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Variation in medicines use by ethnicity: a comparison between 2006/7 and 2012/13

Final report

Auckland UniServices Limited

A wholly owned company of

The University of Auckland

THE UNIVERSITY OF AUCKLAND
NEW ZEALAND
Te Whare Wānanga o Tāmaki Makaurau

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Date:

January 2018

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GLOSSARY

- **Access:** for the purposes of this analysis *access* is measured as the count of patients (measured as unique NHIs) receiving one or more *scripts* for a pharmaceutical during the analytical period.
- **Age Standardised Rates (ASR):** The age standardised rates are those that would have existed had the population of interest and the reference populations (for example, Māori and non-Māori) had the same age distribution as the 'standard' population. For this analysis, the rates of dispensings and NHI counts were adjusted using the World Health Organization's World Population as the 'standard'.
- **Chemical name:** Chemical (generic) name of the active chemical ingredient
- **Disability Adjusted Life Years (DALYs):** Disease burden in Māori and non-Māori populations was estimated using DALYs. DALYs integrate the fatal burden (Years of Life Lost, or YLL) with the non-fatal burden (Year Equivalents Lost to 'Disability', or YLD). One DALY represents the loss of one year of healthy life.
- **Inequality:** differences in medicines dispensing rates, medicine usage or disease burden between ethnic groups.
- **Inequity/disparity:** unnecessary and avoidable (or unjust) differences in medicines dispensing rates, medicine usage or disease burden between ethnic groups.
- **NHI:** National Health Index number is a unique identifier that is assigned to every person who uses health and disability support services in New Zealand (http://www.health.govt.nz/our-work/health-identity/national-health-index)
- **NZBD:** New Zealand Burden of Diseases, Injuries and Risk Factors Study
- **Persistence:** for the purposes of this analysis persistence is measured as *script* minus *access*. Conceptually this represents the extent of continued treatment. *Script* is used in place of the count of dispensings to account for the variation in the number of repeats that may be dispensed from an individual dispensed item.
- **Prescription item:** an individual pharmaceutical on a prescription

- **Prescription:** a written instruction (or a piece of paper) from an authorised prescriber stating the form, dosage strength, etc., of one or more pharmaceuticals (prescription item) to be issued to a specific patient.
- **Scaling:** Records of patients with unknown NHIs were excluded from all analysis. To compensate for this, unique patients (i.e. patients with known NHIs) and dispensings (i.e. counts of scripts and repeat dispensings) are uplifted by NHI compliance rates, which were sourced from PHARMAC at chemical level. All analyses in this report are based on scaled data.
- **Script:** for the purposes of this analysis a script is taken to mean the count of the first dispensing of a prescription item. Repeats are not included in the script count. *Script* is a measure of *access* plus *persistence.*
    - ✓ All single supply (e.g. full dose of amoxicillin) and stat medicines (e.g. 3 months' worth supply of metformin or 6 months' worth of combined oral contraceptives) are considered as initial dispensings.
    - ✓ For non-stat repeat medicines (e.g. for 3 months' worth of ezetimibe), depending on the situation, a pharmacist may dispense in instalments; the first supply of these instalments is considered as the first dispensing, with subsequent dispensings being repeats.
- **Stat (PHARMAC definition):** 90 or more days' supply of a medicine dispensed to the patient at one time.
- **Therapeutic groups**: Community pharmaceuticals are classified anatomically, originally based on the Anatomical, Therapeutic and Chemical (ATC) System, and then further classified under section of the headings structured for the New Zealand medical system.
    - ✓ Therapeutic group level 1 name (TG1): Description for anatomical main group.
    - ✓ Therapeutic group level 2 name (TG2): Description for therapeutic main group
    - ✓ Therapeutic group level 3 name (TG3): Description for therapeutic/pharmacological subgroup

1 EXECUTIVE SUMMARY

In 2013, PHARMAC undertook and published a preliminary analysis of variation in the use of medicines by ethnicity during 2006/07 in New Zealand, through linkage of dispensings of prescription medicines for Māori, Pacific peoples to age/disease burden surrogates of health need (Metcalfe, Laking, & Arnold, 2013).

PHARMAC has commissioned this update using 2006/2007 and 2012/2013 dispensing claims data for publicly funded medicines, and this report is for PHARMAC's use (Deliverable 1). A paper for publication (Deliverable 2) is forthcoming.

This report particularly provides information on disparities in subsidised medicines access and persistence between Māori and non-Māori populations and changes in access and persistence rates over time. In addition, the report includes an overview of crude and age standardised script rates for publicly funded medicines for all ethnic groups in New Zealand.

The key findings of both sets of analyses are summarised below.

- While there are a number of important caveats and limitations to the analysis meaning that caution is needed interpreting its results, apparent disparities exist for Māori in access to and persistence with government funded pharmaceuticals in New Zealand.
- These apparent disparities in medicines access and use are linked to chronic conditions that are responsible for an estimated 88% of the burden of disease in New Zealand.
- Disparities still exist where crude- and age-adjusted script rates *appear* higher for Māori than non-Māori, due to the effects of disparities in the burden of disease.
- After adjusting for burden of disease (beyond age adjustment), pervading apparent inequities remain. In 2012/13 gaps in medicines dispensings meant there were in effect 608,800 lost opportunities for Māori to access medicines, with in total 1,126,280 pharmaceutical treatments that Māori did not receive.

- Over time, while there has been a significant increase in access to and persistence with medicines for Māori, and the total number of prescription items being dispensed, disparities persist. The overall disease burden-adjusted inequalities in medicine dispensings between Māori and non-Māori have widened by 6% for the cohort of medicines available in 2006/2007 (comparing Māori vs. non-Māori age-standardised rate ratio overall in 2012/2013 against that in 2006/2007).
- The overall increase in the apparent gap seems due to a further deterioration in access while persistence has improved – so in 2012/2013 the proportion of Māori receiving their first prescription (compared with expected had they been non-Māori) had decreased compared with in 2006/2007, but those who did so were staying on their medicines for longer (relative to non-Māori) compared with in 2006/2007. Caution is needed interpreting these results, as at a medicine-specific level, changes in persistence need to be understood alongside optimal treatment durations, and changes in prescribing need to be understood in respect to changes in standard treatment pathways. Nevertheless, important apparent disparities in disease burden-adjusted script rates continue to exist for cardiovascular disease, asthma and COPD, mental health (in particular the management of anxiety and depression), diabetes, cancer, and bacterial infections

While PHARMAC has a role to play in ensuring that barriers to Māori accessing medicines are not created because of funding decisions, and that its responsible use of medicines function supports optimal prescribing and uptake, the cause of these apparent disparities is likely to be complex and systematic. Addressing the complex barriers to accessing medicines and optimising their use requires a whole of sector approach.

Once adjusted for burden of disease, inequalities become one of three things:

1. true disparities (inequity in access or persistence, i.e. Māori not receiving sufficient of a medicine if at all, thus lost health gain opportunities)
2. wastage (the non-Māori comparator group is receiving excess medicines, unnecessarily, without real gains), or

3. harm (Māori as the group experiencing disparities are receiving excess medicines of lesser benefit and thus experience harm, i.e. net health loss, compared with the non-Māori comparator group).

This analysis is unable to differentiate between the three.

Further work is also needed to understand what barriers Māori, and other under-served groups including those facing inequities or health disparities, face in accessing and utilising their medicines. Disease-specific, rigorously designed pharmacoepidemiology and outcomes research, making use of clinical data to better resolve the issues of linking medicines use directly to outcomes, is needed.

Important caveats to comparing the data in this report with the data from Metcalfe, et al, 2013.

Although this research is largely based on Metcalfe et al's methodology (Metcalfe, Laking, & Arnold, 2013), direct comparison of findings from Metcalfe et al and this report should be avoided for the following reasons.

- The two studies used different methods to derive the 2006/7 population.
- The data in this report and that from Metcalfe et al have been derived from different sources. The analysis in this report used burden of disease estimates contemporary to the dispensing data, and the updated Burden of Disease Study (Ministry of Health. 2013a, Ministry of Health. 2013b) used a different disease categorisation methodology and the World Health Organization ICD 10 codes and did not discount disability-adjusted life year (DALY) losses over time, whereas Metcalfe et al used a historical disease burden estimates which were based on ICD 9AM codes and which discounted DALY losses over time.
- Crucially, script rates and DALY estimates in this report were age standardised to the (older age structured) WHO standard reference population, rather than the (younger age structured) Segi standard population used in Metcalfe et al's study. Both standards were necessary to align with the corresponding quite separate burden of disease study datasets. Nevertheless, the use of different standard reference populations, regardless of necessity, causes inevitable distortions, at times large.

- There is a difference between the two studies in the number of dispensed medicines linked to clinical indications.
- In this report analysis, medicines dispensed to people who died during the study periods were excluded, whereas they were included in Metcalfe et al's study.
- Metcalfe et al focused on providing an overview of disparities in prevalent medicines access and persistence in Māori and non-Māori populations during 2006/07, whereas the present research extended this analysis using Keppel et al's methodology (Keppel et al., 2005) for measuring change in absolute and relative disparities between 2006/07 and 2012/13.

2 BACKGROUND

In most developed countries, the health of indigenous people is lower than that of the overall population. In New Zealand this is reflected in the well-recognised and long standing disparities in health between the Māori and non-Māori population. Māori are more likely to have less access to publicly funded medicines and experience poorer health outcomes as a result compared with non-Māori population. These disparities not only affect Māori population but also limit the opportunity to improve the overall health of all New Zealanders.

In 2013, PHARMAC undertook and published a preliminary analysis of variation in the use of medicines by ethnicity during 2006/07 in New Zealand, through linkage of dispensings of prescription medicines for Māori, Pacific peoples to age/disease burden surrogates of health need. This study, which was undertaken by Metcalfe et al (Metcalfe, Laking, & Arnold, 2013), was based on medicines dispensed in community pharmacies during 2006/07 and 1991 historical disease burden estimates. Although Metcalfe et al's study was the first of its kind in New Zealand, the use of outdated disease burden estimates limited its use. In 2013, the Ministry of Health published disease estimates for the years 2006 to 2016. The focus of this report is to present an update data to Metcalfe et al's study through linking medicines dispensing claims data for the years 2006/7 and 2012/13 and contemporary disease burden estimates.

3 AIMS AND OBJECTIVES

3.1 Aim

The aim of this report is to provide an analysis of disparities in the use of publicly funded medicines in New Zealand between 2006/7 and 2012/13.

As has been discussed above, using 2006/07 dispensing claims data and adjusting for disease burden, population size and age structure, Metcalfe et al (Metcalfe et al., 2013) reported disparities in publicly funded medicines usage between Māori and non-Māori populations. Metcalfe et al's study was based on disease burden estimates occurring in 1991 (Ministry of Health., 2001); however, since then new

disease burden estimates have been published (Ministry of Health., 2013a). This study represents an update to Metcalfe et al's analysis using 2006/07 and 2012/13 dispensing claims data for publicly funded medicines and more contemporary disease burden estimates.

3.2 Specific objectives

This analysis had the following specific objectives:

1- To provide an overview of medicines dispensed by prescription volumes, category and incidence rates of dispensing for different ethnic groups

2- To assess whether there are disparities in access to and persistence with subsidised medicines between Māori and non-Māori populations, after adjusting for age and disease burden.

3- To explore changes in access and persistence rates between two different time periods (2006/07 and 20012/13) for different ethnic groups, for the cohort of medicines funded in 2006/07 that continued to be funded in 2012/13.

4 METHODOLOGY

This study involves a secondary analysis of routinely collected health data, and as such it is an observational study. Specifically, an ecological design was adopted and the focus was on examining medication access and persistence at population level rather than at individual levels (Sedgwick, 2014). While it is recognised that no single approach is complete, ecological design provides a less time-consuming and more cost-efficient alternative for quantifying and understanding medication related issues, such as access and adherence (Grzeskowiak, Gilbert, & Morrison, 2012). The routine and 'in real time' nature of data collection eliminates nonresponse, social desirability and recall biases (Dolja-Gore, Pit, Parkinson, Young, & Byles, 2013), which are the main limitations of randomised control trials, cross-sectional surveys and case-control studies. In addition, these routinely collected data provide large sample sizes and allow meaningful comparison between ethnic minority and majority groups.

The study also uses data matching across datasets. While it has several benefits, matching records across datasets is one of the many challenges of routinely collected data (Grzeskowiak et al., 2012; Jorm, 2015). Data can be linked either using probabilistic or deterministic method (Grzeskowiak et al., 2012). In deterministic matching, a unique patient identifier is used to match records, whereas in probabilistic matching records are matched using a number of personal identifiers, such as the person's name, sex, date of birth and street address (Jorm, 2015). In this study we used deterministic matching, and this approach is widely recognised as a highly accurate and efficient technique (Grzeskowiak et al., 2012).

The analyses in this report rely mainly on prescription medicines dispensing claims data that arise from claims submitted by community pharmacies. The underlying assumption in using these data is that a dispensed medicine is associated with actual use of that medicine. However, it is noteworthy that dispensed medicines only indicate medicine availability to the patient, and availability is a necessary sufficient condition for medicine-taking behaviour, but does not guarantee the behaviour. Nevertheless, considerable research has been undertaken using dispensing claims data and the findings have been used to influence public health policy and practice (Greenberger, Liao, & Mosca, 2013; Harman, Edlund, & Fortney, 2004; Kharat et al., 2015; Metcalfe et al., 2013; Morgan, Hanley, Cunningham, & Quan, 2011; Nelson, Norris, & Mangione, 2002; Woodard, Kressin, & Petersen, 2004).

5 METHODS

This study comprises a secondary analysis of de-identified, routinely collected health data; ethics committee approval was sought and advised as not required.

5.1 Data sources

Most of the data for this study have been obtained from prescription medicines dispensing claims data for the financial years 01/07/2006 to 30/06/2007 and 01/07/2012 to 30/06/2013. The dispensing claims database is contained in the Pharmaceuticals Collection database and held jointly by the Ministry of Health and PHARMAC. The dispensing claims database provides detailed information on medicines dispensed in community pharmacies in New Zealand, including the medicine's chemical name, formulation, dispensed quantity and three-level Pharmaceutical Schedule therapeutic groupings (i.e. level 1, level 2 and level 3). Additionally, the Pharmaceutical Collection database contains anonymised and National Health Index (NHI) numbers (unique patient identifier code) which can be linked with dispensing claims data. NHIs are associated with sociodemographic variables, such as the person's date of birth, sex, ethnicity and deprivation index, and NHI numbers are issued to all patients enrolled with PHOs. The NHI coverage for the two time periods of the study was very high. During 2006/07, 94% of all medicines dispensed in community pharmacies had NHI numbers, and the coverage for 2012/13 time period was 98%. NHI codes are often used to link data across health databases for either research or administrative purpose in New Zealand.

Information on age, prioritised ethnicity and DHB of domicile was sourced from PHO enrolment in the quarters 2007 Q3 and 2013 Q3 (submitted by practices in June). We used the prioritised ethnicity classification system. In this approach, the person can specify up to three ethnic groups and if any of these are Māori (indigenous people of New Zealand) or Pacific Peoples, then the person is assigned to these ethnic groups.

If the person belongs to both Māori and Pacific Peoples, they will be considered as Māori. Population estimates for each ethnic group were sourced from statistics New Zealand (Statistics New Zealand. 2015).

Data on disease burden and health needs for Māori and non-Māori populations were obtained from the New Zealand Burden of Diseases, Injuries and Risk Factors Study (NZBD), 2006 - 2016 report (Ministry of Health., 2013a). In the NZBD study, disease burden for each ethnic group was measured in terms of Disability Adjusted Life Years (DALYs). DALYs measures the overall disease burden of a population and it combines the number of years lost due to premature death, illness or disability. A DALY is often used to compare the overall health and life expectancy of different populations or groups. A DALY is estimated for each disease or health conditions and it involves complex procedures (Ministry of Health., 2013b). DALY projections for the year 2006 to 2016 of 217 most frequent diseases/conditions in New Zealand are reported elsewhere (Ministry of Health., 2013a). The DALYs are classified into 16 broader disease group codes and several sub-group codes (the sub-group codes represent specific disease/conditions within the major disease/condition group). For example, the broader group code for different infections is “A” and “A01” code is for HIV/AIDS and “A04” code for tuberculosis. The groupings are informed by the World Health Organization International Classification of Disease system - 10th edition (WHO ICD 10) (World Health Organization., 2016).

5.2 Data linking

Prescription medicines dispensed during 2006/07 and 20012/13 were linked to relevant specific (disease) conditions described in 2013 NZBD study, using Metcalfe’s methodology (Metcalfe et al., 2013). First, based on the New Zealand Formulary (the most recent version) (New Zealand Formulary., 1-2 August 2016) and Monthly Index of Medical Specialities of New Zealand (MIMS), the main clinical indication(s) of each dispensed medicine was determined. When information in formulary and MIMS was inadequate, best practice guidelines and the literature were used to determine the main clinical indication(s) of dispensed medicines. Then, we identified the WHO ICD 10 code(s) for the main indication(s) for which the dispensed medicines were used and we used the ICD 10 codes to link the dispensed medicine

to the NZBD study broader and specific disease group codes. For example, the main indication for boceprevir, efavirenz, nevirapine and abacavir is HIV/AIDS. The WHO ICD 10 codes for HIV disease are B_{20} to B_{24} and these codes were linked to the broader NZBD group code “A - Infections” and the specific disease condition code “A01– HIV/AIDS.” Therefore, the above medicines and other pharmaceuticals for HIV/AIDS are linked to “A01” and “A” codes of the NZBD study. If the medicine had multiple clinical indications, it was only linked to one of its major indication (see Appendix A for more details).

5.3 Data analysis

In the pharmaceutical collection database, while ‘scripts’ count refers to initial dispensing (excluding repeats), ‘dispensings’ refers to initial dispensing and any associated repeats authorised by the same prescription. A script is flagged in the database the first time a patient is dispensed a medicine on a given prescription. Therefore, the count of scripts (prescription items) a person has for a given medicine is the count of initial dispensing they receive over a given period of time.

For this analysis, we only included dispensing claims for prescriptions issued to individual patients and with valid NHI numbers. Dispensings without an NHI or with invalid NHIs were excluded. As a result of poor NHI reporting, bulk and practitioner supply orders (PSO) were also excluded. A PSO claim is a dispensing claim containing subsidised medicines supplied to private hospitals or a prescriber in order to be used for emergency use, teaching and demonstration purposes and for provision to some patient groups where an individual prescription is not practicable. To account for excluded dispensing claims, all dispensed medicines with complete NHIs were scaled up. NHI coverage at the therapeutic group and chemical level was available and the scaling was carried out for each specific formulation, using a linear interpolation technique.

To facilitate comparison, dispensed medicines were classified according to their main clinical indications, informed by the New Zealand Formulary (New Zealand Formulary., 1-2 August 2016), and using therapeutic groupings in the New Zealand Pharmaceutical Schedule.

To compare incidence of dispensing rates and medicine usage between ethnic groups, it was necessary to adjust for the difference in population size, age structure and disease burden (or health needs) between the groups being compared. In line with the NZBD study methods (necessary to compare dispensings with the available burden of disease data, which was age-standardised and done in a particular way), both pharmaceuticals and DALYs were direct age-standardised using the WHO standard population as the reference population (Ahmad et al., 2001). To minimise the limitations of direct-age standardisation, the nineteen 5-year age categories reported by the NZBD study were aggregated into five categories (i.e. 0-14, 15-24, 25-44, 45-64 and 65+ years). When comparing health disparities between indigenous and non-indigenous groups, the use of fewer age categories is strongly recommended (Australian Institute of Health and Welfare., 2011).

Age standardised dispensing rates for this study were calculated in two steps. First, according to WHO world population age-group shares (Ahmad et al., 2001); the population for each population sub-group (Māori (M), Pacific Peoples (P), Asian (A), New Zealand Europeans/Others (NZEO) and Non-Māori (nM)) was adjusted. This resulted in population by age estimates for each population subgroup. Then, each age-specific rate (for DALYs and pharmaceuticals) was multiplied by adjusted population; the results were summed and then divided by the total population for that sub-group, giving an age-standardised rate for DALYs and dispensed pharmaceuticals. We did not determine standard errors for the age standardised rates.

Inequities in disease burden (or health needs) and medicine usage between ethnic groups were measured using absolute and relative scales of measurement. Inequities on an absolute scale were estimated using difference in standardised rates, which is the difference in age-standardised rates (ASR) for DALYs or dispensed scripts between the two groups, whereas inequities on a relative scale were estimated using the standardised rate ratio, which is the ratio of the age standardised DALY or dispensed scripts for the two groups.

Data from the entire population were analysed and inferential statistics were not used, rather the results are reported as percentages, means, rates and ratios.

The detailed procedure for estimating the numerical differences in prescription medicines that were dispensed to different ethnic groups can be found in Box 1.

Box 1. Method of calculation: total script count, adapted from Metcalfe (Metcalfe et al., 2013)

For each indication-based pharmaceutical group, we calculated crude rate ratios (RRs) for scripts (or prescription items) comparing script counts per 1000 population in A vs. NZEO, M vs. NZEO, P vs. NZEO and Māori vs. non-Māori ethnicity.

We then calculated age standardised script rates (i.e. incidences of scripts or prescription items dispensed to each ethnic groups). The age-standardised script rates were then used to calculate age-standardised script rate ratios (ASRRs) for A vs NZEO, M vs NZEO, and P vs NZEO.

