APDC and aggregated to the remoteness level of the hospitals.

As this review is an audit of a data collection and conforms to the standards established by the National Health and Medical Research Council for ethical quality review,⁵ ethics committee approval was not sought.

Results

Of the 2581 patients who were asked to participate, 61 (2.4%) declined and a further 58 (2.2%) records were excluded as the patients were interviewed twice. Of the 2462 (95.4%) valid survey responses, 136 (5.5%) were among people who identified themselves as Aboriginal and Torres Strait Islander (Table 1).

The percentage of Aboriginal and Torres Strait Islander peoples correctly reported on the Patient Administration System in 2010 was estimated to be 91% (Table 2), compared to 88% (95% CI 84%–93%) reported in the 2007 survey. This improvement in reporting was not statistically significant. The percentage of correct reports increased with increasing geographic remoteness of the hospital, from 83% for hospitals in major cities to 100% for hospitals in remote and very remote areas. This pattern is similar to that reported for six jurisdictions combined in the 2007 survey.

There was no noticeable increase in the number of reported separations among Aboriginal and Torres Strait Islander peoples at the time of the survey in June 2010 compared to previous months (Figure 1).

Discussion

Most hospital separations among Aboriginal and Torres Strait Islander peoples were correctly recorded on the Patient Administration System. There was an absolute

Table 1. Valid survey responses and Aboriginal and Torres Strait Islander peoples reported by Accessibility/Remoteness Index of Australia (ARIA+) remoteness category of hospital, NSW, 2010

Geographic remoteness of hospital	Valid responses*	Aboriginal people	
		N	%
Major cities	1574	29	1.8
Inner regional	656	62	9.5
Outer regional	162	19	11.7
Remote/Very remote	70	26	37.1
NSW	2462	136	5.5

*Overall response rate was 95.4% of 2581 people invited to participate.

Table 2. Correct reporting of Aboriginal and Torres Strait Islander peoples on hospital admission records by Accessibility/Remoteness Index of Australia (ARIA+) remoteness category of hospital, NSW, 2010 and Australia, 2007

Geographic remoteness of hospital	Correct reporting			
	NSW 2010		Australia 2007*	
	%	95% CI	%	95% CI
Major cities	83	67–92	80	73–86
Inner regional	92	83–96	90	86–94
Outer regional	94	78–100	94	92–97
Remote/Very remote	100	89–100	97	96–98
Total	91	85–94	90	88–91

Figures for Australia exclude Tasmania and the Australian Capital Territory.
 CI: confidence interval.
 *Australian Institute of Health and Welfare. Indigenous identification in hospital separations data: quality report. Cat. No. HSE 85. Canberra: AIHW; 2010.

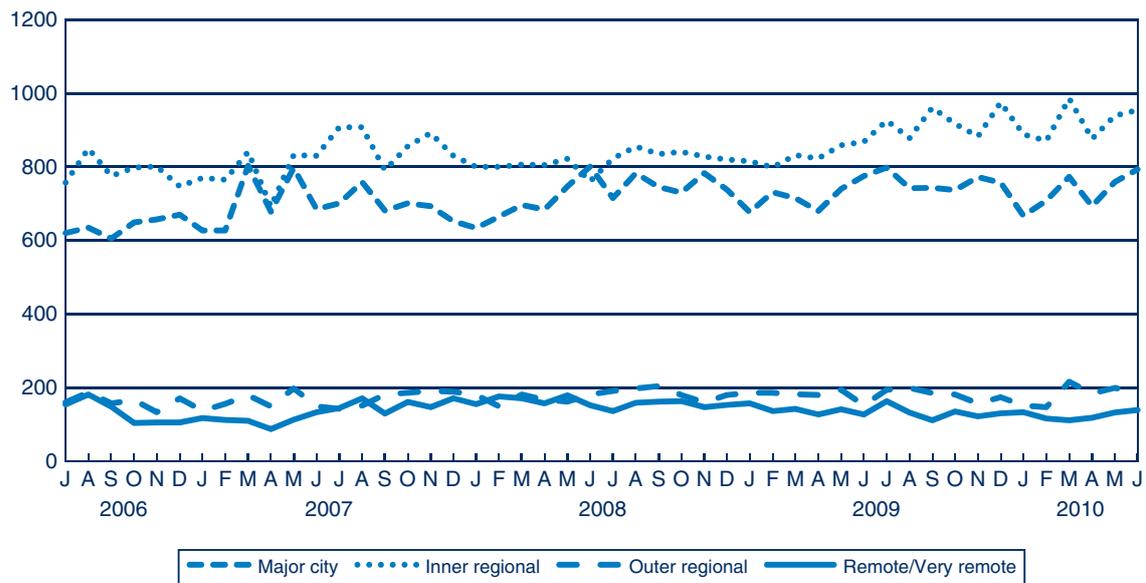


Figure 1. Separations from selected hospitals for Aboriginal and Torres Strait Islander peoples aged 18 years and over by month and location of hospital, NSW, July 2006–June 2010.

The series comprises facilities sampled in the 2010 survey.

Source: NSW Admitted Patient Data Collection (HOIST), Centre for Epidemiology and Research, NSW Ministry of Health.

increase of 3% compared to the 2007 survey, as mentioned. This improvement was not statistically significant.

The survey was stratified by geographic remoteness of the hospital to allow adjustment for differences in levels of reporting caused by the remoteness. The strength of this approach is that it addresses any bias that might be introduced through differences in the population caused by the geographic location. It should be noted, however, that the original sample sizes were calculated to allow estimation of the quality of the reporting for each remoteness level at a national rather than state level. For this reason, the estimates of correct reporting for each level of hospital remoteness for NSW are not precise and this imprecision is reflected by wide confidence intervals (see Table 2). Despite this, correct reporting was found to increase with increased geographic remoteness of the hospital.

There are several aspects to the study design that may affect the generalisability of the results to the NSW hospital population:

- The sample population was restricted to people aged 18 years or over.
- The sample population was restricted to NSW public hospitals.
- The sample population was restricted to those well enough to be interviewed. There is likely to be under-representation of very sick patients who could not be interviewed, or day-only patients.
- Within each geographic stratum, the selection of hospitals for the survey was purposive rather than random. Purpose sampling was used to ensure that a sufficient sample of Aboriginal and Torres Strait Islander peoples were interviewed. Due to the small numbers of Aboriginal and Torres Strait Islander people sampled, we were unable to check the representativeness of the sample. The possibility of sampling bias therefore cannot be excluded.

While the number of Aboriginal and Torres Strait Islander people is small in the survey, the percentage is more than twice the estimated 2.2% of Aboriginal and Torres Strait Islander peoples in the population reported at the 2006 Census.⁶ This reflects the purposive nature of the sampling. Other potential explanations are that hospitals were necessarily aware that an audit was taking place and, during the audit period and administrative staff made a conscious effort to improve reporting of Aboriginal and Torres Strait Islander peoples on the Patient Administration System. Trend information obtained from the APDC, however, provided no evidence to suggest this occurred.

The survey determined the level of correct reporting for those Aboriginal and Torres Strait Islander peoples who

agreed to participate in the survey and who chose to identify themselves as Aboriginal or Torres Strait Islander at interview. It is possible that some Aboriginal or Torres Strait Islander patients chose not to identify themselves at interview and on admission.

While reporting of Aboriginal and Torres Strait Islander peoples was reasonably high overall at 91%, there remains room for improvement. Future interventions to increase reporting should target hospitals in major cities, where the level of reporting, at 83%, remains relatively low. The increase in reporting from 88% in 2007 to 91% in 2010 did not achieve statistical significance. Further surveys are needed to confirm that reporting of Aboriginal and Torres Strait Islander peoples is truly improving over time. Future surveys should have an increased sample size and cover a larger number of hospitals to better assess the significance of small increases in reporting and provide a more representative sample. A greater coverage of hospitals and a larger patient sample size will allow the level of correct reporting to be reliably estimated within levels of geographic remoteness.

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Non-intentional farm injury fatalities in Australia, 2003–2006

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Abstract: Aim: To describe the pattern of non-intentional farm-related fatalities in Australia for 2003–2006 and examine trends. **Methods:** Data from the National Coroners Information System were analysed to define all non-intentional farm injury fatalities for the period. **Results:** The incidence of farm fatalities has declined by 44% over the past 20 years from an average of 146 deaths per year to 82 deaths per year. For adults there are high numbers of fatalities related to tractors, quad bikes and farm utilities. Children aged under 15 years account for 17% of fatalities, with dams or other water bodies and quad bikes remaining the most common causes of non-intentional farm fatalities. Almost half of all on-farm non-intentional fatalities are non-work-related. **Conclusion:** Future interventions targeting these priority areas are required to reduce the incidence of non-intentional farm-related fatalities within Australia.

Farming is regarded internationally as a high-risk industry for injury and fatalities.¹ Despite significant reductions in farm-related fatalities over the past 15 years in Australia, agriculture remains a high-risk industry and lags behind the occupational health and safety gains made in other primary industries such as mining and construction.^{2,3} Furthermore, as most farms in Australia are family owned and operated, the distinction between the workplace and family home environments is often difficult to discern. In turn, this poses significant challenges for the health and safety of not only farmers and their staff, but also family members and visitors.

