Australian hospital morbidity data on antibiotic resistance

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Abstract

Reports of infections with drug-resistant microorganisms are included in the National Hospital Morbidity Database (NHMD) at the Australian Institute of Health and Welfare. This database includes data on diagnoses of patients admitted to Australian hospitals, recorded using codes from the Australian version of the *International Classification of Diseases, 9th Revision, Clinical Modification* (ICD-9-CM), and the *International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Australian Modification*. Reports of infections with drug-resistant microorganisms, recorded as either the patient's principal diagnosis, or as a co-morbidity or complication, increased markedly between 1994–95 (when the first reports were included) and 2000–01. Infections resistant to penicillins were the most commonly recorded. The national introduction of the Australian versions of ICD-9-CM in 1995, and of casemix-based funding and management from the mid-1990s, has possibly led to more accurate medical record documentation and improved coding of these infections and are likely explanations for the observed increase in reporting. The NHMD should be considered as a component of a national surveillance system for antibiotic resistance. Its routine data collection covers almost all hospital separations in Australia and is supported by a comprehensive national data collection infrastructure. *Commun Dis Intell* 2003;27 Suppl:S55–S60.

Keywords: hospital morbidity, antibiotic resistance

Introduction

Antibiotic resistance is a public health issue of major importance, with impacts on health costs resulting from consequent needs to use more expensive antibiotics, multiple courses of antibiotics, increased length of hospital stay, and increased morbidity and mortality.[1] Systems for resistance surveillance in human bacterial isolates seem to be well established.[1] However, efforts to reduce the occurrence and impact of antibiotic resistance, such as those coordinated by the Commonwealth Interdepartmental JETACAR Implementation Group, could usefully be additionally informed by other monitoring activities.

Hospital morbidity data are routinely collected for all patients admitted in Australian hospitals. These data, which include codes for infections with antibiotic resistant organisms, have the advantage of essentially fully covering hospital separations (discharges, deaths or changes in type of care) throughout Australia, and being supported by substantial national data collection infrastructures. These data (collated nationally as the Australian Institute of Health and Welfare's National Hospital Morbidity Database, NHMD) could therefore potentially be used as a component of a national surveillance system for antibiotic resistance. However, the nature of this data collection, and its limitations, need to be taken into consideration.

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The National Hospital Morbidity Database

The NHMD is a compilation of electronic summary records collected in admitted patient morbidity data collection systems in almost all Australian hospitals.[2] The data are provided by state and territory health authorities and are based on the agreed National Minimum Data Set for Admitted Patient Care endorsed by the National Health Information Management Group and detailed in the *National Health Data Dictionary*.[3]

The data relate to hospital episodes of care or separations (discharges, deaths or changes in type of care), compiled by the date of separation: data for 1997–98, for example, include separations from 1 July 1997 to 30 June 1998. As the records relate to separations, rather than to individual patients, a patient who had been hospitalised more than once will have more than one record in the database.

Included in the NHMD are demographic, administrative and length of stay data, and data on diagnoses, procedures and external causes of injury and poisoning. A principal diagnosis is reported for all separations and is defined as the diagnosis established after study to be chiefly responsible for occasioning the patient's episode of care in hospital.[3]

A majority of records also have one or more additional diagnoses. These are defined as conditions or complaints which either coexisted with the principal diagnosis or arose during the episode of care.[3] For diagnoses of injuries and poisonings (which can include adverse events such as nosocomial infections), 'external causes' are reported, defined as the environmental events, circumstances and conditions as the cause of injury, poisoning and other adverse effects.

Infections (such as those reported with antibiotic resistant organisms) can be recorded as the principal diagnosis or as an additional diagnosis. A secondary code is assigned (as an additional diagnosis) if the infection was caused by an antibiotic resistant organism. More than one drug-resistant organism, or more than one type of antibiotic resistance, can be reported within a single record.

Diagnoses and external causes have been assigned codes based on the International Statistical Classification of Diseases and Health Related Problems, 10th Revision, Australian Modification (ICD-10-AM)[4] since 1998-99 in four states or territories, and since 1999-00 in the other four (Table 1). From 1995-96 to the implementation of ICD-10-AM, the Australian editions of the International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM)[5,6] were used. Various other versions of ICD-9-CM (for example, United States' versions) were used prior to 1 July 1995.

