Te Wero tonu—the challenge continues: Māori access to medicines 2006/07–2012/13 update

Scott Metcalfe, Kebede Beyene, Jude Urlich, Rhys Jones, Catherine Proffitt, Jeff Harrison, Ātene Andrews

ABSTRACT

AIM: Analysis of dispensings of prescription medicines in New Zealand in 2006/07 reported large inequities between Māori and non-Māori. This present study has now updated the earlier work by describing variations in disease burden-adjusted medicines access by ethnicity in 2012/13, and changes over time.

METHOD: The update has linked prescription medicine data with burden of disease estimates by ethnicity for 2012/13 and comparing with 2006/07. This has re-examined the shortfall in prescriptions for Māori vs non-Māori adjusting for age, population and burden of disease (ie, health loss, in disability-adjusted life years (DALYs)).

RESULTS: Aft er adjusting for age, population and burden of disease, large inequalities still existed for Māori compared with non-Māori, with generally no improvement over the six years. In 2012/13, Māori had 41% lower dispensings overall than non-Māori; this was nominally worse compared with the 37% relative gap in 2006/07, but the trend was not statistically significant. Many complexities and limitations hamper valid interpretation, but large inequities in access and persistence, across many therapeutic groups, remain. The full University of Auckland report details these inequities.

CONCLUSION: Large inequities in medicines access for Māori continue. Inequities in access are unacceptable, their causes likely complex and entrenched; we believe they need deeper understanding of systems and barriers, pragmatic ways to monitor outcomes, and an all-of-sector approach and beyond. PHARMAC has committed to strategic action to eliminate inequities in access to medicines by 2025, recognising it needs partners to drive the necessary change. Kei a tātou tonu katoa te wero kia mahikaha, kia mahi tino mōhio, me te mahitahi (The challenge continues for us to work harder, work smarter, and work together); everyone in the health sector has a role.

He Karakia Whakatipuranga—A Blessing for Growth and Wellbeing

Manawa mai te mauri nuku
Manawa mai te mauri rangi
Ko te mauri kai au. He mauri tipua
Ka pakaru mai te Pō
Tau mai te mauri
Haumie!
Hui e Taiki e!!endnote A

Tēnā Koutou ngā mātāwaka o Aotearoa. PHARMAC is the New Zealand government agency that decides which pharmaceuticals to publicly fund.[1,endnote B] Under its Statement of Intent,[2,endnote C] PHARMAC has set three new strategic bold goals—with the first goal "to eliminate inequities in access to medicines by 2025".

This article highlights PHARMAC's updated information[3] on Māori:non-Māori inequities in medicines access[4,5] and how these inequities have changed over time. This is key data that will help the health sector prioritise, drive and monitor progress towards achieving this bold goal.[2]

Context

PHARMAC's objective is to secure for eligible people[endnote D(i)] the best health outcomes reasonably achievable from pharmaceutical treatment and from within the funding provided.[6] Its functions include engaging in research to meet its objective,[6] which can include monitoring progress towards best outcomes.

Among eligible people in New Zealand, significant negative health disparities[7] (ie, inequities[8,9]) exist, with Māori and Pacific peoples in particular experiencing poorer health outcomes than non-Māori/non-Pacific populations (see though endnote D(ii)). (Endnotes E[10,11] and F[7–9] further define and differentiate 'equality', 'equity' and 'disparity', and their uses.)

PHARMAC's funding decisions assume people access funded treatments when prescribed and dispensed (according to the Pharmaceutical Schedule rules). PHARMAC takes a range of actions to support responsible and optimal use of funded treatments. Where evidence signals that people are missing out on benefitting from funded pharmaceuticals, PHARMAC can vary those actions for better access.

For better access for populations experiencing poor access/health outcomes, PHARMAC has developed its Māori Responsiveness Strategy, Te Whaioranga[13] (which also helps meet Tiriti o Waitangi (Treaty of Waitangi) obligations[endnote G]) and Pacific Responsiveness Strategy.[14] Each strategy has community-based actions to improve access to medicines.

PHARMAC has committed to eliminate inequities in access to medicines by 2025;[2] a dedicated team is driving the workplan to reach this access equity goal.

Medicines access inequities

Inequalities[10,11,endnote E] in health risks, disease rates, medication access and usage, and health outcomes between ethnic groups are well-described.[16] While some of these inequalities are due in part to population characteristics and are unavoidable, they are also inequitable when associated with social, economic or health-system related factors that are unfair and avoidable.[7–9,17] Inequity (unfair and avoidable difference) is the focus of this updated analysis.[18]

The evidence of inequities in health outcomes[10,11,endnote E] between ethnic groups in New Zealand is clear (see endnote H).[19–23] Excess disease burden in Māori compared with non-Māori has been the leading cause of health loss in New Zealand, more than any disease or risk factor.[24,endnote I] Investing in the latest, sometimes very expensive, medicines and medical devices will not

necessarily secure the best health (which includes equitable) outcomes at a population level.[25] Social values[26] and other issues[7,27,28] such as clinical severity[29] and health equity[10,30] remain important. Better outcomes arise from continuing with important public health actions[32–34]—and having better access to, and uptake of, good healthcare. This means that everyone who needs care can and does get it[35–37,endnote J]—including medicines.

Previous analysis, and update

PHARMAC's focus on best health outcomes including equity has led to developing ways to identify whether access to medicines use varies by ethnicity. In 2013 PHARMAC staff and others published a preliminary analysis,[4] with an overview of medicines dispensed by prescription volumes, category and population dispensing rates for the financial year 2006/07 in Māori, Pacific peoples and non-Māori/non-Pacific peoples' populations.[endnote K] The approach accounted for (i) age differences within each ethnic group, (ii) indicators of health need that combine morbidity and mortality (ie, health loss, in disability-adjusted life years (DALYs)), and (iii) breakdowns by patient numbers vs proxies for adherence. Adjusted for need, there was variable but sizeable differences in medicines dispensed to Māori compared with non-Māori, with Māori, eg, having 19–37% lower dispensings overall than non-Māori. There were however important limitations to what was preliminary analysis.

The preliminary study[4] used the Ministry of Health's New Zealand Burden of Disease Study (NZBDS) 2001,[38,39] which quantified years of life lost by the New Zealand population from premature mortality and disability across many individual diseases. The NZBDS 2001 included some ethnic-specific data, using prioritised ethnicity.[40] Disease burden estimates were for the year 1996. The NZBDS has been updated since (becoming the New Zealand Burden of Disease, Injury and Risk Factors Study (NZBDIRFS)).[21,41,42]

The earlier analysis[4] has helped inform PHARMAC's policy development for medicines funding and access. However, that analysis was preliminary and relied on disease burden estimates that had become

28

NZMJ 9 November 2018, Vol 131 No 1485
ISSN 1175-8716 © NZMA
www.nzma.org.nz/journal

NZMA
New Zealand Medical Association
Te Hauora mō ngā iwi Katoa

especially outdated.[38,39] To further its access equity goal, in 2015 PHARMAC commissioned UniServices (University of Auckland) to update the preliminary analysis. This present article describes the update, which extends the earlier analysis and aims for faster, more efficient routine future updates. The update used 2006/2007 and 2012/2013 dispensing claims data for publicly funded medicines and updated disease burden estimates from 2006 onwards.[21] The full report is available on PHARMAC's website (http://www.pharmac.govt.nz/tools-resources/research/maori-uptake-of-medicines/).[3]

The full UniServices update report[3] again[4] describes inequities in subsidised medicines access and persistence between Māori and non-Māori populations, and changes in access and persistence rates over time. The update also includes an overview of crude and age-standardised script rates for publicly funded medicines for key ethnic groups in New Zealand.

Methods

As with Metcalfe et al 2013,[4] the UniServices update was an observational secondary analysis of medicines access and persistence (defined later) at a population level. It linked community prescription medicines dispensing claims data with primary health care organisation (PHO) enrolment data and burden of disease estimates (linking with anonymised person codes).

Data were obtained from prescription medicine dispensing claims for the financial years 2006/07 and 2012/13 in the New Zealand Pharmaceuticals Collection (patient-level dispensing of medicines listed on the New Zealand Pharmaceutical Schedule with demographic data).

The UniServices updated analyses[3] included two analytical cohorts of medicines/people of most direct policy relevance:

X. medicines/people for people alive[endnote L] on 30 June 2013 who were dispensed 1+ subsidised medicine between 1 July 2012 and 30 June 2013;

Y. medicines/people for people alive during all the seven years 1 July 2006 to 30 June 2013 who were dispensed 1+ subsidised medicine during both the 12-month period 1 July 2006 to 30 June 2007 AND the 12 months 1 July

2012 to 30 June 2013 (thus alive at the end of the two time periods, and restricted to the medicines/people cohort of existing medicines that were subsidised both between 1 July 2006 and 30 June 2007 and that continued to be subsidised at 1 July 2012). Medicines/people Cohort Y represents people dispensed medicines that were listed in both time periods but whose subsidy status or funding rules may have changed.

Endnote M provides more detail on the medicines/people cohorts.

Obtained medicines dispensing data (see endnote N) were linked, via ICD10 codes of relevant presumed/known medical condition(s), with data on disease burden for Māori and non-Māori populations obtained from the NZBDIRFS 2006–2016 report (published in 2013).[21,endnote O] Disease burden in NZBDIRFS is total population DALY losses, which combine incidence/prevalence and case severity (morbidity and years lost from premature death).

Outcome measures involved transformations of ratios of rate ratios for the medicines use and burden of disease data respectively, applying to incidences and denominating populations to derive counts of excess and deficit age/disease burden-adjusted scripts (Cohort X above).[3,4,endnotes P,Q]

Analysis over time in the UniServices update transformed rate ratios by time (Cohort Y above), using Keppel et al's methodology for measuring change in absolute and relative disparities[44] comparing 2012/13 with 2006/07.[3] For this article, subsequent analysis was undertaken for statistical significance between the two time periods, using the Bucher method.[45,46]

Analysis then further disaggregated script excesses/deficits by access and persistence (*access* defined as a person being dispensed their first prescription for each item in the 12-month year; and *persistence* defined as a person continuing treatment with receiving subsequent dispensings in the year—see endnote R for further information); the further calculations are described in Metcalfe et al[4] and the UniServices update.[3]

Please refer to the full UniServices report[3] for further methodological detail, including relevant burden of disease data,

data linking, and calculations. Subsequent analysis for statistical significance between the two time periods is in the Statistical Appendix to this article.

