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INVASIVE GROUP A STREPTOCOCCAL INFECTION IN NEW ZEALAND, 2017–2022

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Disclaimer

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ABBREVIATIONS

Abbreviation	Description
DHB	District health board
DNA	Deoxyribonucleic acid
emm	M protein gene
ESR	Institute of Environmental Science and Research Ltd
GAS	Group A *Streptococcus*
ICD-10-AM	International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification
iGAS	Invasive Group A streptococcal (infections)
IPL	ESR Invasive Pathogens Laboratory
NHI	National health index
NMDS	National minimum data set (hospital discharges)
NZDep2018	New Zealand index of deprivation 2018
PCR	Polymerase chain reaction

SUMMARY

This report presents an overview of the epidemiology of invasive Group A streptococcal (iGAS) infection in New Zealand from 2017 to 2022. Surveillance of iGAS infection is undertaken by ESR, based on isolates sent to the ESR Invasive Pathogens Laboratory (IPL).

The incidence of iGAS infection decreased by 49% between 2018 and 2022, from 9.5 per 100,000 in 2018 to 4.8 per 100,000 in 2022. The incidence of iGAS infection in 2021 and 2022 is the lowest reported in New Zealand since 2005.

There are inequities in iGAS infection in New Zealand. On average, between 2017 and 2022, the highest rates of iGAS infection occurred in the youngest (under 1 year) and oldest (80 years and over) age groups, with rates of 22.5 and 27.2 per 100,000 respectively. Pacific peoples and Māori were particularly affected and experienced higher rates of iGAS infections (15.6 and 9.7 per 100,000 respectively in 2022) compared with other ethnic groups (2.9 per 100,000 for European/Other and 1.3 per 100,000 for Asian) overall, as well as in all age groups and NZDep2018 quintiles. IGAS infection is also strongly associated with socioeconomic deprivation; 64% of iGAS infection cases lived in areas characterised by high deprivation (NZDep2018 quintiles 4 and 5).

There were a number of different GAS *emm* types associated with iGAS infection in New Zealand between 2017 and 2022, and there was variability of dominance of types over this period. *emm*114 has been the most common type in New Zealand since 2019 and accounted for 15% of isolates in 2022, followed by *emm*92 (10%) and *emm*41 (8%). Prior to 2019, *emm*1 was the most dominant *emm* type. The most prevalent *emm* types associated with an increase in iGAS infections in Europe in 2022/2023 (*emm*1, *emm*12, *emm*89, *emm*4, *emm*22) were not common in New Zealand in 2022.

An audit was undertaken in early 2023 to assess the completeness of diagnostic laboratory referrals to the IPL. This audit suggested that while the current voluntary, laboratory-based surveillance system underestimates the burden of iGAS infection in New Zealand, it is likely to give a true indication of long-term trends in iGAS infections, required to inform policy.

Continued surveillance of invasive GAS infection and laboratory molecular typing of isolates will be important to continue to monitor trends in New Zealand.

INTRODUCTION

Invasive group A streptococcal (iGAS) infections are part of the spectrum of disease that can be caused by the bacterium group A *Streptococcus* (GAS), which includes necrotising fasciitis, cellulitis, bacteraemia, pneumonia, puerperal sepsis, and toxic shock syndrome. GAS also causes non-invasive diseases, such as pharyngitis, skin infections, and scarlet fever. Additional sequelae of GAS infections include acute rheumatic fever and post streptococcal glomerulonephritis. Together, invasive and non-invasive GAS diseases account for considerable mortality and morbidity in New Zealand [1, 2].

This report focuses on iGAS infections and provides an overview of the epidemiology of iGAS in New Zealand between 2017 and 2022.

METHODS

In New Zealand, diagnostic laboratories refer iGAS isolates to the ESR Invasive Pathogens Laboratory (IPL) for confirmation.

The following data was extracted from the ESR laboratory information system on 7 February 2023 for isolates received between 1 January 2017 and 31 December 2022:

- National Health Index (NHI) number
- age and sex
- specimen collection date
- specimen type (for example, blood, wound, tissue)
- symptoms, if available.

The NHI number was used to obtain further information on cases from the National Collections, including ethnicity, New Zealand Index of Deprivation 2018 (NZDep2018), and date of death (if applicable). In addition, NHI numbers were used to obtain hospitalisation and diagnosis data (based on ICD-10-AM coding) from the National Minimum Dataset (NMDS). Diagnosis codes were also used to identify cases of invasive infection from non-sterile sites. The NMDS data was extracted on 23 February 2023.

Defining iGAS streptococcal infections

Isolates that were included in this analysis were those received by the IPL between 2017 and 2022 which met the case definition of iGAS infection. The current definition for the purposes of surveillance of iGAS infection in New Zealand is:

1. Isolation of GAS from a normally sterile site (e.g., blood, cerebrospinal fluid, joint, pleural, pericardial fluid) with or without evidence of severity;

OR

2. Isolation of GAS from a non-sterile site with evidence of severity (e.g., streptococcal toxic-shock syndrome, necrosis, meningitis, or death).

The following ICD-10-AM codes were used to confirm whether GAS isolated from a non-sterile site met condition 2:

- A40.0 (sepsis due to *Streptococcus* group A)
- A48.3 (toxic shock syndrome)
- M72.6 (necrotising fasciitis)
- O85 (puerperal sepsis).

Calculation of population rates

All rates presented in this report are crude rates.

The 2017–2022 mid-year population estimates published by Statistics New Zealand were used to calculate the incidence rates for total population.

All rates are presented as the number of cases per 100,000 population. Rates have not been reported where there were fewer than five cases in any category as this produces unstable rates.

Ethnicity

Prioritised ethnicity is used in this report. Ethnicity is prioritised in the following order: Māori, Pacific peoples, Asian, and European/Other ethnicity. For more detail on classification refer to the Ministry of Health ethnicity data protocols [3].

