Public Health Association of New Zealand– Auckland and Canterbury West Coast branch submission on Taumata Arowai's consultation on drinking water standards and quality assurance rules

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The Public Health Association of New Zealand (PHANZ) is a national association representing public, private and voluntary sectors. Our organisation's vision is 'Good health for all - health equity in Aotearoa', or 'Hauora mō te katoa – oranga mō te Ao', and our purpose is to advocate for the health of all New Zealanders. To achieve this, we provide a forum for information and debate about public health action in Aotearoa New Zealand. Public health action aims to improve, promote and protect the health of the whole population through the organised efforts of society. We recognise Te Tiriti o Waitangi as Aotearoa New Zealand's founding document, defining respectful relationships between tangata whenua and tangata Tiriti, and are actively committed to supporting Te Tiriti values in policy and legislation.

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Our submission is summarised below, under drinking water standards and drinking water quality assurance rules. In summary, we recommend public health be prioritised.

Drinking water standards

Standard setting process

Recommendation 1: The Drinking Water Standards should clearly outline Taumata Arowai's adopted risk assessment process used to set MAVs.

Provisional nitrite MAV

Recommendation 2: Do not remove the provisional MAV for nitrite

Provisional nitrate MAV (chronic/long term)

Recommendation 3: Introduce a provisional MAV for chronic nitrate exposure

Drinking water quality assurance rules

- *National database for water quality*

Recommendation 4: Establish a national database for water supply quality

- *National spatial database of water supply components*

Recommendation 5: Create and maintain a national spatial dataset on water supply components

- *Quantifiable testing results over compliance-based records*

Recommendation 6: Quantifiable testing results must be kept rather than compliance-based results

Recommendation 7*:* Increase the frequency of testing and the range of contaminants that are tested.

- **In summary, given new and emerging science around risks of nitrates in drinking water, we recommend adoption of the precautionary principle.**

1) We acknowledge the Maximum Allowable Values (MAVs) were determined through external technical input and review, which were later reviewed by the Institute of Environmental Science and Research Limited (ESR) and the Ministry of Health (MoH).
2) However, it appears there was no consistent decision-making hierarchy adopted when setting the MAVs.

3) The World Health Organization (WHO) Guideline Values (GV) appear to have been used as the basis of the previous Ministry of Health Drinking-Water Standards and the starting point for these current standards. However, some MAVs were removed, added or adjusted based on advice from certain organisations (eg, Cawthron Institute, ESR) or based on the values adopted in other jurisdictions (eg, Australian Drinking Water Guidelines), rather than WHO GV.
4) We acknowledge different jurisdictions adopt different MAVs based on their local context and risk assessment. In fact, in principle, we support Taumata Arowai's willingness to set MAVs that are consistent with New Zealand's risk thresholds and latest evidence.
5) However, without a clearly articulated decision-making hierarchy used to set standards, it is difficult to understand the inconsistencies in the adoption of WHO-GV for example. Further, it also limits our understanding of what evidence is required to inform domestic standard setting.
6) For example, the consultation document says *"Advances in scientific knowledge may lead to changes in the MAVs. When evidence for these changes becomes available, revised MAVs will be included in later editions of the Standards."* However, it is unclear what scientific evidence is required and what process will be used to revise MAVs in the future.
7) We disagree with the decision to remove the provisional MAV of 0.2 (mg/L) for long term exposure to nitrite based on the rationale that the WHO has suspended the value due to uncertainty. Uncertainty is not a valid justification for removing MAVs.
8) An International Agency for Research on Cancer (IARC) Working Group reviewing studies up to 2006, concluded that ingested nitrate or nitrite is probably carcinogenic to humans.[1] Nitrate/Nitrite are precursors to the formation of N-nitroso compounds (NOC) which are known carcinogens.[2] To date, there is not sufficient evidence to overturn IARC's conclusions. Thus, a precautionary approach should be adopted to protect public health when the evidence is uncertain.

