



A population-based approach to the estimation of diabetes prevalence and health resource utilisation

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Abstract

Aim This study estimated diabetes prevalence and utilisation of healthcare services in Counties Manukau using routinely collected administrative data and compared estimates with findings for three other district health boards (DHBs) in close geographic proximity.

Method Records of subsidy claims for pharmaceuticals and laboratory investigations were linked to records in a national hospital admissions database to ‘reconstruct’ populations of four DHBs—Counties Manukau, Northland, Waitemata and Auckland. Individuals were included in reconstructed populations if they had health events recorded between January 2006 and December 2007. Diabetes cases were identified using an algorithm based on claims for monitoring tests and pharmaceuticals, as well as clinical codes for diabetes in hospital admissions.

Results Reconstructed populations were only 6% lower than census population counts indicating that the vast majority of the population use health services in a two year period. The age- and sex-standardised prevalence of diabetes was 7.1% in Counties Manukau and 5.2% in the other three DHBs combined. Prevalence of diabetes was highest amongst Māori (10.6% in women and 12.2% in men) and Pacific peoples (15.0% for women and 13.5% for men). Māori diabetes cases had the highest hospital discharge rate of any ethnic group. Community pharmaceutical prescribing patterns and laboratory test frequency were similar between diabetes cases by ethnicity and deprivation.

Conclusion Estimates of diabetes prevalence using linkage of routinely collected administrative data were consistent with epidemiological surveys, suggesting that linkage of pharmaceutical and laboratory subsidy databases with hospital admissions data can be used as an alternative to traditional surveys for estimating the prevalence of some long-term conditions. This study demonstrated substantial differences in the prevalence of diabetes and in hospitalisation rates by ethnicity, but measures of community diabetes care were similar by ethnicity and deprivation.

Counties Manukau District Health Board (CMDHB) is responsible for the funding and provision of health services for the people of Counties Manukau, serving around 480,000 people in 2009. It has the fastest-growing population of any district health board (DHB), the highest number of young people (aged ≤ 14 years), the highest numbers of Māori and Pacific peoples and the highest number of people living in the most deprived two deciles of the New Zealand deprivation index.¹

Diabetes is a leading cause of morbidity and mortality in New Zealand^{2,3} and is particularly common in Counties Manukau. Māori and Pacific peoples, who together

make up around 40% of the Counties Manukau population, have a disproportionate burden of diabetes compared with other groups.⁴⁻⁶ The 2006/07 New Zealand Health Survey (NZHS) estimated that Counties Manukau had the highest prevalence of self-reported diabetes in those aged ≥ 15 years of any DHB area.⁷ Furthermore, in Counties Manukau around one-third of adult respondents to the NZHS were found to be obese, with body mass indices ≥ 30 kg/m^{2,7}

Initiatives to reduce the growing burden of diabetes in Counties Manukau are underway. *Let's Beat Diabetes* (LBD) is a long-term, intersectoral strategy which draws on wide-ranging activities such as community-based programmes, social marketing, support for primary care and collaboration with the food industry, to prevent or delay the onset of Type 2 diabetes, limit disease progression and improve quality of life for those with diabetes in CMDHB.⁸ The *Chronic Care Management* (CCM) programme, a community- and primary care-focused programme, has a diabetes module aimed at structured management of individuals with complicated diabetes in the community.

In order to plan effectively for future community needs related to diabetes and understand the impact of initiatives such as LBD and CCM, timely and readily updateable estimates of the prevalence of diabetes in Counties Manukau are necessary. To take a 'whole of community' approach to planning, it is also important to gain insight into community care of diabetes, by examining factors such as community pharmaceutical prescribing patterns and laboratory monitoring.

This study estimated diabetes prevalence and utilisation of healthcare services in Counties Manukau using routinely collected administrative data and compared estimates with findings for three other DHBs in close geographic proximity.

