Nationwide dispensing of cardioprotective medications during the first year following acute coronary syndrome (ANZACS-QI 56)

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ABSTRACT

AIM: A number of evidence-based medications are recommended following an acute coronary syndrome (ACS), including statins, antithrombotics (antiplatelet and/or anticoagulants), a beta-blocker and an angiotensin-converting enzyme inhibitor or angiotensin receptor blocker (ACE-I/ARB). This study aimed to describe the dispensing of the cardioprotective medications in the first year following an ACS hospitalisation in New Zealand and how this varies according to age, sex and type of coronary intervention.

METHOD: National hospitalisation data was used to identify all New Zealand residents aged 35–79 years who were discharged from hospital in the years 2013/14 with a primary discharge diagnosis of ACS. Using anonymous linkage to national pharmaceutical dispensing and mortality datasets, the dispensing of each group of medications was examined in survivors of quarters one, two and four of the first year post discharge.

RESULTS: There were 14,496 patients; mean age was 63.4 years and 68.8% were male. Dispensing of medications in survivors steadily fell across quarters one, two and four: 90.8%, 82.1% and 78.8% of patients were dispensed statins; 90.6%, 79.8% and 78.1% were dispensed aspirin; 82.7%, 72.6% and 70.0% were dispensed beta-blockers; 69.6%, 62.7% and 61.3% were dispensed ACE-I/ARB; 67.7%, 53.6% and 40.4% were dispensed a P2Y₁₂ inhibitor; and 68.6%, 53.0% and 40.7% were dispensed a combination of two or more antithrombotics.

CONCLUSION: Cardioprotective medication dispensing was lower than would have been the case if the current ACS guidelines were followed. The greatest decrease in dispensing occurred between quarter one and quarter two, which highlights a potentially important period for targeted interventions to improve adherence.

Unless contraindicated, the current guidelines for secondary prevention following acute coronary syndrome (ACS) recommend a statin for all patients. Patients should also receive combination antithrombotic therapy—usually a combination of aspirin and a P2Y₁₂ inhibitor antiplatelet agent. But, for patients with atrial fibrillation, an oral anticoagulant may be added or substituted for an antiplatelet agent. For most patients, a beta-blocker and an angiotensin-converting enzyme inhibitor or angiotensin receptor blocker (ACE-I/ARB) are also indicated. These medications have been shown to reduce mortality and improve outcomes after ACS.¹⁻⁴

Using routinely collected national datasets, this study aimed to describe the dispensing of the cardioprotective medication in the first year following an ACS hospitalisation in New Zealand, and how this varies according to age, sex and type of coronary intervention.
Methods

Study population
The study cohort was constructed using anonymised individual-level linkage of national hospitalisation, mortality and pharmaceutical data. The initial cohort included all New Zealand residents with a principal diagnosis of ACS (ST Elevation Myocardial Infarction [STEMI], non-STEMI [NSTEMI], myocardial infarction unspecified [MIU] or unstable angina [UA]) and public hospital discharge dates from 1 January 2013 to 31 December 2014. ICD-10-AM codes used were I20.0 (UA), I21.4, I22.2 (NSTEMI), I21.0–I21.3, I22.0, I22.1, I22.8, I22.9 (STEMI) and I21.9 (MIU).

The first ACS admission for each individual during the study period was included in the analysis. The date of discharge from the index ACS hospitalisation was obtained by bundling ACS hospitalisations that were separated by no more than a day. This was required to ensure transfers between different hospitals during the index episode were counted as a single ACS event.

Exclusions
From this initial cohort, the following exclusions were made: patients with no record of dispensing of any medication prior to or post discharge (n=257) (on the presumption that they were not New Zealand residents); patients with no identifiable place of residence (n=11) and patients who died within 30 days of discharge (n=1,318). Those aged less than 35 years or over 79 years were excluded due to potential diagnostic uncertainty and because medical management of older patients is likely to be influenced by comorbidities to a greater extent than for the 35–79 year old cohort.

Separate cohorts were then created for quarter one (91 days) survivors, quarter two (182 days) survivors and one-year (365 days) survivors post discharge.

