HSE Public Health: Health Protection
FSS Sláinte Poiblí: Chosaint Sláinte

Upsurge in invasive Group A *Streptococcus* (iGAS) activity: October 2022 to August 2023

NATIONAL INCIDENT REPORT

Contents

List of Tables and Figures 3

Glossary: 4

1.0 Introduction 6

1.1 Aims and Objectives 6

2.0 Background 7

2.1 Clinical presentation 7

2.2 Transmission 9

2.3 Previous upsurges 9

2.4 Context and Nature of the Incident 9

2.5 Burden of Illness 12

3.0 Investigation 14

3.1 Clinical Presentation and Management 14

3.2 Microbiological / Toxicological investigations and results 16

4.0 Risk Management 18

4.1 Public health control at a national level 18

4.2 Public health control in the community 19

4.3 Infection Prevention and Control (IPC) 19

5.0 Risk Communication 20

5.1 Cross-sectoral Professional Communication 20

5.2 International Communication 21

5.3 Public Communication 21

6.0 Discussion and lessons identified 22

7.0 Recommendations: 24

8.0 Appendices 27

Appendix 1 - Paediatric case review clinical findings 27

Appendix 2 – IMT Membership 30

Appendix 3 - Clinical case review of iGAS (deaths and hospitalizations) in children under 16 years old (October 2022 – June 2023) in Ireland 33

Appendix 4 - After Action Review 34

Strengths 34

Appendix 5 – Timeline of Significant iGAS Incident Events 2022-2023 36

List of Tables and Figures

Figure 1 **-** Monthly iGAS Cases 2017-2023 - by Notification and Epi Date 10
Figure 2 **-** Crude Incident Rate for iGAS per 100,000 population by Epidemiological Date . 11
Figure 3 **–** Total iGAS Cases by Epi Date Week 40 2022-Week 35 2023..... 12
Figure 4 – Total iGAS Cases by Epi Month - October 2022-August 2023..... 13
Figure 5 **–** iGAS CIR Cases by Epi Month - October 2022-August 2023 13
Figure 6 **–** Annual Number of Deaths and Mortality Rate - iGAS - 2017-2023 14
Figure 7 **–** Number of Deaths and Mortality Rate - iGAS – October 2022-August 2023..... 14
Figure 8 - Percentage distribution of the top six iGAS *emm* types, and the total number of iGAS cases, 2012-2023. 17
Figure 9 **-** Number of iGAS cases and number of *emm*1 and *emm*12 and other *emm* types by month, 2022-2023. 17

Glossary:

AAR – After Action Review

AMRIC – Antimicrobial Resistance and Infection Control

CCO – Chief Clinical Officer

CFR – Crude Fatality Rate

CHI – Children's Hospital Ireland

CIR – Crude Incident Rate

CNS – Central Nervous System

DNHP – Director of National Health Protection

DOH – Department of Health

DRA – Dynamic Risk Assessment

ECDC – European Centre for Disease Control and Prevention

ECMO – Extracorporeal Membrane Oxygenation

ENT – Ear, Nose and Throat

EU – European Union

EUHTF – EU Health Task Force

GAS – Group A *Streptococcus*

HCW – Health Care Worker

HERA – EU Health Emergency Preparedness and Response

HPSC – Health Protection Surveillance Centre

HPRA – Health Products Regulatory Authority

HSE – Health Service Executive

iGAS – Invasive Group A *Streptococcus*

IMSRL – Irish Meningitis and Sepsis Reference Laboratory

IMT – Incident Management Team

IPAS – International Protection Accommodation Services

IPC – Infection Prevention and Control

IVIG – Intravenous Immunoglobulin

MCA – Middle Cerebral Artery

NDPH – National Director of Public Health

NF – Necrotising Fasciitis

NID – National Incident Director

NI PHA – Northern Ireland Public Health Agency

NPHO – National Public Health Office

PHA – Public Health Area

PICU – Paediatric Intensive Care Unit

PPE – Personal Protective Equipment

STSS – Streptococcal Toxic Shock Syndrome

TOR – Terms of Reference

UKHSA – United Kingdom Health Security Agency

1.0 Introduction

1.1 Aims and Objectives

The aims of this incident report are to describe an unseasonal and significant upsurge in invasive Group A *Streptococcus* (iGAS) in Ireland, occurring between October 2022 and August 2023; to describe the steps taken to minimise its health impact, and to document the lessons learned.

The objectives of this incident report are to describe the:

- Background and context
- Nature of the incident - burden of illness, drivers of infection.
- Steps taken to minimise health impact.
- Lessons learned.
- Recommendations arising from this incident.

In Week 41 (mid-October) 2022, an unseasonal increase in iGAS activity was reported in the UK. In Ireland, at the same time, iGAS activity was noted to be progressively rising above levels seen in equivalent periods in prepandemic years. A sharp increase in IGAS notifications in Ireland began in Week 49 2022 (the first week of December), some weeks after a similar acceleration in iGAS activity in the UK. In common with the UK, a disproportionate number of iGAS cases were in children, with early indications that the mortality rate in this group was higher than expected. For this reason, the Director of National Health Protection commissioned a National Incident Management Team (IMT), which first met on 12/12/22, to coordinate response to this incident across the health system.

By August 2023, iGAS activity had returned to levels considered seasonally normal in the pre-pandemic era. A decision was made to continue the incident management response beyond the return of more normal iGAS activity, to enable ongoing monitoring and assessment of the situation during Winter 2023 and Spring 2024. By March 2024, there was a sufficient confidence that activity was seasonally typical and unexceptional. Accordingly, this incident report, and its data, covers the period of unusually heightened and unseasonal iGAS activity between **1/10/2022 and 31/8/2023.**

As a result of this incident, national guidelines on the management of iGAS were comprehensively and completely updated.

2.0 Background

Streptococcus pyogenes (syn. Group A *Streptococcus* [GAS]) is a strain of endotoxin-producing, beta-haemolytic *Streptococcus* that exclusively infects humans, resulting in an estimated global annual burden of 700 million infections, with 18.1 million severe cases, and more than 500,000 deaths.

GAS colonise the throat, genital mucosa, rectum, and skin in humans. Among healthy adults, between 1% and 5% will have asymptomatic throat, vaginal, or rectal carriage of GAS. In healthy children, asymptomatic carriage rate typically ranges between 2% and 10%, and at a higher level again in the weeks immediately following extensive community outbreaks of GAS pharyngitis.

GAS remain routinely sensitive to penicillins and cephalosporins. For individuals with penicillin allergy, narrow spectrum cephalosporins (cephalexin, cefadroxil) are effective therapeutic alternatives, in addition to clindamycin, azithromycin, and clarithromycin, if susceptibility testing confirms sensitivity. Resistance to azithromycin and clarithromycin has been reported. There is no safe and effective vaccine available against GAS, although potential candidates are under evaluation.

GAS has the potential to be a highly virulent and destructive organism. It carries a range of surface virulence factors that assist cell attachment and protective inhibition of phagocytosis, which occur particularly as a result of the actions of the cell surface M protein. In addition, GAS exotoxins can act as superantigens that trigger excessive T lymphocyte stimulation and cytokine production that contribute to the intense inflammatory cascade characteristic of severe iGAS infection.

2.1 Clinical presentation

GAS is responsible for a wide range of non-invasive (primarily pharyngitis and scarlet fever) and invasive (primarily iGAS disease) syndromes:

- **Non-invasive**

These tend to be the commonest GAS infections and are characteristically mild. Such infections include scarlet fever, pharyngitis and impetigo. These tend to occur most frequently in children. Pharyngitis secondary to GAS occurs seasonally in the winter and early spring. GAS is a common cause of cellulitis – at least 10-20% of all cases of cellulitis are due to GAS. GAS infection can be complicated by immune-mediated non-suppurative sequelae, including rheumatic fever and post-infectious glomerulonephritis.

