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DOI: https://doi.org/10.3399/BJGPO.2021.0200

To access the most recent version of this article, please click the DOI URL in the line above.

Received 20 October 2021
Revised 01 Febuary 2022
Accepted 04 April 2022

Author Accepted Manuscript

This is an 'author accepted manuscript': a manuscript that has been accepted for publication in BJGP Open, but which has not yet undergone subediting, typesetting, or correction. Errors discovered and corrected during this process may materially alter the content of this manuscript, and the latest published version (the Version of Record) should be used in preference to any preceding versions

Telehealth use in patients with type 2 diabetes in Australian general practice during the COVID-19 pandemic

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Abstract:

Background: The Australian government introduced temporary government-subsidised telehealth service items (phone and video-conference) in mid-March 2020 in response to the COVID-19 pandemic. The uptake of telehealth by type 2 diabetes (T2DM) patients for consulting with General Practitioners (GPs) is unknown.

Aim: To evaluate the uptake of telehealth consultations and associated patient characteristics in Australian general practice, including the frequency of HbA1c tests and change in HbA1c levels by telehealth use, compared to guideline recommendations.

Design and Setting: This study used electronic patient data from approximately 800 general practices in Victoria and New South Wales, Australia. A pre-COVID-19 period from March 2019 to February 2020 was compared to a pandemic period from March 2020 to February 2021. Patients diagnosed with T2DM before March 2018 were included.

Method: Telehealth uptake patterns were examined overall and by patient characteristics. Generalized estimating equation models were used to examine patient probability of 6-monthly HbA1c testing and change in HbA1c levels, comparing between patients who did and patients who did not use telehealth.

Results: Of 57,961 patients, 80.8% had telehealth consultations during the pandemic period. Telehealth consultations were positively associated with T2DM patients who were older, female, had chronic kidney disease, prescribed anti-diabetic medications, and living in remote areas. We found no significant difference in 6-monthly HbA1c testing and HbA1c levels between telehealth users and patients who had face-to-face consultations only.

Conclusion: Telehealth GP consultations were well utilised by T2DM patients. Diabetes monitoring care via telehealth may be utilised as effective measures as face-to-face consultations.

Keywords: General practice; COVID-19; Diabetes Mellitus, Type 2; Telemedicine

How this fits in:

Understanding the use of telehealth consultation modalities in general practice for the ongoing management of diabetes during the COVID-19 pandemic represents a significant gap in current literature. This study investigates the use of telehealth consultations (predominantly via phone) in patients with type 2 diabetes and the patient characteristics as well as the potential effects on the continuity of diabetes care, using a large cohort from approximately 800 Australian general practices. Our findings based on HbA1c testing suggest that diabetes monitoring care via telehealth is as effective as face-to-face consultations.

INTRODUCTION:

As healthcare systems around the world responded to challenges arising from the COVID-19 pandemic, including acute care needs of patients presenting with COVID-19, there was increasing concern about maintaining existing healthcare services for the ongoing management of chronic diseases. Rapidly increasing infection rates necessitated the introduction of COVID-19 containment measures, including social distancing and lockdowns, to control transmission of the virus. However, such measures also had the potential to impact on the lifestyle, health or ongoing management of patients with existing chronic conditions (1), including diabetes mellitus(2).

Patients diagnosed with T2DM need to regularly monitor their diet, exercise, and blood glucose levels in partnership with their healthcare providers(3). In Australian primary care, General Practitioners (GP) perform a fundamental role in the diagnosis and management of patients with diabetes(4), which includes glycated haemoglobin A1c (HbA1c) testing at least 6 monthly to monitor glycaemic control in patients with type 2 diabetes mellitus (T2DM) (4).

During periods of lockdown, many countries facilitated continuity of care for patients with diabetes through rapid implementation or expansion of telehealth modalities such as telephone(5-11) or video(6-8) consultations. Australia funds general practice through a universal health insurance scheme (Medicare) which subsidises fee for service activity(12). In the early stages of the pandemic, the Australian Government implemented a staged rollout to greatly expand Medicare-subsidised telehealth services for GPs to conduct telephone or video telehealth consultations with their existing patients. Whilst the rapid uptake of these new telehealth services has been reported for Australian general practice activity(13), it is not known to what extent these telehealth consultations were utilised by patients with T2DM, or whether this mode of consultation impacted diabetes care. Comparisons between the use of telehealth and face-to-face consultations for glycaemic control in diabetic patients during the pandemic has been studied in outpatient settings in Japan(10), USA(7), South Korea(9) and Australia(8) . However, these studies were based on limited populations (i.e. ≤2 tertiary facilities or diabetes clinics) and short study periods (i.e. < 6 months), and the results of the effects of telehealth on diabetes care were mixed.