Key findings

The key findings of both sets of analyses are <u>summarised</u> below (noting these results are but part of the full UniServices analysis,[3] which should be referred to at www.pharmac.govt.nz/tools-resources/research/maori-uptake-of-medicines). After adjusting for age and burden of disease, pervasive inequalities remained:

- For 2012/13, translating the relative dispensing rates to a deficit or excess of dispensing, there was a shortfall of 1,126,300 pharmaceutical treatments for Māori—ie, treatments that Māori did not receive. This shortfall comprised 41% of the treatments that could be expected to be dispensed to Māori had they been dispensed at rates equitable to non-Māori, when accounting for relative burden of disease data.

- Of the 1,126,300 shortfall in 2012/13 for Māori, approximately 608,800 (54%) represented lost opportunities for Māori to access treatment (ie, be dispensed a first prescription for that item in the 12-month year, 'access'), and the remaining 46% represented unexpected gaps in ongoing treatment, with people not getting continued medicine they'd previously accessed ('persistence').[endnote R]

- Over time, inequalities had continued. For the cohort of medicines available in 2006/2007, between 2006/2007 and 2012/2013 the overall disease burden-adjusted inequalities in medicine dispensings between Māori and non-Māori for Cohort Y nominally widened by 6%, but this trend was not statistically significant (comparing the Māori vs non-Māori age/disease burden-adjusted standardised rate ratio (RR) overall in 2012/2013 against that in 2006/2007, ie, 0.594/0.629=0.944=-6% relative change, 95% uncertainty interval (UI) 0.552–1.615).[endnote S] Realistically, certain inequity in access to medicines for Māori, however, remained (2012/13 Māori vs non-Māori age/disease burden-adjusted standardised

RR 0.594, 95% UI 0.407–0.867). See the Statistical Appendix to this article for details on the uncertainty estimations.

Figure 1 shows trends and large variability in the rate ratios for individual therapeutic groups over time.

- The overall increase in the apparent gap seemed due to a further deterioration in 'access', while relative persistence had improved—so in 2012/2013 the proportion of Māori receiving their first prescription (compared with expected had they received prescriptions at the same rate as non-Māori) had decreased compared with in 2006/2007, but those who did so were staying on their medicines for perhaps a little longer (relative to non-Māori) compared with in 2006/2007;[endnote T] however, confirmatory statistical testing awaits (adapting the methods in Statistical Appendix).

- Much caution is needed interpreting these results, due to many complexities, caveats and limitations[3]—and further uncertainty calculations are awaited (ie, uncertainty limits around multiple point estimates and rate ratios, see Statistical Appendix). Nevertheless, important apparent inequities in disease burden-adjusted script rates continue to exist for cardiovascular disease, asthma and COPD, mental health (particularly the management of anxiety and depression), diabetes, cancer and bacterial infections.

Please refer to <u>the full report</u> including its online appendices and to the Statistical Appendix to this article for further detail.

Discussion

Tēnā rā Koutou. E toru ngā tino mātāpono o Te Tiriti o Waitangi. Ko te noho rangapū-partnership. Ko te mea whakaurunga-participation. Ko te whakamaru-protection. Kei a tātou tonu katoa te wero kia mahikaha, kia mahi tino mōhio, me te mahitahi. (Greetings. The three key principles of te Tiriti o Waitangi—partnership, participation and protection—help guide all of our work. The challenge continues for us to work harder, work smarter, and work together.)

Figure 1: Change and variability in rate ratios for Māori:non-Māori age/disease burden-adjusted script rates, Cohort Y, 2006/07 and 2012/13 (log$_e$ scale).
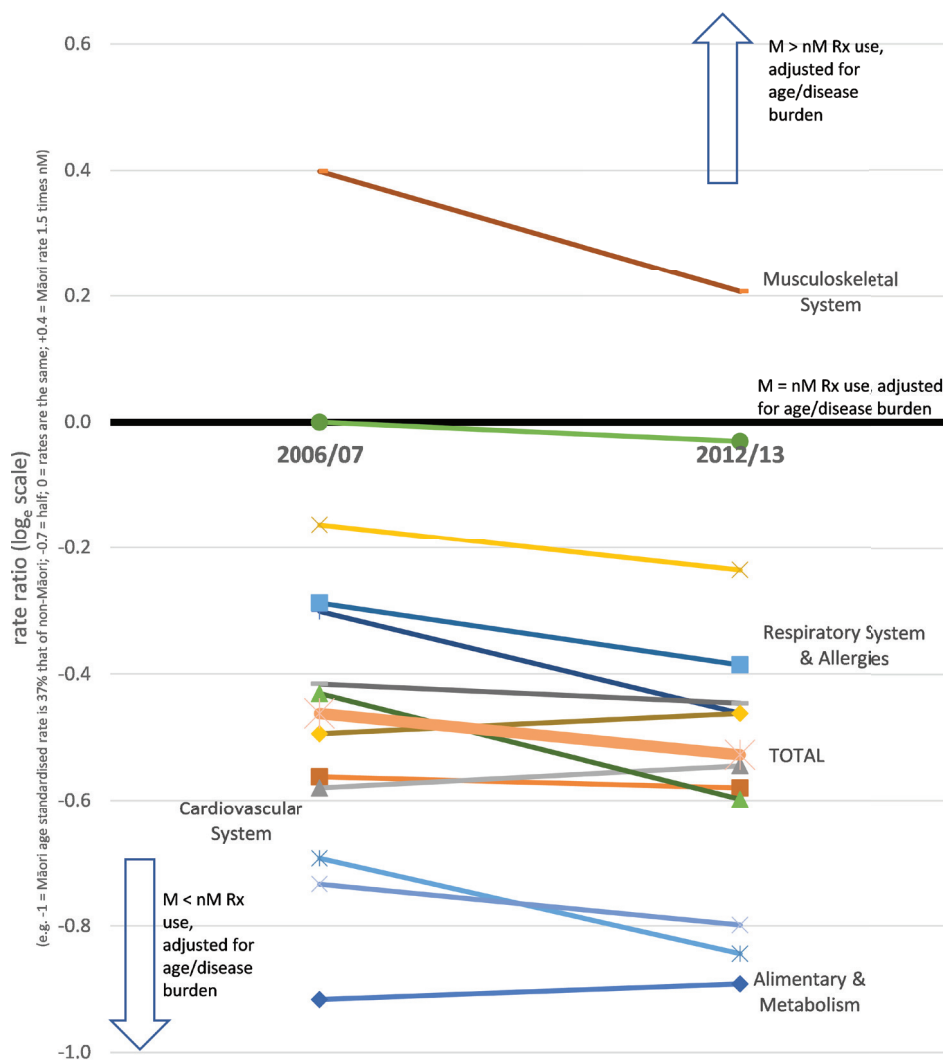
source: UniServices report[3] Table 6.

Interpretation:

- At a rate ratio of 1.0 (depicted as log$_e$(1.0)=0.0), Māori and non-Māori have equal rates of medicines use (ie, scripts received), after adjusting for population, age and disease burden.
- The higher the rate ratio (towards the top of the graph), the greater the extent that medicines use in Māori exceeds that of non-Māori after adjusting for population, age and disease burden.
- The lower the rate ratio (towards the bottom of the graph), the greater the extent that medicines use in Māori trails that of non-Māori, adjusted for population, age and disease burden.
- Rate ratios are depicted logarithmically, ie, on a natural logarithm (log$_e$) scale, where, eg, -1 = Māori age standardised/disease burden-adjusted rate is 37% that of non-Māori (depicted log$_e$ (RR 0.37)=-1.0), -0.7 = Māori rate is half that of non-Māori (log$_e$ (RR 0.50)=-0.69), 0.4 = Māori rate is two-thirds non-Māori (log$_e$ (RR 0.67)=-0.41), 0.0 = Māori rate equals non-Māori (log$_e$ (RR 1.0)=0.0), +0.4 = Māori rate is 50% higher than non-Māori (log$_e$ (RR 1.5)=+0.41), etc.

Hence, eg:

- Total medicines – M:nM age/disease-adjusted script rate ratio RR 0.63 in 2006/07=37% shortfall for Māori overall; RR 0.59 in 2012/13=41% shortfall; thus a small worsening of the already sizeable shortfall, but numerical counts only of medicines and not tested for statistical certainty; depicted as log$_e$(0.63)=-0.462, log$_e$(0.59)=-0.528.
- Cardiovascular medicines – 2006/07 adjusted RR 0.56=44% shortfall, 2012/13 RR 0.58=42%, thus a small improvement in the still sizeable shortfall, but numerical counts only of medicines and not tested for statistical certainty; depicted as log$_e$(0.56)=-0.579, log$_e$(0.58)=-0.545.
- Respiratory medicines – 2006/07 adjusted RR 0.75=25% shortfall, 2012/13 RR 0.68=32%, thus a worsening in the shortfall, but numerical counts only of medicines and not tested for statistical certainty; depicted as log$_e$(0.75)=-0.288, log$_e$(0.68)=-0.386.
- etc.

Caveats

As stated in the UniServices update report, there are many important complexities, caveats and limitations to the analysis, and caution is needed interpreting its results. At least 29 of these limitations are outlined in depth over 10 pages (pages 55 to 64 of the update report itself). These include major influencers such as:[endnote U]

- the standard population age structure used (technical but important);
- diluted gaps by including other groups with high disease burden and low access in the non-Māori comparator (eg, Pacific peoples);
- use of prioritised ethnicity;
- how to interpret gaps themselves (unnecessary overuse with wastage by the non-Māori comparator? true under-use by Māori? Māori experiencing harm from over-use of suboptimal regimens?); and
- at a medicine-specific level, how changes in persistence relate to optimal treatment durations, and how changes in prescribing relate to changes in standard treatment pathways;

alongside many other caveats. Further caveats (not stated in the UniServices update) include:

- ageing of cohort Y (by excluding patients who die);
- possible bias from numerator/denominator mismatch using PHO populations as numerators but Statistics New Zealand census population denominators—affecting pharmaceutical estimates and age-specific ethnic proportions.