- **Invasive**

Invasive GAS (iGAS) infections are uncommon and characteristically severe. Such severe infections involve the organism accessing normally sterile sites, including blood and solid organs. Given the significant pathogenic potential of GAS, when the organism gains access to such sites, there is a significant risk of inflammatory cascade and progression to septic shock and multiorgan failure. iGAS infections tend to follow a seasonal pattern, typically peaking during the first six months of the year in the northern hemisphere.

iGAS is a statutorily notifiable disease in Ireland, having been included on the notifiable schedule in 2003, with data available for reporting from 2004. iGAS infections are notifiable in only a limited number of European countries. iGAS is currently (August 2024) not included in the schedule of EU case definitions and is therefore not a pathogen/disease for which there is EU level surveillance.

Classically iGAS infection can result in:

a. Streptococcal toxic shock syndrome (STSS),
b. Necrotising fasciitis (NF) and
c. Sepsis syndrome (or systemic inflammatory response syndrome), with or without an identifiable focus of infection (including meningitis, pneumonia, pleural empyema, cellulitis, peritonitis, puerperal sepsis, septic arthritis, myositis, and bloodstream infection).

Those at greatest risk of iGAS infection are children (especially those <1 year of age), and adults aged ≥65 years. Other significant risk factors for infection include pregnancy (especially in the third trimester), immunosuppression, diabetes, co-existing or priming viral infection (very particularly viral respiratory infection and varicella), skin lesions and wounds, addiction, poverty, homelessness, overcrowded living conditions and recent surgery.

In addition, GAS infection is a serious, but rare cause of third trimester chorioamnionitis and puerperal sepsis resulting from vertical transmission from the maternal genital tract. In the past, GAS infection was a major contributor to maternal mortality, particularly in the pre-antimicrobial era.

In children, there is a firmly established relationship between varicella infection and subsequent development of iGAS; varicella infection precedes iGAS infection in about 20% of paediatric cases. Varicella is a seasonal infection, with cases peaking between March and May each year, equating to the period of highest iGAS activity in children. There is no clear relationship between varicella infection and iGAS in adults.

2.2 Transmission

GAS is a highly transmissible organism, with transmission considered to occur via large respiratory droplets expelled through coughing, sneezing and talking, but it can also occur through contact with secretions, such as infected saliva, wound discharge, nasal secretions, or skin squames. People with symptomatic *Streptococcus* Group A infections are much more likely to transmit the bacteria to others than asymptomatic pharyngeal carriers. The typical incubation period for GAS is between two and five days. Standard and appropriate transmission-based precautions are essential in minimising onward transmission.

Evidence from outbreak investigations indicates that environmental transmission of GAS may be possible, although it is likely to be a minor route of transmission.

Certain settings may influence the risk of GAS and iGAS infection. The household setting, with extended duration of exposure to individuals with iGAS is associated with an increased risk of transmission and subsequent infection. Effective hand hygiene is especially important in reducing GAS transmission after coughing and sneezing and before preparing foods or eating, as is effective respiratory etiquette. Skin wounds and abrasions should be covered with a waterproof dressing, and patients with treated pharyngitis should isolate at home for 24 hours following commencement of antibiotic therapy.

2.3 Previous upsurges

Starting in the 1980s, a pronounced increase in iGAS infection has been observed in Europe and the United States, associated with the emergence of novel hypervirulent strains. Periodic upsurges of iGAS have been identified in Ireland since the commencement of national surveillance. A prolonged upsurge in iGAS cases was recorded between May 2012 and September 2014, associated with an increase in the number of cases presenting with streptococcal toxic shock syndrome (STSS) with higher mortality among these cases. An increase in *emm*1 and *emm*3 types (*emm* genes are those associated with the M Protein) was detected during this upsurge, both of which are known to be produce greater virulence. An increase in iGAS notifications between January and March 2016 was also observed, with 49 cases reported over this interval. A similar increase was seen in England during this period. Forty percent of isolates during the 2016 upsurge belonged to *emm*1. This upsurge may have been related to the concurrent moderate-severe influenza season.

2.4 Context and Nature of the Incident

Between October 2022 and August 2023, Ireland experienced an unusual and unseasonal upsurge in iGAS disease, affecting particularly children aged under 18 years. This followed a period of particularly low iGAS activity during the COVID-19 pandemic, when application of

non-pharmaceutical public health measures resulted in a generalised reduction in the circulation and transmission of a range of viral and bacterial infections. Similar concurrent increases in iGAS activity were reported in other European countries, including Denmark, Sweden, France, the Netherlands, and the United Kingdom.

BOX: Amendment of National iGAS Case Definition

The national case definition for iGAS was updated at the end of December 2022 to ensure that as many potential iGAS cases as possible were identified and notified. As a result of that change, the case definition became more sensitive, but less specific, contributing partially to a rise in cases reported following this change. Analysis undertaken by HPSC indicated that 19% of cases notified in 2023 would not have met the criteria for the old case definition. However, when analysis was adjusted to account for this, there was no material impact on either the trajectory of the upsurge, nor on the profile of reported disease severity.

iGAS activity follows a seasonal pattern, with levels rising typically in late winter, peaking in spring, and falling to trough levels during summer and early autumn.

Figure 1 shows the unseasonal increase in iGAS case notifications between October 2022 and August 2023, compared with previous seasons. During this upsurge, iGAS activity was strikingly higher than during the pandemic period, when COVID-19 restriction measures were applied, and significantly higher than during equivalent pre-pandemic periods.

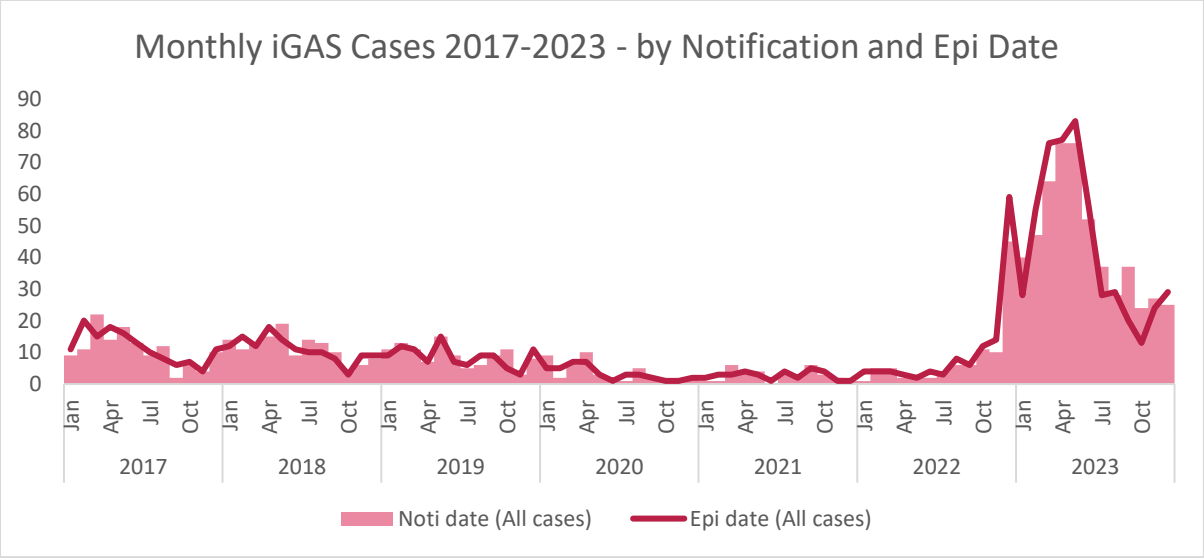

Figure 1 - Monthly iGAS Cases 2017-2023 - by Notification and Epi Date

Figure 2 presents data for the same period but shows the crude incident rate (CIR) for iGAS notifications by age category (<18 years, 18-64 years and ≥65years) and demonstrates the marked preponderance of iGAS infection in children.

