Demographic differences in the initiation and maintenance of statins in the first year post-ACS in New Zealand: a data linkage study (ANZACS-QI 57)

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ABSTRACT

INTRODUCTION: Prior New Zealand studies suggest that only approximately two-thirds of patients who present with an acute coronary syndrome (ACS) are adequately maintained on a statin post-discharge. This could be due to low initiation and/or poor longer-term adherence.

AIM: To identify the pattern and adequacy of statin maintenance following ACS from initial prescription to one-year post-discharge.

METHODS: All New Zealand Acute Coronary Syndrome Quality Improvement (ANZACS-QI) registry data for consecutive New Zealand residents (2015–2017) who were hospitalised with ACS and managed with coronary angiography were anonymously linked to national datasets to derive a medication possession ratio (MPR) to assess medication maintenance. An MPR ≥0.8 is considered adequate maintenance and ≥1 is considered optimal.

RESULTS: Of the 16,557 patients who survived their ACS, 15,431 (93.2%) were prescribed a statin at discharge and 89.8% were dispensed a statin within three months. 79.8% (13,219/16,557) of patients had an MPR ≥0.8 during the first year, but only 61.0% (10,096/16,557) had optimal dispensing over this period. Regression analysis identified the independent predictors of sub-optimal maintenance over the first year as age <45 years, no prior statin and Māori and Pacific ethnicity.

CONCLUSION: After ACS discharge, the gap between prescribing and dispensing rates was small with only minor demographic variation. One in ten patients were not initially dispensed a statin. Although eight in ten patients were adequately maintained, only six in ten had optimal maintenance with clear ethnic and age differences, which may reflect more general disparities in healthcare.

Over 12,000 patients are admitted to New Zealand hospitals with an acute coronary syndrome (ACS) every year.[1] There is robust evidence to support early initiation and long-term use of statin medications to improve outcomes in patients after ACS,[2,3] and poor adherence is associated with increased risk of rehospitalisation and mortality.[4] In a previous New Zealand national analysis we reported that only two-thirds of patients who present with an ACS are adequately maintained on a statin in the three years post-discharge.[5] Variables independently associated with poorer maintenance included younger age and Māori and Pacific ethnicity. However, it is not known whether this was due to sub-optimal prescribing at the time of hospital discharge, barriers to initial dispensing or poor longer-term maintenance. Furthermore, consistent with prior studies, adequate statin maintenance in that study was defined as

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a medication possession ratio (MPR) of ≥0.8, meaning patients had enough statin supply for 80% or more of the days during the study period. However, for low-density lipoprotein (LDL) cholesterol lowering with a statin, more optimal dispensing (MPR≥1) has been associated with greater LDL-cholesterol lowering.[6] The levels of optimal statin maintenance in New Zealand and the demographic factors associated with sub-optimal maintenance have not been studied.

In New Zealand, the All New Zealand Acute Coronary Syndrome Quality Improvement (ANZACS-QI) registry captures data, including discharge prescriptions, for all New Zealand ACS patients who are investigated with coronary angiography. In addition, dispensing data for all subsidised medications, including statins, are captured in the national routine datasets, allowing assessment of post-discharge statin maintenance.[7] The registry cohort can be linked to the national datasets to compare initial prescribing and dispensing of statins.

The aims of this study were therefore to describe the use of statin medication and its demographic and clinical determinants both early and in the first year post-ACS discharge. Specifically, we sought to describe the initial prescribing of statins post-ACS and the gap between the initial prescribing and dispensing of statin medications and the one-year maintenance on statins. We also sought to assess the variables associated with sub-optimal statin utilisation at each stage.

Methods

Cohort and data collection: The study cohort was identified from the ANZACS-QI registry, a web-based electronic database that captures a mandatory dataset for all patients admitted to New Zealand public hospitals with acute coronary syndrome and who are investigated with coronary angiography. Data collected includes patient demographics, admission ACS risk stratification, cardiovascular risk factors, investigations and management, inpatient outcomes and medications prescribed at discharge. Details regarding data collection have previously been reported.[8,9] The registry is subject to monthly auditing to ensure >99% of all patients are captured, and annual auditing to check the accuracy of data entry.

For this study, at least one year of post-discharge follow-up time was required. The study cohort was therefore comprised of consecutive New Zealand residents aged 35 to 84 years who presented to public hospitals with a confirmed diagnosis of myocardial infarction (MI) or unstable angina between 1 January 2015 to 31 December 2017. Only the first admission for each patient in the time period was used. MI was defined according to the contemporary universal definition.[10,11] Patients were excluded if they died within 30 days of discharge or spent less than 30 days out of hospital over the follow-up period. Patients referred for a coronary artery bypass graft (CABG) were excluded, as the prescribing data are not available at hospital discharge for these patients. An encrypted version of the National Health Index (NHI) number, a unique identifier assigned to everyone who uses health and disability support services (>98% of the population),[12] was used to anonymously link in-hospital ANZACS-QI patient records to national administrative datasets, including the medication dispensing, hospitalisation and mortality data, as previously described.[8]

Data and definitions: Variables used for this study included age, sex, ethnicity, prior statin use, diabetes, smoking status, history of cardiovascular disease (CVD), percutaneous coronary intervention (PCI) and a global measure of ACS risk (the Global Registry of ACS (GRACE) score).[13] Sociodemographic variables and residency status were derived from the linked national dataset. In accordance with health sector protocols, the ethnicities of patients for whom more than one ethnic group was recorded were prioritised in the following order: indigenous Māori, Pacific, Indian and New Zealand European (NZEO).[14] Socioeconomic deprivation was assessed by the NZDep13 score, a Census-based, small-area 10-point index of deprivation based on each person's domicile.[15] Prior statin use was derived from the national pharmaceutical claims dataset and was defined as having a statin dispensed during the 90-day period prior to index admission.

