

Medicare-related service use and costs among people with diagnosed and undiagnosed diabetes and respiratory conditions

Catherine R Chittleborough, Michael J Burke, Anne W Taylor, David H Wilson, Patrick J Phillips, Robert J Adams, Richard E Ruffin and the North West Adelaide Health Study Team

Abstract

Objective: To compare Medicare-related costs and service utilisation of people with diagnosed diabetes, asthma or chronic obstructive pulmonary disease (COPD) to those who were previously undiagnosed, and those without these conditions.

Design, setting and participants: Representative cross-sectional study of people (18+ years) living in the north-west area of Adelaide. Participants were recruited by telephone interviews. Biomedical and self-report data for 2352 participants were linked to Medicare Australia Medicare Benefits Schedule (MBS) data from 1997 to 2002.

Main outcome measures: Mean number and cost (benefit paid) of MBS services for people with diagnosed and previously undiagnosed diabetes, asthma, and COPD, and those without these conditions.

Results: Mean (\pm SD) MBS costs were significantly greater for people diagnosed with diabetes (\$4205 \pm 2596), asthma (\$3307 \pm 2542), or COPD (\$3779 \pm 2529) than for those without these conditions. MBS costs for people with asthma or COPD that had not yet been diagnosed were also significantly higher than for those without these conditions, although this was inconsistent across financial years.

Conclusions: Diabetes, asthma, and COPD are costly conditions in terms of health service use. Costs associated with undiagnosed asthma and COPD are similar to their diagnosed states. Prevention of progression along each chronic disease continuum is likely to reduce costs.

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What is known about the topic?

Diabetes, asthma and chronic obstructive pulmonary disease (COPD) are associated with significant health care costs. Little is known about the health care costs associated with these conditions before they are diagnosed.

What does this paper add?

Data from a representative population sample, linked to Medicare Australia data, showed that in addition to the increased health service costs of diagnosed diabetes, asthma and COPD, the undiagnosed states of these conditions also impact health service use.

What are the implications?

Early detection and effective management once diagnosed remain imperative to reducing health care costs of these conditions.

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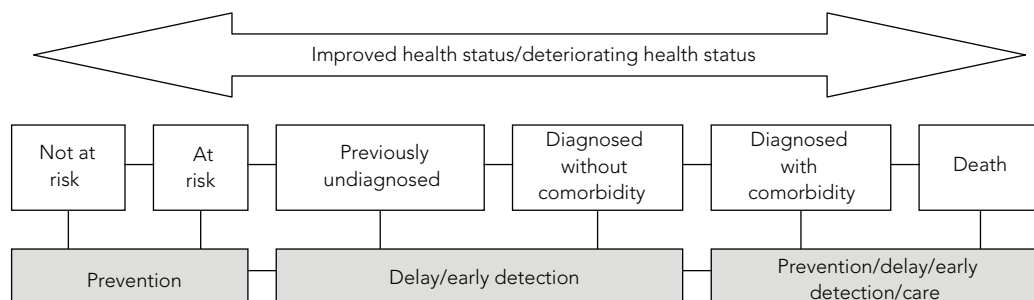
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I The chronic disease continuum



DIABETES, ASTHMA, and chronic obstructive pulmonary disease (COPD) are health priorities because of the significant burden they place on the community in health, social and economic costs, and the potential for their prevention.^{1,2} Undertaking cost of illness studies among people with chronic conditions aids decision making regarding priorities for resource allocation³ and, combined with population prevalence projections, enables future cost projections and planning.⁴