Main outcome measures
Statistical methods used were simple counts and proportions. The proportion of surviving patients dispensed each of the five classes of medications (statin, aspirin, P2Y12 inhibitors, beta-blocker and ACE-I/ARB) and dual therapy were calculated for quarters one, two and four of the first year post discharge. Guidelines recommend at least two antithrombotic agents at discharge for most patients. This can include dual antiplatelet therapy (DAPT) for patients without atrial fibrillation (AF) and either dual therapy (antiplatelet + anticoagulant) or triple therapy (DAPT + anticoagulant) for many patients with AF. In our study, there was no reliable way to identify patients with AF. We have therefore reported the proportions of patients on ‘combination antithrombotic therapy’, defined as at least two antithrombotic agents to capture all DAPT, dual therapy and triple therapy use (see the Appendix Figure 1 for the list of all medications included in each class). Dispensing was examined and displayed in multi-panel figures by age group (35–49 years, 50–64 years and 65–79 years) and sex.

Analysis by quarters was chosen because the usual supply of medications dispensed in New Zealand is 90 days. The quarters were selected because quarter one is a proxy for initial adherence to cardioprotective medications post discharge; dispensing in quarter two aligns with some ACS guidelines for at least six months’ dual therapy for patients at high bleeding risk; and dispensing in quarter four is a proxy for adherence at one year post discharge, which aligns with most ACS guidelines for dual therapy for patients who are not at high bleeding risk. Quarter three did not align with a guideline recommendation, so was omitted for conciseness.

Co-variables
Other variables described were procedure received during hospitalisation, discharge diagnosis (STEMI/MIU or NSTEMI/UA) and ethnicity. Ethnicity was prioritised in the following order when multiple ethnic groups were recorded for an individual: Māori, Pacific, Indian and other. This prioritisation process aligns with national ethnicity protocols.

The types of coronary intervention included: no procedure (defined as no angiogram, percutaneous coronary intervention [PCI] or coronary artery bypass grafting [CABG]), angiogram only (defined as angiogram without subsequent PCI or CABG), PCI (defined as PCI but not CABG) and CABG (defined as any CABG, with or without PCI).
Ethics approval

Ethics approval was granted by the University of Otago Human Ethics Committee (Health) under the Minimal Risk Health Research – Audit and Audit related studies category. A University of Otago mandated consultation process was undertaken with the Māori Research Advisor/ Kaitohutohu Rangahau Māori.

This analysis is part of the All New Zealand Acute Coronary Syndrome Quality Improvement (ANZACS-QI) arm of the VIEW research programme, which receives annual ethical re-approvals from the Northern Region Ethics committee Y (original approval in 2003 [AKY/03/12/314]) and the Multi-Region Ethics Committee (original approvals in 2007 [MEC/01/19/EXP] and 2011 [MEC/11/EXP/078]). Because all data are anonymised, individual patient consent is not required.

Results

Cohorts

In the two-year period 2013/14, 19,075 patients were discharged from hospital with a diagnosis of ACS. The age range of these patients was 19 to 101 years, with a mean of 68.5 years; 36.4% were female, 9.9% Māori, 4.3% Pacific and 3.3% Indian. The majority of patients (79.1%) had a discharge diagnosis of NSTEMI/UA, whereas 20.9% had STEMI/MIU. During their hospital admission, 14.3% of patients received a CABG, 42.6% received a PCI without CABG, 16.5% received angiogram only and 26.6% did not have any procedure. In total, 73.4% of ACS patients received a coronary angiogram.

After age and other exclusions were applied, 14,353 patients survived quarter one, 14,212 patients survived quarter two and 13,953 patients survived quarter four post discharge. Characteristics for these patients are shown in Table 1.

Dispensing of cardioprotective medications for these cohorts are shown in Figure 1 and Table 2.

Dispensing of statins and aspirin over the first year post discharge followed a similar pattern: more than 90% of patients in the first quarter, which fell to around 80% in the second quarter and remained relatively constant between quarters two and four. The dispensing of beta-blockers and ACEI/ARBs was lower than other medication classes in the first quarter (82.7% and 69.6%, respectively) and followed the same pattern as statins and aspirin, with an initial decrease in dispensing in quarter two (72.6% and 62.7%, respectively) followed by relatively constant dispensing between quarters two and four.

Dispensing of a P2Y12 inhibitor did not follow the same pattern as the other medications. Although the greatest absolute percentage decrease was between quarters one and two (from 67.7% to 53.6%), dispensing decreased to 40.4% in quarter
four. These percentages are very similar to dispensing of combination antithrombotic therapy (see Appendix Table 1). Dispensing of anticoagulants was under 10% and changed little over time.

