Appendix A: Notifiable Status Assessment Panel (NSAP) report for iGAS

Access to this Appendix is restricted.

Assessment of the need for national notification of invasive group A streptococcal (iGAS) disease

Notifiable status assessment (NSA) Panel for the Communicable Diseases Network Australia (CDNA)

08 November 2018

Summary

An NSA Panel nominated by CDNA assessed the need for national notification of invasive group A streptococcal (iGAS) disease in Australia against CDNA and PHLN endorsed criteria. The NSA panel considered that the severity, public health impact, observed increase in cases, and disproportionate effect on Indigenous Australians compels the need for national notification in Australia to better understand the epidemiology of iGAS (including circulating *emm* types to inform vaccine development), and so the appropriate public health response can occur. The appropriate public health response, which may be timely contact tracing and management, should be further investigated and a Series of National Guidelines for iGAS developed. Using the current CDNA-endorsed criteria for assessing the need for national notification, iGAS scored within the threshold for action "national notification recommended". National notification is recommended, and should be progressed through AHPPC and the State and Territory and Australian Health Ministers with the endorsement of CDNA.

Introduction

The Australian Government Minister for Health may include a disease in the NNDL if the Minister considers that an outbreak of the disease would be a public health risk. In 2014, the Communicable Disease Network Australia endorsed a set of criteria (Appendix A) to guide assessment of the need for inclusion of a disease on the NNDL, in order to advise the Minister for Health. The criteria are based on a system of scoring developed by the Public Health Agency of Canada (PHAC) which is designed to assist in determining surveillance priorities.[1] CDNA had previously developed and endorsed a system in 2008 based on the Centers for Disease Control and Prevention surveillance goals,[2] but the system allowed too much variation in the way that diseases may be assessed, and the goals and criteria were vague and the criteria were never published.

These assessments are carried out by an NSA panel, consisting of a CDNA jurisdictional executive group member (Chair); a laboratory expert nominated by the Public Health Laboratory Network (PHLN); a local public health unit representative; a technical writer; and other experts drawn from CDNA or elsewhere, when required. On 30 July 2014, CDNA endorsed a revised set of criteria that enables assessment of the public health priority and feasibility of national notification for a disease, and results in a score that guides further action. The NSA panel assess the disease against the CDNA endorsed criteria, and then develop a discussion paper for CDNA and PHLN with recommendations about whether surveillance for the condition would be useful, and the best method of surveillance as compared to other methods of disease monitoring (e.g., surveys, notifications, using existing datasets).

Epidemiology and public health impact

Invasive group A streptococcal disease (iGAS) is a serious infection caused by the bacterium group A *Streptococcus pyogenes* (GAS). Transmission is primarily from person-to-person via large respiratory droplet spread, or direct contact with carriers or infected persons. GAS can asymptomatically colonise the throat and skin, but can sometimes enter normally sterile sites (e.g. blood, cerebrospinal fluid, deep tissue, bone) through non-intact skin and mucous membranes coming into direct or indirect contact with infected wound exudates or respiratory secretions, and in rare cases through contact with infected environmental surfaces.[3]

Infection can lead to a range of clinical manifestations including bacteraemia, streptococcal toxic-shock syndrome (STSS), necrotising fasciitis ('flesh-eating disease'), pneumonia, retropharyngeal abscess, septic arthritis, and meningitis.[4] Recognition of iGAS and life-saving management can be delayed due to its varied syndromes. Management always includes antibiotic therapy, with intensive care therapy, surgical debridement, and intravenous immunoglobulin often required.[4] There are a number of groups in the community at increased risk of infection, including: the elderly, young children, pregnant and-post-partum women, Aboriginal and Torres Strait Islander Australians, and household contacts of iGAS cases.[5, 6]