As well, although the UniServices update is mainly based on Metcalfe et al's[4] methodology, direct comparison of findings from the Metcalfe et al publication and the updated analysis is invalid for several reasons, including different populations, different burden of disease methods, different age standards and different medicine-disease linkages.[endnote V] Cohort Y in the updated analysis instead provides valid internally-consistent comparison over time.

More detailed level analysis at an individual medicine level provides some evidence of both good and relatively less good access to some more commonly prescribed medicines. With individual medicines and therapeutic subgroups (many hundreds), there is much subtlety and variation in the gaps and their changes by time. These data are available in the full report and its associated data tables online,[3] and deserve further investigation, including pharmacoepidemiological research incorporating clinical event data and discussion with relevant parts of the health sector.

The research cannot provide disease-burden adjusted information for other ethnic groups and others, as burden of disease data is unavailable for ethnicities other than Māori, nor other groups, eg, those suffering socioeconomic deprivation. This misses likely large inequities in other groups beyond Māori, while diluting the true extent of Māori medicines inequities compared with, say, New Zealand European people. For example, Pacific peoples are recorded as non-Māori, which means the comparison between Māori and non-Māori would most likely show greater gaps if Pacific peoples' data were excludable from the non-Māori data.

Implications

The overall burden-adjusted approach[3,4] therefore complements and adds to, rather than replaces, other research into disparities in prescription medicines access.[5] Nonetheless, these updated apparent inequities in medicines access and use were linked to chronic conditions responsible for ~88% of the burden of disease in New Zealand; and given the magnitude and extent of the observed inequities (and lack of countervailing evidence, with consistency with other datasets and studies), plausibly, apparent inequities have not only existed but also persisted for government-funded pharmaceuticals in New Zealand.

PHARMAC's funding decisions should not create or worsen barriers to people accessing medicines, and PHARMAC acts to support optimal and equitable prescribing and uptake (part of PHARMAC's responsible use of medicines statutory function). However, the causes of these apparent inequities are likely to be complex and systemic.[47] Addressing the complex barriers to accessing medicines and optimising their use requires a whole of sector approach.[47]

32

NZMA
New Zealand Medical Association
Te Hauora mō ngā Iwi Katoa

NZMJ 9 November 2018, Vol 131 No 1485
ISSN 1175-8716   © NZMA
www.nzma.org.nz/journal

Once adjusted for burden of disease, inequalities become one (or a combination) of three factors:

1. true disparities (inequity in access or persistence, ie, Māori not receiving sufficient of a medicine if at all compared with non-Māori, thus lost health gain opportunities);

2. wastage (the non-Māori comparator group is receiving excess medicines, unnecessarily, without real gains but with near-inevitable side effects); or

3. harm (Māori receiving excess medicines of lesser benefit and/or greater adverse effects, and thus experience harm, ie, net health loss via opportunities foregone, compared with the non-Māori comparator group receiving better or 'gold standard' treatments; eg, Māori receiving more of older antipsychotics and/or depot antipsychotics, but less of newer antipsychotics and/or oral antipsychotics, than non-Māori, or higher rates of inhaled beta-agonist asthma asthma relievers but lower rates of inhaled corticosteroid preventers[4]).

Inequities in healthcare and outcomes[endnote W] borne by Māori and other New Zealanders, including medicines access, are unacceptable (Martin Luther King Jr saying "Of all the forms of inequality, injustice in health is the most shocking and inhuman..."[48]). Health inequities are inconsistent with principles of social justice and human rights, including indigenous rights as reaffirmed by te Tiriti o Waitangi[49] and the United Nations Declaration on the Rights of Indigenous People (UNDRIP).[50–52] This is where the lack of improvement in top-line medicines access for Māori signals that the broader health system[endnote X] as a whole has yet to take all the "necessary steps" for indigenous people to attain equal standards of health (as per UNDRIP article 24(2),[50,51] supported by New Zealand[52]) (see endnote Y).

Human life and potential is wasted when not everyone gets the healthcare they are entitled to—when every person in New Zealand should have the same access to the funded medicines they need; as a society, we lose opportunities when people don't get to live, thrive and participate.[53]

Future directions for PHARMAC with this work will be:

(a) *Further quantitative research and tools development*

The multi-factorial nature of medicines access inequities suggests that we will need multi-agency approaches to provide the range of solutions and interventions to improve equity of access. Recognising this, in addition to the report, PHARMAC has commissioned UniServices to develop two additional tools of use to funders, policy-makers and others within the health sector. These are:

- an updateable process using the New Zealand Universal List of Medicines (NZULM) to link community, cancer and hospital medicines listed on the Pharmaceutical Schedule (Sections B and Section H Part II) to the NZBDIRFS data through the Anatomical Therapeutic Chemical (ATC) classification system; and

- a geospatial analysis of variation in access to pharmaceuticals, adjusted for disease burden, by DHB areas, including the creation of an interactive map to visualise this data.

Other research activities PHARMAC is considering include:

- improving the validity and reliability of DALY-adjusted dispensing measurement, ie, the epidemiology/pharmacoepidemiology (see section 9 of the full UniServices report[3]);

- commissioning or otherwise securing more comprehensive burden of disease data for New Zealand tailored to PHARMAC's needs, eg, including Pacific and perhaps Asian peoples as discrete ethnic populations; using updated prescription data to 2017/18; and using varying standard populations[54] for age-standardisation;

- working with PHARMAC therapeutic group managers for individual medicines within individual therapeutic group levels, to identify particular gaps and needs for future research;

- seeking objective advice from PHARMAC's clinical advisers for specific areas;

33

NZMA
New Zealand Medical Association
Te Hauora mō ngā Iwi Katoa

NZMJ 9 November 2018, Vol 131 No 1485
ISSN 1175-8716   © NZMA
www.nzma.org.nz/journal

- as above, pharmacoepidemiological research at individual medicine level, incorporating clinical event data and discussion with relevant parts of the health sector.

(b) Behavioural and health systems research

The causes of inequities are complex, and solutions lie beyond simply the funding of medicines or simply the health system. There are likely barriers to equity at multiple levels,[5,47] including:

- patient/population factors as access barriers to healthcare (including accessing appointments, delayed access), related to costs, transport, family structure, expectations, beliefs, etc;

- health system factors with structural barriers such as how care is organised (eg, accessing appointments, wait times, after-hours advice and access, completing referrals); and

- health professional factors leading to differential treatment, with inability of providers and health systems to address all groups' needs equitably (institutional and professional bias, cultural competency,[55] health literacy involving health professionals (ie, beyond patients/whānau),[56] knowledge and skills, adherence, etc.)

—all in the context of inequities in wider underlying structural and systems[57] (including institutional and professional bias), social and economic determinants of health.[10,16–18,22,30,47,55,57–70]

More broadly, PHARMAC's newly established Access Equity team will lead further work better understanding what barriers Māori, and other under-served groups including those with relatively poor health outcomes,[7–9] face in accessing and using medicines, including down to the level of particular medicines or therapeutic groups. Such work could include how population factors, health professional factors and health system factors interact to produce inequities,[65–70] alongside a behavioural science with medicines/health system focus. This work would aim beyond simply patient and whānau behaviours; it would extend to, importantly, prescriber and other health sector provider behaviours and systems

effects[47] too, and their interactions[65–70]— where such research remains comparatively sparse, and yet has great potential to advance Māori health.

c) Implementing PHARMAC's equity bold goal

The aim is a robust evidence-base and policy work programme that will focus on:

- Identifying key points of intervention and prioritising these by their amenability and potential to address inequities;

- Reviewing programmes that have successfully reduced health inequities and identify why;

- Opportunities to work with PHARMAC's partners (Whānau Ora collectives and other sector partners) to develop locally-based programmes to reduce inequities;

- Working with system-level partners (clinical, consumer, Māori, other groups experiencing disparities, national health bodies) to identify gaps and influence policy and practice barriers;

- Better understanding the barriers to funded medicines being prescribed and used optimally, eg, commissioning further research; and

Better ways to monitor and evaluate PHARMAC's progress over time.

PHARMAC will also continue to implement Te Whaioranga, its Māori responsiveness strategy,[13] and its Pacific Responsiveness Strategy,[14] both having access equity at their heart.

(d) Implications for the wider health sector and beyond

Although this analysis is about access inequities for medicines, these inequities' causes and responses will be those that apply to generic healthcare inequities—to solve medicines access inequities, alongside the other healthcare inequities. Healthcare disparities comprise health system factors, health professional factors and patient/population factors—so that any inequity in healthcare access, quality or outcomes is ultimately the result of a complex interaction of factors.[47] These factors are themselves complex and entrenched—as a result of historical and contemporary social,

34

NZMA
New Zealand Medical Association
Te Hauora mō ngā Iwi Katoa

NZMJ 9 November 2018, Vol 131 No 1485
ISSN 1175-8716   © NZMA
www.nzma.org.nz/journal

political, cultural and economic processes. Hence we need a systemic (and in fact multi-sectoral) approach.[47]

Eliminating inequities, in access to/use of medicines or health inequities more broadly, will therefore require efforts and partnerships beyond accessing and use of medicines alone, covering wider aspects across the whole health sector and afar.[71,72] This includes public policy, regulators and professional quality assurance organisations, universities and other training providers, personal skills and engaging patients and whānau, community action, and health services themselves.[10,47]

Leadership and commitment by the health system, health organisations and health practitioners is required, with the expectation that all New Zealanders will have equity of health outcomes.[73]

Everyone working in the health system—government agencies like PHARMAC,[74] the Ministry of Health,[73] district health boards[75] and primary health organisations, the Health Quality & Safety Commission (HQSC), doctors, nurses, pharmacists, public health, pharmaceutical suppliers, others—has a role to play to reduce these inequities and make sure funded medicines reach all the people who need them. Good engagement and partnership is essential with tāngata whenua[13,22] and other populations experiencing poor health outcomes[7] and variations in medicine use.