The inaugural assessment of farm-related fatalities in Australia was based on data covering the 1989–1992 period.² In this period there were 587 fatalities, with an annual mean of 146 cases. When examined in respect

to annual deaths per 100 000 employees, the rate of work-related fatalities was 23.3 per 100 000 population. This rate is high compared to an all industries rate of 5.5 per 100 000 population in the same period.⁴ Additionally, it was identified that the rate of fatal injury per 10 000 farms was 9.1 per year.

With core infrastructure support provided by NSW Health through the former Hunter New England Area Health Service, the Australian Centre for Agricultural Health and Safety has provided research for information on farming-related fatalities, injuries and their prevention for over 2 decades. The National Farm Injury Data Centre within the Australian Centre for Agricultural Health and Safety draws on fatality data from the National Coroners Information System (NCIS).⁵ These data have been used to report on the nature of fatalities in agriculture, with this evidence being employed to drive new preventive programs of work across Australia.^{2,6,7}

This paper presents the most recent data on non-intentional farm fatalities based on the NCIS data for the period 2003–2006 and examines trends over time. On-farm fatalities are defined as those non-intentional injuries occurring to farmers and workers undertaking work in agricultural production, as well as to those in the farm workplace as bystanders to work being undertaken, and others in the course of leisure but harmed by hazards used in farm production.^{2,8}

Methods

Data from the NCIS were reviewed on a case-by-case basis for the period 2003–2006. The NCIS is the central repository of information about every death reported to an Australian coroner since July 2000 (January 2001 for Queensland).⁵ The criteria that determine if a death will be reported to the relevant state coroners' office varies between jurisdictions. However, in general terms and in the context of farm injury for this paper, the criteria include: (i) where the person died unexpectedly and the cause of death is unknown; (ii) where the person died in a violent or unnatural manner; and (iii) where a doctor has been unable to sign a death certificate giving the cause of death.

When deaths are referred to a coroner in one of the states or territories, preliminary information is automatically uploaded into the NCIS. These cases remain 'open' until

the coroner hands down a final determination on each case when it is then 'closed'. Only 'closed' cases have been included in this review; 'open' cases generally have limited available detail, particularly in relation to the agent and mechanism of injury.

The NCIS is also able to provide detail on the proportion of cases 'open' and 'closed' in each state and territory by year. To avoid large underestimation of totals for this study it became necessary to apply inclusion criteria (i.e. a national case closure rate of $\geq 90\%$ for the years to be included in the study period). At the time of assessment, this meant that data to 2006 could be included in this study.

The process for extracting the relevant data for the 2003–2006 period involved several data reviews and was finalised in February 2010. All deaths for each year due to external causes were obtained using query design searches. The identification of deaths of relevance involved a number of coded and keyword searches of the NCIS based on the Farm Injury Optimal Dataset, with cases that were not farm-related being withdrawn from the dataset.⁸ The Optimal Dataset also provides specific codes on relevant agents of injury in agricultural, for example tractors, quad bikes, farm dams and grain augers, and has been widely used in other Australian fatality and injury studies in the agricultural sector.^{2,6,7} Cases that were confirmed as intentional by the coroner were also withdrawn from the file. A final verification process assessing farm-related deaths identified in the Media Monitors database was undertaken to match any reported cases with relevant detail in the NCIS.

Following the identification of the non-intentional farm-related deaths, exploration of attached documents such as police, toxicology and reports of coroners' findings was completed. Data from this analysis are presented with reference to the appropriate denominator data with all rates calculated using Australian Bureau of Statistics estimates for the relevant year.^{9–12}

Results

Age and gender

In the period 2003–2006, there were 326 non-intentional farm-related injury fatalities. Of these, 87% occurred in males and 13% in females. Overall, 17% of all deaths occurred in those aged less than 15 years and 40% occurred in people aged over 55 years (Table 1).

On-farm deaths for each year and number of agricultural establishments

The mean number of non-intentional farm injury deaths was 82 each year. Notwithstanding the further addition of 'closed' cases for these data, a continued downward trend in the overall number and rates of deaths per

Table 1. Number of on-farm deaths caused by non-intentional farm injury in Australia, 2003–2006, by age and gender

Age (years)	Male		Female		Total	
	<i>n</i>	%	<i>n</i>	%	<i>N</i>	%
<15	40	14.1	15	35.7	55	16.9
15–24	29	10.2	3	7.1	32	9.8
25–34	28	9.9	2	4.8	30	9.2
35–44	29	10.2	1	2.4	30	9.2
45–54	42	14.8	6	14.3	48	14.7
55–64	43	15.1	5	11.9	48	14.7
65–74	34	12.0	7	16.7	41	12.6
75–84	32	11.3	2	4.8	34	10.4
85+	7	2.5	1	2.4	8	2.5
Total	284	87.1	42	12.8	326	100

Source: National Farm Injury Data Centre on-farm fatality database.

10 000 agricultural establishments by year is apparent (Table 2).

On-farm work-related deaths for each year and number of agricultural workers

A total of 303 cases could be defined as either work-related (52%) or non-work-related (48%). Table 3 describes the work-related cases ($n = 158$) assessed in relation to deaths per 100 000 agricultural workers.

Agents of injury

The leading agents of farm injury across all age groups were tractors (17.5%; $n = 57$), with quad bikes (9.2%; $n = 30$), farm utilities (8.2%; $n = 27$) and dams (5.5%; $n = 18$) all featuring (Table 4).

For the 271 adult (aged over 15 years) fatalities, tractors ($n = 57$), quad bikes ($n = 23$), farm utilities ($n = 23$) and two-wheeled motorcycles ($n = 14$) were the leading agents. These four agents alone were responsible for 43% of the adult fatalities on farms.

Of the 55 fatalities in children (aged less than 15 years), the prime agents associated with deaths were drowning in dams ($n = 13$) and other water sources such as tanks and creeks and rivers ($n = 12$). Overall, drowning ($n = 25$) and quad bikes ($n = 7$) accounted for 58% of all child deaths on farms.

A further analysis of mechanisms associated with the two leading causes of fatality was also undertaken (Table 5). This revealed that almost 40% of tractor deaths were the result of being run over, while over 50% of quad bike fatalities involved rollover events.

Table 2. Non-intentional farm injury deaths and rates per 10 000 farms in Australia, 2003–2006

Year	Work-related deaths <i>n</i>	Non-work-related deaths <i>n</i>	Total deaths (including work status unknown) <i>n</i>	Agricultural establishments ^{a,8} <i>n</i>	Deaths per 10 000 agricultural establishments
2003	47	53	104	132 983	7.8
2004	51	36	98	130 526	7.5
2005	35	25	62	129 934	4.8 ^b
2006	25	31	62	154 472 ^c	4.0 ^b
	158 ^e	145 ^e	326 ^e	136 978 ^d	5.9 ^{b,d}

^aAgricultural establishments producing an Estimated Value of Agricultural Output >\$5000 p.a.

^bMost likely under-enumerated, with further cases to be added as more cases are 'closed'.

^cChange in Australian and New Zealand Standard Industrial Classification, 2006.

^dMean 2003–2006.

^eTotal.

Source: National Farm Injury Data Centre on-farm fatality database.

Table 3. Non-intentional work-related farm injury deaths and rates per 100 000 workers in Australia, 2003–2006

Year	Work-related deaths <i>n</i>	Persons employed in agriculture ^{a,9} <i>n</i>	Annual deaths per 100 000 workers
2003	47	370 500	12.7
2004	51	366 800	13.9
2005	35	357 500	9.8 ^b
2006	25	348 000	7.2 ^b
	158 ^d	360 700 ^c	10.9 ^{b,c}

Source: National Farm Injury Data Centre on-farm fatality database.

^aAgricultural establishments producing an Estimated Value of Agricultural Output >\$5000 p.a.

^bMost likely under-enumerated, with further cases to be added as more cases are 'closed'.

^cMean 2003–2006.

^dTotal.

Discussion

These data indicate persisting high numbers of fatalities related to tractors, quad bikes and farm utilities, representing 46% of fatalities across all ages. For children less than 15 years, dams or other water bodies and quad bikes remain the most common agents of fatalities; children make up 17% of all fatal cases. People aged 55 years and over account for 40%.