The incidence rates for ethnic groups were calculated by applying the usually resident 2018 census population ethnic proportions to the 2017–2022 mid-year population estimates.

Socio-economic deprivation

The New Zealand index of deprivation 2018 (NZDep2018) is used to measure socio-economic deprivation. NZDep2018 is derived from a weighted combination of nine variables from the 2018 census, each reflecting a different aspect of material and social deprivation [4]. The deprivation score is calculated for each geographical mesh block in New Zealand.

This report presents NZDep2018 by quintiles, where 1 represents the least deprived areas and 5 the most deprived areas.

The denominator data used to determine disease rates for NZDep2018 categories is based on the proportion of people in each NZDep2018 category from the usually resident 2018 census population.

30-day mortality

Mortality due to iGAS infection was estimated by reviewing deaths that occurred within 30 days of specimen collection.

The 30-day mortality rate was calculated by dividing the number of cases who died within 30 days of sample collection by the total number of cases in a given year. If a sample collection date was not provided, the date the sample was received at ESR was used.

This measure is used as a proxy for iGAS mortality as the associated death may not have been due to the iGAS infection. These results should be interpreted with caution.

emm typing

Diagnostic laboratories identify GAS isolates by culture following receipt of clinical specimens. The diagnostic laboratories then send the isolates to the ESR IPL for *emm* typing. Molecular typing is performed by polymerase chain reaction (PCR) and deoxyribonucleic acid (DNA) sequencing of the *emm* gene (method described by Beall et al [5]).

AUDIT OF IGAS SURVEILLANCE

Surveillance of iGAS infections in New Zealand relies on laboratories sending clinically relevant isolates for confirmation to the IPL at ESR. Because surveillance is passive and relies on the voluntary participation of laboratories in New Zealand, there were concerns that information on the epidemiology of iGAS infection in New Zealand may be incomplete and a recommendation that making iGAS infection a notifiable disease needs to be considered.

ESR undertook an audit of laboratory referrals of iGAS isolates to the IPL in early 2023 to assess whether the current laboratory-based system provides a true measure of the incidence of iGAS infection as seen in diagnostic laboratories in New Zealand.

All of the 16 diagnostic laboratories in New Zealand were contacted and asked to take part in the audit. Laboratories were requested to send information on all iGAS isolates they had identified in 2022, and this data was compared with information on samples included in the ESR IPL database for iGAS infection surveillance. Eleven laboratories submitted data on iGAS isolates to ESR. The five laboratories that did not take part in the audit represent 25% of the isolates included in iGAS infection surveillance data in 2022.

The audit found that 84% of iGAS isolates identified by the 11 participating laboratories matched with the iGAS infection data in the ESR IPL database. Overall, the audit suggested that the current iGAS infection surveillance system, which is based on voluntary laboratory reporting, underestimates the burden of iGAS infection in New Zealand. However, if the factors associated with under-reporting are consistent over time, the current surveillance system is likely to be able to identify long term trends in iGAS infection in New Zealand. The average time between specimen collection and the date it was received by ESR was seven days. As a result, the current system also has the capacity to identify changes in disease patterns across the population and within specific population groups in a timely manner.

INVASIVE GROUP A STREPTOCOCCAL INFECTION IN NEW ZEALAND

A total of 1996 isolates were received by the IPL between 2017 and 2022. Table 1 summarises the number of samples received per year from each site. Almost all isolates (1947/1996, 97.5%) were from a sterile site, and the majority of these (88.6%) were from blood cultures. Only a small proportion (2.5%) of isolates from iGAS infection cases were from non-sterile or unknown body sites.

Table 1. Invasive GAS isolates by sample site and year, 2017–2022

Isolate site		2017	2018	2019	2020	2021	2022	Total	Percent
Sterile site	Blood	321	407	361	253	211	216	1769	88.6
	Bone and Joints	25	31	34	19	14	19	142	7.2
	Pleura	5	7	2	1	1	0	16	0.8
	Body fluids	2	1	6	1	1	2	13	0.7
	Internal body sites	2	3	0	0	0	2	7	0.4
	Total	**355**	**449**	**403**	**274**	**227**	**239**	**1947**	**97.5**
Non-sterile or unknown site		12	12	11	8	1	5	49	2.5
Total number of isolates		**367**	**461**	**414**	**282**	**228**	**244**	**1996**	**100.0**

Incidence of iGAS infection in New Zealand

Since 2018, there has been a decrease in the incidence of iGAS infection in New Zealand, with rates decreasing from 9.4 per 100,000 population in 2018 (461 cases) to 4.8 per 100,000 in 2022 (244 cases) (Figure 1). Prior to 2018, rates of iGAS infection fluctuated and ranged between 7.0 and 9.2 per 100,000.