Main outcome measures: Statin prescription at discharge is recorded in the ANZACS-QI registry. The registry also records known intolerance/contraindication to statin.

Early dispensing was defined as dispensing within three months of discharge after an acute coronary syndrome event recorded in the national Pharmaceutical Collection. Statin medication included any of the following publicly funded medications: atorvastatin, fluvastatin, pravastatin or simvastatin with or without ezetimibe. Rosuvastatin is not a funded medication in New Zealand and is infrequently prescribed.

Statin use over the year after discharge was assessed by calculating a medication possession ratio (MPR).[16] The MPR is the number of days the drug was assumed to be in a patient's possession (based on dispensed drugs) divided by the number of days spent out of hospital from the date of hospital discharge through to the end of the follow-up period or the date of death, whichever came first. The possession of medications during 80% or more of follow-up time (ie, MPR≥0.8) was used to classify those adequately maintained on medications, as reported in other studies.[4] An MPR=0 indicates no dispensing at all. For many cardiac drugs, even short periods of non-adherence may have adverse clinical consequences. We therefore also reported the proportions of patients with optimal one-year (MPR≥1) dispensing. The MPR can be greater than one when more medication is dispensed than is required to cover the dispensing period.

Statistical analysis

Categorical data were summarised as frequency and percentage, and continuous data were reported as mean and standard deviation (SD). Comparison of categorical data between groups was performed by Chi-squared test. For continuous data, comparison between groups was performed by the non-parametric Mann–Whitney U test, due to data not being normally distributed.

Poisson regression modelling using a robust variance estimator was used to estimate relative risks (RRs) with accompanying 95% confidence intervals (CIs) of initial statin prescribing, one-year statin MPR≥1 and one-year statin MPR≥0.8. The models were adjusted for baseline age, gender, ethnicity, NZDep13 score, smoking status, diabetes, prior CVD, history of congestive heart failure (CHF), prior statin, type of ACS, percutaneous coronary intervention (PCI), Granger risk and non-cardiac Charlson comorbidity. All p-values reported were two-tailed and p-value <0.05 was considered significant. Data were analysed using SAS statistical package, version 9.4 (SAS Institute, Cary, NC).

Ethics approval: ANZACS-QI is part of the wider Vascular Informatics Using Epidemiology and the Web (VIEW) study. The VIEW study was approved by the Northern Region Ethics Committee Y in 2003 (AKY/03/12/314), with subsequent amendments to include the ANZACS-QI registries, and with annual approvals by the National Multi-region Ethics Committee since 2007 (MEC07/19/EXP).

Results

In the three-year study period there were 16,557 patients (Table 1). The mean age of patients was 64.7 years, with 68.2% male (11,288/16,557), 77.8% European/Other (12,873/16,557), 10.9% Māori (1,808/16,557), 4.3% Pacific (713/16,557), 4.2% Indian (702/16,557) and 2.8% Other Asian (461/16,557). There was a socioeconomic gradient with the highest proportion of patients living in the most deprived areas. 35.7% (5,908/16,557) had a history of prior CVD, 40.8% (6,752/16,557) were receiving a statin prior to the index admission, 22.5% (3,730/16,557) had diabetes mellitus and 23.8% (3,934/16,557) were current smokers. 65.9% (10,910/16,557) underwent PCI during the index admission.

Statin prescribing and dispensing (Table 1): 93.2% (15,431/16,557) patients were prescribed a statin at discharge and 1.9% (316/16,557) had a known intolerance to statin. Initial prescribing of statin was higher in men than women, similar for Māori, Pacific and European/Other groups, but slightly higher for Indian patients. There was no difference based on NZDep13 status. Statin prescribing was also higher in those with more severe ACS type, those treated with PCI and those with less non-cardiac comorbidity.

89.8% (14,864/16,557) of patients were dispensed a statin within three months; the mean decrement between prescribing and dispensing was 3.4%. This gap was slightly greater for older versus younger, for women versus men, for non-smokers, those with

prior CVD or less severe ACS type, those who did not receive PCI and those with more non-cardiac comorbidity. However, all differences between levels of each variable were small—no more than 4%. There was no significant difference in the 'prescribed–dispensed' gap across ethnic groups or level of socioeconomic deprivation.

Other secondary prevention medications: The differences between prescribing and dispensing were similar for other secondary prevention medications: aspirin (91.7% prescribed, 88.6% dispensed, difference=3.1%), P2Y12 inhibitor (85.6% prescribed, 84.2% dispensed, difference=1.4%), angiotensin converting enzyme inhibitor/aldosterone receptor blocker (68.8% prescribed, 65.3% dispensed, difference=3.5%) and beta-blocker (79.6 prescribed, 77.2% dispensed, difference=2.4%).