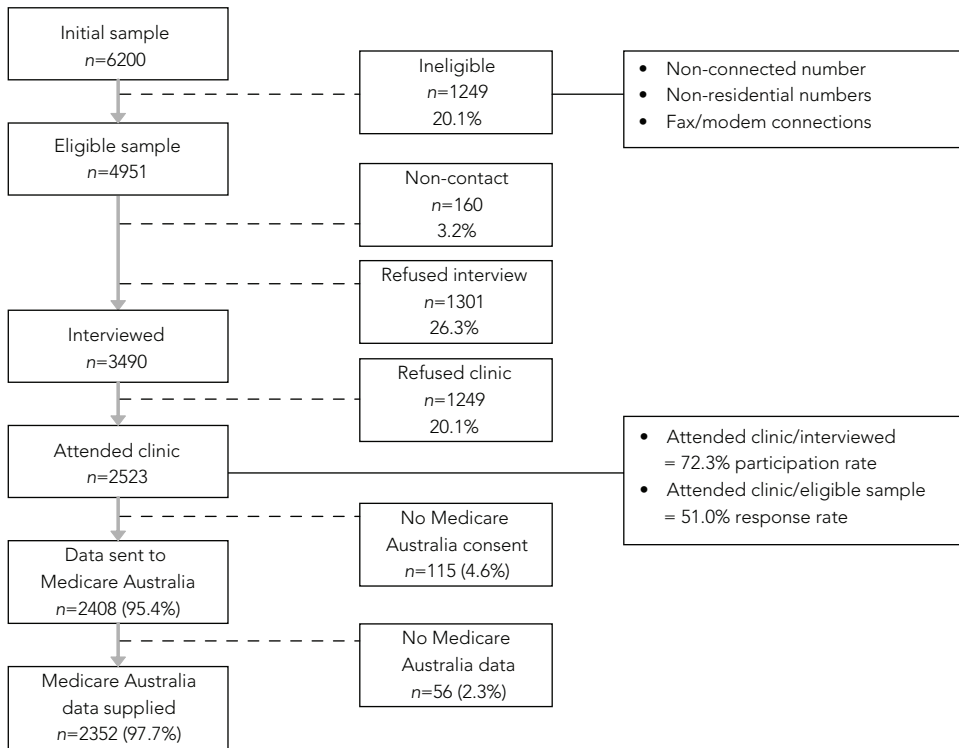
Many national and international studies have examined the direct and indirect costs associated with diabetes, asthma and COPD, although few have examined the costs associated with different stages of the condition. The DiabCoSt Australia study explored the cost of type 2 diabetes in Australia.⁵ This study, however, relied on self-reported service use, drew its sample from a database of people voluntarily registered as having diabetes and restricted its sample to people aged over 40. In estimating the overall cost of diabetes, this study did include people with undiagnosed diabetes but assumed that the cost per person with undiagnosed diabetes was equal to that of a person who had been diagnosed. A United States examination of medical care costs preceding a diagnosis of type 2 diabetes found that an incremental economic burden was present for at least 8 years before diagnosis, although costs of undiagnosed diabetes were not equivalent to those observed for diagnosed diabetes until the year before diagnosis.⁶ A Canadian study found that direct medical costs increased from

\$2.6 billion for people with diagnosed diabetes to \$3.5 billion when undiagnosed diabetes was also taken into account.⁷ Other studies of the United States population have compared the costs for people with and without diabetes but have excluded people with undiagnosed diabetes.^{8,9}

The most recent national data detailing the cost of asthma were based on 1991 prevalence and estimated the direct and indirect costs at between \$585 and \$720 million in Australia.¹⁰ The direct and indirect costs of COPD in Australia were estimated at \$800 million per annum in 1998.¹¹ Studies conducted in the United States and Europe have provided information on direct and indirect costs¹² and shown that increased severity of asthma and COPD are associated with increased costs.^{13,14} These studies, however, are unable to compare costs at the diagnosed and undiagnosed stages of the disease continuum.

The North West Adelaide Health Study is a biomedical cohort study that has been designed to assess a large representative population sample according to stage of disease to identify each segment's characteristics and how they change over time (Box 1).¹⁵ This assessment will improve understanding of how resources can be better allocated and how interventions can be targeted to those who will benefit most in terms of better health outcomes. This study assesses diabetes, asthma, and COPD along a chronic disease continuum to examine and compare the cost of different stages, specifically no disease, undiagnosed disease, and diagnosed disease.