Policymakers and funders need to look for ways to allocate Vote Health funds so that population groups are not unduly burdened by pharmaceutical co-payments[5] or access to primary care itself due to cost (eg, 15% Pacific and 14% Māori adults reporting they're unable to pick up prescriptions due to cost, 22% Māori adults at times not visiting a GP due to cost) or other factors.[76]

Organisations should commit to, fund and be accountable for[63,73,74,75] medicines equity targets. This will need expertise, support, guidance, collaboration and engagement with affected communities and others in the health system. Setting systems and organisational performance indicators and targets[73] may substantially improve equity of access, as with, eg, the Health Targets for childhood immunisation.[77]

Health services must make sure primary care and pharmacy services are redesigned and set up in ways accessible, available and acceptable to all. This may include rethinking the physical location of pharmacies and primary care services and considering alternative ways for patients to receive both medicines and advice about taking the medicine in ways that work for them.

Interventions to help achieve medicines access equity should partner with those most affected. Cultural competence for both prescribers and pharmacists needs to continue to improve,[55,78] alongside ensuring people's experience of the health system overall is culturally safe.[79,endnote Z] Unwarranted variation in medicines prescribing and access should be routinely reported on at the DHB level, as a quality improvement concern.

System wise, there are good frameworks for how the medicines access equity bold goal could be achieved. These include the Ministry of Health's Equity of Healthcare for Māori framework,[73] and others including a Māori implementation framework (He Pikinga Waiora).[80]

There is also participatory/co-design actively involving all stakeholders (eg, end users/customers/patients and whānau, citizens, partners, iwi/hapū/marae, health providers, funders and agencies),[81,82] and the importance of Māori leadership.[73,83]

Information underpins all of this.[5] For tāngata whenua, health service and outcomes data are taonga, and Māori researchers and health providers can be kaitiaki in partnership, with good data governance including dissemination and accountability for progress[84–87] within kaupapa Māori research principles.[88–93]

For the health sector, high-quality ethnicity data is needed to measure and monitor healthcare and outcomes for ethnic groups and identify health inequities; implementing the revised Ethnicity Data Protocols—collecting ethnicity data accurately, appropriately, and often—will be crucial for everyone.[94]

For researchers, issues of age standards need to be promoted both in the New Zealand health sector and wider, including using the age structure of the groups experiencing the greatest disadvantage.[54] Using equal explanatory power study designs (ie, sampling equal number of participants from groups experiencing poorer health outcomes

35

NZMA
New Zealand Medical Association
Te Hauora mō ngā Iwi Katoa

NZMJ 9 November 2018, Vol 131 No 1485
ISSN 1175-8716   © NZMA
www.nzma.org.nz/journal

and the comparator population)[95,96] and equal explanatory analysis and equity focus reporting (which involves reporting on the equity gap as well as by ethnicity)[97] can help gain at least the same depth and breadth of information for smaller disadvantaged groups—for fairer comparisons in policy and funding decisions.

Finally, the current analyses derive from an administrative dataset (the New Zealand Pharmaceuticals collection) and therefore have limited ability to capture relevant clinical variables and system-related barriers. For example, the evolution of data repositories generated by electronic transmission of prescriptions and eDispensing would allow, via anonymised data linkage, better understanding of primary and secondary non-adherence. Linking clinical encounters, or indeed prescriptions, to SNOMED/Read codes would provide more accurate mapping of dispensings to NZBDIRFS categories.

Conclusion

Inequities in access to medicines are unacceptable, and PHARMAC is committed to eliminating these inequities, as a priority. The findings in the Updated Variation in Medicines Use by Ethnicity report[3] provide a good evidence-base[5] to inform PHARMAC's access equity activity and commitment for 2025, and people and the health sector in general.

PHARMAC will be working with its partners in the health sector, tāngata whenua and others to better identify barriers and underlying causes of these inequities and act to improve use of medicines—narrowing and eliminating the gaps.

Nō reira!! Kei te mau tonu tātou i te wero, kei a tātou ngā kaimahi hauora katoa. Ko te wero tonu, kia hikina te hauora Māori kia tae orite ki te Hauora-a-tauiwi i te tuatahi. Kei te werohia tonu te wero nei mo ake tonu atu!! Kia mau!! (Therefore!! The challenge remains for all of us in the health system. The challenge of equitable health outcomes of Māori with non-Māori is the first challenge. The challenge is ever-present. Seize the opportunity!!) Everyone in the health sector has a role.

Note: The full Auckland UniServices update report is available at http://www.pharmac.govt.nz/tools-resources/research/maori-uptake-of-medicines/

Endnotes are available here.

Statistical Appendix

Calculating 95% uncertainty limits for Māori and non-Māori age/disease burden/population-adjusted script rates and rate ratios

Context and overall method

The UniServices analysis on Variation in medicines use by ethnicity: a comparison between 2006/7 and 2012/13 (http://www.pharmac.govt.nz/tools-resources/research/maori-uptake-of-medicines/)[3] provided point estimates of inequities in Māori:non-Māori script rates, adjusted for age, population and disease burden, but did not calculate uncertainty. It is thus limited by not assessing for random error (chance) and other uncertainty; such was not required in PHARMAC's commissioning of the research in 2015. The following supplementary analysis retrofits and retrospectively calculates confidence limits and uncertainty limits (akin to confidence intervals) for overall age standardised rates and year-specific rate ratios for Cohort Y, and relative change over time.

In particular, the UniServices analysis reported a nominal 6% change in relative uptake (Māori:non-Māori script rates, adjusted for age, population and disease burden) for Cohort Y overall over the six years 2012/13 vs 2006/07. This is from the calculated ratio of rate ratio (RR) of 0.944 when comparing the 2012/13 rate ratio (RR 0.594 overall M:nM age standardised disease burden-adjusted scripts) with the 2006/07 rate ratio (RR 0.629), where 0.594/0.629 = the 0.944 RR = the 6% relative reduction (1 (ie, equipoise) minus 0.944). The following analysis thus includes retrospectively calculating uncertainty limits for that 0.944 ratio of rate ratios, to examine chance or non-sampling error as a possible likely reason for the 6% change.

To assess uncertainty, the datasets in the analysis (scripts, burden of disease DALYs) were treated as distinct entities otherwise not directly comparable, and were thus combined using methods for indirect comparison.[98] This approach is common to economic analysis, with the use of model simulation etc. to assess uncertainty.

So separate to the UniServices report,[3] we have calculated 95% confidence or uncertainty limits for age-standardised rates,[99] and used the Bucher method[98,100] to calculate 95% uncertainty limits (ULs), using the following three steps:

1. Firstly, extracting or calculating standard errors for both Māori and non-Māori age-standardised rates for overall scripts and for overall disease burden for each time period;

2. Then for each time period, calculating and combining rate ratios (RRs) for Māori:non-Māori (M:nM) age-standardised rates for overall scripts and for overall disease burden (disability-adjusted life years lost (DALYs)), with sample-based confidence limits (CLs) and ULs for scripts and disease burden respectively;

3. Then calculating and combining the M:nM script:disease burden RR and confidence/uncertainty intervals comparing the 2012/13 period with 2006/07, using standard errors.

The use of uncertainty limits for disease burden (rather than simple sample-based confidence limits) was as used in the Global Burden of Disease Study (GBDS),[101] to account for added uncertainty from modelling—ie, accounting for additional non-sampling error, with both measurement error from model instability in the input non-fatal health loss (YLD) component of disease burden inputs, and model specification error from Rx/disease mapping.

(This is where, internationally (including for New Zealand), the GBDS[42,101,102] now reports 95% uncertainty intervals (UIs) rather than confidence intervals (CIs). Unlike confidence intervals, UIs capture uncertainty from multiple modelling steps, as well as from sources such as model estimation and model specification, rather than simply from sampling error alone. Uncertainty associated with estimation of mortality and years of life lost (YLLs) due to premature mortality reflects sample sizes of data sources, adjustment and standardisation methods applied to data, parameter uncertainty in model estimation, and uncertainty

37

NZMJ 9 November 2018, Vol 131 No 1485
ISSN 1175-8716 © NZMA
www.nzma.org.nz/journal

NZMA
New Zealand Medical Association
Te Hauora mō ngā Iwi Katoa

within all-cause and cause-specific mortality models. For estimation of prevalence, incidence, and years of life lived with disability (YLDs), UIs incorporate variability from sample sizes within data sources, adjustments to data to account for non-reference definitions, parameter uncertainty in model estimation, and uncertainty associated with establishment of disability weights. The GBDS assumes that because direct information about the correlation between uncertainty in YLLs and YLDs has been scarce, uncertainty in age-specific YLDs is assumed independent of age-specific YLLs or death rates.[101])

Equations

Direct age-standardised rate ratios (RRs) and their standard errors calculated as:[99]

RR = (ASR_1)/(ASR_2),

95% CI for RR = ((ARS_1)/(ASR_2))$^{1 \pm Z/\chi}$, where

Z is standardised normal deviate (1.96 for 95% CIs),

χ (ie, variance) = ($ASR_1 - ASR_2$)/$\sqrt{((_{SE}ASR_1)^2 + (_{SE}ASR_2)^2)}$;

$_{SE}ASR$ is the standard error for an age-standardised rate;

algebraically, SE = (95% CI or UI) / Z

Bucher method RR for indirect comparison,[98,100]

Measure of Association	Indirect Estimator	Indirect 100(1-α)% Confidence Interval Estimator	
		In Terms of Variance	In Terms of Confidence Limits*
Relative risk	$\prod_{i=1}^{k-1} RR_{A_i A_{i+1}}$	$\exp\left(\sum_{i=1}^{k-1} \ln(RR_{A_i A_{i+1}}) \pm Z_{\alpha/2} \sqrt{\sum_{i=1}^{k-1} Var(\ln(RR_{A_i A_{i+1}}))}\right)$	$\exp\left(\sum_{i=1}^{k-1} \ln(RR_{A_i A_{i+1}}) \pm \frac{1}{2}\sqrt{\sum_{i=1}^{k-1}(\ln(ucl_{A_i A_{i+1}}) - \ln(lcl_{A_i A_{i+1}}))^2}\right)$

where

$RR_c = RR_a \times RR_b$ (= $\exp^{((\ln(RRa)+\ln(RRb)))}$):

