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Original article

Acute post-streptococcal glomerulonephritis (APSGN) in the Torres Strait and Cape York: surveillance insights pre- and post- mandatory notification

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Abstract

Acute post-streptococcal glomerulonephritis (APSGN) is an immune-mediated kidney condition, typically affecting children. While the incidence has declined in urban Australia, APSGN remains a major concern in rural and remote communities, particularly among First Nations children. This study describes the epidemiology of APSGN in the Torres Strait and Cape York region of Far North Queensland (FNQ) over a three-year period, from January 2022 to December 2024, which spanned pre- and post-mandatory public health notification of APSGN in Queensland.

Cases were initially identified through electronic medical record alerts and later augmented by clinical notification when APSGN became notifiable in Queensland in October 2023. Over the three years of our study period, there were 75 confirmed, probable and possible cases identified, including outbreaks on Waiben (Thursday Island) and New Mapoon. The median age of cases was six years (interquartile range: 4–9 years), with 92% of cases occurring in children under 15, all from First Nations backgrounds. The 63 confirmed and probable cases in children under 15 represent an incidence within this population of 390 cases per 100,000 person-years (95% confidence interval: 294–486 per 100,000 person-years), ostensibly the highest documented rate globally.

In the modern era, the burden of this preventable disease for FNQ First Nations children is the highest in the world. Progress will only be made by addressing the underlying social determinants of health, including childhood disadvantage and household crowding.

Keywords: acute post-streptococcal glomerulonephritis; glomerulonephritis; *Streptococcus pyogenes*; Indigenous health; First Nations health; Aboriginal and Torres Strait Islander health; kidney disease

Introduction

Acute post-streptococcal glomerulonephritis (APSGN) results from an immune-mediated glomerular injury, typically following infection with a nephritogenic strain of *Streptococcus pyogenes* (Strep A).[1] When the kidney injury clinically manifests, it is usually a nephritic picture with haematuria, oedema, and hypertension. In Northern and Central Australia, APSGN usually follows Strep A skin infection, although it can also follow Strep A pharyngitis. APSGN has also been reported to occasionally follow Group C/G streptococcal infections.[1]

Strep A causes a wide spectrum of disease, from acute infections to toxin-related disease and immune-mediated post-infectious sequelae, including acute rheumatic fever.[2] APSGN is both endemic and occurs in outbreaks; it is driven by a type III hypersensitivity reaction and is largely pathogen-dependent. Strep A strains are determined by the bacterial M protein (M-type) and related genotype (*emm*-type). Host immunity is strain-specific. Strep A *emm*-types *emm*55, *emm*49 and *emm*60 are the most commonly reported in APSGN cases worldwide.[3]

APSGN is primarily a disease of childhood poverty and is rare in high-income settings. It has a low incidence in the general Australian population (incidence ~11 cases per 100,000 person-years) and has been so for the last 50 years.[2,4] Nonetheless, high rates of APSGN persist in Aboriginal and Torres Strait Islander (hereafter respectively referred to as First Nation) children, especially in remote and very remote communities across Central Australia, Northern Australia and the Torres Strait. APSGN is a known risk factor for developing chronic kidney disease later in life.[5] Here there are some of the highest reported regional incidences in the world (greater than 150 cases per 100,000 person-years).[6]

APSGN has long been a notifiable condition in the Northern Territory and Western Australia, and in October 2023, it also became a notifiable condition under Queensland public health legislation.[5,7] Numerous APSGN outbreaks have been reported across the Torres Strait and Cape York region over the previous 30 years, with at least seven outbreaks documented over the nine years before mandatory notification was introduced.[8] An outbreak is defined by three reported cases, either probable or confirmed, from a defined community or geographical area, all with an onset within a four week period, and all cases are not household-like contacts of each other.[5] Prior to 2022, the burden of APSGN in the region had not been routinely documented or reviewed outside outbreak settings. This study describes the epidemiology of APSGN in the Torres Strait and Cape York area of Far North Queensland over three years spanning pre- and post-mandatory notification; it is the first known review of its kind for this region.