Method

Study population—We linked three routinely collected administrative health databases in four DHBs: Counties Manukau, Northland, Waitemata and Auckland. Data from the National Minimum Data Set (NMDS—a national database containing details of all public and private hospital discharges from 1990 onwards) were linked with 30 months of community laboratory and pharmacy subsidy claims data for the period July 2005 to December 2007. Laboratory and pharmacy claims data containing details of reimbursement claims for subsidised community laboratory tests and pharmaceuticals dispensed on the New Zealand Pharmaceutical Schedule⁹ were obtained from the Ministry of Health.

The three databases were linked using unique National Health Index (NHI) numbers for each case record and all NHI numbers were encrypted by the Ministry of Health prior to analysis, to avoid identification of individuals. Individuals were included in the aggregated data set if they had any health service recorded in one or more of the three data sets in the 2 years between January 2006 and December 2007 (inclusive). All deceased individuals were removed from the reconstructed group using encrypted data from the Ministry of Health Mortality Collection.

Data were not available for those who did not have hospital events recorded in NMDS, or did not have claims made for subsidised pharmaceuticals or laboratory tests (with NHI numbers documented) during the study period. These aggregated data created a 'reconstructed' population of around 1.4 million people.

Identification of diabetes cases—In this study, 'diabetes' refers to all forms of diabetes mellitus. An individual from the study population defined above was identified as a 'case' if he or she met any of the following criteria: a hospital event with a principal or secondary International Classification of Diseases, 10th edition, Australian Modification (ICD-10-AM) diagnosis code E10-E14 'Impaired glucose regulation and diabetes mellitus', or the codes O24.0 to O24.3 which cover pre-existing diabetes in pregnancy since 1990, three or more HbA1c test claims within 2 years (2006/07), or two or

more community pharmaceutical dispensing claims for New Zealand Pharmaceutical Schedule therapeutic group (TG) level 2 categories 'Diabetes' and 'Diabetes management' in 2006/07.

Ethnicity—Prioritised ethnicity was used to classify ethnicity, so that individuals were categorised into only one ethnic group, according to a prioritised schedule, if more than one ethnicity was recorded in different databases. Consistent with the standard prioritisation protocol recommended by the Ministry of Health, ethnicity was prioritised in the following order: Māori, Pacific, Asian, NZ European/Other.¹⁰

Deprivation—Average NZDep2006 scores for the census area unit (CAU) in which a case lived were applied to each individual as a measure of socioeconomic status. NZDep2006 is a multi-dimensional index of deprivation used for small areas.¹¹ It includes nine dimensions covering income, home ownership, household occupancy, education, employment and access to transport and to a telephone.

Statistical analyses—Statistical analyses used Microsoft Excel™, SPSS® (version 13.0) and SAS® software applications. Prevalence estimates have been calculated using both the reconstructed population and 2006 national census estimates as denominators. Point estimates are reported for descriptive statistics and 95% confidence intervals are included where appropriate (95% CI). For direct standardisation, prevalence proportions were divided into the following age groups: 0-4 years, 10-year age intervals until age 84 years, 85+ years. Standardisation for age and sex used Statistics New Zealand national population estimates for 2006/07. Further detail on statistical methods is available in a background report.¹²

Ethical considerations—Ethical review was not required, as all unit record data were de-identified by the New Zealand Ministry of Health and no contact was made with participants. Only aggregated results have been reported.

Results

Study population—The combined data sets identified about 1.4 million people in all four DHBs, compared with 1.5 million in the March 2006 census estimate. The reconstructed population of CMDHB in 2006/07 contained 427,350 people, 6% fewer than the 454,790 identified in CMDHB in the March 2006 national census estimate. Social and demographic characteristics of the CMDHB reconstructed population are compared with 2006 national census estimates for CMDHB in Table 1.

Diabetes prevalence—Almost 27,000 diabetes cases were identified as resident in Counties Manukau in 2006/07, while 51,000 diabetes cases were identified in the remaining three northern region DHBs. This translated to a crude prevalence of 6.3% (95%CI 6.2%-6.4%) for Counties Manukau and 5.3% (95%CI 5.2%-5.3%) for the remaining three DHBs, using the reconstructed denominator. Counties Manukau had the highest age- and sex-standardised prevalence of diabetes of any of the four DHBs.

