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Real world initiation of newly funded empagliflozin and dulaglutide under special authority for patients with type 2 diabetes in New Zealand

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Abstract

Background Type 2 diabetes (T2D) is sub-optimally managed for many in Aotearoa New Zealand, and disproportionately affects Māori and Pacific peoples. In February 2021, SGLT2i/GLP1RA agents were funded for use for the first time with prioritisation for Māori, Pacific and those with cardiovascular and/or renal disease or risk (CVRD). This study evaluates the impact of health system factors on initiation of SGLT2i/GLP1RA therapy.

Methods Primary care data was collected for patients with T2D aged 18–75 years from four primary care organisations (302 general practices) in the Auckland / Waikato region of New Zealand (Feb 2021 – July 2022). Initiation of SGLT2i/GLP1RA therapy was reviewed by patient (age, gender, ethnicity, CVRD status) and health system variables (funding, provider type, staffing, patient numbers, rurality, after-hours access). Logistic regression was used to estimate the odds ratio of a patient being dispensed SGLT2i/GLP1RA.

Results Of 57,743 patients with T2D, 22,331 were eligible for funded SGLT2i/GLP1RA access and 10,272 of those (46.0%) were prescribed. Initiation of therapy was highest in Māori (50.8%) and Pacific (48.8%) patients (vs. 36·2–40·7% of other ethnic groups; $P < 0.001$), but was comparable in those with and without CVRD (47·1% vs. 48·9%; $P = 0.2$). Prescribing was highest in practices with higher doctor/patient numbers, low-cost fees, Māori health providers and clinics without after-hours access.

Conclusion Prioritised access for SGLT2i/GLP1RA appears to be associated with a reduced health equity gap for Māori and Pacific patients with T2D in NZ, but work is required to improve prescribing for patients with CVRD.

Keywords SGLT2i, GLP1RA, Type 2 diabetes, Health system access

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Introduction

Type 2 diabetes (T2D) is a significant chronic disease, both in Aotearoa New Zealand (NZ) [1] and worldwide [2]. Approximately 303,000 people in NZ are currently affected [1], and rates continue to rise. Importantly, T2D creates an inequitable burden on Māori and Pacific peoples. Māori have a greater prevalence of T2D (8·6% versus 5·7%) [3] and a five-fold greater burden of diabetic complications (97.1 vs. 17.5 per 100,000) [4], including a more than six-fold greater prevalence of end-stage diabetic renal disease than non-Māori. Of concern, the prevalence of diabetes (10.8%) and the burden of diabetic complications are even greater for Pacific peoples than Māori [5]. Thus, Māori and Pacific peoples are over-represented in those with T2D and co-morbid renal disease and/or cardiovascular disease (CVD) or high CVD risk [6].

As well as having a direct impact on patients, T2D also creates a large financial burden on the health system, primarily through diabetes-induced cardiovascular disease (CVD) and renal disease [7]. Indeed, most patients with T2D will die from CVD [8]. As such, T2D care has been recognised as an integral component of healthcare for NZ, and a key area for improvement in outcomes for both Māori [3] and Pacific peoples [5].

In NZ, as elsewhere, T2D is managed predominantly in primary care. Optimal T2D management is oriented towards appropriate glycaemic control and CVD risk management to prevent or slow the progression of T2D and diabetes-induced CVD and renal disease [9, 10]. Disease management includes lifestyle changes [10], glucose-lowering medications to reduce the glycated haemoglobin (HbA1c) to less than 53 mmol/mol [7%], reducing CVD and renal risk factors through smoking cessation, managing hypertension and dyslipidaemia [10].

Following lifestyle management, glycaemic control to target is typically achieved through a stepwise escalation of medications [10, 11]. However, research suggests that the use of medications is sub-optimal for many patients with T2D in NZ, and that non-Māori/non-Pacific (nMnP) peoples are generally more likely than Māori and Pacific to be prescribed the appropriate medications [12, 13]. As such, as many as half of all patients (and up to 70% of Māori and Pacific) with T2D may not be meeting clinical guideline recommendations for glycaemic and CVD risk management [3].

NZ guidelines recommend metformin as the usual first-line medication, with other glucose lowering therapies added based on glycaemic control and comorbidities [10, 11]. For those with T2D and renal disease and/or pre-existing CVD or estimated CVD risk above 15%, sodium-glucose cotransporter 2 inhibitors (SGLT2i; e.g. empagliflozin) and glucagon-like peptide-1 receptor agonists (GLP1RA; e.g. dulaglutide) are also now recommended, due to their ability to reduce the progression of CVD and renal disease independently of their effects on glycaemic control. They typically lead to weight loss and do not cause hypoglycaemia alone [14, 15]. However, whilst SGLT2i and GLP1RA have been used worldwide for many years [16], they have only been funded in NZ since February 2021. Further, only selected agents are approved for funded use. Initially this included only empagliflozin (From Feb 2021) and dulaglutide (from Sept 2021) [17] though more recently (March 2023) liraglutide was also approved for funded use due to a global supply issue with dulaglutide.

In an attempt to address the recognised inequities in T2D outcomes in Māori/Pacific compared with nMnP, the Pharmaceutical Management Agency of New Zealand (PHARMAC) approved the initial funding of empagliflozin and dulaglutide (in 2021) via Special Authority Criteria (SAC) which includes an ethnicity criterion [17]. In brief, this provides funded access for all Māori and Pacific patients with an HbA1c of more than 53 mmol/mol (7%), despite the use of other glucose-lowering therapies, but restricts funding to nMnP patients with T2D to only those with an HbA1c ≥ 53 mmol/mol (7%) and established cardiovascular and/or renal disease or estimated CVD risk above 15% using a validated risk calculator (CVRD). Importantly, PHARMAC only funds one class of medication (SGLT2i or GLP1RA) and not co-administration of both. However, patients may alternate between medications without any loss of funded access, and some may be in a position to self-fund the other class of medication [17].