9) Nitrate is one of the most common drinking water contaminants in NZ, largely driven by agricultural activity (nitrogen fertiliser application and livestock urine).[3] Nitrate leached into water from dairy farming has doubled since 1990.[4]

10) The World Health Organization (WHO) set nitrate MAV at 50mg/L based on epidemiological evidence of the acute risk of Methemogloblobinemia,[5] which has been adopted in the DWSNZ in NZ.[6]

11) There is currently no proposed MAV for chronic nitrate exposure.

12) Epidemiological evidence has observed associations between nitrate in drinking water and a range of adverse health outcomes including colorectal cancer,[7-12] congenital anomalies,[13] preterm births[14] and childhood cancer[15] far below the current MAV.[6] Additionally, there is recent suggestive genetic and experimental evidence that implications nitrate in drinking water and colorectal cancer.[16, 17]

13) *Colorectal Cancer:* The below is a meta-analysis of epidemiological studies investigating the association between drinking water nitrate and colorectal cancer.[18] Almost all the point estimates, the red and black dots, are on the right of the null line, suggesting there is an increased risk of colorectal cancer with higher nitrate levels in drinking water. All nitrate exposures were far below the current MAV (except Fathmawati 2017, >50mg/L). This includes those studies that did not detect a statistically significant finding. These studies often had small populations (insufficient power), poor exposure assessments (relied exclusively on environmental modelling) or focused on a very specific population (eg, elderly women in Iowa. USA).

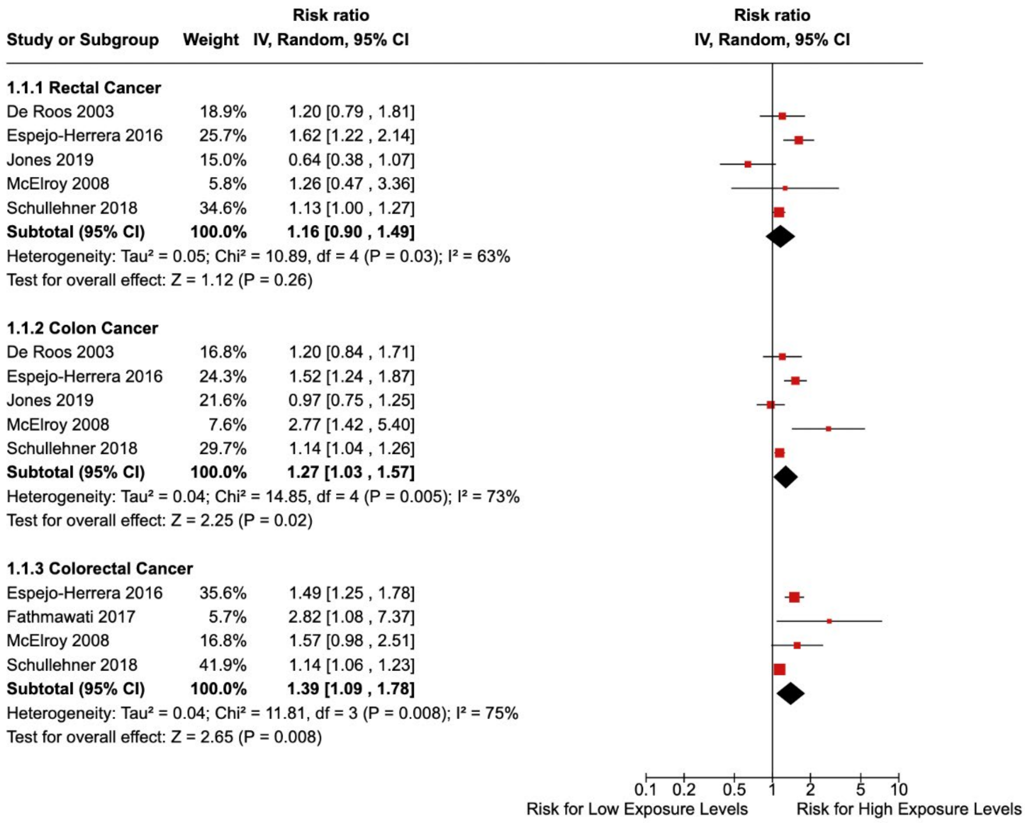

Figure 1. Our meta-analysis of epidemiological studies investigating nitrate contamination and colorectal cancer