Figure 1. Incidence of invasive GAS infections in New Zealand, 2012–2022

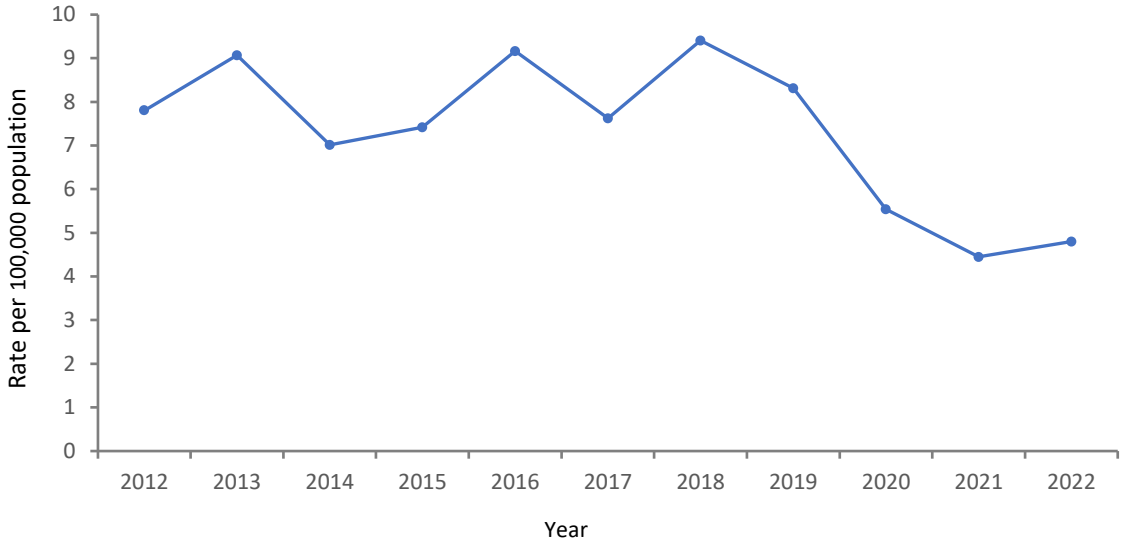
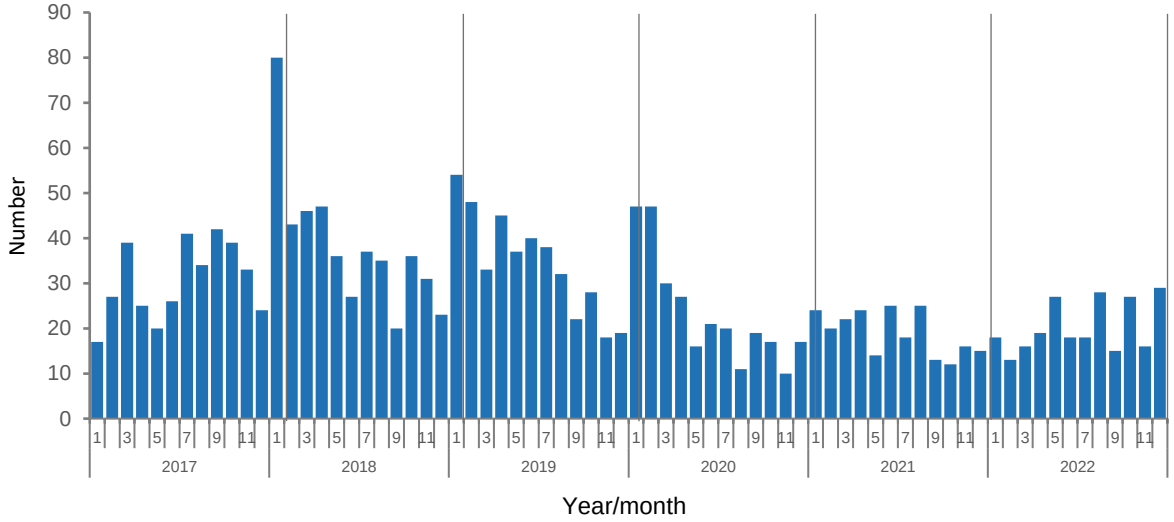


Figure 2 shows that there is no clear seasonal pattern for iGAS infection in New Zealand, although in 2018, 2019 and 2020, there were higher numbers in mid-summer.

Figure 2. Number of invasive GAS infections by month specimen received at ESR, 2017–2022

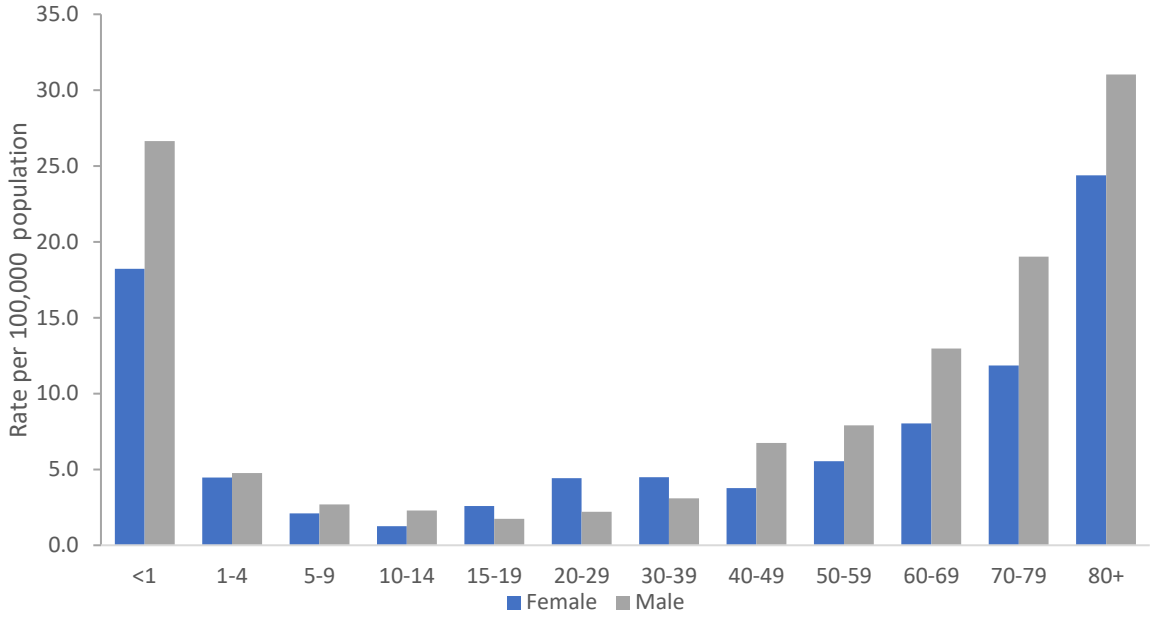


Incidence of iGAS infection by age group and sex

Infants aged under 1 year and adults aged 80 years and over had the highest rate of iGAS infections (22.5 per 100,000 and 27.2 per 100,000 respectively).