**Sex**

Except for ACEI/ARBs, men had higher dispensing than women across all age groups (Figures 2a to 2c and Appendix Table 2). These sex differences were greatest for the youngest age group, and they were smallest for the oldest age group. For ACEI/ARBs, men had higher dispensing in the youngest age group but similar dispensing in middle and older age (Figure 2d).

**Coronary intervention and medication dispensing**

For statins and aspirin, patients who had PCI or CABG had the highest dispensing, followed by angiogram only, with no procedure having the lowest dispensing (Figure 3 and Appendix Table 3). For P2Y$_{12}$ inhibitor dispensing, patients who received PCI had the highest dispensing with CABG lowest. For beta-blockers, people who had PCI or CABG had the highest dispensing, followed by angiogram only and no procedure. Those who had PCI had the highest dispensing of ACEI/ARB.

Women were more likely than men to either not receive a coronary angiogram or have angiography without coronary intervention. The sex difference in rate of coronary angiography without intervention was most marked in younger age bands. In contrast, men were also more likely to receive PCI or CABG than women in all age groups, although the excess for PCI was greater in the younger age group (Appendix Figure 2).

**Figure 1:** Cardioprotective medication dispensing in the first year post ACS discharge.

*Combination antithrombotic therapy* overlaps the P2Y$_{12}$ inhibitor line, so it is not shown in this figure.
Figure 2a: Statin dispensing in quarters one, two and four post ACS discharge, by sex and age group.

Figure 2b: Combination antithrombotic dispensing in quarters one, two and four post ACS discharge, by sex and age group.
Figure 2c: Beta-blocker dispensing in quarters one, two and four post ACS discharge, by sex and age group.

Figure 2d: ACEI/ARB dispensing in quarters one, two and four post ACS discharge, by sex and age group.
Figure 3: Cardioprotective medication dispensing post ACS discharge by coronary procedure.
Discussion

This study is the first to describe the dispensing of all key cardioprotective medications in the first year post discharge in a comprehensive New Zealand ACS cohort, and it serves as a baseline for future comparisons.

Key findings

One in ten people were not dispensed any statin or aspirin immediately after discharge. Two in ten did not receive a beta-blocker and approximately three in ten did not receive an ACEI/ARB or P2Y₁₂ inhibitor agent post discharge.

A further one in ten did not receive a repeat dispensing of each of aspirin, statin, ACEI/ARB and beta-blocker agents in the second quarter. For these medications, the dispensing rate was then maintained at a similar level for up to a year. These agents are generally intended to be continued over the long term.¹⁻⁸ Because quarter two post-discharge medication is typically prescribed by a patient’s general practitioner in primary care, the uniform early decline for each agent suggests a problem with patients engaging with primary care early after discharge to continue their medication. The alternative explanation is a one in 10 intolerance rate to all of these medications, but this alternative explanation is unlikely.¹³⁻²⁰

Multiple factors contribute to non-dispensing of medications. These can be considered broadly as generic and medication specific factors. Generic factors include patient/whānau and medical professional knowledge/beliefs and medical system processes. In this study, we were unable to disentangle all these factors, but there are two important observations. First, despite very good clinical evidence supporting the use of statins and aspirin for virtually all patients post ACS,¹⁻⁸ one in ten patients were not dispensed these agents. Further investigation is required to understand the extent to which this is due to a decision by the hospital team not to prescribe this medication, versus whether there is a prescribing-dispensing gap, with patients not presenting the prescription to their pharmacist. Such a gap would also be relevant to other medications.

The second and most important area for potential improvement that this study identified is the early discontinuation of medication post discharge. Again, further investigations that focus on the reasons for this early discontinuation are needed. Areas where improvement may be possible include the secondary-to-primary-care transition, primary care recall systems and patient/whānau education and support.²¹ Better management of the transition between secondary and primary care is needed with early engagement of patients with a GP post discharge. There may be opportunities in primary care to use both electronic recall systems and education/social support to better support patients with ongoing medication dispensing. Secondary care rehabilitation nursing and pharmacy teams play an important role in educating patients in hospital and early post-discharge, identifying patients at risk and potential causes of non-adherence and helping to manage these, together with providing support in the transition back to primary care.²²

Perhaps the most important medication-specific factor to consider is whether a specific medication is clinically indicated given the specific clinical presentation and treatment for each patient, and whether each one is tolerated. These considerations vary across the five agents. In addition, patient/clinician beliefs about specific agents may also contribute.

