Primary medication non-adherence to analgesics and antibiotics at Counties Manukau Health Emergency Department

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ABSTRACT

AIM: To measure primary medication non-adherence to antibiotics, paracetamol and nonsteroidal anti-inflammatory drugs (NSAIDs) in patients discharged from Counties Manukau Health Emergency Department (CMH-ED).

METHOD: A retrospective observational study based on 1,600 discharged patients' data collected between 28 April–6 May and 28 July–9 August 2014. Data were included for patients who were residents within the Auckland Regional Public Health Service boundaries, presented to CMH-ED and were discharged with a prescription.

RESULTS: Of 992 patients, 48.5% did not have at least one medication on their discharge prescription filled. Patients were mostly born in New Zealand (66.5%), of Pacific Island descent (42.8%), living in the most socioeconomically deprived areas (78.1%) and under 10 years of age (32.6%). Filling rates significantly increased with >1 prescribed item ($p \leq 0.01$). NSAIDs were significantly more likely to be filled compared with paracetamol (59.9% vs 51.3%, $p=0.034$); antibiotics were significantly more likely to be filled than all other medicines (80.4%, $p<0.001$). The most significant predictors for non-adherence when accounting for number and types of medications were patients 10–44 years ($p<0.05$) and smokers ($p<0.01$).

CONCLUSIONS: Age, smoking and number of prescribed medications were predictors of non-adherence to medication type. Further research is warranted to assess whether changes to prescription co-payments affect the rate of nonadherence.

For medication to be therapeutically effective, it is essential that patients adhere to them. Filling a prescription is the first critical step to establish medication adherence.[1,2] Research on medication adherence has primarily focused on secondary non-adherence, which occurs when patients don't take their medicines as prescribed, don't refill their prescriptions on time or stop taking their medicines.[3] However, rates of primary medication non-adherence, where a patient fails to have a prescription filled for newly prescribed medicines or a suitable alternative within a specified timeframe, are far less known.[3,4] Failing to get newly prescribed medications filled places a burden on patients, families and the broader healthcare system by increasing mortality/morbidity, hospitalisation rates and/or emergency department (ED) visits, and it is associated with greater economic cost.[5–7] Previous studies have estimated that around 7–35% of patients in EDs fail to fill new prescriptions,[6,8] and in paediatric EDs the reported percentage is as high as 66%.[9]

Non-adherence occurs due to a dysfunctional triad of patient, healthcare-system and contextual influences,[5–7,10] including a lack of financial and social support, the availability and/or accessibility of healthcare resources, the severity of disease and the available treatment options.[11] In the ED, primary medicine non-adherence is comparatively higher in patients with financial

constraints.[12–16] Patients under financial constraints may select to have certain medicines filled over others, or may be unwilling to pay for a medicine to use in the short term.[6,17] In some cases, patients may also be unaware of the importance of the prescribed medicine, or may have a supply at home.[6,17]

Previous research found that 16% of patients discharged on 'high importance' medication exhibited primary non-adherence 30 days after discharge.[7] These prescriptions included medications such as antibiotics for the treatment of acute infections such as pneumonia, urinary tract infections and cellulitis.[7] Non-adherence to antimicrobial agents carries additional healthcare costs due to treatment failure, readmission to ED and resources being wasted on unused medication.[7,18] In the ED, adherence to antibiotics has been reported as low as 30–40%.[18] Analgesics are often considered to be of lesser importance compared with antibiotics, but pain is one of the most common reasons why patients visit an ED.[19] Although non-adherence to pain relief is generally not life-threatening, failure to receive adequate analgesia can result in significant morbidity.[7] Studies suggest that a significant proportion of ED prescriptions for analgesics remain unfilled[8,19] due to patients reporting a lack of pain, having a home supply, a fear of medication side effects or believing the analgesic is not strong enough.[19]

Non-adherence is also found to increase if patients are prescribed two or more medicines,[6,16] lack access to primary care physician,[20] cannot access a community pharmacy at time of discharge[19] or are tobacco smokers.[11] Patient demographic factors such as age, gender and ethnicity are also thought to influence medication adherence[21–23] but are inconsistently reported in the literature.[12,16]

In New Zealand, little is known about primary medication non-adherence in the ED. Previously we explored the relationship between non-adherence to primary medication and patient sociodemographics, smoking status, access to a regular GP and discharge time and/or day.[24] The aim of this study was to measure primary medication non-adherence to antibiotics, paracetamol and nonsteroidal anti-inflammatory drugs (NSAIDs) in discharge prescriptions from Counties Manukau Health Emergency Department (CMH-ED), and to determine which patient factors are likely to influence patients' decisions to fill prescriptions for these three medication classes.

Method

This was a retrospective, observational study design of patients discharged from CMH-ED. Ethics approval was granted by the University of Auckland Human Participants Ethics Committee (Reference No. 012463) and Counties Manukau District Health Board Ethics Committee.

Participant selection

Data were collected in September from the first 1,000 patients discharged from CMH-ED between 28 April–6 May 2014, and further data were collected in January 2015 from 600 additional patients between 28 July–9 August 2014. The data were purposefully collected on these weeks to facilitate comparison between autumn and winter seasons, and the dates allowed for an assessment of adherence >90 days after the prescription order.

Data were included for patients who were residents within the Auckland Regional Public Health Service boundaries, presented to CMH-ED and were discharged with a prescription for one or more medicines. Patients were excluded if they were admitted to another ward, were transferred to another hospital, left CMH-ED without seeing a doctor or were discharged without a prescription.

Data collection

Patient data were identified through CONCERTO™ (a software programme that coordinates patient data across the whole Auckland region in a central electronic platform) by limiting the search to 'ED speciality' and selecting the dates required. To maintain patient confidentiality, and for auditing purposes, each patient was allocated a unique identifying code linked to their National Health Index (NHI) number. If any patients presented to the ED more than once during the study period, only their first discharge was analysed.

To facilitate data collection, a paper-based tool was developed and piloted for efficiency. Age, gender, country of birth, residential suburb, ethnicity, language spoken and details of each patient's regular

primary physician were collected if available. Presenting indication, discharge date and time, smoking status and medicines provided on discharge were obtained from electronic and paper discharge summaries. To determine whether patients had their ED prescriptions filled, information from community pharmacies was retrieved via TestSafe™, accessed via CONCERTO™. TestSafe™ records the medicines prescribed to patients via their NHI, how many medicines were filled at each dispensing, the date of dispensing and the contact details of the dispensing community pharmacy.

Data entry

Data were entered into Microsoft Excel™, and variables were coded for further analysis. Population data from Stats NZ were used to group ethnicity data into various categories. Ministry of Health guidelines assisted age categorisation, with patients under 25 years further divided into categories: under 10 years, 10–17 years (adolescent) and 18–24 years (young adults). Suburb deprivation was coded using the New Zealand Index of Deprivation (NZDep2013).[25] All other categories were grouped according to the information available in the patient notes. Occupation included patients under the age of five years, who were classed as 'infants/children', and those of school-going age (5–17 years) and/or undergoing tertiary/other education were grouped as 'students'. Although 'others' were adults of employable age (18–65 years), their employment status was unclear and hence were grouped as a separate class.

Data validation

Of the total patient dataset, 20% were randomly selected using the Microsoft Excel™ randomisation function (=RANDBETWEEN) and manually cross-checked by two researchers to confirm data-entry reliability. A further 50 patients were selected by the same randomisation method and telephoned using a pre-scripted telephone checklist to enquire whether they had collected their medicine from a pharmacy following discharge. This was compared to available TestSafe™ data to ensure triangulation of the data.