A recent review of the initial use of these agents in NZ demonstrated that the inclusion of Māori and Pacific ethnicity in the SAC for SGLT2i and GLP1RA has decreased the prescribing equity gap [18]. However, after 18-months of these agents being funded, there still appear to be large numbers of eligible patients not initiating therapy. Whilst we acknowledge the importance of patient level factors such as health literacy, social deprivation and cultural factors on healthcare access [19] research does suggest that the majority of New Zealanders are 'highly satisfied' with their healthcare access [20]. However, variation in practice and general practitioner (GP) prescribing behaviour has previously been shown to be the largest driver of inequity in diabetes prescribing in New Zealand [13], and this is further complicated by the fact that primary care operates under a number of different models of care in NZ (including Māori health care providers, corporate-owned, owner-operated and salaried GP practices as well as very low-cost access (VLCA) practices) [21]. As such, practice staffing, hours, patient fees and processes can be highly variable. Prescribing behaviour is also strongly influenced by government regulation, education and experience of health professionals [22].

Currently, limited data is available on how health system factors contribute to inequitable prescribing in T2D in NZ, particularly regarding medications under special authority criteria. Thus, this study aims to explore how patient- and practice-level variables are associated with the initiation of prescribing of SGLT2i and GLP1RA across all ethnicities, including particularly in Māori and Pacific peoples.

Methods

Study design

This sub-study was part of a larger project to assess the impact of health system factors on inequity in prescribing for T2D in primary care. Ethics approval was provided by the New Zealand Health and Disability Ethics Committee (ref: 19/CEN/8).

Data sources

Primary care data were sourced directly from four large Primary Healthcare Organisations (PHOs) across the Auckland and Waikato regions, covering an enrolled population of approximately 1 million patients. Data was extracted and provided for patients aged 18–75 years who had a diagnosis of T2D (read code C10) recorded in their primary care record as of February 01 2021. The final dataset comprised 57,743 individual patients with T2D across 302 different general practice clinics. This included 11,675 Māori, 10,414 Pacific, 10,940 Asian, 23,280 European, 925 MELAA (Middle Eastern / Latin American / African) and 509 classified as 'Others'.

Extracted patient level data included ethnicity, gender (male, female, other), age (at Feb 01 2021) and deprivation quintile (NZDEP18; provided by the Ministry of Health) as well as all laboratory results (Aug 01 2019 to Feb 01 2021) and prescribing records (Feb 01 2021 – July 31 2022). Ethnicity was coded as Level 1 data as recorded in the primary care dataset, with prioritisation of Māori (first) and Pacific (second) to manage multiple ethnicities where reported (each patient was then only recorded with one ethnicity for analysis). Practice level information included whether they were a VLCA practice (Yes/No), practice size (number of patients with T2D and number of patients eligible for SGLT2i/GLP1RA), after-hours status (Yes = clinic hours after 5:30 pm or on weekends), rurality of practice (Rural versus Urban) and whether they were a recognised Māori health provider – this information was collated from the Ministry of Health and by checking the websites of all practices or organisations to check for Māori ownership and/or governance. Data on the number of doctors employed within each practice during the study period was also collected directly from the PHO and/or from the clinic websites. This was categorised as 1–4, 6–9, 10–14 and ≥ 15 doctors. However, we were unable to collect any information about their hours worked or full-time equivalents (i.e. part-time versus full time) and hence were unable to calculate doctor/patient ratios. Similarly, data were unavailable for other types of prescribers within these practices (i.e. number of nurse prescribers, nurse practitioners or pharmacist prescribers).

Patients were deemed to be eligible for SGLT2i/GLP1RA if they were clinically indicated according to the SAC [17] at Feb 01 2021. Funded access requires a diagnosis of T2D, an HbA1c > 53 mmol/mol despite regular use of at least one glucose-lowering therapy for at least three months and any of the following: (i) Māori or Pacific ethnicity, (ii) pre-existing CVD (defined as prior CVD event, congestive heart failure or familial hypercholesterolaemia), (iii) 5-year CVD disease risk of ≥ 15%, (iv) renal disease (eGFR < 60 mL/min/1.73m^2 and/or urinary albumin: creatine ratio ≥ 3 mg/mmol in two out of three samples OR v) high lifetime risk of CVRD due to an early diagnosis (taken here to be < 25 years). Laboratory measures included all those recorded in the 18 months prior to Feb 01 2021.

All eligible patients were then grouped as those with CVRD, without CVRD or with unknown CVRD status. As funding in NZ is currently limited to either empagliflozin or dulaglutide and not combined use, these were reviewed collectively.

Analysis

Initially, the T2D cohort eligible for SGLT2i/GLP1RA was characterised for those who were eligible to receive SGLT2i/GLP1RA by patient variables (gender, age group, ethnicity, CVRD status, diabetes medication use) and then by practice variables (PHO, VLCA status, practice size, rurality, after hours clinic availaibility [Y/N], Māori Health Provider [Y/N]). Initiation of SGLT2i/GLP1RA (having one or more prescriptions) during the next 18-month post-funding period (Feb 2021 - July 2022) was similarly described.