Overall, males had higher rates of infection than females, with an average incidence rate of 6.9 per 100,000 population among males compared with 5.8 per 100,000 among females. This difference was seen in most age groups (Figure 3).

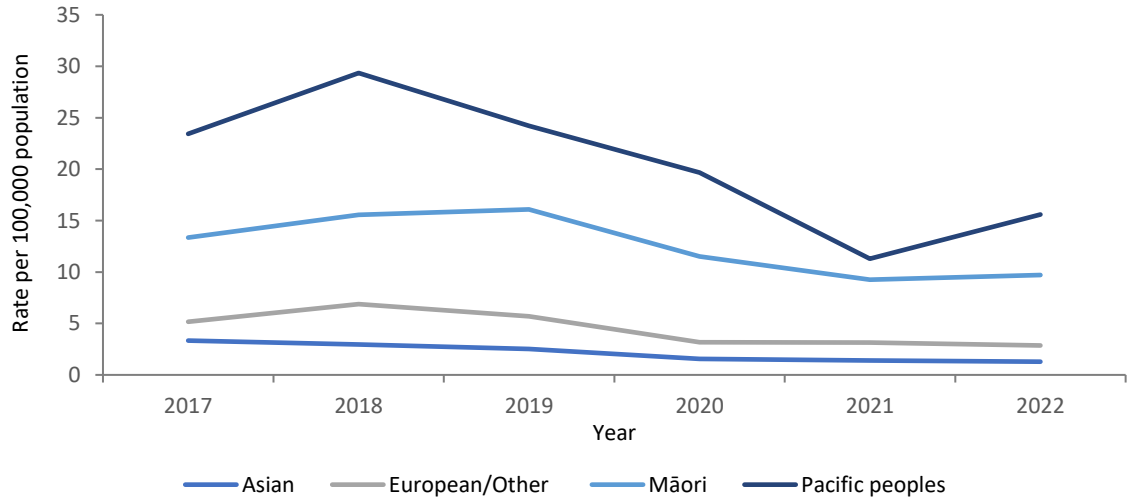
Figure 3. Invasive GAS infection rates by age and sex, 2017–2022 average



Incidence of iGAS infection by ethnicity

Ethnic group was known for 98.0% (1956/1996) of iGAS infections. Pacific peoples experienced the highest rates of iGAS infections, followed by Māori (Figure 4). In comparison, European/Other and Asian people had the lowest rates of disease.

Figure 4. Invasive GAS infection rates by prioritised ethnicity, 2017–2022

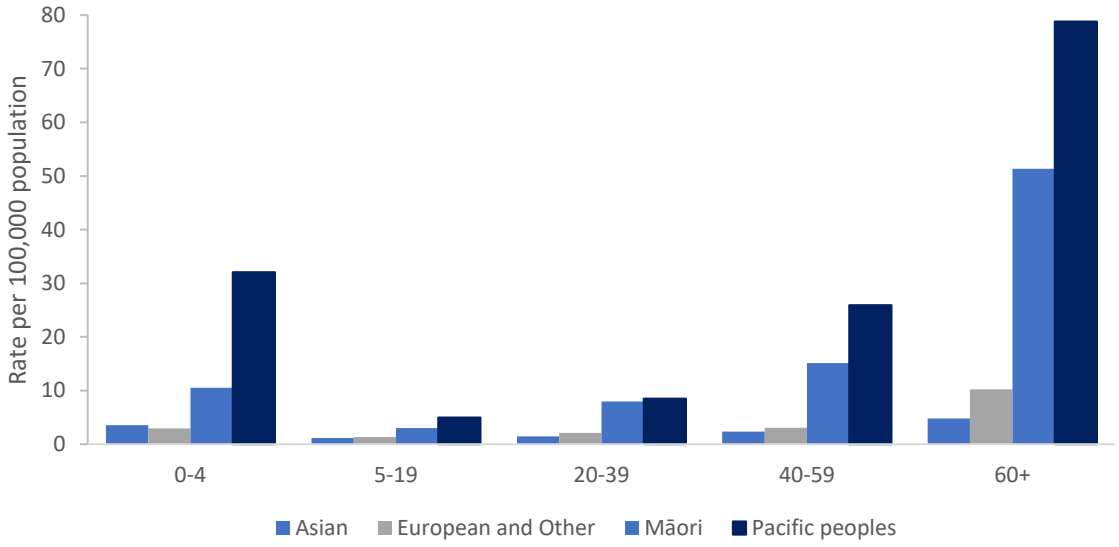


There was a decreasing trend in iGAS infections for all ethnic groups from 2018 to 2021, which was most marked for Pacific peoples. The incidence increased from 2021 to 2022 for Pacific peoples but not for other ethnic groups. iGAS infection numbers and rates by ethnicity for 2017–2022 are presented in Table 2 in the appendix.

In 2022, Pacific peoples had an incidence 15.6 per 100,000, followed by Māori (9.7 per 100,000) while European/Other, and Asian people had lower rates with 2.9 and 1.3 per 100,000 respectively. The rates for Pacific peoples and Māori were 5.5 and 3.4 times respectively higher than for European/ Other.

Figure 5 shows average rates of iGAS infection by age group and ethnicity for 2017–2022. Pacific peoples and Māori had the highest rates among all age groups, with those aged 60 years and over having the highest rates overall.