In comparison to previous data covering the 1989–1992 period, these data indicate a 44% reduction in the mean number on-farm non-intentional fatalities from 587 during the period 1989–1992 (mean 146) to 326 (mean 82) in 2003–2006.⁶ Furthermore, if assessed on the basis of annual deaths per 100 000 employees, the rates of work-related fatalities dropped from 23.3 per 100 000 population in 1989–1992 to 10.9 per 100 000 population in the second

period (54% reduction). A similar reduction is also apparent when assessed by annual deaths per 10 000 agricultural enterprises – 9.1 per 10 000 farms to 5.9 per 10 000 farms (35% reduction).⁶ Overall, these findings support the continued downward trend in non-intentional farm injury fatalities identified in an earlier report.²

This assessment replicates earlier studies by incorporating all non-intentional on-farm injury fatalities. This allows comparative analysis over time, and also captures all of the data relating to work- and non-work-related fatalities on farms. With over 90% of Australian farms being family owned and operated, the farm is frequently both a workplace and a family home, where workers, family and visitors congregate. This provides major challenges in maintaining health and safety as the environment does not tend to be as controlled as those locations (e.g. construction sites/mines) that are clearly delineated as work areas. Moreover, this is reflected by the high proportion of cases that are non-work-related, which corroborates earlier findings.² Undoubtedly, a significant driver behind this result is the fact that nearly all child deaths fall into this non-work-related category.

A limitation of this study is that only cases closed by the NCIS have been used and that further cases are likely to be added, particularly for 2005 and 2006. However, previous experience of the National Farm Injury Data Centre suggests that only a relatively small number of cases are likely to be added. Furthermore, changes adopted by the Australian Bureau of Statistics in 2006 using the Australian and New Zealand Standard Industrial Classification have resulted in an increase in the number of agricultural establishments identified from 2006 onwards.¹² Consequently, this impacts slightly on some of the data presented relating to rates of death where agricultural establishments are used as a denominator. Nonetheless, whether measured by rates per 10 000

Table 4. Agent of on-farm non-intentional injury death in Australia, 2003–2006

Category	Agent	n	%
Farm vehicle	Aircraft	4	1.2
	Car	7	2.1
	Farm vehicle, other NEC*	6	1.8
	Gyrocopter	3	0.9
	Helicopter	7	2.1
	Motorcycle 2-wheel	16	4.9
	Motorcycle 4-wheel	30	9.2
	Truck	7	2.1
	Utility truck	27	8.2
	Sub-total		107
Mobile farm machinery/plant	Cherry picker	1	0.3
	Earth moving equipment	4	1.2
	Fertiliser spreader	3	0.9
	Fire truck/tanker	1	0.3
	Forklift	4	1.2
	Grader	2	0.6
	Grain auger	2	0.6
	Harvesting machine	1	0.3
	Mobile farm machinery/plant NEC*	4	1.2
	Power take off	2	0.6
	Seeder/planter	1	0.3
	Slasher	2	0.6
	Tractor	57	17.5
	Trailer	1	0.3
	Sub-total		85
Fixed plant/equipment	Fixed plant/equipment NEC*	3	0.9
	Pump	3	0.9
	Shearing plant	1	0.3
Sub-total		7	2.2
Workshop equipment	Angle grinder	2	0.6
	Power saw (incl. circular saw)	1	0.3
Sub-total		3	0.9
Materials	Drums	1	0.3
	Hay bale	2	0.6
	Laden carton	1	0.3
	Materials, other NEC*	2	0.6
	Pole	1	0.3
	Tyres	2	0.6
	Wall	1	0.3
	Sub-total		10
Farm structure	Channel/water crossing	4	1.2
	Creek/river	5	1.5
	Dam	18	5.5
	Farm structure, NEC*	1	0.3
	Fence	1	0.3

(Continued)

Table 4. (Continued)

Category	Agent	<i>n</i>	%
	Other shed	1	0.3
	Powerlines	6	1.8
	Septic tank	1	0.3
	Sheep/cattle dip	1	0.3
	Swimming pool	3	0.9
	Tank	6	1.8
	Water trough	3	1.1
	Windmill	1	0.4
	Sub-total	49	15.0
Animal	Cattle	7	2.1
	Dog	1	0.3
	Horse	11	3.4
	Insect	2	0.6
	Pig	1	0.3
	Sheep	1	0.3
	Snake	1	0.3
	Sub-total	26	8.0
Farm chemicals	Pesticides – herbicide	1	0.3
	Pesticides – insecticide	1	0.3
	Sub-total	2	0.6
Working environment	Fire/smoke/flame	5	1.5
	Solar radiation	1	0.3
	Tree, stick branch	9	2.8
	Trees being felled	5	1.5
	Sub-total	20	6.1
Other	Firearms	9	2.8
	Knife	1	0.3
	Other hand tools, NEC	2	0.6
	Chainsaw	1	0.3
	Materials, other NEC	2	0.6
	Unknown	2	0.6
	Sub-total	17	5.2
Total		326	100

NEC: not elsewhere classified.
Source: National Farm Injury Data Centre on-farm fatality database.

agricultural establishments, work-related deaths per 100 000 workers or on actual numbers, the pattern reflects a downward trend in fatalities.

Conclusion

Despite progress in reducing the number of non-intentional farm injury deaths throughout Australia, work remains to

be done. These data suggest that there are several common sources of non-intentional farm injury fatalities, all of which have well-defined solutions. This database is the only one of its type servicing agriculture in Australia; the continued compilation of data will underpin the evidence base for action. Future interventions targeting these priority areas are needed to allow for further reductions in farm-related deaths.

Table 5. Mechanisms of on-farm injury for tractor and quad bike-related injury deaths, Australia, 2003–2006

Mechanism	n	%
Tractors		
Run over by tractor	22	38.6
Tractor rollover	15	26.4
Fall from tractor	4	7.0
Other tractor-related mechanism of injury	4	7.0
Unknown	12	21.0
Total	57	100
Quad bike		
Rollover	16	53.4
Non-rollover	8	26.6
Unknown	6	20.0
Total	30	100

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Developing an environmentally sustainable NHS: outcomes of implementing an educational intervention on sustainable health care with UK public health registrars

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Abstract: Environmental sustainability is a new and fast moving field in health. There is little evidence about how to teach it effectively to health professionals. **Methods:** We conducted a pilot study of an educational intervention with more than 200 UK public health registrars. The intervention consisted of a day-long workshop with the aim of training participants to help make the UK's National Health Service more environmentally sustainable. **Results:** We measured outcomes in three areas: awareness, advocacy and actions. Comparison of baseline and post intervention questionnaire scores showed statistically significant improvements in the awareness and advocacy scores. Actions were assessed qualitatively. Our findings suggest that, while there are some pockets of good practice, many health professionals are yet to engage with sustainability in the workplace. **Discussion:** We propose reasons why health professionals are yet to become involved in sustainability issues despite the related opportunities for health and health services.

There are multiple benefits – health, financial, reputational and environmental – for health services to take a lead on sustainability. In the United Kingdom (UK), a sustainable National Health Service (NHS) is an ambitious goal and achieving it will require large-scale, transformational and organisational change. There are legal and regulatory

drivers of this change,^{1,2} as well as political support: in *Equity and Excellence: Liberating the NHS* White Paper, the coalition government has demonstrated their commitment to a sustainable health service

...Further efficiencies can, and need to, be made from improving energy efficiency and developing more sustainable forms of delivery across the NHS... (Section 5.17).³

The NHS is however one of the largest workforces in the world. How can sustainability be taught to this workforce to help understanding of why and how sustainability is essential to improving patient care and public health?

The NHS Sustainable Development Unit (www.sdu.nhs.uk) was established in April 2008 to assist the NHS to become an exemplar low-carbon, sustainable organisation. As the NHS has a carbon footprint of 21 million tonnes of CO₂ e (CO₂ equivalent) – larger than some medium-sized countries⁴ – there is an additional imperative for it to show leadership on this issue. In 2010, as part of its organisational development strategy, and with financial support from the Department of Health, England, the Sustainable Development Unit developed and piloted an educational intervention on sustainable health care. This paper describes how the project was implemented and evaluated.

Methods

The intervention was developed using an iterative process over a period of several months. The intended audience was public health registrars enrolled with the UK Faculty of Public Health. There were several steps in the development: initially a literature review was conducted to inform the development of the intervention; the design drew on the expertise (e.g. communications, organisational and workforce development) of the Sustainable Development Unit team; and a pilot study was conducted with a group of public health registrars. The evaluation tools (the questionnaires and phone interview questions) were also piloted.

The final model of the intervention consisted of a 4-hour train-the-trainer workshop on climate change,

Table 1. Comparison of 166 participants'* baseline and post-intervention awareness and advocacy scores, from a study of an educational intervention on sustainable health care for UK National Health Service health professionals, 2010

Score	Baseline Mean ± SD	Post-intervention Mean ± SD	Difference (95% CI)	P-value
Awareness	24 ± 2	37 ± 1	12 (11,14)	<0.001
Advocacy	25 ± 2	34 ± 2	9 (8,10)	<0.001
Combined	49 ± 4	70 ± 3	21 (19,24)	<0.001

CI: confidence intervals.
SD: standard deviation.
*Public health registrars

sustainability, health and the NHS. All UK Faculty of Public Health Trainees were encouraged to attend; some public health consultants also attended. It was delivered face-to-face by the same facilitator in 15 sessions in every region of the UK between February and April 2010.