Analysis

Adherence to the three medication classes of interest was analysed by the proportion of prescribed medicines that were filled. Poisson regressions were conducted with a generalised linear model with the log of the total filled per medication class per person as the offset to evaluate medication adherence. Poisson regression with one explanatory variable is given, as well as multivariable regression. Bivariable regression was added to evaluate univariable effect on adherence per medication type. All possible two-way and some relevant three-way interaction terms were evaluated to find the model of best fit. The model with the minimum Akaike Information Criterium (AIC) value was used as the best-fit multivariable model.[26] The evaluated independent (categorical) variables were age, ethnicity, gender, country of birth, suburb deprivation, language, occupation, regular GP, smoking, discharge date, discharge day and discharge time, medication type and total number of medications prescribed. There were no missing data in the response variables (number of filled medicines and total number prescribed per medicine). An extra level, 'unknown', was constructed for the missing values in the explanatory categorical variables. Priory pairwise comparisons were made to group the levels within the categorical variates, using the covariance matrix as derived from the final multivariable model. All parameters denoted by the same letter (ie, a, b, c or d) within a group are not significant from each other, and alpha is 0.05. All analyses were conducted using R (version 4.01, 64 bit).

Results

Of 1,600 patients, data were excluded for 608 because they either were discharged without a prescription (n=470; 29.4%), left without seeing a doctor (n=70; 4.4%), were non-Auckland residents (32; 2%), were admitted to a ward (n=19; 1.2%) or were transferred to another healthcare facility (n=12; 0.8%), or incomplete data were provided for them (n=5; 0.3%).

Patients were predominantly born in New Zealand (n=660; 66.5%), of Pacific Island descent (n=425; 42.8%), 24 years or younger (n=559; 56.4%) and living in the most socioeconomically deprived suburbs (NZDep2013 9 & 10) of Auckland (n=775; 78.1%). The majority were non-smokers (n=804; 81.1%) and had a regular GP (n=958; 96.6%). Almost

a quarter (n=238; 23.4%) presented to the CMH-ED on a Monday, and close to half (n=481; 48.5%) were discharged between 8pm and 8am.

The majority (n=893; 90%) were discharged with a prescription for three medicines or less: of these, 29.2% (n=290) were prescribed one medication, 36.5% (n=362) were prescribed two medications and 24.3% (n=241) were prescribed three medications. The remaining 10% (n=99) were prescribed four or more medicines. Patient data were categorised by the type of medication prescribed (Table 1).

Almost half (n=480; 48.4%) of the patient sample did not have at least one medication item on their prescription filled. Univariable analysis found filling rates significantly increased when patients were prescribed more than one medication ($p \leq 0.01$) (Table 2). Compared with paracetamol (51.3%), NSAIDs (59.9%) and other medications (61%) were significantly more likely to be filled ($p=0.034$ and $p=0.023$, respectively). Antibiotics were significantly more likely to be filled than all other medication ($p<0.001$). Bivariable analyses with medication type showed the strongest associations with age, smoking and number of prescribed items (Appendix Tables 1–4). Compared to patients under 10 years, patients 10–17 years were significantly less likely to have NSAIDs filled ($p=0.036$) and patients 10–24 years were significantly less likely to have paracetamol prescriptions filled ($p \leq 0.023$). Smokers were significantly less adherent to paracetamol ($p=0.022$) and other medication ($p=0.034$). Paracetamol was significantly more likely to be filled if other items were also prescribed, as were other medications if three or four items were co-prescribed ($p \leq 0.01$). Patients born outside of New Zealand were more likely to fill NSAIDs ($p=0.027$). No significant differences were found for antibiotics. Univariable analysis has been described more fully elsewhere.[24]

The best multivariable model for adherence included age, smoking and the two-way interaction medication type and number of medications prescribed (Table 3). This data confirmed that, compared with paracetamol alone, patients who were prescribed more than one item were significantly more likely to have their prescriptions filled ($p<0.01$) (Figure 1). Antibiotics, NSAIDs (if not the only item prescribed) and other medications were all significantly more likely to be filled compared with paracetamol ($p<0.01$).

Discussion

In this study, 90% of patients were prescribed between one and three medications on discharge from CMH-ED, and almost half did not have at least one medication filled within 90 days. Patients were more likely to have their prescription filled when more than one medication was prescribed. Antibiotics, NSAIDs and other medications were significantly more likely to be filled compared with paracetamol alone ($p<0.01$). When accounting for number of medication items and type of medication, the most significant predictors for non-adherence were patients aged 10–44 years and smokers ($p<0.01$).

Literature has shown variable effects from age and income on whether prescriptions are filled. Some studies have revealed that older children were less likely to have their prescriptions filled,[9] as are those who were of low income or vulnerably housed,[9,20] whereas other studies have found no associations.[6,9] In our study, the lowest rates of prescription filling for all medication types were in children aged 10–17 years, which was significant compared to children under 10 years ($p<0.001$). It is important to note that, at the time of this study, the prescription co-payment charge was NZ$5 per item, a $2 increase from the previous year (2013). This co-payment was applied to all patients over the age of six years, regardless of income status,[27] and may have contributed to children under the age of 10 having higher prescription filling rates than older children. The co-payment increase was found to result in some patients delaying or avoiding filling their prescription and/or selecting to fill only certain medicines they deemed more important.[27] It has also been proposed that poorer adherence in younger patients may be due to less established or noncontinuous relationships with a primary care physician,[11] since in an ED setting prescribing clinicians are typically unfamiliar with the patient's lifestyle and/or resources.[28] In this study, prescription filling rates of all medication types were much lower in those who did not have a regular

Table 1: The total number of medications prescribed and the percentage of medication types filled, as characterised across different patient variables (N=992).

	Paracetamol n/n filled (%)		NSAIDs n/n filled (%)		Antibiotics n/n filled (%)		Other n/n filled (%)		Total n/n filled (%)	
	684	(51.3)	676	(59.9)	260	(80.4)	569	(61.0)	2189	(59.9)
Gender										
Male (n=495; 49.9%)	359	(52.6)	370	(63.0)	124	(80.6)	251	(63.7)	1104	(61.8)
Female (n=497; 50.1%)	325	(49.8)	306	(56.2)	136	(80.1)	318	(58.8)	1085	(58.1)
Age										
< 10 (323; 32.6%)	233	(57.9)	120	(67.5)	97	(84.5)	129	(68.2)	579	(66.7)
10–17 (116; 11.7%)	89	(33.7)	87	(44.8)	22	(63.6)	44	(50.0)	242	(43.4)
18–24 (120; 12.1%)	82	(36.6)	114	(50.0)	31	(77.4)	69	(58.0)	296	(51.0)
25–44 (215; 21.7%)	151	(51.0)	196	(58.7)	51	(82.4)	145	(57.2)	543	(58.4)
45–64 (159; 16%)	107	(58.9)	139	(71.2)	44	(75.0)	128	(63.3)	418	(66.0)
> 64 (59; 5.9%)	22	(72.7)	20	(70.0)	15	(93.3)	54	(61.1)	111	(69.4)
Ethnicity										
MELAA[a] (17; 1.7%)	12	(91.7)	13	(92.3)	3	(100)	8	(50.0)	36	(83.3)
NZ European (213; 21.5%)	138	(53.6)	156	(64.1)	52	(92.3)	119	(63.9)	465	(64.1)
Asian (157; 15.8%)	111	(55.0)	123	(60.2)	34	(73.5)	86	(65.1)	354	(61.0)
Pacific (425; 42.8%)	290	(51.7)	252	(61.1)	122	(80.3)	246	(59.8)	910	(60.3)
Māori (175; 17.6%)	128	(41.4)	127	(48.8)	49	(71.4)	107	(57.0)	411	(51.3)
Unknown (5; 0.5%)	5	(40.0)	5	(60.0)	0	(0.0)	3	(100)	13	(61.5)
Country of birth										
Outside NZ (282; 28.4%)	189	(57.7)	225	(68.9)	75	(82.7)	197	(59.9)	686	(64.7)
NZ (660; 66.5%)	461	(48.4)	413	(54.7)	177	(79.1)	332	(63.0)	1383	(57.7)
Unknown (50; 5%)	34	(55.9)	38	(63.2)	8	(87.5)	40	(50.0)	120	(58.3)
Suburb NZDep2013 index[b]										
1 (9; 0.9%)	7	(57.1)	11	(72.7)	0	(0.0)	3	(66.7)	21	(66.7)
2 (23; 2.3%)	13	(46.2)	22	(50.0)	3	(33.3)	9	(44.4)	47	(46.8)
3 (16; 1.6%)	10	(50.0)	13	(76.9)	5	(100)	4	(50.0)	32	(68.7)
4 (44; 4.4%)	35	(65.7)	39	(64.1)	9	(88.9)	20	(65.0)	103	(67.0)
5 (18; 1.8%)	12	(66.7)	13	(69.2)	6	(83.3)	9	1(00.0)	40	(77.5)
6 (43; 4.3%)	25	(60.0)	29	(62.1)	15	(73.3)	32	(75.0)	101	(67.3)
7 (35; 3.5%)	29	(55.2)	29	(69.0)	6	(100)	12	(75.0)	76	(67.1)
8 (25; 2.5%)	18	(55.6)	16	(62.5)	6	(83.3)	11	(45.5)	51	(58.8)
9 (370; 37.3%)	259	(45.2)	235	(54.5)	104	(75.0)	211	(64.0)	809	(56.6)
10 (405; 40.8%)	273	(53.5)	267	(61.8)	105	(84.8)	253	(56.1)	898	(60.4)
Unknown (4; 0.4%)	3	(33.3)	2	(50.0)	1	(100)	5	(40.0)	11	(45.5)