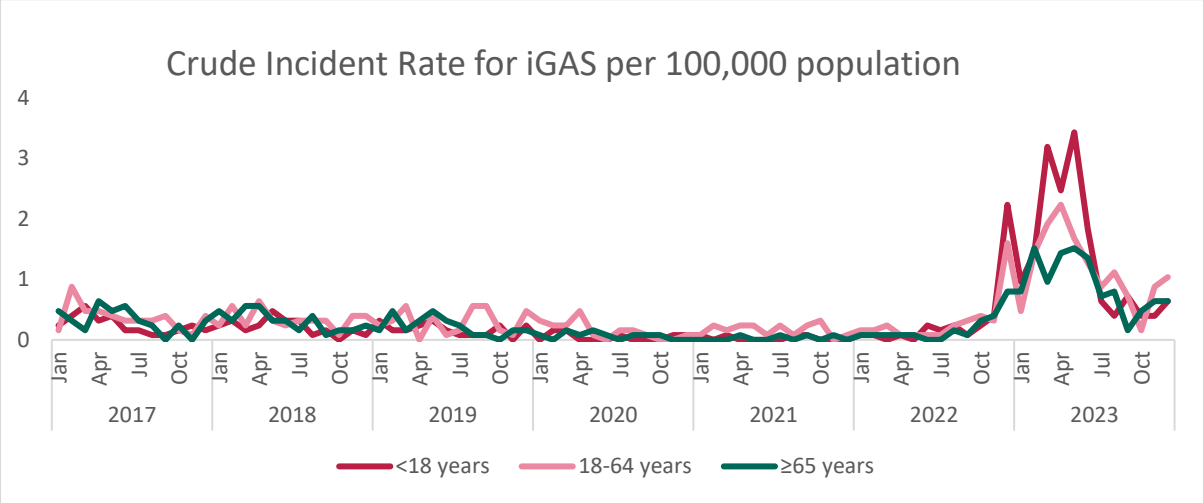

Figure 2 - Crude Incident Rate for iGAS per 100,000 population by Epidemiological Date

On 12/12/2022, the Director of National Health Protection commissioned an Incident management Team (IMT) to investigate and manage this incident. The IMT met on 23 occasions between 12/12/22 and 13/12/23.

In the earlier period of the upsurge, once the winter virus season had begun, increased iGAS activity in both adults and children closely mirrored increases in seasonal influenza and COVID-19, most particularly between week 50 2022 and week 2 2023. However, once the winter virus upsurge had eased (by weeks 4-6) in 2023, iGAS cases continued to remain elevated, with episodic peaks occurring every 4-6 weeks. In 2023, there was a distinct, but less clearly defined association between hospitalised varicella cases and paediatric iGAS notifications.

In children, varicella infection follows a seasonal pattern, appearing in the final weeks of the year, and peaking between March and May, reflecting the well-established relationship between varicella infection and subsequent development of iGAS in children. From February 2023, there was a steady rise in hospitalised paediatric varicella cases, which was most pronounced in the late spring and early summer, with 23% of all paediatric cases in 2023 reported as having preceding varicella infection.

By early July 2023, a sustained fall in iGAS activity in all age groups became evident, most marked in children and coinciding with the onset of school summer holidays. Between August and October 2023, notifications of iGAS in all age groups, but especially in children, had returned to what could be considered baseline level. As a precaution, it was decided at the

IMT not to declare the incident to be at an end until there was sufficient confidence that activity in this early part of the 2024 season was not out of the ordinary.

By March 2024, iGAS notification levels, while slightly higher than in the pre pandemic period, remained at what were considered to be at normal levels. The reason for the slightly sustained increase, over the pre pandemic period were due to two factors: 1) the adoption of a new, less specific case definition in December 2022 (see BOX: Amendment of National iGAS Case Definition, p10), and 2) heightened awareness and more complete reporting of iGAS during the upsurge. Also, by March 2024, iGAS notifications in the UK were comparable - in terms of level and character of activity - with both the UK's own previous seasons' data, and those in Ireland. Accordingly, the IMT declared the incident to be over on 19/3/24.

2.5 Burden of Illness

Between 1/10/2022 and 31/8/2023, 483 cases of iGAS were notified in Ireland. Of these, 189 (or 39%) were in children aged <18 years, of whom 167 were aged 0-9 years. This contrasts with the pre-pandemic years when approximately 25% of iGAS infections were in children aged <18 years. Two hundred and ninety-four (294) cases were in adults.

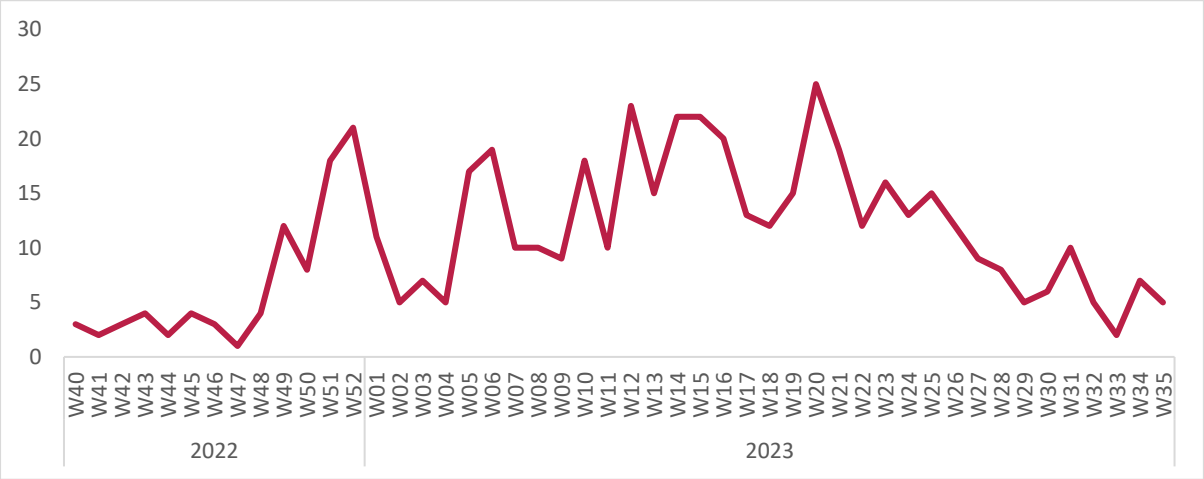

Figure 3 – Total iGAS Cases by Epi Date Week 40 2022-Week 35 2023

Figure 3 shows the epidemic curve by epidemiological date for iGAS upsurge cases between week 40 2022 and week 35 2023.

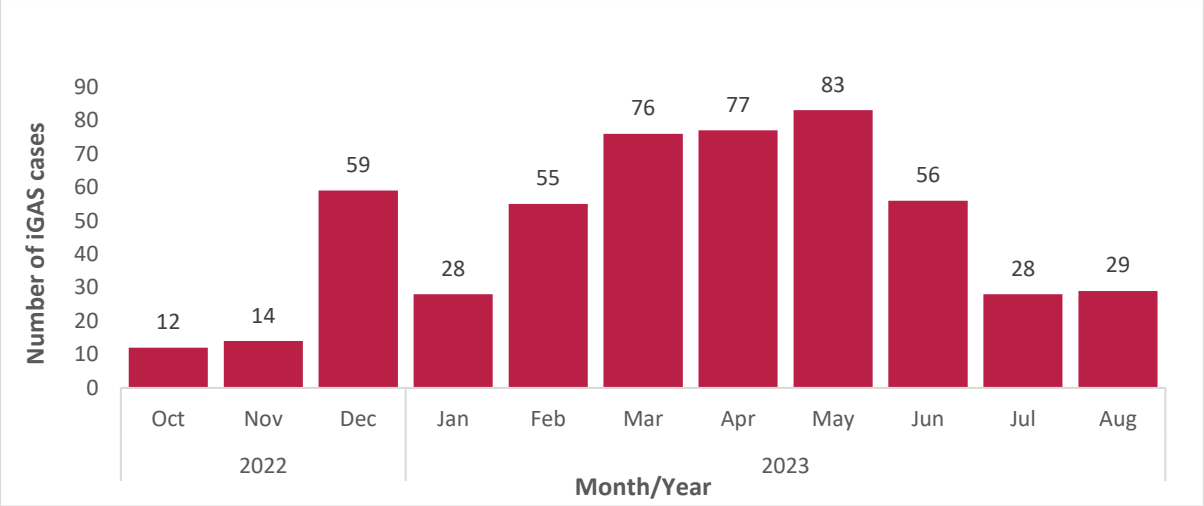

Figure 4 – Total iGAS Cases by Epi Month - October 2022-August 2023

Figure 4 shows the epidemic curve by month for iGAS upsurge cases between October 2022 and August 2023. The peak in December reflects to close association between viral respiratory disease and iGAS infection in all age groups.