Figure 5. Invasive GAS infection rates by age and prioritised ethnicity, 2017–2022 average



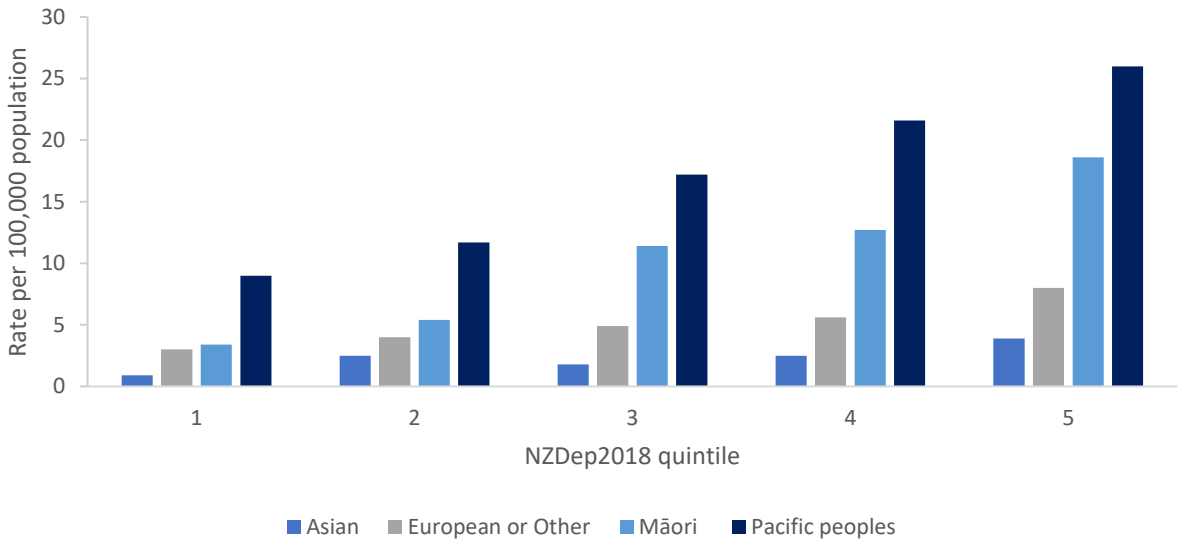
Incidence of iGAS infection by deprivation

The NZDep2018 quintile could be assigned for 98.9% (1974/1996) of iGAS infections.

The average rate of iGAS infection for 2017–2022 increased with increasing deprivation, from 3.5 per 100,000 in quintile 1 to 17.0 per 100,000 in quintile 5, a five-fold difference. Almost two-thirds (64.0%) of iGAS infections were in the most deprived quintiles 4 and 5.

The increase in iGAS infection with increasing deprivation was seen in all ethnic groups (Figure 6). Pacific peoples had the highest rate in all NZDep2018 quintiles, followed by Māori.

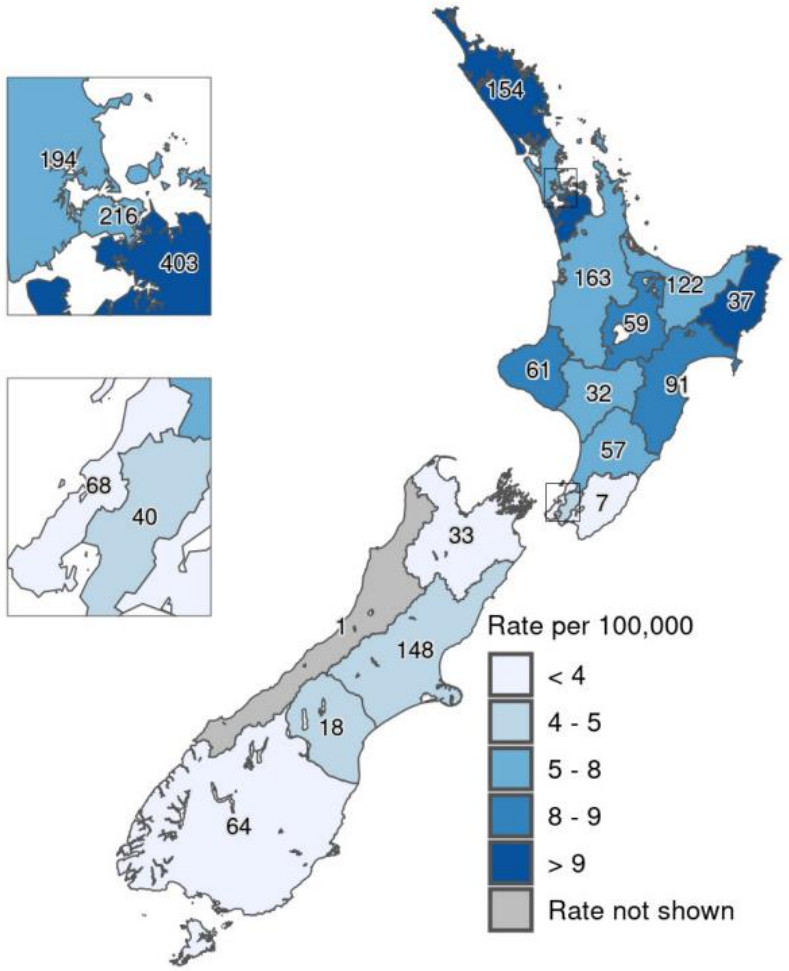
Figure 6. Invasive GAS infection rates by prioritised ethnicity and NZDep2018 quintile, 2017–2022 average



Incidence of iGAS infection by District Health Board

The District Health Board (DHB) was known for 98.8% (1973/1996) of iGAS infections. Overall, Northland and Tairāwhiti DHBs had the highest incidence of iGAS infection in 2017-2022 (Figure 7). Rates of iGAS infection by DHB for 2017–2022 are presented in Table 3 in the Appendix.

