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Increasing Underrepresentation of Pacific Peoples in Community-Based Respiratory Surveillance in Aotearoa New Zealand, 2018–2024

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ABSTRACT

Pacific peoples experience a disproportionate burden of respiratory infectious diseases in Aotearoa New Zealand, and surveillance sensitivity depends on capturing transmission in high-risk populations. Despite substantial post-COVID investment in respiratory surveillance, representativeness for Pacific peoples has not been systematically evaluated. We analysed de-identified data from two national community-based surveillance systems—FluTracking and sentinel general practitioner (GP) respiratory surveillance—from 2018 to 2024. Observed Pacific participation was compared with population benchmarks and non-Pacific participation, and trends by age, sex, deprivation and health district were examined, including Pacific-dense districts. Pacific peoples, who experience a disproportionate burden of respiratory disease, were persistently underrepresented in FluTracking. After a temporary increase in 2020, representation declined by an average of 0.8% per year to 2024 ($p = 0.027$). By 2024, less than one-third of the expected sample was achieved annually. Pacific participants were disproportionately from less deprived areas. Sentinel GP surveillance showed the lowest density of participating practices relative to Pacific population size in Pacific-dense districts, particularly Counties Manukau and Waitematā. Underrepresentation creates a mismatch between disease burden and surveillance visibility, weakening early outbreak detection and limiting equitable public health responses. Embedding representational equity as a core design principle is essential for effective surveillance and equitable health outcomes.

1 | Introduction

Respiratory viruses remain a persistent global health threat. Before COVID-19, the World Health Organization (WHO) coordinated influenza-focused sentinel surveillance through the Global Influenza Surveillance and Response System (GISRS). The purpose of GISRS was to monitor seasonal activity, inform vaccine strain selection and planning and support vaccine effectiveness studies (World Health Organization 2023). Surveillance centred on clinical indicators such as influenza-like illness (ILI) and acute respiratory infection (ARI) reported from primary-care sentinel sites.

COVID-19 exposed the limits of influenza-only surveillance, reinforcing the need for more integrated respiratory surveillance approaches (World Health Organization 2023). In 2023, the WHO released the Mosaic Framework, which conceptualises surveillance as a set of complementary systems, including sentinel and event-based surveillance, participatory community systems, laboratory and genomic surveillance and targeted surveillance in high-risk populations, working together to provide a comprehensive picture of respiratory virus transmission, severity and impact (World Health Organization 2023; Mott et al. 2023). A key principle of the framework is that these combined systems should collectively achieve representativeness across populations at the highest risk, including those with the greatest burden of disease. However, achieving this in practice remains a persistent challenge internationally (Kim et al. 2024; Zang et al. 2024; Djaló et al. 2025; Baum et al. 2024).

Surveillance in Aotearoa New Zealand has evolved in similar directions, incorporating a range of surveillance systems for respiratory monitoring. The New Zealand Institute for Public Health and Forensic Science (PHF Science) coordinates a GP sentinel network that submits diagnostic respiratory swabs, with general practices participating within a sentinel network framework. Historical surveillance protocols described practice recruitment as aiming to achieve geographic and population representativeness, including socioeconomic representation. However, available operational documentation did not identify explicit Pacific-specific recruitment targets or representational frameworks (Science 2026; New Zealand Institute for Public Health and Forensic Science 2026). This is complemented by FluTracking, a participatory, community-based surveillance system in which individuals voluntarily report ILI symptoms on a weekly basis, without structured or design-based sampling or recruitment, capturing illness among people who may not seek care (Baker 2023). These characteristics have important implications for representativeness, particularly in the absence of targeted recruitment or sampling strategies.

While severe ARI (SARI) surveillance in four Auckland hospitals provides valuable information on severe disease (Huang et al. 2014), it is resource intensive, non-representative and poorly suited to early community detection, the core purpose of sentinel surveillance.

During the pandemic, Aotearoa New Zealand also expanded respiratory surveillance through additional approaches including genomic sequencing, wastewater testing, Healthline monitoring and enhanced hospital datasets, implemented alongside existing sentinel and participatory systems. While recent surveillance planning documents conceptually position these components within a broader multi-layered respiratory surveillance framework consistent with the WHO Mosaic model (Mott et al. 2023), available operational documentation provides a limited description of how these systems are integrated, coordinated or collectively assessed for representativeness and equity across high-risk populations (Science 2026; New Zealand Institute for Public Health and Forensic Science 2026).