Māori script ASR ÷ non-Māori script ASR = Script $ASRR_{M:nM}$.

We also calculated age-standardised RRs for Māori vs. non-Māori rates of DALY losses (DALYLs), i.e. DALYL $ASRR_{M:nM}$. DALY estimates are not available for Asian and Pacific populations.

We then adjusted the ASRR ScriptM:nM for disease burden (DALY) using the M:nM DALYs ASRRs. This gave disease burden-adjusted M:nM prescription dispensing ASRRs for each indication-based pharmaceutical group, using the formula:

DALYL-adjusted prescription ASRR ($adjASRR_{M:nM}$)

= (unadjusted) prescription $ASRR_{M:nM}$ ÷ DALYL $ASRR_{M:nM}$

We then estimated the difference in Māori medicines use compared with expected non-Māori usage, after accounting for differences in population size, age structure and disease burden.

This involved the following:

- calculating differences between Māori and non-Māori DALYL-adjusted prescription ASRs, as numerical shortfalls / excesses in prescriptions per 1000 population; then
- re-expressing (1) as the proportional difference in adjusted Māori prescription ASRs; and then
- multiplying (2) across the absolute counts of Māori prescriptions, as the formula:

Gap (DALYL-adjusted shortfall/excess in prescriptions in Māori)

$$= (adjASR_M - ASR_{nM}) \div ASR_M \times \text{no. Prescriptions}_M$$

$$= \text{Prescriptions}_M \div ASR_M \times [ASR_{nM} \times (adjASRR_{M:nM} - 1)]$$

Where:

$$ASR_{nM} \times (adjRR_{M:nM} - 1) = (adjASR_M - ASR_{nM}), \text{ and}$$

$$adjASR_M = ASR_M \times adjASRR_{M:nM} \div ASRR_{M:nM}$$

Access vs. Persistence

It is hypothesised that the shortfall/excess in script count can be attributed to *access* and *persistence*.

In the context of this analysis:

- *'Access* related to differential dispensing to Māori of first prescriptions (index scripts). It was expressed as the variation in numbers of Māori (less or more patients) accessing medicines compared with access in non-Māori after adjusting for population size, age structure and disease burden. We expressed access as the rate ratio of DALY-adjusted ASRs for 12-month patient period-prevalence ($adjASRRa_{M:nM} = adjASRa_{M} \div adjASRa_{nM}$); (Metcalfe et al., 2013)
- *'Persistence* was the subsequent residual variation in overall numbers of scripts dispensed due to variations in subsequent scripts per index patient, i.e. the individualised frequency of subsequent scripts dispensed to those Māori who had an initial script, expressed as: $Persistence_{M:nM} = Scripts/Patient_{Māori} \div Scripts/Patient_{non\text{-}Māori.}$ (Metcalfe et al., 2013)

Total scripts (prescription items dispensed) were therefore the product of access (number of patients) and persistence (scripts/patient).(Metcalfe et al., 2013). The detailed procedure for estimating differences in access to and persistence with prescribed medicines between Māori and non- Māori can be found in Box 2.

Box 2. Method of calculation: 'access' and 'persistence', adopted from Metcalfe et al.(Metcalfe et al., 2013)

Given numbers of prescriptions, patients, and ASRRs, we calculated persistence rates as follows:

Shortfall/excess numbers of prescriptions due to access differences (differences in index patients) were calculated similar to shortfall/excess numbers of prescriptions, using the following steps:

1. for each indication-based pharmaceutical group, age-standardised incidence rates of index patients dispensed a prescription at any time (counts of patients who were dispensed a prescription item during the year, per 1000 population) for Māori and non-Māori; notation ASRaM, ASRanM, as the unadjusted age-standardised patients-dispensed rates for Māori and non-Māori. This is the same as age-standardised rates of first prescriptions dispensed;

2. then using (1) unadjusted age-standardised patients-dispensed rates to calculate unadjusted age-standardised patients-dispensed RRs for Māori vs. non-Māori, as

   ASRRaM:nM = ASRaM ÷ ASRanM

3. then using (2) unadjusted age-standardised patients-dispensed RRs (ASRRaM:nM) and the earlier age-standardised RRs for DALY losses (DALYL ASRRM:nM) to calculate DALYL-adjusted age-standardised patients -dispensed rates (patients-dispensed adjASRRM:nM), as:

   patients-dispensed adjASRRM:nM

   = (unadjusted) patients-dispensed ASRRM:nM ÷ DALYL ASRRM:nM

4. Then using (3) disease burden-adjusted patients-dispensed ASRRs, (1) unadjusted age standardised patients-dispensed rates, and counts of patients, shortfalls/excesses in index patients was calculated:

   shortfall/excess patientsM = (patient adjASRM – patient ASRnM) ÷ patient ASRM × no. patientsM

   = no. patientsM ÷ patient ASRM × [patient ASRnM × (patients adjASRRM:nM – 1)]

   This is also the shortfall/excess numbers of prescriptions due to access differences (differences in index patients).

Further differences in overall prescriptions due to shortfalls/excesses in subsequent scripts per index patient (persistence) were calculated as the remaining differences in prescriptions, after accounting for shortfalls/excesses in prescriptions due to access differences (differences in index patients), for ease of calculation subtracting as follows:

shortfall/excess in subsequent scripts per index patient (persistence)

= overall shortfall/excess prescriptions dispensed – shortfall/excess $patients_M$

Procedures for calculating change in gap in disparities over time

To make valid comparisons of change in gap in disparities between the two time periods (2006/07 Vs 2012/13), this part of analysis only included those medicines subsidised at 2006/07 and remaining to be subsidised in 2012/13.

(i) **Change in gaps in age-standardised script rates (ASR)**

For the cohort of medicines available in 2006/2007 and remaining to be available in 2012/2013, for each indication-based pharmaceutical group, we calculated age standardised script rates for each time period (i.e. incidences of scripts or prescription items dispensed to each ethnic groups). The age-standardised script rates were then used to calculate changes in absolute (simple difference) and relative (percent difference) disparities over time, using Keppel et al methodology (Keppel et al., 2005) (see Box 3).

(ii) **Change in gaps in age-DALY adjusted overall script count, Access and Persistence**

For the cohort of medicines available in 2006/2007 and remaining to be available in 2012/2013, for each time point we calculated age-DALY-adjusted rate ratios for scripts, access (index patients) and persistence (subsequent scripts per index patient), using the formula described in Box 1 and 2. Then, the age-DALY adjusted rate ratios for overall scripts, access and persistence for 2006/07 were divided by the respective age-Daly adjusted ratio ratios for 2012/13. This provides ratio of age-DALY-adjusted rate ratios for overall scripts, access and persistence. Ratio of rate ratios less than 1 indicates that the disease burden-adjusted inequalities in total script counts, access or persistence between Māori and non-Māori has been widened over time. Whereas ratio of rate ratios greater than 1 indicates a reduction in the gap over time.

Overall script count

Ratio of Age-DALY-Adjusted script rate ratio Māori:non-Māori

= [age-DALY-adjusted script rate ratio Māori:non-Māori in 2006/07] ÷ [age-DALY-adjusted script rate ratio Māori:non-Māori in 2012/13]

Access

Ratio of age-DALY-Adjusted access rate ratio Māori:non-Māori

= [age-DALY-adjusted patients rate ratio Māori:non-Māori in 2006/07] ÷ [age-DALY-adjusted patients rate ratio Māori:non-Māori in 2012/13]

Persistence

Ratio of age-DALY-Adjusted persistence rate ratio Māori:non-Māori

= [age-DALY-adjusted persistence rate ratio Māori:non-Māori in 2006/07] ÷ [age-DALY-adjusted persistence rate ratio Māori:non-Māori in 2012/13]

Box 3: Method of calculation: Changes in the gap in disparities over time, for age standardised script rate, adopted from Keppel et al.(Keppel et al., 2005).

Ethnic group	2006/07		2012/13		Change [2012/13 – 2006/07][1]
	Age std. script rate (ASR)	**Simple difference**	**Age std. script rate (ASR)**	**Simple difference**	
NZEO	$ASR_{NZEO06/07}$	Reference	$ASR_{NZEO12/13}$	Reference	Reference
Māori	$ASR_{M06/07}$	$ASR_{M06/07} - ASR_{NZEO06/07}$	$ASR_{M12/13}$	$ASR_{M12/13} - ASR_{NZEO12/13}$	$[ASR_{M12/13} - ASR_{NZEO12/13}] - [ASR_{M06/07} - ASR_{NZEO06/07}]$
Asian	$ASR_{A06/07}$	$ASR_{A06/07} - ASR_{NZEO06/07}$	$ASR_{A12/13}$	$ASR_{A12/13} - ASR_{NZEO12/13}$	$[ASR_{A12/13} - ASR_{NZEO12/13}] - [ASR_{A06/07} - ASR_{NZEO06/07}]$
Pacific	$ASR_{P06/07}$	$ASR_{P06/07} - ASR_{NZEO06/07}$	$ASR_{P12/13}$	$ASR_{P12/13} - ASR_{NZEO12/13}$	$[ASR_{P12/13} - ASR_{NZEO12/13}] - [ASR_{P06/07} - ASR_{NZEO06/07}]$
		Percent difference		**Percent difference**	**Change [2012/13 – 2006/07][2]**
NZEO	$ASR_{NZEO06/07}$	Reference	$ASR_{NZEO12/13}$	Reference	Reference
Māori	$ASR_{M06/07}$	$\frac{ASR_{M06/07} - ASR_{NZEO06/07}}{ASR_{NZEO06/07}} * 100\%$	$ASR_{M12/13}$	$\frac{ASR_{M12/13} - ASR_{NZEO12/13}}{ASR_{NZEO12/13}} * 100\%$	$\frac{ASR_{M12/13} - ASR_{NZEO12/13}}{ASR_{NZEO12/13}} * 100\% - \frac{ASR_{M06/07} - ASR_{NZEO06/07}}{ASR_{NZEO06/07}} * 100\%$
Asian	$ASR_{A06/07}$	$\frac{ASR_{A06/07} - ASR_{NZEO06/07}}{ASR_{NZEO06/07}} * 100\%$	$ASR_{A12/13}$	$\frac{ASR_{A12/13} - ASR_{NZEO12/13}}{ASR_{NZEO12/13}} * 100\%$	$\frac{ASR_{A12/13} - ASR_{NZEO12/13}}{ASR_{NZEO12/13}} * 100\% - \frac{ASR_{A06/07} - ASR_{NZEO06/07}}{ASR_{NZEO06/07}} * 100\%$
Pacific	$ASR_{P06/07}$	$\frac{ASR_{P06/07} - ASR_{NZEO06/07}}{ASR_{NZEO06/07}} * 100\%$	$ASR_{P12/13}$	$\frac{ASR_{P12/13} - ASR_{NZEO12/13}}{ASR_{NZEO12/13}} * 100\%$	$\frac{ASR_{P12/13} - ASR_{NZEO12/13}}{ASR_{NZEO12/13}} * 100\% - \frac{ASR_{P06/07} - ASR_{NZEO06/07}}{ASR_{NZEO06/07}} * 100\%$

[1]Age standardised script rates per 1,000 population (i.e. absolute change in disparity over time)
[2]Change in percentage difference over time (i.e. relative change in disparity over time)

6 RESULTS

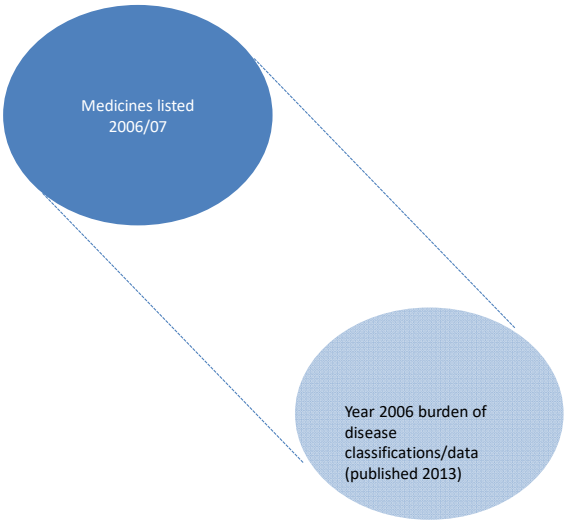
6.1 Description of cohorts

The analyses comprise three cohorts of medicines and people:

1. those people alive on 30 June 2007 for whom one or more subsidised medicine was dispensed between 1 July 2006 and 30 June 2007, and a claim for subsidy made, and
2. those people alive on 30 June 2013 for whom one or more subsidised medicine was dispensed between 1 July 2012 and 30 June 2013, and a claim for subsidy made.
3. those people in 1 or 2 above (alive at the end of those two time periods), but restricting subsidised medicines to the cohort of existing medicines subsidised between 1 July 2006 and 30 June 2007 but which continued to be subsidised at 30 June 2013.

These cohorts and their interconnections (including with burden of disease information) are depicted in the following schematics.

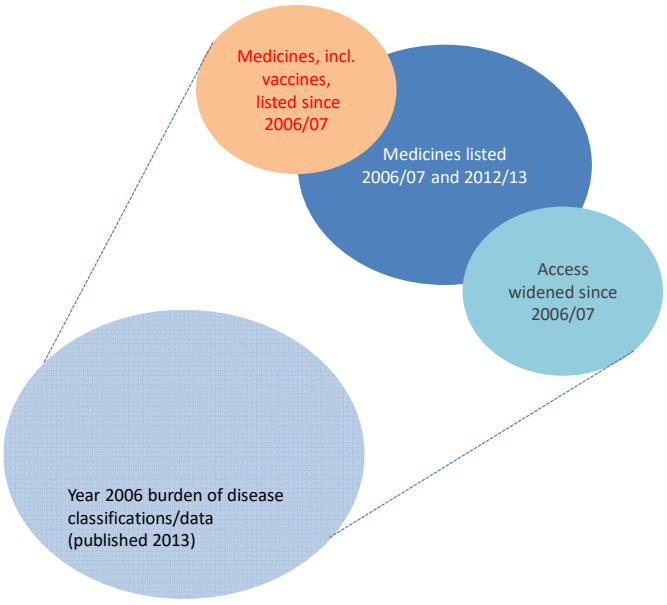
Cohort 1

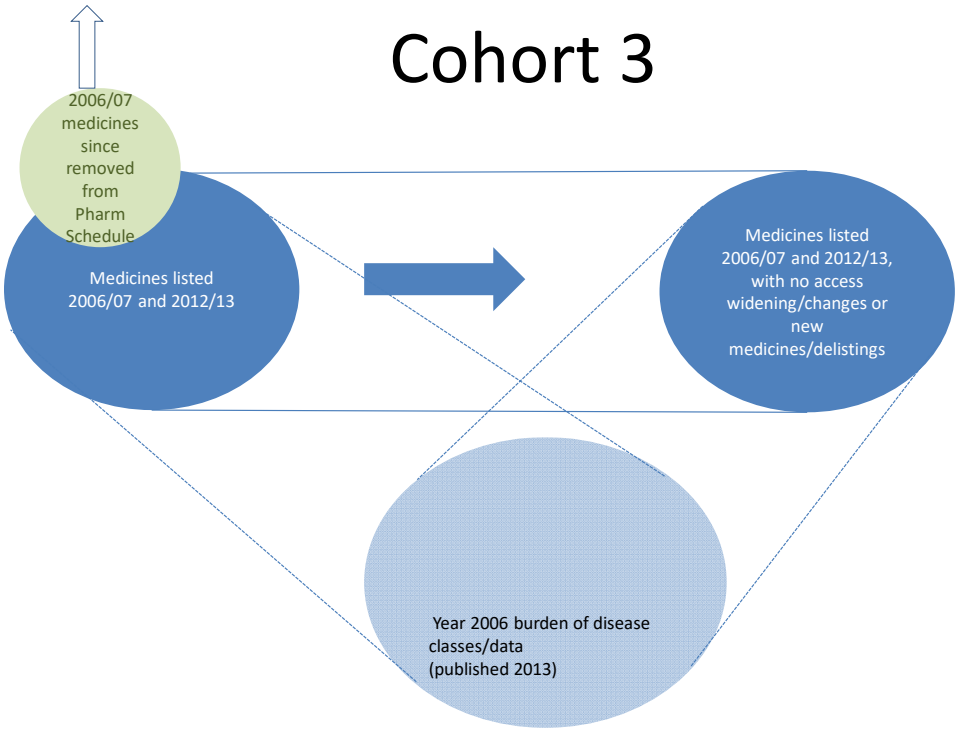


Cohort 2 = Rx listed in 2012/13

3 subsets:

1. Listed continuously (both 2006/07 and 2012/13) = Cohort 3
2. Listed 2006/07 but removed before 2012/13
3. New since 2006/07




Cohort 3
2006/07 medicines since removed from Pharm Schedule
Medicines listed 2006/07 and 2012/13
Medicines listed 2006/07 and 2012/13, with no access widening/changes or new medicines/delistings
Year 2006 burden of disease classes/data (published 2013)

Note the first cohort, i.e., medicines subsidised between 1 July 2006 and 30 June 2007 for people still alive at the end of that time period, differed from the Metcalfe et al preliminary analysis by confining patients to those who did not die during that time. The second cohort (medicines subsidised between 1 July 2012 and 30 June 2013 for people still alive at the end of that time period) was a new time period of analysis. The third cohort was to permit valid comparison between the two years, by confining to relevant medicines (thus avoiding changes in the mix of subsidised medicines between the years as source of a bias).

Excluding patients who die (in all cohorts) permits better valid estimates of patient persistence, preventing the underestimation of persistence that occurs when deaths mid-year are included.

6.1.1 Population

The denominator population used to calculate prescribing rates was taken from Statistics New Zealand Census reports and projections.

The total population for the period ending 2007 was 4,223,800 comprising 249,468 (5.9%) Asian, 558,566 (13.2%) Māori, 257,870 (6.1%) Pacific peoples and the remainder being 3,157,896 (74.8%) NZEO, including New Zealand European, Middle Eastern, Latin American or African (MELAA) ethnicity.

The total population for the period ending 2013 was 4,442,080 comprising 371,247 (8.4%) Asian, 618,745 (13.9%) Māori, 310,464 (7.0%) Pacific peoples and the remainder being 3,141,624 (70.7%) NZEO.

For all comparisons NZEO is taken to be the base case, being the numerically dominant ethnicity in the population.

It is important to note the different population-age structures of the different ethnicities. Māori and Pacific groups have a much younger age distribution with approximately half of their respective populations under the age of 25 and a further third between 25 and 50 years of age. In contrast, the Asian population is slightly older and the NZEO population is older again. This difference is of significance in the

age-standardisation process since age-standardisation was undertaken using the WHO population (in line with the NZBD study methodology) which more closely matches the NZEO age distribution. Figure 2, Figure 3 and Figure 4 in the annexe (see page 60) illustrate the population age structures of the study cohort from 2006/7 and 2012/13, and the WHO standard population, respectively.

6.2 Analysis of intermediary measures

The results of the intermediary measures, unadjusted for disease burden are described in detail in the Annexe starting on page 60 (See *ANNEXE: FINDINGS UNADJUSTED FOR DISEASE BURDEN)*. These measures include:

- Script (prescription items) counts, including by ethnicity
- Crude script rates by ethnicity
    - Observed variation 2006/2007
    - Observed variation 2012/2013
- Age standardised script rates by ethnicity
    - Observed variation 2006/2007
    - Observed variation 2012/2013
- Comparison of age-standardised script rates between 2006/7 and 2012/2013, for those medicines subsidised at 2006/07 and remaining to be subsidised at 30 June 2013
- Longitudinal analysis of the changes in the gaps of age standardised script rates between 2006/07 and 2012/13, for those medicines subsidised at 2006/07 and remaining to be subsidised at 30 June 2013

6.3 Measurement of Disease Burden in Māori and non-Māori from the New Zealand Burden of Disease Study

Table 1 and Table 2 summarise the count of DALYs lost attributed to the cohorts based on the age standardised population estimates from the New Zealand Burden of Disease study.

Table 1 shows the attribution of DALYs at the NZBD condition group level. This is further expanded in Table 2 to the disease condition level. DALY loss estimates based on direct age-standardised rates for 2006 and 2012 were used (with the WHO standard reference population).

Long-term conditions (chronic physical and mental disorders) accounted for 88% of DALYs lost. We were able to link approximately 75% of DALYs to conditions associated with medicines listed on the pharmaceutical schedule for each time period. This represents 715,933 of a total 957,363 DALYs lost in 2006/7, and 812,544 of a total 1,068,857 DALY losses in 2012/13.

As expected, the total DALY losses increased in line with population growth and ageing between the two time periods. It should be noted, however, that the DALY losses accrued by Māori grew 20.1% compared with 12.4% for non-Māori between 2006/7 and 2012/13. In 2006/7 Māori were attributed 99,036 DALYs lost, representing 13.8% of the total DALY loss count for all ethnic groups (Ministry of Health., 2001). In 2012/13 Māori were attributed 118,964 DALYs lost, representing 14.6% of all DALY losses (Ministry of Health., 2013a).