Methods

Setting

The Torres and Cape Hospital and Health Service (TCHHS) serves a population of around 27,000 over a geographical area of 130,278 km^2 (similar to the land area of England) and includes 31 Queensland Health operated primary healthcare centres and four remote hospitals, across 13 local government areas. TCHHS delivers healthcare services in the region in partnership with Aboriginal Community Controlled Health Organisations and the Royal Flying Doctor Service. First Nations people account for nearly 70% of the population.[9]

Data collection and analysis

In January 2022, the Torres and Cape Public Health Unit established a real-time APSGN email alert system which identified potential APSGN cases documented by Queensland Health clinicians on the TCHHS electronic medical record system (Best Practice Software®). Following an alert, suspected cases were immediately investigated, and details were stored on a local Microsoft Excel 2016 database. Once APSGN became notifiable in Queensland in October 2023, cases were recorded on the Queensland Notifiable Conditions System (NoCS). Data for this review were extracted from the local database and NoCS and included confirmed, probable, and possible APSGN cases notified between 1 January 2022 and 31 December 2024 for residents of the TCHHS region.

Laboratory results were cross-checked against those held on the Pathology Queensland Laboratory Information System (AusCare), and the clinical information was checked against patient records in Best Practice Software®. Contact tracing was conducted for all confirmed and probable cases in line with the Northern Territory Health APSGN guideline, and later, when published, the Queensland Health guideline.[5] *Emm*-typing was performed by the Queensland Public and Environmental Health Laboratory (PEHRL) for individual cases on request by the Torres and Cape Public Health Unit. Case and outbreak definitions were as per the Queensland Health APSGN Guidelines for Public Health Units (Appendix A).[5] Crude incidence was calculated using 2022 estimated resident populations for the TCHHS region based on 2021 census data.[10] Data were analysed and the epidemic curve was created in Microsoft Excel.

Ethics approval

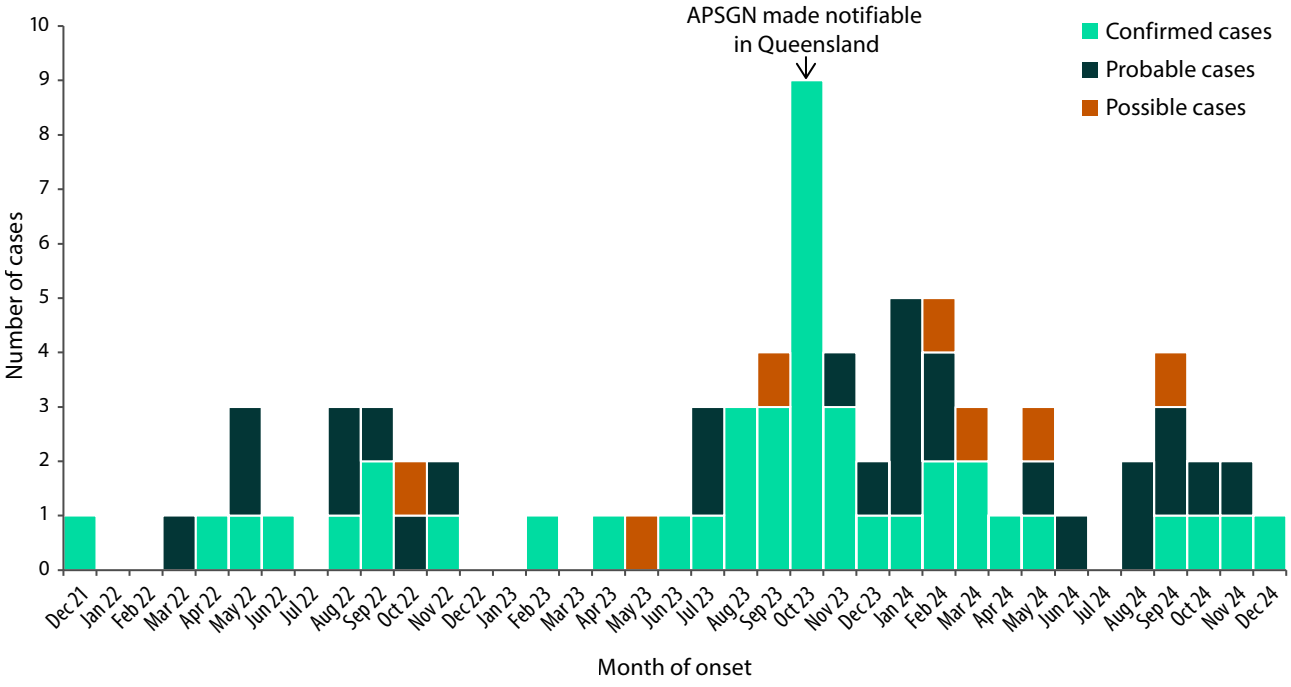
An ethics exemption was granted by the Far North Queensland Human Research Ethics Committee (EX/2022/QCH/92523).