95% CI or UI = $\exp^{(\Sigma((\ln RRa, \ln RRb,..) \pm Z\sqrt{(\Sigma(var(\ln(RRa)), var(\ln(RRb)), var...))}}$

= $\exp^{(\Sigma((\ln RRa, \ln RRb,..) \pm Z\sqrt{(\Sigma(SERRa2, SERRb2, ...))}}$

where

ln is natural logarithm $\log_e$, exp is natural exponential base e, var(ln(RR)) = SE, var(RR) = SE^2, Z = 1.96

Calculations

The above three steps were calculated and combined as follows:

1. Age-standardised rates with standard errors

Using standard methods for direct age standardisation,[99]

- $ASR_{M,s,1}$ Māori direct age-standardised overall scripts in 2006/07
  = 7154.9 per 1000 population age-standardised scripts,
  standard error (SE) ±273.6:1,000

- $ASR_{nM,s,1}$ non-Māori age-standardised overall scripts in 2006/07
  = 6057.5:1,000 age-standardised scripts, SE ±116.7:1,000

- $ASR_{M,s,2}$ non-Māori age-standardised overall scripts in 2012/13
  = 8517.8:1,000 age-standardised scripts, SE ±299.7:1,000

- $ASR_{nM,s,2}$ non-Māori age-standardised overall scripts in 2012/13
  = 7685.2:1,000 age-standardised scripts, SE ±140.1:1,000

2. Rate ratios with standard errors and uncertainty limits

Using the Bucher method RR for indirect comparison,[98,100] and age-standardised rates data from Appendices F and G of the UniServices analysis (at http://www.pharmac.govt.nz/assets/2018-02-26-Maori-uptake-of-medicines-appendices.xlsx),

- s_1 rate ratio (RR) Māori:non-Māori (M:nM) overall age-standardised scripts in 2006/07
  - s_1 = $ASR_{M,s,1}$/$ASR_{nM,s,1}$
    = 7,154.9/6,057.5 per 1,000
  - RR = 1.1812, 95% CI 1.1809–1.1814, standard error (SE) ±0.00011626

- s_2 RR M:nM overall age-standardised scripts in 2012/13

   s_2 = $ASR_{M,s,2}/ASR_{nM,s,2}$

           = 8,517.8/7,685.2 per 1,000

   RR   = 1.1083 (1.1082–1.1085), SE ±0.00005646

- d_1 RR M:nM overall age-standardised DALYs in 2006/07,

   d1   = $ASR_{M,d,1}/ASR_{nM,d,1}$

   RR   = 1.741, 95% UI 1.300–2.331, SE ±0.1938;

   (where sample error-only 95% CI is 1.7017–1.7811, SE ±0.0148)

- d_2 RR M:nM overall age-standardised DALYs in 2012/13,

   d^2 = $ASR_{M,d,2}/ASR_{nM,d,2,}$

   RR = 1.741, 95% UI 1.301–2.329, SE ±0.1931;

   (where sample error-only 95% CI is 1.7018–1.7810, SE ±0.0116)

where:

- s_2's age distribution is proxied by 2006/07 age distribution
- d_1's by 2013 New Zealand Burden of Disease, Injury and Risk Factors Study (NZBDIRFS)[42,102] standard errors (proportional to point estimates) to total disease then calculated for Māori and non-Māori
- d_2's proportional standard errors for calculating 95% confidence limits are proxied by 2006 NZBDIS[21,41,103] standard errors (proportionate to point estimates) for total disease for Māori and non-Māori (adjusted for RR 1.754), where Māori in 2006 experienced 207,150 DALYs (sample error-only SE 2,323), non-Māori 747,426 (sample error-only SE 5,320).

Note that the standard errors for the 2006 NZBDIS DALY estimates,[21,41,103] for total disease for Māori and non-Māori, are based solely on sampling error-derived 95% confidence intervals. By contrast, the standard errors for the 2013 NZBDIRFS DALY estimates,[42,102] for total disease for total population (ie, not stratified by ethnicity for Māori and non-Māori), are based in sampling and nonsampling error-derived uncertainty intervals. This means that available standard errors for DALYs in 2006 are necessarily smaller than available standard errors for DALYs in 2013; standard errors in the 2006 NZBDIS relate to 95% confidence limits, whereas the bigger standard errors in the 2013 NZBDIRFS related to less confident uncertainty limits.

3. Ratio of rate ratios, with 95% uncertainty limits

Using the Bucher method again,[98,100]

Calculation 1: rate ratio for M:nM disease burden-adjusted age-standardised scripts in 2006/07:

RR$_1$ = s_1/d_1 = 1.18/1.74 = 0.629

95% UI = $\exp(\ln(RR_1) \pm Z\sqrt{(\Sigma(_{SE}(s_1)^2,(_{SE}(d_1)^2)))}$

    = $\exp(\ln(0.629) \pm 1.96\sqrt{((00011626)^2+(0.1938)^2)))}$

    = **0.430 to 0.920**

(And where corresponding 95% CI (ie, sample error only) is similarly calculated substituting new SEs in the above equation, ie 95% CI = 0.611 to 0.648)

Calculation 2: rate ratio for M:nM disease burden-adjusted age-standardised scripts in 2012/13:

RR$_2$ = s_2/d_2 = 1.083/1.74 = 0.594

95% UI = $\exp(\ln(RR_2) \pm Z\sqrt{(\Sigma(_{SE}(s_2)^2,(_{SE}(d_2)^2)))}$

    = $\exp(\ln(0.594) \pm 1.96\sqrt{((00005646)^2+(0.1931)^2)))}$

    = **0.407 to 0.867**

(With corresponding sample error-only 95% CI = 0.518 to 0.608)

39

NZMA
New Zealand Medical Association
Te Hauora mō ngā Iwi Katoa

NZMJ 9 November 2018, Vol 131 No 1485
ISSN 1175-8716   © NZMA
www.nzma.org.nz/journal

Calculation 3: rate ratio 2012/13 vs. 2006/07 for M:nM disease burden-adjusted age-standardised scripts:

$RR_3 = RR_2/RR_1 (= (s_2/d_2)/(s_1/d_1)) = 0.594/0.629 = 0.944$,

95% UI $= \exp(\ln(RR_3) \pm Z\sqrt{(\Sigma(_{SE}(s_1)^2,(_{SE}(d_1)^2,(_{SE}(s_2)^2,(_{SE}(d_2)^2)))}$

$\qquad = \exp(\ln(0.944) \pm 1.96\sqrt{((00011626)^2+(0.1938)^2)+(00005646)^2+(0.1931)^2)))}$

$\qquad =$ **0.552 to 1.615**

(With corresponding sample error-only 95% CI = 0.910 to 0.980)

Interpretation and extended use

For each of the individual years 2006/07 and 2012/13, Cohort Y's rate ratios for M:nM disease burden-adjusted age-standardised scripts were statistically significant.

- For 2006/07, with the rate ratio for M:nM disease burden-adjusted age-standardised scripts of 0.63, 95% UI 0.43 to 0.92, the overall adjusted rate in Māori was 37% less than expected vs. non-Māori (calculated from 1 minus 0.63).
- For 2012/13, with the rate ratio for M:nM disease burden-adjusted age-standardised scripts of 0.59, 95% UI 0.43 to 0.92, the overall adjusted rate in Māori was 41% less than expected vs. non-Māori (calculated from 1 minus 0.59)

However, Cohort Y's relative differences in overall adjusted scripts over time were not statistically significant.

- With the ratio of rate ratios 2012/13 vs 2006/07 for M:nM disease burden-adjusted age-standardised scripts of 0.944, 95% UI 0.552 to 1.615, the relative change over the 6 years was -5.6%, with a plausible range (95% UI) of -61.5% to +44.8% (calculated from 1 minus 0.944, 1 minus 1.615, 1 minus 0.552)

Hence, although Cohort Y's overall differences were significant for individual years, the magnitude of the overall difference did not change significantly over the six years. We were unable to exclude chance and accepted modelling artefacts, with uncertainty limits, causing any nominal 6% "deterioration" in Cohort Y's M:nM inequity over time. The 6% gap could have plausibly improved by half, or deteriorated by 3/5ths. Simply, there was no improvement in the overall pattern over the six years, but likewise no good evidence that any "deterioration" was real and overt.

(Confining analysis to sampling error, ie, just confidence limits, did provide statistically significant deterioration, with a range around the 6% relative worsening of 2 to 10%, but this excluded additional nonsampling modelling error, so is not reasonably valid.)

The above approaches can be used to assess uncertainty in PHARMAC's and others' future monitoring of disease burden-adjusted script inequities, including one-year prevalence by therapeutic subgroup and major pharmaceuticals, access vs persistence, etc.

Because of the suitability of sampling-only error-derived standard errors for pharmaceutical usage (with 95% confidence limits), but not for burden disease (which require additional nonsampling error, to derive 95% uncertainty limits), note we would be more confident of detecting changes in pharmaceutical usage over time, but less so detecting changes in disease burden and consequent DALY-adjusted pharmaceutical usage.

Author information:

Scott Metcalfe, Chief Advisor Population Medicine/Deputy Medical Director (on external secondment); Catherine Proffitt, Manager Access Equity; Ātene Andrews, (Ngāti Porou), Kaiwhakahaere Whakarata Māori/Manager Māori Responsiveness, PHARMAC, Wellington; Jude Urlich, Wellington; Kebede Beyene, Research Fellow in Pharmacoepidemiology and Health Outcomes; Jeff Harrison, Head of School, School of Pharmacy, Faculty of Medical and Health Sciences; Rhys Jones, (Ngāti Kahungunu), Senior Lecturer, Te Kupenga Hauora Māori, Faculty of Medical and Health Sciences, University of Auckland, Auckland.