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Table 1: Total DALYs reported by NZBD study and relevance to pharmaceuticals in Māori and non-Māori

	2006/07						2012/13					
	DALY NZBD			DALY relevant to pharmaceuticals			DALY NZBD			DALY relevant to pharmaceuticals		
NZBD Condition Group	Māori	Non-Māori	Total	Māori	Non-Māori	Total	Māori	Non-Māori	Total	Māori	Non-Māori	Total
Cancers and other neoplasms	20,101.0	147,888.2	167,989.2	20,101.0	147,888.2	167,989.2	25,087.1	169,010.3	194,097.4	25,087.1	169,010.3	194,097.4
Diabetes and other endocrine disorders	7,202.0	31,517.4	38,719.4	7,199.2	31,477.6	38,676.7	9,099.9	35,958.7	45,058.5	9,096.6	35,913.6	45,010.2
Gastrointestinal disorders	1,931.9	23,875.3	25,807.2	1,619.4	20,977.6	22,597.0	2,380.3	26,775.6	29,155.8	1,982.6	23,436.8	25,419.4
Genitourinary disorders	2,326.4	17,873.1	20,199.5	1,840.1	12,335.4	14,175.6	2,875.0	20,455.7	23,330.6	2,270.9	14,208.6	16,479.5
Infant conditions and birth defects	11,885.4	38,132.0	50,017.4	3,632.2	14,195.8	17,828.1	12,871.0	38,570.7	51,441.6	3,953.5	14,372.0	18,325.5
Infections	4,668.9	17,314.3	21,983.2	3,181.7	12,328.7	15,510.4	5,292.2	18,727.7	24,019.9	3,610.2	13,480.6	17,090.7
Injury	17,886.6	58,085.5	75,972.1	1,647.2	8,596.1	10,243.3	19,528.1	60,054.8	79,582.9	1,762.1	8,786.8	10,548.9
Mental disorders	22,016.4	84,538.5	106,554.9	14,457.6	60,919.2	75,376.8	23,955.6	86,743.2	110,698.9	15,766.6	62,874.1	78,640.7
Musculoskeletal disorders	8,551.8	79,395.9	87,947.7	2,843.7	33,565.7	36,409.4	10,128.4	88,435.7	98,564.1	3,548.2	38,290.1	41,838.3
Neurological conditions	6,391.9	59,474.1	65,866.0	5,929.5	55,661.6	61,591.1	7,451.9	66,491.3	73,943.2	6,921.0	62,309.9	69,230.9
Oral disorders	1,431.6	7,279.2	8,710.8	1,385.2	7,060.0	8,445.1	1,651.6	8,127.0	9,778.7	1,597.1	7,873.2	9,470.3
Reproductive and gestational disorders	4,047.0	29,891.0	33,938.0	42.9	437.1	479.9	4,418.4	30,572.0	34,990.4	48.6	460.0	508.6
Respiratory disorders	8,910.4	51,526.8	60,437.3	8,164.9	47,711.9	55,876.9	10,881.6	58,065.1	68,946.7	9,969.5	53,676.5	63,646.0
Sense organ disorders	808.4	7,743.8	8,552.2	236.3	2,225.2	2,461.5	993.1	8,941.5	9,934.6	299.2	2,603.9	2,903.1
Skin disorders	2,891.7	14,592.9	17,484.5	2,832.5	13,599.2	16,431.7	3,188.0	15,248.1	18,436.0	3,110.9	14,073.7	17,184.6
Vascular and blood disorders	23,562.3	143,622.1	167,184.4	23,922.8	147,918.4	171,841.2	29,499.9	167,377.9	196,877.7	29,939.5	172,210.5	202,150.1
Total	**144,613.7**	**812,750.2**	**957,363.9**	**99,036.1**	**616,897.7**	**715,933.8**	**169,302.0**	**899,555.2**	**1,068,857.2**	**118,963.6**	**693,580.6**	**812,544.2**
Proportion of DALY linked to conditions relevant to pharmaceutical schedule medicines						**74.8%**						**76.0%**

NZEO = New Zealand Europeans/Others

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Table 2: DALY loses attributable to the subsidised pharmaceuticals (Māori and Non-Māori)

		2006/07						2012/13					
		DALY			ASR DALY		Rate Ratio	DALY			ASR DALY		Rate Ratio
NZBD Condition Group	NZBD Condition	Māori	Non-Māori	Total	Māori	Non-Māori	$DALY_{M:nM}$	Māori	Non-Māori	Total	Māori	Non-Māori	$DALY_{M:nM}$
Cancers and other neoplasms	Cancers	20,101.0	147,888.2	167,989.2	49.19	29.60	1.66	25,087.1	169,010.3	194,097.4	49.19	29.60	1.66
Diabetes and other endocrine disorders	Adrenocortical insufficiency	20.1	86.2	106.3	0.06	0.02	3.22	26.3	94.8	121.0	0.06	0.02	3.22
	Diabetes	6,378.2	22,270.0	28,648.3	16.32	4.40	3.71	8,089.1	25,531.3	33,620.4	16.32	4.40	3.71
	Hypothalamic-pituitary axis disorders	39.8	218.8	258.6	0.09	0.05	1.87	45.5	240.7	286.3	0.09	0.05	1.87
	Other endocrine disorders	567.2	6,372.9	6,940.1	1.38	1.39	1.00	704.2	7,169.9	7,874.1	1.38	1.39	1.00
	Thyroid disorders	193.7	2,529.7	2,723.5	0.46	0.51	0.90	231.4	2,876.9	3,108.3	0.46	0.51	0.90
Gastrointestinal disorders	Chronic liver disease	381.0	3,916.2	4,297.2	0.84	0.83	1.02	461.1	4,372.5	4,833.6	0.84	0.83	1.02
	Inflammatory bowel disease	46.7	2,653.2	2,699.9	0.11	0.64	0.16	54.7	2,812.7	2,867.3	0.11	0.64	0.16
	Irritable bowel syndrome	202.8	2,123.3	2,326.1	0.41	0.51	0.81	228.0	2,248.9	2,476.9	0.41	0.51	0.81
	Other gastrointestinal disorders	339.5	4,113.5	4,453.0	0.87	0.86	1.01	420.1	4,638.2	5,058.3	0.87	0.86	1.01
	Pancreatitis	106.8	577.4	684.3	0.24	0.12	2.11	124.3	657.8	782.1	0.24	0.12	2.11
	Upper GI disorder	542.6	7,594.0	8,136.6	1.42	1.51	0.94	694.4	8,706.7	9,401.1	1.42	1.51	0.94
Genitourinary disorders	BPH	176.6	2,611.7	2,788.3	0.51	0.49	1.03	234.9	3,037.6	3,272.5	0.51	0.49	1.03
	Chronic kidney disease	1,238.5	6,110.6	7,349.1	3.13	1.20	2.62	1,552.5	7,056.5	8,609.1	3.13	1.20	2.62
	Other genito-urinary disorders	118.4	897.4	1,015.8	0.22	0.16	1.31	116.5	1,049.6	1,166.2	0.22	0.16	1.31
	Urinary incontinence	306.7	2,715.7	3,022.3	0.72	0.56	1.29	366.9	3,064.9	3,431.7	0.72	0.56	1.29
Infant conditions and birth defects	Congenital malformations of the brain	80.9	402.9	483.9	0.14	0.12	1.12	84.4	412.3	496.8	0.14	0.12	1.12
	Other birth defects	888.3	4,896.8	5,785.1	1.39	1.61	0.86	983.0	4,913.0	5,896.0	1.39	1.61	0.86
	Pre-term birth complications	2,663.0	8,896.1	11,559.1	4.06	2.84	1.43	2,886.1	9,046.7	11,932.7	4.06	2.84	1.43
Infections	Cellulitis and other skin infections	106.4	481.2	587.6	0.24	0.09	2.51	130.0	559.3	689.3	0.24	0.09	2.51
	Gastrointestinal infections	852.3	3,580.6	4,432.9	1.47	1.02	1.44	934.3	3,700.4	4,634.6	1.47	1.02	1.44
	Hepatitis	426.2	734.8	1,161.0	0.91	0.17	5.44	505.5	796.5	1,302.0	0.91	0.17	5.44
	HIV/AIDS	88.2	804.6	892.8	0.17	0.21	0.82	96.1	821.0	917.1	0.17	0.21	0.82

	Lower respiratory tract infection	1,104.3	4,330.1	5,434.3	1.99	0.92	2.16	1,250.2	4,962.5	6,212.6	1.99	0.92	2.16
	Other Infections	154.5	568.8	723.2	0.29	0.13	2.14	169.8	623.6	793.4	0.29	0.13	2.14
	STI	30.7	118.7	149.4	0.05	0.03	1.56	33.4	121.4	154.8	0.05	0.03	1.56
	Tuberculosis	67.2	302.1	369.3	0.20	0.07	2.99	88.6	334.6	423.2	0.20	0.07	2.99
	Upper respiratory tract infections	151.0	373.6	524.7	0.24	0.11	2.19	164.3	381.4	545.6	0.24	0.11	2.19
	Urinary tract infections	102.0	757.8	859.8	0.28	0.14	2.04	128.7	894.6	1,023.2	0.28	0.14	2.04
	Varicella-zoster	99.2	276.4	375.6	0.16	0.08	1.95	109.4	285.5	394.9	0.16	0.08	1.95
Injury	Poisoning	1,647.2	8,596.1	10,243.3	2.97	2.27	1.31	1,762.1	8,786.8	10,548.9	2.97	2.27	1.31
Mental disorders	ADHD (child only)	264.5	1,284.2	1,548.6	0.40	0.45	0.89	291.3	1,286.2	1,577.4	0.40	0.45	0.89
	Anxiety and depressive disorders	7,368.4	43,946.8	51,315.2	13.93	11.44	1.22	8,080.0	45,423.1	53,503.1	13.93	11.44	1.22
	Bipolar Disorders	1,492.8	3,415.4	4,908.2	2.70	0.94	2.86	1,617.2	3,457.1	5,074.3	2.70	0.94	2.86
	Drug use disorders	2,105.7	3,226.8	5,332.6	3.78	0.90	4.18	2,282.0	3,237.4	5,519.4	3.78	0.90	4.18
	Schizophrenia and related psychotic disorders	3,226.2	9,046.0	12,272.2	6.15	2.27	2.71	3,496.2	9,470.2	12,966.4	6.15	2.27	2.71
Musculoskeletal disorders	Gout	625.0	3,039.3	3,664.3	1.56	0.61	2.55	779.9	3,459.9	4,239.8	1.56	0.61	2.55
	Osteoarthritis	1,360.4	19,581.4	20,941.8	3.55	3.78	0.94	1,731.0	22,587.9	24,318.9	3.55	3.78	0.94
	Other non-arthritis MSK conditions	102.5	1,271.9	1,374.4	0.19	0.30	0.63	115.1	1,396.6	1,511.7	0.19	0.30	0.63
	Rheumatoid arthritis	755.8	9,673.0	10,428.9	1.76	2.05	0.86	922.2	10,845.7	11,767.9	1.76	2.05	0.86
Neurological conditions	Dementia	640.1	16,486.8	17,126.8	2.21	2.78	0.79	874.5	19,817.5	20,691.9	2.21	2.78	0.79
	Epilepsy	1,183.6	5,240.9	6,424.5	2.24	1.34	1.67	1,306.4	5,568.2	6,874.6	2.24	1.34	1.67
	Migraine	1,573.5	11,646.1	13,219.6	3.00	2.97	1.01	1,746.2	12,267.7	14,013.8	3.00	2.97	1.01
	Multiple sclerosis	65.1	2,339.3	2,404.4	0.14	0.50	0.27	75.6	2,595.4	2,671.0	0.14	0.50	0.27
	Other neurological conditions	448.9	6,138.0	6,586.8	1.01	1.58	0.64	575.5	6,556.2	7,131.7	1.01	1.58	0.64
	Parkinson's disease	76.5	2,955.8	3,032.3	0.26	0.50	0.52	103.9	3,539.7	3,643.6	0.26	0.50	0.52
	Sleep disorders	1,941.9	10,854.7	12,796.6	3.95	2.46	1.60	2,239.0	11,965.2	14,204.2	3.95	2.46	1.60
Oral disorders	Dental caries	1,269.6	6,275.9	7,545.5	2.65	1.36	1.95	1,459.7	6,999.1	8,458.8	2.65	1.36	1.95
	Gingivitis and Periodontal disease	106.6	692.9	799.5	0.24	0.14	1.69	127.6	781.4	909.0	0.24	0.14	1.69
	Other dental disorders	9.0	91.1	100.1	0.01	0.03	0.53	9.9	92.7	102.6	0.01	0.03	0.53

Reproductive and gestational disorders	Maternal haemorrhage	2.3	9.3	11.6	0.00	0.00	1.44	2.4	9.0	11.4	0.00	0.00	1.44
	Other gynacological disorders	40.6	427.8	468.3	0.08	0.11	0.77	46.2	451.0	497.2	0.08	0.11	0.77
Respiratory disorders	Asthma	2,219.9	12,969.8	15,189.7	4.08	3.49	1.17	2,480.3	13,590.8	16,071.0	4.08	3.49	1.17
	Chronic obstructive pulmonary disease	4,942.6	30,461.4	35,404.0	13.20	5.74	2.30	6,291.7	35,478.0	41,769.7	13.20	5.74	2.30
	Cystic fibrosis	74.3	448.2	522.6	0.12	0.14	0.83	83.7	444.9	528.6	0.12	0.14	0.83
	Obstructive sleep apnoea syndrome	440.0	2,633.3	3,073.3	0.88	0.63	1.39	505.9	2,833.6	3,339.5	0.88	0.63	1.39
	Other respiratory conditions	488.1	1,199.2	1,687.3	1.03	0.26	3.92	607.9	1,329.3	1,937.2	1.03	0.26	3.92
Sense organ disorders	Cataract and other lens disorders	41.2	570.5	611.8	0.12	0.10	1.17	54.0	675.6	729.5	0.12	0.10	1.17
	Glaucoma	27.6	532.0	559.6	0.09	0.09	1.04	37.5	639.2	676.7	0.09	0.09	1.04
	Other hearing and vestibular disorders	34.0	153.1	187.0	0.06	0.04	1.35	37.8	161.7	199.5	0.06	0.04	1.35
	Other visual disorders	133.5	969.6	1,103.1	0.34	0.18	1.83	169.9	1,127.4	1,297.3	0.34	0.18	1.83
Skin disorders	Acne	173.8	972.2	1,146.0	0.29	0.31	0.93	188.8	962.1	1,150.9	0.29	0.31	0.93
	Eczema and dermatitis	1,932.3	7,553.9	9,486.1	3.23	2.25	1.44	2,103.2	7,718.9	9,822.1	3.23	2.25	1.44
	Other skin disorders	232.6	2,039.3	2,271.9	0.44	0.51	0.87	261.5	2,189.2	2,450.7	0.44	0.51	0.87
	Psoriasis	493.8	3,033.9	3,527.7	1.00	0.73	1.37	557.4	3,203.5	3,760.9	1.00	0.73	1.37
Vascular and blood disorders	Cardiovascular disorders	23,045.7	143,256.4	166,302.1	58.62	26.74	2.19	28,955.7	167,193.8	196,149.5	58.62	26.74	2.19
	Iron deficiency anaemia	406.1	1,568.3	1,974.4	0.67	0.45	1.48	443.9	1,593.4	2,037.2	0.67	0.45	1.48
	Other blood disorders	471.1	3,093.7	3,564.7	0.97	0.71	1.38	539.9	3,423.4	3,963.3	0.97	0.71	1.38
Total		**99,036.1**	**616,897.7**	**715,933.8**	**225.48**	**131.53**	**1.71**	**118,963.6**	**693,580.6**	**812,544.2**	**225.48**	**131.53**	**1.71**
Total DALY reported by NZBD study				**957,363.9**						**1,068,857.2**			
% DALY loss relevant to pharmaceuticals schedule/All DALY loss				**74.8%**						**76.0%**			
% DALY loss in Māori/DALY loss in all ethnic groups				**13.8%**						**14.6%**			

6.4 Variation in age- and disease burden-adjusted script rates between Māori and non-Māori

After adjusting both for age and disease burden there are clearly identifiable areas of potential shortfall in the dispensing of subsidised medicines in Māori compared with what would be expected if Māori received equal treatment with non-Māori, adjusting for disease burden, population size and age.

6.4.1 Observed variations in 2006/2007

See Annexe on page 60.

6.4.2 Observed variation 2012/2013

In the 2012/13 cohort 4,771,936 scripts were identified as dispensed to Māori, of which 4,592,646 (96.2%) were linked to NZBD study disease or condition groups. The overall gap, after adjusting for age and disease burden, is estimated to be 1,126,281 scripts. While the absolute shortfall has grown, this should be interpreted in light of a greater burden of disease estimate and a significant increase in the absolute number of scripts dispensed. It still represents a significant shortfall.

Figure 1 illustrates, at an aggregate disease level, the main areas of shortfall and excess. As can be seen, the majority of areas are seen as a shortfall.

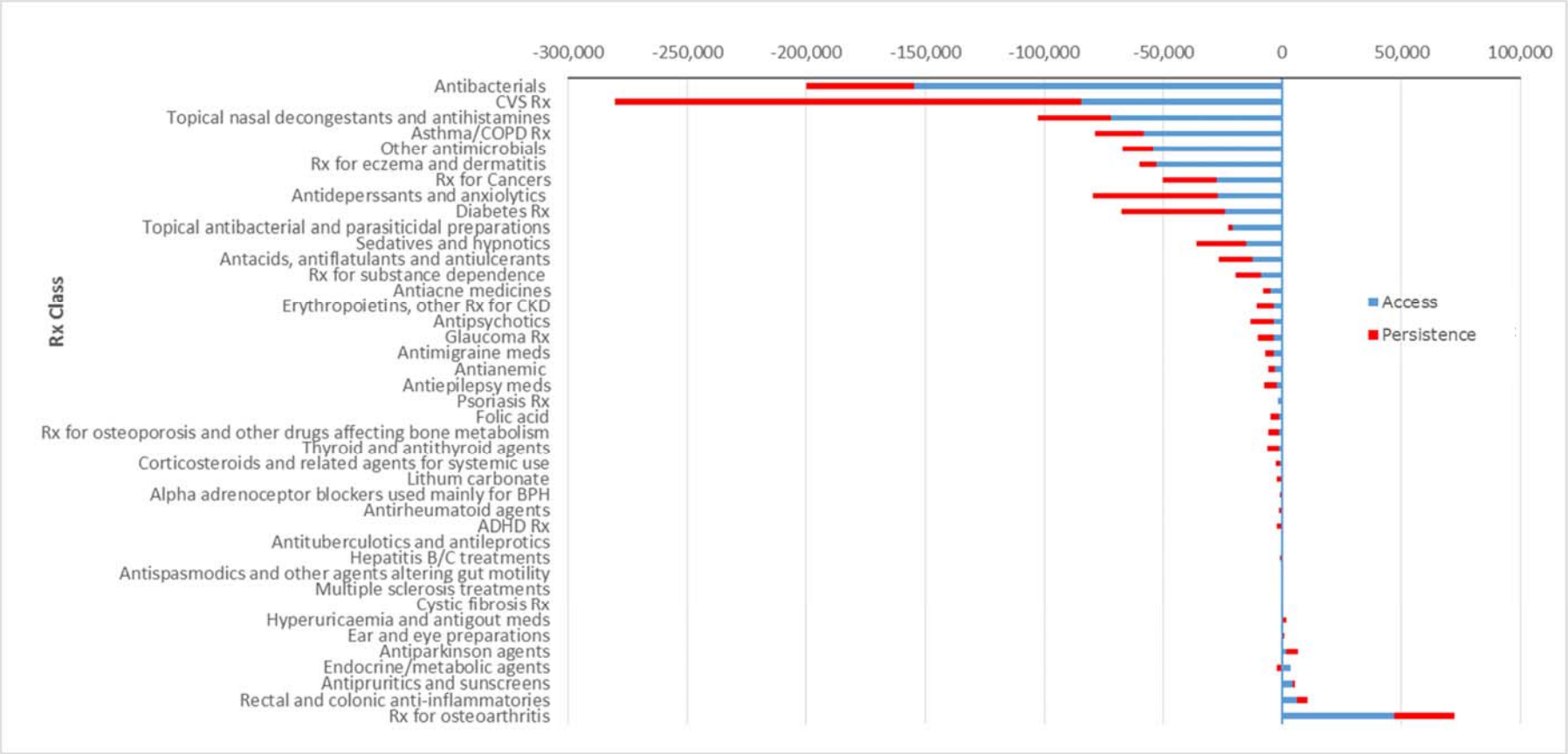
The areas of apparent under treatment are comparable to the 2006/7 analysis and broadly represent the focus areas identified in Te Whaioranga.(Pharmaceutical Management Agency., 27 May 2016)

Of the 1,126,281 scripts estimated to be ‘missing’ for Māori in 2012/13, i.e. funded pharmaceutical treatments that Māori did not receive, over half (608,807) were identified as lost opportunities for Māori to be able to access prescriptions, that is, to be dispensed a first prescription for that item in the calendar year. The remaining 46% (517,474) were identified as Māori missing out on receiving a second or subsequent dispensing (‘persistence’), compared with what would be expected for non-Māori patients dispensed the same medicine. This represents a significant change from 2006/7, where lower persistence was the leading reason for under supply.

The largest gaps in terms of access were for antibiotics, with significantly better uptake of cardiovascular medicines and respiratory medicines, although a shortfall was still evident. Disappointingly, even though overall persistence was improved, and access to cardiovascular medicines appears greater, there remains a significant emphasis on cardiovascular medicines in those most likely to demonstrate a persistence deficit. The largest gaps in terms of persistence were again for cardiovascular medicines including aspirin, cholesterol lowering agents and ACE- inhibitors (see Appendix G and H for details).