Results

Seventy-five cases of APSGN were identified over the three-year review period, comprising 42 confirmed, 26 probable and seven possible cases (Figure 1). A further 84 cases were investigated but did not meet the case definition criteria.[5] Most cases, 67/75 (89%) were identified by clinical presentation; 8/75 cases (11%) were identified through contact tracing. The median age of cases was six years (interquartile range: 4–9 years; range: 0–55 years), with 69/75 cases (92%) aged under 15 years. Males accounted for 44/75 of cases (59%). All cases identified occurred in First Nations people, and cases were resident across 28 communities in the Torres and Cape region (Table 1). The 68 confirmed and probable cases represented a region-wide incidence of 88 cases per 100,000 person-years (95% confidence interval [95% CI] 67–108 per 100,000 person-years) and an incidence among First Nations people of 133 per 100,000 person years (95% CI: 101–165 per 100,000 person-years). The 63 confirmed and probable cases among First Nations children aged under 15 years represented an incidence within this demographic of 390 cases per 100,000 person years (95% CI: 294-486 per 100,000 person-years). Two outbreaks were declared during the three-year review period, with an *emm*55 outbreak of eight cases on Waiben (Thursday Island) declared in November 2023, and a smaller outbreak of unknown *emm* type among three cases in New Mapoon during January 2024.

Urine collection for microscopy, culture and sensitivity plus blood tests for streptococcal serology and complement testing were completed for 72/75 cases (96%). Incomplete collection was noted for one case before APSGN became notifiable, and for two cases afterwards. In total, 5/75 cases (6%) had incomplete investigation, as two further cases had tests unable to be completed on provided samples ('no test'). The five cases were all determined probable cases, representing 19% of all probable cases. In terms of treatment, the majority had documented antibiotic treatment, with intramuscular benzathine penicillin in 59/75 cases (79%) and with oral antibiotics in 4/75 cases (5%). In one case, antibiotics were not given and the treatment status of 12 cases was not documented. Fifty-seven cases (57/75; 76%) were hospitalised and there were no deaths.

Figure 1: APSGN cases in the Torres Strait and Cape York region[a], Queensland, Australia, January 2022 – December 2024



a Includes two cases in which the date of notification is used, as the date of onset is unknown.

Table 1: Characteristics of APSGN cases in the Torres Strait and Cape York region, Queensland, Australia, by case definition status, January 2022 – December 2024

Characteristic	Category	Case definition status					
		Confirmed		Probable		Possible	
		n/total	%	n/total	%	n/total	%
Age group	0–4 years	17/42	40	6/26	23	3/7	43
	5–9 years	19/42	45	9/26	35	3/7	43
	10–14 years	5/42	12	7/26	27	0/7	0
	15+ years	1/42	2	4/26	15	1/7	14
First Nations status	Aboriginal	14/42	33	5/26	19	2/7	29
	Torres Strait Islander	20/42	48	11/26	42	3/7	43
	Aboriginal and Torres Strait Islander	8/42	19	10/26	38	2/7	29
	non-First Nations	0/42	0	0/26	0	0/7	0
Clinical criteria	Macroscopic haematuria[a]	40/42	95	21/26	81	6/7	86
	Hypertension	36/42	86	21/26	81	2/7	29
	Facial oedema	21/42	50	15/26	58	1/7	14
	Peripheral oedema	7/42	17	6/26	23	0/7	0
Laboratory criteria:	Collected	42/42	100	26/26	100	7/7	100
Microscopic haematuria (urine erythrocyte count)	Median (10^6/L)[b]	500	500–500	25	10–225	210	130–500
Laboratory criteria:	Collected[a]	42/42	100	23/26	88	7/7	100
C3 complement	Median (g/L)[b]	0.22	0.17–0.31	1.27	1.14–1.49	0.46	0.18–0.81
Laboratory criteria:	Collected[a]	42/42	100	24/26	92	7/7	100
Antistreptolysin O titre (ASOT)	Median (U/mL)[b]	635	395–1,125	286	169–664	661	216–1,320
Laboratory criteria:	Collected[a]	42/42	100	24/26	92	7/7	100
Anti-DNAse B	Median (U/mL)[b]	979	534–1,515	959	457–1,515	730	592–1,210