Corresponding author:

Dr Scott Metcalfe, PHARMAC, PO Box 10-254, Wellington.
scott.metcalfe@pharmac.govt.nz

URL:

http://www.nzma.org.nz/journal/read-the-journal/all-issues/2010-2019/2018/vol-131-no-1485-9-november-2018/7737

REFERENCES:

1. PHARMAC. About PHARMAC [internet]. http://www.pharmac.govt.nz/about/

2. Pharmaceutical Management Agency. Statement of Intent 2017/18-2020/21. Wellington: PHARMAC, 2017. http://www.pharmac.govt.nz/assets/statement-of-intent-2017-18-2020-21.pdf

3. Auckland UniServices. Variation in medicines use by ethnicity: a comparison between 2006/7 and 2012/13. Final Report. Prepared for PHARMAC. Auckland: University of Auckland, 2018. http://www.pharmac.govt.nz/tools-resources/research/maori-uptake-of-medicines/, http://www.pharmac.govt.nz/assets/2018-01-19-Variation-in-medicines-use-by-ethnicity-Final-Report.pdf. Appendices and data http://www.pharmac.govt.nz/assets/2018-02-26-Maori-uptake-of-medicines-appendices.xlsx

4. Metcalfe S, Laking G, Arnold J. Variation in the use of medicines by ethnicity in 2006/07; a preliminary analysis. N Z Med J 2013; 126:14–41. http://www.nzma.org.nz/journal/read-the-journal/all-issues/2010-2019/2013/vol-126-no-1384/5869

5. Horsburgh S, Norris P. Ethnicity and access to prescription medicines. N Z Med J. 2013; 126(1384):7–11. http://www.nzma.org.nz/journal/read-the-journal/all-issues/2010-2019/2013/vol-126-no-1384/5874

6. New Zealand Public Health and Disability Act 2000 http://www.legislation.govt.nz/act/public/2000/0091/latest/DLM80051.html section 47 Objectives of Pharmac (47(a)), section 48 Functions of Pharmac (48(c)).

7. PHARMAC. Factors for consideration: supporting information [internet]. Wellington: PHARMAC, 2018. http://www.pharmac.govt.nz/medicines/how-medicines-are-funded/factors-for-consideration/supporting-information/#factors

8. Braveman P, Gruskin S. Defining equity in health. J Epidemiol Community Health. 2003; 57(4):254–8. http://jech.bmj.com/content/57/4/254.long

9. Braveman P. What are health disparities and health equity? We need to be clear. Public Health Rep. 2014; 129 Suppl 2:5–8. http://journals.sagepub.com/doi/pdf/10.1177/00333549141291S203

10. New Zealand College of Public Health Medicine / New Zealand Medical

Association. NZCPHM Policy Statement on Health Equity (adopting the New Zealand Medical Association Position Statement on Health Equity 2011). Wellington: NZCPHM, 2016. http://www.nzcphm.org.nz/media/5892 3/2016_11_17_nzcphm_ health_equity_policy_ statement.pdf

11. World Health Organization. Equity [internet]. Geneva: World Health Organization, 2016. http://www.who.int/healthsystems/topics/equity/en/

12. Ministry of Health. Eligibility for publicly funded health services [internet]. Wellington: Ministry of Health, 2011. http://www.health.govt.nz/new-zealand-health-system/eligibility-publicly-funded-health-services

13. PHARMAC. Te Whaioranga 2013-2023: Māori Responsiveness Strategy. Wellington: PHARMAC, 2017. http://www.pharmac.govt.nz/maori/, http://www.pharmac.govt.nz/assets/te-whaioranga-iii-strategy-2013-2023.pdf

14. PHARMAC. PHARMAC's Pacific responsiveness strategy 2017–2026. Wellington: PHARMAC, 2017. http://www.pharmac.govt.nz/pacific/, http://www.pharmac.govt.nz/assets/pacific-responsiveness-strategy-2017-2026.pdf

15. Crown Entities Act 2004, Schedule 1 http://www.legislation.govt.nz/act/public/2004/0115/latest/DLM331113.html

16. Marrone S. Understanding barriers to health care: a review of disparities in health care services among indigenous populations. Int J Circumpolar Health. 2007; 66(3):188–198.

17. Woodward A, Kawachi I. Why reduce health inequalities? J Epidemiol Community Health. 2000; 54(12):923–9. http://jech.bmj.com/content/54/12/923.long

18. Hebert PL, Sisk JE, Howell EA. When does a difference become a disparity? conceptualizing racial and ethnic disparities in health. Health Aff (Millwood). 2008; 27(2):374–82. http://www.healthaffairs.org/doi/full/10.1377/hlthaff.27.2.374

19. Statistics NZ. New Zealand period life tables: 2012–14. http://www.stats.govt.nz/browse_for_stats/health/life_expectancy/NZLifeTables_HOT P12-14.aspx

20. Cowan S. The Rainbow Report: understanding recent infant mortality changes in New Zealand: 2001–2014. Christchurch: Change for our Children Limited, 2015. http://www.changeforourchildren.nz/files/docs/the%20rainbow%20report_01 0515.pdf

21. Ministry of Health. Health loss in New Zealand: A report from the New Zealand Burden of Diseases, Injuries And Risk Factors Study, 2006–2016. Wellington. Ministry of Health. 2013. http://www.moh.govt.nz/notebook/nbbooks.nsf/0/F85C39E4495B9684C-C257BD3006F6299/$file/health-loss-in-new-zealand-final.pdf

22. New Zealand College of Public Health Medicine. NZCPHM Policy Statement on Māori Health. Wellington: NZCPHM, 2015. http://www.nzcphm.org.nz/media/897 86/2015_11_30_m_ori_ health_policy_statement. pdf

23. New Zealand College of Public Health Medicine. NZCPHM Policy Statement on Pacific Peoples' Health. Wellington: NZCPHM, 2015. http://www.nzcphm.org.nz/media/87942/2015 _08_14_pacific_peoples__ health_policy_statement. pdf

24. New Zealand College of Public Health Medicine. Public health: a strong focus on prevention [internet]. Wellington: NZCPHM, 2014. http://www.nzcphm.org.nz/media/95762/2006_ daly_losses.pdf

25. Gauld R. Questions about New Zealand's health system in 2013, its 75th anniversary year. N Z Med J. 2013; 126(1380):68–74. http://www.nzma.org.nz/journal/read-the-journal/all-issues/2010-2019/2013/vol-126-no-1380/view-gauld

26. Gluckman P. The role of evidence in policy formation and implementation: a report from the Prime Minister's Chief Science Advisor. Wellington: Office of the Prime Minister's Chief Science Advisor, 2013. http://www.pmcsa.org.nz/wp-content/uploads/The-role-of-evidence-in-policy-formation-and-implementation-report.pdf

27. New Zealand Health Strategy 2016. Wellington: Ministry of Health, 2016. http://www.health.govt.nz/publication/new-zealand-health-strategy-2016

28. Gauld R. Ahead of its time? Reflecting on New Zealand's Pharmac following its 20th anniversary. Pharmacoeconomics. 2014; 32(10):937–42. http://link.springer.com/article/10.1007%2Fs40273-014-0178-2; with correction: Metcalfe S et al. Clarification from PHARMAC: PHARMAC Takes No Particular Distributive Approach (Utilitarian or Otherwise). Pharmacoeconomics 2014; 32:1031–1033. http://link.springer.com/

article/10.1007/s40273-014-0208-0/fulltext.html

29. Singer P, McKie J, Kuhse H, Richardson J. Double jeopardy and the use of QALYs in health care allocation. J Med Ethics. 1995; 21:144–50. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1376689/pdf/jmedeth00296-0016.pdf

30. Marmot M, Friel S, Bell R, Houweling TA, Taylor S; Commission on Social Determinants of Health. Closing the gap in a generation: health equity through action on the social determinants of health. Lancet. 2008; 372(9650):1661–9. http://www.sciencedirect.com/science/article/pii/S0140673608616906

31. The World Bank. Equity and development: World Development Report 2006. New York: The World Bank & Oxford University Press, 2006. http://siteresources.worldbank.org/INTWDR2006/Resources/477383-1127230817535/082136412X.pdf

32. Williams D, Garbutt B, Peters J. Core Public Health Functions for New Zealand. N Z Med J. 2015; 128(1418):16–26. http://www.nzma.org.nz/journal/read-the-journal/all-issues/2010-2019/2015/vo-128-no-1418-24-july-2015/6592

33. Wilson N. Commentary on 'Core public health functions for New Zealand' [Editorial]. N Z Med J. 2015; 128(1418):7–10. http://www.nzma.org.nz/journal/read-the-journal/all-issues/2010-2019/2015/vo-128-no-1418-24-july-2015/6589

34. Masters R, Anwar E, Collins B, Cookson R, Capewell S. Return on investment of public health interventions: a systematic review. J Epidemiol Comm Health

2017; 71:827–834. http://jech.bmj.com/content/jech/71/8/827.full.pdf

35. OECD. Universal health coverage and health outcomes: final report for the G7 Health Ministerial meeting, Kobe, Japan, 11–12 September 2016. Paris: OECD, 2016. http://www.oecd.org/els/health-systems/Universal-Health-Coverage-and-Health-Outcomes-OECD-G7-Health-Ministerial-2016.pdf

36. New Zealand Medical Association. NZMA Position Statement on Health as an Investment. Wellington: NZMA, 2017. http://www.nzma.org.nz/__data/assets/pdf_file/0003/77277/Health-as-an-investment_FINAL.pdf

37. Metcalfe S, Gunasekara S, Baddock K, Clarke L, for the New Zealand Medical Association. Time for healthy investment. N Z Med J. 2017; 130(1464):7–10. http://www.nzma.org.nz/journal/read-the-journal/all-issues/2010-2019/2017/vol-130-no-1464-27-october-2017/7390

38. Ministry of Health. The Burden of Disease and Injury in New Zealand. Public Health Intelligence Occasional Bulletin No. 1. Wellington: Ministry of Health, 2001. http://www.moh.govt.nz/notebook/nbbooks.nsf/0/E916C53D599AE126C-C2569F0007AAA23/$file/BurdenofDisease.pdf