2 North West Adelaide Health Study response rates



A source for estimating use of health services in Australia is Medicare Australia (formerly the Health Insurance Commission), which collects data on provider service claims for payment purposes, and therefore captures the majority of resource use. It has been shown to be more accurate than self-reported service utilisation data.^{16,17} This study describes stages of the continuum for diabetes, asthma, and COPD in terms of Medicare Benefits Schedule (MBS) service use and benefits paid.

Methods

Recruitment

All households in the north-western area of Adelaide with a telephone connected and the telephone number listed in the Electronic White Pages (EWP) were eligible for selection in the

North West Adelaide Health Study. The north-west region represents about half of the population of Adelaide, and about one-quarter of the population of South Australia.¹⁸ The north and west regions reflect the demographic profile of the state's population, containing pockets of both socioeconomic disadvantage and advantage.¹⁵ Selected households were sent an introductory letter and information brochure informing them of the purpose of the study. Within each household, the person who had their birthday last, and was 18 years or older, was selected for interview and invited to attend the clinic. Telephone interviewing was conducted by professional interviewers using the Questionnaire Programming Language (QPL) system. This system allows automatic data entry of respondents' answers from the interviewer's computer screen to the study database. It correctly sequences questions, incorporates skips, and enforces a range of

3 Unadjusted median, and adjusted mean number of services and total benefit paid per person for the diabetes, asthma, and COPD continuum, July 1997 to June 2002

	<i>n</i>	Median	Mean	SD	Statistical significance
Diabetes					
No diabetes					
Number of services	2185	44.00	62.62	59.13	
Benefit paid (\$)	2185	1338.25	2177.06	2527.26	
Previously undiagnosed diabetes					
Number of services	30	65.11	70.84	59.23	
Benefit paid (\$)	30	1937.95	2257.58	2531.03	
Diagnosed diabetes					
Number of services	132	114.93	113.12	60.75	* ^
Benefit paid (\$)	132	4059.41	4204.75	2596.01	* ^
Asthma					
No asthma					
Number of services	2075	45.00	62.61	59.54	
Benefit paid (\$)	2075	1339.46	2163.17	2535.98	
Previously undiagnosed asthma					
Number of services	54	88.00	83.79	59.88	*
Benefit paid (\$)	54	3402.11	3085.88	2550.71	*
Diagnosed asthma					
Number of services	224	64.00	89.58	59.67	*
Benefit paid (\$)	224	2093.76	3307.47	2542.08	*
COPD					
No COPD					
Number of services	2250	46.00	64.58	59.29	
Benefit paid (\$)	2250	1425.65	2252.57	2522.60	
Previously undiagnosed COPD					
Number of services	60	78.00	86.62	59.69	*
Benefit paid (\$)	60	2421.93	2971.99	2539.54	*
Diagnosed COPD					
Number of services	16	142.07	106.96	59.46	*
Benefit paid (\$)	16	5058.48	3779.22	2529.49	*

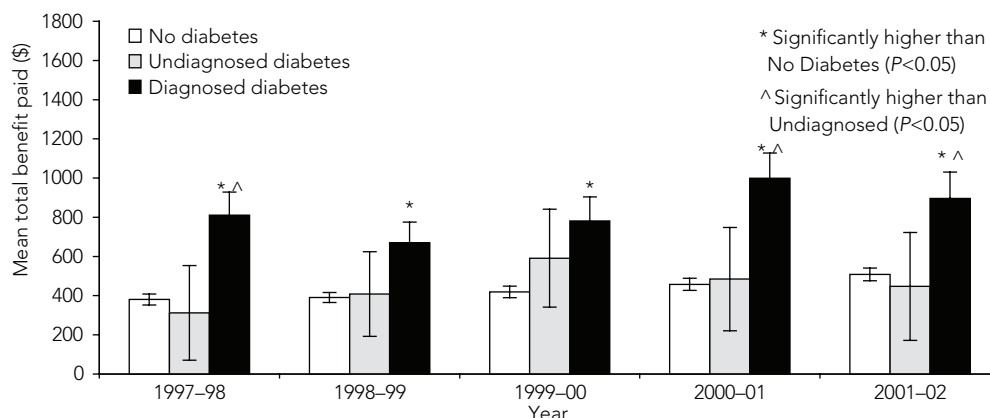
Diabetes missing cases $n=6$, COPD missing cases $n=26$. Means controlled for age and sex. * Statistically significantly higher than "No condition" ($P < 0.05$) ^ Statistically significantly higher than "Undiagnosed condition" ($P < 0.05$).