The pandemic experience highlighted both the value and the fragility of respiratory surveillance. Successive COVID-19 waves reinforced the need to maintain multi-source systems to guide public health action and risk communication (Ministry of Health 2023b). Equitable representation in community surveillance is particularly critical for Pacific peoples. They are the fourth-largest ethnic group in Aotearoa New Zealand, making up about 9% of the national population. They also experience a persistent life expectancy gap compared with non-Pacific and non-Māori population (Stats NZ 2025). Pacific peoples in Aotearoa New Zealand are geographically concentrated, with nearly two-thirds residing in the Auckland health districts (Counties Manukau, Waitematā and Auckland) and have a younger age structure than the non-Pacific population. This concentration in specific regions and high-deprivation areas, where respiratory disease burden is highest among Pacific peoples (Stats NZ 2024; Ministry of Health 2021), has implications for how well surveillance systems capture populations at the highest risk. Supporting this, a systematic review confirms higher respiratory morbidity for Pacific children compared with non-Pacific children (Matenga-Ikihele et al. 2025). Historical data show that Pacific and Māori populations experienced higher mortality during past influenza pandemics (Wilson et al. 2012) and a markedly higher risk of COVID-19 and measles hospitalisation (Steyn et al. 2021; Turner 2019; Jeffries et al. 2025). This demonstrates why surveillance systems that fail to reliably capture Pacific communities risk reinforcing existing inequities through delayed detection and response.

Despite this context, the representation of Pacific peoples within national respiratory surveillance (specifically GP sentinel ILI networks and participatory systems) shows a critical gap in equity-oriented surveillance evaluation. Insufficient representativeness undermines both the equitable implementation and the capacity of surveillance systems to detect outbreaks promptly in high-risk communities. Ensuring equity in surveillance is not only an ethical imperative but also a functional necessity, because failure to adequately capture populations at high risk fundamentally undermines the sensitivity and responsiveness of the entire system.

This study evaluates the representation of Pacific peoples in Aotearoa New Zealand's community-based ILI surveillance. Using anonymised data from FluTracking and the GP sentinel network, we compare representation with national and sub-national population characteristics. By assessing whether Pacific communities are equitably captured, this research provides essential evidence on equity in surveillance and identifies system-level gaps. These findings can inform strategies for strengthening surveillance design and implementation. This will help ensure systems are robust and equitable, consistent with the WHO's Mosaic principles (World Health Organization 2023).

2 | Methods

2.1 | Data Sources

2.1.1 | FluTracking

FluTracking is an online participatory surveillance system that collects weekly self-reported ILI symptoms. FluTracking participants enrol online and voluntarily report symptoms on a weekly basis. Recruitment relied on broad public and participant-based approaches, with no targeted recruitment strategies identified for Pacific populations or regions (Science 2026; New Zealand Institute for Public Health and Forensic Science 2026). It was introduced in Aotearoa New Zealand in 2018. For this study, we obtained de-identified FluTracking data for the period 2018–2024 from PHF Science. Data variables included participant registration status, age, gender, postcode and prioritised ethnicity. Ethnicity was classified using the Aotearoa New Zealand prioritised ethnicity approach. Participants who identified as

Pacific, but not Māori, were classified as Pacific, and all remaining participants were grouped as non-Pacific for comparison in this study. This approach assigns individuals identifying with multiple ethnic groups to a single category according to a fixed hierarchy, which can reduce the visibility of multi-ethnic identities and lead to undercounting of groups not first in the hierarchy, including Pacific peoples (Yao et al. 2025).

2.1.2 | Sentinel GP Respiratory Surveillance

The Sentinel GP Respiratory Surveillance Programme is coordinated by PHF Science as part of the WHO Global Influenza Surveillance and Response System. Since 2009, sentinel GP practices have participated within a sentinel network framework to collect swabs for laboratory confirmation of respiratory viruses (PHF Science 2024). We obtained de-identified data on participating practices for 2009–2024 from PHF Science, who had cleaned and aggregated the data to produce annual practice counts by postcode. There were no missing values in the aggregated data set, so all practices were used in the analysis.

2.2 | Data Definitions

For FluTracking analyses, the sample included all registered participants who had not formally opted out of the system, defined as those who were available to participate. Socioeconomic deprivation was assessed by mapping residential postcodes to New Zealand Index of Socioeconomic Deprivation 2023 (NZDep2023) (Atkinson et al. 2023) deciles using Statistical Area 2 (SA2) boundaries, based on the centroid location. Deciles were subsequently aggregated into quintiles ranging from 'Q1 least deprived' to 'Q5 most deprived'.