14) The two more methodological robust epidemiological studies conducted to date are Espejo-Herrera (2016)[12] and Schullehner (2018).[19] Espejo-Herrera (2016) was a case-control study with 1,869 cases diagnosed with colorectal cancer matched with 3,530 healthy controls in Spain and Italy.[12] The number of colorectal cases in Espejo-Herrera (2016) (n=1,869) were over four times more than all the other comparable case-control studies on the topic combined (n=413).[8-10] Nitrate levels were assigned to each individual based on the participant's residential history, nitrate data was collected from public and private supplies and the participants' reported their daily water intake. Long-term exposure to nitrate-nitrogen concentrations above 7mg/L was associated with 49% increased colorectal cancer risk compared to individuals with

concentrations less than 3.5 mg/L (reference group). Key confounders (sex, age, socioeconomic status, physical activity, smoking and family history of colorectal cancer) were adjusted for in analyses.

15) Schullehner (2018) was a nation-wide, cohort study across the Danish population (n = 1.7 million people and 5,944 colorectal cancer cases).[11] Schullehner (2018) had far higher numbers people and cases than the only other cohort on the topic (n=15,910 people, 767 colorectal cancer cases), which was also focused on elderly women in Iowa.[7]

16) Schullehner (2018) assigned annual average drinking water nitrate concentrations to each individual based on their residential history and nitrate data from public and private water supplies over a 15-year exposure period. The authors found a 11% increased risk of colorectal cancer for individuals exposed to average drinking water nitrate concentrations above 3.8 mg/L compared to individuals with less than 1.3 mg/L (reference group).

17) The study had a large sample, with a robust exposure measurement and adjusted for key confounders (age, sex, socioeconomic status). Any residual confounding is more likely to result in non-differential bias that would push observed relative risks towards the null, not increase them.[20] For example, in Denmark, like New Zealand, other major risk factors for colorectal cancer such as alcohol, smoking and diet are socially patterned, which means socioeconomic status provides some indirect adjustment for these variables. Further, there is insufficient evidence to suggest nitrate contamination is systematically linked to one or more of these other risk factors for colorectal cancer (eg, those with high nitrate levels in drinking water are also systematically more likely to be hazardous drinkers). Additionally, how much of any potential differential distribution in risk factors is not simply accounted for by adjustment by socioeconomic status (eg, how much of any hypothetical link between nitrate contamination and hazardous alcohol consumption is not explained by socioeconomic status).

18) Area-level discrepancies between nitrate exposure, colorectal cancer and modifiable risk factors suggest nitrate contamination could be a contributing factor for New Zealand's internationally high rates of colorectal cancer. The areas with the highest nitrate contamination (Nelson Marlborough, South Canterbury, Canterbury and Southern DHBs) also have some of the highest colorectal cancer rates.[21] However, these same regions also variably have some of the lowest rates of obesity, smoking, alcohol consumption and actually have higher than average rates of fruit and vegetable consumption and physically activity levels nationally.[22] Thus, regional differences in colorectal cancer in these areas cannot be simply dismissed by disproportionate distribution of known risk factors.
19) Experimental studies, in which, subjects consumed a high levels of drinking water nitrate show increases in the biomarkers of endogenous nitrosation measured as apparent total N-nitroso compounds (ATNC).[23]
20) N-nitroso compounds induce DNA-damaging metabolites, which can lead to a specific DNA damage signature that can be detected in cancerous lesions.[24] A recent study identified this specific DNA damage in biopsies from a cohort of 900 colorectal carcinoma cases.[17] Red meat consumption was associated with the alkylating signature in colorectal cancer sites which provided molecular evidence of the mutagenic impact of dietary nitrate/nitrite via the NOC pathway.[17] This finding is supported by other specific genetic somatic mutations linked to dietary factors and CRC.[16, 17, 25, 26]
21) The consultation document states that MAVs for chemical determinands should not result in *"excess lifetime cancer risk of 10−5 (or one additional case of cancer per 100,000 of the population ingesting drinking water containing the substance at the guideline value for 70 years)."*
22) One US study[27] estimated the lifetime cancer risk of 10−5 for nitrate using the California Office of Environmental Health Hazard formula. A nitrate concentration of 1.4 mg/L was the central estimate for an annual one in 100,000 cancer risk.