MPR, medication possession ratio; LDL, low-density lipoprotein; CVD, cardiovascular disease; CHF, congestive heart failure; ACS, acute coronary syndrome; USA, unstable angina; NSTEMI, non-ST-elevation myocardial infarction; STEMI, ST segment elevation MI; PCI, percutaneous coronary intervention.

Maintenance over one-year post-discharge (Table 1 and Figures 1 and 2): Overall, 79.8% (13,219/16,557) of patients had a statin MPR ≥0.8 in the first year post discharge but only 61.0% (10,096/16,557) had an ideal MPR ≥1. Figure 2 shows the distribution of MPRs by age, sex, ethnic group and NZDep13 level. The MPRs are divided into four groups: no statin dispensed (MPR=0), sub-optimal statin dispensing (MPR>0–<0.8), adequate but not ideal (MPR.8–<1) and ideal dispensing (MPR≥1). Women were more likely than men to not receive a statin, which is consistent with their lower initial prescription rate. Despite similar initial prescribing and dispensing rates, only 50.8% (918/1,808) of Māori and 53.7% (383/713) of Pacific patients had ideal MPRs, lower than Indian (457/702, 5.1%), Other Asian (297/461, 64.4%) and European/Other (8,041/12,873, 62.5%). Older patients were also more likely than younger patients to have ideal MPRs. In contrast, Māori, Pacific and younger patients are disproportionately represented in the sub-optimal MPR category. There is no clear difference according to NZDep13 status. Other variables associated with higher rates of ideal dispensing were non-smoking, diabetes, no prior CVD, more severe ACS type, coronary revascularisation and higher GRACE ACS risk scores.

Multiple regression analyses of initial prescribing and one-year statin maintenance (Table 2): After adjustment, the variables associated with higher statin initial prescribing rates included male sex, age over 45, Indian ethnicity, prior statin dispensing, current smoking, more severe ACS presentation, coronary intervention and less non-cardiac comorbidity. All differences in adjusted relative risks were small and under 10%. There was no difference between Māori, Pacific and European people.

One-year optimal statin maintenance: After adjustment, the largest adjusted relative risks were prior statin therapy and PCI, which were associated with 61%- and 23%-higher ideal dispensing than those with no prior statin or no PCI, respectively. The oldest patients were approximately 20% more likely to have ideal dispensing than the youngest patients. Optimal dispensing did not vary by sex. European patients were 12% more likely than Māori or Pacific patients to have optimal dispensing. Patients without prior CVD and those with STEMI were also over 10% more likely than reference groups to have ideal dispensing. These findings were mirrored in the multivariable analysis (Appendix Table 1) using the adequate MPR>=0.8 cut-off, but the adjusted risks were all less marked.

Discussion

In this nationwide study there were high rates of statin prescribing at discharge for all subgroups, with only slightly lower use in women than men and higher use in Indian than other ethnic groups. Reassuringly, nine out of ten patients were dispensed a statin; the percentage of people dispensed a statin was only 3% lower than those prescribed, with only small differences between demographic and clinical subgroups. Less than 2% of patients had a known intolerance to a statin. Statin maintenance over the first year was lower, with eight out of ten patients at least adequately maintained on a statin but only six out of ten receiving optimal dispensing. There was clinically important

Table 1: Patient characteristics according to initial statin prescribing and dispensing and maintenance over the year post discharge.