Characteristic	Category	Case definition status					
		Confirmed		Probable		Possible	
		n/total	%	n/total	%	n/total	%
Current or recent infection: throat	Sore throat diagnosed	14/42	33	8/26	31	4/7	57
	Throat swab collected[c]	14/42	33	7/26	27	4/7	57
Current or recent infection: skin	Strep A cultured from throat swab	1/14	7	2/7	29	0/4	0
	Impetigo or skin lesions diagnosed	29/42	69	15/26	58	4/7	57
	Skin swab collected[d]	19/42	45	8/26	31	2/7	29
Current or recent infection: scabies	Strep A cultured from skin swab	12/19	64	8/8	100	2/2	100
	Scabies diagnosed[e]	5/42	12	4/26	15	1/7	14

a Includes two blood specimens collected for ASOT that were not able to be tested by the laboratory (defined as a 'no test'), along with two 'no tests' for Anti-DNAse B, and three 'no tests' for C3 complement blood specimens.

b Values in '%' columns for this row are interquartile ranges, not percentages.

c Includes swabs collected from six cases who were not diagnosed with a sore throat.

d Includes a swab collected from one case who was not diagnosed with impetigo or skin lesions.

e Scabies diagnosis data was collected from an audit of clinician's documentation on Best Practice software.

Contact tracing was completed for the 68 confirmed and probable cases, with a median of five household contacts and a mean of 6.6 contacts for 43 cases with documented household contacts.

Skin and throat swabs were not consistently taken for microscopy, culture and sensitivity. A skin swab was taken from 28/48 cases (60%)with current or recent skin sores, with one swab taken in a case without documented clinical signs of impetigo. A throat swab was taken from 19/26 cases (73%) with a current or recent sore throat, noting that a further six cases also had throat swabs taken as part of their diagnostic workup. Strep A was cultured from 22/29 skin swabs (76%) and from 3/25 throat swabs (12%). Positive cultures were also not consistently *emm*-typed, with 9/25 Strep A isolates (36%) sent for typing. *emm*55 was identified from skin cultures of five cases, including four cases from the 2023 Waiben outbreak. *emm*81 was identified twice from skin swabs, *emm*53 was identified once from skin, and *emm*76 was identified once from a throat swab.

Discussion

The APSGN incidence of 88 cases per 100,000 person years in the Torres Strait and Cape York is eight times the Australian rate of 11 cases per 100,000 person-years.[11] The crude incidence of 390 cases per 100,000 person-years in FNQ First Nations children is perhaps the highest documented incidence of APSGN globally and surpasses the estimated incidence of 229 cases per 100,000 person-years found in First Nations children admitted to hospital for APSGN in Central Australia in 2020.[2,6] All documented cases in this three-year review involved First Nations children, highlighting the disproportionate impact of the disease. Our findings reflect similar trends reported by other Australian jurisdictions, especially those with remote First Nations communities.[12,13] Notably, 28 of the 55 Queensland cases identified during 2024 (51%) were resident in the Torres Strait and Cape York region, despite this region having only 0.5% of the Queensland population.[14] As APSGN is a risk factor for developing chronic kidney disease later in life, APSGN clearly remains a pressing public health issue in this region.

Comparison of the confirmed to possible cases shows similar rates of haematuria at 86% (possible) versus 95% (confirmed), but much lower frequencies of oedema and hypertension among possible cases (respectively 14% and 29%) than among confirmed cases. Most children with APSGN continue to have microscopic haematuria for a year or more, long after the other classic nephritic features have resolved. In about 20% of patients, microscopic haematuria and proteinuria persist for up to five years post-acute illness.[15] Given that APSGN is, in most cases, a clinically self-remitting disease, the 'possible' cases may represent APSGN further along the clinical course or those with a subclinical or mild clinical presentation. If this is the case, it may point to a need to further raise awareness in affected communities of the symptoms of APSGN to ensure affected patients present to clinics, and clinicians involved recognise the condition early. Classifying APSGN, therefore, can be a challenge; hence, keeping track of possible cases is an important component of APSGN surveillance.

The majority of all APSGN cases (96%) had the complete array of investigations requested, highlighting extensive clinician awareness of this disease in this region. There have also been public health efforts to ensure that, if APSGN is suspected, clinicians are easily able to find the appropriate investigations to order, with posters in all Queensland health facilities. However, five probable cases did not have all required laboratory tests performed, so were unable to be confirmed as APSGN cases. This may have been due to confidence of clinical staff in taking paediatric venous blood samples or to the long distances pathology are required to travel, which at times breach timeframes for pathology processing.