2.2.1 | Population Denominators and Geographic Boundaries

Population denominators were obtained from Health New Zealand Te Whatu Ora population estimates, accessed via the Populations web tool (Health New Zealand Te Whatu Ora 2025c). These estimates are routinely used in health reporting and surveillance analyses in Aotearoa New Zealand (Ministry of Health 2025). They are derived from Statistics New Zealand Estimated Resident Population (ERP) data and are re-worked for health system use through projection, prioritised ethnicity classification and alignment to health district boundaries (Health New Zealand Te Whatu Ora 2025c).

Population data were available stratified by age, sex, prioritised ethnicity, health district and NZDep2023 decile for the period 2018–2024. Health district geographic coordinates were sourced from Statistics New Zealand for mapping purposes.

2.3 | Statistical Analysis

2.3.1 | FluTracking Analysis

We assessed overall Pacific representation by comparing observed Pacific FluTracking participation counts with expected counts based on the Pacific share of the Health New Zealand population estimates. Chi-square goodness-of-fit tests were used to compare the observed distribution of the FluTracking sample with the expected distribution derived from population estimates. Representation among non-Pacific participants was assessed similarly. Representation gaps for both Pacific and non-Pacific samples were quantified annually using the formula (observed − expected)/expected and expressed as percentages. Expected counts were based on the Pacific share of the Health New Zealand population estimates. A positive percentage indicated overrepresentation, while a negative percentage indicated underrepresentation.

Temporal trends in participation were examined using beta regression models, appropriate for analysing proportional outcomes. Following a substantial increase in total FluTracking enrolment following government promotion of the system in March–April 2020, in response to COVID-19 surveillance concerns, a significant breakpoint in the data was observed. Segmented (broken stick) beta regression models were therefore used to estimate changes separately for 2018–2020 and 2020–2024.

Demographic profiles of Pacific participants were compared with the Pacific population estimates from the Health New Zealand population tool based on age, gender and health district across all study years (2018–2024). Socioeconomic representation was examined using data from the 2023 cohort, comparing the distribution of participants across NZDep2023 quintiles with the 2023 population estimates.

All participants with complete records were included in the analysis. Records with missing data (<0.5%) were also included in the analysis, but only where the key data items required for specific analyses were present.

2.3.2 | Sentinel GP Respiratory Surveillance

We assessed the Pacific representation by examining how closely the distribution of participating GP practices aligns with the distribution of the Pacific population across health districts. Because the GP ILI surveillance system does not collect patient-level data, including ethnicity, representation was assessed using a proxy measure: the number of participating GP practices per 100,000 Pacific population within each health district in 2024. This approach assumes that general practice location approximates population coverage at the health district level, recognising that individuals may access care across district boundaries. Rates were assigned to ranked bins and presented in a choropleth heatmap. Practice postcodes were assigned to health districts using centroid mapping.

2.3.3 | Software

All statistical analyses were conducted in RStudio version 4.5.1 (R Foundation for Statistical Computing, Vienna, Austria).

3 | Results

3.1 | FluTracking

The total number of registered FluTracking participants increased from 4813 in 2018 to 8672 in 2019 and then to 97,841 in 2020, following government promotion of the survey (Table S1). This expanded sample size was largely sustained through 2024. Pacific participation followed a similar trajectory, increasing from 61 registered participants in 2018 to 2131 in 2020, with annual counts stabilising between 1888 and 2168 for 2020–2024 (Figure 1).

The observed Pacific sample was consistently smaller than expected between 2018 and 2024 ($p < 0.001$) (Table S2). Following the temporary improvement in 2020, regression modelling showed an average annual decline in the Pacific participation of 0.8% between 2020 and 2024 ($p = 0.027$) (Figure 1 and Table S1). Each year after 2020, less than one-third of the expected Pacific sample was achieved, resulting in an average annual shortfall of 4674 participants.

The Pacific representation gap (the difference between the observed and expected sample, relative to the expected) increased by an average of 3.1% a year between 2020 and 2024 ($p < 0.001$) (Table S3). This widening gap reflects both a decline in Pacific FluTracking participation and a concurrent increase in Pacific population estimates ($p < 0.001$) (Table S1).

Pacific peoples were substantially underrepresented relative to non-Pacific participants, indicating that the system did not achieve equitable representation. Non-Pacific people were consistently overrepresented, with a larger than expected sample each year between 2018 and 2024 ($p < 0.001$) (Table S2). Non-Pacific participation increased between 2020 and 2024 ($p = 0.027$) (Table S1), resulting in increasing overrepresentation by 1.7% annually ($p < 0.001$) (Table S3).