checks on the data entered by the interviewers. Up to ten call-backs were made in an effort to interview the selected individual. Non-respondents were not replaced. Further details of the study methodology have been published previously.¹⁵

Data collection and definitions

Self-reported health-related information, including questions on diabetes, asthma and COPD, was collected in the recruitment telephone interview and a self-completed questionnaire. Bio-medical data were obtained at the clinic

4 Mean (\pm SD) total benefit paid per person with no diabetes, previously undiagnosed diabetes, and diagnosed diabetes, by year, controlling for age and sex



appointment.¹⁵ Clinic appointments were conducted within about 10 days of the telephone interview.

People with diagnosed diabetes were those who reported having been told by a doctor that they had diabetes. People with previously undiagnosed diabetes were defined as having a fasting plasma glucose level of at least 7.0mmol/L¹⁹ but who did not report having been told by a doctor that they had diabetes.

People with diagnosed asthma were those who reported having been told by a doctor that they had asthma. People with previously undiagnosed asthma were defined as having a bronchodilator response of at least a 15% increase in forced expiratory volume in one second (FEV_1), or at least a 12% increase in FEV_1 with an absolute difference in FEV_1 greater than 200ml, and who did not report a previous diagnosis. Spirometry was conducted according to American Thoracic Society criteria.²⁰

Participants were considered to have COPD according to the European Respiratory Society (ERS) criteria if their measured $FEV_1:FVC$ (forced vital capacity) ratio was less than the result of the formula: $87.21 - (0.18 \times age) \times 0.882$ for males, and $89.10 - (0.19 \times age) \times 0.893$ for females.^{21,22} In this formula, 0.882 and 0.893 represent one minus two standard deviations

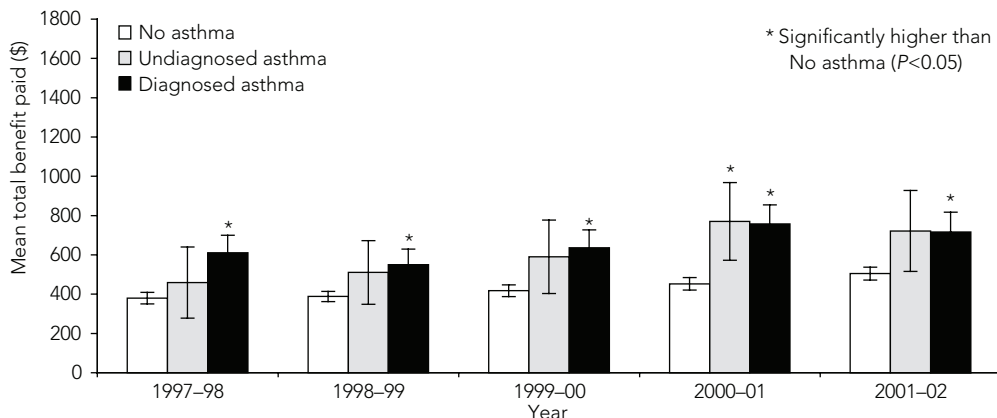
from the predicted mean for males and females, respectively. People with previously undiagnosed COPD were defined as having COPD according to the above ERS criteria, but who did not report having been told by a doctor that they had COPD (chronic bronchitis or emphysema).