Table 1: The total number of medications prescribed and the percentage of medication types filled, as characterised across different patient variables (N=992) (continued).

	Paracetamol n/n filled (%)		NSAIDs n/n filled (%)		Antibiotics n/n filled (%)		Other n/n filled (%)		Total n/n filled (%)	
	684	(51.3)	676	(59.9)	260	(80.4)	569	(61.0)	2189	(59.9)
Language										
Non-English (61; 6.2%)	40	(55.8)	31	(61.3)	13	(76.9)	30	(73.3)	117	(64.1)
English (877; 88.4%)	604	(51.2)	612	(60.0)	230	(80.9)	520	(60.2)	1966	(59.8)
Unknown (54; 5.4%)	37	(48.6)	33	(57.6)	17	(76.5)	19	(63.2)	106	(58.5)
Occupation										
Other (171; 17.2%)	125	(59.2)	173	(67.1)	43	(88.4)	109	(69.7)	450	(67.6)
Infant/child (236;23.8%)	175	(58.3)	90	(66.7)	62	(83.9)	85	(70.6)	412	(66.5)
Retired (51; 5.1%)	20	(65.0)	16	(62.5)	14	(92.9)	47	(59.6)	97	(66.0)
Employed (143; 14.4%)	100	(49.0)	126	(62.7)	37	(78.4)	99	(56.6)	362	(58.8)
Student (228; 23%)	162	(45.1)	144	(55.6)	61	(80.3)	113	(57.5)	480	(55.6)
Unemployed (77; 7.8%)	47	(36.2)	64	(46.9)	19	(73.7)	60	(46.7)	190	(46.8)
Homemaker (66; 6.7%)	41	(36.6)	45	(40.0)	19	(57.9)	46	(54.3)	151	(45.7)
Unknown (20; 2.0%)	14	(57.1)	18	(66.7)	5	(60.0)	10	(90.0)	47	(68.1)
Regular GP										
Yes (958; 96.6)	662	(51.4)	654	(60.4)	249	(81.5)	552	(61.2)	2117	(60.3)
No (34; 3.4%)	22	(50.0)	22	(45.5)	11	(54.5)	17	(52.9)	72	(50.0)
Smoking										
No (804; 81.1%)	557	(54.0)	511	(61.6)	200	(82.0)	437	(64.3)	1705	(62.2)
Yes (139; 14.0%)	93	(35.5)	123	(55.3)	48	(75.0)	102	(46.1)	366	(50.3)
Unknown (49; 4.9%)	34	(50.0)	42	(52.4)	12	(75.0)	30	(63.3)	118	(56.8)
Total number of medications prescribed										
1 (290; 29.2%)	121	(24.8)	35	(42.9)	56	(78.6)	78	(42.3)	290	(42.1)
2 (362; 36.5%)	278	(52.2)	248	(51.2)	58	(84.5)	140	(57.1)	724	(55.4)
3 (241; 24.3%)	197	(60.9)	261	(65.1)	96	(80.2)	169	(68.6)	723	(66.8)
4 (71; 7.2%)	63	(66.7)	100	(71.0)	37	(70.3)	84	(79.8)	284	(72.5)
>4 (28; 2.8%)	25	(56.0)	32	(68.8)	13	(100)	98	(52.0)	168	(59.5)
Discharge month										
Autumn (n=511;51.5%)	339	(54.3)	346	(61.0)	134	(85.8)	343	(60.6)	1162	(61.8)
Winter (n=481;48.5%)	345	(48.4)	330	(58.8)	126	(74.6)	226	(61.5)	1027	(57.8)

Table 1: The total number of medications prescribed and the percentage of medication types filled, as characterised across different patient variables (N=992) (continued).

	Paracetamol n/n filled (%)		NSAIDs n/n filled (%)		Antibiotics n/n filled (%)		Other n/n filled (%)		Total n/n filled (%)	
	684	(51.3)	676	(59.9)	260	(80.4)	569	(61.0)	2189	(59.9)
Discharge day										
Sun (n=120; 12.1%)	93	(46.2)	75	(65.3)	26	(84.6)	43	(58.1)	237	(58.6)
Mon (n=238; 23.4%)	163	(52.1)	150	(57.3)	67	(70.1)	147	(61.2)	527	(58.4)
Tues (n=173; 17.4%)	108	(56.5)	134	(64.9)	56	(89.3)	118	(64.4)	416	(65.9)
Wed (n=127; 12.8%)	89	(47.2)	85	(52.9)	40	(75.0)	70	(62.9)	284	(56.7)
Thurs (n=98; 9.9%)	70	(48.6)	69	(55.1)	21	(76.2)	69	(66.7)	229	(58.5)
Fri (n=120; 12.1%)	88	(47.7)	77	(57.1)	21	(81.0)	66	(42.4)	252	(52.0)
Sat (n=116; 11.7%)	73	(60.3)	86	(65.1)	29	(93.1)	56	(67.9)	244	(67.6)
Discharge time										
2400–0400 (178; 17.9%)	141	(53.9)	137	(55.5)	42	(81.0)	85	(61.2)	405	(58.8)
0400–0800 (111; 11.2%)	78	(48.7)	82	(63.4)	36	(83.3)	55	(63.6)	251	(61.8)
0800–1200 (158; 15.9%)	98	(62.2)	104	(74.0)	49	(77.6)	106	(63.2)	357	(68.1)
1200–1600 (138; 13.9%)	91	(45.1)	106	(60.4)	23	(82.6)	83	(72.3)	303	(60.7)
1600–2000 (212; 21.4%)	145	(47.6)	125	(49.6)	53	(77.4)	137	(51.8)	460	(52.8)
2000–2400 (192; 19.3%)	129	(50.4)	121	(61.2)	57	(82.5)	103	(60.2)	410	(60.5)
Unknown (3; 0.3%)	2	(50.0)	1	(0.0)	0	(0.0)	0	(0.0)	3	(33.3)

[a] MELAA: Middle Eastern, Latin American and African.
[b] Suburb NZDep2013 index: 1 represents areas of least deprived; 10 is most deprived.

GP, although these patient numbers were insufficient to indicate significance.

Medication-level analysis revealed an association between the medication class, number of prescribed items and likelihood of filling a prescription. Other studies have found adherence to be lower in those co-prescribed two or more medications,[6] or that there was no significant difference between number of medications prescribed versus the number of prescriptions filled.[7] Our analysis did not determine whether patients prescribed two or more medications may have been co-prescribed an antibiotic or other high-importance medication, and hence it is not possible to conclude the reasons for the higher rate of filling. It is, however, plausible that patients with more medications are sicker and/or exhibit more severe symptoms and may therefore be more inclined to fill all medications, in comparison to patients with milder and more transient presentations. Furthermore, once patients have presented to a pharmacy with a prescription, they may be more motivated to fill all items.