Taking skin and throat swabs for Strep A culture is an important part of investigating APSGN. Once the presence of Strep A is confirmed, isolates should be sent for *emm*-typing, particularly in the context of an outbreak. Sixty percent (60%) of cases with clinical signs of impetigo had samples collected for culture. *Emm*-typing to further understand nephrogenic and endemic strains of Strep A, or to direct Strep A vaccine research, is required to better identify its importance. Of the collected samples, nine were *emm*-typed notably with *emm*55 identified in four cases in the Waiben outbreak.[3] Other strains identified included *emm*53, *emm*76, and *emm*81, with the former two not typically recognised as nephritogenic. The non-nephritogenic strains may point to concurrent incidental Strep A infection or colonisation or may even represent newly identified nephritogenic strains.[3] Routine referral of Strep A isolates for *emm*-typing from suspected and confirmed APSGN cases would support prompt outbreak detection and would provide public health with ongoing intelligence of circulating strains. Public health could employ similar isolate referral mechanisms from diagnostic to

public health laboratories as are currently in place for the routine *emm*-typing of invasive Strep A isolates in Queensland.

Strep A related diseases, including APSGN, are markers of childhood disadvantage. The primary precursor to APSGN, impetigo, is strongly tied to environmental factors such as overcrowding. In the Torres Strait and Cape York region, poor skin health and conditions such as impetigo and scabies are all too common.[16] Our study showed that 12% of our confirmed cases had clinically diagnosed scabies, while 69% had signs of impetigo. These are both likely under-reported. Household overcrowding is a key contributing factor, particularly in the Torres Strait and Cape York region, with rates of household crowding more than double those seen in the broader Queensland population.[17] Though overcrowding was not directly measured in this study, contact tracing of 68 cases revealed a median number of five household contacts and a mean of 6.6. This is much higher than the Australian population at large, with a mean household size of 2.5, or 1.5 household contacts according to the 2021 census.[18] Tackling these key social determinants underpinning Strep A infection, such as housing, requires political will. Otherwise, there is unlikely to be substantial progress in tackling Strep A infection and APSGN even with the most sophisticated health services.

In addition to housing, there is community knowledge that seasonality is an environmental risk factor for precursor skin infections. Seasonal patterns in Strep A have been demonstrated in European temperate climates and Australian contexts such as in the Northern Territory.[19,20] With three years of data, cases in the Torres Strait and Cape York appear to be more frequent in the late dry season of September and October. However, a greater period of surveillance is required to investigate these trends.

This study has several limitations. The retrospective design, and the relatively short duration capturing only one year of mandatory notification, do not allow for statistical outcome comparisons. The low percentage of cases identified by the screening of household contacts, at 11%, indicates this study probably does not capture all subclinical cases. Subclinical cases have been reported to outnumber clinical cases by at least two to one in previous APSGN outbreaks in Cape York.[8,21] Furthermore, while the APSGN email alert system identified most cases, it relied on visit reason terminology entered by clinicians, so may have missed some suspected cases if they were also not clinically notified. The majority of cases (89%) were identified by their clinical presentation as opposed to contact tracing (11%); thus APSGN cases with milder symptoms may not have presented to healthcare services and may not have been captured in our study.

There has been some progress in the public health management of APSGN in the Torres Strait and Cape York with Queensland's transition to mandatory notification and the publication of a state APSGN guideline.[5] Yet despite this, APSGN incidence in First Nations children of the Torres Strait and Cape York region is among the highest documented incidence globally. This is an astonishing statistic to report in Australia in the twenty-first century and highlights the desperate need to address overcrowding and socioeconomic disadvantage in the region. In the words of Sir Michael G. Marmot: *At the end of every scientific paper there is a familiar coda: more research is needed, more research is needed. What, I wondered, if we added a new coda: more action is needed*.[22]

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Appendix A

APSGN case definition from the Queensland Health APSGN Guidelines for Public Health Units[5]

Case definitions

Confirmed

Laboratory definitive evidence

OR

Laboratory suggestive evidence AND clinical evidence

Probable

Clinical evidence only and APSGN is considered the most likely cause by a treating clinician

Possible

Laboratory suggestive evidence only

Laboratory definitive evidence

Renal biopsy suggestive of APSGN

Laboratory suggestive evidence

1. Microscopic haematuria (RBC > 10/ul)

AND

2. Evidence of recent streptococcal infection (Isolation or detection of GAS by culture, NAAT or rapid antigen detection test from skin or throat or elevated/rising ASO or Anti-DNase B titre, as defined by Steer et al, 2019

AND

3. Reduced C3 complement level (< 0.7 g/L)

Clinical evidence

At least 2 of the following:

- Facial and/or peripheral oedema
- Macroscopic and/or moderate haematuria (≥ 2+ red blood cells on urine dipstick)
- Hypertension, according to age/sex/height percentiles from the American Academy of Paediatrics, 2017.