Statins

Statin dispensing (along with aspirin) was relatively high across all quarters. In a prior study from two New Zealand hospitals, 95% of a 2007–2011 ACS cohort were prescribed a statin at discharge and 92% had one dispensed in the first quarter post discharge, which is similar to the current study.²³

Although the rate of statin intolerance in the current study is unknown, it is likely to be very low, given several systematic reviews and review panel findings that have found no difference in rates of myalgia between statins and placebo and rates of adverse events of 1% or less.¹³⁻¹⁸ Therefore, it is very likely that the prescribing rate of 95.0% found by Kerr and colleagues, and the dispensing rate of 90.8% in quarter one (and lower rates in subsequent quarters) found in the current study, are lower than they could be. It is likely that perceived statin intolerance is a factor in sub-optimal prescribing and dispensing, and that this has likely caused excess mortality.²⁴
Aspirin

Aspirin was dispensed to 90.6% of patients in the first quarter, similarly to the prior regional New Zealand study that reported a first quarter dispensing rate of 87.9%. Possible clinical reasons for patients not being dispensed aspirin include intolerance, bleeding complications and substitution of an anticoagulant medication in those with atrial fibrillation. Aspirin intolerance is very low, with published estimates ranging from 0.3% to 2.5%. But aspirin intolerance can be up to 10% in patients with asthma. In an international ACS cohort admitted to a coronary care unit, 1.8% (24 patients) had a documented history of aspirin hypersensitivity, and all were able to be de-sensitised. In a larger study of patients with coronary artery disease, 1.5% (142 patients) were found to have histories of aspirin reactions. Of these 142 patients, 18% had histories of cutaneous reactions, 2.1% of respiratory reactions, 26.8% of gastrointestinal intolerance and 23.2% of bleeding. Most adverse events caused by aspirin are due to bleeding. International ACS guidelines recommend aspirin post discharge, even in patients with a high bleeding risk, because the risk of mortality in those not taking aspirin outweighs the bleeding risk. New Zealand’s 30-day and one-year bleeding rates post ACS were reported to be around 5% and 8%, respectively. Bleeding events may account for some of those not dispensed aspirin in this study, but it cannot account for the finding that more than 20% of the surviving cohort were not taking aspirin at six months post discharge. Discontinuation or non-adherence to aspirin is associated with a three-fold higher risk of major adverse cardiac events.

P2Y₁₂ inhibitors

Recent Australian, European and American guidelines recommend that all ACS patients not at high bleeding risk should have at least 12 months of DAPT. Those at high bleeding risk are recommended to have at least six months of DAPT or dual therapy, except for those medically managed and at high bleeding risk, for whom European guidelines state that at least one month of dual therapy should be considered. In medically managed patients without bleeding risk, the same guidelines recommend 12 months of dual therapy. The proportion dispensed P2Y₁₂ inhibitors in the first quarter should then be similar to that of aspirin (90.6%), but this study found a much lower dispensing proportion of 67.7%, which can’t be explained by substitution with anticoagulants for those with AF.

In a 2012 two-week national audit of New Zealand ACS patient management, Ellis and colleagues found an ‘other antiplatelet’ prescribing rate of 68.9%, a very similar proportion to that found by this study, as would be expected, given the similarity of the cohorts.

A notable difference between P2Y₁₂ inhibitors dispensing and dispensing of the other four medications is that the dispensing proportion continued to decrease after quarter two. The absolute decrease in dispensing percentage from quarter two to quarter four for the other medications ranged from 1.4% to 2.6%, compared to 13.2% for P2Y₁₂ inhibitors. This difference in pattern will partly be due to physician-guided discontinuation, given the recommendation that the risk of bleeding should be taken into consideration when prescribing dual therapy. Patients who have physician-guided discontinuation of dual therapy post PCI have reportedly lower rates of major adverse cardiovascular events compared to those who remain on dual therapy, which points to the importance of individualised treatments.

The most recent guideline on dual antiplatelet therapy recommends that consideration be given to six months’ duration for patients after PCI with a high (>25) PRECISE-DAPT score. Prior to PRECISE-DAPT, there was no bleeding risk score specifically developed to assist clinicians in deciding duration of DAPT post ACS. The current study did not have the clinical data required to estimate bleeding risk, so it was not possible to determine the proportion of patients who were suitable candidates for a reduced duration of dual therapy.