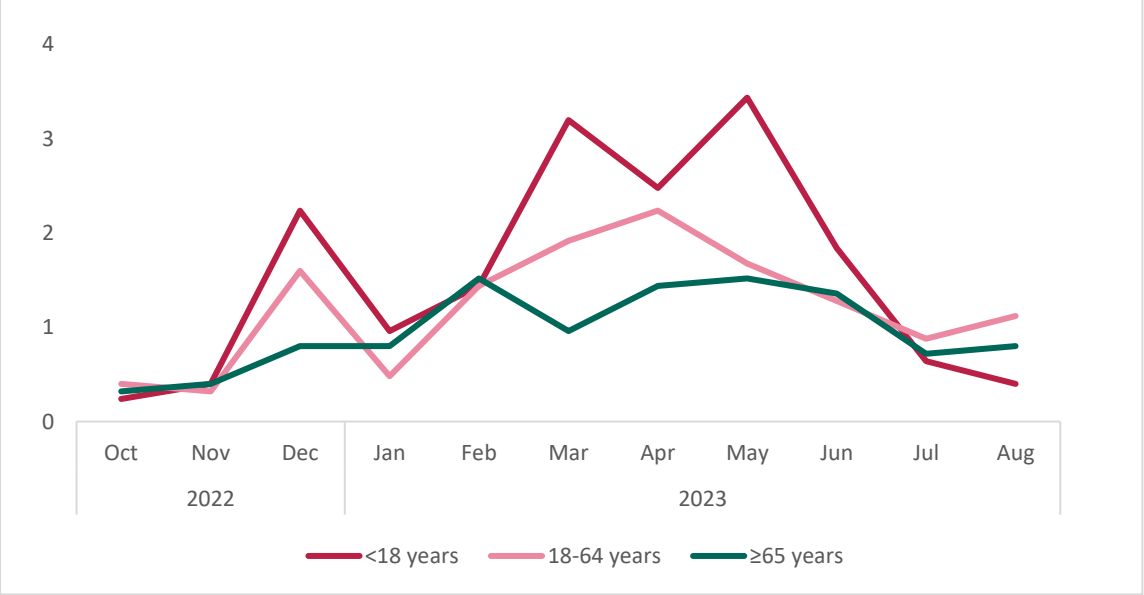

Figure 5 – iGAS CIR Cases by Epi Month - October 2022-August 2023

Figure 5 shows the crude incidence rate by month for iGAS upsurge cases between October 2022 and August 2023. This shows clearly that the paediatric population was disproportionately affected by this upsurge.

Among cases notified 2/10/2022 and 30/12/2023, sadly there were 12 deaths in children (10 in children aged under 10 years old and two in children aged 10-17 years) and 21 deaths in adults (age range, 46-96 years).

	All age groups			All adults			Children		
Year	N cases	N deaths*	CFR	N cases	N deaths*	CFR	N cases	N deaths*	CFR
2017	139	5	3.6%	102	5	4.9%	37	0	0.0%
2018	131	8	6.1%	98	6	6.1%	32	2	6.3%
2019	104	6	5.8%	78	4	5.1%	26	2	7.7%
2020	40	4	10.0%	33	4	12.1%	7	0	0.0%
2021	33	1	3.0%	29	1	3.4%	4	0	0.0%
2022	123	13	10.6%	74	9	12.2%	48	4	8.3%
2023	518	20	3.9%	311	12	3.9%	207	8	3.9%

Number of cases shown by epi date
* where iGAS is main cause of death/death due to this ID

Figure 6 – Annual Number of Deaths and Mortality Rate - iGAS - 2017-2023

	All age groups			All adults			Children		
Upsurge period	N cases	N deaths*	CFR	N cases	N deaths*	CFR	N cases	N deaths*	CFR
1/10/22 - 31/8/23	483	31	6.4%	294	19	6.4%	189	12	6.3%

Number of cases shown by epi date
* where iGAS is main cause of death/death due to this ID

Figure 7 – Number of Deaths and Mortality Rate - iGAS – October 2022-August 2023

Figure 6 shows the annual total case count, deaths and crude fatality rate (CFR) among adults and children for 2017-2023; **Figure 7** shows the same parameters for the upsurge period.

From the above, the mean CFR for adults during the period 2017-2021 (6.3%) was slightly higher than the CFR during the iGAS upsurge (4.7%). This is likely to reflect the less specific case definition in use for much of the upsurge. This is in marked contrast to paediatric mortality, wherein the CFR of 2.8% during the 2017-2021 period almost doubled to 5.1% during the upsurge.

There was an increase in the proportion of more virulent strains of GAS, with *emm*1 and *emm* 12 accounting for 55% and 22% of typed strains in 2023 (see S3.2; p16).

3.0 Investigation

3.1 Clinical Presentation and Management

Paediatric Clinical Presentation

During the 2022-23 upsurge in iGAS infections, the proportion of cases occurring in children increased from ~25% in previous years to ~42%. In response to this increase, and the need to rapidly investigate this apparent change in the epidemiology of the disease in a vulnerable population, **a clinical case review of every death and hospitalised case in children under**

16 years from October 2022 to June 2023 inclusive was performed by a subgroup of the IMT.

In 2023, given the severity of the upsurge, and an absence of EU wide surveillance for iGAS, resulting in inconsistent availability of information on the incidence of iGAS in the EU (especially in children), Ireland requested of ECDC the activation the EU's Health Task Force (EUHTF). This was the first instance of this new asset being activated since its creation. Following liaison between Ireland and the EUHTF, it was decided that a more extensive review of paediatric iGAS cases in the UE/EEA, for the 2022-23 season was necessary. This study was coordinated by ECDC. To date, (August 2024) eight countries have submitted data. Preliminary analysis of the data shows that the most affected age group is young children 0-4 years of age. *Emm* typing of GAS isolates showed predominance of *emm*1 and *emm*12 types in the 2022-23 season.

The Irish paediatric review demonstrated the significant rate of viral co-infection with varicella zoster and respiratory viruses among iGAS cases, which was seen in 28% and 41% of cases respectively. Only four patients (2.3%) had a history of preceding GAS pharyngitis or scarlet fever, three of whom had completed full courses of antimicrobials. Of the 12 patients who died, eight had an out of hospital cardiac arrest. The majority (83%) of patients who died had rapidly progressive necrotizing pneumonia. The case fatality rate was 6.5% in children with iGAS infection. Most survivors (84%) had no adverse outcomes at follow-up.

The rapidity and severity of secondary deterioration and death in children with iGAS highlights **the importance of sepsis awareness in primary and secondary care**. The high prevalence **of viral co-infection/superinfection with iGAS** emphasises the **importance of maximising vaccine uptake rates.** The findings of this incident investigation confirmed once again the firmly established relationship between varicella infection and subsequent development of iGAS in children and supports the expansion of the Irish national schedule to include varicella immunisation. An important finding from this episode was that neither GAS pharyngitis nor scarlet fever precede the great majority of cases of iGAS infection; important findings that should influence messaging and management of future incidents.

The results of the study are described in further detail in **Appendix 3**, with the main findings summarised in Tables 1-4 in **Appendix 1**.