Understanding of the use of telehealth consultation modalities in general practice for the ongoing management of diabetes, along with patient outcomes, represents an important aspect of continuity of care if telehealth is to remain part of general practice care. Hence, this study aimed to evaluate the use of telehealth consultations and the potential impact on the continuity of diabetes care, by assessing 1) the uptake of telehealth consultations and associated patient characteristics and 2) testing frequency compared to guideline-recommended 6-monthly HbA1c testing and HbA1c levels by consultation mode (telehealth versus. face-to-face). This was an exploratory study utilising a large cohort from approximately 800 general practices to examine the telehealth use in diabetes patients since telehealth became widely accessible to Australians during the COVID-19 pandemic.

METHODS:

Study design and setting

The study period covered 2 years from March 2019 to February 2021. Medicare-subsidised GP consultations via phone and video-conference were introduced in mid-March 2020 shortly after the COVID-19 pandemic was declared. The study period was separated into two intervals: the first year (March 2019 to February 2020) was defined as the pre-COVID-19 period and the second year (March 2020 to February 2021) as the COVID-19 pandemic period. In this study, telehealth included phone and video-conference. Since the use of

video-conference was limited (<0.1% of total consultations) in our study population, telehealth indicated here represents phone consultations.

Participants

Inclusion criteria to be met by all study participants were i)diagnosis with T2DM before March 2018 (to have had at least a one year history), ii) active status (defined by the Royal Australian College of General Practitioners (RACGP)(14) as individuals who had attended a practice three or more times in the past 2 years at the time of visit), and iii) having at least one HbA1c test during the pre-COVID-19 period. As patients in Australia can visit more than one general practice and may have died or moved during the study period, the latter two inclusion criteria were required to ensure that study patients attended a practice within the study catchment area for diabetes care.

Data Sources and Definition

This study used non-identifiable electronic health records collected from approximately 800 general practices in Victoria and NSW, Australia (extracted in August 2021). Outcome Health, as the data custodians, routinely gather electronic data from general practices into the Population Level Analysis and Reporting (POLAR) Aurora research platform in a de-identified and secured format. POLAR data include patient demographics, Medicare service item numbers, diagnosis, pathology testing and prescription medications. Details of the POLAR data are comprehensively documented elsewhere(15).

Patients with T2DM were identified using Systematized Nomenclature of Medicine-Clinical Terms (SNOMED) codes that fell into the concept of 'diabetes mellitus type 2 (disorder)' were used to identify T2DM(16). We also identified study patients with chronic kidney disease (CKD) as one of the serious diabetes complications(17). The identification of CKD was based on SNOMED codes classified into 'chronic kidney disease (disorder)(16) or pathology results (having ≥2 estimated glomerular filtration rate values <60 mL/min/1.73 m2 and/or ≥2 albumin-to-creatinine ratio values ≥3.5 mg/mmol for females or ≥2.5 mg/mmol for males, at least 90 days apart)(18).

Drug therapies were identified based on the Anatomical Therapeutic Chemical classification codes(19) in the prescription data. Prescriptions under the group of A10 (Drugs used in diabetes) were used and categorised into three groups: insulin (A10-A), oral glucose-lowering agents only (A10-B) and no medication (i.e., no A10 prescription records). An insulin group can include patients using the combined therapy with oral glucose-lowering agents.

GP consultation type (face-to-face and telehealth) was identified from item numbers in the Medicare service data(20, 21). In this study, patients who had one or more consultations billed as telehealth GP consultations were considered telehealth users in comparison to patients who had GP consultations via face-to-face only (e.g. a patient was classified a telehealth user if both telehealth and face-to-face consultations were used).

Australian guidelines consider HbA1c ≤53 mmol/mol (7%) with a range of 48–58 mmol/mol as the target glucose level, with the recommendation of HbA1c testing every 6 months in patients with adequate glycaemic control and 3 months in patients with inadequate control(4). Thus, we evaluated HbA1c levels and testing performance in patients, comparing to the recommended threshold (HbA1c ≤53 mmol/mol) and frequency (at least once every 6 months allowing 15 days leeway).