Codes for infections with antibiotic resistant organisms were available in ICD-9-CM versions used since 1994-95, but only in ICD-10-AM since 2000-01. In ICD-9-CM, infections with drug-resistant organisms were classified and coded to V09 (Infection with drug-resistant microorganism), with sub-categories available for different types of antibiotic resistance. In ICD-10-AM, a single code for drug resistance of any type (Z06) was available for data from 1 July 2000,[7] and separate codes for multidrug-resistant *Staphylococcus aureus* and vancomycin resistant enterococci were included from July 2002.[8]

Reports of infections with drug-resistant microorganisms

Between 1994-95 and 1997-98, there were marked increases in reports of infections with drug-resistant microorganisms, and of hospital separations for which they were reported (Table 2). The most common type of antibiotic resistance reported was resistance to penicillins. Reports continued to increase (by 16%) in 1998–99 for the four jurisdictions that continued to use ICD-9-CM in that year (Queensland, Western Australia, South Australia and Tasmania) (data not shown). Nationally, there was a decline between 1997-98 and 1998-99, reflecting the introduction of the first edition of ICD-10-AM (which did not include a relevant code) in four jurisdictions from July 1998. In 2000-01 (in which the second edition of ICD-10-AM was used, with a relevant code), there were 21,704 separations reported nationally with infections with drug-resistant organisms, 25 per cent more than for 1997–98.

Table 1. International classification of disease codes used for infection with drug-resistant microorganisms

ICD version	Edition	Date of effect	Codes	Description
ICD-9-CM Australian version	First	1 July 1995*	V09.0	Infection with microorganisms resistant to penicillins
	Second	1 July 1996	V09.1	Infection with microorganisms resistant to cephalosporins and other ß-Lactam antibiotics
			V09.2	Infection with microorganisms resistant to macrolides
			V09.3	Infection with microorganisms resistant to tetracyclines
			V09.4	Infection with microorganisms resistant to aminoglycosides
			V09.5	Infection with microorganisms resistant to quinolones and fluoroquinolones
			V09.50	Without mention of resistance to multiple quinolones and fluroquinolones
			V09.51	With resistance to multiple quinolones and fluoroquinolones
			V09.6	Infection with microorganisms resistant to sulfonamides
			V09.7	Infection with microorganisms resistant to other specified anti-mycobacterial agents
			V09.70	Without mention of resistance to multiple anti-mycobacterial agents
			V09.71	With resistance to multiple anti-mycobacterial agents
			V09.8	Infection with microorganisms resistant to other specified drugs
			V09.80	Without mention of resistance to multiple drugs
			V09.81	With resistance to multiple drugs
			V09.9	Infection with microorganisms resistant to unspecified drugs
			V09.90	Without mention of multiple drug resistance
			V09.91	With multiple drug resistance
ICD-10-AM	First	1 July 1998†		No codes to indicate infection with drug-resistant microorganisms
	Second	1 July 2000	Z06	Infection with drug-resistant microorganism
	Third	1 July 2002	Z06.1	Infection with multidrug-resistant *Staphylococcus aureus*
			Z06.2	Infection with vancomycin resistant enterococci
			Z06.8	Infection with other drug-resistant microorganism
			Z06.9	Infection with drug-resistant microorganism, unspecified

* Prior to 1 July 1995, ICD-9 and various versions of the United States' ICD-9-CM were used.

† ICD-10-AM first edition was used in New South Wales, Victoria, the Australian Capital Territory and the Northern Territory from 1 July 1998, and in all states and territories from 1 July 1999.

Table 2. Infections with drug-resistant microorganisms reported to the National Hospital Morbidity Database, Australia, 1994–95 to 2000–01

ICD-9-CM Code	Description	1994-95	1995-96	1996-97	1997-98	1998-99†	2000-01
V09.0	Penicillins	2,160	5,901	9,764	12,592	6,532	‡
V09.1	Cephalosporins and other ß-Lactam antibiotics	68	560	1,090	1,459	827	‡
V09.2	Macrolides	9	228	450	544	325	‡
V09.3	Tetracyclines	46	180	385	494	290	‡
V09.4	Aminoglycosides	32	234	331	451	282	‡
V09.5	Quinolones and fluoroquinolones						
V09.50	Without mention of resistance to multiple quinolones and fluroquinolones	7	48	137	166	87	‡
V09.51	With resistance to multiple quinolones and fluoroquinolones	0	39	86	150	41	‡
V09.6	Sulfonamides	35	75	90	85	19	‡
V09.7	Other specified anti-mycobacterial agents						
V09.70	Without mention of resistance to multiple anti-mycobacterial agents	8	28	34	43	22	‡
V09.71	With resistance to multiple anti-mycobacterial agents	9	51	77	164	67	‡
V09.8	Other specified drugs						
V09.80	Without mention of resistance to multiple drugs	20	362	780	1,005	555	‡
V09.81	With resistance to multiple drugs	148	850	1,782	2,283	1,001	‡
V09.9	Unspecified drugs						‡
V09.90	Without mention of multiple drug resistance	19	100	87	131	100	‡
V09.91	With multiple drug resistance	59	416	838	1,157	643	‡
Z06 (ICD-10-AM)	Infection with drug-resistant micro-organism	‡	‡	‡	‡	‡	21,824
	Total infections with drug-resistant microorganisms	2,620	9,072	15,931	20,724	10,791	21,824
	Total separations with infections with drug-resistant organisms	2,451	7,752	13,412	17,350	8,920	21,704

* See Table 1 for information on relevant ICD codes. There was no code available for 1999-00.