Using the reconstructed denominator, the age- and sex-standardised prevalence of diabetes in Counties Manukau was 7.1% (95%CI 7.0%-7.2%), compared with 5.2% (95%CI 5.1%-5.2%) for the remaining three DHBs combined. While a difference of 0.4% was found between the two crude Counties Manukau prevalence estimates using reconstructed and census denominators, this difference narrowed considerably with standardisation (Table 2).

Age-standardised prevalence of diabetes by ethnicity is presented in Table 3. Pacific women had the highest prevalence of any group, with an age-standardised prevalence (using reconstructed denominator) of 15.0%. Women of NZ European/Other ethnicity had the lowest diabetes prevalence of any group, at 4.0%.

Table 1. Social and demographic characteristics of reconstructed CMDHB population and estimated population in 2006 national census

	Category	Proportion of reconstructed population	Proportion of 2006 census estimate	Reconstructed count as a proportion of 2006 census count
Age group (years)	0-14	27%	25%	99%
	15-24	14%	15%	87%
	25-34	12%	13%	88%
	35-44	14%	15%	86%
	45-54	12%	13%	93%
	55-64	10%	9%	100%
	65-74	6%	5%	108%
	≥75	4%	4%	108%
Sex	Male	46%	49%	88%
	Female	54%	51%	99%
Ethnicity	Māori	15%	17%	86%
	Pacific	21%	21%	97%
	Asian	12%	16%	71%
	NZ European/ Other	52%	46%	104%
Deprivation quintile (average NZDep2006 for CAU)	Unknown	<1%	-	
	1	17%	23%	69%
	2	13%	8%	143%
	3	10%	16%	59%
	4	15%	9%	149%
	5	45%	44%	98%

Table 2. Crude and age- and sex-standardised diabetes prevalence estimates in CMDHB, 2006/07, using reconstructed and 2006 census denominators

		Prevalence (%)	95% CI for prevalence (%)	Adult (15+ years) prevalence (%)	95% CI for adult prevalence (%)
Reconstructed denominator	Crude	6.3	6.2-6.4	8.6	8.5-8.7
	Age- and sex-standardised	7.1	7.0-7.2	9.0	8.9-9.1
Census denominator	Crude	5.9	5.8-5.9	8.3	8.2-8.4
	Age- and sex-standardised	7.0	7.0-7.1	8.9	8.8-9.0

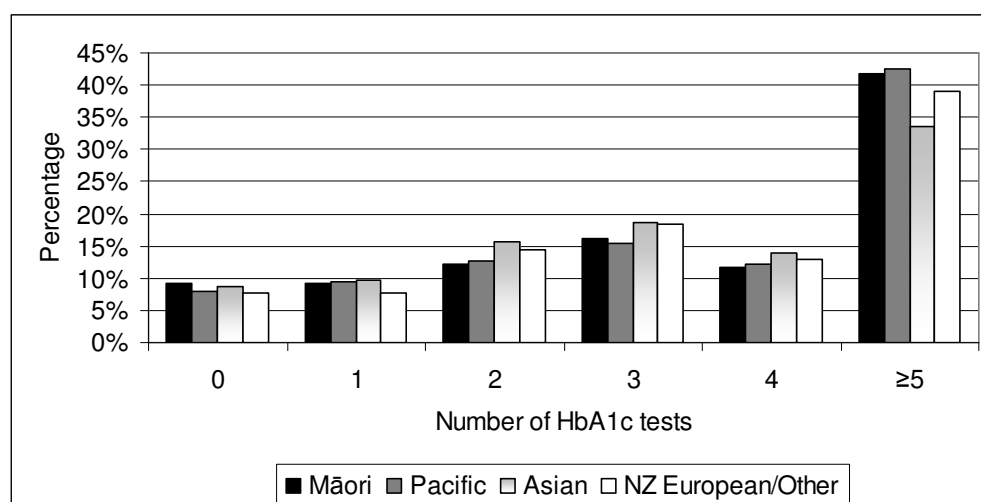
Table 3. Age-standardised prevalence of diabetes in Counties Manukau, by ethnicity, 2006/07*