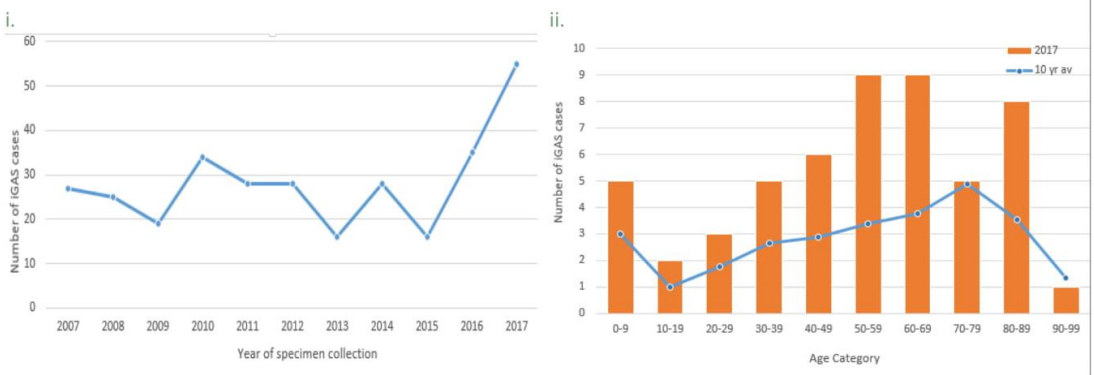
Table 1: Summary of published Australian iGAS incidence rates

Study area	Study cohort	Study period	Incidence rate			Case fatality rate	Reference
			Total	Indigenous	non-Indigenous		
Western Sydney	Adult hospital patients	2008	19[(a)]	n.a.	n.a.	0%	Sivagnanam et al.[7]
		2010	33[(a)]	n.a.	n.a.	13.0%	
Queensland	Children ≤ 18 years old	2007	2.6[(b)]	9.9[(b)]	2.2[(b)]	n.a.	Whitehead et al.[8]
		2008	3.5[(b)]	13.2[(b)]	3.0[(b)]	n.a.	
North Queensland	All isolates	1996–2001	n.a.	82.5[(c)]	10.3[(c)]	Overall: 7.0%; STSS: 22.0%	Norton et al.[5]
Victoria	Public and private hospitals and laboratories	2002–2004	2.7[(d)]	n.a.	n.a.	Overall: 7.8%; STSS: 23.0%	O'Grady et al.[9]
Northern Territory	GAS bacteraemia	1991–1996	9.3[(c)]	23.8[(c)]	4.7[(c)]	13.0%	Carapetis et al.[10]
		1998–2009	15.2[(e)]	59.4[(e)]	9.9[(e)]	14.6%	Gear et al.[11]
	Isolates from normally sterile sites	2011–2013	n.a.	69.7[(d)]	8.8[(d)]	Overall: 8.0% STSS: 11.0%	Boyd et al.[12]

(a) per 100,000 public hospital admissions per year.
(b) per 100,000 population aged <18 years old per year.
(c) crude incidence rate per 100,000 population per year.
(d) annualised incidence rate per 100,00 population per year.
(e) age-adjusted, per 100,000 people per year.
n.a. not available.
STSS Streptococcal Toxic Shock Syndrome.

There appears to be a recent resurgence of GAS infections, both globally, as observed in Canada and the United Kingdom (UK)[13, 14] and in Australia. Public hospital admissions with laboratory-confirmed iGAS infections in Western Sydney increased by almost two-fold over a two-year period, from 19 per 100,000 admissions per year in 2008, to 33 per 100,000 admissions per year in 2010 and the case fatality rate (CRF) also increased from 0% in 2008 to 13% in 2010.[7] The CFR due to iGAS is reported to be as high as 23% when complicated with STSS.[9] Unpublished data (Figure 1) from Hunter New England region of New South Wales (NSW), show an apparent increase in the number of iGAS cases in 2017 compared to the 10-year average.

Figure 1: Number of iGAS cases in the Hunter New England (HNE) region, i. 2007–2017; ii. by age group, 2017 vs 10-year average; data from Pathology North



i: iGAS cases in HNE region, 2007–2017.

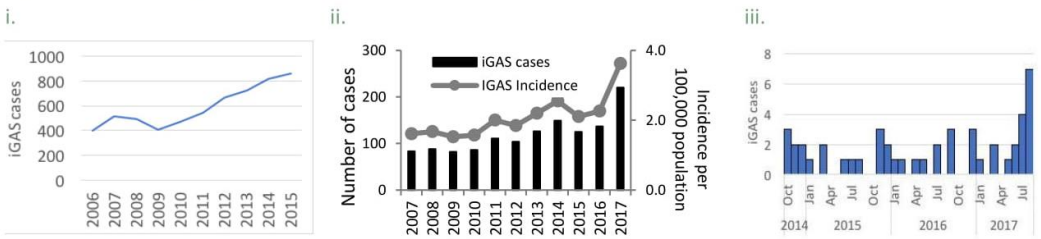
ii: iGAS cases in HNE region, by age group, 2017 vs 10-year average.