Figure 1: Numerical differences in script counts for Māori compared with non-Māori, adjusted for age and historical disease burden, disaggregated by access (i.e. index patient) and persistence 2012/13

Shortfalls (-) or excess (+) in Rx uptake by Māori, adjusted for age and relative disease burden (DALY loss)



6.4.3 Comparison of observed variation in script rates between 2006/7 and 2012/2013, for medicines continuously funded between July 2006 and June 2013, adjusting for age, population size and disease burden

To make valid comparisons between the two time periods, newly funded medicines and defunded medicines were excluded from this part of analysis.

Table 3 and Table 4 summarise, at the broadest therapeutic group level, of the difference in script counts, access and persistence between Māori and non-Māori for each time period, adjusted for age and disease burden.

Table 5 and Appendix I summarise the change in the ratio of age and DALY adjusted script rates between Māori and non-Māori. This ratio of ratios must be viewed in the context of the underlying difference between age and DALY adjusted script counts in the base year (2006/7). Where there was a lower rate of dispensing for Māori and the ratio of ratios is greater than 1, this can be interpreted as a reduction in the gap, for example there appears to have been a small narrowing in the gap for Oncology Agents and Immunosuppressants. However, in the contrary situation where Māori appeared to have higher age and DALY adjusted rates of dispensing, a ratio less than 1 represents a lower dispensing rate but also a narrowing of the excess dispensing for Māori, this can be seen for medicines used for the treatment of musculoskeletal disorders (including but not limited to gout).

While the concept of deficit/excess is a useful way of conceptualising 'missing' scripts for Māori, one cannot make direct comparisons of this measure between time periods. The deficit/excess measure is an estimate of the absolute number of scripts missing and therefore is a function of the total number of prescription items dispensed in each time period (30.5 million in 2006/7 versus 41.3 million in 2012/13). A better measure of changes in disparity between time periods is the ratio of age-DALY-adjusted rate ratios, for the cohort of medicines available in 2006/2007 remaining available for government subsidy in 2012/2013. These can be found in Table 5, Table 6 and Appendix I. Using this measure, the overall disease burden-adjusted inequalities in medicine dispensings between Māori and non-Māori widened by 6% (0.94 ratio of rate ratios, comparing Māori vs. non-Māori age-standardised rate ratio overall in 2012/2013 (0.59) against that in 2006/2007 (0.63)).

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Table 3: Numerical differences in script counts, access and persistence for Māori compared with non-Māori, adjusted for age and historical disease burden, excluding newly funded and defunded medicines, 2006/07

			Age-DALY-adjusted rate ratio Māori:non-Māori			Age-DALY adjusted shortfall/excess Māori		
TG1	**Total Scripts**	**Total Patient**	**Scripts**	**Access**	**Persistence**	**Scripts**	**Access**	**Persistence**
Alimentary Tract and Metabolism	4,263,908	1,631,456	0.40	0.42	0.52	-95,438.92	-23,748.65	-71,690.27
Blood and Blood Forming Organs	1,564,160	502,269	0.57	0.60	0.68	-33,342.79	-8,070.79	-25,272.01
Cardiovascular System	6,109,627	1,704,964	0.56	0.59	0.40	-168,510.86	-45,802.03	-122,708.83
Dermatologicals	1,985,882	1,518,130	0.85	0.84	0.62	-46,376.76	-39,352.25	-7,024.51
Extemporaneously Compounded Preparations and Galenicals	69,342	41,762	0.58	0.57	1.42	-540.69	-203.60	-337.09
Genito-Urinary System	826,458	522,545	0.50	0.55	1.04	-6,946.14	-4,013.15	-2,933.00
Hormone Preparations - Systemic Excluding Contraceptive Hormones	1,077,816	433,367	1.00	1.09	0.63	-4,767.35	1,530.84	-6,298.19
Infections - Agents for Systemic Use	3,474,597	2,519,134	0.74	0.72	0.49	-111,954.11	-86,595.26	-25,358.85
Musculoskeletal System	1,490,832	796,762	1.49	1.44	0.93	41,678.42	28,334.54	13,343.88
Nervous System	5,648,789	2,183,603	0.66	0.72	0.56	-59,987.09	10,326.10	-70,313.19
Oncology Agents and Immunosuppressants	159,453	42,609	0.61	0.60	0.57	-5,876.24	-1,615.31	-4,260.93
Respiratory System and Allergies	2,486,508	1,358,985	0.75	0.68	0.37	-90,552.17	-68,070.96	-22,481.21
Sensory Organs	742,964	506,312	0.65	0.72	0.62	-26,468.74	-16,977.74	-9,491.00
Special Foods	59,972	24,297	0.48	0.48	1.12	-692.59	-249.07	-443.52
Unknown	100,390	64,997						
Total	**30,060,699**	**13,851,194**	**0.63**	**0.65**	**0.57**	**-609,776.03**	**-254,507.33**	**-355,268.70**

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Table 4: Numerical differences in script counts, access and persistence for Māori compared with non-Māori, adjusted for age and historical disease burden, excluding newly funded and defunded medicines, 2012/13

			Age-DALY-adjusted rate ratio Māori:non-Māori			Age-DALY adjusted shortfall/excess Māori		
TG1	**Total Scripts**	**Total Patient**	**Scripts**	**Access**	**Persistence**	**Scripts**	**Access**	**Persistence**
Alimentary Tract and Metabolism	5,575,371	2,392,434	0.41	0.40	0.57	-124,240.44	-53,770.54	-70,469.90
Blood and Blood Forming Organs	2,116,550	704,557	0.56	0.54	0.84	-52,567.17	-14,905.11	-37,662.06
Cardiovascular System	7,542,264	2,147,147	0.58	0.59	0.43	-220,531.38	-63,386.49	-157,144.89
Dermatologicals	2,738,649	2,116,849	0.79	0.77	0.59	-95,688.78	-83,824.98	-11,863.80
Extemporaneously Compounded Preparations and Galenicals	73,711	46,013	0.66	0.54	1.31	-148.48	-53.40	-95.09
Genito-Urinary System	910,440	582,193	0.43	0.48	1.03	-14,692.60	-10,377.01	-4,315.59
Hormone Preparations - Systemic Excluding Contraceptive Hormones	1,336,952	575,933	0.97	0.99	0.67	-16,646.79	-7,172.06	-9,474.73
Infections - Agents for Systemic Use	4,519,927	3,340,563	0.63	0.62	0.45	-222,809.09	-171,740.09	-51,069.00
Musculoskeletal System	2,316,657	1,387,524	1.23	1.14	0.89	22,102.58	13,884.18	8,218.40
Nervous System	7,633,429	3,355,397	0.64	0.64	0.59	-125,446.63	-37,675.13	-87,771.50
Oncology Agents and Immunosuppressants	303,864	70,763	0.63	0.60	0.57	-11,212.75	-2,891.47	-8,321.28
Respiratory System and Allergies	2,950,820	1,623,532	0.68	0.61	0.39	-145,522.56	-106,256.39	-39,266.18
Sensory Organs	953,952	646,292	0.55	0.61	0.66	-48,371.01	-32,674.97	-15,696.04
Special Foods	71,858	29,796	0.45	0.48	1.02	-1,185.10	-396.24	-788.86
Various	517,675	428,983						
Unknown	126,805	80,596						
Total	**39,688,924**	**19,528,573**	**0.59**	**0.58**	**0.59**	**-1,056,960.19**	**-571,239.68**	**-485,720.51**

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Table 5: Changes in age-DALY-adjusted rate ratio, excluding newly funded and defunded medicines: 2006/7 (base year) and 2012/13

	2006/07 (base year)			2012/13			Change from 2006/07 to 2012/13		
	Age-DALY-adjusted rate ratio Māori:non-Māori			Age-DALY-adjusted rate ratio Māori:non-Māori			Ratio of Age-DALY-Adjusted Rate Ratio Māori:non-Māori		
TG1	**Scripts**	**Access**	**Persistence**	**Scripts**	**Access**	**Persistence**	**Scripts**	**Access**	**Persistence**
Alimentary Tract and Metabolism	0.40	0.42	0.52	0.41	0.40	0.57	1.03	0.94	1.09
Blood and Blood Forming Organs	0.57	0.60	0.68	0.56	0.54	0.84	0.97	0.89	1.25
Cardiovascular System	0.56	0.59	0.40	0.58	0.59	0.43	1.02	0.99	1.08
Dermatologicals	0.85	0.84	0.62	0.79	0.77	0.59	0.93	0.91	0.96
Extemporaneously Compounded Preparations and Galenicals	0.58	0.57	1.42	0.66	0.54	1.31	1.15	0.94	0.92
Genito-Urinary System	0.50	0.55	1.04	0.43	0.48	1.03	0.87	0.88	0.99
Hormone Preparations - Systemic Excluding Contraceptive Hormones	1.00	1.09	0.63	0.97	0.99	0.67	0.97	0.91	1.07
Infections - Agents for Systemic Use	0.74	0.72	0.49	0.63	0.62	0.45	0.85	0.85	0.91
Musculoskeletal System	1.49	1.44	0.93	1.23	1.14	0.89	0.83	0.79	0.96
Nervous System	0.66	0.72	0.56	0.64	0.64	0.59	0.97	0.88	1.05
Oncology Agents and Immunosuppressants	0.61	0.60	0.57	0.63	0.60	0.57	1.05	0.99	1.01
Respiratory System and Allergies	0.75	0.68	0.37	0.68	0.61	0.39	0.91	0.90	1.07
Sensory Organs	0.65	0.72	0.62	0.55	0.61	0.66	0.85	0.84	1.05
Special Foods	0.48	0.48	1.12	0.45	0.48	1.02	0.93	0.99	0.91
Total	**0.63**	**0.65**	**0.57**	**0.59**	**0.58**	**0.59**	**0.94**	**0.89**	**1.02**

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Table 6: Changes in simple difference and the percentage difference between age-DALY adjusted shortfall/excess in Māori compared with NZEO: 2006/7 (base year) and 2012/13

	2006/07 (base year)			2012/13			Change from 2006/07 to 2012/13					
	Age-DALY adjusted shortfall/excess Māori			Age-DALY adjusted shortfall/excess Māori			Difference in shortfall/excess Māori			Change in % Difference		
TG1	**Scripts**	**Access**	**Persistence**	**Scripts**	**Access**	**Persistence**	**Scripts**	**Access**	**Persistence**	**Scripts**	**Access**	**Persistence**
Alimentary Tract and Metabolism	-95,438.9	-23,748.6	-71,690.3	-124,240.4	-53,770.5	-70,469.9	-28,801.5	-30,021.9	1,220.4	30%	126%	-2%
Blood and Blood Forming Organs	-33,342.8	-8,070.8	-25,272.0	-52,567.2	-14,905.1	-37,662.1	-19,224.4	-6,834.3	-12,390.1	58%	85%	49%
Cardiovascular System	-168,510.9	-45,802.0	-122,708.8	-220,531.4	-63,386.5	-157,144.9	-52,020.5	-17,584.5	-34,436.1	31%	38%	28%
Dermatologicals	-46,376.8	-39,352.3	-7,024.5	-95,688.8	-83,825.0	-11,863.8	-49,312.0	-44,472.7	-4,839.3	106%	113%	69%
Extemporaneously Compounded Preparations and Galenicals	-540.7	-203.6	-337.1	-148.5	-53.4	-95.1	392.2	150.2	242.0	-73%	-74%	-72%
Genito-Urinary System	-6,946.1	-4,013.1	-2,933.0	-14,692.6	-10,377.0	-4,315.6	-7,746.5	-6,363.9	-1,382.6	112%	159%	47%
Hormone Preparations - Systemic Excluding Contraceptive Hormones	-4,767.3	1,530.8	-6,298.2	-16,646.8	-7,172.1	-9,474.7	-11,879.4	-8,702.9	-3,176.5	249%	-569%	50%
Infections - Agents for Systemic Use	-111,954.1	-86,595.3	-25,358.9	-222,809.1	-171,740.1	-51,069.0	-110,855.0	-85,144.8	-25,710.2	99%	98%	101%
Musculoskeletal System	41,678.4	28,334.5	13,343.9	22,102.6	13,884.2	8,218.4	-19,575.8	-14,450.4	-5,125.5	-47%	-51%	-38%
Nervous System	-59,987.1	10,326.1	-70,313.2	-125,446.6	-37,675.1	-87,771.5	-65,459.5	-48,001.2	-17,458.3	109%	-465%	25%
Oncology Agents and Immunosuppressants	-5,876.2	-1,615.3	-4,260.9	-11,212.8	-2,891.5	-8,321.3	-5,336.5	-1,276.2	-4,060.3	91%	79%	95%
Respiratory System and Allergies	-90,552.2	-68,071.0	-22,481.2	-145,522.6	-106,256.4	-39,266.2	-54,970.4	-38,185.4	-16,785.0	61%	56%	75%
Sensory Organs	-26,468.7	-16,977.7	-9,491.0	-48,371.0	-32,675.0	-15,696.0	-21,902.3	-15,697.2	-6,205.0	83%	92%	65%
Special Foods	-692.6	-249.1	-443.5	-1,185.1	-396.2	-788.9	-492.5	-147.2	-345.3	71%	59%	78%
Total	**-609,776.0**	**-254,507.3**	**-355,268.7**	**-1,056,960.2**	**-571,239.7**	**-485,720.5**	**-447,184.2**	**-316,732.4**	**-130,451.8**	**73%**	**124%**	**37%**

6.4.4 Observed variation in new medicines funded after 2006/07 (until 2012/13)

Table 7 shows the count of scripts in 2012/13 for those medicines that were approved for and achieved subsidy between 2007 and 2012. This represents the "new" medicines not included in the analysis described above.

As can be seen from this high-level summary, that when adjusted for age and historical disease burden there appears to be a substantial shortfall for Māori in access to and use of these newer agents, across all therapeutics groups. Caution should be exercised when drawing conclusions from this data however as the analysis represents relatively small numbers of patients, Māori and non-Māori, for some medicines and disease groupings.

Of particular note is the inequality in scripts for conditions known to have a higher prevalence in Māori such as respiratory disease, and nervous system disorders (including mental health conditions). This may represent unwarranted variation, that is to say, an inequity; however, taken out of the context of other available treatments for these conditions no firm conclusions may be drawn. More detailed level analysis of the script rate ratios, adjusted for age and historical disease burden, at an individual medicine level provides some evidence of good access to more commonly prescribed medicines (see Appendix J). By way of example, dabigatran (a new oral anticoagulant), first funded in July 2012, was dispensed to 16,380 patients in the period 2012/13 with equivalent script count and access between Māori and non-Māori. Similarly, benzbromarone (an agent used in the prophylaxis of gout) was dispensed to Māori and non-Māori at an equivalent rate once adjusted for disease burden. In contrast, escitalopram and sertraline (two newer SSRI antidepressants) were dispensed to Māori at approximately half the rate they were to non- Māori, representing an inequality in both access and persistence in Māori.

These data warrant further investigation, perhaps through pharmacoepidemiological research incorporating clinical event data.

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Table 7: Numerical differences in script counts, access and persistence for Māori compared with non-Māori, adjusted for age and historical disease burden, for medicines receiving funding approval between 2006/07 and 2012/13

			Age-DALY-adjusted rate ratio Māori:non-Māori			Age-DALY adjusted shortfall/excess Māori		
TG1	**Total Script**	**Total Patient**	**Script**	**Access**	**Persistence**	**Script**	**Access**	**Persistence**
Alimentary Tract and Metabolism	205,978	117,042	0.31	0.33	0.27	-6,790.87	-2,206.01	-4,584.87
Blood and Blood Forming Organs	70,479	25,451	0.93	0.85	0.52	-604.95	-360.21	-244.74
Cardiovascular System	17,989	7,155	0.53	0.52	0.44	-658.93	-273.87	-385.06
Dermatologicals	79,395	56,506	0.42	0.44	0.64	-6,248.19	-4,326.43	-1,921.76
Extemporaneously Compounded Preparations and Galenicals	5,021	2,156				0.00	0.00	0.00
Genito-Urinary System	66,442	23,656	0.53	0.50	1.17	-1,859.35	-643.00	-1,216.35
Hormone Preparations - Systemic Excluding Contraceptive Hormones	93,874	23,937	0.62	0.64	0.67	-2,772.93	-671.90	-2,101.03
Infections - Agents for Systemic Use	7,621	2,801	0.97	0.88	0.27	-119.27	-32.64	-86.63
Musculoskeletal System	8,427	7,734	0.25	0.24	0.57	-314.02	-315.03	1.00
Nervous System	736,218	348,128	0.73	0.75	0.53	-26,128.89	-12,947.30	-13,181.59
Oncology Agents and Immunosuppressants	14,287	2,766	0.57	0.64	0.48	-466.49	-74.42	-392.07
Respiratory System and Allergies	293,086	191,525	0.34	0.36	0.44	-23,166.92	-15,551.09	-7,615.83
Sensory Organs	1,730	1,595	0.23	0.24	0.44	-168.03	-152.78	-15.24
Special Foods	615	328	0.71	0.66	0.99	-21.69	-12.42	-9.27
Unknown	3,399	2,750						
Total	**1,604,561**	**813,532**	**0.50**	**0.50**	**0.47**	**-69,320.52**	**-37,567.11**	**-31,753.42**

7 KEY FINDINGS

7.1 Findings for Te Whaioranga Māori health areas of focus

The stated aim of PHARMAC's Māori responsiveness strategy Te Whaioranga (Pharmaceutical Management Agency., 27 May 2016) is to support the goal that Māori have access to subsidised medicines and use these medicines appropriately and safely. During the development of the vision for Te Whaioranga, seven health conditions were identified as areas of focus. These are:

- Diabetes and renal disease
- Respiratory disease including asthma, chronic obstructive pulmonary disease (COPD), lung disease
- Heart and cardiovascular disease including management of risk factors, smoking cessation, raised blood pressure, thrombosis, dyslipidaemia, and metabolic syndrome
- Mental health
- Arthritis and gout
- Obesity
- Rheumatic fever

7.1.1 Diabetes and renal disease

There is an overall deficit of script counts for diabetes, compared with what would be expected after adjusting for age and disease burden, and excluding funded and defunded medicines between the two time points. Analysis of individual medicine and medicine class data for both time periods indicate that Māori appear to be less likely to be dispensed insulin and oral hypoglycaemic agents than non-Māori. This finding is consistent with the age-standardised dispensing data and the findings of others (Health Quality & Safety Commission. 28 Nov 2016). The insulins dispensed to Māori were more likely to be intermediate and long acting insulins and less likely to be dispensed the newer short and ultrashort acting insulin when compared with non-Māori. When comparing these data to the 2012/13 script rate ratios, there

appeared to be some increase in the use of rapid acting insulins in Māori, but this remains low relative to non-Māori. Comparison between the two time points indicated that the relative disparity in the use of the second line oral hypoglycaemic agent, acarbose, is increasing. While it is difficult to draw causal conclusions from this observational analysis, this may indicate a switch to other treatment options, including prescribing insulin earlier.

There is very limited opportunity to draw conclusions about the management of renal disease from the data. Pharmaceuticals used in dialysis and in the management of the complications of renal disease are often prescribed for other conditions making attributing DALYs to this condition challenging. Although they are dispensed relatively infrequently in community pharmacy, treatments for hyperkalaemia (such as sodium polystyrene sulphonate and calcium polystyrene sulphonate) associated with renal replacement therapy are dispensed to Māori at a lower rate than non-Māori. This may reflect the presence of Pacific peoples, who have a high prevalence of chronic kidney disease, in the non-Māori cohort or may reflect effective management in Māori.

For the purposes of this study, angiotensin converting enzyme (ACE) inhibitors and angiotensin receptor blockers (ARBs) were mapped to cardiovascular disease for burden of disease adjustment. Both of these classes of blood pressure lowering medicines are indicated for the intensive management of raised blood pressure in people with either diabetes or chronic kidney disease. There appears to be a deficit in dispensing for these agents, and the gap in shortfall is widening over time. This is difficult to draw firm conclusions about this without addressing the confounding resulting from the inability to disaggregate use for diabetes/renal disease from cardiovascular risk management, and without addressing the confounding resulting from including Pacific People with non-Māori in the DALY adjustment – since Pacific People are known to have higher rates of diabetes and renal disease, thereby inflating disease burden in the non-Māori comparison group.

In conclusion, the apparent deficit in disease burden adjusted, age-standardised dispensing for diabetes and renal disease does not appear to be closing. The deficit is equally between access and persistence. This should be interpreted as requiring activity to both increase access and maintain persistence in those who are initiated on treatment.

7.1.2 Respiratory disease

Asthma is a chronic condition which is readily remediable in most cases with preventative therapy, including inhaled corticosteroids. This analysis indicates that Māori have a deficit in the dispensing of inhaled corticosteroids (ICS, preventers) and long-acting beta-agonists (LABA, controllers) relative to non-Māori. Furthermore, the deficit is in access more than in persistence.

Comparison between the 2006/7 and 2012/13 data indicates that there has been a relative increase in deficit gap in overall script count, access and persistence to inhaled corticosteroids (ICS). This has been accompanied by a decrease in access and in persistence with inhaled long-acting beta-agonists, and a small increase in access to combination inhalers of corticosteroids and beta-agonists. These last two classes of medicines were almost at parity between Māori and non-Māori in the 2012/13 age standardised, disease adjusted analysis indicating that there may have been a shift from ICS to combination therapy in Māori. Of importance when interpreting these data however, is the finding in the HQSC Atlas of Variation 2014 update that Pacific people (21 percent) were significantly less likely to receive a preventer than Māori (18%) or European (19 %) patients. The effect of Pacific in the non-Māori cohort may be masking some residual deficit in Māori access to ICS.