Adult Clinical Presentation and Management

Among adults, those aged ≥65 years are at greatest risk of severe iGAS disease. Skin and soft tissue infection (with or without blood stream infection), pharyngeal abscess and pneumonia are the commonest modes of presentation in adults. Less common are

osteomyelitis, necrotising fasciitis, STSS and CNS infection. Ascending GAS infection presents a potential source of chorioamnionitis, neonatal iGAS, and puerperal sepsis in the mother.

During the upsurge, there were 298 adult cases of iGAS, 45% (n=135) of whom had a bloodstream infection, compared with 57% in the 2017-2021 period. Forty-six (15%) had deep tissue infection and 8% presented with an abscess during the upsurge, compared with 6.4% and 3.5% in the 2017-2021 period, respectively. This difference in presentation is accounted by the change in case definition, which meant that more deep tissue infections and abscesses were being notified as iGAS during the upsurge than would have been the case previously.

3.2 Microbiological / Toxicological investigations and results

At the Irish Meningitis and Sepsis Reference Laboratory (IMSRL), nucleotide sequencing of the variable 5' of the *emm* gene encoding the surface-expressed M protein is the basis for the current *Streptococcus* typing scheme (https://www.cdc.gov/streplab/groupa-strep/index.html). To date >200 *emm* types and 1200 subtypes have been reported worldwide. The *emm* sequence types can be grouped into 48 *emm* type clusters which correlate with tissue tropism (pharyngitis with clusters A-C, impetigo with cluster D and both for cluster E). The main invasive types in the Northern Hemisphere are usually *emm*1, *emm*3, *emm*12 (cluster A-C) and, *emm*28 and *emm*89 (cluster E). *emm* sequence typing of S. pyogenes has been undertaken at IMSRL since 2012.

Between 2022 and 2023, an associated GAS isolate was received at IMSRL for 60% of notified iGAS cases. Among these *emm*1 and *emm*12 were the predominant *emm* type identified, accounting for 55% and 22% of typed isolates respectively (Figures 8 and 9). These represent the highest proportions seen for these *emm* types in Ireland since the national typing service began (ranges from 0-46% *emm*1 and 2-12% *emm*12, 2012-2021).

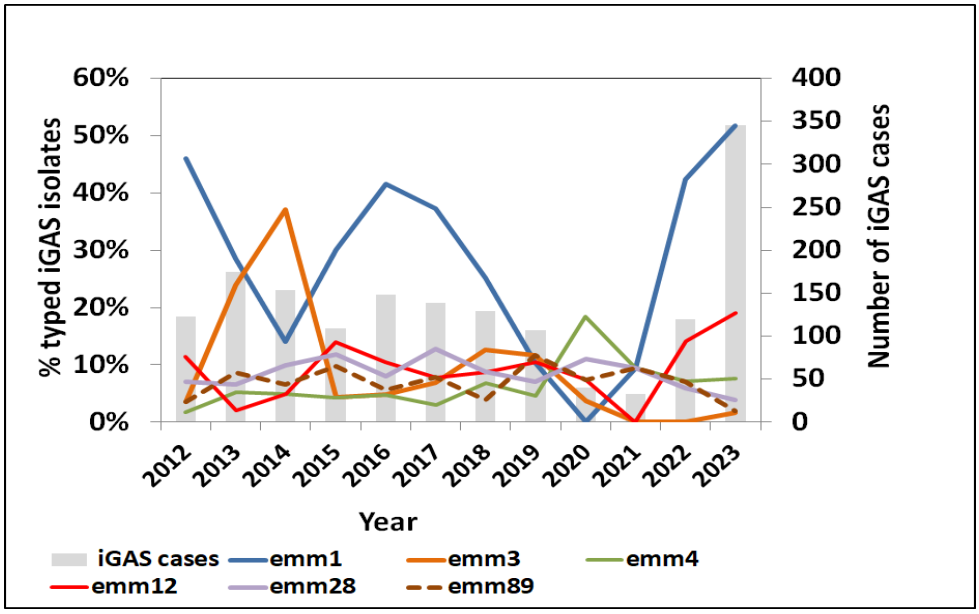

Figure 8 - Percentage distribution of the top six iGAS emm types, and the total number of iGAS cases, 2012-2023.

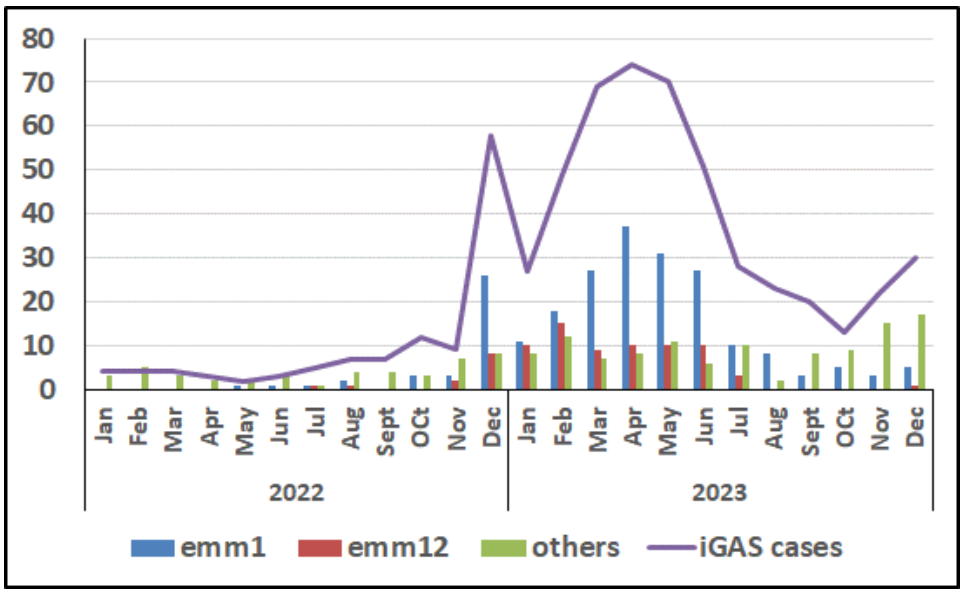

Figure 9 - Number of iGAS cases and number of emm1 and emm12 and other emm types by month, 2022-2023.

Since the 1980s there has been a resurgence of iGAS and scarlet fever, largely related to the emergence of a subtype of GAS *emm*1; the M1T1 clone. In 2010, a new iGAS-related sub-lineage of GAS *emm*1 was identified in the UK ($M1_{UK}$). By 2020 this had expanded to account for 91% of invasive *emm*1 GAS strains in the UK. GAS $M1_{UK}$ has spread globally and was first detected in Ireland in 2015. During the 2022/2023 upsurge in iGAS a new *emm*1 sub-lineage was also described in Denmark ($M1_{DK}$).

When Irish isolates from the upsurge period were analysed, 86% belonged to the $M1_{UK}$ sub-lineage, with the remainder belonging to the older global (M1T1) clone. None of the isolates belonged to the $M1_{DK}$ sub-lineage.

In 2022-2023, there were five known outbreaks of non-invasive and/or invasive GAS infections associated with *emm*12, *emm*18, *emm*28, *emm*80, and *emm*81 respectively. Known epidemiological links and association with infrequent *emm* types contributed to confirmation of these outbreaks.

Antimicrobial susceptibility testing on invasive and non-invasive GAS isolates received between 2012 and 2023 indicated that all were susceptible to penicillin. Increases in resistance to tetracycline, erythromycin, and clindamycin were seen between 2019 and 2022, though these decreased in 2023. This decrease is explained by the finding that the dominant iGAS-associated strains (including *emm*1 and *emm*12) were associated with low levels of antimicrobial resistance (<1% resistance to all three antibiotics, in the case of *emm*1).