Source: Pathology North; Personal communication: Dr Kathryn Taylor, Hunter New England Population Health, NSW Health.

Unpublished data from the Victorian Hospital Pathogens Surveillance Scheme (VHPSS) indicate the annual incidence of iGAS is greater than 4 per 100,000 population per year—more than double that of invasive meningococcal disease[15]—with a case-fatality rate of 11%. VHPSS is a voluntary system whereby hospitals in Victoria contribute information on bacterial and fungal isolates from bloodstream infections and meningitis to Microbiological Diagnostic Unit (MDU). Coverage of Victorian hospitals in VHPSS is incomplete and might be inconsistent. Data from several sources, including VPHSS, indicate that iGAS incidence is increasing in Victoria (Figure 2). An interim analysis of data obtained from The Victorian Admitted Episodes Dataset (VAED) demonstrated a 9.5% increase per year [95% CI 8.5%–10.5%] from 2006–2015 (unpublished data; personal communication: Dr Katherine Gibney, Doherty Institute). Prospective hospital-based surveillance at Victoria's Royal Children's Hospital (RCH) indicated an upsurge of cases in July–August 2017, however the effect of the very large 2017 influenza season should also be considered.

An unpublished review of the Queensland Notifiable Conditions Register (NoCS), indicates the overall incidence rate of iGAS in Queensland increased 3-fold from 2.5 per 100,000 population per year in 2006, to 7.4 per 100,000 population per year in 2017 (Figure 3).

Figure 2: Increasing iGAS cases, Victoria; data from i. VAED; ii. VHPSS; iii. RCH

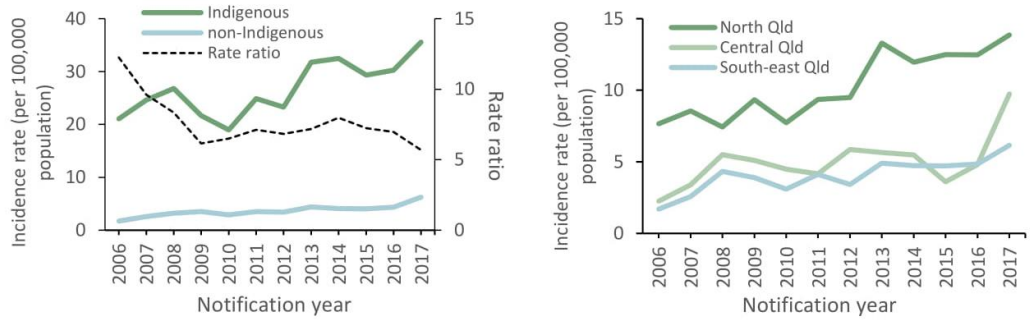


i: Victorian Admitted Episodes Dataset, Jan 2011–Dec 2015.
ii: Victorian Hospital Pathogens Surveillance Scheme data, 2007–2017
iii: Royal Children's Hospital data, Oct 2014–Aug 2017.

Sources: i and iii: Unpublished data, Dr Katherine Gibney, Department of Health and Human Services Victoria; ii: Oliver, J. et al. (in press).[16]

Increased infection rates, of 10 times greater, have been observed in Indigenous communities compared to non-Indigenous communities in Canada and New Zealand[17, 18] and Australia. Indigenous Australians are disproportionately affected by iGAS in Queensland, with the incidence rate of notifications increasing, and consistently higher, in Indigenous Australians compared to non-Indigenous Australians during 2006–2017 (Figure 3). In 2017, the incidence rate was 5.6 times greater for Indigenous Australians (34.7 per 100,000 population per year) than non-Indigenous Australians (6.2 per 100,000 population per year). The highest incidence rate was observed in North Queensland (82.5 per 100,000 population per year from 1996–2001), a region where 13.8% of the population are Indigenous.[19] The incidence rate ratio appears to have decreased, due to a greater rate of increase in the incidence of iGAS cases in non-Indigenous compared to Indigenous Australians.

Figure 3: Incidence rate of notified iGAS cases, Queensland, 2006–2017, by i. Indigenous status; ii. Region



i: iGAS incidence rate by Indigenous status*, Queensland 2006–2017.
ii: iGAS Incidence rate by region, Queensland 2006–2017.