In terms of Chronic Obstructive Pulmonary Disease (COPD) management, the 2006/7 data and 2012/13 data indicate an increase in the use of the newer, long acting anticholinergic agent, tiotropium. Based on the age-standardised, disease burden adjusted data, the excess in overall script count translates from a small deficit in 2006/7 to a small excess in access/persistence in 2012/13.

Smoking cessation is an important part of the prevention and management of respiratory disease, notably COPD. The age-standardised script rate for nicotine replacement therapy, bupropion and varenicline is 50% higher in Māori than non-Māori indicating good access for Māori. However, after adjustment by the NZBD substance misuse category indicates a residual deficit in disease burden adjusted access. Further investigation is warranted to establish whether the higher dispensing ratio is meeting the required health need for smoking cessation amongst Māori specifically.

7.1.3 Cardiovascular disease

Cardiovascular medicines are, in both time periods, the leading class of medicines for which there is a deficit in age-standardised, disease-burden adjusted script counts. The shortfall in scripts is estimated to be 207,638 in 2006/7 and 280,149 in 2012/13. While Māori have a higher age-standardised script rate of 1,578 per 1000 population compared with 1,265 per 1000 population for non-Māori in 2006/07 and 1,720 per 1000 population compared with 1,356 per 1000 population for non-Māori in 2012/13, they also have higher prevalence of cardiovascular disorders than non-Māori.(Riddell, Jackson, Wells, Broad, & Bannink, 2007)

The deficit is consistent across almost all classes of cardiovascular medicine and represents both a shortfall in access and in persistence.

Of interest, the new oral anticoagulant, dabigatran, which was funded by PHARMAC in July 2012 achieved near parity in access for Māori (0.98), but very poor persistence (0.46) compared with non-Māori. This is in contrast to warfarin, the main alternative to dabigatran, which has a significant shortfall in dispensing of 4,898 scripts in Māori resulting from low rates of both access (0.75) and persistence (0.43) in 2012/13.

7.1.4 Mental health

Consistent with the previous analysis by Metcalfe et al,(Metcalfe et al., 2013) this analysis indicates a disparity in access to and persistence with medicines for a range of mental health conditions as well as an apparent variation in the pattern of prescribing for Māori when compared with non-Māori.

Metcalfe et al (Metcalfe et al., 2013) highlighted an apparent variation in the use of antipsychotics in the treatment of schizophrenia and related disorders. Māori appear, on the basis of the updated analyses undertaken in the preparation of this report, to be prescribed depot and older antipsychotics more frequently than non-Māori, leading to an excess of dispensing of depot antipsychotics and a shortfall in second generation agents such as olanzapine, risperidone and the newer agents aripiprazole and ziprasidone. For the second generation and newer agents, it

appears that persistence is contributing more for an overall shortfall than access. Further investigation is needed to understand if this variation is warranted.

A shortfall in treatments for anxiety and depressive disorders is also apparent. Recent data from the Māori Health Chart Book (2015) indicated that these disorders are more common among Māori than non-Māori at a rate of 1.56 (1.24–1.97) (Ministry of Health., 2015b). However, this analysis indicates approximately 40% lower script rates for Māori compared with NZEO consistent across time. This results in a shortfall of 47,877.78 scripts in 2006/7 and 60,948.12 scripts in 2012/13. However, comparison between the two time points (after excluding newly funded/defunded medicines) indicates that the relative disparity in overall script counts is narrowing over time. It may well be that there are alternative approaches to the management of anxiety and depression being sought and delivered, but further research is needed to understand if there is unmet need and how that is being addressed.

7.1.5 Arthritis and gout

Between 4% and 5% of the population experiences gout. The prevalence in Māori and Pacific people is approximately twice that in NZEO and Asian ethnicities. Gout is approximately 3 times more common in men than women.

In this analysis, we report an equivalent rate of crude, age-standardised and disease-burden adjusted script counts of allopurinol for Māori, compared with non-Māori in both time periods. The crude and age-standardised script rates are to be expected noting that the script rate of nearly 3 times that of NZEO rate for Māori and Pacific People. The disease-burden adjustment is confounded by the inclusion of Pacific people in the non-Māori cohort. A deficit but a near parity rate ratio for allopurinol for Māori: non-Māori is reassuring. However, this is at odds with the findings of the HQSC analysis for the atlas of variation; they report variation between ethnic groups with Pacific peoples and Māori patients with gout receiving significantly less allopurinol (33% and 39% respectively) compared with people identifying as European/Other (43%).

While the analysis undertaken in the preparation of this report indicates near parity in the rates of dispensing of allopurinol between Māori and non- Māori, the 2006/7 data indicate a significant excess of colchicine dispensing to Māori. This finding is

consistent with HQSC's findings that 8% of Pacific people with gout receive colchicine compared with 6.7% for Māori and 6.4% for NZEO (Health Quality & Safety Commission., 28 Nov 2016). This finding warrants further investigation; in gout management allopurinol is used exclusively for prophylaxis while excess colchicine dispensing may represent poor management since colchicine may be used to treat an attack of gout rather than to prevent one. Without more clinical data to link to the analysis it is hard to draw firm conclusions, but this may represent a disparity in treatment outcomes for Māori relative to other groups. This excess colchicine prescribing in 2006/7 is approximately halved in the 2012/3 analysis indicating that some progress may be being made in this area but specific clinical outcomes studies are needed to confirm this.

Potentially related to the treatment of gout, both cohorts indicated a significant excess in the dispensing of non-steroidal anti-inflammatory drugs (NSAIDs) to Māori and Pacific Peoples. This possibly represents poor control of gout. The HQSC reports that over half of those with gout were dispensed NSAIDs and that Māori and Pacific peoples with gout were dispensed more NSAIDs than other ethnic groups. The HQSC report goes on to suggest that this may indicate the need for more preventive treatment and suggest more research and debate into the use of these drugs is needed; however, they also indicate that there was no ethnic variation in the number of patients who received an NSAID without allopurinol. This does not preclude disparities in the outcome of allopurinol treatment though, and more research is required.

7.1.6 Obesity

The analyses undertaken in the preparation of this report is unable to present any data about obesity directly.

7.1.7 Rheumatic fever

While the NZBD Study did collect data on chronic rheumatic heart disease there was no reliable way for this study, without patient level clinical data, to disaggregate treatment with antibiotics – for example – to link with this sequel to rheumatic fever. Likewise, the use of antibiotics specifically to treat GAS sore throat (to prevent rheumatic fever occurring). As a result, no data are available for commentary on this priority area.

8 LIMITATIONS

This report extends the work of Metcalfe et al, providing a comparison of access to public funded by different ethnic groups adjusted for disease burden. The methods mirrors those developed by Metcalfe and are subject to the same limitations, outlined in detail below.

As previously discussed, the results from this analysis and the original by Metcalfe should not be directly compared quantitatively. The analysis in this report used burden of disease estimates contemporary to the dispensing data whereas Metcalfe et al used a historical disease burden estimates which were based on ICD 9AM codes. The updated Burden of Disease Study (Ministry of Health. 2013a, Ministry of Health. 2013b) uses a different disease categorisation methodology and the World Health Organization ICD 10 disease classification codes. The updated NZBD study is age-standardised to the WHO standard reference population rather than the Segi standard reference population (where both standard reference populations were necessary to align with the corresponding separate burden of disease study datasets in each analysis).

Using Segi's reference population, in Metcalfe et al's study the total gap in script count was 977,400 (with a 0.63 RR, i.e. 37% less than expected). For the same cohort (i.e. for 2006/07 dispensings), in the analyses undertaken for this report the gap in total script count falls by greater than one-third to 609,776 (the relative difference is the same, RR =0.63).

Although there may be several factors contributing for this difference (including differences in linking medicines to clinical indications and datasets), changing the reference population to WHO is likely to have considerable contributions for the observed difference. In addition, the updated NZBD study did not discount DALY losses, whereas the earlier NZBD study (used by Metcalfe et al) did discount DALY losses (Ministry of Health. 2013b). The results of Metcalfe et al's work and this current analysis are, therefore, not directly comparable but, as would be expected, the findings are consistent.

The findings presented here, similarly to Metcalfe et al's study, should be interpreted with the following caveats:

1. Ecological studies are only used for making large scale comparisons between groups rather than for examining differences at individual level, and our findings are therefore open to bias. However, the results allow initial examination of disparities in medicine access and use between Māori and non-Māori populations. Most importantly, this study does not provide definitive information about disparities; the results should be seen as an initial effort to generate hypotheses.
2. The findings are based on secondary data analysis and are observational in nature, thus cause and effect relationships cannot not be established. Furthermore, quantitative analysis of observational data cannot fully explain complex issues associated with health disparity between ethnic groups. To uncover fully the underlying reasons for observed disparities, qualitative research on psychosocial, cultural, economic, and health system related factors influencing medicine access and utilisation is required.
3. The data used for this research are based on administrative records, and each record has its own quality performance and validity measures, and the comparability of these different data sources is unknown. Detailed discussion about data sources for DALYs calculation and their limitations is provided elsewhere (Ministry of Health., 2013a). Moreover, some of the data sources (e.g. PHO registers and the dispensing claims database) are primarily administrative records and their validity for research purposes has not been assessed.
4. In New Zealand, different sources of health records are primarily linked through NHI. Previous investigators have voiced concerns about errors in NHIs and the lack of rigorous quality assurance of NHI records by the Ministry of Health (Horsburgh et al., 2010; Swan, Lillis, & Simmons, 2006). For instance, incorrectly entered NHIs with correct format might not easily be detected.
5. It has also been reported that indigenous people and disadvantaged ethnic minorities tend to under-report their health care needs due to language, cultural or economic barriers to visit health facilities (Morgan et al., 2011) and DALYs for Māori might be under-stated. If that is the case, our findings might under-state the

extent of needs-adjusted disparities. Furthermore, some healthcare needs may have been addressed by other forms of treatment, such as spiritual healing, complementary and alternative medicines, homeopathy, and so forth. Non-allopathic health care is likely to be more frequent among Māori than non-Māori, and by ignoring the contribution of non-allopathic healthcare we might have overstated needs-adjusted disparities between Māori and non-Māori. However, this needs to be ascertained in future research.

6. The NZEO category consisted of a heterogeneous population in terms of its origins and the same can be said for the Asian category. Different ethnic population groups within these heterogeneous groups may have different attitudes and beliefs about medicines. Furthermore, cultural and language barriers, for example may result in differences between ethnic groups in terms of ability to explore the health care system and this could affect access and persistence with medicines.
7. There is no absolute measure for disparity. The definition of disparity and when a difference should be considered as unjust/unfair has been much debated (Hebert, Sisk, & Howell, 2008). Although age and health needs are adjusted in this study, ethnicity is a social construct and has complex dimensions, and all potential confounders of ethnicity could not be adjusted. In this study disparity, has been measured as deviation from the reference group (i.e., NZEO). This approach inherently assumes that there is adequate access and optimal use of medicines among NZEO. However, some of the observed differences, after adjusting for disease burden, could be due to under or over use of medicines by NZEO, rather than inadequate access or poor persistence among ethnic minority groups. Therefore, our findings can be difficult to interpret without wider contextual information and deeper analysis.
8. Observed associations between dispensings and those disease burden (DALY) measures that incorporate hospitalisation outcomes will probably be subject to confounding from other factors. There are multiple factors leading to hospital admissions, for reasons beyond the simple availability of medicines. Relevant factors occupy several different domains, including socioeconomic, cultural, and behavioural. This may, however, not substantially affect the results.

9. Script counts are an imprecise measure of adherence concepts such as persistence with treatment since the coverage (days) that medicines are actually provided are confounded by dispensings/script rates and duration (days' coverage) of dispensings. With scripts versus dispensings, people living in rural areas tend to get longer dispensings (e.g. 3 months, where 1 month would be standard in non-rural setting). Hence, to the extent that Māori are overrepresented in rural populations, the gaps may be over-stated to an uncertain extent.
10. Gaps in script counts do not necessarily equate with gaps in disease burden and capacity to benefit from effective medicines treatment. Population health gains (expressed for example as QALYs gained) reflect not only numbers of patients and script frequencies per patient, but also the effectiveness of medicines in relation to patients' health needs. Hence gaps in health outcomes from patients receiving less medicine are not necessarily the same as gaps in script counts.
11. Scaling produces small distortions in absolute script numbers, although underlying patterns are unlikely to be affected appreciably.
12. Although the advantages of using DALYs is widely acknowledged and frequently employed in public health research, particularly for the ability to combine morbidity and mortality for fatal and non-fatal health outcomes, the use of DALYs has been criticised for a lack of consideration of the non-health effects of medical conditions or health risks, such as the economic, emotional and social consequences of medical conditions (Anand & Hanson, 1997).
13. The use of dichotomous grouping of the cohort into Māori and non-Māori for the disease burden adjusted analysis introduces unmeasured confounding. As has been previously observed by Metcalfe et al (Metcalfe et al., 2013) and supported in this analysis, the dispensing of medicines to Pacific people and, for some conditions, South Asian groups mirrors that for Māori. This is likely to be a need led and justified variation. By way of example, Pacific peoples have a significantly higher prevalence of diabetes than all other ethnic groups, while those identifying as NZEO have significantly lower rates of diabetes. People of Indian ethnicity are categorised as Asian in this study; however, their inclusion in Asian confounds the crude and age-standardised comparison of Asian with NZEO since rates of

diabetes in Indian populations are similar to those observed in Pacific peoples. This further confounds the Māori:non-Māori disease burden adjusted comparison. Burden of disease data are urgently needed for ethnicities other than Māori and non-Māori.

14. We used the prioritised ethnicity system. Each person was assigned to a mutually exclusive ethnic group based on the priority system (Māori, Pacific Peoples, Asian, and New Zealand European/other) (Ministry of Health., 2004). This system is based on ethnic groups of policy importance and is useful for ensuring minority groups are not 'overwhelmed' by the majority group, and is commonly used in New Zealand. However, this system may over represent some groups at the expense of others; for example, Māori gained at the expense of Pacific Peoples (approximately 31,542 according to 2004 estimate) and Pacific Peoples gained at the expense of others (34,602 according to 2006 estimate) (Ministry of Health., 2004). The impact of this on the overall findings cannot be determined; it could have resulted in an under- or over-stating of our findings.

15. Age-standardised rates and rate ratios are summary measures and may obscure wide variations across age groups. Examining differences in age-specific overall script/access/persistence rates between ethnic groups is more informative, but comparison of multiple age-specific rates can be cumbersome. To account for differences in disease burden and medicine usage between ethnic groups, we used a direct age-standardisation method. Although this method often produces better estimates when making multiple comparisons (such as by ethnicity, age, etc.) compared with the alternative - an indirect age standardisation method, this method is sensitive to small cell sizes, for example, when the breakdown of the population into sub-groups leads to very small population sizes in some subgroups. (Australian Institute of Health and Welfare., 2011)

16. We age-standardised using the WHO Standard Population (in line with the available standard in the NZBD study and which differs from that used by Metcalfe et al, 2013). Only 3.5% of the Māori population are aged 65 years or more, compared with 13% of the non-Māori population (Robson, Purdie, Cram, & Simmonds, 2007). Thus, the use of the WHO standard privileges the non-Māori population's mortality experience, potentially influencing our estimates of disparities between the two populations. In general, choosing a standard

population with higher proportions in the younger age groups gives greater weight to events more likely to occur in these age groups, for example, infant deaths (Ahmad et al., 2001). Conversely, the choice of an older standard gives more prominence to events that are more frequent at older ages, such as deaths from cancer or cardiovascular disease. As noted by Robson et al, this could potentially affect perceptions of disparities, prioritising funding or prevention efforts (Robson et al., 2007). Future studies may consider the use of a standard population with higher proportions in the younger age groups, for instance, standardising to the Māori population itself. This could help to approximate crude overall mortality rates for Māori, more closely representing the real rates (or average risk) for Māori population (Robson et al., 2007).

17. We did not include an estimate of uncertainty. In principle, confidence limits could be calculated for age standardised rates and age standardised rate ratios, which would allow standard hypothesis-testing to help rule out gaps explainable by chance.

18. ‘Scripts dispensed’ is not the same as ‘medicines prescribed’. There is evidence that many prescriptions are either not presented or not collected at pharmacies. Reasons for this may include time, cost and transportation. Such factors can affect populations differentially. Māori are more likely to have uncollected prescriptions due to cost barriers (Ministry of Health., 2015a). It is not possible to tell from this analysis the extent that failure to dispense represents a systematic failure to prescribe or a systematic failure to ensure that prescriptions are filled. However, this feature may appreciably understate true gaps.

19. From our data, it is impossible to determine the relationships between accessibility of community pharmacies and medicine access and persistence. Those who live in urban areas and have easy access to community pharmacies are likely to have better access to medicines and higher persistence than rural residents.

20. In 2013 prescription charges increased from NZ$3 to NZ$5 and past research has shown that this could further fuel disparities between ethnic groups (Ministry of Health., 2015a). Part-charges (i.e. a small contribution by the patient ($5) to the cost of subsidised medicines) are independent of the PHARMAC budget and

are not necessarily used to fund medicines, and if some people are unable to access medicines due to an inability to pay the part-charges, gaps in disparities might be increased. Our study could not shed any light on the impact of this change in prescription charges on medicine access.

21. We excluded patients who died during the one-year periods studied, measuring dispensings only to those patients still alive at the end of the relevant time period. This was to better and more validly estimate patient persistence, preventing the underestimation of persistence that occurs when deaths mid-year are included. However, this risks immortal time bias (a survivor bias) (Levesque, Hanley, Kezouh, & Suissa, 2010; Suissa, 2008), especially where mortality rates differ by ethnicity (as is the case in this study).

22. The dispensing claims data only indicate the medicine strength; they do not indicate the dose, frequency or clinical indications; nor do they describe what happens to medicines once they are dispensed. The factors influencing medicines use by patients, post dispensing are complex and needs in-depth exploration, for example, using qualitative and survey research. In addition, dispensing claims data only contain records of dispensing, and the appropriateness and rates of prescribing cannot be determined. Information regarding prescribed, but not dispensed medicines is not also available. In addition, some medicines could be accessed with or without a prescription (such as paracetamol and aspirin), so dispensing claims data may not provide full picture of utilisation of these medicines.

23. The dispensing claims databases do not allow accurate assessment of the indication for a given medicine. For instance, to avoid double counting of dispensed medicines, a specific medicine is only linked to one specific medical condition; however, some medicines have multiple indications and can be used for several purposes; for example, the same pain killer can be used for osteoarthritis, gout or cancer pain. In addition, the broad scope of our analysis does not allow detailed review of antibiotics, cancer and cardiovascular medicines for specific disease conditions.

24. PSO data were excluded from the analysis. Some of these medicines might have been issued for those who could not access medicines through community pharmacies, particularly those who are living in remote areas where access to pharmacies is difficult. Therefore, excluding PSO data may understate the true numbers of people receiving medicines, which may mean gaps are overstated to some extent.

25. The pharmaceutical claims database excludes medicines where the cost of the medicines to government is under the $5 co-payment threshold, over-the-counter medicines and medicines that are not subsidised. Therefore, excluding non-dispensing claims medicines could over-state the observed needs-adjusted disparity across ethnic groups. However, lower co-payments provide a very strong financial incentive for PHO enrolled patients to obtain their subsidised medicines from community pharmacies. Medicines that are dispensed in the hospital inpatient settings are also excluded, but those dispensed to patients discharged from hospitals would be captured by the dispensing claims database, and as such the claims database is likely to reflect most medicines dispensed to patients. Additionally, only New Zealand citizens, permanent residents and people with a long-term work visa are eligible for publicly funded health care, and medicines dispensed to other individuals are thus not recorded in the claims database.

26. In pharmaceuticals claims data, persistence (refill rates) can only be determined adequately for medicines with stable dose regimens and medicines used on a regular basis for long term conditions, rather than medicines that require frequent dose adjustment (e.g. warfarin), that are used as needed (pain killers) or that are taken for isolated episodes of an illness (e.g. allergy, infection). It is also noteworthy that dispensed medicines may or may not be taken by the patient, thus refill rates might not be an accurate representation of actual medicine-taking behaviours. As a result of unanticipated side effects or poor treatment outcomes, the patient might discontinue or switch to another medicine and these scenarios may have distorted the level of persistence reported in this study. Nevertheless, past studies have documented concordance between refill persistence and other measures of persistence (e.g. pill count) (Grymonpre, Cheang, Fraser, Metge, & Sitar, 2006), and refill persistence has been correlated with better clinical

outcomes and survival rates (Crystal, Sambamoorthi, Moynihan, & McSpiritt, 2001; Crystal, Akincigil, Bilder, & Walkup, 2007; Grymonpre et al., 2006; Nachega et al., 2006).