23) One New Zealand study estimated the current nitrate levels in drinking water could be attributable to up to 100 cases of colorectal cancer per year.[28] The study used a compiled nitrate database on drinking water and the pooled risk estimate from a meta-analysis of eight epidemiological studies.[27]

24) In summary, Picetti et al concluded that there is a paucity of robust studies from settings with high levels of nitrate pollution in drinking water [29]. This finding from the 2022 meta-analysis supports our recommendation of a precautionary approach.

25) *Preterm births:* A recent retrospective cohort study of 4.6 million births in California from 2000-2011 observed an increased risk of early preterm birth for mothers exposed to nitrate >22.1mg/L (OR 1.49 95%CI 1.42, 1.56) and >45mg/L (OR 1.34 95%CI 1.12, 1.60).[14] The authors also conducted a within-mother analysis of exposure-discordant consecutive births which controlled for inter-participant differences. The within-mother analysis showed pregnancies exposed to >22.1mg/L (OR 1.47 95%CI 1.29, 1.67) and >45mg/L (OR 2.52 95%CI 1.49, 4.26) had increased odds of early preterm birth compared to pregnancies exposed to <22.1mg/L. In contrast, one very small cohort study of 4,625 births (~200 PTB defined as <37 weeks gestation) did not find an association between drinking water nitrate and PTB (OR 0.89 95%CI 0.55, 1.43). Some major limitations of this study included the exclusion of 81% of the original cohort, conflation of early and late preterm births (given the differential effect sizes) and extremely small number of preterm births (~200).[30] A recent review of the links between nitrate and maternal outcomes commissioned by the Ministry of Health (MoH) concluded that more high quality, large epidemiology studies are needed to further assess any associations.[31]

26) In summary, the emerging epidemiological, experimental and genetic evidence points towards a relationship between nitrate contamination and cancer.[32] There is also suggestive evidence linking nitrate with congenital anomalies,[13] preterm births[14] and childhood cancer.[15] We acknowledge there remain uncertainties around the potential health impacts of nitrate in drinking.[33] However, this uncertainty supports

the need for a precautionary approach until this relationship is better understood, particularly as nitrate levels in water rise in many areas in New Zealand. Introducing a provisional MAV for the chronic effects of nitrate contamination would help New Zealand potentially reduce the health burden associated with one of its most common drinking water contaminants.

27) Currently, quantitative water quality results are not consistently collated into a central water quality database. For example, *Drinking Water Online*, contains nitrate testing results for only 7% of all registered supplies, with its earliest measurements starting in 2017.

28) Under the proposed rules, individual water suppliers will still be responsible for record keeping and data management. This decentralised arrangement of data collection and management is likely to continue the fragmented system that has prevented efficient and effective public health surveillance and epidemiological research.

29) Recent information requests for water quality data from all district councils revealed substantial differences in data management and storage capacities between councils. A situation that has led to major data losses and placed enormous time-burdens on council staff and researchers interested in doing basic public health surveillance and epidemiological research.

30) To ensure data is collected and stored consistently and efficiently, Taumata Arowai should create and maintain a centralised database of quantified water quality results.

31) This centralised database should be made accessible to researchers for public good research as defined by Statistics New Zealand.