Further analysis showed that the demographic profile of the Pacific sample was not representative of the broader Pacific population estimates. Statistically significant differences were observed in age, gender and geographic distribution between the Pacific FluTracking sample and the Pacific population estimates (Tables 1, S4 and S5). Counties Manukau, where 38.5% of Aotearoa New Zealand's Pacific population resided in 2024, showed the highest underrepresentation ($p < 0.001$) (Tables 1 and S4). Only 24.5% of the Pacific FluTracking sample was from Counties Manukau, a proportion that did not change significantly between 2020 and 2024 ($p = 0.383$) (Table S5). Conversely, Capital Coast and Hutt Valley had the highest Pacific overrepresentation relative to their population share ($p < 0.001$) (Tables 1 and S4).

Socioeconomic analysis of the 2023 Pacific sample showed further disparities (Table 1). The sample was skewed towards less deprived areas ($p < 0.001$), when compared to the Pacific population distribution. For example, 14.9% of the Pacific FluTracking sample resided in NZDep2023 quintile 1 (least deprived) compared with only 4.9% of the Pacific population estimates. Conversely, 36.9% of the Pacific FluTracking sample resided in quintile 5 (most deprived), compared with 55.8% of the Pacific population estimates.

3.2 | Sentinel GP Respiratory Surveillance Programme

There were 77 GP practices participating in the Sentinel GP Respiratory Surveillance Programme in 2024, which was also the average number of GP practices participating each year between 2009 and 2024. A marked geographic variation in participation was observed relative to the distribution of the Pacific population (Figure 2). Counties Manukau, which contains 38.5% of the Aotearoa New Zealand Pacific population, had two participating GP practices, representing 2.6% of all practices participating in 2024. Waitematā, with 13.3% of the Pacific population, had four (5.2%) participating GP practices. These patterns indicate comparatively low sentinel GP coverage in districts with the largest Pacific populations.

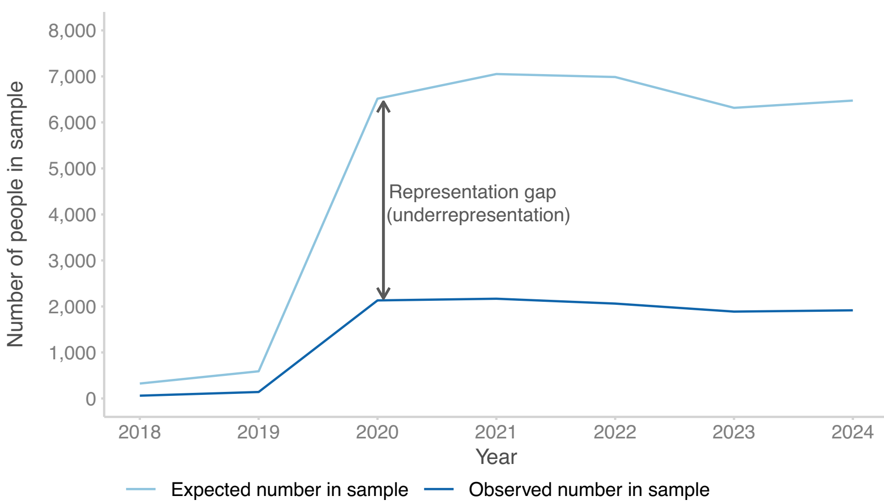

FIGURE 1 | Representation of Pacific peoples in the FluTracking sample, 2018–2024. Observed counts are compared with expected counts based on the Pacific share of Health New Zealand population estimates applied to the total FluTracking sample size. Differences between observed and expected values indicate under- or overrepresentation.

TABLE 1 | Distribution of Pacific participants in the FluTracking sample compared with the expected distribution based on Health New Zealand population estimates, by demographic characteristics, 2024.