27. The types of publicly funded medicines, the funding criteria and the amount of co-payment are different across countries. These are largely related to public health priorities, disease distribution and the wealth of the country; hence the transferability of the study's findings beyond New Zealand is limited. In the New Zealand health system, patients receive health care and medicines at low co-payment or no cost, but this is not always true for other countries. Additionally, the difference between dispensing claims data across countries makes comparison of findings challenging, if not impossible. However, our findings can be reasonably compared with countries that have similar health system and funding structures, for example, Australia.
28. At a medicine-specific level, changes in persistence need to be understood alongside optimal treatment durations, and changes in prescribing need to be understood in respect to changes in standard treatment pathways.
29. Once adjusted for burden of disease, inequalities become one of three things:

    1. true disparities (inequity in access or persistence, i.e. Māori not receiving sufficient of a medicine if at all, thus lost health gain opportunities);
    2. wastage (the non-Māori comparator group is receiving excess medicines, unnecessarily, without real gains); or
    3. harm (Māori as the group experiencing disparities are receiving excess medicines of lesser benefit and thus experience harm, i.e., net health loss, compared with the non-Māori comparator group).

    This analysis is unable to differentiate between the three.

Despite the above limitations, the methodology adopted for this study is established in the peer-reviewed literature, and can be adopted by other investigators engaged in data linkage studies evaluating disparities in medicines use.

9 SUMMARY AND IMPLICATIONS

This report was commissioned to revise and update the work of Metcalfe et al. who investigated ethnicity-specific dispensing rates in New Zealand in 2006/7 and, using historical burden of disease data, attempted to adjust for need.

In addition to updating the earlier analysis this report presents a cross sectional analysis 5 years on. The key findings of both sets of analyses are summarised below.

- There are a number of important complexities, caveats and limitations to the analysis, and caution is needed interpreting its results. Nonetheless, apparent disparities exist for Māori in access to and persistence with government funded pharmaceuticals in New Zealand.
- These disparities in medicines access and use are linked to chronic conditions that are responsible for an estimated 88% of the burden of disease in New Zealand.
- Disparities still exist where crude- and age-adjusted script rates *appear* higher for Māori than non-Māori due to the effects of disparities in the burden of disease.
- While there has been a significant increase in access to and persistence with medicines for Māori, important apparent disparities in dispensing rates continue to exist for cardiovascular disease, asthma and COPD, and mental health, in particular the management of anxiety and depression, diabetes, cancer, and bacterial infections
- While PHARMAC has a role to play in ensuring that barriers to Māori accessing medicines are not created because of funding decisions, the cause of these disparities is likely to be complex and systematic.
- While the cost of prescriptions may have some effect, our study could not evaluate this.
- Addressing the complex barriers to accessing medicines and optimising their use is a whole of sector approach.
- Further work is also needed in order to understand what barriers Māori, and other under-served groups, face in accessing and utilising their medicines.

While analyses such as these are helpful in guiding policy and identifying areas of focus further research is required. Disease-specific, rigorously designed pharmacoepidemiology and outcomes research, making use of clinical data to better resolve the issues of linking medicines use directly to outcomes, is needed.

Expanding access to health data in the Statistics New Zealand's Integrated Data Infrastructure (IDI) has provided the infrastructure for researchers and analysts to access New Zealand health data more readily and linked these data to social and economic data, provides the opportunity for further research into the extent and causes of health and treatment disparities. The Virtual Health Information Network (VHIN) may provide the necessary data science and epidemiological expertise to move this field of research forward.

In addition to the increasing amount of and access to routinely collected claims data, (including coded hospital discharge data), there is a need to gather patient level clinical data from registries (such as ANZACS-QI) and increasingly from electronic health records (including GP practice management systems) to understand better the impact of inequalities in prescribing and dispensing.

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11 DESCRIPTION OF APPENDICES

Appendix A	Group linking pharmaceuticals with DALYs
	This table provides information on linking dispensed medicines (indication-based therapeutic groups) with New Zealand Burden of Disease study disease categories.
Appendix B	Age-standardised script rates and rate ratios by ethnicity at chemical level, 2006/7
	This table summarises, at individual chemical level, the age-standardised script rates and rate ratios for 2006/7.
Appendix C	Age-standardised script rates and rate ratios by ethnicity at chemical level, 2012/13
	This table summarises, at individual chemical level, the age-standardised dispensing rate, rate ratios for 2012/13.
Appendix D	Comparison of age-standardised script rate ratios at Therapeutic Group 3 level, 2012/13 versus 2006/07
	This table summarises, at therapeutic group 3 level, the age-standardised script rate, rate ratios and comparison between the 2006/7 and 2012/13 rate ratios, excluding newly funded and defunded medicines between 2006/07 and 2012/13.
Appendix E	Change in simple difference and the percentage difference between age-standardised script rates by ethnicity: 2006/7 versus 2012/13.
	This table summarises, at therapeutic group 3 (+/-) chemical level, changes in simple difference and the percentage difference between age standardised script rates for each of the three ethnic groups and the age standardised script rate for NZEO, excluding newly funded and defunded medicines between 2006/07 and 2012/13.
Appendix F	Māori vs. non-Māori prescriptions dispensed, disease burden (DALYs) and age-DALY-adjusted differences for specific Rx groups, 2006/07
	This table summarises, for selected therapeutic groups, shortfall/excess in script counts in Māori (compared with non-Māori), after adjusting for population structure, age and disease burden for the year 2006/07.
Appendix G	Māori vs. non-Māori prescriptions dispensed, disease burden (DALYs) and age-DALY-adjusted differences for specific Rx groups, 2012/13
	This table summarises, for selected therapeutic groups, shortfall/excess in script counts in Māori (compared with non-Māori), after adjusting for population structure, age and disease burden for the year 2012/13.
Appendix H	Maori vs. non-Maori disease burden (DALYs) and age-DALY-adjusted differences in overall scripts, access and persistence for specific Rx groups, 2006/07 versus 2012/13.
	This table summarises, for selected therapeutic groups, shortfall/excess in script counts, access and persistence in Māori (compared with non-Māori), adjusted for population structure, age and disease burden for the year 2006/07 and 2012/13.
Appendix I	Changes in simple difference and the percentage difference between age-DALY adjusted shortfall/excess in Māori compared with NZEO: 2006/7 (base year) and 2012/13
	This table summarises, at therapeutic group 3 level (+/-) chemical, the changes in simple difference and the percentage difference in shortfall/excess in Māori compared with non-Maori between the year 2006/07 and 2012/13.
Appendix J	Numerical differences in script counts, access and persistence for Māori compared with non-Māori, adjusted for age and historical disease burden, for medicines receiving funding approval between 2006/07 and 2012/13
	This table summarises, at chemical level, shortfall/excess in script counts, access and persistence in Māori (compared with non-Māori), after adjusting for population structure, age and disease burden for medicines receiving funding approval between 2006/07 and 2012/13

ANNEXE: FINDINGS UNADJUSTED FOR DISEASE BURDEN

A 1 Description of cohorts

A 1.1 Population

The denominator population used to calculate prescribing rates was taken from Statistics New Zealand Census reports and projections.

The total population for the period ending 2007 was 4,223,800 comprising 249,468 (5.9%) Asian, 558,566 (13.2%) Māori, 257,870 (6.1%) Pacific peoples and the remainder being 3,157,896 (74.8%) NZEO, including New Zealand European, Middle Eastern, Latin American or African (MELAA) ethnicity.

The total population for the period ending 2013 was 4,442,080 comprising 371,247 (8.4%) Asian, 618,745 (13.9%) Māori, 310,464 (7.0%) Pacific peoples and the remainder being 3,141,624 (70.7%) NZEO.

For all comparisons NZEO is taken to be the base case, being the numerically dominant ethnicity in the population.

It is important to note the different population-age structures of the different ethnicities. Māori and Pacific groups have a much younger age distribution with approximately half of their respective populations under the age of 25 and a further third between 25 and 50 years of age. In contrast, the Asian population is slightly older and the NZEO population is older again. This difference is of significance in the age-standardisation process since age-standardisation was undertaken using the WHO population (in line with the NZBD study methodology) which more closely matches the NZEO age distribution. Figure 2, Figure 3 and Figure 4 illustrate the population age structures of the study cohort from 2006/7 and 2012/13, and the WHO standard population, respectively.

Figure 2: 2007 population age-distribution by ethnicity

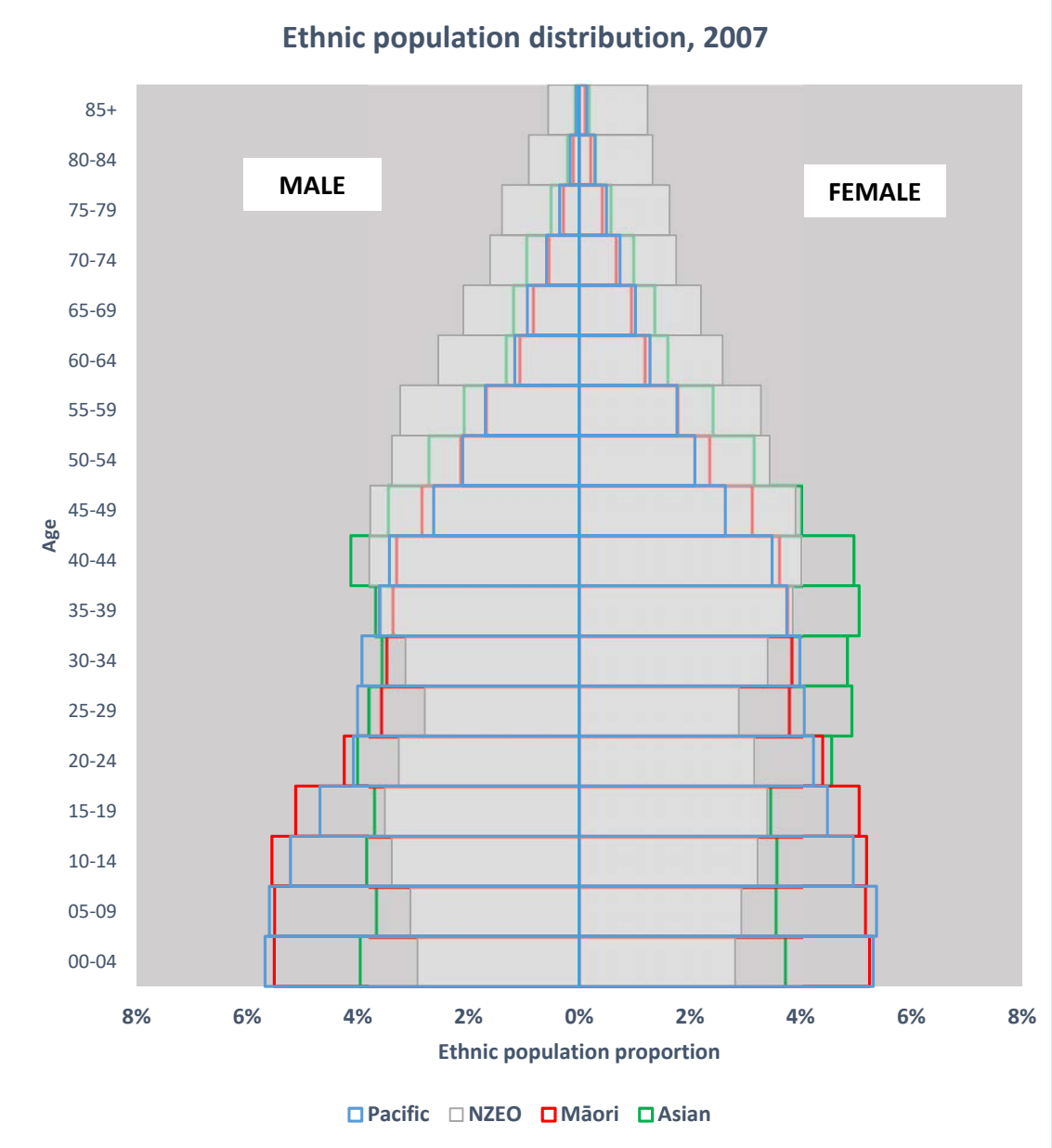


Figure 3: 2013 population age-distribution by ethnicity

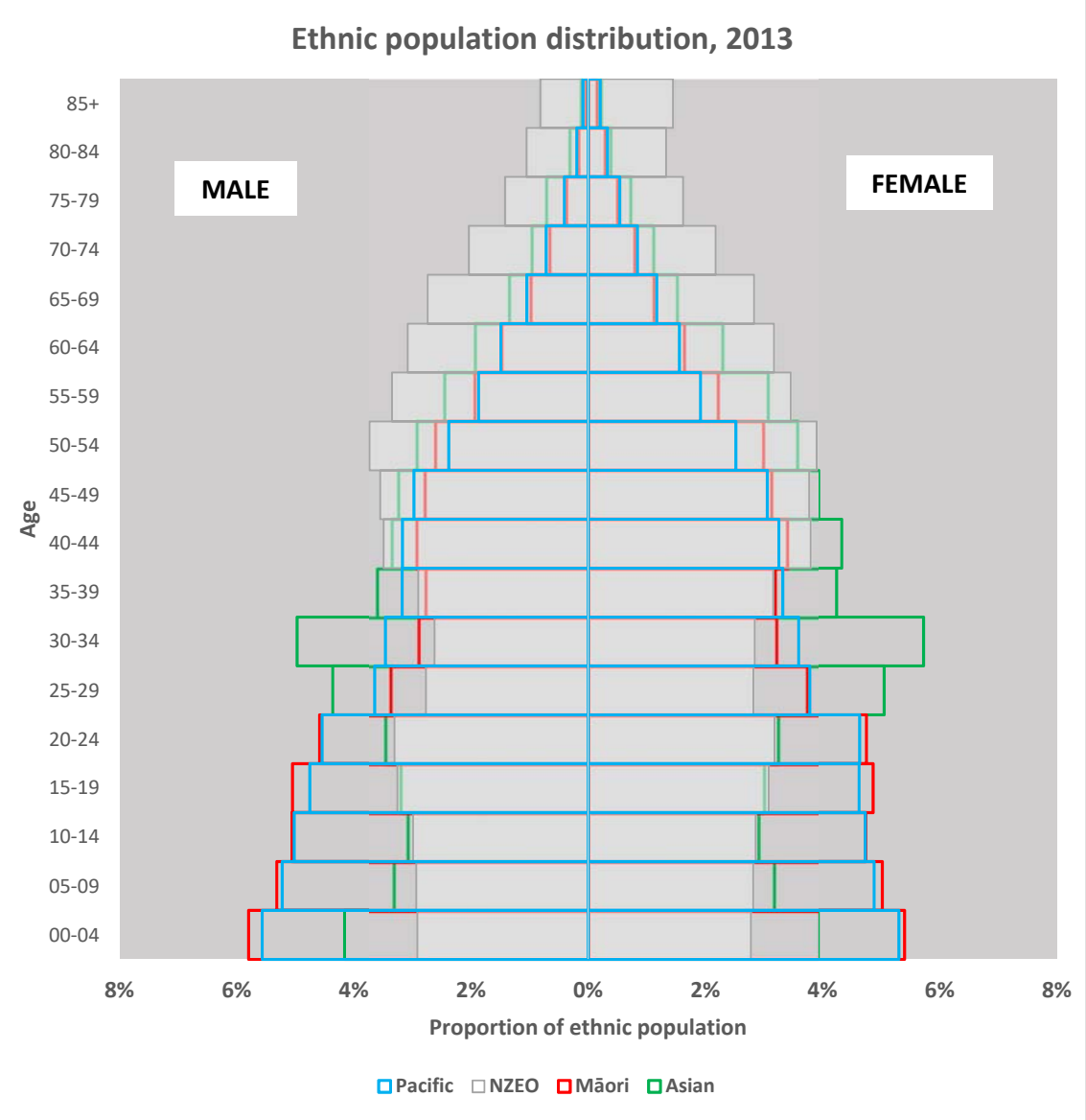
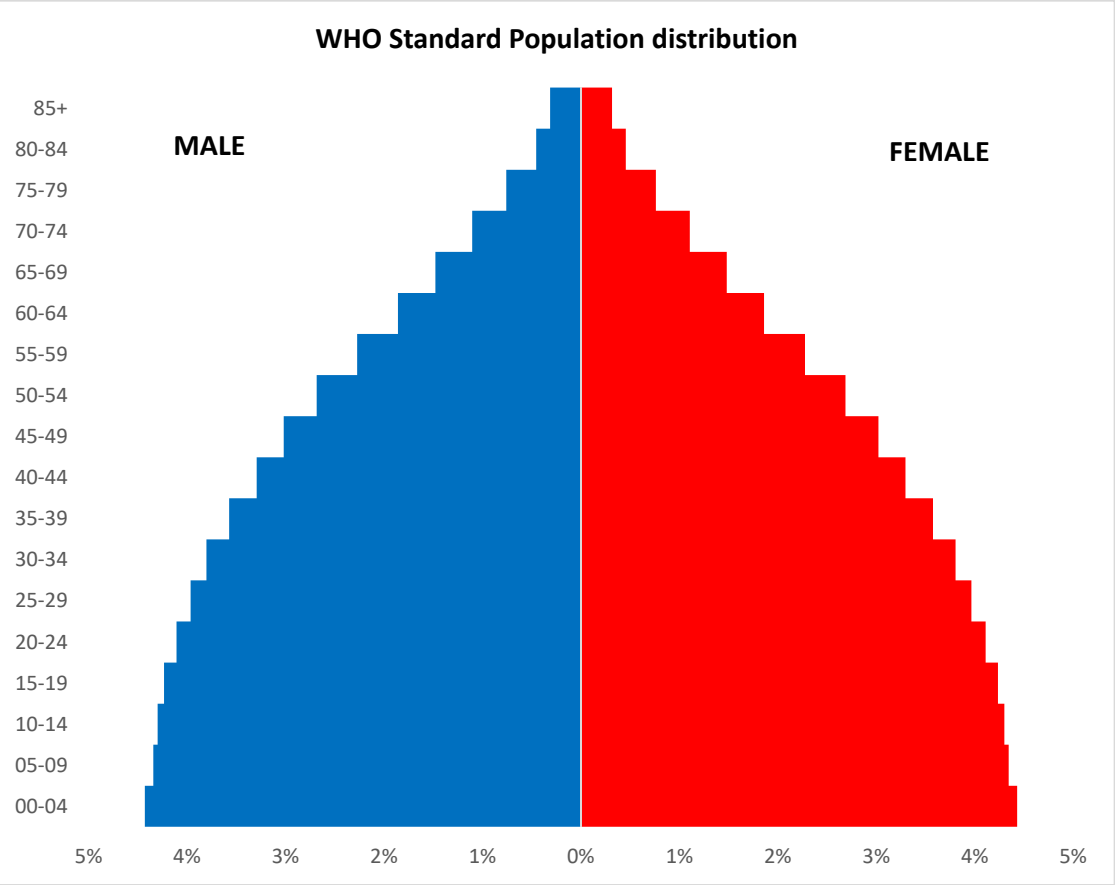


Figure 4: WHO population structure used for age-standardisation (as NZBD)



A 2 Script (prescription items) counts by ethnicity

The total script count for 2006/7 was 30,511,765, of which 3,401,207 (11.2%) were attributable to Māori, 1,736,262 (5.7%) to Pacific Peoples, 1,568,674 (5.1%) to Asian, and the remaining 23,805,622 (78%) to NZEO (see Table 8)

The total script count for 2012/13 was 41,293,485, of which 4,771,936 (11.6%) were attributable to Māori, 2,633,834 (6.4%) to Pacific, 2,984,247 (7.2%) to Asian and the remaining 30,903,468 (74.8%) to NZEO (see Table 9).

A 3 Unadjusted script rates by ethnicity

Analysis of crude (unadjusted) script rates (per 1000 population) was undertaken at the therapeutic group and individual chemical level. Linkage was undertaken at the formulation level to enable the best match of chemicals used in a variety of forms in different disease/conditions.

A 3.1 Observed variation 2006/2007

Table 8 summarises the crude script rates for Māori, Asian, Pacific and NZEO, including the crude script rate ratio, using NZEO as the base case.

The crude script rate ratio, compared with NZEO was 0.81 for Māori, 0.89 for Pacific and 0.83 for Asian people.

Māori were prescribed oncology and immunosuppressive agents, and medicines for the cardiovascular system at approximately 55% of the rate of NZEO. It is well recognised that Māori have higher rates of cardiovascular disease mortality (2.17, [2.08–2.26]) and hospital admissions for cardiovascular disease (1.64 [1.61–1.67]) and that they have a higher rate of cancer registrations (1.25 [1.21–1.28]).

In contrast, Māori had rates of scripts for respiratory conditions approximately 23% higher than NZEO, reflecting the higher rates of both asthma (1.96 [1.87–2.07]) and COPD hospitalisations (3.59 [3.46–3.74]). The rate of scripts for systemic infections was approximately 37% higher than NZEO, again consistent with higher rates of childhood infections such as meningococcal disease and rheumatic fever.

The patterns of script rates were very similar for Pacific peoples, with the apparent (unadjusted) shortfall being greater in some areas, including genito-urinary

treatments, and oncology and immunosuppressive therapies and an excess in dispensings for anti-infective, respiratory and dermatological agents.

The patterns of script rates for Asian people, including both south-east Asian and far east Asian, illustrates a significantly different pattern from Māori and Pacific peoples with some conditions, such as alimentary tract disorders and infections at parity with NZEO, but an apparent deficit in other areas such as cardiovascular, oncology and immunosuppressive therapies.

A 3.2 Observed variation 2012/2013

Table 9 summarises the crude script rates for Māori, Asian, Pacific and NZEO, including the crude script rate ratio, using NZEO as the best case.