Paracetamol was the most commonly prescribed item (31.2% of all prescribed medications) and also the least filled prescription (51.3%). Although NSAIDs were prescribed at a similar rate to paracetamol (30.9%), NSAIDs had a significantly higher fill rate (59.9%) in comparison (p<0.01). Analgesics are reported to be some of the more common medications left unused from previous prescriptions, due largely to over-prescribing and/or the patient experiencing adverse effects.[29] Hence it is not uncommon for patients to have a supply of analgesics at home, which they may opt to take rather than filling another prescription. Or patients may make rational decisions to not take analgesics when they no longer seek pain relief.[30,31] It has been proposed that pain relief is a desired health endpoint that health professionals should not attempt to modify.[30] However, assessing the patient's analgesic requirements and questioning them regarding their home supply may help to better optimise analgesic prescribing in EDs.

Unlike analgesics and anti-inflammatories, the failure to take antibiotics can lead to more potentially serious consequences. In this study, antibiotics accounted for 11.9% of prescription items and exhibited a significantly higher fill rate compared with other medications (80.4%, p<0.001). One study reported similar fill rates but found no significant differences between antibiotics and other classes of

Table 2: Univariable analysis comparing medication adherence with total number of medicines and medication types (N=992).

			Percentage filled			
Variable	**Rate ratio**	**95% CI**	**%**	**95% CI**	**Overall P-value**	**Group**
Total meds prescribed						
1	1.00		42.1	(35.2–50.2)	<0.001	a
2	1.32	(1.08–1.61)	55.4	(50.2–61.1)		b
>4	1.41	(1.09–1.84)	59.5	(48.9–72.4)		b c
3	1.59	(1.30–1.94)	66.8	(61.1–73.0)		c
4	1.72	(1.38–2.16)	72.5	(63.3–83.2)		c
Medication type						
Paracetamol	1.00		51.3	(46.2–57.0)	<0.001	a
NSAID	1.17	(1.01–1.35)	59.9	(54.3–66.0)		b
Other	1.19	(1.02–1.38)	61.0	(54.9–67.8)		b
Antibiotic	1.57	(1.32–1.86)	80.4	(70.2–92.1)		c

Table 3: Multivariable analysis comparing medication adherence with age, smoking and number and type of medication (N=992)

					Estimated percentage filled	
Variable	**Level**	**Rate ratio**	**95% CI**	**p-value**	**%**	**95% CI**
Age						
	<10	1.00			64.7	(55.4–75.7)
	10–17	0.64	(0.52–0.80)	<0.001	41.6	(33.3–52.0)
	18–24	0.74	(0.61–0.91)	0.004	48.1	(40.1–57.7)
	25–44	0.83	(0.70–0.97)	0.023	53.6	(46.4–62.0)
	45–64	0.93	(0.79–1.11)	0.426	60.4	(52.2–70.0)
	> 64	1.02	(0.79–1.31)	0.886	65.9	(51.3–84.8)
Smoking						
	No	1.00			62.0	(56.9–67.5)
	Yes	0.79	(0.67–0.93)	0.006	48.9	(41.5–57.7)
	Unknown	0.89	(0.69–1.14)	0.347	54.9	(42.7–70.7)
Total number of medications prescribed						
1	Paracetamol	1.00			20.5	(14.1–29.9)
2		2.25	(1.51–3.33)	<0.001	46.1	(38.2–55.7)
3		2.75	(1.84–4.13)	<0.001	56.5	(46.4–68.8)
4		3.01	(1.87–4.83)	<0.001	61.8	(44.9–84.9)
>4		2.54	(1.34–4.83)	0.004	52.1	(30.5–89.1)
1	NSAID	1.81	(0.98–3.37)	0.060	37.2	(22.2–62.5)
2		2.25	(1.51–3.36)	<0.001	46.1	(37.9–56.3)
3		3.04	(2.05–4.52)	<0.001	62.4	(52.6–74.1)
4		3.35	(2.16–5.19)	<0.001	68.8	(53.3–88.7)
>4		3.06	(1.74–5.37)	<0.001	62.8	(40.7–97.0)
1	Antibiotic	3.13	(1.97–4.99)	<0.001	64.3	(47.2–87.8)
2		3.46	(2.20–5.46)	<0.001	71.1	(52.8–95.8)
3		3.50	(2.29–5.34)	<0.001	71.7	(56.4–91.2)
4		3.40	(2.00–5.77)	<0.001	69.7	(46.9–103.5)
>4		4.48	(2.32–8.68)	<0.001	92.1	(52.6–161.1)
1	Other	1.79	(1.09–2.96)	0.022	36.8	(25.9–52.3)
2		2.49	(1.63–3.80)	<0.001	51.1	(40.4–64.7)
3		2.96	(1.98–4.44)	<0.001	60.8	(49.6–74.6)
4		3.42	(2.21–5.27)	<0.001	70.1	(54.2–90.6)
>4		2.33	(1.47–3.69)	<0.001	47.8	(35.6–64.0)

medication,[31] whereas other studies have found that oral anti-infective agents exhibit the lowest rates of primary medication non-adherence.[4–6] These discrepancies are likely due to the varying methods of dispensing antibiotics in ED studies: for example, some were dispensed in the form of a fully-paid prescription, and in others as a starter pack with instructions for a follow-on prescription.[18] Although in our study there were no patient factors that significantly affected antibiotic filling, there was some indication to suggest that age, ethnicity and access to a regular GP may be associated with primary medication non-adherence.

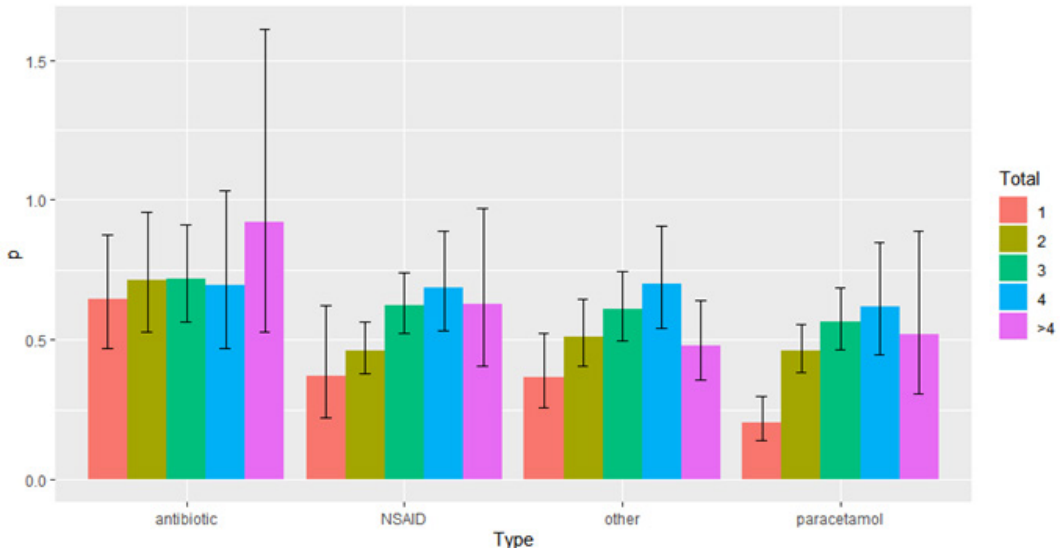
Several strategies to improve antibiotic filling rates in EDs have yielded variable results. Patients who were dispensed antibiotics directly from an ED tended to have better adherence than patients issued with a prescription, even if their prescription had been fully paid for.[18] Previous studies have reported that, once patients fill their prescriptions and get into a routine, they are more likely to continue taking their antibiotics;[30] for those who do not fill their prescriptions, commonly reported reasons were cost, lack of transportation and being busy.[30] It has also been suggested that patients who are discharged during pharmacy opening hours may be more likely to fill their prescriptions,[18] but discharge day and time was not seen to influence filling in our study.