4.0 Risk Management

4.1 Public health control at a national level

On 12/12/2022, in response to the unusual increase in iGAS activity, a national incident was declared by the Director of National Health Protection who then commissioned the establishment of an Incident Management Team (IMT), with the Clinical Lead in Health Protection Operations as National Incident Director (NID), with a Consultant in Health Protection from the National Health Protection Office as alternate. Membership was drawn from a wide range of subject matter experts. Its core aims were to coordinate the Public Health/Health Protection investigation, reporting, and control of *Streptococcus* A infection/iGAS in collaboration with all relevant stakeholders.

The IMT met on 23 occasions, and on 12/3/2024, following a sustained return of iGAS activity to levels in line with previous normal seasons, the incident was declared at an end.

The IMT ensured uniformity of approach in relation to:

- The co-ordinated cross-discipline response
- Minimising of the health impact of iGAS infection through:
    - Rapid identification of cases and notification to Public Health to ensure any necessary contact tracing activities be undertaken
    - Clinical messaging to ensure that clinicians were aware of the need to have a low threshold for referral/intervention in case of deterioration in the clinical course of infections that predisposed to iGAS
    - Promotion of vaccination against infections that were known risk factors for the development of iGAS (including influenza, COVID-19 and VZV).

- Given the extent of public concern around iGAS, considerable work was undertaken to provide documentation and messaging for the general public. This included advice on when to contact one's GP and steps to take in terms of minimising risk (including ensuring that children were age appropriately vaccinated). There was strong public messaging and advice around the necessity for parents/patients to return for clinical assessment if there was clinical deterioration in the case of infections that predisposed to iGAS infection.

4.2 Public health control in the community

iGAS is a notifiable disease under the Infectious Diseases Regulations 1981. A medical practitioner or a clinical director of a diagnostic laboratory, on suspecting or identifying a case of the infection, is statutorily obliged to notify cases to the Director of Public Health/Medical Officer of Health for the area of residence of the patient.

Public Health multidisciplinary teams undertook contact tracing and control actions on all notified probable and confirmed iGAS cases, both in hours and out of hours. At the time of notification, the great majority of iGAS cases had been hospitalised (either in the Emergency Dept or an inpatient).

The coordination of case and contact management involved liaison with microbiological and clinical teams, patient/next-of-kin interview, identification of, and provision of advice to close contacts, and provision of chemoprophylaxis of high-risk close contacts. Chemoprophylaxis was prescribed by Public Health physicians or by the contact's family doctor following discussion with Public Health. Symptomatic contacts were referred urgently for appropriate clinical assessment.

Most iGAS close contacts were identified from among cases' household members. However, close contacts were identified from a **range of other settings** including schools, childcare facilities, residential care facilities, and International Protection Accommodation Services (IPAS).

4.3 Infection Prevention and Control (IPC)

The principles of IPC that minimise onward transmission of infection from confirmed or suspected cases of iGAS infection in **health & care facilities**, include:

- **Isolation** in a single room, with a self-contained toilet and its own hand basin for a minimum of 24 hours of effective antibiotic therapy
- Implementation of droplet and/or contact precautions
- Use of a Point of Care Risk Assessment for every patient contact episode

- Strict adherence to hand hygiene policy and use of appropriate Personal Protective Equipment (PPE) including disposable gloves, surgical masks and aprons when in contact with the patient or their equipment and their immediate surroundings

Notes and charts should be kept outside the room and patients should have dedicated equipment where possible. Breaks in the skin must be covered with a waterproof dressing. Fluid repellent surgical masks and eye protection must be used during operative debridement/change of dressings of necrotising fasciitis and for procedures where droplet spread is possible.

The isolation room, furniture, and equipment should be cleaned between patients. Whilst the patient is considered infectious, linen and waste must be handled as hazardous.

Antimicrobial Stewardship

During the course of the incident, primary care antibiotic prescribing guidance for iGAS was reviewed and updated by AMRIC, with regular and timely updates published on www.antibioticprescribing.ie. Ensuring antibiotic supply and provision of timely updates on the availability of antibiotic supply was coordinated between AMRIC, DOH and HPRA, including engagement with HERA at EU level.

5.0 Risk Communication

5.1 Cross-sectoral Professional Communication

Given the potential severity of outcome in paediatric and adult cases of sepsis, and profile of this upsurge in the media, there was the potential for increased pressure on busy GP and Emergency Department services. The IMT decided that provision of new learning, emerging from the incident, required rapid appraisal and communication to clinical staff in a timely manner, in addition to flagging of updated guidance and dissemination of necessary clinical advice messages by health care professionals for parents and patients. During the upsurge period, clinicians were urged to have a low threshold of clinical suspicion for iGAS, especially in vulnerable groups, and in those with a higher risk, whether by virtue of age, or concomitant predisposing infection, for the development of iGAS.

Cross sectoral communication was an integral and primary part of this management of this incident given that it involved such a wide variety of healthcare professionals and settings. For healthcare professionals, HSE and HPSC websites were reviewed and updated as

necessary to ensure that accurate and timely guidance and protocols were available. Regular updates were provided to the healthcare system and the Department of Health. Professional queries were routed through the IMT chair for resolution. Epidemiological updates were initially produced daily for the IMT, and a brief daily update was provided for the HSE's CCO, NDPH, DNHP and the NHPO. Regular updates were provided for clinicians and GPs, IPC professionals and acute and residential services managers. To support awareness of this incident and its progress, a publicly facing iGAS epidemiological update was published monthly.

5.2 International Communication

Communication and collaboration between public health professionals began early in the incident with bilateral links between UKHSA and NI PHA. Although iGAS was not included in the agents/diseases under surveillance at a European Union level, a number of countries do undertake surveillance. The IMT reached out to these countries through **EpiPulse** to flag developments in Ireland, seek information on disease patterns in Europe and to investigate best practice in other countries.

5.3 Public Communication

For communication with the public, HSE and HPSC websites were reviewed and updated as necessary to ensure that accurate and timely information was available. A new web section on wound management was created on the HSE website to provide public information to help mitigate the risk of developing iGAS following a wound injury. Information for parents on when to seek medical advice for their children was provided through mychild.ie. This web material was promoted through HSE and HPSC social media channels. The IMT developed a communication campaign, responding both to media bids and developing proactive messaging (for professionals and public), according to need. The approach was balanced and managed in order not to create unnecessary public concern and to limit the impact that 'worried well' might have on frontline services, with risk that a large upsurge in people seeking care inappropriately from emergency departments could result in increased harm to patients, due to excessive demand on triage and assessment services. As iGAS symptoms are similar to many less serious illnesses, high intensity media engagement had the potential to inadvertently raise public concerns and put unnecessary pressures on already over worked GP and Emergency Department Services.

6.0 Discussion and lessons identified

This incident represented the largest upsurge of iGAS in Ireland since systematic surveillance of the disease began. A number of elements contributed to making its management particularly challenging:

- ***Severity/uncertainty***: This was a significant and severe incident characterised by a worrying excess in paediatric mortality. Initially, the underlying causes, the trajectory of case count and the potential extent of the upsurge were unknown. These factors resulted in considerable concern, within the health system and among the general public.
- ***Complexity*****:** due to the unseasonal nature and extent of the incident. Pandemic restrictions resulted in markedly reduced circulation and transmission of a range of viral and bacterial agents. Young children, in particular, had considerably less exposure to circulating infections than would be normal. With the lifting of restrictions, there was a period of rapid exposure to agents that were relatively unfamiliar to paediatric immune systems, resulting in anomalous epidemiological behaviour by these infections.
- ***Knowledge gaps***: The behaviour of GAS and iGAS is incompletely understood resulting in the necessity of regular monitoring of evidence and updating of clinical and public health advice.
- ***Information burden*****:** Managing the incident required the processing of large amounts of information, and rapid knowledge dissemination to key stakeholders, which led to intense drawdown of significant resources. Amendment of the national iGAS case definition, which led to it becoming less specific, created greater work without facilitating or expediating the management of the incident (see Box p10).
- ***Criticality of notification***: The necessity for rapid notification if iGAS cases took some time to be appreciated by the clinical system.