Matching Medicare data

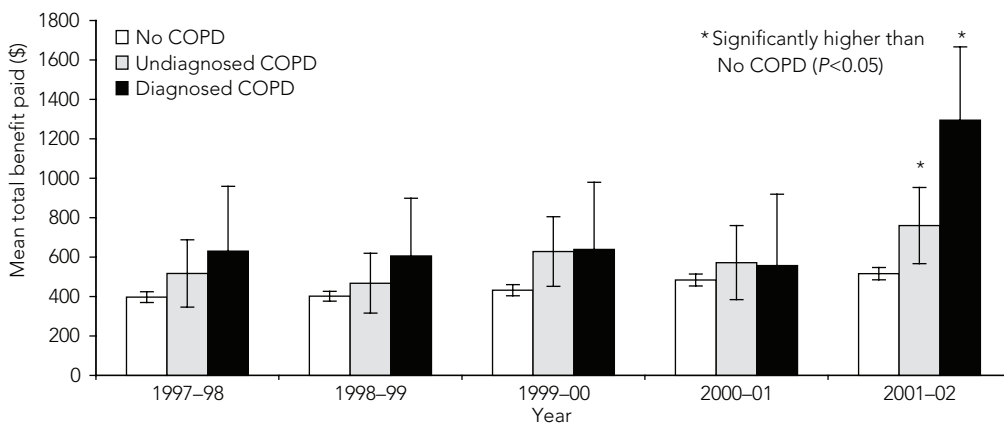
The process of matching North West Adelaide Health Study participants with Medicare Australia data was performed in two ways, depending on the data supplied to Medicare Australia. Method 1 involved matching Medicare enrolment details using the supplied surname, first name, second initial (if it existed), date of birth and sex. Alternatively, Method 2 involved matching Medicare enrolment details using Medicare card number, date of birth and sex. Method 2 resulted in a higher match rate. Where available, names were included in data supplied for Method 2 matching to enable differentiation between same-sex twins.

Informed, written consent was obtained from participants before their personal information was sent to Medicare Australia for matching. Data obtained from Medicare Australia for each participant included date of service, MBS item number, and benefit paid, for each service for the 5-year period from 1 July 1997 to 30 June 2002. Medicare claims data included only those services

5 Mean (\pm SD) total benefit paid per person with no asthma, previously undiagnosed asthma, and diagnosed asthma, by year, controlling for age and sex



6 Mean (\pm SD) total benefit paid per person with no COPD, previously undiagnosed COPD, and diagnosed COPD, by year, controlling for age and sex



that qualify for a Medicare benefit and for which a claim had been processed. They did not include services provided by hospital doctors to public patients in hospitals, or services that qualify for a benefit under the Department of Veterans' Affairs National Treatment Account.

Ethics

The North Western Adelaide Health Service Ethics of Human Research Committee approved the study design for the North West Adelaide Health

Study, and all participants provided written consent to participate in the study. Separate informed, written consent was obtained from participants at their clinic appointment, before their personal information was sent to Medicare Australia for matching.

Statistical analyses

Data analyses were performed using SPSS, Version 11 (SPSS Inc., Chicago, Ill, USA). The data were weighted by region, age groups, sex, and

probability of selection in the household to the Australian Bureau of Statistics Estimated Residential Population.¹⁸ Median, mean values and standard deviations were obtained for the total number of occasions of service and total benefit paid for the 5-year period. Mean values were also examined by each financial year period. When comparing groups along each disease continuum, means were calculated using multiple analysis of variance (MANOVA) to control for differences in age and sex. Comparisons of means were conducted using *t*-tests and ANOVA at a significance level of 0.05.

Results

The response rates of the overall study and the proportion of participants for whom Medicare Australia data were obtained are shown in Box 2. It could not be determined whether data for the 56 participants for whom Medicare Australia data were not supplied were unable to be matched, or whether these participants did not use any MBS services in this 5-year period. Those who did not consent to release of their Medicare Australia data were significantly more likely to be male and aged under 40 years. No significant differences in the prevalence of diagnosed or undiagnosed asthma, COPD or diabetes existed between those who did and did not consent for their Medicare data to be extracted. Any bias in cost estimates resulting from non-consent is therefore likely to be negligible.