Limitations

This study was conducted at a single ED site (CMH-ED), and given the small cohort and patient demographic at CMH-ED, it may not be possible to generalise the results to other EDs across New Zealand. Sampling of the study population was obtained from consecutive patients over a period of four weeks, which may have contributed to selection bias. As primary medication non-adherence is influenced by a multitude of factors, including ED-system factors, access to a dispensing pharmacy, patient social and psychological influences and financial support, many of these factors could not be determined using a retrospective method. Moreover, it could not be determined whether patients had an existing supply of medicine at home, experienced symptom resolution and no longer required analgesics, or were provided with a 'back-pocket prescription' (ie, 'just in case' prescribing) that was no longer required, resulting in unfilled prescription medications. Additionally, patients could not be assessed for possible medication adverse effects over time, and readmission rates due to non-adherence were not assessed.

Since medication adherence was inferred from a prescription being filled, true nonadherence rates are likely to be under-

Figure 1: Percentage (p) of medication types filled compared with number of items prescribed. Black lines indicate confidence intervals.



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estimated. TestSafe™ displayed only those prescriptions that had been entered into the system, but it did not indicate whether the medication had been collected or taken by the patient. Telephoning patients several months after ED discharge to confirm medical records could have resulted in recall bias. With two of 15 patients having reported conflicting dispensing records, it suggests that the system may have a fairly substantial error rate. These differences, however, could also be based on inaccurate recall or biased by social desirability. Moreover, admission records for CMH-ED patients were not always accurate or complete. In busy EDs, these are often written under time constraints and personal information is mainly obtained through patient self-reporting.

Conclusions

In this study, age, smoking and number of prescribed medications were predictors of non-adherence to antibiotics and analgesics. Since this study, changes have been made to the New Zealand prescription co-payment structure and free paediatric prescriptions have been extended to 13-year-olds. There are also a growing number of discount pharmacies offering free prescriptions for all patients. With the cost of medication affecting the ability of some patients to fill their prescriptions, free prescriptions may ease the financial burden for people who are unable to afford co-payments and improve treatment opportunities, and further research is warranted to determine whether these changes have any notable effects on the rates of non-adherence in the ED. More work is required to identify patients likely to be non-adherent and enlist available resources to reduce barriers to adherence. Hospital discharge may be the best time at which to communicate medication treatments and emphasise medication adherence.

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Appendix

Appendix Table 1: Bivariable analysis of paracetamol (N=992).

Variable	Total filled	Total prescribed	% filled	% lower 95	% upper 95	RR [a]	RR lower 95	RR upper 95	p-value	Group
Gender										
Male	189	359	52.6%	45.6%	60.7%	1.00				a
Female	162	325	49.8%	42.7%	58.2%	0.95	0.77	1.17	0.610	a
Age										
< 1	135	233	57.9%	48.9%	68.6%	1.00				a
10-17	30	89	33.7%	23.6%	48.2%	0.58	0.39	0.86	0.007	b
18-24	30	82	36.6%	25.6%	52.3%	0.63	0.43	0.94	0.023	b
25-44	77	151	51.0%	40.8%	63.8%	0.88	0.67	1.16	0.371	a b
45-64	63	107	58.9%	46.0%	75.4%	1.02	0.75	1.37	0.916	a
> 64	16	22	72.7%	44.5%	118.8%	1.26	0.75	2.11	0.390	a
Ethnicity										
NZ European	74	138	53.6%	42.7%	67.4%	1.00				a b
Asian	61	111	55.0%	42.8%	70.6%	1.02	0.73	1.44	0.887	a b
MELAA[b]	11	12	91.7%	50.7%	165.6%	1.71	0.91	3.22	0.097	a
Māori	53	128	41.4%	31.6%	54.2%	0.77	0.54	1.10	0.151	b
Pacific	150	290	51.7%	44.1%	60.7%	0.96	0.73	1.27	0.800	a b
Unknown	2	5	40.0%	10.0%	160.1%	0.75	0.18	3.04	0.683	a b
Country of Birth										
NZ	223	461	48.4%	42.4%	55.2%	1.00				a
Outside NZ	109	189	57.7%	47.8%	69.6%	1.19	0.95	1.50	0.132	a
Unknown	19	34	55.9%	35.6%	87.6%	1.16	0.72	1.85	0.546	a
Suburb Deprivation [c]										
1	4	7	57.1%	21.4%	152.4%	1.00				a
2	6	13	46.2%	20.7%	102.8%	0.81	0.23	2.86	0.741	a
3	5	10	50.0%	20.8%	120.2%	0.88	0.23	3.26	0.842	a
4	23	35	65.7%	43.7%	98.9%	1.15	0.40	3.33	0.796	a
5	8	12	66.7%	33.3%	133.4%	1.17	0.35	3.87	0.801	a
6	15	25	60.0%	36.2%	99.6%	1.05	0.35	3.16	0.931	a
7	16	29	55.2%	33.8%	90.1%	0.97	0.32	2.89	0.950	a
8	10	18	55.6%	29.9%	103.3%	0.97	0.30	3.10	0.962	a
9	117	259	45.2%	37.7%	54.2%	0.79	0.29	2.14	0.644	a
10	146	273	53.5%	45.5%	62.9%	0.94	0.35	2.53	0.896	a
Unknown	1	3	33.3%	4.7%	236.9%	0.58	0.07	5.22	0.630	a

Appendix Table 1: Bivariable analysis of paracetamol (N=992) (continued).

Variable	Total filled	Total prescribed	% filled	% lower 95	% upper 95	RR [a]	RR lower 95	RR upper 95	p-value	Group
Language										
English	309	604	51.2%	45.8%	57.2%	1.00				a
Non-English	24	43	55.8%	37.4%	83.3%	1.09	0.72	1.65	0.681	a
Unknown	18	37	48.6%	30.6%	77.2%	0.95	0.59	1.53	0.836	a
Occupation										
Student	73	162	45.1%	35.8%	56.7%	0.01				a
Unemployed	17	47	36.2%	22.5%	58.2%	1.00	0.47	1.36	0.414	a
Homemaker	15	41	36.6%	22.0%	60.7%	0.81	0.47	1.42	0.462	a
Retired	13	20	65.0%	37.7%	112.0%	1.44	0.80	2.60	0.224	a
Other	74	125	59.2%	47.1%	74.4%	1.31	0.95	1.82	0.098	a
Employed	49	100	49.0%	37.0%	64.8%	1.09	0.76	1.56	0.650	a
Infant/child	102	175	58.3%	48.0%	70.8%	1.29	0.96	1.75	0.093	a
Unknown	8	14	57.1%	28.6%	114.3%	1.27	0.61	2.63	0.524	a
Regular GP										
Yes	340	662	51.4%	46.2%	57.1%	1.00				a
No	11	22	50.0%	27.7%	90.3%	0.97	0.53	1.77	0.930	a
Smoking										
No	301	557	54.0%	48.3%	60.5%	1.00				a
Yes	33	93	35.5%	25.2%	49.9%	0.66	0.46	0.94	0.022	b
Unknown	17	34	50.0%	31.1%	80.5%	0.93	0.57	1.51	0.755	a b
Items prescribed										
1	30	121	24.8%	17.3%	35.5%	1.00				a
2	145	278	52.2%	44.3%	61.4%	2.10	1.42	3.12	0.000	b
3	120	197	60.9%	50.9%	72.9%	2.46	1.65	3.67	0.000	b
4	42	63	66.7%	49.3%	90.2%	2.69	1.68	4.30	0.000	b
>4	14	25	56.0%	33.2%	94.6%	2.26	1.20	4.26	0.012	b
Discharge month										
Autumn	184	339	54.3%	47.0%	62.7%	1.00				a
Winter	167	345	48.4%	41.6%	56.3%	0.89	0.72	1.10	0.284	a

Appendix Table 1: Bivariable analysis of paracetamol (N=992) (continued).