	Overall N	**Statin contraindicated or not tolerated** n (row %)	**Prescribed statin** n (row %)	**Prescribed and dispensed** n (row %)	**Prescribed but not dispensed** n (row %)	**MPR 1y ≥ 0.8** n (row %)	**MPR 1yr ≥ 1** n (row %)
Total	16557	316 (1.9)	15431(93.2)	14864 (89.8)	567/15431 (3.7)	13219 (79.8)	10096 (61.0)
Age							
Mean (SD)	64.7 (11.0)	69.3 (9.8)	64.6 (11.0)	64.5 (11.0)	66.4 (10.7)	64.9 (10.9)	65.6 (10.8)
P-value	-	*<.001*	*<.001*	*<.001*	*<.001*	*<.001*	*<.001*
Age group							
35–<45	667 (4.0)	4 (0.6)	616 (92.4)	602 (90.3)	14 (2.3)	488 (73.2)	328 (49.2)
45–<55	2676 (16.2)	27 (1.0)	2516 (94.0)	2449 (91.5)	67 (2.7)	2067 (77.2)	1431 (53.5)
55–<65	4385 (26.5)	56 (1.3)	4154 (94.7)	4010 (91.4)	144 (3.5)	3516 (80.2)	2580 (58.8)
65–<75	5182 (31.3)	122 (2.4)	4828 (93.2)	4632 (89.4)	196 (4.1)	4230 (81.6)	3335 (64.4)
75–<85	3647 (22.0)	107 (2.9)	3317 (91.0)	3171 (86.9)	146 (4.4)	2918 (80.0)	2422 (66.4)
P-value	-	*<.001*	*<.001*	*<.001*	*0.001*	*<.001*	*<.001*
Sex							
Male	11288 (68.2)	185 (1.6)	10696 (94.8)	10344 (91.6)	352 (3.3)	9273 (82.2)	7016 (62.2)
Female	5269 (31.8)	131 (2.5)	4735 (89.9)	4520 (85.8)	215 (4.5)	3946 (74.9)	3080 (58.5)
P-value	-	*<.001*	*<.001*	*<.001*	*<.001*	*<.001*	*<.001*
Ethnicity							
Māori	1808 (10.9)	22 (1.2)	1680 (92.9)	1630 (90.2)	50 (3.0)	1325 (73.3)	918 (50.8)
Pacific	713 (4.3)	8 (1.1)	672 (94.3)	653 (91.6)	19 (2.8)	532 (74.6)	383 (53.7)
Indian	702 (4.2)	6 (0.9)	685 (97.6)	664 (94.6)	21 (3.1)	589 (83.9)	457 (65.1)
Other Asian	461 (2.8)	3 (0.7)	431 (93.5)	422 (91.5)	9 (2.1)	382 (82.9)	297 (64.4)
European/ Other	12873 (77.7)	277 (2.2)	11963 (92.9)	11495 (89.3)	468 (3.9)	10391 (80.7)	8041 (62.5)
P-value	-	*<.001*	*<.001*	*<.001*	*0.053*	*<.001*	*<.001*
NZDep13							
1–2	2841 (17.2)	46 (1.6)	2650 (93.3)	2534 (89.2)	116 (4.4)	2317 (81.6)	1774 (62.4)
3–4	2851 (17.2)	55 (1.9)	2649 (92.9)	2546 (89.3)	103 (3.9)	2274 (79.8)	1752 (61.5)
5–6	3247 (19.6)	61 (1.9)	3024 (93.1)	2916 (89.8)	108 (3.6)	2630 (81.0)	2024 (62.3)
7–8	3772 (22.8)	84 (2.2)	3505 (92.9)	3389 (89.8)	116 (3.3)	3016 (80.0)	2319 (61.5)
9–10	3798 (22.9)	69 (1.8)	3557 (93.7)	3441 (90.6)	116 (3.3)	2969 (78.2)	2218 (58.4)
Missing	48 (0.3)	1 (2.1)	46 (95.8)	38 (79.2)	8 (17.4)	13 (27.1)	9 (18.8)
P-value	-	*0.720*	*0.715*	*0.333*	*0.127*	*<.001*	*0.003*
Smoking status							
Non-smoker	6980 (42.2)	152 (2.2)	6429 (92.1)	6147 (88.1)	282 (4.4)	5526 (79.2)	4288 (61.4)
Ex-smoker	5643 (34.1)	113 (2.0)	5265 (93.3)	5077 (90.0)	188 (3.6)	4620 (81.9)	3665 (64.9)
Current smoker	3934 (23.8)	51 (1.3)	3737 (95.0)	3640 (92.5)	97 (2.6)	3073 (78.1)	2143 (54.5)
P-value	-	*<.001*	*<.001*	*<.001*	*<.001*	*<.001*	*<.001*
LDL							
<2	5298 (32.0)	80 (1.5)	4966 (93.7)	4792 (90.4)	174 (3.5)	4478 (84.5)	3531 (66.7)
2–<3	4828 (29.2)	80 (1.6)	4487 (92.9)	4334 (89.8)	153 (3.4)	3840 (79.5)	2975 (61.6)
≥3	6413 (38.7)	156 (2.4)	5960 (92.9)	5720 (89.2)	240 (4.0)	4889 (76.2)	3582 (55.9)
Missing	18 (0.1)	0 (0)	18 (100)	18 (100)	0 (0)	12 (66.7)	8 (44.4)
P-value	-	*0.001**	*0.001**	*0.083**	*0.184**	*<.001**	*<.001**

Table 1: Patient characteristics according to initial statin prescribing and dispensing and maintenance over the year post discharge (continued).