Beta-blockers and ACEI/ARBs

The prevailing New Zealand ACS guidelines at the time of this cohort recommended beta-blockers and ACEI/ARBs in all patients without known intolerance or contraindications. From this study’s first quarter dispensing rates of 82.7% for beta-blockers...
and 69.6% for ACEI/ARBs, it appears that clinicians were not following those guidelines. However, this may represent clinical uncertainty regarding the evidence base behind these universal recommendations. Indeed recent guidelines have taken a more nuanced view regarding the use of ACEI/ARB and beta-blockers. For example, the 2016 National Heart Foundation of Australia and Cardiac Society of New Zealand and Australia recommend that, in the absence of a documented contraindication/intolerance, patients with high-risk features (left ventricular ejection fraction (LVEF) <40%, clinical heart failure, anterior MI, diabetes or hypertension) should have an ACEI/ARB, and those with LVEF <40% should have a beta-blocker. Information on left ventricular function and the other high-risk features was not available in these routinely collected datasets, so the proportion of this cohort that might be expected to be on these medications is unknown.

Medication dispensing by age, sex and coronary intervention

Men of all age groups were more likely to be dispensed statins, aspirin, a second antiplatelet/anticoagulant and beta-blockers. This sex difference was most obvious in younger patients. Women have a higher bleeding risk post PCI than men, present at an older age and with more comorbidities, which may influence prescribing decisions and contribute to lower dispensing rates. The finding that women had lower rates of coronary revascularisation can partly be attributed to sex differences in the pathophysiological mechanisms of ACS, which may therefore also play a part in the observed sex differences in medication use. Women with ACS may be more likely to have microvascular disease and, despite greater morbidity and mortality, have less severe obstructive disease of coronary arteries. The higher rate of angiography without associated revascularisation in young women is consistent with them having less obstructive coronary artery disease. The evidence base for routine secondary prevention therapy in patients without obstructive coronary disease is less clear, particularly for non-atherosclerotic causes of ACS such as spontaneous coronary artery dissection, which constitute a greater proportion of ACS presentations in younger women, and Takotsubo syndrome, another non-atherosclerotic condition which mimics ACS, which occurs predominantly in women and may sometimes be misclassified as ACS. Furthermore, a recent Swedish observational study reported that the most important components of ACS evidence-based treatment for reducing recurrent major adverse cardiac events in patients without obstructive coronary artery disease were statins and ACEI/ARBs, and that there was a neutral effect of dual antiplatelet therapy. Further research is required to better understand the reasons and clinical implications of the observed age and sex differences in specific medication utilisation.

Strengths

This study is the first to describe dispensing of the key cardioprotective medication classes over the first year post ACS in a New Zealand resident cohort. The linked administrative data sets are of a high quality and completeness for discharge data and medication dispensing.

Limitations

Dispensing data was used as a proxy for medication use. Although this method is used elsewhere, it may not necessarily equate to adherence. The methodology used to determine dispensing in each quarter only required any dispensing to have taken place, rather than dispensing to cover each day within the quarter with an adequate dose of medication. Other studies have used a medication possession ratio to address this issue.

Routinely collected datasets were used. The datasets did not contain information on certain clinical variables that are important to decisions of whether to prescribe cardioprotective medications, such as medication intolerance, factors related to bleeding risk and left ventricular function. This study could not distinguish between physician-guided discontinuation of dispensing, interruption due to bleeding events or surgery and patient non-adherence. The cohort studied is from 2013/14 with one-year minimum follow-up. It took several years to obtain, analyse and report. Except for ACEI/ARB and beta-blocker advice, there have been no major changes in prevention medication guidelines, nor dispensing practice, in New Zealand primary care since then.
to suggest that findings in a more updated cohort would be meaningfully different.

**Conclusions**

In this New Zealand-resident, post-ACS cohort, cardioprotective medication dispensing for all medication classes was lower than would have been the case if the current international ACS guidelines were followed. For all cardioprotective medications, the greatest decrease in dispensing occurred between quarter one and quarter two, and then dispensing remained relatively steady, except for P2Y<sub>12</sub> inhibitors. This drop in dispensing is unlikely to be explained by true medication intolerance, and it highlights an important period for targeted interventions to improve adherence.
Appendix

Appendix Figure 1: Medication list.