32) Eventually, this centralised database could be integrated into the Integrated Data Infrastructure (IDI), which would facilitate large epidemiological studies at very low cost. The IDI is a series of large linked datasets of individual-level personal data from most of the country's ministries linked by a single identifier.[34] IDI integration of centralised water quality database would enable New Zealand to be at the forefront of public health research on drinking water internationally and ensure we can detect any

adverse health outcomes that occur below the current MAVs to inform future standard setting.

33) If a centralised database is unachievable, Taumata Arowai should at the very least, prescribe to water suppliers a standardised template for record keeping and data management. The template could be created through consultation with water suppliers and commercial testing labs. In this situation, at least water quality data could be compiled relatively easy once the lengthy and repetitive data retrieval process is completed.

34) The current rules do not specify what spatial information on supply components will be required from registered water supplies. Section 53 of the Water Services Act 2021 specifies that registered water suppliers must provide information on the location of the drinking water supply and the drinking water supply boundary.[35] Further, Section 55 specifies that Taumata Arowai must maintain a separate publicly available version of this information.[35]

35) Without specific instructions to standardise spatial information on water supply components (sources, treatment plants and distribution systems) it will remain a time-consuming and error-prone process to compile spatial information at regional and national levels.

36) Taumata Arowai should maintain a national spatial dataset of registered water supply components. In particular, it should specify a standardised format for spatial information for registered supplies. Ideally, this would be a spatial file format that is compatible with common geographic information systems (GIS) such as a shapefile or KML file. The information should include standardised naming conventions that align with testing and compliance information so they can be easily linked to water quality data. Registered water suppliers should be required to review these files at each registration event to ensure they are representative of their current water supply boundaries.

37) Taumata Arowai should maintain this database each year with any changes submitted by suppliers incorporated so that trends in the size and location of water supply components can be documented and incorporated into analyses. Without specification in the Taumata Arowai rules document, the current wasteful, ad hoc, and fragmented development and storage of spatial information will continue.

38) It is unclear if Taumata Arowai will require actual quantitative testing results (eg, the more informative precise value of any given test in mg/L) or merely the documentation of achieving a regulatory threshold (eg, does the contaminant comply with the drinking water standards? yes/no).

39) The compliance-based approach has severe limitations for public health surveillance and research to assess risk to the public. For public health surveillance, it is important to assess trends in water quality to identify areas of degrading and improving water quality and potentially pre-empt future problems. From an epidemiological perspective, without actual testing results it is impossible to assess the potential health impact of key contaminants at levels below the MAV, effectively prevented high quality domestic research that could inform standards. Our understanding of the human health impacts of some chemical contaminants is still limited, thus, research into exposure below the MAV is central to informing future drinking water standards and protecting public health.

Testing frequency and range for drinking water contaminants

40) The current testing regime lacks the frequency of testing and range of contaminants covered to ensure effective public health surveillance. Testing frequencies should be increased for all supply types. Most supplies are required to test at weekly or at least yearly rates for some basic contaminants (eg, *E. coli*). The marginal cost of adding contaminants to this testing is negligible compared to the total operating costs and asset values. For example, private correspondence with commercial labs suggests the marginal cost of adding a nitrate test is ~$6-10 per sample, while an estimated cost to

test for the identified contaminants proposed in the simple distribution system would cost approximately $50.

41) The expansion of the frequency of testing, for nitrate in particular, is supported by a recent Ministry of Health report that concluded that there is sufficient evidence on adverse birth outcomes *“to warrant nitrate exposure monitoring and reporting in New Zealand.”* [31, p.24]

42) Lastly, source water testing for some contaminants should not replace testing of treatment or distribution system water, particularly when those systems draw from multiple source waters. Reliance on source water data for multi-source drinking water systems prevents determination of the actual levels of contaminants in water being supplied to citizens, since the volume of water derived from each source varies and is often unrecorded. For example, if three different sources contributing to a distribution system have three different determinand levels, it is difficult to accurately determine the exact concentration in the water in the network at any given time.

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