	Overall N	Statin contraindicated or not tolerated n (row %)	Prescribed statin n (row %)	Prescribed and dispensed n (row %)	Prescribed but not dispensed n (row %)	MPR 1y ≥ 0.8 n (row %)	MPR 1yr ≥ 1 n (row %)
Diabetes							
Yes	3730 (22.5)	80 (2.1)	3494 (93.7)	3375 (90.5)	119 (3.4)	3027 (81.2)	2382 (63.9)
No	12827 (77.5)	236 (1.8)	11937 (93.1)	11489 (89.6)	448 (3.8)	10192 (79.5)	7714 (60.1)
P-value	-	*0.039*	*0.192*	*0.105*	*0.337*	*0.023*	*<.001*
Prior CVD							
Yes	5908 (35.7)	183 (3.1)	5452 (92.3)	5112 (86.5)	340 (6.2)	4593 (77.7)	3494 (59.1)
No	10649 (64.3)	133 (1.2)	9979 (93.7)	9752 (91.6)	227 (2.3)	8626 (81.0)	6602 (62.0)
P-value	-	*<.001*	*0.001*	*<.001*	*<.001*	*<.001*	*<.001*
History of CHF							
Yes	626 (3.8)	25 (4.0)	547 (87.4)	524 (83.7)	23 (4.2)	492 (78.6)	399 (63.7)
No	15931 (96.2)	291 (1.8)	14884 (93.4)	14340 (90.0)	544 (3.7)	12727 (79.9)	9697 (60.9)
P-value	-	*<.001*	*<.001*	*<.001*	*0.502*	*0.429*	*0.149*
Prior statin							
Yes	6752 (40.8)	25 (4.0)	6592 (97.6)	6436 (95.3)	156 (2.4)	6157 (91.2)	5025 (74.4)
No	9805 (59.2)	291 (1.8)	8839 (90.1)	8428 (86.0)	411 (4.6)	7062 (72.0)	5071 (51.7)
P-value	-	*<.001*	*<.001*	*<.001*	*<.001*	*<.001*	*<.001*
Type of ACS							
USA	2767 (16.7)	76 (2.7)	2495 (90.2)	2343 (84.7)	152 (6.1)	2122 (76.7)	1540 (55.7)
NSTEMI	9410 (56.8)	191 (2.0)	8719 (92.7)	8403 (89.3)	316 (3.6)	7418 (78.8)	5653 (60.1)
STEMI	4380 (26.5)	49 (1.1)	4217 (96.3)	4118 (94.0)	99 (2.4)	3679 (84.0)	2903 (66.3)
P-value	-	*<.001*	*<.001*	*<.001*	*<.001*	*<.001*	*<.001*
PCI							
Yes	10910 (65.9)	191 (1.8)	10443 (95.7)	10124 (92.8)	319 (3.1)	9155 (83.9)	7122 (65.3)
No	5647 (34.1)	125 (2.2)	4988 (88.3)	4740 (83.9)	248 (5.0)	4064 (72.0)	2974 (52.7)
P-value	-	*<.001*	*<.001*	*<.001*	*<.001*	*<.001*	*<.001*
Granger risk							
<1%	4587 (27.3)	70 (1.5)	4307 (93.9)	4151 (90.5)	156 (3.6)	3580 (78.1)	2530 (55.2)
1–3%	6813 (41.1)	138 (2.0)	6337 (93.0)	6094 (89.5)	243 (3.8)	5453 (80.0)	4121 (60.5)
≥3%	5157 (31.1)	108 (2.1)	4787 (92.8)	4619 (89.6)	168 (3.5)	4186 (81.2)	3445 (66.8)
P-value	-	*0.156*	*0.081*	*0.163*	*0.650*	*0.001*	*<.001*
Non-cardiac Charlson							
0	12024 (72.6)	193 (1.6)	11321 (94.2)	10944 (91.0)	377 (3.3)	9705 (80.7)	7374 (61.3)
1	1666 (10.1)	37 (2.2)	1535 (92.1)	1458 (87.5)	77 (5.0)	1299 (78.0)	1012 (60.7)
2	1510 (9.1)	38 (2.5)	1359 (90.0)	1298 (86.0)	61 (4.5)	1171 (77.6)	896 (59.3)
3+	1357 (8.2)	48 (3.5)	1216 (89.6)	1164 (85.8)	52 (4.3)	1044 (76.9)	814 (60.0)
P-value	-	*<.001*	*<.001*	*<.001*	*0.005*	*<.001*	*0.403*

* P-value excluded missing LDL.

Figure 1: Initial statin prescribing and dispensing and maintenance over the year post discharge.