The mean time to first prescription and the percent of patients prescribed were calculated overall (at the practice level), and the proportion of practices with a lower or higher mean time to first prescription was compared. To determine if specific health system factors were associated with increased rates of prescribing, we reviewed the proportion of practices that prescribed to > 75% of all patients who were eligible for SGLT2i/GLP1RA.

For SGLT2i/GLP1RA eligible patients, a multivariate logistic regression was used to estimate the effects (odds ratios) of patient level variables on the likelihood of prescription of SGLT2i/GLP1RA, adjusting for gender, age group, ethnicity, HbA1c, CVRD status, social deprivation score, metformin prescription, insultion prescription and other glycaemic prescriptions. To examine the effects of practice level effects, the study unit was individual

practices. A second separate multivariate logistic regression was used to estimate the effects of VCLA, rurality, and whether the clincs were after hours clincs and/or Māori Health Providers on the proportion of eligible patients who were prescribed SGLT2i/GLP1RA.

Results

A total of 22,391 patients with T2D who were eligible for SGLT2i/GLP1RA funding based on the SAC were identified. After excluding those who had been using these medications unfunded prior to Feb 2021 ($n = 60$), the final study cohort consisted of 22,331 patients (38·7% of all T2D patients within the dataset). The characteristics of this group are given in Tables 1 and 2. Multivariate logistic regression with adjustment for various patient (age, gender, ethnicity, social deprivation, HbA1c and medication use) and practice variables (rurality, VLCA, number of eligible patients, Māori health provider, after hours clinic and PHO) is given in Table 3.

Patient-level variables

Approximately half of those eligible for SGLT2i/GLP1RA (10,272; 46.0%) initiated therapy within the 18 months following funding approval. This included 47.1% of those with CVRD and 48.9% without CVRD. The mean age at the time of first prescription was 57·4 ± 11·0 years and was higher in those who had CVRD versus those who did not (59·1 ± 10·5 vs. 52·6 ± 10·0; $P < 0·01$).

Eligible patients initiating therapy were more likely to be Māori or Pacific (in both those with and without CVRD), aged 45–54 years and to have an HbA1c ≥ 64 mmol/mol (Table 1). The mean HbA1c for those initiating therapy was 76·1 ± 18·1 mmol/mol (9·1 ± 3·8%) which is comparable to the overall eligible cohort (72·9 ± 18·0 mmol/mol [8·8 ± 3·8%]) but higher than the full cohort of patients with T2D (61·5 ± 18·5). After adjustment for other patient factors, higher prescribing persisted for Māori (OR 1·50, 95% CI: 1·43 – 1·69; $P < 0·001$) and Pacific OR 1·38, 95% CI: 1·19 – 1·43; $P < 0.001$) when compared to European but not other ethnic groups, as well as for individuals with higher HbA1c levels (OR 1.02; $P < 0·001$; Table 3). The proportion of patients prescribed empagliflozin and dulaglutide was also higher in men compared to women, and in those with increased social deprivation (Table 1), even after adjustment for other factors (Table 3).

Despite prioritised access for those with CVRD, there was no significant difference in the proportion of eligible patients who initiated therapy with (47·1%) or without CVRD (48·9%), although commencement of therapy was more likely in patients who had an HbA1c above 64 mol/mol and/or were already receiving metformin, insulin and/or other glucose-lowering therapies (Tables 1 and 2).

Practice-level variables

The impact of practice level factors on the proportion of eligible patients prescribed SGLT2i/GLP1RA is shown in Table 2. The proportions of eligible patients (All, with and without CVRD) who were prescribed SGLT2i/GLP1RA significantly increased as the number of eligible and 'all T2D' patients in each practice increased, but this increase in prescribing was not seen with the increase in doctors on staff.

Similarly, the overall initiation of therapy with SGLT2i/GLP1RA was significantly higher in VLCA practices (47·1 vs. 44.1; $P = 0·003$ vs. non VLCA) and in Māori health providers (49·9% vs. 45·6%; $P = 0·002$, Table 2) and, these differences persisted in multivariate analysis (Table 3). The proportion of patients initiating therapy did not differ based on whether practices were based in an urban or rural location, though therapy was less likely to be initiated in patients enrolled with clinics that offered after-hours access (OR 0·83, 95% CI: 0·78 – 0·87; $P < 0·001$; Table 3).

Initiation of SGLT2i/GLP1RA therapy was also shown to vary considerably between general practices. Across practices, the proportion of eligible patients prescribed SGLT2i/GLP1RA ranged from 100 to 8.33%, and the mean time to first SGLT2i/GLP1RA prescriptions across all practices was 208 ± 144 days (Fig. 1). Of those practices with 100% of eligible patients prescribed SGLT2i/GLP1RA ($n = 49$), the majority (47 practices; 96·0%), had fewer than 150 eligible patients with T2D enrolled in their practice, were non-VLCA (36 practices, 73·5%), urban (41 practices, 83·7%) and not a Māori Health provider (46 practices, 93·9%). Approximately half of the 302 (53·9%) practices had a mean time to SGLT2i/GLP1RA prescription greater than the mean of 208 days. Overall, practices were quicker to prescribe for Māori (207 ± 147 days), Pacific (205 ± 142 days), MELAA (209 ± 148 days) and Others (200 ± 148 days) than for European (214 ± 146 days) and Asian (214 ± 141 days) ethnic groups ($P < 0.05$). Seven practices had not commenced SGLT2i/GLP1RA therapy in any of the patients for whom it was clinically indicated. While one had 49 eligible patients, the remaining six practices had only 1 or 2 patients.