We assessed outcomes in three areas: awareness, advocacy and actions, which acted as surrogate measures of knowledge, attitudes and practices. Levels of awareness and advocacy were assessed by comparison of baseline and post-intervention self-rated scores (using a four-point modified Likert scale). This information was gathered using questionnaires that were administered at the beginning and at the end of each workshop. Participants' baseline and post-intervention awareness and advocacy scores were compared using the 2-tailed Pearson's correlation test and P-values from significance testing in a parametric paradigm were derived using a 2-tailed Student's *t*-test.

The action objective was evaluated by conducting telephone interviews 3 months after the intervention with a stratified (by region), random sample of 26 participants. The interviews consisted of eight semi-structured open-ended questions. Interviewees were asked whether and to what extent they had achieved their actions, and they were encouraged to speak freely about their experiences and their opinions. Framework analysis of these qualitative data was conducted.

Results

The intervention was conducted with a total of 238 individuals, of which 205 were public health registrars. The group of registrars based around Cambridge (*n* = 33) was excluded from the evaluation as some had been involved in the pilot. Of the remainder, there were complete data for 166 participants (of which 147 were public health registrars). The response rate was 81%. Reasons for the incomplete data included: participants arriving late or leaving the workshop early (and so failing to complete either the baseline or the post-intervention questionnaires) and some participants not answering all the questions. Comparison of baseline and post-intervention questionnaire scores showed statistically significant improvement

in both awareness (mean increase 12 points) and advocacy (mean increase 9 points) scores (Table 1).

In keeping with the advocacy objective, one of the additional aims of the intervention was for the registrars to subsequently facilitate a similar (albeit shorter) workshop themselves, thereby cascading the learning further. The bank of slides used in the workshop was therefore made available to participants for them to use and adapt for their own workshop. In the follow-up telephone interviews, we asked whether they had facilitated a workshop: of the 26, five had delivered one and three had set a date. Several others had raised the issue with colleagues or supervisors, and one had become involved with teaching medical students on sustainability. The reasons cited for not running a workshop included: lack of time, lack of confidence, inexperience, being of the view that it is not the role of a health professional, and being cynical about how much influence they would have and how difficult it would be to make changes.

The themes that emerged from the framework analysis of the phone interview responses are presented in the Discussion as five key lessons learnt.

Discussion

The quantitative results show that participants' self-rated levels of knowledge and attitudes increased following the intervention. While this finding is encouraging for promoting system-wide change, do these improvements translate into actions and do those actions help to make the NHS more sustainable? To answer these questions the lessons that emerged from the qualitative results from the phone interview responses are instructive.

Lessons learnt

Get the facts straight

You do need to get the (climate change) story straight: clarifying climate change terms and examining the basic science (including common myths and misconceptions) were rated by participants as among the 'most useful' parts of the workshop. They were surprised by the graphical comparison of countries' per capita carbon footprints, the

NHS's carbon footprint, the multiple ways in which climate change affects health (e.g. mass migration and food and water shortages), and the fact that climate change is a major global issue of social justice and health inequality.

Tailor your message

Most people respond to messages that address their own interests and concerns.⁵ Sustainability is well aligned with many other health objectives (such as the importance of prevention, more cost-effective use of resources, providing care close to or in the home and the greater use of information and communication technology) and is relevant to the practice of many medical specialties and health issues. The Sustainable Development Unit has found that most clinicians and general practitioners respond best to the health co-benefits argument (that is, that a low-carbon lifestyle is a healthy lifestyle); that medical students and public health professionals are often interested in the social justice and health inequalities issues; whereas finance directors and chief executives are often attracted by the financial savings and reputational issues. In this study one registrar working in maternal and child health began to consider the links between sustainability, family planning and population issues. Another registrar working on a needs assessment pledged to think about how to incorporate sustainability issues.

Be realistic

The participants wanted to focus on practical, achievable, individualised actions. Thus the expectation was of actions that they could carry out as public health registrars and in their workplaces. Some examples of their subsequent achievements were: incorporating sustainability in their current work (e.g. including carbon reduction in a procurement policy and in a commissioning contract); raising the issue with colleagues and implementing workplace changes (e.g. sustainable meetings, home-working and remote access, organising a 'green week'); another was submitting sustainability proposals to the finance director who had asked for cost-cutting suggestions. One regional group of registrars conducted an audit of the business miles travelled (and costs incurred) in meeting their training commitments and several groups implemented teleconferencing of trainee meetings.

Be positive

If people feel that a challenge is too great or that they are powerless to act, a powerful coping mechanism is denial.^{6,7} Thus, doomsday scenarios are unlikely to be effective in encouraging engagement with the issues.⁸ With health professionals, we have found that talking about sustainability rather than climate change can be much more broadly and positively framed as a set of solutions. As noted, there are many reasons for the NHS to deliver

services sustainably; climate change is just one of them. Responses from this group confirm this, for example: 'it is hard to win people over by scaring them'. Several registrars advised re-framing the issue as a positive first, emphasising 'what's in it for them', especially the financial benefits.

Tell stories

Having narrative examples of success that are not too ambitious can be highly motivating. Stories are what people remember and often what inspires them. In the feedback from this pilot, participants frequently asked for more anecdotes and case studies.

Why don't we take sustainability seriously?

Currently there are relatively low levels of engagement in this issue by health professionals. In this study, at 3 months after the intervention, around one-third of those in the follow-up sample had facilitated a similar workshop themselves, and the actions achieved by this group had been modest. These findings are in keeping with the Sustainable Development Unit's wider experience that, while there are some exemplary individuals and pockets of good practice, many in the NHS are yet to engage with this agenda. Given that climate change is the biggest global health threat of the 21st century⁹ and that implementing the principles of sustainable development are an opportunity – particularly for health and health services – it is perhaps surprising that so many health professionals are yet to be convinced and engaged.

Drawing from this study and the Sustainable Development Unit's wider experience we would suggest that there are at least four reasons conspiring against the broader and deeper involvement of health professionals:

1. We naturally apply a critical and balanced approach to all new evidence which may result in our being overly sceptical of new health threats or opportunities.
2. We are very busy, and focused on the day job – hence we have less time than we would like for longer-term issues such as sustainability or climate change.
3. We are focused on reacting to demand, problems and crises; and not on being proactive to need, preparation or prevention.
4. We work in health and so feel that we are already making a worthy contribution to society (sometimes termed a moral offset).

We hope that these reasons – and thoughts about how to overcome them – will promote discussion and debate among health professionals, and that future interventions of this type will take our lessons and experiences into account.

Next steps

There was significant interest in this intervention from Australian colleagues; it was adapted for an Australian

public health audience and a feasibility study of running the workshops was successfully conducted in Sydney in June 2011. The Australasian Faculty of Public Health Medicine (AFPHEM) has subsequently endorsed the workshops, and intends delivering a series of 10 in 2012.

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Notifications of Q fever in NSW, 2001–2010

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Abstract: Q fever is the most frequently notified zoonotic infection in NSW residents. The past decade has seen the introduction of a targeted national Q fever vaccination program. **Methods:** We undertook a descriptive analysis of Q fever notifications in NSW, for the period 2001–2010. **Results:** A total of 1912 cases of Q fever were notified in NSW between 2001 and 2010 (average 2.8 per 100 000 persons per annum). The majority of Q fever cases were reported in men, aged 40–59 years, living in rural NSW and working in agricultural related occupations. **Conclusion:** The results suggest changes in the epidemiology of Q fever in response to the targeted vaccination program.

Q fever is an important human and veterinary disease worldwide and is most significant in areas where its primary reservoir, cattle, sheep and goats, resides in close proximity to humans. In Australia, Q fever is endemic, with between 300 and 800 cases notified annually over the past decade, primarily in the eastern states.¹ In New South Wales (NSW), the majority of Q fever notifications have occurred in the rural areas of the state's west.²

Q fever is caused by the pathogen *Coxiella burnetii*, which has recently been removed from the *Rickettsiales*; *C. burnetii* is now considered more closely related to the *Legionella* genus.³ Transmitted most commonly via the airborne route, the organism is carried in dust contaminated with tissue, birth fluids or excreta from infected animals. Q fever commonly presents as a self-limiting febrile illness with malaise, weakness, headache and chills.⁴ The severity and duration of illness varies greatly. In up to 50% of cases

infection is asymptomatic or sub-clinical.⁵ Complications of Q fever include pneumonia, endocarditis, hepatitis, osteomyelitis, aseptic meningitis and encephalitis.⁶ Acute infection may be followed by Q fever fatigue syndrome, which occurs in approximately 10% of cases and may persist for as long as 5 years.⁷

C. burnetii is a pathogen with the potential to cause epidemics, due to its relative ease of transmission, environmental resilience, low infective dose and airborne route of transmission.⁴ Outbreaks of Q fever are commonly reported. An epidemic of Q fever has been sustained in the Netherlands since 2007, with several hundred cases in humans reported each year.^{8–10} Outbreaks have occurred in NSW, commonly associated with abattoir and farm workers,^{11–13} but alternative sources such as veterinary practices as well as geographical clusters with no known likely source of infection have been reported anecdotally.