39. Priorities for Maori and Pacific health: evidence from epidemiology. Public Health Intelligence Occasional Bulletin No. 3. Wellington: Ministry of Health, 2001. http://www.moh.govt.nz/notebook/nbbooks.nsf/0/A31842D91480064FC-C256A55007A980A/$file/PrioritiesForMaoriand-PacificHealth.pdf

40. Didham R, Callister P. The effect of ethnic prioritisation on ethnic health analysis: a research note. N Z Med J. 2012; 125(1359):58–66. http://www.nzma.org.nz/journal/read-the-journal/all-issues/2010-2019/2012/vol-125-no-1359/view-didham

41. Ministry of Health. Ways and means: A report on methodology from The New Zealand Burden Of Diseases, Injuries And Risk Factors Study, 2006–2016. Wellington, New Zealand: Ministry of Health, 2013. http://www.moh.govt.nz/notebook/nbbooks.nsf/0/248BE961B0F3AE3B-CC257BD300786265/$file/ways-and-means-final.pdf

42. Ministry of Health. Health loss in New Zealand 1990–2013: a report from the New Zealand Burden of Diseases, Injuries and Risk Factors Study. Wellington: Ministry of Health, 2016. http://www.health.govt.nz/publication/health-loss-new-zealand-1990-2013, http://www.health.govt.nz/nz-health-statistics/health-statistics-and-data-sets/new-zealandburden-diseases-injuries-and-risk-factors-study

43. PHARMAC. New Zealand Pharmaceutical Schedule. http://www.pharmac.health.nz/tools-resources/pharmaceutical-schedule

44. Keppel K, Pamuk E, Lynch J, Carter-Pokras O, Kim Insun, Mays V, et al. Methodological issues in measuring health disparities. Vital Health Stat 2. 2005; (141):1–16. http://www.cdc.gov/nchs/data/series/sr_02/sr02_141.pdf

45. Wells GA, Sultan SA, Chen L, Khan M, Coyle D. Indirect evidence: indirect treatment comparisons in meta-analysis. Ottawa: Canadian Agency for

Drugs and Technologies in Health, 2009. http://www.cadth.ca/media/pdf/H0462_itc_tr_e.pdf

46. Appendix to: Bucher HC, Guyatt GH, Griffith LE, Walter SD. The results of direct and indirect treatment comparisons in meta-analysis of randomized controlled trials. J Clin Epidemiol. 1997; 50(6):683–91. http://pdfs.semanticscholar.org/bcb6/07385e98e1a3c5058f-092b3c1474499af4e5.pdf

47. Smedley BD, Stith AY, Nelson AR. Institute of Medicine, Committee on Understanding and Eliminating Racial and Ethnic Disparities in Health Care. Unequal treatment: confronting racial and ethnic disparities in health-care. Institute of Medicine (US) Committee on Under-standing and Eliminating Racial and Ethnic Dispar-ities in Health Care. Washington (DC): National Academies Press (US). 2003. http://www.ncbi.nlm.nih.gov/books/NBK220358/

48. Physicians for a National Health Program. Dr. Martin Luther King on health care injustice. Chicago Il: PNNP, 2014. http://www.pnhp.org/news/2014/october/dr-martin-luther-king-on-health-care-injustice

49. Reid P, Cram F. Connecting health, people and country in Aotearoa New Zealand. In: Health and Society in Aotearoa New Zealand. (eds Peter Davis, Kevin Dew). Melbourne: Oxford Univer-sity Press, 2005. pp.33–48.

50. United Nations. United Nations Declaration on the Rights of Indigenous Peoples. Adopted by the UN General Assembly 13 September 2007. http://www.un.org/development/desa/indigenouspeoples/decla-ration-on-the-rights-of-in-

digenous-peoples.html, http://www.un.org/esa/socdev/unpfii/documents/DRIPS_en.pdf

51. New Zealand Human Rights Commission. United Nations Declaration on the Rights of Indigenous Peoples. Wellington: New Zealand Human Rights Commission, 2008. http://www.hrc.co.nz/files/5814/5618/4456/NZHR_Booklet_12_WEB.pdf

52. Ministry of Foreign Affairs Trade. Statement by Hon Dr Pita Sharples, Minis-ter of Māori Affairs, 19 April 2010. Ninth session of the UN Permanent Forum on Indigenous Issues, 19–30 April 2010. http://www.mfat.govt.nz/Media-and-pub-lications/Media/MFAT-speeches/2010/0-19-April-2010.php; Hon Dr Pita Sharples. Supporting UN Declaration restores NZ's mana. 20 April 2010 http://www.beehive.govt.nz/release/supporting-un-dec-laration-restores-nzs-mana

53. Metcalfe S. Looking at inequities in access. http://www.pharmac.govt.nz/about/2017/bold-goal-1/in: PHARMAC. Year in Review 2017. Wellington: PHARMAC, 2017. http://www.pharmac.govt.nz/about/2017/ pp.8–9 Let's be bold—bold goal 1: Eliminate inequities in access to medicines.

54. Robson B, Purdie G, Cram F, Simmonds S. Age standardisation–an indig-enous standard?. Emerg Themes Epidemiol. 2007; 4(1):3. http://ete-online.biomedcentral.com/arti-cles/10.1186/1742-7622-4-3

55. Connolly A. Cultur-al Competence, Partnership and Health Equity. Symposium 1 June 2017. Wellington: Medical Council of New Zealand, 2017. http://

www.mcnz.org.nz/assets/News-and-Publications/Presentation-MCNZ-An-drew-Connolly.pdf

56. New Zealand Medical Association. NZMA Policy Briefing: Improving health literacy. Wellington: NZMA, 2017. http://www.nzma.org.nz/__data/assets/pdf_file/0019/56053/Health-Literacy-Pol-icy-Briefing-web.pdf pp.12–14.

57. Consedine R, Consedine J. Healing our history: the challenge of the Treaty of Waitangi (3rd ed.). Auck-land: Penguin Books, 2012. http://www.waitangi.co.nz/healingourhistory.htm

58. Pitama S, Huria T, Lacey C. Improving Maori health through clinical assessment: Waikare o te Waka o Meihana. N Z Med J. 2014; 127(1393):107–19. http://www.nzma.org.nz/journal/read-the-journal/all-issues/2010-2019/2014/vol-126-no-1393/viewpoint-pitama

59. Williams DR, Mohammed SA. Racism and health I: pathways and scientific evidence. Am Behav Sci. 2013;57(8):1152–73. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3863357/

60. Ministry of Health and University of Otago. Decades of disparity III: Ethnic and socioeconomic inequalities in mortality, New Zealand 1981–1999. Wellington: Ministry of Health, 2006. http://www.otago.ac.nz/wellington/otago024509.pdf

61. Curtis E, Harwood M, Riddell T, Robson B, Harris R, Mills C, Reid P. Access and society as determi-nants of ischaemic heart disease in indigenous populations. Heart Lung Circ. 2010; 19(5–6):316–24. http://www.sciencedirect.com/science/article/pii/S1443950610002404

62. Rumball-Smith J, Sarfati D, Hider P, Blakely T. Ethnic disparities in the quality of hospital care in New Zealand, as measured by 30-day rate of unplanned readmission/death. Int J Qual Health Care. 2013; 25(3):248–54. http://academic.oup.com/intqhc/article/25/3/248/1814318

63. Scott N. A Maori cultural reluctance to present for care, or a systems and quality failure? How we pose the issue, informs our solutions. N Z Med J. 2014; 127(1393):8–11. http://www.nzma.org.nz/journal/read-the-journal/all-issues/2010-2019/2014/vol-126-no-1393/edit-scott

64. Scott N, Lawrenson R. Potential for health gain equity. N Z Med J. 2015; 128(1415):10–3. http://www.nzma.org.nz/journal/read-the-journal/all-issues/2010-2019/2015/vol-128-no-1415/6545

65. Jones CP. Invited commentary: "Race", racism, and the practice of epidemiology. Am J Epidemiol. 2001; 154(4):299–304. http://academic.oup.com/aje/article/154/4/299/61900

66. Harris R, Tobias M, Jeffreys M, Waldegrave K, Karlsen S, Nazroo J. Effects of self-reported racial discrimination and deprivation on Māori health and inequalities in New Zealand: cross-sectional study. Lancet. 2006; 367(9527):2005–9. http://linkinghub.elsevier.com/retrieve/pii/S0140-6736(06)68890-9

67. van Ryn M, Burgess DJ, Dovidio JF, Phelan SM, Saha S, et al. The impact of racism on clinician cognition, behavior, and clinical decision making. Du Bois Rev. 2011; 8(1):199–218. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3993983/

68. Paradies Y, Ben J, Denson N, Elias A, Priest N, et al. Racism as a determinant of health: a systematic review and meta-analysis. PLoS One. 2015; 10(9):e0138511. http://dx.plos.org/10.1371/journal.pone.0138511

69. Came H, McCreanor T, Doole C, Rawson E. The New Zealand Health Strategy 2016: whither health equity? N Z Med J. 2016; 129(1447):72–77. http://www.nzma.org.nz/journal/read-the-journal/all-issues/2010-2019/2016/vol-129-no-1447-16-december-2016/7107

70. Harris RB, Stanley J, Cormack DM. Racism and health in New Zealand: Prevalence over time and associations between recent experience of racism and health and wellbeing measures using national survey data. PLoS One. 2018; 13(5):e0196476. http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0196476

71. World Health Organization. The Ottawa Charter for Health Promotion. First International Conference on Health Promotion, Ottawa, 21 November 1986. http://www.who.int/healthpromotion/conferences/previous/ottawa/en/index1.html

72. Bangkok Charter for Health Promotion in a globalised world. 6th Global Conference on Health Promotion, Bangkok, Thailand, August 2005 [internet]. http://www.who.int/healthpromotion/conferences/6gchp/hpr_050829_%20BCHP.pdf

73. Ministry of Health. Equity of healthcare for Māori: a framework. Wellington: Ministry of Health, 2014. http://www.health.govt.nz/publication/equity-health-care-maori-framework

74. Hon. Dr David Clark, Minister of Health. Letter of expectations for the Pharmaceutical Management Agency for 2018/19. Wellington, 20 June 2018. http://www.pharmac.govt.nz/assets/Letter-of-expectations-2018-21.pdf

75. Hon. Dr David Clark, Minister of Health. Letter of expectations for District Health Boards and Subsidiary Entities for 2018/19. Wellington, 10 May 2018. http://nsfl.health.govt.nz/dhb-planning-package/201819-planning-package/supplementary-information-201819-planning-guidelines-0

76. Ministry of Health. New Zealand Health Survey: Annual Data Explorer 2016/17 (Annual Update of Key Results 2016/17: New Zealand Health Survey). Wellington: Ministry of Health, 2017. http://www.health.govt.nz/publication/annual-update-key-results-2016-17-new-zealand-health-survey, http://minhealthnz.shinyapps.io/nz-health-survey-2016-17-annual-data-explorer/_w_51d929ff/#!/explore-indicators Populations: Adults (aged 15 years and over), Children (aged 0–14 years); Topic: Barriers to accessing health care; Indicators: Experienced one or more types of unmet need for primary health care in the past 12 months; Unmet need for GP due to cost in the past 12 months; Unfilled prescription due to cost in past 12 months.