The majority of health system factors did not appear to impact on higher prescribing rates per practice. The proportion of practices that prescribed to > 75% of eligible patients was comparable for rural vs. urban (45·5% vs. 37·2%; $P = 0·297$), VLCA ([yes] 32·7% vs. [no] 40·6%; $P = 0·174$) and Māori Health Provider ([yes] 37·5% vs. [no] 38·2%; $P = 0·946$). However, significantly fewer clinics with after-hours access reached a prescribing rate of > 75% of eligible patients (26·8% vs. 45·5% of practices without after hours; $P = 0·016$). None of the 11 practices with ≥ 300 eligible patients had prescribed to > 75% of patients, though 39·5% and 34·6% of those with 0–149

Table 1 Characteristics of the overall T2D study population and SGLT2i/GLP1RA-eligible patients (*n*=22,331) during the study period

Characteristic	Overall Type 2 Diabetes Cohort[1]	Eligible for SGLT2i/GLP1RA[2]				Those eligible who initiated therapy[3]								*p*-value
						All prescribed		CVRD		Non_CVRD		Unknown CVRD		
		All	CVRD patients	Non CVRD patients	Unknown CVRD patients	n	% of ALL eligible	n	% of CVRD eligible	n	% of non CVRD eligible	n	% of unknown eligible	
ALL	**57,743**	**22,331**	**17068**	**2721**	**2542**	**10,272**	**46.0**	**8,036**	**47.1**	**1,328**	**48.9**	**908**	**35.7**	
Mean Age at first prescription (S.D)	57.2 (12.2)	57.4 (12.2)	59.6 (11.1)	52.1 (11.6)	48.0 (13.4)	57.4 (11.0)		59.1 (10.5)		52.6 (10.0)		49.7 (11.3)		<0.001
Ethnicity														
European	23,280	6,030	5,851	51	128	2,457	40.7	2,449	41.8	2	3.9	6	4.7	<0.001
Māori	11,675	6,401	3,974	1,260	1,167	3,255	50.8	2,164	54.5	655	52.0	436	37.3	
Pacific	10,414	6,888	4,263	1,401	1,224	3,359	48.8	2,227	52.3	668	47.7	464	37.9	
Asian	10,940	2,667	2,645	7	15	1,058	39.7	1,054	39.9	3	42.9	1	6.7	
MELAA	925	213	205	2	6	77	36.2	76	37.1	0	0.0	1	16.7	
Others	509	128	128	0	0	66	51.6	66	51.6	0	0.0	0	0	
Gender														
Male	31,484	12,284	10,060	1,157	1,067	5,773	47.0	4,837	48.1	580	50.1	356	33.3	<0.001
Female	26,253	10,042	7,005	1,564	1,473	4,498	44.8	3,198	45.6	748	47.8	552	37.5	
Other / Unknown	6	1	1	0	0	1	100.0	1	100.0	0	0	0	0	
Age Group (years)														
18–24	682	374	98	80	196	52	13.9	24	24.5	7	8.8	21	10.7	<0.001
25–34	2601	856	451	158	247	306	35.7	163	36.1	67	42.4	76	30.8	
35–44	5,887	2,079	1,232	373	474	958	46.1	592	48.1	182	48.8	184	38.8	
45–54	11,796	4,547	3,016	830	701	2,408	53.0	1,653	54.8	462	55.7	293	41.7	
≥ 55	36,777	14,471	12,269	1,280	922	6,548	45.2	5,604	45.7	610	47.7	334	36.2	
HbA1c (mmol/mol)														
Mean (SD)	61.5 (18.5)	72.9 (18.0)	72.7 (18.1)	71.8 (16.8)	74.8 (19.0)	76.1 (18.1)		76.2 (18.3)		74.5 (16.5)		78.4 (18.6)		<0.001
53–64	15,411	9,456	7,279	1,176	1,001	3,271	34.6	2,569	35.3	440	37.4	262	26.2	
>64	17,263	12,871	9,787	1,545	1,539	7,002	54.4	5,469	55.9	888	57.5	645	41.9	
Deprivation Quintile														
Quintile 1 (lowest)	9,656	2,474	2,109	203	162	1,067	43.1	930	44.1	96	47.3	41	25.3	<0.001
Quintile 2	14,374	4,559	3,698	504	357	1,992	43.7	1,655	44.7	225	44.6	112	31.4	
Quintile 3	11,501	4,466	3,474	534	458	2,102	47.1	1,667	48.0	274	51.3	161	35.2	
Quintile 4	8,585	3,866	2,855	550	461	1,782	46.1	1,354	47.5	270	49.1	158	34.2	
Quintile 5 (highest)	12,730	6,655	4,685	897	1,073	3,196	48.0	2,319	49.5	448	49.9	429	39.9	
Metformin_prescribed[3]														
No	17792	4481	3,276	502	703	1263	28.2	997	30.4	144	28.7	122	17.4	<0.001
Yes	39951	17846	13,790	2,219	1,837	9010	50.5	7041	51.1	1184	53.4	785	42.7	

Table 1 (continued)

Characteristic	Overall Type 2 Diabetes Cohort[1]	Eligible for SGLT2i/GLP1RA[2]				Those eligible who initiated therapy[3]								*p*-value
						All prescribed		CVRD		Non_CVRD		Unknown CVRD		
		All	CVRD patients	Non CVRD patients	Unknown CVRD patients	n	% of ALL eligible	n	% of CVRD eligible	n	% of non CVRD eligible	n	% of unknown eligible	
Insulin_prescribed[3]														
No	44672	14482	10,603	2,051	1,828	6,196	42.8	4601	43.4	959	46.8	635	34.7	<0.001
Yes	13071	7845	6,463	670	712	4,076	51.8	3437	53.2	369	55.1	272	38.2	
Other glucose lower medications_prescribed[3]														
No	36232	10285	7,650	1,232	1,403	3770	36.6	2962	38.7	477	38.7	331	23.6	<0.001
Yes	21511	12042	9,416	1,489	1,137	6503	54.0	5076	53.9	851	57.2	576	50.7	