Overall costs

The mean number of services used by each of the 2352 participants increased from 11.9 (SD, 14.7) in 1997–98 to 14.4 (SD, 18.0) in 2001–02. The proportion of people using no services within a year ranged from a high of 7.4% in 1997–98 to a low of 5.5% in 1999–00. The mean annual benefit paid increased from \$403.66 (SD, \$701.71) in 1997–98 to \$529.71 (SD, \$815.32) in 2001–02.

MBS service use and costs were significantly associated with age and sex, so these factors were controlled for in subsequent analyses. Females

used statistically significantly more MBS services (78.88) than males (51.34), and had a significantly higher mean benefit paid (2731.95 v 1818.04) over the 5-year period. Older age was significantly associated with greater MBS service use (Pearson correlation 0.38, $P < 0.001$) and benefit paid (Pearson correlation 0.36, $P < 0.001$).

Disease-specific costs

The prevalence of diabetes was 6.7% (95% CI, 5.6%–7.8%), with 18.3% of these patients previously undiagnosed (1.2% overall undiagnosed prevalence). The prevalence of asthma was 11.6% (95% CI, 10.3%–12.8%), with 19.1% of these patients previously undiagnosed (2.2% overall undiagnosed prevalence). For COPD, the prevalence was 3.2% (95% CI, 2.5%–3.9%), and 78.6% of these patients were previously undiagnosed (2.5% overall undiagnosed prevalence).

The total mean number of services and benefit paid for the 5-year period July 1997 to June 2002 for diabetes, asthma and COPD, assessed according to each disease continuum, are shown in Box 3. A statistically significantly higher mean benefit paid was associated with having diagnosed diabetes, asthma or COPD compared with not having these conditions. In addition, the mean benefits paid for people with asthma or COPD that had not yet been diagnosed were also significantly higher than for those without these conditions.

The mean benefits paid by year for each disease continuum are shown in Box 4, Box 5 and Box 6. The relationship observed with the mean benefit paid for the overall 5-year period being higher for people with diagnosed diabetes than with undiagnosed diabetes was not statistically significant in the individual years 1998–99 or 1999–00. The mean benefit paid was not significantly different between the diagnosed and undiagnosed states of asthma. Diagnosed COPD was only associated with a statistically significantly higher mean benefit paid than undiagnosed COPD in 2001–02.

Applying the mean benefit paid per person to population estimates, the overall MBS costs of diagnosed diabetes, diagnosed asthma and diagnosed COPD among South Australians aged 18 years and over in 2001–02 were \$69.1 million,

\$76.9 million, and \$10.3 million, respectively. Including the additional costs of the undiagnosed conditions, these overall MBS costs for diabetes, asthma and COPD in 2001–02 increased to \$76.9 million, \$99.6 million, and \$48.7 million, respectively.

Discussion

This study is the first published in Australia to provide self-reported doctor diagnosis and biomedical data linked to the national Medicare Australia database for individual cases with and without chronic conditions. This study has shown that for the chronic conditions diabetes, asthma, and COPD, MBS costs, as well as the number of MBS items used, were greater for those people diagnosed with a condition than those without the condition (although in the case of COPD this was only statistically significant in 2001–02). After controlling for differences in age and sex between people with diagnosed diabetes and without diabetes, the total MBS benefit paid among people with diagnosed diabetes was 1.9 times higher than that among people without diabetes. Similarly, the total MBS benefits paid among people with diagnosed asthma or diagnosed COPD were 1.5 and 1.7 times higher than that among people without asthma or COPD, respectively. These results were comparable to a US analysis that showed people with diabetes had medical expenditures that were 2.4 times higher than expenditures that would be incurred by the same population in the absence of diabetes.⁹ The average Medicare expenditure per beneficiary with COPD was 2.4 times the average expenditure for all Medicare beneficiaries in another US study, although this analysis only included people aged 65 years and over.²³

Few studies, particularly in the case of respiratory conditions, have examined resource utilisation or costs among people who meet symptom or diagnostic criteria but who have not yet been diagnosed.²⁴ MBS resource use among people with undiagnosed diabetes, asthma or COPD was higher than among those who did not have the condition. Although this did not reach statistical

significance in the case of diabetes, point estimates indicate that these conditions have an effect on health service use even before the condition has been diagnosed.