- Statins
  - Atorvastatin
  - Fluvastatin
  - Pravastatin
  - Simvastatin
- P2Y_{12} inhibitors
  - Clopidogrel
  - Ticagrelor
- Anticoagulants
  - Warfarin
  - Dabigatran
- ACE inhibitors
  - Benazepril
  - Captopril
  - Cilazapril
  - Enalapril
  - Lisinopril
  - Perindopril
  - Quinapril
  - Trandolapril
- Angiotensin receptor blockers
  - Candesartan
  - Losartan

Appendix Figure 2: Proportion receiving coronary procedure by sex and age group, post ACS.
Appendix Table 1: Cardioprotective medication dispensing in quarters one, two, three and four post ACS discharge, for 35–79 year olds.

<table>
<thead>
<tr>
<th>Medication</th>
<th>Q1 n (%) N=14,353</th>
<th>Q2 n (%) N=14,212</th>
<th>Q3 (%) N=14,072</th>
<th>Q4 (%) N=13,953</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statin</td>
<td>13,032 (90.8)</td>
<td>11,538 (81.2)</td>
<td>11,239 (79.9)</td>
<td>10,992 (78.8)</td>
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<td>Aspirin</td>
<td>12,998 (90.6)</td>
<td>11,338 (79.8)</td>
<td>11,082 (78.8)</td>
<td>10,896 (78.1)</td>
</tr>
<tr>
<td>Beta-blocker</td>
<td>11,865 (82.7)</td>
<td>10,318 (72.6)</td>
<td>10,011 (71.1)</td>
<td>9,766 (70.0)</td>
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<tr>
<td>ACE-I/ARB</td>
<td>9,993 (69.6)</td>
<td>8,911 (62.7)</td>
<td>8,671 (61.6)</td>
<td>8,552 (61.3)</td>
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<tr>
<td>≥ 2 Antithrombotics</td>
<td>9,842 (68.6)</td>
<td>7,526 (53.0)</td>
<td>6,535 (46.4)</td>
<td>5,679 (40.7)</td>
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<tr>
<td>P2Y₁₂ inhibitors</td>
<td>9,715 (67.7)</td>
<td>7,616 (53.6)</td>
<td>6,565 (46.7)</td>
<td>5,643 (40.4)</td>
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<tr>
<td>Anticoagulant</td>
<td>1,267 (8.8)</td>
<td>1,116 (7.9)</td>
<td>1,110 (7.9)</td>
<td>1,096 (7.9)</td>
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</table>

Appendix Table 2: Cardioprotective medication dispensing in quarters one, two and four post ACS discharge, by sex and age group.

<table>
<thead>
<tr>
<th>Age group</th>
<th>Statins</th>
<th>Q1 n/N (%)</th>
<th>Q2 n/N (%)</th>
<th>Q4 n/N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>35–49 years</td>
<td>306/367 (83.4)</td>
<td>249/364 (68.4)</td>
<td>248/361 (68.7)</td>
</tr>
<tr>
<td></td>
<td>50–64 years</td>
<td>1346/1517 (88.7)</td>
<td>1155/1511 (76.4)</td>
<td>1113/1495 (74.4)</td>
</tr>
<tr>
<td></td>
<td>65–79 years</td>
<td>2234/2597 (86.0)</td>
<td>2008/2567 (78.2)</td>
<td>1876/2499 (75.1)</td>
</tr>
<tr>
<td>Male</td>
<td>35–49 years</td>
<td>1117/1179 (94.7)</td>
<td>955/1176 (81.2)</td>
<td>896/1171 (76.5)</td>
</tr>
<tr>
<td></td>
<td>50–64 years</td>
<td>3830/4086 (93.7)</td>
<td>3384/4064 (83.3)</td>
<td>3244/4025 (80.6)</td>
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<tr>
<td></td>
<td>65–79 years</td>
<td>4199/4607 (91.1)</td>
<td>3787/4530 (83.6)</td>
<td>3615/4402 (82.1)</td>
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<tr>
<td>Aspirin</td>
<td>35–49 years</td>
<td>327/367 (89.1)</td>
<td>261/364 (71.7)</td>
<td>254/361 (70.4)</td>
</tr>
<tr>
<td></td>
<td>50–64 years</td>
<td>1349/1517 (88.9)</td>
<td>1160/1511 (76.8)</td>
<td>1119/1495 (74.8)</td>
</tr>
<tr>
<td></td>
<td>65–79 years</td>
<td>2259/2597 (87.0)</td>
<td>2001/2567 (78.0)</td>
<td>1891/2499 (75.7)</td>
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<tr>
<td>Male</td>
<td>35–49 years</td>
<td>1104/1179 (93.6)</td>
<td>935/1176 (79.5)</td>
<td>882/1171 (75.3)</td>
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<td></td>
<td>50–64 years</td>
<td>3825/4086 (93.6)</td>
<td>3351/4064 (82.5)</td>
<td>3260/4025 (81.0)</td>
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<td></td>
<td>65–79 years</td>
<td>4134/4607 (89.7)</td>
<td>3630/4530 (80.1)</td>
<td>3490/4402 (79.3)</td>
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<tr>
<td>P2Y₁₂ inhibitors</td>
<td>35–49 years</td>
<td>237/367 (64.6)</td>
<td>161/364 (44.2)</td>
<td>131/361 (36.3)</td>
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<td></td>
<td>50–64 years</td>
<td>993/1517 (65.5)</td>
<td>738/1511 (48.8)</td>
<td>547/1495 (36.6)</td>
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<tr>
<td></td>
<td>65–79 years</td>
<td>1633/2597 (62.9)</td>
<td>1255/2567 (48.9)</td>
<td>923/2499 (36.9)</td>
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<tr>
<td>Male</td>
<td>35–49 years</td>
<td>874/1179 (74.1)</td>
<td>695/1176 (59.1)</td>
<td>535/1171 (45.7)</td>
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<tr>
<td></td>
<td>50–64 years</td>
<td>2939/4086 (71.9)</td>
<td>2360/4064 (58.1)</td>
<td>1766/4025 (43.9)</td>
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<tr>
<td></td>
<td>65–79 years</td>
<td>3039/4607 (66.0)</td>
<td>2407/4530 (53.1)</td>
<td>1741/4402 (39.6)</td>
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**Appendix Table 2:** Cardioprotective medication dispensing in quarters one, two and four post ACS discharge, by sex and age group (continued).

