We thank Metcalfe et al (18 January 2019) for their careful consideration of our article describing ethnic disparities in community antibacterial dispensing in New Zealand during 2015, and for their comments on whether the health of Māori and Pacific people in New Zealand would be best served by increasing or reducing their current rates of antibacterial dispensing. We consider that the data in our article and in other recently published studies shows that: (a) the overall rate of antibacterial dispensing in New Zealand is very high compared with many other developed nations, (b) a large proportion of antibacterial dispensing in New Zealand is likely to be inappropriate conferring little or no clinical benefit, and (c) the rates of dispensing of antibiotics for Māori and Pacific people differs relatively little from the rates of dispensing for other ethnic groups despite a significantly higher incidence of many infectious diseases in Māori and Pacific people.

We found the rate of community dispensing of antibiotics for people of European ethnicity in New Zealand during 2015 was 3.02 prescription items/1,000 population/day. This was approximately 3.3 times higher than the national rate in Sweden (0.90), 2.1 times higher than the national rate in Denmark (1.45), 1.7 times higher than the national rate in Canada (1.79), 1.5 times higher than the national rate in England (1.95), and 1.3 times higher than the estimated national rate in the US (2.31). While the incidence of infectious diseases in European people in New Zealand no doubt differs from that in residents of these other nations, we would be surprised if differences in the incidence of infectious disease justified these major differences in the rates of community antibacterial dispensing. A much more likely explanation is that the high rate of antibacterial dispensing for European people in New Zealand reflects higher rates of inappropriate prescribing in New Zealand than in these other nations.

Metcalfe et al suggest that we may have overestimated the magnitude of inappropriate antibiotic prescribing in New Zealand and refer to articles indicating that the rate of overprescribing might be approximately 30% in the US, and 8–23% in the UK. We note two recently published studies that have used large general practice databases to estimate current rates of inappropriate community antimicrobial prescribing for patients with respiratory tract infections in the UK and Australia. These studies estimated that inappropriate prescribing accounted for: 75% of prescribing for acute cough in the UK, 87% of prescribing for acute rhinosinusitis in the UK and 77%
in Australia, and 80% of prescribing for acute otitis media in the UK and 45% in Australia. As these conditions comprise a large proportion of community antimicrobial prescribing, we believe it reasonable to estimate that approximately 50% of total community antibiotic dispensing in New Zealand may be inappropriate.

There is strong evidence that the overall rate of inappropriate antibiotic dispensing is very high in New Zealand. For example, Figure 1 shows that, overall, an antibiotic was dispensed at 61% (31,082/50,691) of consultations for acute upper respiratory tract infections in 111 New Zealand general practices during 2014.

In approximately 73% of general practices included in this survey an antibiotic was prescribed and dispensed for more than 50% of patients who presented with a respiratory tract infection. (Personal communication Tomlin A, Tilyard M. 2019) Many guidelines suggest that antibiotics should be prescribed for a minority of such patients.12–14

Other data indicating high rates of inappropriate antibiotic prescribing include a 26% increase in the national rate of antibacterial dispensing during winter in New Zealand,2 presumably mostly for patients with self-limited viral respiratory tract infections, and an average annual rate of 1.9 antibiotic dispensings/child/year in the first five years of life, for the 5,581 children enrolled in the Growing Up in New Zealand study.5 We acknowledge that there are no studies that have directly measured the rate of inappropriate community antimicrobial prescribing in New Zealand, however we consider that the figure of 8–23% suggested by Metcalfe et al is likely to be a significant underestimate. The available data suggest to us that the overall rate of inappropriate community antibiotic prescribing in New Zealand is more likely to be between 30% and 50%. Furthermore, the marked similarity between ethnic groups in the magnitude of the increase in antibiotic dispensing during the winter,2 suggests that inappropriate antibiotic dispensing is a comparable problem for all ethnic groups in New Zealand.