Statistical Analysis

For the analysis of aim 1 (telehealth use and patient characteristics), we looked at the overall proportion (%) of telehealth consultations and the characteristics of patients who were telehealth users during the COVID-19 pandemic period. Patient characteristics included patient age, sex, socioeconomic status (SES), CKD,

prescriptions for antidiabetic medications, residence remoteness (i.e. city or regional/remote), and state. To evaluate the association between patient sociodemographic factors and the use of telehealth consultations, we estimated adjusted relative risks (RR) by using a generalized estimating equation (GEE) model with the Poisson distribution and the Huber-White Sandwich estimator(22, 23). The GEE model included the covariates of patient factors (i.e. age, sex, SES, remoteness, prescription, state, and CKD), with practice attended as a cluster and the exchangeable correlation structure.

For aim 2 (the patient probability (%) of ≤6-monthly HbA1c testing and mean HbA1c level by telehealth use during the pandemic period), the analysis used GEE models with the Poisson and Gaussian distributions respectively. The outcome variable of each model was the binary outcome of ≤6-monthly testing (i.e. yes and no) and the continuous variable of the mean HbA1c level for each patient. Both GEE models included practice attended as a cluster and the exchangeable correlation structure, with the covariates of telehealth use (i.e. yes and no), patient characteristics, the total number of GP consultations, and mean HbA1c value measured during the pre-COVID-19 period. For subgroup analyses, we examined patients by the adequacy of glycaemic control (≤53 mmol/mol) before the pre-COVID-19 period. All analyses were performed in R (version 4.0.2).

RESULTS

Study patients

We identified 113,569 patients with T2DM who had visited a general practice at one point in time from March 2019 to February 2021, of which 70,675 patients attended actively throughout the two years. After excluding 12,759 patients with no records of HbA1c tests during the pre-COVID-19 period, 57,961 patients were finally selected as the study cohort. As a sensitivity analysis, we compared characteristics of patient demographics between all identified T2DM patients (n=113,569) and the selected cohort (n=57,961). Overall characteristics were similar between the two groups (Supplementary document Figure S1).

Telehealth use and patient characteristics

Of the total of 57,961patients, the number of patients who claimed telehealth GP consultations was 114 (0.2%) and 47,061 (80.8%) during the pre-COVID-19 and pandemic periods, respectively.

While the mean of telehealth consultation claims was only 0.03% of the weekly total claims (4 out of 11,384) before the pandemic period, the proportion of telehealth consultations during the pandemic period was 35.4% (4,499 out of total 12,595). The proportion of telehealth consultation claims peaked in August 2020 (Figure 1) when the COVID-19 positive case numbers increased in Australia. The mean HbA1c level in study patients during the pre-pandemic and pandemic periods were 54.5mmol/mol (95%CI; 54.4 – 54.6) and 55.6mmol/mol (95%CI; 55.4 – 55.7), respectively.

Table 1 provides the demographic characteristics of study participants who had telehealth consultation claims during the pandemic period. Telehealth consultations were more likely to be used by diabetes patients if they were older (e.g., 65-74 years old vs. <65: RR; 1.02, 95% CI;1.01 – 1.03), female (RR; 1.06, 95% CI; 1.05 – 1.07), residing in regional/remote areas (RR; 1.05, 95% CI; 1.03 – 1.07) or Victoria (RR; 1.19, 95% CI; 1.14– 1.243, had CKD (RR; 1.04, 95% CI; 1.03 – 1.05), or prescribed anti-diabetic medications (e.g. none vs. oral-agents only: RR; 1.05, 95% CI; 1.04 – 1.06). We did not observe strong evidence for the association between telehealth use and patient SES (e.g. low vs. high SES: RR; 1.01, 95% CI; 1.00 – 1.03).

HbA1c testing frequency and HbA1c level

The estimated probability for patients to have carried out ≤6-monthly HbA1c tests during the pandemic period is presented in Figure 2A. Overall, patients who had sub-optimal glycaemic control (i.e.