* Notifications where Indigenous status is recorded on NoCS as 'unknown' are excluded (n=297).

Note: 2016 ERP is used for 2017.

Sources: Unpublished analysis of Queensland Notifiable Conditions System (NoCS) iGAS records as at 15 Oct 2018 12:00pm; Australian Bureau of Statistics Estimated Resident Population Catalogue No. 3235.0 – Population by Age and Sex, Regions of Australia, as at 30 June 2006 to 2016;[19] Hospital and Health Service area level data derived by Statistical Analysis Linkage Team, Statistical Services Branch, Department of Health, Queensland.

Household contacts—those who spent over 24 hours in the same house as an index case in the 7 days prior to symptom onset—are at increased risk of iGAS. Secondary cases usually occur within one month of the index case (median 2 days as per recent UK study).[20] A Victorian study estimated an incidence rate ratio (IRR) of iGAS in contacts compared to the general population of 2,011 [95%CI 413–5,929] in the first 30 days after disease occurrence in the index case.[21] An IRR of 1,940 [95% CI 1,240–2,880] was estimated using iGAS surveillance in the UK.[20]

Outbreaks of iGAS have been reported to occur in hospitals, nursing homes, homeless populations, people who inject drugs, and in childcare centres.[3, 22-30] A UK study revealed that nursing home outbreaks of iGAS often go undetected.[22] In England in 2009–2010, 6% of iGAS cases were hospital acquired.[31] Without national notification, healthcare-associated clusters are likely to be undetected and underreported. Whole genome sequencing has been used in the public health assessment of apparent iGAS clusters to determine relatedness[32] between iGAS isolates, and the presence of virulence and antibiotic resistance genes.[22, 33] High transmissibility of the disease is demonstrated by molecularly-confirmed household transmission between Indigenous infant twins in the Northern Territory (NT) who were hospitalised with iGAS complicated by STSS.[12, 34]

Guidelines for public health follow-up and management iGAS cases, contacts, and outbreaks, are currently available in the NT,[35] Queensland,[36] and NSW.[37] Some individual hospitals, such as the Royal Children's Hospital, Melbourne and Perth Children's Hospital, have an approach for the management of contacts of children admitted to their institution with iGAS.[38] The next edition of *Therapeutic Guidelines: Antibiotic* will contain a section on prevention of iGAS infection (personal communication: Dr Asha Bowen, paediatric infectious disease specialist, Perth Children's Hospital). National recommendations are available for the UK, Ireland, the United States of America (USA), Canada, and France.[39-43]

Preventability

There is no vaccine currently available to prevent iGAS. Active development of a vaccine is underway in the USA, Brazil, Europe and in Australia. [44-46] Of the three current GAS vaccine trials underway internationally, two have completed Phase I, and the third has completed both Phases I and II.[47-49]

At the 2016 World Health Organization (WHO)/International Vaccine Institute (IVI) stakeholder meeting, the lack of baseline data about iGAS was identified as a serious limitation to vaccine development.[50] A possible action to address this included requesting countries to agree to classify iGAS, among other GAS syndromes, as notifiable where surveillance structures exist.[50] Establishing the burden, circulating *emm* types, and financial cost of iGAS in Australia is an important step in vaccine development. Baseline surveillance data are also crucial to enable assessment of the impact of future GAS vaccines on iGAS.

In the absence of a vaccine, current prevention strategies for household contacts include education and antibiotic prophylaxis.[35, 36, 40] In a recent study from England, the theoretical number needed to treat (NNT) to prevent one secondary case using antibiotic prophylaxis (assuming 100% effectiveness) was 271 overall [95% CI: 194–454], 50 for mother-neonate pairs [95% CI: 27–393], and 82 for couples aged ≥75 years [95% CI: 46–417].[20] The overall NNT for iGAS is similar to that for invasive meningococcal disease (NNT = 284).[51]

There are no studies confirming the effectiveness of antibiotic prophylaxis with prevention of secondary cases as an end-point. However, making iGAS nationally notifiable could be an important mechanism in providing data supporting the use of secondary prophylaxis for household contacts. The recommended prophylaxis course of 10 days is prolonged, raising potential for non-adherence.