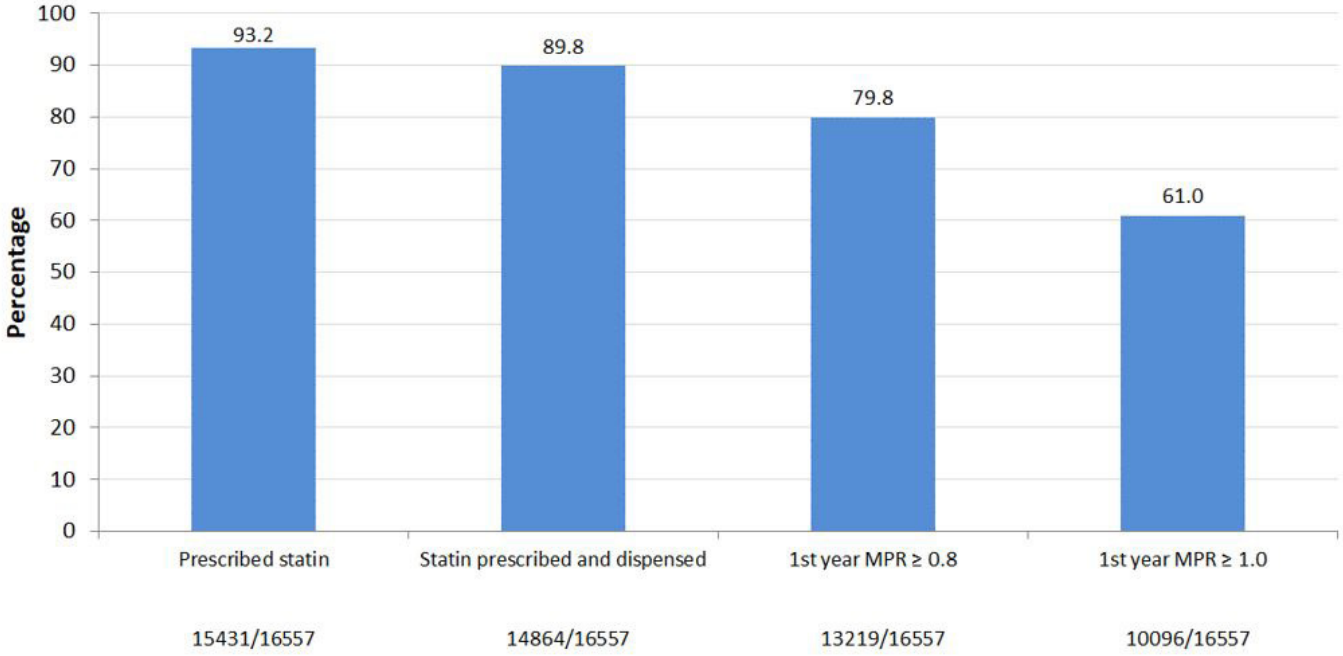

Figure 2: Distribution of one-year MPRs for gender, age, ethnicity and NZDep13.

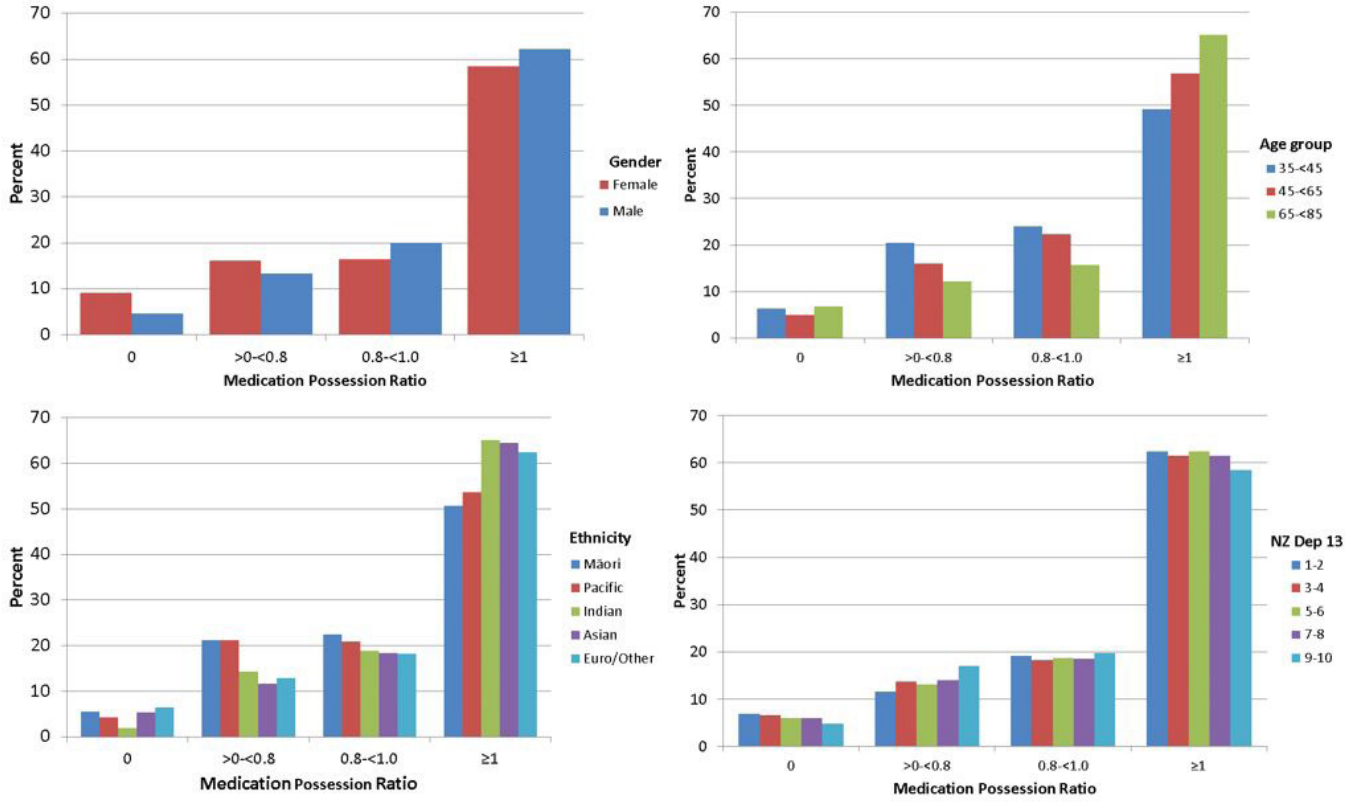

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Table 2: Multivariable models: predictors of initial prescribing and one-year MPR ≥1.