Variable	Total filled	Total prescribed	% filled	% lower 95	% upper 95	RR[a]	RR lower 95	RR upper 95	p-value	Group
Discharge Day										
Sun	43	93	46.2%	34.3%	62.4%	1.00				a
Mon	85	163	52.1%	42.2%	64.5%	1.13	0.78	1.63	0.520	a
Tues	61	108	56.5%	43.9%	72.6%	1.22	0.83	1.80	0.315	a
Wed	42	89	47.2%	34.9%	63.9%	1.02	0.67	1.56	0.925	a
Thurs	34	70	48.6%	34.7%	68.0%	1.05	0.67	1.65	0.830	a
Fri	42	88	47.7%	35.3%	64.6%	1.03	0.67	1.58	0.884	a
Sat	44	73	60.3%	44.8%	81.0%	1.30	0.86	1.98	0.216	a
Discharge Time										
2400-0400	76	141	53.9%	43.0%	67.5%	1.00				a
0400-0800	38	78	48.7%	35.4%	67.0%	0.90	0.61	1.33	0.611	a
0800-1200	61	98	62.2%	48.4%	80.0%	1.15	0.82	1.62	0.402	a
1200-1600	41	91	45.1%	33.2%	61.2%	0.84	0.57	1.22	0.355	a
1600-2000	69	145	47.6%	37.6%	60.3%	0.88	0.64	1.22	0.454	a
2000-2400	65	129	50.4%	39.5%	64.3%	0.93	0.67	1.30	0.690	a
Unknown	1	2	50.0%	7.0%	355.4%	0.93	0.13	6.67	0.941	a

[a] RR: Rate ratio
[b] MELAA: Middle Eastern, Latin American and African
[c] Suburb deprivation: 1 represents areas of least deprived; 10 is most deprived.

Appendix Table 2: Bivariable analysis of nonsteroidal anti-inflammatory drugs (N=992).

Variable	Total filled	Total prescribed	% filled	% lower 95	% upper 95	RR[a]	RR lower 95	RR upper 95	p-value	Group
Gender										
Male	233	370	63.0%	55.4%	71.6%	1.00				a
Female	172	306	56.2%	48.4%	65.3%	0.89	0.73	1.09	0.258	a
Age										
< 10	81	120	67.5%	54.3%	83.9%	1.00				b c
10-17	39	87	44.8%	32.7%	61.4%	0.66	0.45	0.97	0.036	a
18-24	57	114	50.0%	38.6%	64.8%	0.74	0.53	1.04	0.083	a b
25-44	115	196	58.7%	48.9%	70.4%	0.87	0.65	1.16	0.334	a b c
45-64	99	139	71.2%	58.5%	86.7%	1.06	0.79	1.42	0.720	c
> 64	14	20	70.0%	41.4%	118.2%	1.04	0.59	1.83	0.900	a b c
Ethnicity										
NZ European	100	156	64.1%	52.7%	78.0%	1.00				a b
Asian	74	123	60.2%	47.9%	75.6%	0.94	0.69	1.27	0.679	a b
MELAA[b]	12	13	92.3%	52.4%	162.6%	1.44	0.79	2.62	0.233	a
Māori	62	127	48.8%	38.1%	62.6%	0.76	0.55	1.05	0.092	b
Pacific	154	252	61.1%	52.2%	71.6%	0.95	0.74	1.23	0.710	a b
Unknown	3	5	60.0%	19.3%	186.2%	0.94	0.30	2.95	0.910	a b
Country of Birth										
NZ	226	413	54.7%	48.0%	62.3%	1.00				a
Outside NZ	155	225	68.9%	58.8%	80.6%	1.26	1.03	1.54	0.027	b
Unknown	24	38	63.2%	42.3%	94.3%	1.15	0.76	1.76	0.504	a b
Suburb Deprivation[c]										
1	8	11	72.7%	36.4%	145.5%	1.00				a
2	11	22	50.0%	27.7%	90.3%	0.69	0.28	1.71	0.420	a
3	10	13	76.9%	41.4%	143.0%	1.06	0.42	2.68	0.906	a
4	25	39	64.1%	43.3%	94.9%	0.88	0.40	1.95	0.756	a
5	9	13	69.2%	36.0%	133.1%	0.95	0.37	2.47	0.919	a
6	18	29	62.1%	39.1%	98.5%	0.85	0.37	1.96	0.709	a
7	20	29	69.0%	44.5%	106.9%	0.95	0.42	2.15	0.899	a
8	10	16	62.5%	33.6%	116.2%	0.86	0.34	2.18	0.749	a
9	128	235	54.5%	45.8%	64.8%	0.75	0.37	1.53	0.428	a
10	165	267	61.8%	53.0%	72.0%	0.85	0.42	1.73	0.653	a
Unknown	1	2	50.0%	7.0%	355.4%	0.69	0.09	5.50	0.724	a

Appendix Table 2: Bivariable analysis of nonsteroidal anti-inflammatory drugs (N=992) (continued).

Variable	Total filled	Total prescribed	% filled	% lower 95	% upper 95	RR [a]	RR lower 95	RR upper 95	p-value	Group
Language										
English	367	612	60.0%	54.1%	66.4%	1.00				a
Non-English	19	31	61.3%	39.1%	96.1%	1.02	0.64	1.62	0.926	a
Unknown	19	33	57.6%	36.7%	90.3%	0.96	0.61	1.52	0.863	a
Occupation										
Student	80	144	55.6%	44.6%	69.2%	1.00				a b
Unemployed	30	64	46.9%	32.8%	67.1%	0.84	0.55	1.28	0.427	a b
Homemaker	18	45	40.0%	25.2%	63.5%	0.72	0.43	1.20	0.208	a
Retired	10	16	62.5%	33.6%	116.2%	1.12	0.58	2.17	0.725	a b
Other	116	173	67.1%	55.9%	80.4%	1.21	0.91	1.60	0.196	b
Employed	79	126	62.7%	50.3%	78.2%	1.13	0.83	1.54	0.446	a b
Infant/child	60	90	66.7%	51.8%	85.9%	1.20	0.86	1.68	0.286	a b
Unknown	12	18	66.7%	37.8%	117.4%	1.20	0.65	2.20	0.556	a b
Regular GP										
Yes	395	654	60.4%	54.7%	66.7%	1.00				a
No	10	22	45.5%	24.4%	84.5%	0.75	0.40	1.41	0.375	a
Smoking										
No	315	511	61.6%	55.2%	68.8%	1.00				a
Yes	68	123	55.3%	43.6%	70.1%	0.90	0.69	1.17	0.416	a
Unknown	22	42	52.4%	34.5%	79.6%	0.85	0.55	1.31	0.460	a
Items prescribed										
1	15	35	42.9%	25.8%	71.1%	1.00				a b
2	127	248	51.2%	43.0%	60.9%	1.19	0.70	2.04	0.514	b
3	170	261	65.1%	56.0%	75.7%	1.52	0.90	2.58	0.120	a
4	71	100	71.0%	56.3%	89.6%	1.66	0.95	2.89	0.076	a
>4	22	32	68.8%	45.3%	104.4%	1.60	0.83	3.09	0.158	a b
Discharge month										
Autumn	211	346	61.0%	53.3%	69.8%	1.00				a
Winter	194	330	58.8%	51.1%	67.7%	0.96	0.79	1.17	0.713	a

Appendix Table 2: Bivariable analysis of nonsteroidal anti-inflammatory drugs (N=992) (continued).