Current surveillance mechanisms

iGAS disease (defined as isolation of GAS bacteria from a normally sterile site) is not currently nationally notifiable in Australia, however it has been notifiable in NT since May 2011, and in Queensland since December 2005. There are no alternative national surveillance systems.

Alternative surveillance mechanisms that capture iGAS at the sub-national level include the VHPSS, and the Paediatric Active Enhanced Diseases Surveillance (PAEDS) network—a hospital-based sentinel surveillance system. A limitation of the VHPSS is that submission of iGAS isolates is voluntary and data may underestimate the true incidence of disease.

NSAP nomination

At the CDNA teleconference on 7 September 2018, members agreed to form a NSA panel to assess and make recommendations about whether iGAS should be made nationally notifiable. The NSA Panel came to be nominated after it was proposed by a CDNA jurisdictional executive group representative that iGAS be considered for status as a nationally notifiable disease.

For status as a nationally notifiable disease to have any effect, the disease must be notifiable in the states and territories, as this will provide the basis for laboratories and state and territories to collect the information under jurisdictional public health legislation.

Composition of the Panel

The NSA panel comprised:

- Dr Louise Flood, Chair, CDNA jurisdictional executive group member South Australia
- Dr Kathryn Taylor, PHU Representative
- Dr Jen Kok, PHLN Representative
- Dr Anton Forsyth, General Expert
- Dr Paul Armstrong, General Expert
- Ms Lucinda Franklin, General Expert
- Dr Stephen Lambert, General Expert
- Dr Daniel Engelman, iGAS Technical Expert
- Dr Asha Bowen, iGAS Technical Expert
- Ms Rowena Boyd, iGAS Technical Expert
- Ms Dharshi Thangarajah, iGAS Technical Writer

Assessment against CDNA endorsed criteria 2014

The NSA panel assessed the need for national notification against the 12 criteria endorsed by CDNA in 2014. The scoring matrix, the assessed scores for iGAS and the explanation for each of the scores is at Appendix A. Possible scores under the revised criteria range from 0 to 48, with thresholds for action set as <15 national notification not recommended, 15 to 25 national notification to be considered further, and 26+ national notification recommended (unless there are compelling reasons not to recommend this). The score for iGAS was 28, thus national notification is recommended.

iGAS scored highly against necessity for a public health response (timely investigation and response necessary), importance for Indigenous health (evidence that Indigenous populations are disproportionately affected), severity and socioeconomic impacts (high individual morbidity and mortality), a case is definable (there is an acceptable laboratory case definition, without a clinical definition), and data completeness is likely to be acceptable (based on laboratory case definition).

The accepted laboratory case definition of iGAS—isolation of GAS bacteria from a sterile site—enables data on iGAS cases to be collected regardless of capacity for public health follow-up, and without the need for a clinical definition.

International public health significance and notification practices

An estimate of the current iGAS global burden is limited due to the lack of high-quality data.[50] A comprehensive review in 2005 estimated that in more developed countries the incidence rate was 2.45 cases per 100,000 person-years.[52] iGAS has a high morbidity and mortality. In developed countries the CFR for iGAS is approximately 15%.[52, 53] This increases up to 25% in USA and Australian Indigenous populations, and up to 45% when complicated by STSS.[52, 54] iGAS-associated peri-partum sepsis was the leading cause of direct maternal death in the UK in 2006–2008.[55]

Internationally, iGAS is nationally notifiable in England and Canada,[39, 40] while in the USA iGAS is included in the Active Bacterial Core surveillance (ABCs) system which covers a population of nearly 34 million.[56]

Further considerations (if required)

A timely public health response is required to identify outbreaks and prevent secondary cases. With respect to post-exposure management of contacts, the risk of secondary infections in close contacts, and the number needed treat to prevent one case, is comparable to invasive meningococcal disease. However, the efficacy of post-exposure antibiotic treatment is not as well understood and the recommended length of treatment is longer (10 days). If iGAS was made nationally notifiable, national public health guidelines would need to be developed and this would necessitate a careful examination of contact management recommendations and the additional burden placed on already-stretched public health units for case and contact management.

Recommended monitoring

The NSAP recommend that CDNA progress with making iGAS a nationally notifiable condition. The severity, public health impact, and possible increasing trends in reported iGAS cases in Australia warrants national reporting of iGAS, including laboratory reporting of circulating *emm* types.