<table>
<thead>
<tr>
<th>Two or more antithrombotics</th>
<th>Female</th>
<th>Male</th>
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<tbody>
<tr>
<td><strong>35–49 years</strong></td>
<td>237/367 (64.6)</td>
<td>875/1179 (74.2)</td>
</tr>
<tr>
<td><strong>50–64 years</strong></td>
<td>155/364 (42.6)</td>
<td>719/1511 (47.6)</td>
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<tr>
<td><strong>65–79 years</strong></td>
<td>127/361 (35.2)</td>
<td>913/2499 (36.5)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Beta-blocker</th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>35–49 years</strong></td>
<td>270/367 (73.6)</td>
<td>999/1179 (84.7)</td>
</tr>
<tr>
<td><strong>50–64 years</strong></td>
<td>220/364 (60.4)</td>
<td>1183/1517 (78.0)</td>
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<tr>
<td><strong>65–79 years</strong></td>
<td>211/361 (58.4)</td>
<td>2091/2597 (80.5)</td>
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<table>
<thead>
<tr>
<th>ACE–Is/ARBs</th>
<th>Female</th>
<th>Male</th>
</tr>
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<tbody>
<tr>
<td><strong>35–49 years</strong></td>
<td>217/367 (59.1)</td>
<td>790/1179 (67.0)</td>
</tr>
<tr>
<td><strong>50–64 years</strong></td>
<td>182/364 (50.0)</td>
<td>1037/1517 (68.4)</td>
</tr>
<tr>
<td><strong>65–79 years</strong></td>
<td>170/361 (47.1)</td>
<td>1878/2597 (72.3)</td>
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### Appendix Table 3: Cardioprotective medication dispensing post ACS discharge by coronary procedure.