	Initial prescribing		One-year MPR ≥1	
	RR (95% CI)	**P-value**	**RR (95% CI)**	**P-value**
Age				
<45	1.00	-	1.00	-
45–<55	1.02 (1.00–1.05)	0.03	1.06 (0.97–1.15)	0.20
55–<65	1.04 (1.02–1.06)	<.01	1.10 (1.02–1.20)	0.02
65–<75	1.04 (1.02–1.07)	<.01	1.18 (1.09–1.28)	<.01
75–<85	1.03 (1.01–1.06)	0.01	1.21 (1.11–2.32)	<.01
Gender				
Female	0.97 (0.96–0.98)	<.01	0.98 (0.95–1.00)	0.07
Male	1.00	-	1.00	-
Ethnicity				
Māori	1.00 (0.99–1.01)	0.79	0.88 (0.84–0.92)	<.01
Pacific	1.01 (0.99–1.03)	0.28	0.88 (0.82–0.94)	<.01
Indian	1.03 (1.01–1.04)	<.01	1.00 (0.94–1.05)	0.91
Asian	0.99 (0.97–1.02)	0.59	1.01 (0.95–1.09)	0.67
European/Other	1.00	-	1.00	-
NZDep13				
1–2	0.99 (0.98–1.00)	0.20	1.02 (0.98–1.06)	0.38
3–4	0.99 (0.98–1.00)	0.10	1.00 (0.96–1.04)	0.96
5–6	0.99 (0.98–1.00)	0.18	1.02 (0.98–1.06)	0.38
7–8	0.99 (0.98–1.00)	0.25	1.02 (0.98–1.05)	0.36
9–10	1.00	-	1.00	-
Smoking status				
Non-smoker	1.00	-	1.00	-
Ex-smoker	1.01 (1.00–1.01)	0.25	1.03 (1.00–1.06)	0.03
Current smoker	1.02 (1.01–1.03)	<.01	0.93 (0.90–0.97)	<.01
Diabetes				
Yes	1.01 (1.00–1.02)	0.28	1.02 (0.98–1.05)	0.34
No	1.00	-	1.00	-
Prior CVD				
Yes	0.98 (0.97–0.99)	<.01	0.81 (0.79–0.83)	<.01
No	1.00	-	1.00	-
History of CHF				
Yes	0.97 (0.94–0.99)	0.01	1.08 (1.02–1.15)	0.01
No	1.00	-	1.00	-
Prior statin				
Yes	1.10 (1.09–1.11)	<.01	1.61 (1.57–1.65)	<.01
No	1.00	-	1.00	-

Table 2: Multivariable models: predictors of initial prescribing and one-year MPR ≥1 (continued).

	Initial prescribing		One-year MPR ≥1	
	RR (95% CI)	**P-value**	**RR (95% CI)**	**P-value**
Type of ACS				
USA	0.93 (0.92–0.95)	<.01	0.80 (0.76–0.83)	<.01
NSTEMI	0.97 (0.96–0.98)	<.01	0.91 (0.88–0.94)	<.01
STEMI	1.00	-	1.00	-
PCI				
Yes	1.07 (1.06–1.08)	<.001	1.23 (1.20–1.27)	<.01
No	1.00	-	1.00	-
Granger risk				
<1%	1.00	-	1.00	-
1-3%	0.98 (0.97–0.99)	<.01	1.00 (0.97–1.04)	0.94
≥3%	0.97 (0.96–0.98)	<.01	1.02 (0.98–1.07)	0.28
Non-cardiac Charlson				
0	1.00	-	1.00	-
1	0.97 (0.96–0.99)	<.01	0.94 (0.90–0.98)	<.01
2	0.96 (0.95–0.98)	<.01	0.92 (0.88–0.96)	<.01
3+	0.96 (0.95–0.98)	<.01	0.92 (0.88–0.96)	<.01

MPR, medication possession ratio; LDL, low-density lipoprotein; CVD, cardiovascular disease; CHF, congestive heart failure; ACS, acute coronary syndrome; USA, unstable angina; NSTEMI, non-ST-elevation myocardial infarction; STEMI, ST segment elevation MI; PCI, percutaneous coronary intervention.

variation, with younger patients, Māori and Pacific people less likely to receive optimal dispensing.

Prior studies: The maintenance rates for statins in our cohort are slightly higher than those reported using a 2007 New Zealand national ACS cohort. In that study, which included all ACS patients, 69% had a statin MPR >=0.8 in the first year post-ACS.[17] The higher rate in our cohort is partially due to the cohort only being comprised of patients receiving coronary angiography, who are more likely to receive medications than those not referred for coronary angiography, although the result is better than the MPR of 75% reported in a smaller, two-centre ANZACS-QI cohort from 2007 to 2011. The prior studies also reported lower statin use in Māori, Pacific and younger people. In the prior national study, there was no information about how many patients were prescribed a statin at discharge or recorded as being intolerant of statins. In the current and the prior studies, patients who were dispensed a statin prior to the index admission were more likely than those without prior statin dispensing to continue on a statin. These are presumably patients who have previously tolerated statin therapy and have accepted it use. The current study demonstrates that approximately 10% of the sub-optimal longer-term maintenance of statin is due to initial prescribing practice, known intolerances or barriers to getting medication dispensed early after discharge. In this cohort, only another 10% had inadequate (MPR<0.8) statin maintenance over the first year. This will include some patients who stopped due to experiencing side effects. Prior large observational studies have reported an up-to-10% intolerance due to the statin-specific side-effects of myalgia and myopathy[18,19] and real or perceived intolerance to statins. Despite 80% receiving adequate dispensing, only 60% of patients received optimal dispensing (MPR≥1), and for Māori, Pacific and younger patients this is lower at around 50%. Māori and Pacific people have the worst ischaemic heart disease outcomes.[1,20] The clinical significance of this difference between optimal and adequate dispensing is not known. The definition of adequate dispensing (MPR>0.8) is an accepted convention,[4] but for LDL cholesterol lowering, more optimal dispensing has been associated with better LDL lowering.[6] Of perhaps greater significance, the lower MPRs for these patients may be a marker of less-optimal medical management and other healthcare more generally. This has previously been postulated as the inverse of the 'healthy adherer' effect.[4, 21]

Furthermore, although the observed differences in these two studies are relatively small, they add to other work demonstrating similar differences between ethnic groups at several points across the pathway of care. These include Māori with STEMI having longer delays in initially calling for help, and both Māori and Pacific patients having slightly lower angiography and intervention rates even after adjustment for covariates.[22,23] Although the difference between ethnicities may be small at each point, cumulatively they may add up to a significant impact on outcome.