	Female		Male	
	Standardised prevalence (%)	95% CI for prevalence (%)	Standardised prevalence (%)	95% CI for prevalence (%)
Māori	10.6	10.1 - 11.1	12.2	11.6 - 12.7
Pacific	15.0	14.6 - 15.4	13.9	13.5 - 14.3
Asian	9.1	8.7 - 9.4	11.3	10.9 - 11.8
NZ European/Other	4.0	3.9 - 4.1	5.0	4.9 - 5.2
Total	6.8	6.7 - 6.9	7.4	7.3 - 7.5

* Using the 'reconstructed' population as the denominator

Community care of diabetes—In Counties Manukau, 83% of diabetes cases had at least two glycated haemoglobin (HbA1c) community test claims in 2006/07, compared with 82% in the other DHBs. Just over half (52%) of Counties Manukau diabetes cases had four or more HbA1c test claims in 2006/07, versus 44% of cases in the other DHBs. Almost 40% of Counties Manukau diabetes cases had five or more HbA1c tests in 2006/07. Frequency of HbA1c test monitoring appeared consistent both by ethnicity and by socioeconomic status. Figure 1 shows the similarity between distributions of HbA1c test frequency by ethnicity in Counties Manukau, while Figure 2 compares HbA1c test frequency for those living in the most deprived areas with the remainder of diabetes cases in Counties Manukau.

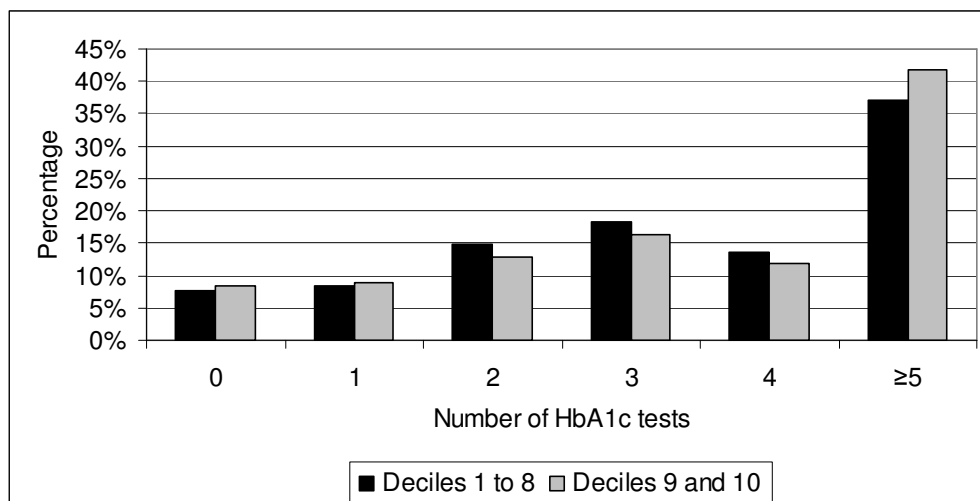
Figure 1. Frequency of HbA1c testing by ethnicity in Counties Manukau in 2006/07



Ninety-two percent of diabetes cases in Counties Manukau had fasting lipid studies performed at least once in 2006/07 (90% in other three DHBs) and 81% of Counties Manukau cases had two or more fasting lipid tests in this two-year period (75% in

other DHBs). Around one third of Counties Manukau cases had five or more claims for lipid tests in 2006/07. As with HbA1c, no important differences in serum lipid test frequency were noted by ethnicity or by socioeconomic status.

Figure 2: Frequency of HbA1c testing by NZDep2006 socioeconomic status in Counties Manukau, 2006/07



Use of a range of different medications by diabetes cases in Counties Manukau was examined. Of particular value in our understanding of quality of care was use of medications to treat secondary complications of diabetes, such as lipid lowering agents and agents affecting the renin-angiotensin system (like ACE inhibitors).