The crude script rate ratios, compared with NZEO were 0.78 for Māori, 0.86 for Pacific and 0.82 for Asian.

This apparent widening of the rate ratio does not take into account age standardisation. On a crude basis, one might expect a higher script count in populations with older members since one expects increasing age to be associated with increasing prevalence of disease and treatment for many chronic conditions. In contrast, younger populations may expect higher rates of treatment for childhood disease.

The pattern of lower script rates in Māori and Pacific Peoples in 2006/7 was similar in 2012/13. When compared with 2006/7 there has been a small narrowing of the gap reflecting both small increases in the rate of scripts for oncology treatments, cardiovascular disease and disorders of the alimentary tract (which includes diabetes mellitus). There has also been a decrease in the apparent excess script rate for infectious diseases and for respiratory diseases. It is unclear whether this reduction is in line with changes in disease burden.

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Table 8: Crude script rate, for each ethnic group, 2006/07

TG1 level names	Number of Scripts					Script rate:1000				Rate Ratio		
	Asian	Māori	Pacific	NZEO	Total	Asian	Māori	Pacific	NZEO	Asian vs NZEO	Māori vs NZEO	Pacific vs NZEO
Alimentary Tract and Metabolism	276,760	334,338	201,368	3,506,376	4,318,842	1,109.40	598.56	781	1,110.35	1.00	0.54	0.70
Blood and Blood Forming Organs	68,544	136,215	75,125	1,284,333	1,564,217	274.76	243.87	291	406.71	0.68	0.60	0.72
Cardiovascular System	224,951	490,189	230,628	5,172,353	6,118,121	901.72	877.59	894	1,637.91	0.55	0.54	0.55
Dermatologicals	165,209	324,174	209,999	1,295,356	1,994,737	662.25	580.37	814	410.20	1.61	1.41	1.99
Extemporaneously Compounded Preparations and Galenicals	7,618	8,681	15,694	40,557	72,550	30.54	15.54	61	12.84	2.38	1.21	4.74
Genito-Urinary System	38,233	88,844	25,303	683,249	835,629	153.26	159.06	98	216.36	0.71	0.74	0.45
Hormone Preparations - Systemic Excluding Contraceptive Hormones	45,580	115,314	48,231	872,043	1,081,168	182.71	206.45	187	276.15	0.66	0.75	0.68
Infections - Agents for Systemic Use	201,546	583,422	293,095	2,404,964	3,483,028	807.90	1,044.50	1,137	761.57	1.06	1.37	1.49
Musculoskeletal System	68,016	192,844	98,863	1,213,949	1,573,672	272.65	345.25	383	384.42	0.71	0.90	1.00
Nervous System	244,820	626,503	304,589	4,708,861	5,884,774	981.37	1,121.63	1,181	1,491.14	0.66	0.75	0.79
Oncology Agents and Immunosuppressants	6,776	13,095	5,405	134,178	159,453	27.16	23.44	21	42.49	0.64	0.55	0.49
Respiratory System and Allergies	161,697	389,449	172,428	1,791,541	2,515,116	648.17	697.23	669	567.32	1.14	1.23	1.18
Sensory Organs	47,649	81,630	41,192	582,510	752,980	191.00	146.14	160	184.46	1.04	0.79	0.87
Special Foods	2,808	4,908	1,626	50,955	60,296	11.26	8.79	6	16.14	0.70	0.54	0.39
Various	00	00	00	00	00							
Unknown	8,466	11,601	12,716	64,399	97,182	33.94	20.77	49	20.39	1.66	1.02	2.42
Total	**1,568,674**	**3,401,207**	**1,736,262**	**23,805,622**	**30,511,765**	**6,288.08**	**6,089.18**	**6,733**	**7,538.44**	**0.83**	**0.81**	**0.89**

NZEO = New Zealand Europeans/Others

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Table 9: Crude script rate, for each ethnic group, 2012/13

TG1 level names	Number of Scripts					Script rate:1000				Rate Ratio		
	Asian	Māori	Pacific	NZEO	Total	Asian	Māori	Pacific	NZEO	Asian Vs NZEO	Māori Vs NZEO	Pacific Vs NZEO
Alimentary Tract and Metabolism	563,937	530,439	363,502	4,323,471	5,781,349	1,519.03	857.28	1,171	1,376.19	1.10	0.62	0.85
Blood and Blood Forming Organs	135,189	209,945	129,546	1,712,350	2,187,029	364.15	339.31	417	545.05	0.67	0.62	0.77
Cardiovascular System	419,928	685,546	368,810	6,085,969	7,560,252	1,131.13	1,107.96	1,188	1,937.20	0.58	0.57	0.61
Dermatologicals	303,521	455,136	306,201	1,753,186	2,818,044	817.57	735.58	986	558.05	1.47	1.32	1.77
Extemporaneously Compounded Preparations and Galenicals	11,079	12,485	18,800	48,256	90,620	29.84	20.18	61	15.36	1.94	1.31	3.94
Genito-Urinary System	60,488	92,662	29,720	794,012	976,883	162.93	149.76	96	252.74	0.64	0.59	0.38
Hormone Preparations - Systemic Excluding Contraceptive Hormones	90,831	159,377	73,571	1,107,047	1,430,826	244.66	257.58	237	352.38	0.69	0.73	0.67
Infections - Agents for Systemic Use	334,244	693,605	374,914	3,124,785	4,527,549	900.33	1,120.99	1,208	994.64	0.91	1.13	1.21
Musculoskeletal System	155,043	294,308	172,768	1,702,965	2,325,085	417.63	475.65	556	542.07	0.77	0.88	1.03
Nervous System	473,917	967,050	467,923	6,460,758	8,369,647	1,276.55	1,562.92	1,507	2,056.50	0.62	0.76	0.73
Oncology Agents and Immunosuppressants	16,421	31,327	12,642	257,761	318,151	44.23	50.63	41	82.05	0.54	0.62	0.50
Respiratory System and Allergies	276,933	476,371	218,391	2,272,211	3,243,906	745.95	769.90	703	723.26	1.03	1.06	0.97
Sensory Organs	91,506	92,035	52,669	719,472	955,681	246.48	148.74	170	229.01	1.08	0.65	0.74
Special Foods	4,981	6,660	2,085	58,746	72,473	13.42	10.76	7	18.70	0.72	0.58	0.36
Various	33,090	49,622	28,053	406,910	517,675	89.13	80.20	90	129.52	0.69	0.62	0.70
Unknown	13,140	15,367	14,238	75,571	118,316	35.39	24.84	46	24.05	1.47	1.03	1.91
Total	**2,984,247**	**4,771,936**	**2,633,834**	**30,903,468**	**41,293,485**	**8,038.44**	**7,712.28**	**8,484**	**9,836.78**	**0.82**	**0.78**	**0.86**

NZEO = New Zealand Europeans/Others

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Table 10: Comparison of crude script rate ratios, for each ethnic group, between 2006/7 and 2012/13

TG1 level names	2006/07 (base year) Rate Ratio			2012/13 Rate Ratio			2012/13, relative to 2006/07 Ratio of Rate Ratio		
	Asian Vs NZEO	Māori VS NZEO	Pacific Vs NZEO	Asian Vs NZEO	Māori Vs NZEO	Pacific Vs NZEO	Asian Vs NZEO	Māori Vs NZEO	Pacific Vs NZEO
Alimentary Tract and Metabolism	1.00	0.54	0.70	1.10	0.62	0.85	1.10	1.16	1.21
Blood and Blood Forming Organs	0.68	0.60	0.72	0.67	0.62	0.77	0.99	1.04	1.07
Cardiovascular System	0.55	0.54	0.55	0.58	0.57	0.61	1.06	1.07	1.12
Dermatologicals	1.61	1.41	1.99	1.47	1.32	1.77	0.91	0.93	0.89
Extemporaneously Compounded Preparations and Galenicals	2.38	1.21	4.74	1.94	1.31	3.94	0.82	1.09	0.83
Genito-Urinary System	0.71	0.74	0.45	0.64	0.59	0.38	0.91	0.81	0.84
Hormone Preparations - Systemic Excluding Contraceptive Hormones	0.66	0.75	0.68	0.69	0.73	0.67	1.05	0.98	0.99
Infections - Agents for Systemic Use	1.06	1.37	1.49	0.91	1.13	1.21	0.85	0.82	0.81
Musculoskeletal System	0.71	0.90	1.00	0.77	0.88	1.03	1.09	0.98	1.03
Nervous System	0.66	0.75	0.79	0.62	0.76	0.73	0.94	1.01	0.93
Oncology Agents and Immunosuppressants	0.64	0.55	0.49	0.54	0.62	0.50	0.84	1.12	1.01
Respiratory System and Allergies	1.14	1.23	1.18	1.03	1.06	0.97	0.90	0.87	0.83
Sensory Organs	1.04	0.79	0.87	1.08	0.65	0.74	1.04	0.82	0.86
Special Foods	0.70	0.54	0.39	0.72	0.58	0.36	1.03	1.06	0.92
Various				0.69	0.62	0.70			
Unknown	1.66	1.02	2.42	1.47	1.03	1.91	0.88	1.01	0.79
Total	**0.83**	**0.81**	**0.89**	**0.82**	**0.78**	**0.86**	**0.98**	**0.97**	**0.97**

NZEO = New Zealand Europeans/Others

Cells shaded GREEN indicate an increase in the crude script rates (rate ratios) for 2012/3 when compared with those in 2006/7. In contrast cells shaded RED indicate a decrease.

Ratios in columns 7, 8, and 9 are calculated from Rate Ratios in 2012/3 (from Table 9)/ Rate Ratios in 2006/7 (from Table 8).

Table 10 compares crude script rates for each ethnic group between the two time points. Cells shaded green in the table above indicate an increase in the crude script rates (rate ratios) for 2012/3 when compared with those in 2006/7. In contrast, cells shaded red indicate a decrease.

This change must be interpreted in light of the underlying deficit or excess relative to NZEO patients in 2006/7. In the context of cardiovascular disease, where Māori, Pacific and Asian people had an apparent deficit, an increase in the ratio is desirable indicating a narrowing of that gap. On the other hand, a decrease in the apparent excess of dispensings for anti-infective agents seen for Māori and Pacific patients could be interpreted as reflecting improvement, providing the burden of disease is also falling, but is likely confounded by the difference in the population age structures between ethnic groups prior to standardisation.

A 4 Age standardised script rates by ethnicity

A 4.1 Observed variation 2006/2007

In 2006/7 the age-standardised script rates for Māori were 7,154.9 scripts per 1000 population compared with 7,615.80 for Pacific People, 6,686.75 for Asians and 5,837.11 for NZEO. This represents an age standardised script rate ratio, compared with NZEO of 1.23, 1.30 and 1.15. These age standardised rates are in contrast to the crude script rate ratios of 0.81, 0.89 and 0.83 reported above (see Table 11).

Figure 5 illustrates the absolute deficit or excess of the age-standardised script rates for different ethnic groups in 2006/7, using NZEO as the base case. From this it can be seen that – unadjusted for disease burden, there is substantial variation between ethnic groups. Māori and Pacific Peoples having higher script rates for anti-infectives, cardiovascular drugs, medicines used for nervous system disorders (including mental health conditions), and medicines used in the treatment of musculoskeletal conditions (including gout). Notably alimentary tract medicines (which also includes diabetes medications) have a higher script rate in Pacific People and Asians (including those from the Asian sub-continent) than in Māori, although an excess is still seen among Māori (see Appendix B for more details).

Figure 5: Absolute deficit/excess Age-standardised script rates for Asian, Māori and Pacific compared with NZ European/Other (2006/7)

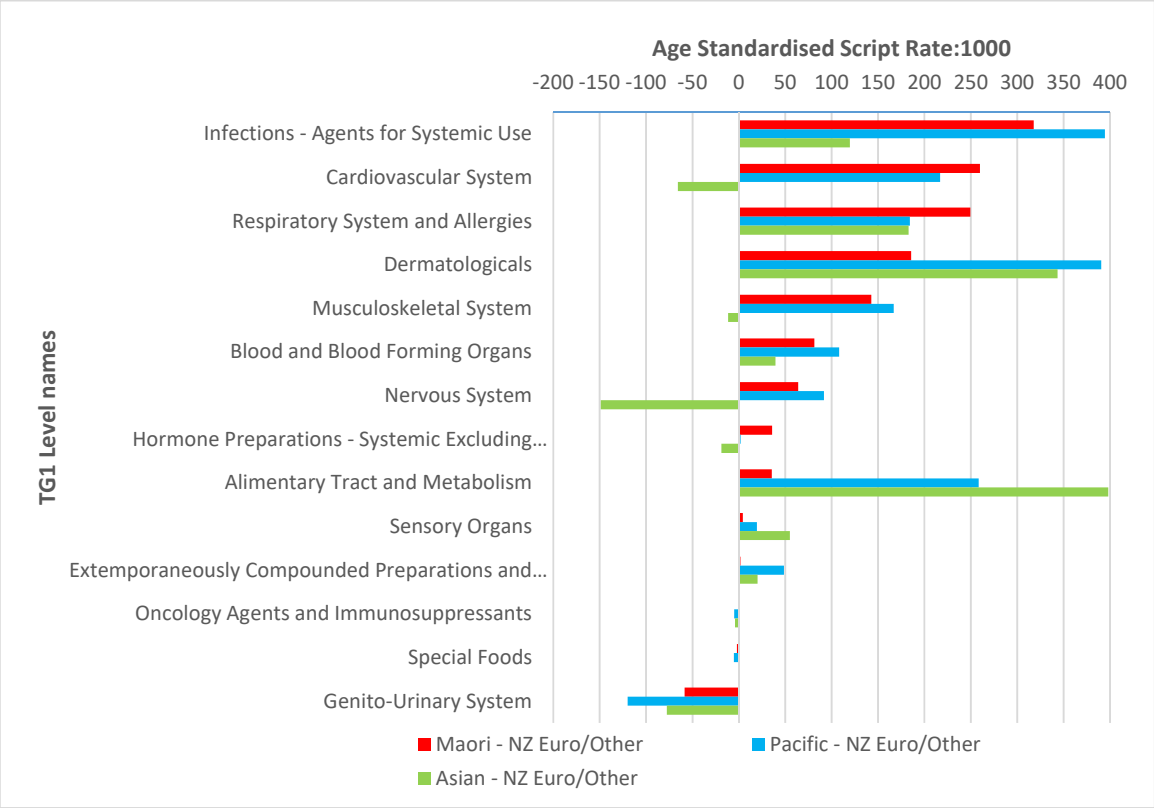

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Table 11: Age-Standardised script rates and rate ratios at Therapeutic Group level 1 for each ethnic group, 2006/07

TG1 level names	Total number of Scripts	Script rate:1000				Age standardised Script rate:1000				Age Standardised Rate ratio		
		Asian	Māori	Pacific	NZEO	Asian	Māori	Pacific	NZEO	Asian Vs NZEO	Māori Vs NZEO	Pacific Vs NZEO
Alimentary Tract and Metabolism	4,318,842	1,109.40	598.56	780.89	1,110.35	1,166.54	803.83	1,026.83	768.38	1.52	1.05	1.34
Blood and Blood Forming Organs	1,564,217	274.76	243.87	291.33	406.71	300.21	342.10	368.79	260.74	1.15	1.31	1.41
Cardiovascular System	6,118,121	901.72	877.59	894.36	1,637.91	976.63	1,302.24	1,259.33	1,042.40	0.94	1.25	1.21
Dermatologicals	1,994,737	662.25	580.37	814.36	410.20	723.25	565.36	770.29	379.77	1.90	1.49	2.03
Extemporaneously Compounded Preparations and Galenicals	72,550	30.54	15.54	60.86	12.84	33.92	15.32	62.23	13.70	2.48	1.12	4.54
Genito-Urinary System	835,629	153.26	159.06	98.12	216.36	142.32	161.47	100.06	219.99	0.65	0.73	0.45
Hormone Preparations - Systemic Excluding Contraceptive Hormones	1,081,168	182.71	206.45	187.04	276.15	188.46	243.08	208.95	207.17	0.91	1.17	1.01
Infections - Agents for Systemic Use	3,483,028	807.90	1,044.50	1,136.60	761.57	854.18	1,052.31	1,129.02	734.58	1.16	1.43	1.54
Musculoskeletal System	1,573,672	272.65	345.25	383.38	384.42	280.58	435.18	459.20	292.30	0.96	1.49	1.57
Nervous System	5,884,774	981.37	1,121.63	1,181.17	1,491.14	1,044.43	1,257.35	1,285.04	1,193.37	0.88	1.05	1.08
Oncology Agents and Immunosuppressants	159,453	27.16	23.44	20.96	42.49	27.04	31.12	26.25	31.29	0.86	0.99	0.84
Respiratory System and Allergies	2,515,116	648.17	697.23	668.66	567.32	692.31	758.97	693.80	509.47	1.36	1.49	1.36
Sensory Organs	752,980	191.00	146.14	159.74	184.46	206.49	155.62	170.86	151.41	1.36	1.03	1.13
Special Foods	60,296	11.26	8.79	6.30	16.14	12.96	10.80	7.62	12.94	1.00	0.83	0.59
Various	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
Unknown	97,182	33.94	20.77	49.31	20.39	37.43	20.15	47.52	19.60	1.91	1.03	2.42
Total	**30,511,765**	**6,288.08**	**6,089.18**	**6,733.09**	**7,538.44**	**6,686.75**	**7,154.90**	**7,615.80**	**5,837.11**	**1.15**	**1.23**	**1.30**

NZEO = New Zealand Europeans/Others

A 4.2 Observed variation 2012/2013

In 2012/13 the age-standardised script rates for Māori were 8,517.8 scripts per 1000 population compared with 9,271.9 for Pacific People, 8,031.9 for Asians and 7,494.2 for NZEO. This represents an age standardised script rate ratio, compared with NZEO of 1.14, 1.24 and 1.07. These age-standardised rates are in contrast to the crude script rate ratios of 0.78, 0.86, and 0.82 (see Table 12).

Figure 6 illustrates the absolute deficit or excess of the age-standardised script rates for different ethnic groups in 2012/13, using NZEO as the base case. As for the earlier time period, Māori have higher rates of dispensing for anti-infectives, cardiovascular drugs and medicines used in the treatment of musculoskeletal conditions (including gout). Of interest, the excess of scripts for medicines used for nervous system disorders (including mental health conditions) appears to now illustrate a small deficit, when compared with the disease unadjusted script rates for NZEO (see Appendix C for more details).