[1]Includes those patients with a diagnosis of T2D of at least one year (at Feb 01 2021) as recorded in the primary care dataset

[2]Includes those patients from the initial T2D cohort who were eligible based on Pharmac criteria [17] for funded access to SGLT2i/GLP1RA

[3]Medications are coded as a yes if patients were prescribed these agents at least once during the study period

Table 2 Impact of practice-level variables on initiation of SGLT2i/GLP1RA during the study period

Characteristic	Number of Practices	Number of enrolled patients with T2D	SGLT2i/GLP1RA Eligible Cohort[2]				Those who initiated therapy[3]								
							All prescribed (*n* = 22,331)		CVRD (*n* = 17,068)		Non_CVRD (*n* = 2,721)		Unknown CVRD (*n* = 2,542)		
			All	CVRD	Non CVRD	Unknown CVRD	*n*	% of eligible	*n*	% of CVRD eligible	*n*	% of Non CVRD eligible	*n*	% of unknown eligible	
ALL		**57,743**	**22,331**	**17,068**	**2721**	**2542**	**10,272**	**46.0**	**8,036**	**47.1**	**1,328**	**48.9**	**908**	**35.7**	
Practice Size - number of enrolled patients with T2D per practice															
0–149	166	11,646	4,126	3,246	430	450	1,749	42.4	1,420	43.7	190	44.2	139	30.9	< 0.001
150–299	79	16,550	5,903	4,684	680	539	2,620	44.4	2,113	45.1	323	47.5	184	34.1	
300–449	29	10,646	4,050	3,065	435	550	1,868	46.1	1,451	47.3	211	48.5	206	37.5	
450–599	12	6,295	2,270	1,740	242	288	1,149	50.6	899	51.7	136	56.2	114	39.6	
≥ 600	17	12,606	5,978	4,331	934	713	2,887	48.3	2,155	49.8	468	50.1	264	37.0	
Practice Size - number of Eligible patients per practice															
0–149	266	36,083	12,399	9,790	1,340	1,269	5,492	44.3	4,426	45.2	640	47.8	426	33.6	< 0.001
150–299	26	13,121	5,131	3,938	667	526	2,374	46.3	1,873	47.6	310	46.5	191	36.3	
300–449	6	4,241	2,138	1,497	358	283	1,064	49.8	775	51.8	185	51.7	104	36.7	
≥ 450	5	4,298	2,659	1,841	356	462	1,343	50.5	964	52.4	193	54.2	186	40.3	
Staffing (number of doctors)															
1–4	169	21,756	8297	6,388	1,059	850	3846	46.4	3011	47.1	528	49.9	307	36.1	< 0.001
6–9	90	18,724	7,431	5,679	1,008	744	3,442	46.3	2,690	47.4	483	47.9	269	36.2	
10–14	30	12,582	4,908	3,692	469	747	2,279	46.4	1,774	48.0	236	50.3	269	36.0	
≥ 15	4	1,892	531	425	57	49	236	44.4	187	44.0	32	56.1	17	34.7	
Primary Healthcare Organisation (PHO)															
PHO 1	19	4,509	1,701	1,274	224	203	878	51.7	677	53.2	128	57.1	73	36.0	< 0.001
PHO 2	45	4,455	1,915	1,334	232	349	946	49.4	680	51.1	117	50.4	149	42.5	
PHO 3	87	20,648	6,497	5,153	836	508	3,039	46.8	2,473	48.0	414	49.5	152	29.9	
PHO 4	151	28,129	12,214	9,305	1,429	1,480	5,409	44.3	4,206	45.2	669	46.8	534	36.1	
Rurality															
Rural	44	8,324	2,917	2,323	316	278	1,321	45.3	1,080	46.5	155	49.1	86	30.9	0.30
Urban	253	48,613	19,044	14,490	2,356	2,198	8,806	46.2	6,847	47.2	1,155	49.0	804	36.5	
VLCA Status															
No	192	30,846	10,221	8,256	997	968	4,565	44.7	3,765	45.6	488	48.9	312	32.2	< 0.001
Yes	110	26,896	12,106	8,810	1,724	1,572	5,707	47.1	4,271	48.5	840	48.7	596	37.9	
Practices Offering After Hours Access															
No	189	32,322	11,932	9,179	1,506	1,247	5,736	48.1	4,519	49.2	774	51.4	443	35.5	< 0.001
Yes	105	24,072	9,856	7,482	1,166	1,208	4,323	43.9	3,348	44.8	536	46.0	439	36.3	
Māori Health Provider															
No	275	52,813	20,049	15,445	2,459	2,145	9134	45.6	7,207	46.7	1,183	48.1	744	34.7	< 0.001
Yes	24	3,818	1,750	1,239	174	337	873	49.9	627	50.6	101	58.0	145	43.0	

Table 3 Unadjusted odds ratios for prescribing rates and adjusted odds ratios (including 95% confidence intervals) from multivariate logistic regression for eligible patients initiating SGLT2i/GLP1RA therapy by demographic/patient and practice level variables during the 18-month study period following approval of funding