>53mmol/mol) before the pandemic were more likely to conduct ≤6-monthly testing than patients with adequate glycaemic control (i.e. ≤53mmol/mol). The association between telehealth use and ≤6-monthly testing was not identified. For instance, in patients with adequate glycaemic control (i.e. ≤53mmol/mol) before the pandemic, the ≤6-monthly testing probability was 52.3% (95%CI; 51.5% - 53.2%) for individuals who did use telehealth consultations during the pandemic period and 53.1% (95%CI; 51.9% - 54.3%) for those who did not use telehealth.

Figure 2B provides the estimated mean of HbA1c levels during the COVID-19 pandemic period. We did not observe associations between telehealth use and HbA1c levels. In the subgroup of patients who had inadequate glycaemic control before the pandemic period, for instance, individuals who used telehealth had 63.4mmo/mol, (95%CI; 63.2 – 63.6mmol/mol) whereas patients who did not use telehealth had 63.7mmo/mol (95%CI; 63.3 – 64.1mmol/mol) during the pandemic period. In patients who had adequate glycaemic control before the pandemic, the mean HbA1c level also did not differ by telehealth use (telehealth users (49.5mmo/mol, 95%CI; 49.3 – 49.6mmol/mol) vs. no telehealth use (49.0mmo/mol, 95%CI; 48.7 – 49.3mmol/mol).

DISCUSSION

Summary:

The rapid adoption of telehealth GP consultations in T2DM patients was observed after temporary Medicare-subsidised telehealth services were introduced in mid-March 2020. Overall, the majority of the T2DM patients in our study (80.9%) used telehealth during the pandemic period, with higher uptake by individuals who were older, female, had CKD, or resided in remote/regional areas. The findings illustrate that telehealth was more likely to be utilised not only by patients who had geographically limited access to healthcare (remote/regional areas), but also those who were at a higher risk of serious COVID-19 complications (i.e. older adults) and those who require close monitoring of care (i.e., having a complication or antidiabetic prescription). Both the probability of carrying out ≤6-monthly HbA1c testing and HbA1c values did not change by consultation modality.

Strengths and limitations:

As the identification of factors was not the main objective of this study, one limitation in our study was that we did not include all possible factors for the uptake of telehealth consultations and HbA1c tests such as other common diabetes complications (e.g., cardiovascular disease, retinopathy), mental health conditions, or COVID-19 infections. The comparison between different telehealth modes (phone vs video) would have been also important to explore. While we could not pursue the analysis for the limited use of video conference in this cohort, a systematic review study comparing the effects between video and phone consultations (24) found that video had advantages in provider-related outcomes (e.g. diagnosis accuracy, fewer readmissions) over phone consultations, which potentially suggests varying effects on patient outcomes by telehealth mode. Additionally, our study sites (NSW and Victoria) were most significantly impacted by COVID-19 in Australia. Thus patients in the study states were more likely to have promoted telehealth use and the telehealth use in other states require further studies. Another limitation is unavailability of other important diabetes care information such as electronic prescribing and specialist consultations. In Australia, electronic prescribing service became available with staged rollouts in 2020(25); however the use of electronic prescribing in the study cohort could not be identified. Specialist data was also not available in this study as specialist care is generally provided outside general practice in Australia. Future studies on the utilisation of electronic prescriptions and telehealth for specialist care will be critical to elucidate the overall flow of monitoring care and treatment as well as to understand the effectiveness and efficiency of remotely provided services within diabetes care.

Despite these limitations, there are substantial strengths in our study over existing research including the large study population and comprehensive data which include both patient demographic and longitudinal clinical information. A prior study using Australian general practice data from the POLAR platform has demonstrated the value of the data source for evaluating the quality of care and patient outcomes in a sample population approximating the Australian diabetes population(26). Furthermore, telehealth in Australia was primarily limited to certain patient populations (e.g. between specialists and patients in remote areas, at home or supported by rural clinics (27)) before the COVID-19 pandemic. Our study is one of the first to utilise a large cohort and explore the telehealth use and potential effects on diabetes care since telehealth became widely available to all Australian patients. Thus, the study data are greatly beneficial in illustrating the general characteristics of diabetes care activities and the use of telehealth during the COVID-19 pandemic.