Clinical implications and what is achievable: In this study some subgroups are achieving adequate statin maintenance in over 90% of patients, which suggests a target level that is potentially achievable overall.

Commencement and continuation of statins and other medications of proven clinical benefit that have been started in hospital requires optimal performance across this care continuum. While the patient is in hospital, multidisciplinary involvement of the medical, nursing and cardiac-rehabilitation teams and pharmacists is required to both educate and support patients and their families regarding the benefits and potential risks of medications. Practical considerations include simplifying the dosing regimen and encouraging patients to blister pack their medications or utilise a similar adherence-facilitating process.[24] Financial barriers have an impact on adherence and should be addressed.[24] The default charge per item dispensed in New Zealand is $5. Although there are programmes to reduce this for high-needs populations, it is likely that some patients defer medications because of cost considerations. Ideally there should be referral to culturally appropriate cardiac-rehabilitation programmes after discharge to continue to educate and support patients and facilitate the transition to primary care.[25] Beyond hospital, primary-care-based self-monitoring and

self-management programmes have demonstrably improved adherence to medication regimes, and technology that ensures re-prescription of medications does continue after discharge should be adopted.[24] In addition, the publication of data is an important way to give feedback to clinicians and modify prescribing behaviour.[26]Since 2019, New Zealand's ANZACS-QI programme has reported the one-year post-ACS statin maintenance within each of the 20 district health board catchments. From 2020, this annual report has been provided directly to the public via the Heart Foundation website.[27] This reporting is intended to prompt units to review their local guidelines and will allow progress to be tracked.

In this study, the initial post-ACS-discharge prescribing and dispensing rates were similar, which supports the use of dispensing data for future research and quality-improvement projects.

Limitations

We used dispensing of statin as a marker of maintenance, but not everyone who is dispensed a drug routinely is necessarily taking the medication.

Conclusions

In this cohort of ACS patients managed with an invasive strategy, the rate of initial statin prescribing and dispensing was high but could be further improved. A high proportion of patients had adequately maintained dispensing over the year post discharge, but optimal maintenance was less satisfactory and there are clear ethnic and age differences in the optimal use of medication, which may reflect more general disparities in healthcare.

Appendix

Appendix Table 1: Multivariable models: predictors of one-year MPR ≥0.8.

	One-year MPR ≥ 0.8	
	RR (95% CI)	**P-value**
Age		
<45	1.00	-
45–<55	1.04 (0.99–1.10)	0.08
55–<65	1.07 (1.02–1.12)	0.01
65–<75	1.09 (1.24–1.15)	<.01
75–<85	1.09 (1.03–1.14)	<.01
Gender		
Female	0.94 (0.92–0.96)	<.01
Male	1.00	-
Ethnicity		
Māori	0.94 (0.91–0.97)	<.01
Pacific	0.93 (0.89–0.97)	<.01
Indian	1.00 (0.96–1.03)	0.82
Asian	1.01 (0.97–1.05)	0.54
European/Other	1.00	-
NZDep13		
1–2	1.01 (0.99–1.04)	0.23
3–4	0.99 (0.97–1.02)	0.60
5–6	1.01 (0.99–1.03)	0.37
7–8	1.01 (0.98–1.03)	0.59
9–10	1.00	-
Smoking status		
Non-smoker	1.00	-
Ex-smoker	1.01 (1.00–1.03)	0.09
Current smoker	1.00 (0.98–1.02)	0.86
Diabetes		
Yes	1.00 (0.98–1.02)	0.99
No	1.00	-
Prior CVD		
Yes	0.87 (0.85–0.89)	<.01
No	1.00	-
History of CHF		
Yes	1.03 (0.99–1.07)	0.16
No	1.00	-
Prior statin		
Yes	1.38 (1.36–1.41)	<.01
No	1.00	-

Appendix Table 1: Multivariable models: predictors of one-year MPR ≥0.8 (continued).

	One-year MPR ≥ 0.8	
	RR (95% CI)	**P-value**
Type of ACS		
USA	0.88 (0.85–0.90)	<.001
NSTEMI	0.94 (0.92–0.96)	<.001
STEMI	1.00	-
PCI		
Yes	1.15 (1.13–1.17)	<.001
No	1.00	-
Granger risk		
<1%	1.00	-
1–3%	0.99 (0.97–1.01)	0.19
≥3%	0.97 (0.94–0.99)	0.01
Non-cardiac Charlson		
0	1.00	-
1	0.94 (0.92–0.97)	<.01
2	0.95 (0.92–0.97)	<.01
3+	0.94 (0.91–0.97)	<.01

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