Characteristic	Unadjusted OR	Adjusted OR	Adjusted OR 95% CI	Adjusted OR *p*-value
Patient variables (Baseline)				
Male (Female)	1.09	1.12	(1.06, 1.19)	< 0.001
Age_Group (> 54 years)				
18–24	0.20	0.27	(0.19, 0.37)	< 0.001
25–34	0.67	0.64	(0.54, 0.75)	< 0.001
35–44	1.03	0.92	(0.83, 1.02)	0.11
45–54	1.36	1.19	(1.10, 1.28)	< 0.001
Ethnicity (European)				
Māori	1.50	1.55	(1.43, 1.69)	< 0.001
Pacific	1.38	1.31	(1.19, 1.43)	< 0.001
Asian	0.96	0.87	(0.79, 0.96)	0.005
MELAA	0.82	0.81	(0.59, 1.08)	0.16
Others	1.55	1.41	(0.97, 2.04)	0.07
HbA1c	N/A	1.02	(1.017, 1.020)	< 0.001
CVRD Status (No CVRD)				
CVRD	1.02	1.04	(0.85, 1.14)	0.35
Unknown CVRD	0.65	0.69	(0.61, 0.77)	< 0.001
Metformin prescribed (No)	2.60	2.55	(2.36, 2.76)	< 0.001
Insulin prescribed (No)	1.45	1.59	(1.49, 1.69)	< 0.001
Other glycaemics prescribed (No)	2.03	1.67	(1.57, 1.77)	< 0.001
Deprivation (Quintile 1)				
Quintile 2	1.02	0.93	(0.84, 1.04)	0.20
Quintile 3	1.18	0.98	(0.88, 1.09)	0.66
Quintile 4	1.13	0.90	(0.81, 1.01)	0.08
Quintile 5	1.22	0.89	(0.80, 0.99)	0.04
Practice VARIABLES (Baseline)				
VLCA (Non VLCA)	-	1.14	(1.08, 1.21)	< 0.001
GCH2018 Urban (Rural)	-	1.14	(1.05, 1.23)	0.002
After Hours Clinics (No)	-	0.83	(0.78, 0.87)	< 0.001
Māori Health Provider (No)	-	1.21	(1.09, 1.35)	< 0.001

and 150–299 eligible patients, respectively, reached this target ($P < 0.05$).

The proportion of practices that had a mean time to first prescription of less than the overall practice average of 208 days was also comparable for rural vs. urban ([yes] 47·7% vs. [no] 41·5%; $P = 0{\cdot}458$), VLCA ([yes] 40·6% vs. [no] 43·6%; $P = 0.610$), Māori Health Provider ([yes] 33·3% vs. [no] 42·9%; $P = 0{\cdot}362$) and after-hours access ([yes] 40·0% vs. [no] 44·4%; $P = 0{\cdot}466$). Further, no specific health system factors correlated with increased rates of prescribing (> 50%) of eligible patients with CVRD (all $p > 0.05$).

Discussion

Our study aimed to identify the patient and practice-level variables that are associated with the initiation of SGLT2i/GLP1RA prescribing among individuals with T2D. Overall, our results showed that nearly half of eligible individuals with T2D were prescribed SGLT2i/GLP1RA under SAC in the 18-months following funded availability. Whilst initiation of new medications will always be dependent on the rate of patient engagement with healthcare, our study shows that approximately 17·8% of all patients with T2D were prescribed these medications, which is 3–4 times higher than the rate of use reported in international studies [23, 24]. Importantly, these agents were prescribed to nearly a third of all Māori and Pacific patients with T2D, which has helped reduce inequity in prescribing overall.

Despite the overall uptake of SGLT2i/GLP1RA agents being comparatively high in NZ it is concerning that we did not see a significantly higher proportion of patients with CVRD intitating therapy given that they are most likely to receive the greatest benefit from these agents. Ideally all patients with CVRD should be considered for a SGLT2i and/or GLP1RA [25], yet the use of SAC and the strong messaging around ethnic prioritisation for access for Maori and Pacific people may have diluted the fact that these agents should be also be prioritised for all patients with CVRD, regardless of ethnicity. Further,