Immunisation is the primary protective measure against Q fever. A vaccine against Q fever has been available in Australia since 1989; however, initial uptake of the vaccine was low and mostly limited to staff of several large abattoirs. The National Q Fever Management Program, an initiative of the Australian Government, was launched in 2000 and implemented in NSW in 2002.¹⁴ The Program included funded screening and vaccination of workers in high-risk occupations and training for immunisation providers. The Program initially targeted abattoir workers and shearers, but was subsequently expanded to sheep, dairy and cattle farmers along with their families.¹⁴

The last 2 decades have seen significant change in the management of Q fever in NSW and Australia. This study sought to determine whether the implementation of the National Q Fever Management Program has altered the epidemiology of the disease since it was introduced in NSW.

Methods

Q fever is notifiable by laboratories under the *Public Health Act 1991* (NSW). Public health units investigate all notified cases of Q fever to: collect relevant risk information; identify the likely source of infection; and, where necessary, instigate control measures. The NSW case definition for confirmed Q fever requires laboratory definitive evidence which comprises detection of *C. burnetii* by nucleic acid testing or culture, or by seroconversion or significant rise in titre to Phase II antigen in the absence of recent vaccination. Before 2004, the detection of IgM in the absence of recent vaccination was also accepted as evidence of infection, however, since 2004,

detection of IgM is accepted only in conjunction with a clinically compatible illness.¹⁵ Confirmed cases are entered onto the NSW Notifiable Conditions Information Management System.¹⁶ Information related to chronic Q fever sequelae is not routinely collected.

Notification data for the period 2001–2010 were extracted from the NSW Health Outcomes Information and Statistical Toolkit (HOIST) using SAS (version 9.2, SAS Institute, Cary, NC, USA). Variables used in the analysis included basic demographical descriptors, jurisdiction, onset date, occupation and recorded vaccination status. Analysis of the geographical distribution of Q fever notifications in NSW was reported by Local Health District whose boundaries came into effect in January 2011. Mid-year population estimates for Local Health Districts were also obtained from HOIST. Data were analysed using JMP® (version 8).

While a small proportion of the Q fever cases notified in NSW over the study period were related to identified outbreaks, a description of Q fever outbreak investigations in NSW was not part of this review.

Results

In the 10-year period (2001–2010), a total of 1912 notifications of Q fever were reported in NSW. The average annual Q fever notification rate for this period was 2.8 cases per 100 000 population. The annual rate varied from a peak of 4.5 per 100 000 population in 2002 and 2003 down to 1.8 per 100 000 in 2010 (Figure 1). Fifty-seven cases (3%) of Q fever were in people who identified as Aboriginal; however, Aboriginality was unknown or not recorded in 774 cases.

The mean age of cases was 44 years (range 1 month–86 years). Males accounted for 75% of all notifications. The highest age-specific annual notification rates were 7.7 cases per 100 000 for men in the 50–59-year age group and 2.2 cases per 100 000 for women in the 40–49-year age group (Figure 2). Twenty-six cases (1.3% of notifications) occurred among children aged less than 10 years, all of whom resided in rural and regional Local Health Districts.

The Hunter New England and Western NSW Local Health Districts accounted for 30% and 28% of all notified Q fever cases, respectively (Table 1). Annual notification rates were highest in the Western NSW Local Health District (19.9 per 100 000) and the Northern NSW Local Health District (10 per 100 000). Metropolitan Local Health Districts recorded notification rates less than one case per 100 000 population with the exception of Illawarra Shoalhaven Local Health District (2.1 cases per 100 000).

Information on the occupation of the case was recorded in 1046 (55%) of notifications. Of these, the most commonly reported occupation group was agriculture related such as farmers, shearers and graziers (52%); and occupations related to the slaughter of animals and meat processing such as abattoir workers, meat workers, butchers and professional shooters (10%). The annual number of cases notified with agriculture-related occupations varied between years in proportion to the total number of cases reported, ranging from 13–36% of total annual notifications. Notifications among abattoir and related occupations remained at a constant low level, ranging from a peak of 20 cases (7% of annual notifications) in 2002 to two cases (1.6%) in 2010.

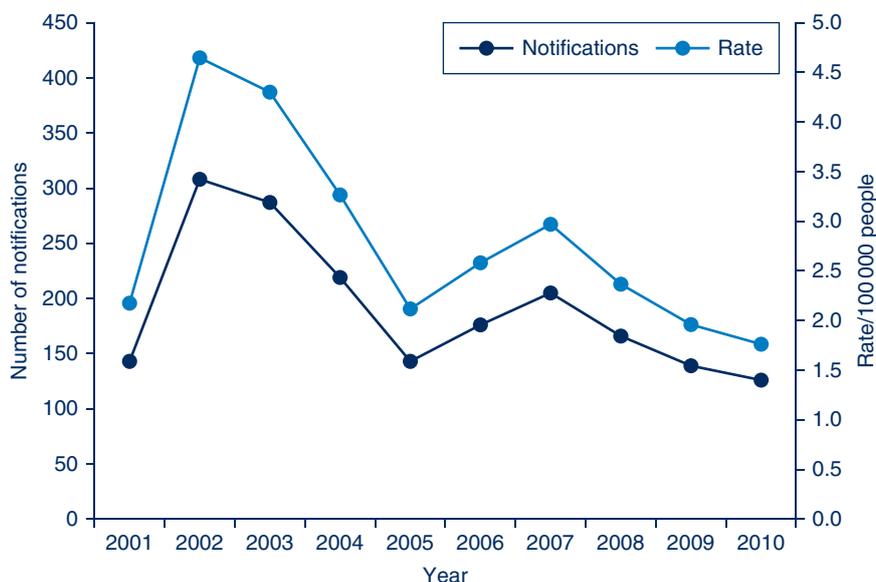


Figure 1. Q fever notifications and population rate for the disease in NSW by year, for the period 2001–2010. Source: NSW Health Outcomes Information and Statistical Toolkit (HOIST)

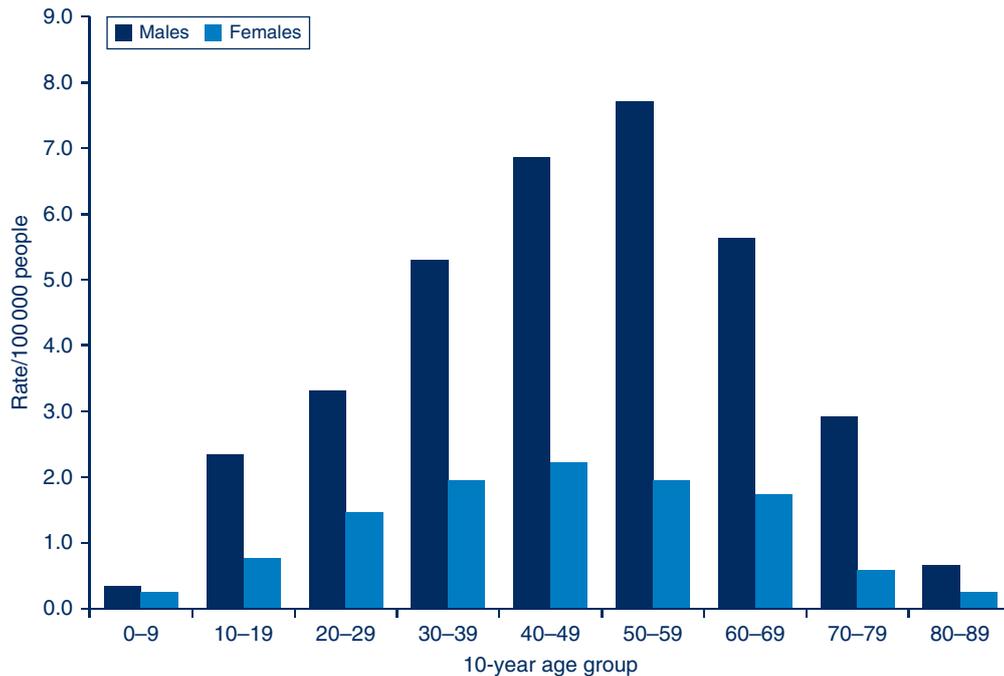


Figure 2. Q fever notification rates for each 10-year age group for males and females, NSW, for the period 2001–2010. Source: NSW Health Outcomes Information and Statistical Toolkit (HOIST)

Table 1. Q fever notifications and rates for each Local Health District in NSW, presented from highest to lowest population rate for the disease, for the period 2001–2010

NSW Local Health District	Cases		Rate (per 100 000)
	n	%	
Western NSW	532	27.9	19.9
Northern NSW	279	14.6	10.0
Far West	27	1.4	8.2
Mid North Coast	142	7.4	7.1
Hunter New England	570	29.9	6.8
Southern NSW	99	5.2	5.3
Murrumbidgee	68	3.6	2.9
Illawarra Shoalhaven	79	4.1	2.1
Albury (Victoria in-reach)	8	0.4	1.7
Central Coast	17	0.9	0.6
Nepean Blue Mountains	10	0.5	0.3
South Western Sydney	25	1.3	0.3
Western Sydney	14	0.7	0.2
South Eastern Sydney	15	0.8	0.2
Northern Sydney	16	0.8	0.2
Sydney	7	0.4	0.1
Total^a	1912	100	2.8

^aIncludes three cases attributed to Justice Health Service
 Source: NSW Health Outcomes Information and Statistical Toolkit (HOIST)

Q fever vaccination status of the case was recorded for 654 (34%) of notifications; however, of these, 72 cases (4%) were recorded as ‘unknown’ by patient and doctor. A total of 23 cases were reported to have been vaccinated prior to

illness, including 15 abattoir workers. A review of the notes of vaccinated cases in the Notifiable Conditions Information Management System revealed that two cases were vaccinated within 1 week of illness onset and so would be unlikely to have developed protective immunity. Records of validation of vaccination status were not available for most of the other cases.