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Other sources of information

Northern Territory guidelines for the public health management of iGAS infection:
https://digitallibrary.health.nt.gov.au/prodjspui/bitstream/10137/1187/1/iGAS%20guidelines%20Nov%202020 15.pdf

Queensland Health iGAS guidelines for Public Health Units
https://www.health.qld.gov.au/cdcg/index/igas

Royal Children's Hospital iGAS guidelines for the management of household contacts
https://www.health.qld.gov.au/cdcg/index/igas

Appendix A – Reporting template– Assessment against CDNA criteria for national notification of invasive group A streptococcal (iGAS) disease

Criterion	Possible scores	Score given	Notes/explanation for scores given
Priority setting			
1. Necessity for public health response	0 = Not important for public health to know about a case 1 = Case reporting important for describing trends only 2 = Case reporting important for detecting outbreaks that require investigating or contacts require routine intervention 3 = Case reporting important to detect outbreaks of cases and investigate contacts that require immediate intervention to prevent fatalities or severe outcomes 4 = A single case can be considered an outbreak or having the potential to cause an outbreak and requires immediate follow-up	**3**	Timely identification of cases and public health response is a major goal of national iGAS surveillance. The risk of iGAS in household contacts of an index case is increased approximately 2,000 times above baseline,[21] and even higher for mother-neonate pairs and couples aged 75 years and over.[20] Reports of large scale iGAS outbreaks indicate timely investigation and response is necessary.[29, 30] Guidelines are currently available for Queensland, NT and NSW, and nationally for the UK, Ireland, the USA, Canada, and France.[40, 41] The NSA panel scored this criterion based on the assumption that consideration of the nature of public health follow-up will occur during development of a national guideline.
2. Utility and significance of notification for	0 = No national prevention program / international or national regulation	**1**	National surveillance would provide important information regarding the burden of iGAS in Australia and circulating *emm* types, which has not been well established. This will enable priority setting for iGAS research and prevention, including

prevention programs	1 = Need to establish burden of illness for monitoring or research purposes / priority setting 2 = Notifiable to the WHO but no regional / global targets for elimination or eradication 3 = National prevention programs in place or WHO Western Pacific Regional Office (WPRO) targets for elimination or eradication 4 = Security sensitive biological agent (SSBA) or WHO global targets for elimination or eradication / critical for monitoring prevention programs		ongoing vaccine development.[50] If and when a vaccine becomes available, surveillance will also enable vaccine effectiveness to be monitored.
3. Vaccine preventability	0 = No vaccine available 2 = Vaccine available, but no national immunisation program 4= Vaccine available, national immunisation program in place (including programs targeted at particular sub-groups)	**0**	Currently there is no vaccine to prevent iGAS. However, active development of a number of vaccines in Phase 1 and 2 trials is underway in the USA, Brazil, Europe and in Australia, endorsed by WHO.[44-46] Availability of baseline surveillance data will be crucial to enable assessment of the impact of future GAS vaccines on iGAS.
4. Importance for Indigenous health	0 = Low 2 = Medium 3 = High 4 = Very high	**3**	Incidence rates of iGAS amongst Indigenous populations have been reported to be up to 82.5 per 100,000 population per year.[5] In the NT from 2011–2013, notification incidence was 7.9 times higher among Indigenous compared to non-Indigenous residents.[12] In 2017 in Queensland, Indigenous populations had 5.6 greater incidence than non-Indigenous populations (Figure 2). Indigenous Australians also experience greater disease severity than non-Indigenous Australians.[11]