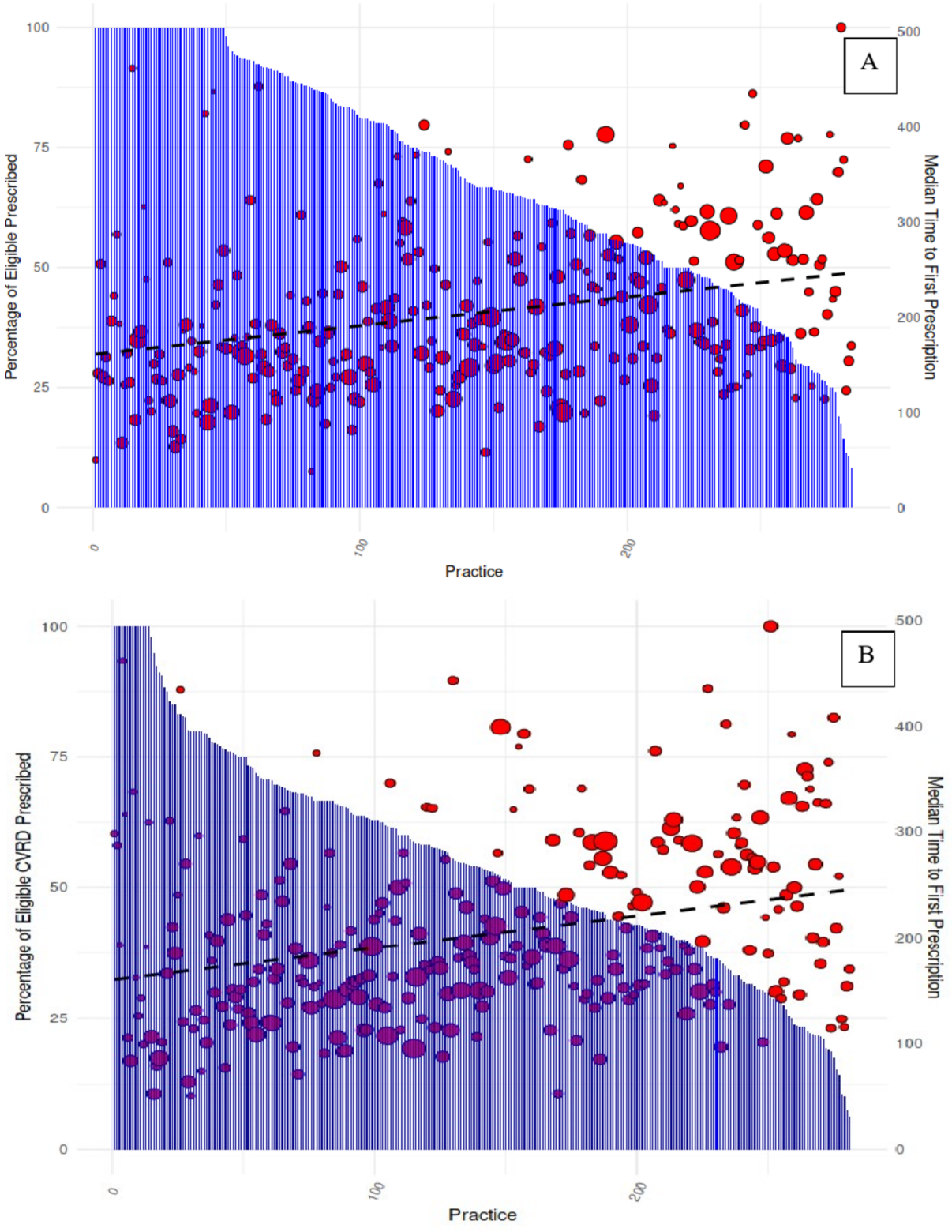

Fig. 1 The proportion of **A** all eligible patients and **B** eligible patients with CVRD in each practice who have been prescribed SGLT2i/GLP1RA (blue bars) and the median time per practice until the first prescription (for those prescribed only) [red circles]. The size of the red circle correlates to the number of patients with T2D enrolled within each practice (range 1 to 971 patients). Practices are numbered only and are not ID matched between **A** and **B** above

the need for an HbA1c of more than 53 mmol/mol (7%) to access the funded agents may be a barrier given that many patients have lower HbA1c levels only because of the use of alternative glucose-lowering therapies. Indeed, there has been some discussion about whether clinicians need to 'deprescribe patients' in order to achieve an eligible HbA1c value, though this comes with its own issues, including the risk that highly vulnerable people may be 'lost' during this process. Clearly there is a need to ensure that patients with CVRD of all ethnicities are provided with the opportunities to access these agents, and additional pathways to improve SGLT2i/GLP1RA prescribing are still needed.

Regardless, it is encouraging to see that SGLT2i/GLP1RA agents were prescribed to more than half of all Māori and Pacific with CVRD, particularly given these groups are more likely to experience worse T2D outcomes as well as faster progression of comorbidities and lower life expectancy [26]. These results suggest that the funding model used by PHARMAC in NZ does appear to be supporting a move towards more equitable health outcomes for T2D in this country. However, significantly more work is required to ensure that other barriers to healthcare access are also addressed for these underserved and high-risk populations [27].

Further, we note that 908 patients in our study did not have their CVRD status recorded. The majority of these patients were Māori and Pacific (so were able to access these agents via the ethnicity criterion without the need for CVRD information), though it is concerning that the importance of this information may be overlooked. CVRD is an essential part of overall management as well as a criterion for patients of other ethnicities to access these medications under the current funding criteria. Care should be taken to ensure that patients have their CVRD status assessed annually, and that medication records are updated and complete to maximise access to all eligible medications. Clinician education may also be required to ensure optimal uptake of these (and other) medications. A recent study here in NZ suggested that some clinicians have been reluctant to prescribe these new agents [26], often as a result of reduced confidence with T2D management and prescribing. To optimise care for all T2D patients in NZ, free clinical education/training programs have been provided annually since 2021 [28, 29], though the efficacy and translation of this education program to improved practice are yet to be measured.

Despite socioeconomic status being a known influencing factor for CVRD risk individuals with T2D [30], our results show that higher deprivation positively associated with higher SGLT2i/GLP1RA prescribing rates. This agrees with a UK study that patients living in higher deprivation had a higher probability of initiating SGLT2i/GLP1RA therapy [31] though contrasts with studies from Denmark [32] and Australia [33] that showed lower rates of prescribing in those living with social deprivation. However, in line with these findings about socioeconomic status, our study also showed that patients enrolled with a VLCA practice had higher rates of prescribing than those at a non VLCA practice (i.e. a full fee-paying practice). Whilst VLCA practices are often working with limited resources, these results do suggest that healthcare access and prescribing can be improved by reducing barriers such as clinic fees [34]. However, despite targeted funding and interventions, more work is clearly required to ensure that patients living in lower socioeconomic areas (including a disproportionate number of Māori [40% vs. 15% European), are all able to equitably access healthcare and relevant medications [35]. This may include facilitating greater access to culturally-appropriate Māori and Pacific healthcare providers given that patients enrolled with Māori healthcare clinics had higher SGLT2i/GLP1RA prescribing rates, though the role of Pacific providers has not been evaluated in this study and should be explored further.