Discussion

Lin et al previously reported the epidemiology of Q fever in NSW² before the introduction of the National Q Fever Management Program. Our results demonstrate significant changes in the epidemiology of Q fever in NSW since the introduction of this Program.

There has been a decrease in the overall notification rate over the last 10 years, in addition to a 26% decrease, from 3.8 cases per 100 000 between 1991 and 2000, as reported by Lin et al,² to 2.8 cases per 100 000 between 2001 and 2010. Despite the overall reduction in cases, there was a trend towards older age and increased rates of infection in some age groups when compared to the period 1991–2000. From 1991 to 2000 the highest age-specific notification rate was in men aged 20–29 years.² In contrast, we found the highest notification rate in the period 2001–2010 in men aged 50–59 years. These results are consistent with the findings of another national study where the decrease in cases among young males was attributed to the impact of the national vaccination program in the primary target groups.¹⁴ Females were also found to represent a greater proportion of total notifications when compared to the

previous decade; 25% in 2001–2010, up from 16% in 1991–2000.

During this review period, the peak rates of disease were seen in 2003 and 2004. This is consistent with the pattern of Q fever epidemiology nationally at the time. It is hypothesised that this increase in notifications may have been due to severe drought conditions which promote airborne distribution of potentially contaminated dust particles,^{6,14,17} as well as increased livestock movements. National Q fever hospitalisation data show a concurrent peak in hospitalisations, supporting the idea that this peak was a true increase in disease incidence rather than increased awareness and testing.¹⁴

Abattoir and meat workers accounted for 51.4% of Q fever case notifications for 1991–2000² but notifications were seen to be declining over time. Between 2001 and 2010, notifications of Q fever in abattoir and meat workers have remained at a stable low level accounting for only 10% of notifications where occupation was recorded. In contrast, the proportion of notifications in agriculture-related occupations increased from 29% of notifications where occupation was recorded in 1991–2000,² to 52% in 2001–2010. This pattern is consistent with previous findings¹⁸ and may be due also to greater uptake of vaccine among abattoir workers when compared to workers in the agricultural sector. However, as occupation status was missing for almost half of all notified cases in 2001–2010, caution must be exercised when examining these data for trends.

The reasons for significant variation in rates of notification between rural Local Health Districts are unclear. High notification rates were seen in central and north-western NSW, an area which typically experiences low rainfall, between 200 mm and 500 mm per year.¹⁹ As previously noted, dry conditions can promote airborne distribution of contaminated dust. However this hypothesis does not explain the high rate of notifications in the Northern NSW Local Health District, which receives relatively high average rainfall compared to elsewhere in the state.¹⁹ It is likely that the reasons for variation in Q fever notification rates across NSW are multifactorial, and may include differences in land use, livestock density, farming practices and relative proportion of the population engaged in the agricultural and meat processing industries. Variation in case ascertainment is likely to impact on notification rates, which may be due to differing levels of clinician awareness and interest in Q fever and local diagnostic testing practices.

Collection of exposure source and risk-factor data is an important aspect of the public health follow-up for Q fever notifications. The Notifiable Diseases Database, used for collection of notifiable disease case information in NSW until the implementation of the Notifiable Conditions Information Management System in 2010, included only

a single occupation field for recording risk for infection. From analysis of the occupation field, it was evident that risk for, and likely source of, infection were not adequately captured. This issue has been previously described.¹⁸ Improved characterisation of risk for infection is now available in the Notifiable Conditions Information Management System through fields for collecting exposure to animals and animal-related environments.

The results of this review are limited by incomplete occupation and vaccination data. The use of these results in judging the impact of the Q fever vaccination program is also limited by the lack of data on uptake or coverage of Q fever vaccination. Consideration should also be given to the potential impact of other factors, such as drought or changes in farm animal management practices, on the epidemiology of Q fever over the review period. Nevertheless the overall decrease in the rate of Q fever notifications, together with the observed changes in age, sex and occupation distribution of cases, strongly suggest that the National Q Fever Management Program has had a positive impact in reducing the risk of human Q fever in NSW.

Conclusion

The changing epidemiology of Q fever highlights the importance of continued public health surveillance to monitor the likely source of infection in cases and to characterise emerging risk groups. This information will inform immunisation policy and enable effective targeting of vaccination programs. Public health units are encouraged to collect detailed risk factor information for notified cases, in particular, occupation and vaccination status.

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Meningococcal disease

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What is meningococcal disease?

Meningococcal disease is caused by the bacterium *Neisseria meningitidis*. The bacteria are transmitted from person to person through nasopharyngeal secretions. Close and prolonged contact is usually required for transmission. Most people carry the bacteria asymptotically in the nose and throat. Disease occurs very rarely when bacteria invade the bloodstream. Meningococcal disease usually presents as meningitis, septicaemia, or a combination of the two, and is fatal in approximately 3% of cases.¹ *N. meningitidis* can be classified into serogroups. Most meningococcal disease in Australia is caused by serogroup B; less common serogroups are C, A, W135 and Y.

Is there a vaccine for meningococcal?

There are two types of vaccine available for meningococcal disease. The meningococcal C conjugate vaccine protects against serogroup C disease, and since 2003 has been included in free routine vaccination of all children at 12 months of age. The meningococcal polysaccharide vaccine protects against serogroups A, C, W135 and Y. This vaccine is recommended for people travelling to parts of the world where epidemics of group A, W135 or Y disease are frequent (e.g. sub-Saharan Africa); and for the control of outbreaks caused by serogroup A, W135 or Y. There is no licensed vaccine for serogroup B, although one is currently under licensing review in the European Union.²

Epidemiology of meningococcal disease in NSW

In New South Wales (NSW) in 2010 there were 74 notifications of meningococcal disease and five deaths. Eighty percent of these notifications were for serogroup B disease.³ Notifications of meningococcal disease in Australia have decreased steadily since 2002.¹ This reduction in notifications over the past 8 years occurred for both serogroup B and C, but much more in serogroup C, the decline of which coincided closely with the introduction of the meningococcal C vaccination program. The reason for the decline in serogroup B disease is probably due to natural variations in the epidemiology of meningococcal disease over time, as the community develops natural immunity to prevalent strains in the absence of new virulent strains that are yet to emerge.⁴

Public health response

Under the *NSW Public Health Act 1991*, hospitals and laboratories are required to notify cases of meningococcal disease to public health units. The public health response to a case of meningococcal disease aims to prevent secondary cases of disease. Public health actions include providing information about meningococcal disease, and providing antibiotics to people who have had close contact with a case. Known as clearance antibiotics, these drugs are used to eliminate the bacteria from the throat and prevent its transmission to others. Vaccination is also offered if the disease was caused by a vaccine-preventable serogroup. National guidelines recommend that the public health response to a case of meningococcal disease begins as soon as possible. In recent years, technological advances have made it possible to respond more rapidly. For example, polymerase chain reaction (PCR) testing allows rapid laboratory confirmation of the diagnosis, and SMS technology (text messaging) has been used to send information to contacts about meningococcal disease and antibiotic clinics.

Long-term health outcomes

Survivors of meningococcal disease can experience severe long-term health problems. For example, a study in the UK of adolescent survivors of meningococcal disease found that 57% had ongoing physical problems including skin scarring, mobility difficulties, and speech and hearing problems.⁵ These problems were more severe with serogroup C than serogroup B disease. Survivors also reported more psychosocial problems, including more fatigue and depression, lower quality of life, and less social support compared to controls. These findings indicate that people with meningococcal disease need long-term follow-up that encompasses both physical and psychosocial aspects of health.

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Antimicrobial resistance: moving forward to the past

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Mankind pinned its hopes on antibiotics in the war against infection. Since the introduction of penicillin in 1945, many other antibiotics have been introduced; unfortunately the subsequent development of bacterial resistance has threatened the contribution of antibiotics to disease control. Dr Margaret Chan, Director-General of the World Health Organization (WHO), said earlier this year¹:

The world is on the brink of losing these miracle cures. In the absence of urgent corrective and protective actions, the world is heading towards a post-antibiotic era, in which many common infections will no longer have a cure.

Antibiotics have contributed greatly to our ability to treat disease, however we risk losing these gains. While antibiotic resistance becomes increasingly widespread, the research development of new agents to combat evolving bacteria has slowed. It is not commercially viable to develop new drugs if there is a high probability of their becoming ineffective soon after introduction.