77. Willing EA. Understanding the implementation of New Zealand's immunisation health target for two year olds. Thesis submitted for PhD in Health Science, University of Auckland, 2014. http://researchspace.auckland.ac.nz/bitstream/handle/2292/23807/whole.pdf

78. Pharmacy Council. Cultural competence [internet]. http://www.pharmacycouncil.org.nz/New-Zealand-Registered-Pharmacists/Recertification/Cultural-Competence

79. Durie M. Cultural competence and medical practice in New Zealand. Paper presented to the Australian and New Zealand Boards and Councils Conference, Wellington, New Zealand, November 2001. http://www.massey.ac.nz/massey/fms/Te%20Mata%20O%20Te%20Tau/Publications%20-%20Mason/M%20Durie%20Cultural%20competence%20and%20medical%20practice%20in%20New%20Zealand.pdf?593A067DE46338C6A-EA781519C30CC73

80. http://healthierlives.co.nz/research/making-health-interventions-work-for-maori-communities/

81. Boyd H, McKernon S, Mullin B, Old A. Improving healthcare through the use of co-design. N Z Med J. 2012 Jun 29; 125(1357):76–87. http://www.nzma.org.nz/journal/read-the-journal/all-issues/2010-2019/2012/vol-125-no-1357/article-boyd

82. Nesta/IDEO. Designing for public services: a practical guide [internet]. 2017. http://www.nesta.org.uk/toolkit/designing-for-public-services-a-practical-guide/

83. Durie M. Te Pae Māhutonga: a model for Māori health promotion. Health Promotion Forum of New Zealand 1999:Newsletter 49. http://www.cph.co.nz/wp-content/uploads/TePaeMahutonga.pdf

84. Ngā Pae o te Māramatanga. Te Mana Raraunga—the Māori Data Sovereignty Network. http://www.maramatanga.co.nz/news-events/news/te-mana-raraunga-m-ori-data-sovereignty-network

85. Reid P, Paine SJ, Curtis E, Jones R, Anderson A, Willing E, Harwood M. Achieving health equity in Aotearoa: strengthening responsiveness to Māori in health research. N Z Med J. 2017; 130(1465):96–103. http://www.nzma.org.nz/journal/read-the-journal/all-issues/2010-2019/2017/vol-130-no-1465-10-november-2017/7414

86. Jansen R. Indigenous data sovereignty: a Māori health perspective. Chapt 11 of: Kukutai K, Taylor J (eds.). Indigenous data sovereignty: toward an agenda. Acton, ACT: ANU Press; 2016. pp.191-213. http://www.jstor.org/stable/j.ctt1q1crgf.18?seq=1#page_scan_tab_contents = http://www.jstor.org/stable/pdf/j.ctt1q1crgf.18.pdf

87. Robson B, Reid P. Review of the measurement of ethnicity—Māori perspective. Wellington: Te Röpü Rangahau Hauora a Eru Pömare, 2001. For Statistics New Zealand. http://archive.stats.govt.nz/browse_for_stats/population/census_counts/review-measurement-of-ethnicity/maori-perspective.aspx

88. Pipi K, Cram F, Hawke R, Hawke S, Huriwai TM, et al. A Research Ethic for Studying Māori and Iwi Provider Success. Soc Pol J NZ Te Puna Whakaaro. 2004; (23):141–53. http://www.msd.govt.nz/documents/about-msd-and-our-work/publications-resources/journals-and-magazines/social-policy-journal/spj23/23-pages141-153.pdf

89. Walker S, Eketone A, Gibbs A. An exploration of kaupapa Maori research, its principles, processes and applications. Int J Soc Res Meth. 2006; 9(4):331–44.

http://www.tandfonline.com/doi/full/10.1080/13645570600916049

90. Jones R, Crengle S, McCreanor T. How Tikanga Guides and Protects the Research Process: Insights from the Hauora Tāne Project. Soc Pol J NZ Te Puna Whakaaro. 2006; (29):60–77. http://www.msd.govt.nz/documents/about-msd-and-our-work/publications-resources/journals-and-magazines/social-policy-journal/spj29/29-pages-60-77.pdf

91. Mane J. Kaupapa Māori: A community approach. MAI Review 2009;3(1). Māori Education Commission. Report to the Minster of Māori Affairs. Report 2. Wellington, 1998. http://www.review.mai.ac.nz/index.php/MR/article/viewFile/243/282

92. Te Ara Tika Guidelines for Māori research ethics: A framework for researchers and ethics committee members. Hudson M, Milne M, Reynolds P, Russell K, Smith B; The Pūtaiora Writing Group. Auckland: Health Research Council, 2010. http://www.hrc.govt.nz/sites/default/files/Te%20Ara%20Tika%20Guidelines%20for%20Maori%20Research%20Ethics.pdf

93. http://www.katoa.net.nz/kaupapa-maori; http://whatworks.org.nz/kaupapa-maori/; http://www.fmhs.auckland.ac.nz/en/faculty/tkhm/tomaiora/what-we-do-mahi/kaupapa-m_ori-research.html; http://www.mcguinnessinstitute.org/wp-content/uploads/2016/08/Working-Paper-200902-Web.pdf

94. Gurney JK, Scott N, Thompson G, Turner S, Anson J, et al; for Hei Āhuru Mōwai – National Māori Cancer Leadership Group. New Zealand's revised Ethnicity Data Protocols must not

become a shelved document: a challenge from Hei Āhuru Mōwai. N Z Med J 2018; 131(1470):104–6. http://www.nzma.org.nz/journal/read-the-journal/all-issues/2010-2019/2018/vol-131-no-1470-23-february-2018/7505

95. Mana Whakamärama—Equal Explanatory Power: Mäori and non-Mäori sample size in national health surveys. Wellington: Te Röpü Rangahau Hauora a Eru Pömare, Wellington School of Medicine and Health Sciences, University of Otago Wellington, 2012. Available from http://www.fmhs.auckland.ac.nz/assets/fmhs/faculty/tkhm/tumuaki/docs/Equal_explanatory_power.doc

96. Sarfati D, Gurney J, Stanley J, Koea J. A retrospective cohort study of patients with stomach and liver cancers: the impact of comorbidity and ethnicity on cancer care and outcomes. BMC Cancer. 2014; 14:821. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4233029/

97. Welch V, Petticrew M, Petkovic J, Moher D, Waters E, White H, Tugwell P; PRISMA-Equity Bellagio group. Extending the PRISMA statement to equity-focused systematic reviews (PRISMA-E 2012): explanation and elaboration. J Clin Epidemiol. 2016; 70:68–89. http://www.sciencedirect.com/science/article/pii/S0895435615004205

98. Wells GA, Sultan SA, Chen L, Khan M, Coyle D. Indirect evidence: indirect treatment comparisons in meta-analysis. Ottawa: Canadian Agency for Drugs and Technologies in Health, 2009. https://www.cadth.ca/media/pdf/H0462_itc_tr_e.pdf

99. Boyle P, Parkin DM. Statistical Methods For Registries [Internet]. in: Jensen OM, Parkin DM, MacLennan R, Muir RS, Skeet RG (eds.). Cancer registration principles and methods. IARC Scientific Publication No. 95. http://publications.iarc.fr/Book-And-Report-Series/Iarc-Scientific-Publications/Cancer-Registration-Principles-And-Methods-1991. Chpt 11 pp. 126-158. Lyon: International Agency for Research on Cancer, 1991.

100. Appendix to: Bucher HC, Guyatt GH, Griffith LE, Walter SD. The results of direct and indirect treatment comparisons in meta-analysis of randomized controlled trials. J Clin Epidemiol. 1997;50(6):683-91. http://pdfs.semanticscholar.org/bcb6/07385e98e1a3c5058f-092b3c1474499af4e5.pdf

101. GBD 2016 DALYs and HALE Collaborators. Global, regional, and national disability-adjusted life-years (DALYs) for 333 diseases and injuries and healthy life expectancy (HALE) for 195 countries and territories, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet. 2017; 390(10100):1260-1344. doi: 10.1016/S0140-6736(17)32130-X. http://www.sciencedirect.com/science/article/pii/S014067361732130X, http://www.ncbi.nlm.nih.gov/pmc/articles/pmid/28919118/

102. Burden of disease data for New Zealand for 2013 obtained from Institute for Health Metrics and Evaluation (IHME) GBD Results Tool http://ghdx.healthdata.org/gbd-results-tool, http://www.healthdata.org/data-visualization/gbd-compare for DALYS New Zealand 2013 all ages / all diseases / both sexes, 95% lower and upper uncertainty values (ULs)

103. Burden of disease data for New Zealand for 2006, including ethnicity and standard errors (sample error-only), from NZBDIRF 2006-2016 Ways and means report pp ix,7,10,82,83, and from http://www.health.govt.nz/publication/new-zealand-burden-diseases-statistical-annexe