Characteristics		Observed, %, *n*	Expected, %, *n*	*p*-value
Gender	Females	45.5 (871)	49.5	
	Males	54.5 (1045)	50.5	<0.001
Age group	5–14 years	22.0 (421)	16.9	
	15–24 years	20.8 (398)	18.5	
	25–44 years	23.5 (450)	29.7	
	45–64 years	22.9 (438)	19.6	
	65 years+	10.8 (207)	7.5	<0.001
Health district	Northland	1.4 (27)	1.3	
	Waitematā	12.7 (237)	13.3	
	Auckland	18.6 (346)	15.0	
	Counties Manukau	24.5 (456)	38.5	
	Waikato	4.8 (90)	4.0	
	Lakes	0.6 (11)	0.9	
	Bay of Plenty	2.0 (37)	1.6	
	Taranaki	0.6 (11)	0.5	
	Tairāwhiti	0.3 (5)	0.5	
	Whanganui	0.3 (6)	0.6	
	Hawke's Bay	1.0 (18)	2.2	
	MidCentral	2.9 (54)	1.9	
	Wairarapa	0.6 (11)	0.3	
	Capital Coast and Hutt Valley	18.9 (353)	9.9	
	Nelson Marlborough	0.8 (16)	1.1	
	Canterbury	6.4 (119)	5.1	
	West Coast	0.1 (1)	0.1	
	South Canterbury	0.6 (11)	0.5	
	Southern	3.1 (57)	2.8	<0.001
NZDep2023	1 (least deprived)	15.0 (287)	4.9	
	2	17.5 (335)	7.5	
	3	21.3 (408)	11.8	
	4	9.1 (174)	20.0	
	5 (most deprived)	37.2 (712)	55.8	<0.001

Note: Values are percentages with corresponding counts (n) for the FluTracking sample. Expected percentages represent the distribution of the Pacific population based on Health New Zealand population estimates. Chi-square goodness-of-fit tests compare observed and expected distributions within each demographic variable.

4 | Discussion

This study provides the first systematic temporal analysis of Pacific peoples' representation in Aotearoa New Zealand's two main community-based respiratory surveillance systems: FluTracking and sentinel GP surveillance. Across both platforms, Pacific peoples were consistently underrepresented compared with their share of the national population. Although participation in FluTracking rose sharply in 2020, Pacific representation remained disproportionately low and has since fallen further, deepening existing inequities. These gaps were compounded by geographic and socioeconomic disparities, with low participation in Counties Manukau in particular and among Pacific peoples residing in the most deprived areas of Aotearoa New Zealand. GP sentinel surveillance had the lowest density of participating practices relative to the Pacific population in Counties Manukau, followed by Waitematā. This further limits representational equity in the areas of the greatest Pacific population concentration.

This pattern represents a mismatch between surveillance visibility and patterns of infection and severe disease, as illustrated by Aotearoa New Zealand's COVID-19 experience. Nationally, surveillance data show that Pacific peoples and residents of the most deprived areas were consistently at the forefront of every COVID-19 wave, including the surge following the introduction of

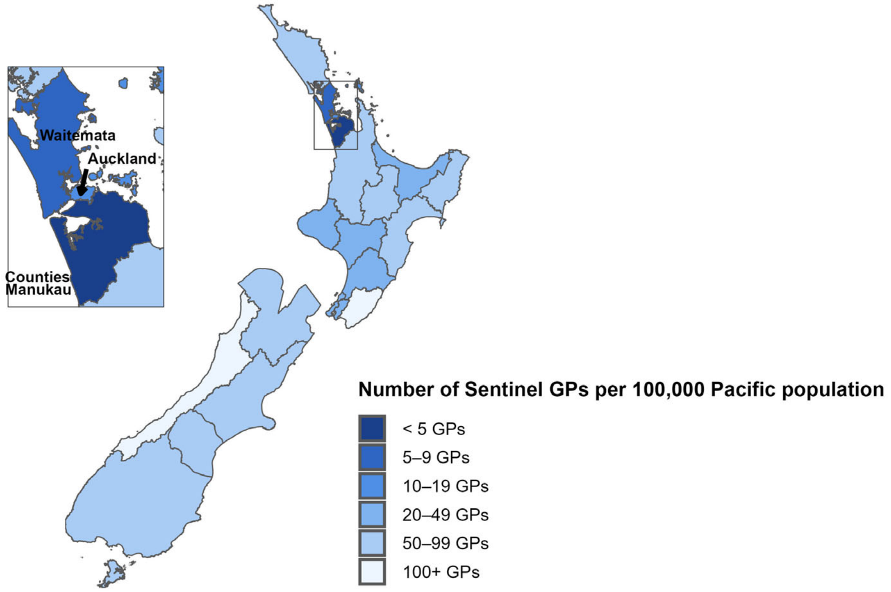

FIGURE 2 | Number of sentinel general practices per 100,000 Pacific population, by Aotearoa New Zealand health district, 2024. Darker shading indicates lower sentinel GP coverage relative to the Pacific population.