Figure 7. Number of cases and rate of invasive GAS infections by DHB, 2017–2022



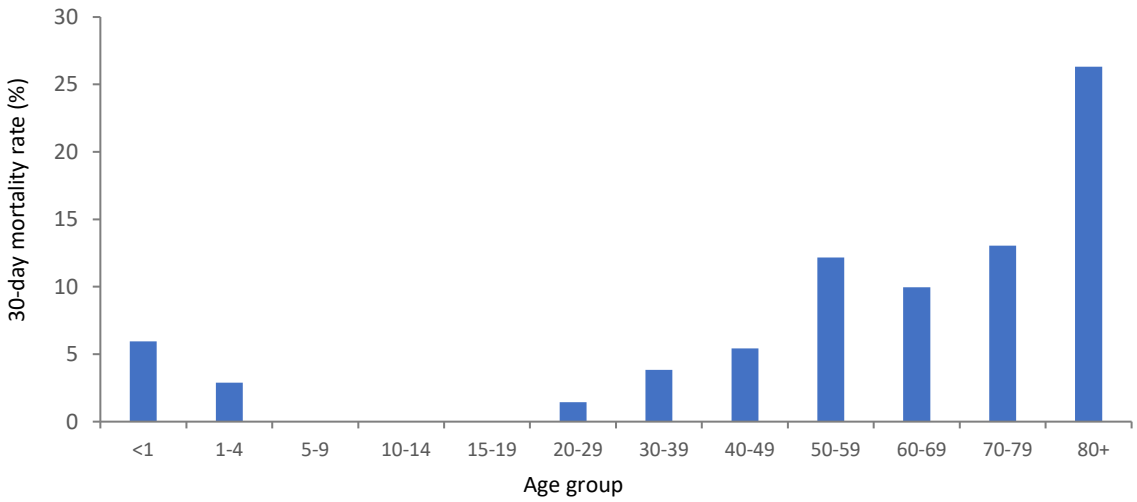
Rates not shown if count <5

30-day mortality

Between 2017 and 2022, there were 213 deaths that occurred within 30 days of collection of an iGAS specimen.

Overall, the 30-day mortality rate for iGAS infections for 2017–2022 was 10.5%. The 30-day mortality rate increased with age from 20 years with the highest rate among those aged 80 years and over (26.3%), followed by those aged 70–79 years (13.0%) and 50–59 years (12.2%) (Figure 8). The 30-day mortality rate was 6.0% for infants aged under 1 year. There were no deaths reported for those aged 5–19 years within 30 days of specimen collection.

Figure 8. 30-day mortality rate for invasive GAS infection by age group, 2017–2022 average



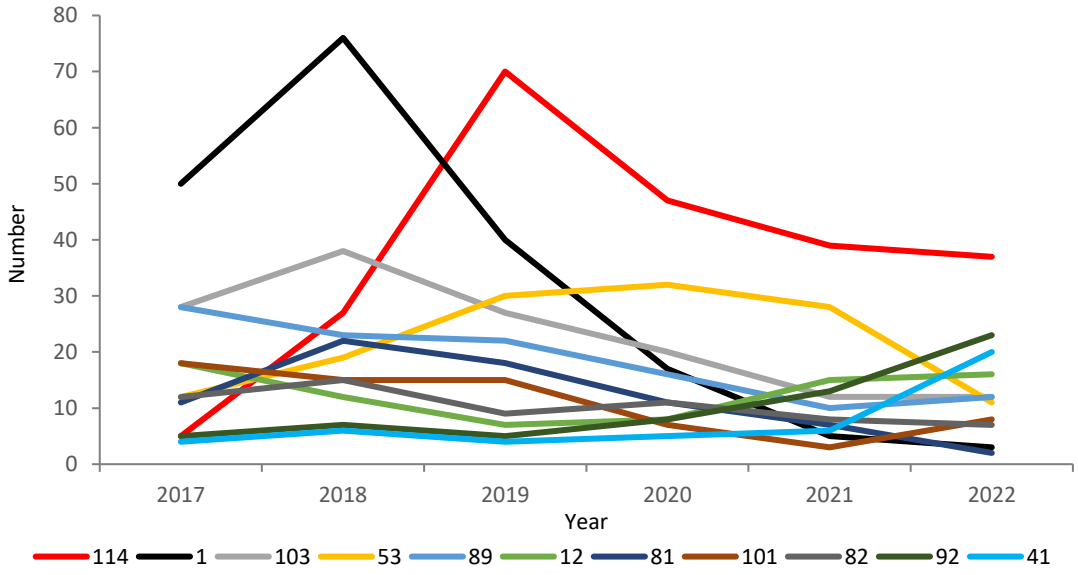
emm type distribution

Molecular *emm* typing is a common method used to characterise GAS strains. The '*emm*' in molecular typing is derived from genotyping the N-terminal region of the *emm* gene which encodes the M protein, a major GAS virulence factor. *emm* typing provides insight into the diversity of strains that are circulating and causing infection, including invasive disease.

emm typing was carried out on all iGAS isolates received by the IPL between 2017 and 2022. There were 104 *emm* types associated with iGAS infections in New Zealand between 2017 and 2022. Figure 9 shows the 11 most common *emm* types during this period. *emm*114 has been the most dominant *emm* type in New Zealand since 2019 and accounted for 15% of isolates in 2022. Prior to 2019, *emm*1 was the most common *emm* type, but has steadily decreased since 2018.

Since 2020, there has been an increase in *emm* types 92 and 41. In 2022, *emm*92 was the second most common *emm* type, accounting for 9.4% of all iGAS isolates that year. *emm*41 was the third most common *emm* type in 2022, accounting for 8.1% of isolates. See Table 4 for a list of *emm* types identified between 2017 and 2022.

Figure 9. Number of invasive GAS infections by *emm* type, 2017–2022



DISCUSSION

This report describes the epidemiology of iGAS infections in New Zealand between 2017 and 2022. The analysis is based on iGAS isolates received and genotyped (*emm* typed) at the IPL at ESR following referrals by diagnostic laboratories.