Figure 6: Absolute deficit/excess age-standardised script rates for Asian, Māori and Pacific compared with NZ European/Other (2012/13)

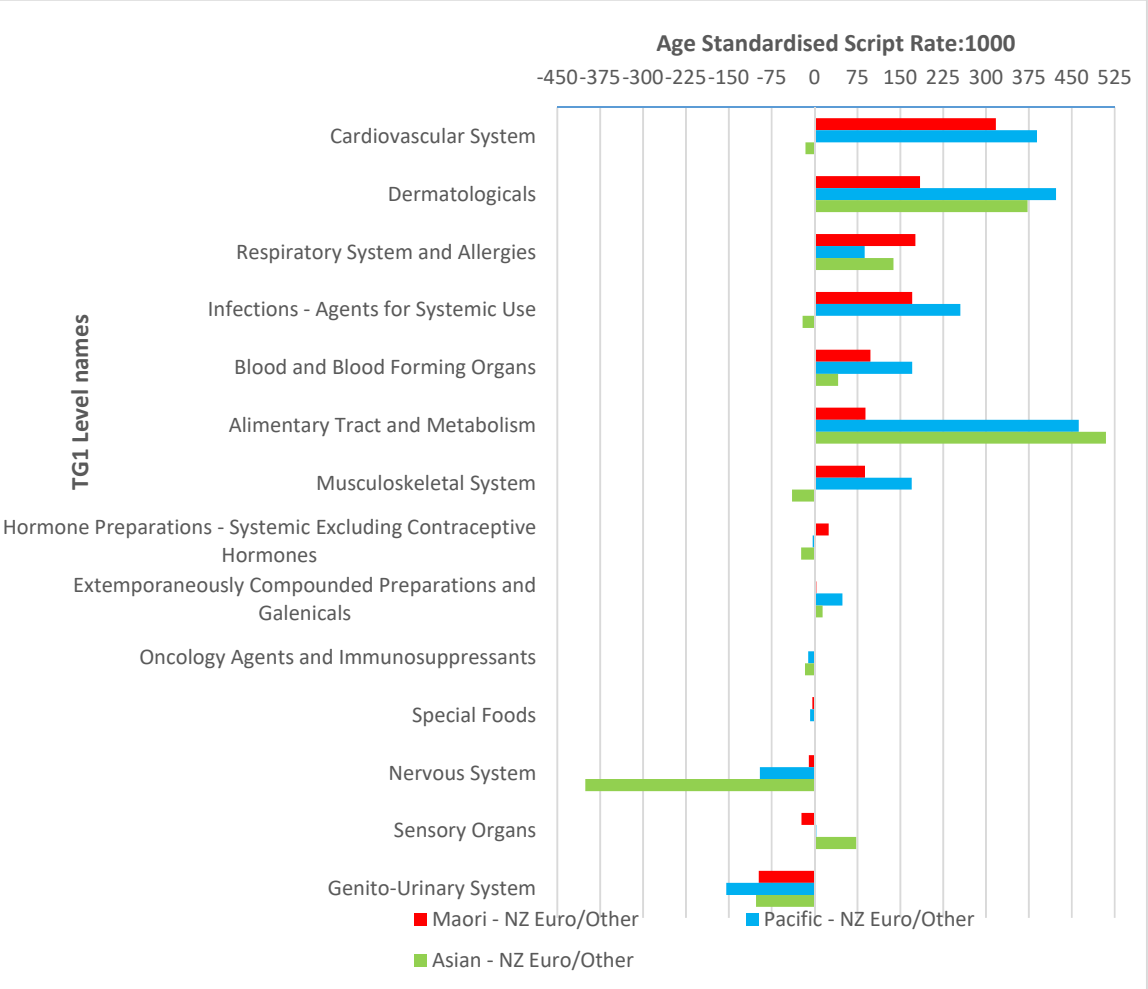

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Table 12: Age-Standardised script rates and rate ratios at Therapeutic Group level 1 for each ethnic group, 2012/13

TG1 level names	Total #Script	Script rate:1000				Age standardised Script rate:1000				Age Standardised Rate ratio		
		Asian	Māori	Pacific	NZEO	Asian	Māori	Pacific	NZEO	Asian Vs NZEO	Māori Vs NZEO	Pacific Vs NZEO
Alimentary Tract and Metabolism	5,781,349	1,519.03	857.28	1,170.83	1,376.19	1,441.83	1,020.76	1,393.95	931.95	1.55	1.10	1.50
Blood and Blood Forming Organs	2,187,029	364.15	339.31	417.27	545.05	362.93	419.37	492.66	321.76	1.13	1.30	1.53
Cardiovascular System	7,560,252	1,131.13	1,107.96	1,187.93	1,937.20	1,076.99	1,409.99	1,481.83	1,092.78	0.99	1.29	1.36
Dermatologicals	2,818,044	817.57	735.58	986.27	558.05	896.93	708.91	946.70	524.48	1.71	1.35	1.81
Extemporaneously Compounded Preparations and Galenicals	90,620	29.84	20.18	60.56	15.36	31.31	20.22	65.89	17.19	1.82	1.18	3.83
Genito-Urinary System	976,883	162.93	149.76	95.73	252.74	152.47	157.27	100.75	255.07	0.60	0.62	0.39
Hormone Preparations - Systemic Excluding Contraceptive Hormones	1,430,826	244.66	257.58	236.97	352.38	236.51	284.75	256.86	260.11	0.91	1.09	0.99
Infections - Agents for Systemic Use	4,527,549	900.33	1,120.99	1,207.59	994.64	930.20	1,121.91	1,206.27	951.06	0.98	1.18	1.27
Musculoskeletal System	2,325,085	417.63	475.65	556.48	542.07	404.71	532.37	614.16	444.11	0.91	1.20	1.38
Nervous System	8,369,647	1,276.55	1,562.92	1,507.17	2,056.50	1,289.57	1,680.75	1,595.06	1,690.81	0.76	0.99	0.94
Oncology Agents and Immunosuppressants	318,151	44.23	50.63	40.72	82.05	41.19	58.65	46.84	57.92	0.71	1.01	0.81
Respiratory System and Allergies	3,243,906	745.95	769.90	703.44	723.26	776.84	815.08	726.55	638.80	1.22	1.28	1.14
Sensory Organs	955,681	246.48	148.74	169.65	229.01	250.60	154.77	180.70	177.73	1.41	0.87	1.02
Special Foods	72,473	13.42	10.76	6.72	18.70	15.33	11.75	7.62	15.39	1.00	0.76	0.50
Various	517,675	89.13	80.20	90.36	129.52	84.99	97.36	110.20	91.23	0.93	1.07	1.21
Unknown	118,316	35.39	24.84	45.86	24.05	39.49	23.91	45.90	23.84	1.66	1.00	1.93
Grand Total	**41,293,485**	**8,038.44**	**7,712.28**	**8,483.54**	**9,836.78**	**8,031.89**	**8,517.81**	**9,271.93**	**7,494.19**	**1.07**	**1.14**	**1.24**

NZEO = New Zealand Europeans/Others

A 4.3 Comparison of age-standardised script rates between 2006/7 and 2012/2013, for those medicines subsidised at 2006/07 remaining to be subsidised at 30 June 2013

Between 2006/07 and 2012/13 a number of changes have been made to which medicines are funded, which confounds the ability to attribute any changes in script rates between the two time points to an improvement or worsening of inequality - in particular, where new classes of medicines have been funded that change prescribing practice. Valid inferences can only be drawn by comparing the historic and current gaps of the same cohort of medicines. Therefore, comparison of age standardised script rates between the two time periods is restricted to the cohort of medicines subsidised between 1 July 2006 and 30 June 2007 and which continued to be subsidised at 30 June 2013. New classes of medicines which have been funded and delisted medicines between the two time points are not included in analysis presented in this section.

As can be seen from Table 13, the age-standardised script rate ratios have remained largely unchanged between 2006/7 and 2012/13.

Variation in script rates, adjusted for age, was highly variable across different therapeutic groups and even within therapeutic sub-groups (see Appendix D).

Māori and Pacific peoples had lower rates of antiulcerant use than NZEO patients in both time periods, notably proton pump inhibitors and anti-secretory and cytoprotective agents. This probably represents overuse by NZEO rather than underuse by others. Māori and Pacific patients' access to medicines for osteoporosis was 14% to 31% that of NZEO, while Asians accessed at approximately the same rate as NZEO. Māori, Pacific and Asian patients had consistently lower use of antidepressants. In contrast, Māori, Pacific and Asian patients used oral hypoglycaemic agents (3 - 5 times), blood glucose testing kits (1.8 - 3.6 times) and insulin-intermediate acting preparations (1.5 - 4.5 times) at a significantly higher rate than NZEO. Māori, Pacific and Asian patients' access to insulin-rapid acting preparations was considerably lower than that of NZEO. For inhaled corticosteroids and long-acting beta-agonists, Māori, but not Asian or Pacific patients accessed at higher rates than that of NZEO, while inhaled anticholinergics and inhaled long-acting beta agonist use in Asians was 35% to 57% that of NZEO.

Māori, Asian and Pacific patients' access to statins was 14% to 59% higher than that of NZEO.

In terms of mental health treatments, Māori were 5 times as likely to be using depot antipsychotic treatments compared with NZEO patients and 1.5 times more likely to be taking an oral antipsychotic; this is a gap that appears to be growing. By contrast, Asian patients were approximately half as likely as a NZEO patient to be taking an antipsychotic. This indicates a significant variation in both treatment and the approach to treatment that warrants further exploration.

Data that are more detailed are available in the data tables provided in the Appendices.

A 4.4 Longitudinal analysis of the changes in the gaps of age standardised script rates between 2006/07 and 2012/13, for those medicines subsidised at 2006/07 remaining to be subsidised at 30 June 2013

Changes in inequality over time, for two time periods (2006/07 and 2012/13) in age standardised script rates for all ethnic groups were measured both in absolute and relative terms (see Methods section for details). An absolute measure of inequality (i.e. simple difference) is expressed in the same units (per 1000 population) as the age standardised script rates themselves. On the other hand, the relative measure of inequality (i.e. percent difference) is expressed as the difference between age standardised script rates in terms of reference point. In this analysis NZEO and year 2006/07 are the reference points. As described in the previous section, to make valid inferences, this part of the analysis did not include newly funded and defunded medicines between the two time points.

We adopted Keppel et al's methodology for measuring absolute and relative inequality over time (Keppel et al., 2005). This approach was chosen for its ability to take in to account the impact of difference in denominator (population size for each ethnic group is different in the two time points) while comparing the change in script rates over time. It is also noteworthy that in some instances, the absolute and relative measures may provide contradictory evidence concerning changes in disparity over time. Thus, results should be interpreted carefully.

Table 13: Comparison of Age Standardised script rate ratios at Therapeutic Group 1 level, 2012/13 vs 2006/07

TG1 level names	2006/07 (base year)							2012/13							2006/7 Vs 2012/13		
	Age-Standardised Script Rate:1000				Rate Ratio			Age-Standardised Script Rate:1000				Rate Ratio			Ratio of Rate Ratio		
	Asian	Māori	Pacific	NZEO	Asian Vs NZEO	Māori Vs NZEO	Pacific Vs NZEO	Asian	Māori	Pacific	NZEO	Asian Vs NZEO	Māori Vs NZEO	Pacific Vs NZEO	Asian Vs NZEO	Māori Vs NZEO	Pacific Vs NZEO
Alimentary Tract and Metabolism	1,141.4	790.0	1,010.9	759.0	1.50	1.04	1.33	1,395.9	976.6	1,343.9	887.8	1.57	1.10	1.51	1.05	1.06	1.14
Blood and Blood Forming Organs	300.2	342.1	368.8	260.7	1.15	1.31	1.41	359.2	400.5	484.4	311.5	1.15	1.29	1.55	1.00	0.98	1.10
Cardiovascular System	975.5	1,301.0	1,259.0	1,040.8	0.94	1.25	1.21	1,074.1	1,406.8	1,480.2	1,090.0	0.99	1.29	1.36	1.05	1.03	1.12
Dermatologicals	721.0	562.9	767.9	378.1	1.91	1.49	2.03	881.0	699.0	936.4	508.5	1.73	1.37	1.84	0.91	0.92	0.91
Extemporaneously Compounded Preparations and Galenicals	33.9	15.3	62.2	13.7	2.48	1.12	4.54	30.2	18.7	64.8	15.9	1.90	1.18	4.09	0.77	1.06	0.90
Genito-Urinary System	141.4	160.4	99.6	217.2	0.65	0.74	0.46	144.3	150.9	96.9	244.4	0.59	0.62	0.40	0.91	0.84	0.86
Hormone Preparations - Systemic Excluding Contraceptive Hormones	187.9	242.6	208.6	206.4	0.91	1.18	1.01	226.7	275.3	252.8	243.1	0.93	1.13	1.04	1.02	0.96	1.03
Infections - Agents for Systemic Use	852.7	1,050.4	1,128.1	732.8	1.16	1.43	1.54	925.5	1,119.4	1,203.2	950.1	0.97	1.18	1.27	0.84	0.82	0.82
Musculoskeletal System	266.2	408.9	439.9	276.5	0.96	1.48	1.59	404.0	532.0	614.0	442.8	0.91	1.20	1.39	0.95	0.81	0.87
Nervous System	1,015.8	1,199.6	1,245.2	1,149.3	0.88	1.04	1.08	1,226.1	1,506.3	1,506.0	1,525.7	0.80	0.99	0.99	0.91	0.95	0.91
Oncology Agents and Immunosuppressants	27.0	31.1	26.3	31.3	0.86	0.99	0.84	39.8	56.6	44.3	55.7	0.71	1.02	0.79	0.83	1.02	0.95
Respiratory System and Allergies	658.3	751.0	680.2	504.9	1.30	1.49	1.35	703.2	775.9	693.1	576.6	1.22	1.35	1.20	0.94	0.90	0.89
Sensory Organs	201.8	154.1	168.4	149.7	1.35	1.03	1.12	249.9	154.6	180.5	177.4	1.41	0.87	1.02	1.05	0.85	0.91
Special Foods	12.9	10.7	7.6	12.8	1.00	0.84	0.59	15.0	11.6	7.5	15.3	0.99	0.76	0.49	0.98	0.91	0.82
Unknown	37.4	20.1	47.5	19.6	1.91	1.03	2.42	39.5	23.9	45.9	23.8	1.66	1.00	1.93	0.87	0.98	0.79
Total	**6,573.5**	**7,040.3**	**7,520.1**	**5,752.9**	**1.14**	**1.22**	**1.31**	**7,714.3**	**8,108.1**	**8,953.8**	**7,068.6**	**1.09**	**1.15**	**1.27**	**0.96**	**0.94**	**0.97**

NZEO = New Zealand Europeans/Others

As can be seen from Table 14, there has been an overall increase in absolute inequality over time for Asians and Māori populations compared with NZEO - 175 scripts and 248 scripts per 1000 population, respectively. Conversely, for Pacific people age standardised script rates overall increased by 118 scripts per 1000 populations compared with NZEO over the two time periods. However, there are considerable variations in observed change in absolute inequality across therapeutic groups and individual medicines. At therapeutic group level, for medicines used to treat systemic infections, respiratory, nervous system, genito-urinary and sensory organs disorders, there has been an overall decline in absolute inequality over time for Māori, Asians and Pacific People compared with NZEO. Conversely, there has been an increase in absolute inequality over time for cardiovascular medicines, dermatologicals, and for medicines used to treat blood and blood forming organs, and alimentary tract and metabolism disorders.

However, in terms of change in relative inequality (i.e. change in percent difference of age standardised script rates), over the two time periods, there has been an apparent overall increase in inequality for Asians (-5%), Māori (-8%), and Pacific People (-4%) compared with NZEO. At therapeutic groups 1 level, the pattern of change in relative inequality is mostly in line with changes in absolute disparity. Apart from cardiovascular medicines and medicines used for alimentary tract and metabolism disorders, the gaps in relative inequality have been widening over time for Asians, Māori and Pacific People compared with NZEO (see Appendix E for more details).

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Table 14: Changes in absolute and percentage differences between age standardised script rates for each of the three ethnic groups and the age standardised script rate for NZEO (i.e. best group rate): 2006/7 (base year) and 2012/13

	2006/07										2012/13										2006/07 to 2012/13					
	ASR Script				Simple difference in ASR Script: 1000			% difference in ASR Script			ASR Script				Simple difference in ASR Scripts: 1000			% Difference in ASR Script			Change in simple ASR Script difference: 1000			Change in % difference		
	Asian	Māori	Pacific	NZEO	A - NZEO	M - NZEO	P - NZEO	A - NZEO	M - NZEO	P - NZEO	Asian	Māori	Pacific	NZEO	A - NZEO	M - NZEO	P - NZEO	A - NZEO	M - NZEO	P - NZEO	A Vs NZEO	M Vs. NZEO	P Vs NZEO	A Vs. NZEO	M Vs. NZEO	P Vs. NZEO
Alimentary Tract and Metabolism	1,141.38	790.04	1,010.86	759.00	382.39	31.04	251.86	50.38%	4.09%	33.18%	1,395.87	976.56	1,343.90	887.81	508.06	88.76	456.09	57.23%	10.00%	51.37%	125.67	57.72	204.23	6.85%	5.91%	18.19%
Blood and Blood Forming Organs	300.21	342.09	368.79	260.73	39.47	81.36	108.06	15.14%	31.20%	41.44%	359.18	400.52	484.36	311.52	47.66	89.00	172.84	15.30%	28.57%	55.48%	8.18	7.64	64.78	0.16%	-2.63%	14.04%
Cardiovascular System	975.49	1,301.02	1,259.01	1,040.82	-65.33	260.20	218.19	-6.28%	25.00%	20.96%	1,074.13	1,406.77	1,480.24	1,090.01	-15.88	316.76	390.23	-1.46%	29.06%	35.80%	49.45	56.56	172.04	4.82%	4.06%	14.84%
Dermatologicals	720.98	562.87	767.93	378.06	342.92	184.81	389.87	90.70%	48.88%	103.12%	880.96	699.00	936.39	508.55	372.41	190.45	427.84	73.23%	37.45%	84.13%	29.50	5.64	37.97	-17.47%	-11.43%	-18.99%
Extemporaneously Compounded Preparations and Galenicals	33.92	15.32	62.23	13.70	20.23	1.62	48.54	147.65%	11.80%	354.31%	30.16	18.71	64.79	15.85	14.31	2.86	48.94	90.25%	18.04%	308.67%	-5.92	1.24	0.40	-57.39%	6.24%	-45.64%
Genito-Urinary System	141.41	160.41	99.57	217.23	-75.82	-56.82	-117.65	-34.90%	-26.16%	-54.16%	144.29	150.92	96.87	244.43	-100.13	-93.51	-147.56	-40.97%	-38.25%	-60.37%	-24.31	-36.69	-29.90	-6.06%	-12.10%	-6.21%
Hormone Preparations - Systemic Excluding Contraceptive Hormones	187.94	242.58	208.57	206.41	-18.47	36.17	2.17	-8.95%	17.53%	1.05%	226.71	275.34	252.83	243.09	-16.38	32.25	9.74	-6.74%	13.27%	4.01%	2.09	-3.93	7.57	2.21%	-4.26%	2.96%
Infections - Agents for Systemic Use	852.65	1,050.36	1,128.08	732.75	119.90	317.61	395.33	16.36%	43.35%	53.95%	925.52	1,119.37	1,203.19	950.13	-24.60	169.25	253.06	-2.59%	17.81%	26.63%	-144.51	-148.37	-142.26	-18.95%	-25.53%	-27.32%
Musculoskeletal System	266.22	408.91	439.88	276.51	-10.30	132.39	163.36	-3.72%	47.88%	59.08%	403.99	532.03	614.00	442.76	-38.77	89.28	171.24	-8.76%	20.16%	38.68%	-28.47	-43.12	7.88	-5.03%	-27.72%	-20.40%
Nervous System	1,015.84	1,199.58	1,245.21	1,149.32	-133.48	50.26	95.88	-11.61%	4.37%	8.34%	1,226.07	1,506.30	1,506.01	1,525.70	-299.62	-19.40	-19.69	-19.64%	-1.27%	-1.29%	-166.15	-69.66	-115.58	-8.02%	-5.64%	-9.63%
Oncology Agents and Immunosuppressants	27.04	31.12	26.25	31.29	-4.25	-0.17	-5.04	-13.57%	-0.55%	-16.09%	39.81	56.59	44.26	55.71	-15.90	0.88	-11.45	-28.54%	1.57%	-20.56%	-11.65	1.05	-6.42	-14.97%	2.12%	-4.46%
Respiratory System and Allergies	658.31	751.01	680.20	504.93	153.38	246.09	175.27	30.38%	48.74%	34.71%	703.17	775.93	693.09	576.61	126.56	199.32	116.48	21.95%	34.57%	20.20%	-26.82	-46.76	-58.79	-8.43%	-14.17%	-14.51%
Sensory Organs	201.78	154.08	168.39	149.74	52.04	4.34	18.64	34.75%	2.90%	12.45%	249.87	154.58	180.53	177.38	72.49	-22.80	3.15	40.87%	-12.85%	1.78%	20.45	-27.14	-15.49	6.12%	-15.75%	-10.67%
Special Foods	12.86	10.74	7.60	12.83	0.03	-2.09	-5.22	0.26%	-16.26%	-40.72%	15.05	11.58	7.46	15.27	-0.22	-3.68	-7.81	-1.44%	-24.14%	-51.15%	-0.25	-1.60	-2.59	-1.69%	-7.88%	-10.43%
Unknown	37.43	20.15	47.52	19.60	17.84	0.55	27.92	91.02%	2.82%	142.49%	39.49	23.91	45.90	23.84	15.66	0.07	22.07	65.68%	0.30%	92.59%	-2.18	-0.48	-5.85	-25.34%	-2.53%	-49.90%
Total	**6,573.47**	**7,040.30**	**7,520.09**	**5,752.91**	**820.56**	**1,287.38**	**1,767.18**	**14.26%**	**22.38%**	**30.72%**	**7,714.28**	**8,108.12**	**8,953.82**	**7,068.64**	**645.64**	**1,039.48**	**1,885.19**	**9.13%**	**14.71%**	**26.67%**	**-174.92**	**-247.90**	**118.01**	**-5.13%**	**-7.67%**	**-4.05%**

NZEO = New Zealand Europeans/Others

A 5 Variation in age- and disease burden-adjusted script rates between Māori and non-Māori

After adjusting both for age and disease burden there are clearly identifiable areas of potential shortfall in the dispensing of subsidised medicines in Māori compared with what would be expected if Māori received equal treatment with non-Māori, adjusting for disease burden, population size and age.

A 5.1 Observed variations in 2006/2007

In the 2006/7 cohort 3,401,207 scripts were identified as dispensed to Māori, of which 3,278,206 (96.3%) were linked to NZBD study disease or condition groups. The overall gap, after age-standardisation and adjusting for disease burden, is estimated to be 601,871 scripts. [Note that, because of the different standard reference populations used, this ~601,900 script shortfall differs from the 977,400 calculated in Metcalfe et al 2013 commensurately for the same 2006/07 year]. Figure 7 illustrates, at an aggregate disease level, the main areas of shortfall and excess. As can be seen, the majority of areas are seen as a shortfall.

Among the largest areas of apparent under treatment are cardiovascular disease, diabetes, infectious diseases, mental health including anxiety and depression, respiratory diseases such as asthma and COPD, and cancer.

Of the 601,871 scripts estimated to be 'missing' for Māori, i.e., funded pharmaceutical treatments that Māori did not receive, approximately two-fifths (249,199) were identified as lost opportunities for Māori to be able to access a prescription, that is, to be dispensed a first prescription for that item in the calendar year. The remaining three fifths (352,672) were identified Māori missing out on receiving a second or subsequent dispensing ('persistence'), compared with what would be expected for non-Māori who were dispensed the same medicine. The largest gaps in terms of access were for antibiotics, cardiovascular medicines and respiratory medicines. The largest gaps in terms of persistence were for cardiovascular medicines including aspirin, cholesterol-lowering agents and ACE-inhibitors (see Appendix F for details).

Figure 7: Numerical differences in script counts for Māori compared with non-Māori, adjusted for age and historical disease burden, disaggregated by access (i.e. index patient) and persistence 2006/07

Shortfalls (-) or excess (+) in Rx uptake by Māori, adjusted for age and relative disease burden (DALY loss)