<table>
<thead>
<tr>
<th>Medication</th>
<th>Cardiac procedure</th>
<th>Q1 n/N (%)</th>
<th>Q2 n/N (%)</th>
<th>Q3 n/N (%)</th>
<th>Q4 n/N (%)</th>
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</thead>
<tbody>
<tr>
<td><strong>Statin</strong></td>
<td>No procedure</td>
<td>1716/2206 (77.8)</td>
<td>1491/2144 (69.5)</td>
<td>1438/2086 (68.9)</td>
<td>1378/2038 (67.6)</td>
</tr>
<tr>
<td></td>
<td>Angiogram only</td>
<td>2402/2724 (88.2)</td>
<td>2056/2702 (76.1)</td>
<td>1970/2677 (73.6)</td>
<td>1924/2664 (72.2)</td>
</tr>
<tr>
<td></td>
<td>PCI</td>
<td>6762/7114 (95.1)</td>
<td>6028/7082 (85.1)</td>
<td>5914/7043 (84.0)</td>
<td>5796/7006 (82.7)</td>
</tr>
<tr>
<td></td>
<td>CABG</td>
<td>2152/2309 (93.2)</td>
<td>1963/2284 (85.9)</td>
<td>1917/2266 (84.6)</td>
<td>1894/2245 (84.4)</td>
</tr>
<tr>
<td><strong>Aspirin</strong></td>
<td>No procedure</td>
<td>1727/2206 (78.3)</td>
<td>1435/2144 (66.9)</td>
<td>1377/2086 (66.0)</td>
<td>1322/2038 (64.9)</td>
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<tr>
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<td>Angiogram only</td>
<td>2319/2724 (85.1)</td>
<td>1946/2702 (72.0)</td>
<td>1870/2677 (69.9)</td>
<td>1837/2664 (69.0)</td>
</tr>
<tr>
<td></td>
<td>PCI</td>
<td>6785/7114 (95.4)</td>
<td>6024/7082 (85.1)</td>
<td>5948/7043 (84.5)</td>
<td>5873/7006 (83.8)</td>
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<tr>
<td></td>
<td>CABG</td>
<td>2167/2309 (93.9)</td>
<td>1933/2284 (84.6)</td>
<td>1887/2266 (83.3)</td>
<td>1864/2245 (83.0)</td>
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<tr>
<td><strong>P2Y₁₂ inhibitors</strong></td>
<td>No procedure</td>
<td>926/2206 (42.0)</td>
<td>675/2144 (31.5)</td>
<td>589/2086 (28.2)</td>
<td>506/2038 (24.8)</td>
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<tr>
<td></td>
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<td>1515/2724 (55.6)</td>
<td>928/2702 (34.3)</td>
<td>767/2677 (28.7)</td>
<td>658/2664 (24.7)</td>
</tr>
<tr>
<td></td>
<td>PCI</td>
<td>6307/7114 (88.7)</td>
<td>5367/7082 (75.8)</td>
<td>4663/7043 (66.2)</td>
<td>3978/7006 (56.8)</td>
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<td>CABG</td>
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<td>646/2284 (28.3)</td>
<td>546/2266 (24.1)</td>
<td>501/2245 (22.3)</td>
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<td><strong>ACE-I/ARB</strong></td>
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<td>1150/2144 (53.6)</td>
<td>1106/2086 (53.0)</td>
<td>1076/2038 (52.8)</td>
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<tr>
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<td>1853/2724 (68.0)</td>
<td>1598/2702 (59.1)</td>
<td>1566/2677 (58.5)</td>
<td>1526/2664 (57.3)</td>
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<tr>
<td></td>
<td>PCI</td>
<td>5516/7114 (77.5)</td>
<td>4840/7082 (68.3)</td>
<td>4718/7043 (67.0)</td>
<td>4646/7006 (66.3)</td>
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<td></td>
<td>CABG</td>
<td>1340/2309 (58.0)</td>
<td>1323/2284 (57.9)</td>
<td>1281/2266 (56.5)</td>
<td>1304/2245 (58.1)</td>
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<tr>
<td><strong>Beta-blocker</strong></td>
<td>No procedure</td>
<td>1562/2206 (70.8)</td>
<td>1343/2144 (62.6)</td>
<td>1283/2086 (61.5)</td>
<td>1243/2038 (61.0)</td>
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<tr>
<td></td>
<td>Angiogram only</td>
<td>2101/2724 (77.1)</td>
<td>1749/2702 (64.7)</td>
<td>1682/2677 (62.8)</td>
<td>1664/2664 (62.5)</td>
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<tr>
<td></td>
<td>PCI</td>
<td>6176/7114 (86.8)</td>
<td>5417/7082 (76.5)</td>
<td>5283/7043 (75.0)</td>
<td>5131/7006 (73.2)</td>
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<tr>
<td></td>
<td>CABG</td>
<td>2026/2309 (87.7)</td>
<td>1809/2284 (79.2)</td>
<td>1763/2266 (77.8)</td>
<td>1728/2245 (77.0)</td>
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<tr>
<td><strong>Anticoagulant</strong></td>
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<td>276/2206 (12.5)</td>
<td>247/2144 (11.5)</td>
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<td>329/2724 (12.1)</td>
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<td>PCI</td>
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<td>241/2284 (10.6)</td>
<td>220/2266 (9.7)</td>
<td>221/2245 (9.8)</td>
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Competing interests:
Nil.

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