5. Emerging or re-emerging disease	0 = Has been stable, absent or declined in incidence over past 5 years 2 = Slowly re-emerging or increasing 3 = Risk of emergence in Australia due to ecological or epidemiological change or importation 4 = New, rapidly emerging disease in Australia	**2**	International surveillance data indicate increasing incidence of iGAS in Canada, the USA and England, with emergence within at-risk groups such as the homeless, people who inject drugs, and nursing home residents.[57-59] Local data also indicate that iGAS incidence may be increasing in NSW (Figure 1), Queensland (Figure 2) and Victoria (Figure 3). Surveillance of circulating *emm* types causing iGAS will support identification of emerging types and will inform vaccine development.
6. Communicability and potential for outbreaks	0 = Not communicable or no outbreak potential 1 = Low 2 = Medium 3= High 4= Very high	**2**	iGAS is communicable to close contacts, with analysis of iGAS surveillance data in England demonstrating an overall 1,940-fold [95% CI: 1,240–2,880] elevation over background incidence during the 30-day period after disease occurrence in the index case.[20] Recent international iGAS outbreaks among nursing home residents, people who inject drugs, and homeless people are of particular public health concern.[23, 30, 31, 60-63] Nosocomial outbreaks have been reported.[25-28] Transmissibility has also been confirmed between Indigenous infant twins in the NT.[34]
7. Severity and socioeconomic impacts	1= Low severity and socioeconomic impacts 2= Medium severity and socioeconomic impacts 3 = High severity and socioeconomic impacts 4 = Very high severity and socioeconomic impacts	**3**	Published Australian data indicate the overall case fatality rate in Australia ranges from 7% to 15%, and up to 23% when complicated by STSS (Table 1). Morbidity following recovery is not benign with a number of children recently losing digits and limbs to iGAS purpura (personal communication: Dr Asha Bowen, paediatric infectious disease specialist, Perth Children's Hospital).

8. Preventability	0 = No preventive measure 1 = Preventive measure available but low efficacy 2 = Preventive measure with moderate efficacy /low acceptability or uptake 3 = Preventive measure with moderate efficacy/low side effects/acceptable uptake 4 = Preventive measure with high efficacy/low side effects/high acceptability and uptake	**2**	The theoretical number needed to treat (NNT) to prevent one secondary iGAS case using antibiotic prophylaxis was 271 overall [95% CI: 194–454], based on 5/1133 (0.4%) sporadic cases resulting in secondary cases and assuming 100% efficacy of prophylactic antibiotics. The theoretical NNT was 50 for mother-neonate pairs [95% CI: 27–393] and 82 for couples aged 75 years and over [95% CI: 46–417].[20] Evidence for prophylaxis adherence is limited. The NSA panel scored this criterion based on the assumption that this criterion refers to prevention of secondary cases (e.g. household contacts, mother-neonate pairs).
9. Level of public concern and/or political interest	1 = No to low public concern or political interest 2 = Low to medium public concern or political interest 3 = Medium to high public concern or political interest 4 = High public concern/perceived "crisis" situation if cases identified	**2**	Significant media and public interest can follow diagnosis of iGAS, particularly necrotising fasciitis, and severe disease in children and women who have recently given birth. In the absence of a vaccine, important public health strategies include public alerts, education and prophylactic antibiotics for contacts. In 2018, Western Australia had television and print media coverage on iGAS (personal communication: Dr Asha Bowen, paediatric infectious disease specialist). Despite being more common than invasive meningococcal disease, iGAS currently has low public concern or political interest. Scoring is based on the low to medium level of concern and interest that would likely be generated if the public had knowledge of the severity and burden of iGAS in Australia.
Feasibility of collection			

10. A case is definable	0 = Case is difficult to define, or agreement between stakeholders on definition cannot be reached 2 = A case is definable, but with complexities 4 = Case has an acceptable laboratory definition without or without a clinical definition	**4**	Most iGAS cases have a clear and accepted laboratory definition, without need for a clinical definition. An important gap in laboratory-based case definitions of iGAS is severe skin and soft tissue infections such as necrotising fasciitis and deep neck-space infections. Scoring of this criterion is based on a case definition of iGAS alone and not GAS infections, such as necrotising fasciitis, which have a clinical component.
11. Data completeness is likely to be acceptable	1 = Data likely to be incomplete, representing only a very small fraction of community cases 2 = Data represent a proportion of community 4 = Data likely to represent a high proportion of cases, or all cases	**4**	iGAS has a laboratory-based definition and data are likely to represent a high proportion of all cases.
12. Alternative surveillance mechanisms	0 = Robust, comprehensive and continuing alternative national surveillance mechanism in place e.g. HPV 2 = Alternative surveillance mechanism in place, but not nationally co-ordinated, only sentinel sites or surveys, significant gaps or weaknesses 4 = No alternative surveillance mechanisms in place.	**2**	There are currently no alternative national surveillance systems for iGAS. Public health surveillance for iGAS is only present in the NT and Queensland. Alternate surveillance systems which capture iGAS—VHPSS and PAEDS—have significant gaps and weaknesses.
Total score:		**28**	