Several key lessons were identified from the paediatric case review. Foremost among these were:

- **Rapidity and severity of secondary deterioration and deaths**. Children who developed iGAS infection became rapidly unwell, and required speedy and aggressive intervention
- **The presence of viral co-infection, and the necessity for appropriate vaccination**
- **Sepsis awareness and red flags for parents**
- **The need for early use of IVIG in Toxic Shock Syndrome**.

As clinical information accumulated on presentation and clinical course of paediatric patients during the incident, a number of important features with potential value in early identification and effective management of paediatric iGAS cases became apparent:

(i) A majority of the deaths occurred in children who developed extremely sudden onset, and overwhelming sepsis resulting in rapid collapse before being able to access hospital care; and

(ii) A commonly observed feature of iGAS cases that complicated a preceding infection (due either to a viral respiratory infection or varicella), was a biphasic distribution in the case's temperature – an initial fever associated with the viral illness, followed by apparent recovery, before a resurgence of fever and progressive deterioration following the development of iGAS.

One important clinical lesson from (ii) above is that, during seasonal periods of high circulating viral infections, any deterioration due to supervening iGAS in a child who had been diagnosed with such an infection, can potentially be misinterpreted (by clinicians, as well as parents) as simple fluctuations in the course of the child's viral illness, rather than the onset of iGAS. In addition, reassurances that "it's just a virus" run the risk of overly reassuring parents of a sick child who is deteriorating.

These key features have been incorporated into clinical messaging and guidance.

7.0 Recommendations:

The recommendations are largely informed by the After-Action Review (**Appendix 4**).

Recommendations are directed towards:

A. Prevention/early control of future incidents
B. Improving surveillance and detection of incidents
C. Improving the process of outbreak investigation and control and
D. Communications

The main recommendations are:

A. Prevention/Early Control

No.	Recommendation	Owner
A1	There is a need to ensure clear understanding at all levels and in all parts of the system, of the primacy of serious national incidents and to ensure that such incidents receive all necessary support and resourcing until the incident is declared closed and the final report has been produced.	HSE/NHPO
A2	There is a need to ensure early consideration of the development of an AAR and final report as part of TORs of IMT, and recognition of the fact that an incident is not official closed until the final incident report has been published – this should be made explicit in the National Incident Response Plan	NHPO
A3	There is a need to ensure inclusion of an administrative section in the Incident Response Plan, outlining key administrative functions	NHPO
A4	Development of tabletop exercises to plan for emerging threats, ensuring that all stakeholders are considered, with the establishment of a plan and templates that could be easily adapted for any incident.	NHPO
A5	The findings of the close association of varicella and iGAS infection in children and the relative absence of GAS pharyngitis or scarlet fever as leading indicators of iGAS infection, should be incorporated in future public health and clinical messaging.	HSE/NHPO

B. Surveillance

No.	Recommendation	Owner
B1	The role of the IMT in making necessary decisions can be facilitated by the early formation of subject/area specific cells/subgroups which should routinely work to produce data and options for consideration by the IMT	NHPO/NID
B2	There is a need to upskill all HPSC teams in rapid epidemiological report development and turnaround as any team may find themselves involved an incident	Clinical Lead Surveillance
B3	There is a need to identify and implement more robust mechanisms for analysing data, especially when looking at co-infections (R/R markdown and other data visualisation tools, e.g. Power BI).	NHPO
B4	Rather than changing a national case definition during an incident, consideration should rather be given to development of a temporary incident/outbreak case definition to guide management.	NHPO/NID

C. Investigation and Control

No.	Recommendation	Owner
C1	There is a need to ensure structuring of updates to the health system occurs in a timely way without producing excessive information overload	NHPO/NID
C2	There is a need to develop a national approach to support more efficient way of communicating information on shortages of medicines/supplies and including medicines and other medical countermeasure management issues including logistics as core part of future incident responses.	HSE/NHPO
C3	There is a need to review the available evidence-based guidance on the use of chemoprophylaxis for iGAS.	TBD when international evidence available
C4	There is a need to ensure that the relevant teams in HPSC/laboratories are properly resourced (time/staff numbers) to deal with the incident and reports.	HSE/DOH

D. Communications

No.	Recommendation	Owner
D1	There is a need to nominate a formal director of communications for the IMT to coordinate the communication strategy and drive its development and delivery throughout the incident.	NHPO
D2	There is a need to ensure that information for the public is curated at a single highly visible section of the HSE website, which is easily accessible, up-to-date, and consistent.	HSE Comms
D3	Engagement with patient groups/service representatives should be considered for every national incident though this may not always be feasible or appropriate	HSE-NQPSD/ NHPO
D4	There is a need to establish small regular survey/focus group with parents (in incidents involving severe morbidity/mortality of children) to ensure their understanding of communications/health information available.	HSE/NHPO

8.0 Appendices

Appendix 1 - Paediatric case review clinical findings

Table 1 – Clinical case review of iGAS (deaths and hospitalizations) in children under 16 years old (October 2022 – June 2023) in Ireland – Clinical Presentation - Main results

Parameter	**No.**
Number of notifications	181
Number of cases with clinical data available	167
Number of deaths	12
Median age of cases	4.45 years old
Median length of stay during hospitalization	8.5 days
Median duration of symptoms prior to hospital admission	4 days
Number of cases that had Varicella-Zoster infection prior to iGAS	47 (28%)
Number of patients presenting ≥1 respiratory virus co-infection	69 (41%)
Case-fatality rate	6.5%

Table 2 – Clinical case review of iGAS (deaths and hospitalizations) in children under 16 years old (October 2022 – June 2023) in Ireland – Comparison between notifications received from 2012 to 2021 and from Oct 2022 to June 2023 based on primary diagnosis and requirement for surgical interventions.

	Oct 2022- June 2023		**2012-2021**	
Total Number of cases	181		286	
Data Available	168		259	
Primary Diagnoses	n (% of data available)	Surgical Intervention (% of diagnosis)	n (% of data available)	Surgical Intervention (% of diagnosis)
Skin Soft Tissue Infection	49 (29%)	14 (29%)	74 (29%)	16 (22%)
Lower Respiratory	48 (28%)	29 (60%)	31 (12%)	15 (48%)
Head and Neck	40 (24%)	26 (65%)	50 (19%)	21 (42%)
Musculoskeletal	9 (5%)	7 (78%)	71 (27%)	43 (61%)

Table 3: Clinical case review of iGAS (deaths and hospitalizations) in children under 16 years old (October 2022 – June 2023) in Ireland -Clinical management of paediatric patients admitted with iGAS.

Management/Intervention documented	**No. of patients**	**%**	**Additional information**
≥ 1 Paediatric Early Warning Score (PEWS)	109	67%	
Sepsis form completion	17	10%	
Fluid bolus	58	36%	
Supplemental O2	36	20%	
Immunoglobulin administration (total)	23	13%	
Immunoglobulin administration in patients with toxic shock syndrome (TSS)	11/19		
Clindamycin administered	104	67	
≥ 1 radiological investigation		63%	
Procedural intervention (total)	76	47%	
Chest drain insertion	26		
ENT intervention	26		
Orthopaedic intervention	6		
Empyema decortication	1		
Urgent medical review on ward during admission due to deterioration	26		
PICU admission from ward level care	6		
PICU admissions (total)	34	21%	Average length of stay 3 days (1-20 days)
Intubation and ventilation	23		
Non-invasive ventilation	9		
ECMO (transfer to Karolinska Institute, Sweden)	2		
Ionotropic support	13		
Renal replacement	5		

Table 4. Clinical case review of iGAS (deaths and hospitalizations) in children under 16 years old (October 2022 – June 2023) in Ireland -Outcome amongst paediatric patients admitted with iGAS