It was not possible from the data available to identify which diabetes cases ‘should’ have had subsidy claims for lipid lowering agents, although current guidelines suggest a high proportion of diabetes cases may benefit from them. In CMDHB, 64% of diabetes cases had at least two pharmaceutical claims for lipid lowering agents, the majority of which were HMG CoA reductase inhibitors (statins). Minor differences were identified in the proportion of diabetes cases accessing these medications by ethnicity and by deprivation (Figures 3 and 4).

Seventy percent of diabetes cases had at least two pharmaceutical claims for blood pressure-lowering medications. As expected from guidelines, claims for agents affecting the renin-angiotensin system were particularly common, with 61% of diabetes cases recording regular claims for these medications. The distribution of subsidy claims for agents affecting the renin-angiotensin system showed a relatively even spread across all ten deprivation deciles (Figures 3 and 4). Asian diabetes cases were found to have slightly lower utilisation of these medications than the other three groups.

Figure 3. Proportion of diabetes cases with regular claims for agents affecting the renin-angiotensin system and statins, by ethnicity in Counties Manukau, 2006/07

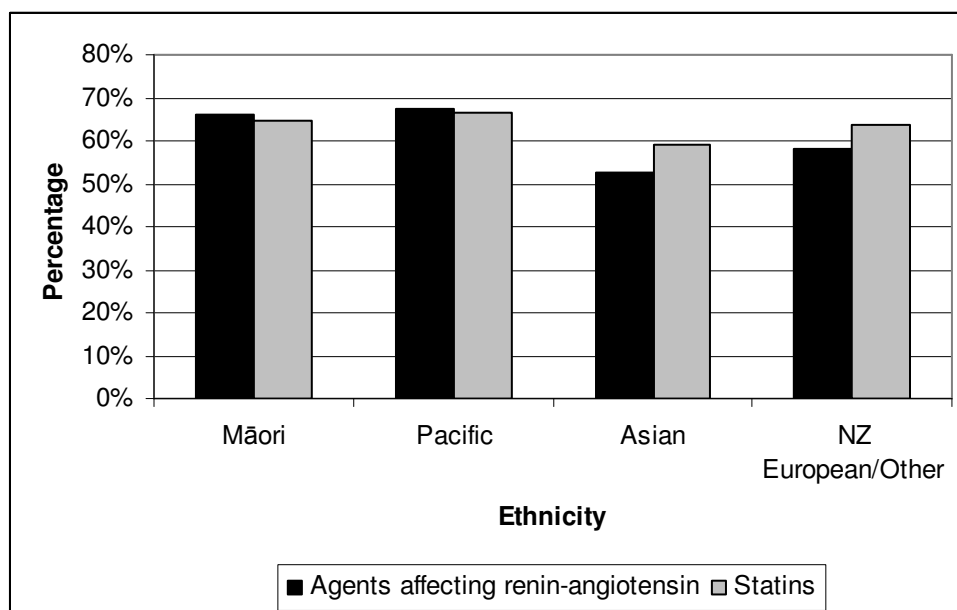
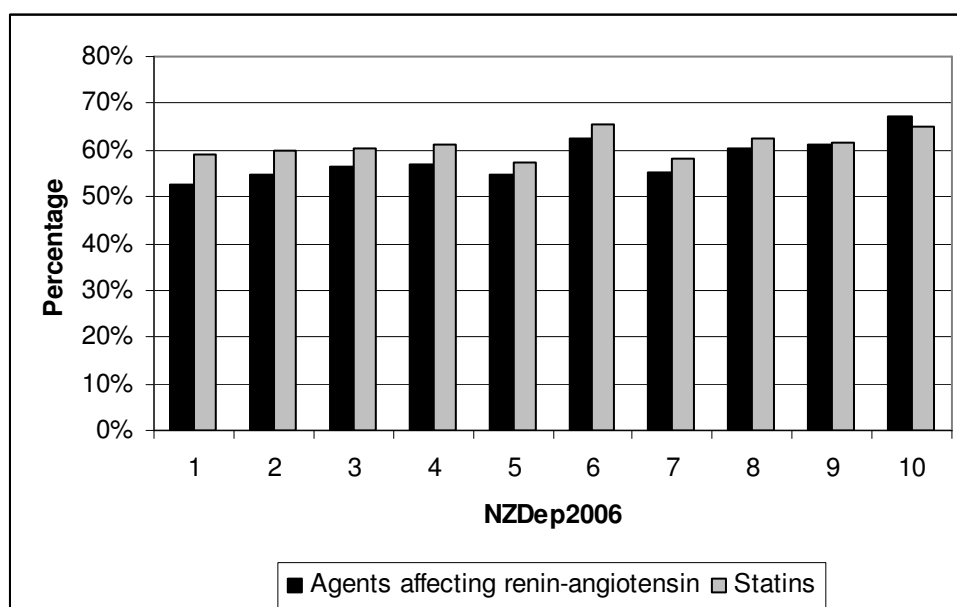