Omicron in February 2022 (Jeffries et al. 2025; Health New Zealand Te Whatu Ora 2025b), yet they were systematically underrepresented in both FluTracking and GP sentinel surveillance. This mismatch highlights a critical weakness in the current system, undermining both equity and preparedness.

4.1 | Equity Implications

Our findings show that inequities in community respiratory surveillance are persistent and, for Pacific peoples, compounded over time. Pacific peoples were markedly underrepresented in both sentinel GP and participatory surveillance, with particularly low representation among those living in the most socioeconomically deprived areas. This pattern reduces the visibility of communities at the highest risk of severe outcomes and weakens the sensitivity of surveillance systems to detect outbreaks early. Quantifying the magnitude of this reduction would require specification of outbreak size, case capture probabilities and detection thresholds, as described in formal approaches to early detection surveillance sensitivity, which were beyond the scope of this study (Cameron et al. 2020). While analytical approaches such as post-stratification weighting can partially address representativeness, their effectiveness depends on the accuracy of underlying population data, which is subject to known limitations for Pacific populations, including long-standing undercounting at the national level and greater additional uncertainty at subnational levels (Sonder et al. 2024). These limitations reflect broader, well-documented challenges in the completeness and accuracy of ethnicity data across administrative and population datasets in Aotearoa New Zealand, including known issues of misclassification and undercounting for Māori and Pacific peoples (Sonder et al. 2024; Ministry of Health 2020; Sonder and Ryan 2025). These limitations reflect broader challenges in the completeness and accuracy of ethnicity data across administrative and population datasets in Aotearoa New Zealand, alongside documented concerns regarding the robustness of population estimates under evolving census methodologies (Statistics New Zealand 2026).

From a preparedness perspective, underrepresentation in high-risk populations delays the identification of emerging transmission and diminishes the effectiveness of public health responses. The WHO's Mosaic Framework emphasises inclusive, risk-based surveillance (World Health Organization 2023); however, our findings indicate that Aotearoa New Zealand's early warning systems fall short on this principle. Surveillance frameworks further suggest that populations at elevated risk should be deliberately oversampled to maximise early detection (Cameron et al. 2020), underscoring that representational equity is a core determinant of surveillance performance, not simply a matter of fairness. In the context of this article, this would include oversampling of Pacific peoples as well as targeted sampling in geographic areas with high Pacific populations and high levels of socioeconomic deprivation, recognising that these factors overlap but are not interchangeable.

4.2 | Equity and Structural Gaps in Community-Based Surveillance

Pacific underrepresentation in FluTracking during the 2020/2021 period has previously been reported in a cross-sectional analysis of a single pandemic year (Harvey et al. 2022). Our study confirms this finding and extends it by providing the first longitudinal analysis of Pacific representation in FluTracking from its introduction in Aotearoa New Zealand through the post-pandemic period, allowing examination of sustained trends and the 2020 surge in participation.

By contrast, no published analyses assessing ethnic or socioeconomic representativeness in Aotearoa New Zealand's GP Sentinel Respiratory Surveillance were identified. Existing reports primarily describe participation and virological findings, without reporting ethnicity or routinely evaluating representativeness (Institute of Environmental Science and Research Ltd. 2025; PHF Science n.d.; PHF Science n.d.; Adnan et al. 2017). To our knowledge, this study is the first to assess representation for a high-risk population within the sentinel GP network, addressing an important gap in surveillance evaluation.

Although surveillance documentation recognised representativeness and demographic diversity as important considerations, available operational documents did not identify explicit Pacific-specific recruitment targets, representational thresholds or equity accountability mechanisms (PHF Science 2026; New Zealand Institute for Public Health and Forensic Science 2026).

The available documentation further suggests that representational inequities were potentially detectable within surveillance systems themselves, yet limited evidence was identified that these inequities systematically informed recruitment adaptation or equity accountability mechanisms. Long-standing barriers, including workforce shortages, reliance on telehealth and self-management and the cost of care, disproportionately affect Māori and Pacific peoples and are most pronounced in high-deprivation areas (Health Quality and Safety Commission 2021; Ryan et al. 2019; Jeffreys et al. 2024). These barriers reduce access to general practice and, in turn, limit the likelihood that Pacific peoples are captured in GP-based sentinel surveillance. Additional cultural and linguistic barriers, as well as experiences of racism, further compound these inequities (Paine et al. 2018; Teevale et al. 2013; Health New Zealand Te Whatu Ora 2025a; Ministry of Health 2022).