Similarly, the impact of after-hours clinics should also be explored further. Our study shows that patients enrolled with a clinic offering these after-clinic hours had fewer SGLT2i/GLP1RA prescriptions, despite the fact that previous studies have reported the challenges of needing to access care during 'usual working hours' [36]. We hypothesize that the lower rates of prescribing seen in these clinics with after-hours services may be due to more urgent care doctors staffing the clinics rather than general practitioners, with patients possibly accessing care as casual users rather than for ongoing diabetes management. In line with this, our study also indicated that large practices with more than 15 doctors generally had lower rates of SGLT2i/GLP1RA prescribing. Collectively, these findings reinforce the idea that ongoing relationships between patients and clinicians are essential to ensure that T2D care and management are optimised [28, 37], particularly as Māori are more likely than non-Māori to use after hour clinics (42.5% vs. 15.1%) [38]. Unfortunately, however, we do note that our study was unable to record staff hours worked (FTE), and thus we were unable to report on the impact of staff to patient ratios which are highly likely to be an important contributor to quality of diabetes care.

Not surprisingly, rates of SGLT2i/GLP1RA prescribing generally increased with patient age, and this appears to be due to an increased likelihood of CVRD. However, lower rates of prescribing are then seen in those aged more than 55 years, despite their increased risk of cardiovascular events and renal failure. Some older patients in NZ may have fewer clinical visits, particularly if they live alone [39], though a lack of clinician knowledge

about the benefits and appropriate use of new medication alongside polypharmacy and complex medical histories have been identified as barriers to medication initiation among older populations [40]. Concern about patient safety in a population with a higher risk of experiencing adverse drug reactions may also be a barrier to prescribing SGLT2i/GLP1RA in older individuals, though studies have reported that SGLT2i/GLP1RA prescribing increases as positive effects in health outcomes are clinically observed in similar groups [41].

Whilst our study is large, comprising more than 57,000 patients with T2D we do note the following limitations. First, our study has no data on practice staff hours worked or full-time equivalents, nor the number of nurses prescribers, practitioners, pharmacists within each of these practices. We acknowledge that these are critical components when considering the impact of practice-level variables on any outcome, yet they are challenging to record in across multiple practices. Further, we did not have data on whether individual clinicians or practices had access to and/or were using reports or dashboards to indicate who is eligible for SGLT2i/GLP1RA medication. Practice and patient dashboards are becoming increasingly common and knowledge on the use of these systems would be highly beneficial in future studies to better understand how health system variables are impacting on prescribing outcomes. We suggest that these details should all be included in future study design to support optimal analyses and interpretation of findings.

Secondly, we have no visilibty of whether the practices or PHOs had any specific interventions in place to support / optimise prescribing of these new agents during our study, though our inclusion of clinical leads (as authors) from several of the PHOs reported on this paper have helped to mitigate this. Secondly, whilst we have explored prescribing in those with and without CVRD, we did not have appropriate data to be able explore the rates of prescribing in those with specific CVD events, nor in those with established CVD versus those with high CVD risk. This ideally needs to be explored further, including how this might differ in different ethnic groups.

Third, we note that there are limitations in the patient variables in our dataset. For example, data analyses were restricted to those aged at least 18 years, though it is likely that there are also younger patients accessing these medications. Indeed, the cohort of patients aged 18–24 years had the lowest rate of eligible patients prescribed SGLT2i/GLP1RA and the use of these medications (including barriers to prescribing in this group) need to be explored further. There is also a lack of relevant patient-level information such as co-morbidites, health literacy and cultural beliefs. These are also likely to impact the rate of initiation of new medications, alongside the patients frequency of healthcare engagement.

Fourth, our dataset does not contain information on patient duration of diabetes as this is not well recorded in primary care records, the 'date of diagnosis' often incorrectly being cited as the date the patient enrolled with the practice. Lastly, our dataset was restricted to a time period when only the two agents (dulaglutide and empagliflozin) were available. More recently, this has changed to include additional agents, (e.g liraglutide) and a small cohort of patients are accessing at least two agents at the same time. Clearly aditional studies into the use of equitable and timely prescribing of diabetes medications are warranted. Studies are also required to explore the cost impact of SGLT2i/GLP1RA use in a NZ context (e.g. does their use in patients with CVRD reduce hospitalisation rates), the tolerability of these medications given their known advere event profiles and whether the use of SAC for prioritised access for Maori and Pacific patients has also led to enhanced prescribing of other medications as well.

Abbreviations

CVD	Cardiovascular disease
CVRD	Cardiovascular and/or renal disease
GLP1RA	Glucagon-like peptide-1 agonists
PHO	Primary healthcare organisation
SGLT2i	Sodium-glucose cotransporter 2 inhibitors
T2D	Type 2 diabetes

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Authors' contributions

LC is the project lead and has co-ordinated data collection, analysis and prepared the primary manuscript draft with assistance from SM. MR and HG analysed the data. JSJ and AM facilitated access to primary care data. TLK, RP and RK provided cultural and clinical support. TK, RM, PC and RL provided clinical support. TLK, RP, RK, PC, RM and RL contributed to manuscript writing, particularly clinical interpretation. All authors contributed to the preparation of this manuscript and approve the work for publication.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

This study was approved by the Health and Disability Ethics Committee of New Zealand (ref: 19/CEN/8).

Consent for publication

Not applicable. Only deidentified data was analysed.

Competing interests

The authors declare no competing interests.

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