Variable	Total filled	Total prescribed	% filled	% lower 95	% upper 95	RR [a]	RR lower 95	RR upper 95	p-value	Group
Discharge Day										
Sun	49	75	65.3%	49.4%	86.5%	1.00				a
Mon	86	150	57.3%	46.4%	70.8%	0.88	0.62	1.25	0.466	a
Tues	87	134	64.9%	52.6%	80.1%	0.99	0.70	1.41	0.972	a
Wed	45	85	52.9%	39.5%	70.9%	0.81	0.54	1.21	0.308	a
Thurs	38	69	55.1%	40.1%	75.7%	0.84	0.55	1.29	0.429	a
Fri	44	77	57.1%	42.5%	76.8%	0.87	0.58	1.31	0.519	a
Sat	56	86	65.1%	50.1%	84.6%	1.00	0.68	1.46	0.986	a
Discharge Time										
2400-0400	76	137	55.5%	44.3%	69.5%	1.00				a b
0400-0800	52	82	63.4%	48.3%	83.2%	1.14	0.80	1.63	0.457	a b
0800-1200	77	104	74.0%	59.2%	92.6%	1.33	0.97	1.83	0.074	a
1200-1600	64	106	60.4%	47.2%	77.2%	1.09	0.78	1.52	0.618	a b
1600-2000	62	125	49.6%	38.7%	63.6%	0.89	0.64	1.25	0.513	b
2000-2400	74	121	61.2%	48.7%	76.8%	1.10	0.80	1.52	0.550	a b
Unknown	0	1	0.0%	0.0%	Inf	0.00	0.00	Inf	0.978	a b

[a] RR: Rate ratio
[b] MELAA: Middle Eastern, Latin American and African
[c] Suburb deprivation: 1 represents areas of least deprived; 10 is most deprived.

Appendix Table 3: Bivariable analysis of antibiotics (N=992).

Variable	Total filled	Total prescribed	% filled	% lower 95	% upper 95	RR[a]	RR lower 95	RR upper 95	p-value	Group
Gender										
Male	100	124	80.6%	66.3%	98.1%	1.00				a
Female	109	136	80.1%	66.4%	96.7%	0.99	0.76	1.30	0.964	a
Age										
< 10	82	97	84.5%	68.1%	105.0%	1.00				a
10-17	14	22	63.6%	37.7%	107.5%	0.75	0.43	1.33	0.326	a
18-24	24	31	77.4%	51.9%	115.5%	0.92	0.58	1.44	0.705	a
25-44	42	51	82.4%	60.8%	111.5%	0.97	0.67	1.41	0.890	a
45-64	33	44	75.0%	53.3%	105.5%	0.89	0.59	1.33	0.562	a
> 64	14	15	93.3%	55.3%	157.6%	1.10	0.63	1.95	0.732	a
Ethnicity										
NZ European	48	52	92.3%	69.5%	122.5%	1.00				a
Asian	25	34	73.5%	49.7%	108.8%	0.80	0.49	1.29	0.356	a
MELAA[b]	3	3	100.0%	32.2%	310.3%	1.08	0.34	3.48	0.893	a
Māori	35	49	71.4%	51.3%	99.5%	0.77	0.50	1.20	0.249	a
Pacific	98	122	80.3%	65.9%	97.9%	0.87	0.62	1.23	0.430	a
Unknown	0	0		16.4%	288.8%	0.75	0.18	3.04	0.683	a
Country of Birth										
NZ	140	177	79.1%	67.0%	93.4%	1.00				a
Outside NZ	62	75	82.7%	64.4%	106.0%	1.05	0.78	1.41	0.772	a
Unknown	7	8	87.5%	41.7%	183.6%	1.11	0.52	2.36	0.794	a
Suburb Deprivation[c]										
1	0	0		9.0%	3249.0	1.00				a
2	1	3	33.3%	4.7%	236.9%	0.19	0.01	6.66	0.364	a
3	5	5	100.0%	41.6%	240.4%	0.58	0.03	12.54	0.731	a
4	8	9	88.9%	44.4%	177.8%	0.52	0.03	10.63	0.670	a
5	5	6	83.3%	34.7%	200.3%	0.49	0.02	10.45	0.645	a
6	11	15	73.3%	40.6%	132.5%	0.43	0.02	8.58	0.579	a
7	6	6	100.0%	44.9%	222.7%	0.58	0.03	12.28	0.729	a
8	5	6	83.3%	34.7%	200.3%	0.49	0.02	10.45	0.645	a
9	78	104	75.0%	60.1%	93.6%	0.44	0.02	8.34	0.583	a
10	89	105	84.8%	68.9%	104.3%	0.49	0.03	9.42	0.640	a
Unknown	1	1	100.0%	14.1%	710.9%	0.58	0.07	5.22	0.630	a

Appendix Table 3: Bivariable analysis of antibiotics (N=992) (continued).

Variable	Total filled	Total prescribed	% filled	% lower 95	% upper 95	RR [a]	RR lower 95	RR upper 95	p-value	Group
Language										
English	186	230	80.9%	70.0%	93.4%	1.00				a
Non-English	10	13	76.9%	41.4%	143.0%	0.95	0.50	1.80	0.878	a
Unknown	13	17	76.5%	44.4%	131.7%	0.95	0.54	1.66	0.845	a
Occupation										
Student	49	61	80.3%	60.7%	106.3%	1.00				a
Unemployed	14	19	73.7%	43.6%	124.5%	0.92	0.51	1.66	0.776	a
Homemaker	11	19	57.9%	32.0%	104.6%	0.72	0.37	1.39	0.326	a
Retired	13	14	92.9%	53.9%	160.0%	1.16	0.63	2.13	0.642	a
Other	38	43	88.4%	64.3%	121.5%	1.10	0.72	1.68	0.659	a
Employed	29	37	78.4%	54.5%	112.8%	0.98	0.62	1.54	0.916	a
Infant/child	52	62	83.9%	63.9%	110.1%	1.04	0.71	1.54	0.828	a
Unknown	3	5	60.0%	19.3%	186.2%	0.75	0.23	2.40	0.624	a
Regular GP										
Yes	203	249	81.5%	71.0%	93.6%	1.00				a
No	6	11	54.5%	24.5%	121.5%	0.67	0.30	1.51	0.332	a
Smoking										
No	164	200	82.0%	70.4%	95.6%	1.00				a
Yes	36	48	75.0%	54.1%	104.0%	0.91	0.64	1.31	0.628	a
Unknown	9	12	75.0%	39.0%	144.2%	0.91	0.47	1.79	0.794	a
Items prescribed										
1	44	56	78.6%	58.5%	105.6%	1.00				a
2	49	58	84.5%	63.8%	111.8%	1.08	0.72	1.62	0.727	a
3	77	96	80.2%	64.1%	100.3%	1.02	0.70	1.48	0.913	a
4	26	37	70.3%	47.8%	103.2%	0.89	0.55	1.45	0.652	a
>4	13	13	100.0%	58.0%	172.3%	1.27	0.69	2.36	0.445	a
Discharge month										
Autumn	115	134	85.8%	71.5%	103.0%	1.00				a
Winter	94	126	74.6%	60.9%	91.3%	0.87	0.66	1.14	0.314	a

Appendix Table 3: Bivariable analysis of antibiotics (N=992) (continued).

Variable	Total filled	Total prescribed	% filled	% lower 95	% upper 95	RR [a]	RR lower 95	RR upper 95	p-value	Group
Discharge Day										
Sun	22	26	84.6%	55.7%	128.5%	1.00				a
Mon	47	67	70.1%	52.7%	93.4%	0.83	0.50	1.38	0.468	a
Tues	50	56	89.3%	67.7%	117.8%	1.06	0.64	1.74	0.834	a
Wed	30	40	75.0%	52.4%	107.3%	0.89	0.51	1.54	0.667	a
Thurs	16	21	76.2%	46.7%	124.4%	0.90	0.47	1.71	0.750	a
Fri	17	21	81.0%	50.3%	130.3%	0.96	0.51	1.80	0.891	a
Sat	27	29	93.1%	63.8%	135.8%	1.10	0.63	1.93	0.739	a
Discharge Time										
2400-0400	34	42	81.0%	57.8%	113.3%	1.00				a
0400-0800	30	36	83.3%	58.3%	119.2%	1.03	0.63	1.68	0.908	a
0800-1200	38	49	77.6%	56.4%	106.6%	0.96	0.60	1.52	0.856	a
1200-1600	19	23	82.6%	52.7%	129.6%	1.02	0.58	1.79	0.944	a
1600-2000	41	53	77.4%	56.9%	105.1%	0.96	0.61	1.51	0.845	a
2000-2400	47	57	82.5%	61.9%	109.8%	1.02	0.66	1.58	0.935	a
Unknown	0	0		10.1%	556.3%	0.93	0.13	6.67	0.941	a

[a] RR: Rate ratio
[b] MELAA: Middle Eastern, Latin American and African
[c] Suburb deprivation: 1 represents areas of least deprived; 10 is most deprived.