The strengths of this study lie in its focus on the disease continuum, including previously undiagnosed conditions in the general community, its large sample size, and its use of data linkage. Use of the EWP sampling frame means that people without a listed telephone number were not eligible for selection in the study. Telephone surveys, however, have been shown to be representative, with the majority of households owning telephones, and few health or socioeconomic differences existing between those with and without a telephone number listed in the EWP.^{25,26} Participants in this cohort have also been shown to be similar to non-participants in terms of health-related risk factors and socio-demographics.²⁷

This study relied on participant recall of doctor diagnosis, as information confirming diagnosis, such as from general practitioner or hospital records, was unavailable. If a participant does not recall being told by a doctor that they have the condition, however, it is unlikely that effective management is occurring.

Although patients may make use of services that are not eligible for an MBS rebate, the service data held by Medicare Australia is the most comprehensive and reliable single source of health care utilisation in Australia.²⁸ In the North West Adelaide Health Study, over 85% of participants used at least one Medicare-eligible service over a calendar year. MBS data, however, does not contain any information regarding patient out-of-pocket expenses, so the impact that this had on service utilisation, and the difference in service utilisation between different demographic and health status groups, has not been addressed in this paper. It will be possible, in future data analyses, to examine Pharmaceutical Benefits Scheme and hospitalisation data to more comprehensively determine the direct health costs of these diseases.

Participants with diabetes, asthma or COPD are more likely to have additional comorbidities,

such as cardiovascular disease or mental health conditions,²⁹ which may have influenced service use and costs. Analyses, however, were controlled for age. Previous comparisons have also shown that people with diagnosed and undiagnosed asthma have similar current smoking, cholesterol, physical activity and asthma symptom profiles to those without asthma.³⁰ People with undiagnosed COPD also have similar risk factor and comorbidity profiles to those with diagnosed COPD.²⁹ It is also difficult to assess the population who are truly without disease, as MBS items are not disease specific. For example, those identified as not having diabetes may have other comorbidities.

For those without diabetes, asthma or COPD, the number of MBS items and the mean cost per person showed a slow increase over the 5 years. This is not unexpected, as the costs of individual MBS items increase over time, and the concurrent ageing of the sample is associated with increasing service use. The data from Medicare Australia contained information regarding the amount of rebate provided per item. These figures were given in dollars at the time of processing. As the primary interest of this paper is the comparison of costs across health status rather than time, costs have been presented in nominal rather than constant real dollar terms, and have not been standardised to a certain point in time. Any changes in MBS items or pricing structures that occurred during this period would have been changes that affected all participants at that time. For example, observed increases in costs after 1999–00 among the diagnosed groups, particularly among participants with diagnosed diabetes or COPD, could be related to the introduction of the Enhanced Primary Care Program. To be able to compare totals across time, the item costs would need to be adjusted for inflation to ensure a constant real dollar value. Adjusting for inflation would not alter the relative distribution of costs within individual years.

Use of MBS data has shown that diabetes, asthma and COPD are costly conditions to the health system. Even the undiagnosed states of these conditions are impacting on health service

use. Burden of disease studies that only examine costs of diagnosed conditions may underestimate the true costs. There is potential for these costs to be reduced given that diabetes and COPD, and asthma to some extent, are considered to be at least partly preventable. While it is likely that diagnosis of these undetected conditions may increase costs associated with management in the short term, primary prevention, early detection and effective management once diagnosed to reduce related complications remain imperative to reducing the costs of these conditions to the health system in the long term.

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Competing interests

The authors declare that they have no competing interests.

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