Figure 4. Proportion of diabetes cases with regular claims for agents affecting the renin-angiotensin system and statins, by socio-economic status in Counties Manukau, 2006/07



Hospital service utilisation—In 2007, 11,800 CMDHB medical and surgical hospital discharges were recorded in NMDS among diabetes cases, 17% of all hospital

discharges in that year. The average length of stay for diabetes cases was 3.6 days, compared with 2.4 days for those without diabetes.

Twenty-three percent of diabetes cases had one or more medical or surgical hospital admissions in 2007, compared with only 11% of those without diabetes in the reconstructed population. When these figures were age- and sex-standardised, 29% of diabetes cases were found to have had one or more admissions in 2007, compared with 11% of those without diabetes. Considerably more Māori diabetes cases had one or more hospital admissions in 2007 than diabetes cases of other ethnicities (Table 4).

Table 4. Proportion of diabetes cases in CMDHB with medical/surgical hospital admissions in 2007, by ethnicity

	Crude proportion of cases admitted ≥ 1 times in 2007 (%)	Age-standardised proportion admitted ≥ 1 times in 2007 (%)
Māori	31	37
Pacific	25	25
Asian	18	21
NZ European/Other	22	27

Discussion

This study used routinely collected administrative data from community laboratory and pharmaceutical subsidy claims, together with data on hospital discharges recorded in NMDS, to create a reconstructed population for four northern region DHBs. It took a ‘whole of community’ approach to explore both diabetes prevalence and utilisation of monitoring tests, medications and hospital services. Record linkage of administrative databases has previously been used to examine the epidemiology of diabetes in Denmark, Scotland, Canada and Sweden.¹³⁻¹⁷ Administrative data has also been used to estimate prevalence and to review quality of care of conditions like cardiovascular disease and asthma.^{18, 19} To our knowledge, this is the first study to estimate the prevalence of diabetes and resource utilisation in a DHB setting in New Zealand, using record linkage of administrative data sources.

We found diabetes to be common in Counties Manukau, with almost 27,000 people identified as diabetes cases. The age- and sex-standardised prevalence of diabetes was seven percent. This was the highest prevalence of any of the four DHBs studied and almost two percent higher than the average prevalence in the other three DHBs. Standardised prevalence estimates were similar using reconstructed and census denominators. Māori and Pacific people, in particular Māori men and Pacific women, had the highest prevalence of diabetes.

Our prevalence estimates are consistent with other estimates of diabetes in Counties Manukau. The 2006/07 New Zealand Health Survey estimated the total number of adults aged 15+ years with self-reported diabetes to be around 26,400, only around 600 less than our estimate.⁷ The crude adult prevalence of diabetes in this survey was 8.2%, similar to findings in our study. The LBD 2006/07 benchmark survey of 2,520

people in Counties Manukau found an age-standardised, self-reported prevalence of 7.0% in those aged 16+ years, a finding consistent with our estimates.⁵ Our findings were also comparable to diabetes prevalence estimates by ethnicity for adults aged 35-74 years in the Diabetes Heart and Health Survey (DHAH) undertaken in Auckland in 2002/03, where 9.3% of respondents were found to have Type 2 diabetes (previously- or newly-diagnosed).⁴ While there were important differences between the study populations in DHAH and our study, analysis of the same age group for the three Auckland DHBs using the reconstructed population gave an estimated diabetes prevalence of 9.5%.