Globally emerging antibiotic-resistant bacteria such as methicillin-resistant *Staphylococcus aureus* (MRSA)² and extended spectrum beta-lactamase (ESBL)-producing *Escherichia coli*³ present increasing challenges to community transmission of infection. Recently, New Delhi metallo-beta-lactamase-1 (NDM-1) was identified;⁴ this enzyme makes bacteria resistant to most beta-lactam antibiotics which are used to treat antibiotic-resistant bacterial infections.

Causes of resistance

Microbes that cause infectious diseases are complex, dynamic and evolving. They reproduce rapidly, mutate frequently, exchange genetic material freely and adapt to new environments. These processes are further promoted by inappropriate prescription practices and poor drug access control.

Possible solutions in Australia

The NPS (formerly the National Prescribing Service) develops educational material for both practitioners and consumers to influence the culture surrounding antibiotic prescription and use. The NPS has identified specific conditions, such as upper respiratory tract infections, for which antibiotic prescribing may not always comply with best practice guidance (see www.nps.org.au). The Australian Group on Antimicrobial Resistance (AGAR), a collaboration between clinicians and microbiology laboratories, conducts ongoing surveillance to monitor resistance development in pathogens. These data are used to inform clinical processes, policy and research in preventing bacterial resistance.

Future action to reduce resistance includes improving prescription and consumption practices by implementing guidelines on appropriate antibiotic use and education; enhanced surveillance to monitor resistance; developing new vaccines and new antibiotics; and researching other potential treatment modalities such as bacteriophage therapy.⁵

It is apparent that action is needed to prevent a post antibiotic future similar to the pre antibiotic past.

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Communicable Diseases Branch **NSW Ministry of Health**

For updated information, including data and information on specific diseases, visit www.health.nsw.gov.au and click on **Public Health** and then **Infectious Diseases**. The communicable diseases site is available at: <http://www.health.nsw.gov.au/publichealth/infectious/index.asp>.

Figure 1 and Tables 1 and 2 show notifications of communicable diseases received in November and December 2011 in New South Wales (NSW).

Enteric infections

Outbreaks of suspected foodborne disease

Six outbreaks of gastrointestinal disease thought to be due to consumption of contaminated food were reported in November and December 2011. These outbreaks occurred in restaurants or cafes (5) and in a private residence (1); 63 people were affected. Four outbreaks were identified through complaints to the NSW Food Authority (NSWFA) and two outbreaks were identified through emergency department reports to public health units. Stool samples were tested in two outbreaks, and the pathogens identified were *Salmonella* Typhimurium, and *Campylobacter*. Due to limited ability to recall the food eaten (in two outbreaks) or lack of an association between eating a particular food and gastrointestinal illness in cases who were interviewed and controls (in three outbreaks), there was not enough evidence to identify the food vehicle in five of the outbreaks.

Scombroid poisoning

In the outbreak where the food vehicle of the illness could be identified, the cause was likely to be fresh tuna steaks used in a salad. This outbreak was identified by emergency department reports to a public health unit in November of symptoms consistent with Scombroid poisoning (skin flushing, headache, tremor, palpitations, tachycardia, hypertension, diarrhoea). Four cases were reported and

were colleagues who all reported eating a fresh tuna salad from an organic café. Onset of symptoms ranged from 20 minutes to a few hours after eating the salad. The NSW Food Authority spoke to the café owner who took the salad off the menu. The NSW Food Authority inspected the premises and sampled the small amount of remaining tuna; histamine was detected within acceptable levels. As most of the salad had been sold and only four people had reported illness, the Authority concluded that only a small portion of the tuna product used for the salad that day was contaminated. Food appeared to be maintained at appropriate temperatures. The product was imported from Indonesia by a company in Queensland.

Outbreaks of gastroenteritis in institutional settings

In November and December 2011, 43 outbreaks of gastroenteritis in institutions were reported, affecting 622 people. Twenty-four outbreaks occurred in aged-care facilities, 10 in child-care centres and 9 in hospitals. All outbreaks appear to have been caused by person-to-person spread of a viral illness. In 26 (60%) outbreaks one or more stool specimens were collected. In nine (35%) of these, norovirus was detected. Rotavirus was detected in four (15%) outbreaks. Adenovirus was detected in two (8%) outbreaks. *Clostridium difficile* was detected in one outbreak along with norovirus; this finding was thought to be coincidental during a viral gastroenteritis outbreak. In six outbreaks no pathogens were detected in stool specimens. Results for five outbreaks are still outstanding.

Viral gastroenteritis increases in winter months. Public health units encourage institutions to submit stool specimens from cases for testing during an outbreak to help determine the cause of the outbreak (for further information see: *Guidelines for the public health management of gastroenteritis outbreaks due to norovirus or suspected viral agents in Australia* available at: <http://www.health.nsw.gov.au/internet/publications/publishing.nsf/Content/cda-cdna-norovirus.htm-1>).

Respiratory infections

Influenza

Influenza activity in NSW was low during November and December 2011. Activity was measured by the number of people who presented with influenza-like illness to 56 of the state's largest emergency departments, and the number of patients whose respiratory specimen tested positive for influenza at diagnostic laboratories. The rate of laboratory

confirmed influenza activity has been declining steadily since activity peaked in mid July 2011.

There were 72 presentations of influenza-like illness (rate 0.5 per 1000 presentations) for November, and 79 presentations (rate 0.5 per 1000 presentations) for December to select Emergency Departments.

There were 176 cases of laboratory-confirmed influenza reported in November; including 159 (90%) influenza A and 15 (9%) influenza B. There were 97 cases, including 77 (79%) influenza A and 14 (14%) influenza B, reported in December.

For a more detailed report on respiratory activity in NSW see: http://www.health.nsw.gov.au/PublicHealth/Infectious/influenza_reports.asp.

Vaccine-preventable diseases

Meningococcal disease

Seven cases of meningococcal disease were notified in November and December 2011. Of these, five cases were due to serogroup B and one to serogroup C, while the serogroup was unknown for one case. The case with serogroup C disease was an unimmunised elderly woman who was not eligible for vaccination. There were no deaths due to meningococcal disease reported during November and December.

It is recommended that a single dose of vaccine for meningococcal disease be given to all children at the age of 12 months as well as to those at high risk of disease.¹

Measles

All 10 measles cases reported during November and December were linked to cases imported from overseas, with two distinct clusters identified. Seven cases with onset dates during this period were associated with an outbreak at a school in the Australian Capital Territory (ACT), of which six were students and one was a health-care worker from a practice where a patient who was a case had presented. The index case was a traveller returning from New Zealand. This cluster highlights the importance of ensuring that all health-care workers have immunity to vaccine-preventable diseases. Documented evidence of two doses of measles, mumps and rubella vaccination or serological evidence of protection from measles is recommended for health-care workers born after 1966. This

experience illustrates the challenge to measles control in pockets of non-immunised school children.

For the remaining three cases, an interstate traveller from New Zealand was identified as the likely source of infection for the two other cases: one case was exposed in Sydney, while the other was likely exposed in Victoria and later developed the infection. Both cases were unvaccinated.

Recently, a fatal case of measles was reported in France with acute respiratory distress syndrome, but without rash, emphasising the potentially deadly nature of the disease. This situation highlights the need for health-care workers to consider a diagnosis of measles, even in the absence of classical clinical features, during measles outbreaks.²

Pertussis (whooping cough)

Of the 13 198 pertussis cases reported in NSW in 2011, 2154 cases were reported during November and December. This is considerably lower than the number of cases reported for the same period in 2010 (3491 cases), and lower than the number of cases from September and October 2011 (2408 cases). Caution should be exercised when interpreting these data because of possible delays in notifications.

Immunisation of babies is an important strategy to provide protection for an age group most at risk of severe illness. A free vaccine for infants administered at 2, 4 and 6 months of age is available. It is currently recommended that the first dose can be provided as early as 6 weeks of age and the booster at 3½ to 4 years. In addition, NSW has adopted a strategy to provide immunisation to all other people who care for or who have a baby in the household to encourage them to be fully up-to-date with immunisation. The impact of this strategy is currently being evaluated to inform future vaccine policies.

References

1. National Health and Medical Research Council. The Australian Immunisation Handbook. 9th ed. Canberra: Australian Government Department of Health and Ageing; 2008.
2. Lupo J, Bernard S, Wintenberger C, Baccard M, Vabret A, Antona D et al. Fatal measles without rash in immunocompetent adult, France [letter]. *Emerg Infect Dis* 2012 Mar. Available at: http://wwwnc.cdc.gov/eid/pdfs/11-1300-ahead_of_print.pdf [Cited 1 February 2012].

Figure 1. Reports of selected communicable diseases, NSW, Jan 2004 to December 2011, by month of onset.

Preliminary data: case counts in recent months may increase because of reporting delays.
 Laboratory-confirmed cases only, except for measles, meningococcal disease and pertussis.