International studies from South Korea, Mozambique, China and Finland demonstrate that representational biases in sentinel surveillance systems are common and well-recognised, including underrepresentation related to reliance on voluntary participation, limited site recruitment and uneven geographic coverage (Kim et al. 2024; Zang et al. 2024; Djaló et al. 2025; Baum et al. 2024).

Importantly, this evidence also shows that such biases are modifiable through deliberate design choices, including oversampling high-risk areas, targeting recruitment to underserved communities and co-designing participatory approaches. Focusing surveillance on populations at elevated risk can substantially improve the sensitivity and timeliness of outbreak detection (PHF Science 2024).

Taken together, these findings indicate that Aotearoa New Zealand's respiratory surveillance does not equitably represent Pacific peoples and lacks systematic consideration of equity in design, implementation and reporting. These findings highlight ongoing challenges in achieving the representativeness and equity objectives outlined in the WHO Mosaic Framework, which emphasises the importance of complementary surveillance systems capturing populations at the highest risk. This limits both the ability of surveillance systems to address health inequities and their effectiveness as an early warning system in communities most likely to experience outbreaks first and most severely.

5 | Limitations

Several limitations should be considered when interpreting these findings. Comparisons with COVID-19 burden are subject to known limitations in health data systems, including ethnicity misclassification and changes in case ascertainment over time, particularly following the introduction of self-reported rapid antigen testing (Institute of Environmental Science and Research Ltd 2025.; PHF Science n.d.; PHF Science n.d.; Adnan et al. 2017). In this study, COVID-19 data are therefore used as a contextual indicator of disease burden rather than a precise measure of incidence.

Population denominators used throughout this study were obtained from Health New Zealand population estimates, consistent with national health reporting practice (Ministry of Health 2025). These estimates are based on census-derived Statistics New Zealand population statistics, which have long-standing known undercounting of Pacific peoples (Sonder et al. 2024). Health New Zealand projections also rely on sub-national projections derived from the 2018 Census, which are subject to additional uncertainty and may not reflect true population distributions. Changes in the size and distribution of Pacific populations since 2018, alongside limitations in census and administrative ethnicity data, may therefore affect estimation of expected counts at the sub-national level, particularly for highly mobile populations, and assessments of representativeness, disproportionately affecting Pacific population estimates (Sonder et al. 2024). These findings are consistent with wider recognition of data quality and representation issues for Pacific peoples in national health strategies, including the Pacific health strategy, Te Mana Ola (Ministry of Health 2023a). Importantly, undercounting of Pacific peoples in population data would be expected to overestimate, rather than underestimate, Pacific representation in surveillance systems. This limitation therefore introduces uncertainty into absolute estimates of representativeness but is unlikely to account for the observed FluTracking participation gaps or the sentinel GP coverage proxy patterns and may mean that the magnitude of underrepresentation reported here is conservative.

In addition, Health New Zealand population estimates combine census-based population estimates with intercensal projections. Health New Zealand produces sub-national prioritised ethnicity population estimates derived from customised datasets provided by Statistics New Zealand (Health New Zealand Te Whatu Ora 2025c). Statistics New Zealand has demonstrated that sub-national population estimates underestimate Māori and Pacific populations, particularly between censuses (Statistics New Zealand 2020). These patterns disproportionately affect younger, high-mobility and high-deprivation populations, which are prevalent in districts such as South Auckland, where Counties Manukau is located (StatsNZ 2019). When combined with the use of prioritised ethnicity in health system population data, these factors further reduce the visibility of Pacific people in routinely used population denominators. As a result, population benchmarks in these areas are likely underestimated and apparent surveillance coverage overestimated, further strengthening the argument that observed inequities are conservative.

At the time of analysis (2025), sub-national Health New Zealand population denominators were still based on 2018 Census–derived estimates and projections, as rebased sub-national estimates incorporating the 2023 Census were not yet available, adding to the uncertainty in the benchmarks for highly mobile populations.

FluTracking is a longitudinal participatory surveillance system subject to both active and passive opt-out. While active opt-outs are recorded, the extent of passive disengagement is unknown (Hartley et al. 2021). This analysis included all registered participants who had not actively opted out, implicitly assuming similar rates of passive disengagement among Pacific and non-Pacific participants. Although previous analyses suggest that this assumption is reasonable, differential disengagement cannot be excluded.

For sentinel GP surveillance, representation was assessed using GP practice location relative to the Pacific population size within health districts as a proxy for population coverage. This approach assumes that people generally attend primary care services close to where they live, which may not always hold in practice (Jeffreys et al. 2024, 2019; Hartley et al. 2021; Whitehead, Pearson and Lawrenson 2019; Irurzan-Lopez, Jeffreys and Cumming 2021). This may bias estimates in either direction, as patients do not necessarily attend general practices within their area of residence; in urban settings, cross-district care seeking may result in both overestimation and underestimation of local population coverage.