Key strengths in this study were currency of the data, low additional cost to the DHB of data collection, extensive detail in the three contributing databases and the ability to link numerators with denominators from the same dataset. Laboratory and pharmaceutical data came from the HealthPAC General Transaction Processing System for reimbursement of community laboratories and retail pharmacies, meaning that data became available only a few months after claims for late 2007 were processed. All data had already been collected for administrative purposes and there was no requirement for the DHB to undertake any further data collection.

Substantial data were available for analysis in the final data set. The pharmaceutical data alone contained 42 separate variables. All numerators and denominators in the analyses came from the same reconstructed population and social and demographic variables in the data analyses were directly linked, thereby avoiding numerator-denominator bias in the analysis of ethnicity²⁰ (although ethnicity data in hospital records can still differ substantially from self-identified ethnicity²¹).

The validity of the decision rules has not yet been formally established. Only subsidy claims for HbA1c were recorded in the data and not laboratory values. Also, only claims for community laboratory and pharmaceutical tests were available. Such data were unavailable for hospital admissions. Three approaches were taken to assess the suitability of the rules. A literature review substantiated the scope of HbA1c use and use of diabetes medications for conditions other than diabetes. Both HbA1c and diabetes medications were predominantly used in diabetes, although medications like metformin are sometimes used for other purposes.^{22, 23} Individuals with local expertise in diabetes care, primary care, epidemiology and clinical coding were consulted about suitability of the rules and sensitivity analyses were undertaken using a range of test frequency and pharmaceutical dispensing claim thresholds. Further work is underway, validating the rules using capture-recapture methods. In the interim, we believe our findings are a reasonable reflection of diabetes in Counties Manukau. Not only are our estimates consistent with those of other studies, but work validating similar rules has demonstrated high levels of sensitivity and positive predictive value.²⁴ Some individuals at high risk of developing diabetes may have been misclassified as having diabetes. Such misclassification is acceptable for planning purposes, as these people share many of the risks experienced by those with diabetes.²⁵⁻²⁹

Only individuals with records of hospital events or subsidy claims during 2006/07 were included in the reconstructed population, meaning exclusion of the remainder from the reconstructed group. 'Residential churn' over the period of data collection also meant obsolescence of some addresses, despite most recent health encounter being used to allocate address. However, our estimated population for CMDHB was

only six percent less than that estimated by the 2006 national census and only small differences were seen between the socio-demographic profiles of the two groups. Use of the smaller reconstructed population as denominator resulted in over-estimation of crude diabetes prevalence, although the effect of over-estimation was lost when prevalence was age- and sex-standardised, as the bulk of diabetes cases occurred in those aged 35+ years and this group had the best coverage in the reconstructed population compared with census data.

Analysis of ethnicity using high-level categories such as 'Pacific' and 'Asian' is not without limitation and assumes ethnicities aggregated within these groups have similar health characteristics. This is not necessarily the case, as was highlighted in a report on Asian health needs which found considerable heterogeneity in health indicators between different Asian groups (such as Indian and Chinese).³⁰

No data were available on appropriateness of prescribing and laboratory monitoring for individual clinical cases. For example, similarities in community care by ethnicity did not account for differences in diabetes severity. Results of the descriptive analysis were checked using logistic regression and findings for resource utilisation were consistent with those described. However, pharmaceutical and laboratory utilisation for Māori and Pacific was similar to other groups, despite substantial differences in hospital admission frequency. Further work is needed to understand whether resource use and quality of care are appropriate to disease severity and are equitable across these groups.

This study used a set of timely, comprehensive and inexpensive data to examine diabetes prevalence and resource utilisation in Counties Manukau. The analysis will be repeated regularly to inform planning for the diabetes epidemic. The methods may also be used to examine other long-term conditions and other aspects of diabetes care, such as the additional health care cost to the DHB of diabetes.⁶ Disparities in the prevalence of diabetes by ethnicity were demonstrated, highlighting again the need for community-based primary prevention programmes such as LBD, which aim to address this inequity.

Competing interests: None known.

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