† In 1998-99, only Queensland, South Australia, Western Australia and Tasmania were using ICD-9-CM.

‡ Not applicable.

Data for 2000-01 provides an illustration of the other information recorded for the separations for which infections with drug-resistant microorganisms were reported. For example, males accounted for more separations (12,094 separations, 55.7%) than females (9,610 separations). Fifty-six per cent (12,252 separations) were for patients aged over 65 years, with highest numbers reported for males in the 75-79 years age group (1,731 separations) and for females aged over 85 years (1,536 separations).

The principal diagnoses most frequently reported were infection following a procedure, not elsewhere classified (code T81.4, 1,309 separations) and care involving a rehabilitation procedure, unspecified (code Z50.9, 1,289 separations). The organisms (within ICD-10-AM Chapter 1 infectious and parasitic diseases) most commonly reported were *Staphylococcus aureus* (code B95.6, 13,894 separations) and *Pseudomonas* (code B96.5, 2,444 separations).

The complications of surgical and medical care (ICD-10-AM codes T80-T88) reported most frequently as principal or additional diagnosis for these separations were infection following a procedure, not elsewhere classified (code T81.4, 3,813 separations) and infection and inflammatory reaction due to other cardiac and vascular devices, implants and grafts (code T82.7, 1,096 separations). External causes relating to complications (ICD-10-AM codes Y60–Y84) that were commonly reported with infections with drug-resistant microorganisms included surgical operation with implant of artificial internal device (code Y83.1, 1,419 separations) and other surgical procedures (code Y83.8, 1,352 separations).

Discussion

As noted above, the NHMD covers essentially all admissions to Australian hospitals, and is supported by substantial national data collection infrastructures. It includes a range of information that could potentially be used to supplement other antibiotic resistance surveillance activities.

However, the data on infections with drug-resistant microorganisms collected to date is of limited use. The antibiotic resistance codes available in ICD-9-CM may not have matched priority needs for surveillance data, without, for example, a code specific for multidrug-resistant *Staphylococcus aureus*. The first edition of ICD-10-AM (used from July 1998) did not include any codes for antibiotic resistance, and the second edition's single code (used from July 2000 to June 2002) is also unlikely to suit surveillance needs.

The third edition of ICD-10-AM may prove more suitable for monitoring of infections with drug-resistant microorganisms, with its specific codes for infections with multidrug-resistant *Staphylococcus aureus* and vancomycin resistant enterococci. It will be in use from July 2002 to June 2004 (with 2002–03 data available nationally from July 2004), and coders are to be guided in the use of the codes with definitions and examples of the correct coding in an accompanying Australian Coding Standard.

Limitations of the data collected to date also arise from the changes in codes available for infections with drug-resistant microorganisms since 1994–95, which mean that comparison of the data over time is currently problematic. In addition, the increase in separations with antibiotic resistant organisms since 1994-95 is unlikely to represent increased numbers of these infections with these organisms. Improvements in coding quality, associated with the introduction of casemix-based funding and management, the introduction of the Australian editions of ICD-9-CM, major national and state/territory coder and clinician education initiatives and coding audit activities could have played significant roles in the increased reporting of these infections.

Importantly, coding of antibiotic resistance is largely dependant on the accuracy and completeness of entries made by clinical and laboratory staff in patients' medical records. Definitions for drug resistance have not been included within ICD-10-AM, so coding is likely to have reflected the definitions used for clinician documentation of the drug resistance in the medical record. Hence, it is not certain that all the reported resistance was laboratory-confirmed. In addition, although coders are instructed to code infectious organisms only if a clinically significant infection has been documented, some colonisations may also have been included.

Association of the antibiotic resistance information with the principal diagnosis, additional diagnosis or the external cause information in a record cannot be assumed. More detailed analysis of the data (using information on the sequencing of the codes) could allow associations to be clarified, as would better linkage of these data within separation records.

Hence, whilst increased numbers of reports provide some indication of increased coding quality in relation to infections with drug-resistant microorganisms, and the introduction of the new codes for 2002 may better reflect surveillance needs, the use of these data will continue to require caution, and further refinements to data collection may be required. ICD-10-AM is revised every two years, so refinement of relevant codes and coding standards could be sought as necessary. In addition, the Australian Council for Safety and Quality in Health Care is working to improve the use of morbidity data sets for adverse event monitoring,[9] and this work could encompass enhancements relating to infections with antibiotic resistant organisms. With such alterations, hospital morbidity data collections such as the NHMD could be considered as potential components of a national surveillance system for antibiotic resistance in Australia.

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