Overall, there has been a decrease in iGAS infections between 2018 and 2022. The incidence rate decreased by 49.5% between 2018 and 2022, from 9.5 per 100,000 in 2018 to 4.8 per 100,000 in 2022. Of note, the incidence of iGAS infections in 2021 and 2022 is the lowest reported in New Zealand since 2005.

International comparisons should be undertaken with caution as there are differences in reporting procedures and observation periods. However, prior to 2018, New Zealand had relatively high rates of iGAS infections compared to other countries. For example, in 2016, New Zealand had almost double the rate of iGAS infections compared with other high-income countries [1]. The rates in New Zealand in 2017 and 2018 (7.6 and 9.4 per 100,000 respectively), were higher than those reported in the United States (7.2 and 7.6 per 100,000) and Canada (6.8 and 8.6 per 100,000) [6, 7]. After 2018, however, New Zealand saw a decreasing trend while other countries experienced increases. These different trends have resulted in New Zealand now having lower rates of iGAS infections than other countries. In 2021 for example, the incidence in New Zealand (4.5 per 100,000) was lower than in the United States (6.0 per 100,000) for the same year [8]. National iGAS infection rates for Australia are not readily available, however, the incidence of iGAS infection varies widely by state/territory, ranging from 0.4 per 100,000 in the Australian Capital Territory to 42 per 100,000 in the Northern Territories in 2022 [9]. A recent national study focused on paediatric iGAS only has shown an increase from 3.7 per 100,000 in 2018 to 5.2 per 100,000 in 2022 [10].

In 2022, the incidence of iGAS infection varied by age and ethnicity. The age distribution of iGAS infections follow a U-shaped curve, with those aged under 1 year and those aged 80 years and over having the highest rates (22.5 and 27.2 per 100,000 respectively). For adults aged over 20 years, the 30-day mortality rate increased with age, with the highest rate among those aged 80 years and over.

Māori and Pacific peoples experience a higher incidence of iGAS infection than those of European/Other and Asian ethnicity. This higher incidence is consistent across all age groups and NZDep2018 quintiles. The inequities in iGAS infections for Māori and Pacific peoples are similar to ethnic inequities reported internationally, with iGAS infections disproportionally affecting Indigenous peoples and other ethnic minorities [11-13]. For example, a 2017 study from Ontario, Canada, reported an incidence rate of 56.2 per 100,000 among First Nations communities, a rate 10 times that of the general population [14]. In the Northern Territory of Australia, a study estimated the incidence of iGAS infection among the Indigenous population to be eight times that of the non-Indigenous population [15].

There is wide variation in *emm* types

Globally, large-scale epidemiological analyses show that there is significant temporal and geographic variability in the distribution of *emm* types and subtypes. This variability of *emm* types was also seen in New Zealand between 2017 and 2022. Prior to 2019, *emm*1 was the most dominant *emm* type but there has been a steady decrease in this strain type since then. *emm*114 has been the most common *emm* type in New Zealand since 2019, accounting for 15% of isolates in 2022.

The increase in iGAS infections internationally in 2022 was not seen in New Zealand

In late 2022, several European countries, including the United Kingdom, France, Ireland, the Netherlands, and Sweden, as well as the United States and Australia, experienced an increase in iGAS infections that coincided with the relaxation of pandemic restrictions [7-9, 16, 17]. This increase was particularly notable for children aged under 10 years. However, in the United Kingdom, there was also an increase in iGAS infections among older age groups compared to the pre-pandemic period [17-20]. New Zealand did not experience a similar increase in iGAS infections in 2022, with the incidence remaining similar to 2021.

A possible explanation for the increase in iGAS infections may be due to a rise in predisposing viral illnesses (for example, varicella zoster and respiratory viruses) following a period of reduced circulation during the COVID-19 pandemic, alongside an increase in the population of susceptible individuals, especially children, who have had limited exposure to GAS and predisposing illnesses due to pandemic measures [16, 19].

While early typing data from Europe suggests the recent increase in iGAS infections cannot be attributed to a specific or new strain [16], *emm*1 and *emm*12 have been commonly reported in 2022–2023 isolates from the United Kingdom [17], the Netherlands [18], and France [16]. *emm*1, and in particular the sublineage $M1_{UK}$, was reported as the most common type during the 2022/23 winter season in England, accounting for 30% of all cases and 50% of cases aged under 15 years [17, 19]. The number of *emm*1 strains belonging to the $M1_{UK}$ sublineage in New Zealand is unknown as this sublineage is not detected by standard *emm*-typing methods. Other prevalent strains reported among European iGAS infections in 2022/23 include *emm*89, *emm*4, and *emm*22. The strains circulating in these countries were not as common in New Zealand over the same period, and in particular, *emm*1 accounted for only 1% of New Zealand cases in 2022.

CONCLUSION

Although there has been a decrease in iGAS infections in New Zealand since 2018, with the incidence in 2021 and 2022 the lowest it has been since 2005, inequities persist. Māori and Pacific peoples have higher rates than other ethnic groups, and the most vulnerable age groups, those under 1 year and those aged 80 years and over, are also disproportionately affected.

The increase in iGAS infections reported overseas has not been seen in New Zealand and the incidence in New Zealand in 2022 was similar to 2021. A laboratory audit undertaken in early 2023 suggests that the current surveillance system underestimates the burden of iGAS infection in New Zealand but is likely to give a true indication of long-term trends and differences between population groups, necessary to inform policy.

The circumstances contributing to the 2022/23 European increases in iGAS infections, including increasing rates of viral illnesses and reduced immunity due to pandemic measures, particularly among children, are also present in New Zealand. This highlights the importance of continued surveillance of iGAS infections alongside efforts to address systemic and health care access issues that may contribute to the spread of iGAS infection.