Appendix Table 4: Bivariable analysis of other medication (N=992).

Variable	Total filled	Total prescribed	% filled	% lower 95	% upper 95	RR [a]	RR lower 95	RR upper 95	p-value	Group
Gender										
Male	160	251	63.7%	54.6%	74.4%	1.00				a
Female	187	318	58.8%	50.9%	67.9%	0.92	0.75	1.14	0.454	a
Age										
< 10	88	129	68.2%	55.3%	84.1%	1.00				a
10-17	22	44	50.0%	32.9%	76.0%	0.73	0.46	1.17	0.192	a
18-24	40	69	58.0%	42.5%	79.0%	0.85	0.58	1.23	0.393	a
25-44	83	145	57.2%	46.2%	71.0%	0.84	0.62	1.13	0.252	a
45-64	81	128	63.3%	50.9%	78.7%	0.93	0.69	1.25	0.626	a
> 64	33	54	61.1%	43.4%	86.0%	0.90	0.60	1.34	0.590	a
Ethnicity										
NZ European	76	119	63.9%	51.0%	80.0%	1.00				a
Asian	56	86	65.1%	50.1%	84.6%	1.02	0.72	1.44	0.912	a
MELAA [b]	4	8	50.0%	18.8%	133.3%	0.78	0.29	2.14	0.633	a
Māori	61	107	57.0%	44.3%	73.3%	0.89	0.64	1.25	0.509	a
Pacific	147	246	59.8%	50.8%	70.2%	0.94	0.71	1.23	0.638	a
Unknown	3	3	100.0%	32.2%	310.3%	1.57	0.49	4.96	0.446	a
Country of Birth										
NZ	209	332	63.0%	55.0%	72.1%	1.00				a
Outside NZ	118	197	59.9%	50.0%	71.8%	0.95	0.76	1.19	0.666	a
Unknown	20	40	50.0%	32.2%	77.5%	0.79	0.50	1.26	0.325	a
Suburb Deprivation [c]										
1	2	3	66.7%	16.7%	266.8%	1.00				a
2	4	9	44.4%	16.7%	118.5%	0.67	0.12	3.64	0.640	a
3	2	4	50.0%	12.5%	200.1%	0.75	0.11	5.32	0.774	a
4	13	20	65.0%	37.7%	112.0%	0.97	0.22	4.32	0.973	a
5	9	9	100.0%	52.0%	192.3%	1.50	0.32	6.94	0.604	a
6	24	32	75.0%	50.3%	111.9%	1.12	0.27	4.76	0.873	a
7	9	12	75.0%	39.0%	144.2%	1.12	0.24	5.21	0.880	a
8	5	11	45.5%	18.9%	109.3%	0.68	0.13	3.51	0.647	a
9	135	211	64.0%	54.0%	75.7%	0.96	0.24	3.88	0.954	a
10	142	253	56.1%	47.6%	66.2%	0.84	0.21	3.40	0.809	a
Unknown	2	5	40.0%	10.0%	160.1%	0.60	0.08	4.26	0.609	a

Appendix Table 4: Bivariable analysis of other medication (N=992) (continued).

Variable	Total filled	Total prescribed	% filled	% lower 95	% upper 95	RR [a]	RR lower 95	RR upper 95	p-value	Group
Language										
English	313	520	60.2%	53.9%	67.2%	1.00				a
Non-English	22	30	73.3%	48.3%	111.4%	1.22	0.79	1.88	0.371	a
Unknown	12	19	63.2%	35.9%	111.3%	1.05	0.59	1.87	0.870	a
Occupation										
Student	65	113	57.5%	45.1%	73.4%	1.00				a
Unemployed	28	60	46.7%	32.2%	67.6%	0.81	0.52	1.26	0.355	a
Homemaker	25	46	54.3%	36.7%	80.5%	0.94	0.60	1.50	0.809	a
Retired	28	47	59.6%	41.1%	86.3%	1.04	0.66	1.61	0.877	a
Other	76	109	69.7%	55.7%	87.3%	1.21	0.87	1.69	0.255	a
Employed	56	99	56.6%	43.5%	73.5%	0.98	0.69	1.41	0.927	a
Infant/child	60	85	70.6%	54.8%	90.9%	1.23	0.86	1.74	0.253	a
Unknown	9	10	90.0%	46.8%	173.0%	1.56	0.78	3.14	0.208	a
Regular GP										
Yes	338	552	61.2%	55.0%	68.1%	1.00				a
No	9	17	52.9%	27.5%	101.8%	0.86	0.45	1.68	0.667	a
Smoking										
No	281	437	64.3%	57.2%	72.3%	1.00				a
Yes	47	102	46.1%	34.6%	61.3%	0.72	0.53	0.98	0.034	b
Unknown	19	30	63.3%	40.4%	99.3%	0.98	0.62	1.57	0.949	a b
Items prescribed										
1	33	78	42.3%	30.1%	59.5%	1.00				a
2	80	140	57.1%	45.9%	71.2%	1.35	0.90	2.03	0.146	a b
3	116	169	68.6%	57.2%	82.3%	1.62	1.10	2.39	0.014	b c
4	67	84	79.8%	62.8%	101.4%	1.89	1.24	2.86	0.003	c
>4	51	98	52.0%	39.5%	68.5%	1.23	0.79	1.91	0.354	a b
Discharge month										
Autumn	208	343	60.6%	52.9%	69.5%	1.00				a
Winter	139	226	61.5%	52.1%	72.6%	1.01	0.82	1.26	0.897	a

Appendix Table 4: Bivariable analysis of other medication (N=992) (continued).

Variable	Total filled	Total prescribed	% filled	% lower 95	% upper 95	RR[a]	RR lower 95	RR upper 95	p-value	Group
Discharge Day										
Sun	25	43	58.1%	39.3%	86.1%	1.00				a
Mon	90	147	61.2%	49.8%	75.3%	1.05	0.68	1.64	0.819	a
Tues	76	118	64.4%	51.4%	80.7%	1.11	0.71	1.74	0.657	a
Wed	44	70	62.9%	46.8%	84.5%	1.08	0.66	1.77	0.755	a
Thurs	46	69	66.7%	49.9%	89.0%	1.15	0.70	1.87	0.582	a
Fri	28	66	42.4%	29.3%	61.5%	0.73	0.43	1.25	0.252	a
Sat	38	56	67.9%	49.4%	93.3%	1.17	0.70	1.93	0.548	a
Discharge Time										
2400-0400	52	85	61.2%	46.6%	80.3%	1.00				a
0400-0800	35	55	63.6%	45.7%	88.7%	1.04	0.68	1.60	0.857	a
0800-1200	67	106	63.2%	49.7%	80.3%	1.03	0.72	1.48	0.860	a
1200-1600	60	83	72.3%	56.1%	93.1%	1.18	0.82	1.71	0.378	a
1600-2000	71	137	51.8%	41.1%	65.4%	0.85	0.59	1.21	0.363	a
2000-2400	62	103	60.2%	46.9%	77.2%	0.98	0.68	1.42	0.931	a
Unknown	0	0		7.7%	416.3%	0.93	0.13	6.67	0.941	a

[a] RR: Rate ratio
[b] MELAA: Middle Eastern, Latin American and African
[c] Suburb deprivation: 1 represents areas of least deprived; 10 is most deprived.

Competing interests:
Nil.
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