The higher incidence of many infectious diseases in Māori and Pacific people than in people of other ethnicities in New Zealand,2,6–8 is a compelling reason why Māori and Pacific people require higher rates of antibiotic dispensing. We appreciate the efforts of Metcalfe et al to calculate a suitable ratio for the rate of antibiotic dispensing for Māori and Pacific people in relation to that for non-Māori and non-Pacific people. We do not disagree with their suggestion that an appropriate rate of antibiotic dispensing for Māori and Pacific people may be approximately 1.66 times

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**Figure 1:** The proportion of consultations for an acute upper respiratory tract infection, at 111 general practices in New Zealand, during 2014, that were associated with dispensing of an antibiotic during the subsequent seven days. Each column represents one general practice.
the rate for non-Māori and non-Pacific people. However, we strongly believe that the appropriate rate of antibiotic dispensing for Māori and Pacific people should be estimated in relation to the appropriate rate of dispensing for people of other ethnicities, and not in relation to the current excessively high rates.

Here we consider two scenarios in which we assume: (a) that in non-Māori and non-Pacific people, either 30% or 50% of antibiotic dispensings are inappropriate; and (b) that the appropriate rate of antibiotic dispensing for Māori and Pacific people is 1.66 times the appropriate rate of dispensing for non-Māori and non-Pacific people.

If approximately 30% of current dispensing for non-Māori and non-Pacific people is inappropriate, then the estimated rate of appropriate dispensing for these people is approximately 2.1 (70% X 3.02) antibiotic dispensings/1,000 population/day, a rate midway between the current national dispensing rates in the US and Canada, and slightly higher than the current national dispensing rate in England. The rate of appropriate antibiotic dispensing for Māori and Pacific people may therefore be estimated as approximately 3.5 (1.66 X 2.1) antibiotic dispensings/1,000 population/day, which is similar to the actual current rates of 3.2 (Māori) and 3.5 (Pacific people) antibiotic dispensings/1,000 population/day.

If approximately 50% of current dispensing for non-Māori and non-Pacific people is inappropriate, then the estimated rate of appropriate dispensing for these people is 1.5 (50% X 3.02) antibiotic dispensings/1,000 population/day, a rate similar to the current national dispensing rate in Denmark. The rate of appropriate antibiotic dispensing for Māori and Pacific people may therefore be estimated as approximately 2.5 (1.66 X 1.5) antibiotic dispensings/1,000 population/day, significantly lower than the current rates of 3.2 (Māori) and 3.5 (Pacific people) antibiotic dispensings/1,000 population/day.

We believe that Māori and Pacific people currently do “suffer from double jeopardy, being harmed by both over-prescribing and under-prescribing” as Metcalfe et al suggest. Both under- and over-prescribing contribute to health inequities in these ethnic groups. The higher proportion of staphylococcal disease in Māori and Pacific people caused by methicillin-resistant Staphylococcus aureus (MRSA) is likely to be in part a consequence of over-prescribing of antibiotics for Māori and Pacific people, while their higher rates of admission to hospital for infectious diseases are strongly suggestive of harm arising from under-prescribing of antibiotics. Therein lies the challenge with antimicrobial stewardship programmes in New Zealand. As we suggested in our previous article, we must reduce our rates of inappropriate antibiotic prescribing, while increasing our rates of appropriate antibiotic prescribing. The need to reduce inappropriate antibiotic prescribing is not just limited to non-Māori and non-Pacific people since unnecessary antibiotics should not be prescribed for any patient. The need to increase appropriate antibiotic prescribing is greatest in Māori and Pacific people. Therefore, we reiterate our previous recommendation that antimicrobial stewardship programmes should be sufficiently nuanced to not only reduce rates of inappropriate prescribing but also to increase rates of treatment for infections that do require antimicrobial therapy. We welcome further commentary on how this delicate but important balance can be achieved in an equitable manner across all population groups in New Zealand.
Competing interests: Nil.

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