Comparison with existing literature:

Previously, factors such as older age, lower SES, and remote locations were considered potential barriers to deliver healthcare via telehealth due to financial hurdles to internet use as well as limited infrastructure, internet skills, and acceptance of technology(28). However, the present study identified higher telehealth uptake in older patients as well as rural residence, in addition to no disparity of telehealth use by patient SES. The discrepancy of the findings may be partially explained by different study settings between our study and the majority of existing literature. For instance, the predominant mode of telehealth in Australia is via telephone(29), which requires less technological challenges than video-conference. Furthermore, in our study setting, telehealth GP consultations were covered by Medicare for Australian residents and utilised by a majority of T2DM patients. On the other hand, telehealth was less commonly used before the COVID-19 pandemic when prior studies were published. In the light of the COVID-19 pandemic, telehealth was rapidly adopted in the Australian healthcare system to address pandemic associated challenges. As a result, the characteristics of patients utilising telehealth might have shifted in such a way that the present study observed patterns of higher telehealth uptake in the populations who were at higher risk of serious COVID-19 complications (i.e., older patients) and requiring regular GP consultations (i.e., antidiabetic prescriptions, having CKD). A recent study conducted during the pandemic period in the U.S. has similarly reported higher uptake of telehealth (phone) consultations in diabetes patients of older age and using insulin(7).

Given the recent emergence of the COVID-19 pandemic, there are few comparable studies using large population cohorts to comprehensively evaluate the potential effects of telehealth use in general practice on diabetes care during the pandemic. However, several studies based on cohorts from a tertiary or specialist care facility have investigated the effects of telehealth on glycaemic control. Although these studies reported mixed results, most studies reported either improvement (8,10,11) or no significant changes (7) in HbA1c levels by utilising telehealth during the pandemic. Systematic reviews (30-32) published before the COVID-19 pandemic also reported the positive effects of telehealth on T2DM management including a greater reduction in mean HbA1c levels compared with conventional face-to-face consultations. Overall, existing literature points to the potentially positive impact of telehealth for diabetes care which corresponds to our findings outlined in this study.

Implications for research and/or practice:

Our findings based on HbA1c testing suggest that diabetes care monitoring via telehealth is as effective as face-to-face consultations. Considering the effectiveness of telehealth on diabetes care, it may be also beneficial to promote more utilisations of telehealth to support the continuity of diabetes care, particularly among the populations our study identified who had fewer telehealth uptakes, such as younger patients and those who were not anti-diabetic medications.

With the recent announcement that MBS funding for telehealth became indefinitely available (as of January 2022), further investigations on improving video uptake, understanding which patients/monitoring activities are most amenable to telehealth, and long-term effects of integrating in-person and remotely provided care for diabetes patients will be critical for both consultation modalities to be used synergistically to improve patient outcomes.

Additional information:

Funding:

The study was funded by the Digital Health Cooperative Research Centre (DHCRC) grant DHCRC-0118.

Ethical approval:

This study has received ethical approval from Macquarie University Human Research Ethics Committee (52020675617176). Outcome Health(13) has been granted ethical approval to collect and use general practice data by the RACGP ethics committee.

Competing interests:

None declared

Acknowledgements:

The authors would like to thank and acknowledge all GPs, participating PHNs, as well as the data custodians Outcome Health.

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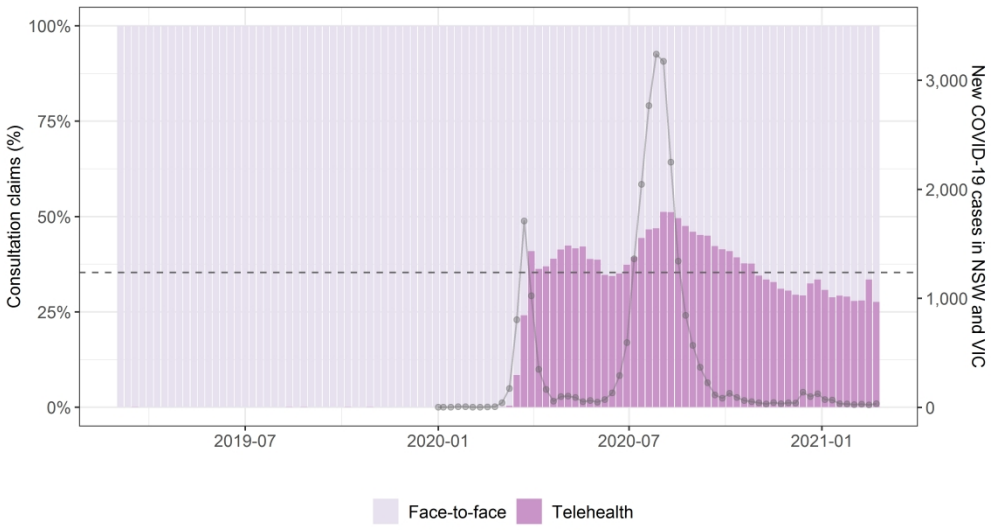
Figure and table legends