Finally, some misclassification may have occurred in the assignment of socioeconomic deprivation due to the mapping of postcodes to statistical areas and NZDep2023 deciles, particularly in cases where postcode centroids overlapped multiple areas or fell outside land boundaries. These issues were addressed through manual assignment using overlapping area averages, but minor inaccuracies may remain.

5.1 | Implications for Policy and Practice

The populations most affected by respiratory virus outbreaks are the least represented in sentinel and participatory surveillance, reducing the system effectiveness where it is most needed. Addressing these gaps requires deliberate redesign of surveillance systems to prioritise representational equity.

For GP sentinel surveillance, this includes targeted recruitment of practices in Pacific-dense areas such as Counties Manukau and Waitematā, with proportional or risk-adjusted representation. For FluTracking, co-designed strategies with Pacific community organisations could improve recruitment and retention, particularly among underrepresented age groups and residents of high-deprivation areas. Embedding equity metrics—such as representational benchmarks by ethnicity, socioeconomic status and region—within surveillance performance frameworks would support accountability and ongoing monitoring. In practice, this could include proactive recruitment of general practices serving populations with high Pacific enrolment, outreach through primary care networks in high-need areas and routine monitoring of participation against predefined benchmarks aligned with the underlying population distribution.

Surveillance design should begin with explicit decisions about the desired sensitivity and representational thresholds, informed by existing methodological frameworks, with implementation aligned accordingly. Achieving this may require additional resources for high-risk populations or redistribution of limited resources to where risks are greatest. While integration of surveillance layers can help address representational gaps, integration without explicit attention to equity risks reproducing existing biases (World Health Organization 2023; Mott et al. 2023). Recent surveillance planning documents demonstrate increasing conceptual integration of respiratory surveillance components; however, available operational documentation provides limited evidence that representational equity is systematically embedded within this integration (Kim et al. 2024; Zang el al. 2024). Importantly, integration of surveillance systems does not in itself ensure representativeness. If different surveillance components draw from similar or overlapping population groups, gaps in coverage—particularly among populations at the highest risk—may persist even when data streams are analysed together. Our findings suggest that the lack of complementary population coverage is a key driver of the observed inequities.

Ensuring that community, laboratory, hospital, genomic and environmental surveillance operate as complementary components of a coherent national system will require strong central coordination and oversight. A unified framework, led by a single coordinating agency, would enhance both representational equity and operational efficiency, ensuring that early signals in high-risk populations translate rapidly into public health action. Strengthening representational equity in surveillance is therefore not only a matter of fairness, but a core requirement for pandemic preparedness.

6 | Conclusions

This study demonstrates persistent and widening underrepresentation of Pacific peoples in community-based respiratory surveillance in Aotearoa New Zealand, despite their disproportionate burden of respiratory infectious diseases. These inequities compromise both the fairness and surveillance performance, weakening early detection in populations at the highest risk and reducing overall system sensitivity for pandemic preparedness. By evaluating representativeness across participatory and sentinel surveillance platforms, this study identifies a critical system-level gap and highlights the need to embed equity as a core design principle in respiratory surveillance. These findings suggest that representational equity must be systematically operationalised within integrated surveillance design, recruitment, coordination and monitoring frameworks, rather than treated as an implicit outcome of surveillance expansion. Strengthening representational equity is therefore essential to the validity and effectiveness of surveillance systems, because early transmission and the highest disease burden often occur in the same high-risk populations.

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Ethics Statement

The study received ethics approval from the Aotearoa Research Ethics Committee (AREC 25 05) on 12 March 2025.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Reporting Guidelines

The manuscript has been prepared in line with the STROBE checklist for observational studies.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Table S1:** Number and percentage of Pacific and non-Pacific people in the FluTracking sample and estimated resident population (ERP), 2018–2024. **Table S2:** Observed and expected Pacific and non-Pacific FluTracking samples, 2018–2024. **Table S3:** Representation gap for the Pacific and non-Pacific FluTracking samples, 2018–2024. **Table S4:** Percentage of the Pacific FluTracking sample and Pacific ERP, by demographic factor, 2018–2024. **Table S5:** Broken-stick beta regression model statistics for the Pacific FluTracking sample demographic profile, 2018–2020 and 2020–2024.