BFV = Barmah Forest virus infections, RRV = Ross River virus infections,

Lab Conf = laboratory confirmed,

Men Gp C and Gp B = meningococcal disease due to serogroup C and serogroup B infection, other/unk = other or unknown serogroups.

NB: multiple series in graphs are stacked, except gastroenteritis outbreaks.

NB: Outbreaks are more likely to be reported by nursing homes and hospitals than by other institutions.

NSW Population	
Male	50%
<5 y	7%
5-24 y	27%
25-64 y	53%
65+ y	13%
Rural	46%

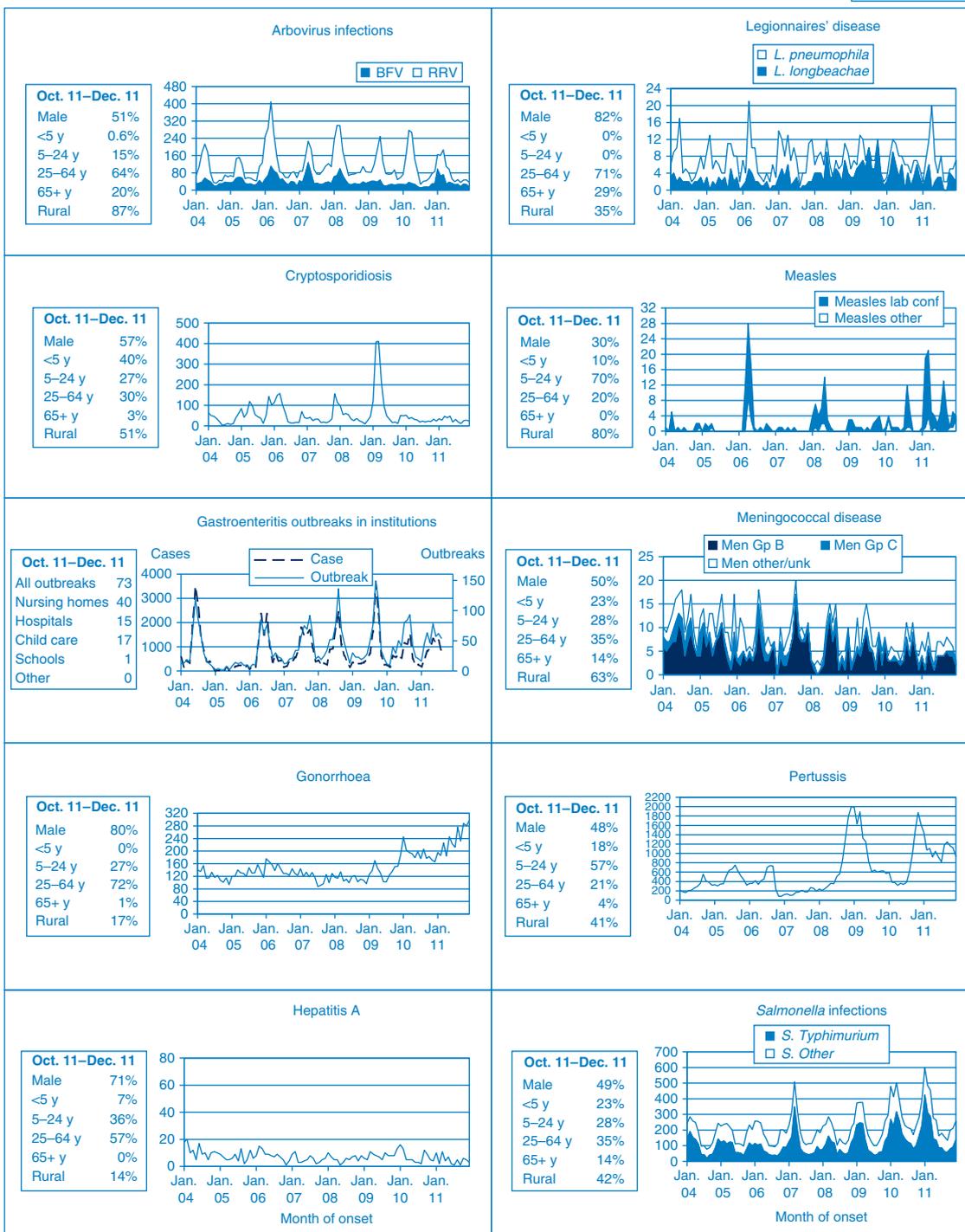


Table 2. Notifications of scheduled medical conditions received in December 2011 by Local Health District, NSW

Condition	Local Health District										Justice Health	Total For Dec ^b	Year to date ^b			
	Murrumbidgee NSW	Southern NSW	Western NSW	Far West	Hunter New England	Northern NSW	Mid North Coast	Central Coast	Northern Sydney	South Eastern Sydney				Illawarra Shoalhaven	Sydney	South Western Sydney
Bloodborne and sexually transmitted																
Chancroid ^a	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlamydia (genital) ^a	66	30	64	11	200	78	32	64	106	252	74	150	135	128	50	17
Gonorrhoea ^a	3	1	4	2	17	8	1	2	22	71	5	44	29	29	5	1
Hepatitis B – acute viral ^a	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hepatitis B – other ^a	-	-	2	1	3	2	-	1	30	21	1	27	27	29	1	1
Hepatitis C – acute viral ^a	7	9	12	5	20	14	3	12	13	20	13	25	27	23	8	19
Hepatitis C – other ^a	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hepatitis D – unspecified ^a	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lymphogranuloma venereum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Syphilis	-	1	-	-	5	-	-	2	1	8	1	-	-	4	2	24
Vectorborne																
Barmah Forest virus ^a	-	-	-	1	4	7	2	-	-	-	-	-	-	-	-	-
Ross River virus ^a	4	-	2	1	5	6	1	-	-	-	-	-	-	-	-	14
Arboviral infection (other) ^a	-	1	-	-	2	-	3	1	2	2	6	-	1	-	-	19
Malaria ^a	1	-	-	-	-	-	-	-	3	3	-	2	-	-	-	16
Zoonoses																
Anthrax ^a	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Brucellosis ^a	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	6
Leptospirosis ^a	-	-	-	-	-	-	2	-	-	-	1	-	-	-	-	3
Lyssavirus ^a	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Psittacosis ^a	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
Q fever ^a	1	-	1	-	4	3	1	-	-	-	2	-	-	-	-	19
Respiratory and other																
Blood lead level ^a	1	-	3	7	-	-	-	-	-	-	-	-	-	1	-	12
Influenza ^a	1	1	4	1	4	3	-	4	13	18	6	8	14	22	2	247
Invasive pneumococcal infection ^a	1	2	5	-	7	1	-	1	2	9	2	3	2	5	3	5005
<i>Legionella longbeachae</i> infection ^a	-	-	-	-	-	-	-	2	-	-	1	-	-	1	-	42
<i>Legionella pneumophila</i> infection ^a	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	527
Legionnaires' disease (other) ^a	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	31
Leptosy ^a	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	51
Meningococcal infection (invasive) ^a	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	9
Tuberculosis	1	-	-	-	2	-	-	1	3	2	1	2	-	-	-	2
Vaccine-preventable																
Adverse event after immunisation	2	1	-	-	-	-	-	-	2	-	2	-	-	1	-	8
<i>H. influenzae b</i> infection (invasive) ^a	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
Measles	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	4
Mumps ^a	-	-	-	-	1	-	-	-	1	1	-	3	1	-	-	7
Pertussis	87	21	47	8	74	114	22	35	76	95	48	48	109	114	82	980
Rubella ^a	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	17
Tetanus	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1
Enteric																
Botulism	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cholera ^a	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Cryptosporidiosis ^a	-	-	-	-	5	4	5	2	2	5	1	3	1	3	-	31
Giardiasis ^a	6	3	5	1	13	1	-	6	27	35	8	9	10	13	3	352
Haemolytic uraemic syndrome	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2358
Hepatitis A ^a	-	-	1	-	-	-	-	-	1	-	-	-	3	1	-	6
Hepatitis E ^a	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
Listeriosis ^a	-	-	-	-	1	-	-	-	1	-	-	1	1	-	-	20
Rotavirus ^a	4	-	4	1	10	5	2	2	18	10	1	1	1	7	3	20
Salmellosis ^a	17	7	8	-	39	19	9	6	31	26	7	16	25	13	8	1200
Shigellosis ^a	1	-	-	-	-	-	1	-	1	2	1	2	1	4	-	3483
Typhoid ^a	-	-	-	-	-	-	-	-	-	-	1	2	1	4	-	126
Verotoxin producing <i>E. coli</i> ^a	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	44
Miscellaneous																
Creutzfeldt-Jakob disease	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
Meningococcal conjunctivitis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1

^aLaboratory-confirmed cases only. ^bIncludes cases with unknown postcode. NB: Data are current and accurate as at the preparation date. The number of cases reported is, however, subject to change, as cases may be entered at a later date or retracted upon further investigation. Historical data configurations are included for continuity/comparison purposes and to highlight regional differences. NB: HIV and AIDS data are reported separately in the Public Health Bulletin quarterly. Data are reported as of public health unit office.

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