Figure 1. Telehealth uptake from March 2019 to March 2021. Pink bars represent consultation types by percentage (left y-axis). The dashed horizontal line represents the mean of weekly total telehealth consultation claims during the COVID-19 pandemic period. The solid line with dots is the total reported number of new weekly COVID-19 cases for NSW and Victoria combined (right y-axis).

Figure 2. (A) Estimated testing probability for patients to carry out ≤6-monthly HbA1c tests and (B) estimated HbA1c level during the COVID-19 pandemic period.

Table 1. The characteristics of patients who had a teleconsultation during the COVID-19 pandemic period (April 2020 – March 2021).



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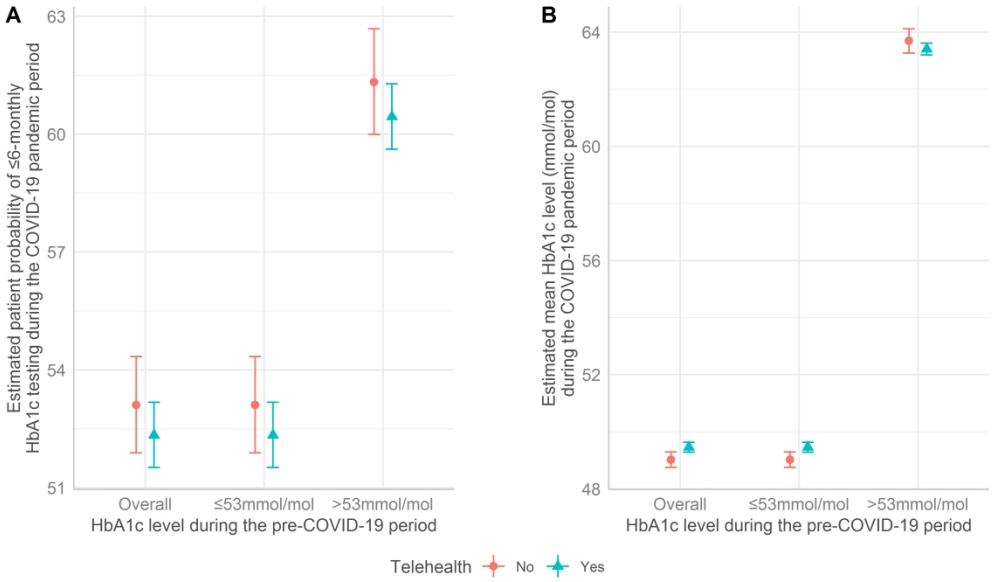
219x119mm (500 x 500 DPI)



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		No. of patients			RR		
		Total	Telehealth	%	Estimate	95% CI	
Total		57,916	46,783	80.8			
Age	<65	17,979	13,892	77.3	Ref		
	65-74	18,405	14,801	80.4	1.02	1.01	1.03
	75+	21,532	18,090	84.0	1.05	1.04	1.07
Sex	Male	31,569	24,844	78.7	Ref		
	Female	26,347	21,939	83.3	1.06	1.05	1.07
SES	Low	18,925	14,726	77.8	Ref		
	Middle	18,581	15,364	82.7	1.02	1.00	1.03
	High	20,410	16,693	81.8	1.01	1.00	1.03
CKD	None	45,088	35,966	79.8	Ref		
	Yes	12,828	10,817	84.3	1.04	1.03	1.05
Prescription	None	13,230	10,485	79.3	Ref		
	Oral-agents only	38,861	31,277	80.5	1.05	1.04	1.06
	Insulins	5,825	5,021	86.2	1.09	1.08	1.11
Major city	Yes	48,388	38,512	79.6	Ref		
	No	9,528	8,271	86.8	1.05	1.03	1.07
State	New South Wales	20,976	14,700	70.1	Ref		
	Victoria	36,940	32,083	86.9	1.19	1.14	1.23