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APPENDIX

Table 2. Number of cases and rate of invasive GAS infection by prioritised ethnicity, 2017–2022

Ethnic group	2017		2018		2019		2020		2021		2022	
	Cases	Rate[1]	Cases	Rate[1]	Cases	Rate[1]	Cases	Rate[1]	Cases	Rate[1]	Cases	Rate[1]
Māori	99	13.4	127	15.6	133	16.1	97	11.5	79	9.3	83	9.7
Pacific People	72	23.4	97	29.3	81	24.2	67	19.7	39	11.3	54	15.6
Asian	19	3.3	22	3.0	19	2.5	12	1.6	11	1.4	10	1.3
European/ Other	165	5.2	207	6.9	174	5.7	100	3.2	99	3.1	90	2.9
Unknown	12	NA	8	NA	7	NA	6	NA	0	NA	7	NA
Total	**367**	**7.6**	**461**	**9.4**	**414**	**8.3**	**282**	**5.5**	**228**	**4.5**	**244**	**4.8**

[1] Rate per 100,000 population. Where there were fewer than five cases in any category, a rate has not been calculated.

Table 3. Number of cases and rate of invasive GAS infection by DHB, 2017–2022

DHB	2017		2018		2019		2020		2021		2022	
	Cases	Rate[1]	Cases	Rate[1]	Cases	Rate[1]	Cases	Rate[1]	Cases	Rate[1]	Cases	Rate[1]
Northland	24	13.2	41	22.1	35	18.5	15	7.7	19	9.6	20	9.9
Waitemata	40	6.6	40	6.5	44	7.0	31	4.9	17	2.7	22	3.5
Auckland	44	9.0	56	11.4	37	7.4	26	5.1	30	6.0	23	4.8
Counties Manukau	52	9.4	106	18.7	88	15.2	78	13.1	35	5.8	44	7.3
Waikato	30	7.3	35	8.3	36	8.4	21	4.8	22	4.9	19	4.2
Lakes	6	5.4	9	7.9	22	19.1	7	6.0	8	6.8	7	5.9
Bay of Plenty	20	8.3	11	4.4	26	10.1	18	6.8	23	8.5	24	8.7
Tairawhiti	5	10.2	9	18.2	5	10.0	8	15.7	6	11.7	4	-
Hawke's Bay	13	7.7	17	9.9	16	9.2	20	11.1	13	7.2	12	6.6
Taranaki	13	10.8	15	12.4	15	12.2	9	7.2	9	7.1	0	-
Midcentral	16	8.9	14	7.7	8	4.3	7	3.7	9	4.8	3	-
Whanganui	4	-	8	12.0	6	8.9	3	-	2	-	9	12.9
Capital & Coast	15	4.8	15	4.7	15	4.7	7	2.2	4	-	12	3.7
Hutt	13	8.5	5	3.2	10	6.4	6	3.8	2	-	4	-
Wairarapa	1	-	2	-	1	-	1	-	0	-	2	-
Nelson Marlborough	8	5.2	12	7.7	3	-	1	-	8	4.9	1	-
West Coast	0	-	0	-	1	-	0.	-	0	-	0	-
Canterbury	43	7.8	34	6.1	24	4.2	17	2.9	13	2.2	17	2.9
South Canterbury	2	-	10	16.4	5	8.2	1	-	0	-	0	-
Southern	11	3.3	19	5.6	11	3.2	5	1.4	8	2.3	10	2.9

[1] Rate per 100,000 population. Where there were fewer than five cases in any category, a rate has not been calculated.

Table 4: Number of invasive GAS infections by *emm* type, 2017–2022

emm type	2017	2018	2019	2020	2021	2022	Total
114	5	27	70	47	39	37	225
1	50	76	40	17	5	3	191
103	28	38	27	20	12	12	137
53	12	19	30	32	28	11	132
89	28	23	22	16	10	12	111
12	18	12	7	8	15	16	76
81	11	22	18	11	7	2	71
101	18	15	15	7	3	8	66
82	12	15	9	11	8	7	62
92	5	7	5	8	13	23	61
75	10	9	8	10	8	11	56
49	11	7	12	11	7	1	49
41	4	6	4	5	6	20	45
4	7	13	10	5	3	1	39
58	11	17	2	1	2	4	37
44	11	9	9		3	3	35
91	7	6	8	4	4	4	33
28	6	4	9	4	4	2	29
59	13	4	5	2	1	3	28
22	5	2	7	4	5	5	28
11	4	3	7	4	5	4	27
76	3	5	10	1	6	1	26
65	1	5	12	2	4	1	25
77		8	5	3	4	4	24
108	3	6			7	6	22
100	10	2		1		6	19
3	2	6	1	3		2	14
112	4	4	3		2	0	13
6	6	4	1	1		0	12
70	2	3	3	1	2	0	11
66		1				0	1
74	1	4	2	3	1		11
87	3		6		2		11
113		7		2			9
93	3	5	1				9

104	1		3	4		8
116	1	2		2	3	8
19	1	5	1	1		8
8		1	1	4	2	8
118	1	5		1		7
2	1	2	4			7
25	3	1	1	2		7
68		3	2	2		7
124	3		2	1		6
15	3	2	1			6
232	4	1	1			6
233	3	3				6
95			2	2	2	6
98	2	2		2		6
183			3	1	1	5
225	3			2		5
55		1	3	1		5
86	2	2	1			5
217	1	2	1			4
39	3			1		4
63	1	1	1		1	4
73	1	3				4
85	1	1		2		4
88		2	1		1	4
9	2		1	1		4
105	1	1		1		3
110		2	1			3
238		1	2			3
52		2		1		3
56		1	2			3
67	3					3
71		2	1			3
90	2		1			3
97		1		2		3

Note: 34 *emm* types have not been included Table 4 as there were less than two cases in 2017–2022.

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