Outcome	No. of patients	%	Additional information
Full recovery amongst survivors	133/159	84%	A further 23 patients expected to have no long-term medical issues
Amputation for ischaemic injuries	2		
Subglottic stenosis	1		
Left-sided weakness and visual loss secondary to MCA infarction	1		
Total no. of deaths	12		4/12 had significant co-morbidities
Total no. of deaths among patients admitted to PICU	2/22		
Out of hospital cardiac arrests	8		4 deteriorated rapidly in ED (2 of which were admitted to PICU)

Appendix 2 – IMT Membership

The IMT membership included broad range of representatives:

The membership of the IMT consisted of representatives from:

Name	Role
Dr Una Fallon *(NID Dec 2022 – Sep 2023)*	National Clinical Lead Acute Operations Response Programme, HSE Public Health: National Health Protection Office
Dr Paul McKeown *(NID Sep 2023 – Mar 2024)*	Consultant in Public Health Medicine (CPHM) Infectious Diseases, HSE Public Health: National Health Protection Office
Dr Éamonn O'Moore	Director National Health Protection, HSE Public Health: National Health Protection Office
Dr Greg Martin	National Clinical Lead Surveillance, Health Protection Surveillance Centre (HPSC), HSE Public Health: National Health Protection Office
Mr Stephen Murchan	Senior Epidemiologist, HPSC, HSE Public Health: National Health Protection Office
Mr Umut Gurpinar	Epidemiologist, HPSC, HSE Public Health: National Health Protection Office
Dr Louise Cullen	Principal Epidemiologist, HPSC, HSE Public Health: National Health Protection Office
Dr Jane Stapleton	Senior Medical Officer, PH Regions South West, HPSC, HSE Public Health: National Health Protection Office
Dr Jane Salmon	Senior Medical Officer, HPSC, HSE Public Health: National Health Protection Office
Prof Robert Cunney	Consultant Microbiologist and Quality Improvement and Clinical Safety Lead, Children's Health Ireland Microbiology
Dr Cilian O'Maoldomhnaigh	Consultant in Infectious Diseases, Children's Health Ireland Infectious Diseases
Dr Lois O'Connor	CPHM Health Protection, HSE Public Health Region Dublin and North East
Dr Paul Mullane	Specialist in Public Health Medicine (SPHM), HSE Public Health Region Dublin and North East

Dr Mary Ward	CPHM Health Protection, HSE Public Health Region Dublin and Midlands
Dr Ruth McDermott	SPHM, HSE Public Health Region Dublin and Midlands
Dr Niall Conroy	CPHM Health Protection, HSE Public Health Region Dublin and South East
Dr Margaret O'Sullivan	CPHM Health Protection, HSE Public Health Region South West
Dr Breda Cosgrove	CPHM Health Protection, HSE Public Health Region Midwest
Dr Emer O'Connell	CPHM Health Protection, HSE Public Health Region West and North West
Dr Anne Sheahan	Area Director of Public Health, HSE Public Health Region South West
Dr Eimear Brannigan	National Clinical Lead, Antimicrobial Resistance and Infection Control (AMRIC)
Mr Ciaran Browne	Assistant National Director, HSE Acute Hospital Operations
Ms Marie Philbin	Chief Antimicrobial Pharmacist Antimicrobial Resistance and Infection Control (AMRIC)
Ms Shirley Keane	National Head of Service, Antimicrobial Resistance and Infection Control (AMRIC)
Dr Ciara Martin	National Clinical Advisor and Group Lead (NCAGL) for Children and Young People
Dr Abigail Collins	National Clinical Lead Child Health Public Health, HSE
Mr Maurice Kelly	Client Director, HSE Communications
Mr Kirsty Mackenzie	Communications Manager, HPSC, HSE Public Health: National Health Protection Office
Ms Grainne Power	Director of Compliance, The Health Products Regulatory Authority (HPRA)
Mr Darren Sully	Medicine Shortages Division, The Health Products Regulatory Authority (HPRA),
Dr Scott Walkin	Assistant Programme Director of GP Training, Antimicrobial Resistance and Infection Control Lead, Irish Council of General Practitioners (ICGP),
Dr Orla Cotter	Specialist Registrar (SpR) in Public Health Medicine
Dr Cliodhna Ni Bhuachalla	SpR Public Health Medicine
Mr Toney Thomas	Director of Health Protection Nursing, HSE Public Health: National Health Protection Office

Ms Rafaela Franca	CNM2, HPSC, HSE Public Health: National Health Protection Office
Dr Randal Parlour	Research & Guideline Development Unit Coordinator, HSE Public Health: National Health Protection Office
Dr David Hanlon	NCAGL Primary Care HSE
Ms Cliodhna O'Mahony *Secretariat*	Programme Manager, HSE Public Health: National Health Protection Office
Ms Hilda Matthews, *Secretariat*	Programme Administrator, HSE Public Health: National Health Protection Office
Ms Aideen McLoughlin *Secretariat*	Programme Administrator, HSE Public Health: National Health Protection Office

Appendix 3 - Clinical case review of iGAS (deaths and hospitalizations) in children under 16 years old (October 2022 – June 2023) in Ireland

During the 2022-23 upsurge in iGAS infections, the proportion of cases occurring in children increased from ~25% in previous years to ~42%. In response to this increase, a clinical case review of every death and hospitalised case in children under 16 years from October 2022 to June 2023 inclusive was performed by a subgroup of the IMT. This work was a joint quality improvement project between HSE National Health Protection Service of Ireland, Children's Health Ireland, HSE National Clinical Advisor and Group Lead for Children and the HSE Healthy Childhood Programme and was carried out under the MOH mandate provided for by various Infectious Diseases Regulations. Paediatric teams across the country were requested to conduct a chart review and to complete an online questionnaire including clinical, epidemiological and outcome data.

One hundred and eighty-one (181) cases of iGAS in children were notified to Public Health during the study period. Clinical data was available for 168 (93%) cases, including the 12 deaths that occurred during this time period. The median age was 4.45 years (0 days – 15.4 years) with an even sex distribution; 52% male. The median length of stay was 8.5 days (range 2-105 days) with a median duration of symptoms of four days prior to admission. The most common presenting complaint was fever which occurred in 90% of cases, with a wide variety of other non-specific symptoms reflecting the variety of clinical conditions caused by iGAS in children.

Each patient was categorized by their primary diagnosis. If more than one diagnosis was present, the most clinically significant was chosen. Comparison was made with paediatric iGAS cases notified to Public Health from 2012-2021 and these results are shown in Table 2. There was an increase in diagnosis of lower respiratory tract infection and subsequent surgical intervention, an increase in suppurative head and neck infections requiring drainage and a decrease in musculoskeletal infections (preliminary data accurate at time of report submission).

Appendix 4 - After Action Review

An After Action Review (AAR) was conducted to seek the rapid identification of learning, with a view to using this to build into future management of iGAS and to strengthen incident response plans. The AAR survey was developed in Qualtrics for online completion to capture views of IMT members on what went well, what did not go so well and the lessons that they would want us to learn from this process. Answers were online only and the survey took approximately 15 -20 minutes to complete. The link to participate in the survey went to 42 people who were either directly or indirectly involved in the IMT through the duration of the regular meetings. The link to the survey was emailed on Thursday 30th November 2023, with an initial closing date of Monday 11th December 2023, later extended to end of December. We received 22 responses (52.3%).

The survey was divided into seven headings for feedback, these were:

1. Co-ordination and incident Management
2. Collaboration and Partnerships
3. Communication
4. Guidance and Case Definition
5. Incident Response
6. Data and Intelligence
7. Other

Respondents mainly provided feedback on the areas that were cross cutting and those related to their work.

AAR indicated that the following model worked well:

Strengths

- Strong leadership and chairing expertise, excellent administrative support, clear terms of reference (TOR) and agenda, and appropriate time allocated per item. Also, the sharing of pre-meeting documents in advance seems to have had an impact on members' engagement and meeting productivity as IMT members had enough time to review the documents.
- IMT representativeness and members' collaboration was often described as great and excellent based on members' skill mix and decision-making roles, including support from other public health authorities (ECDC, UKHSA).

- Messages disseminated to the public and stakeholders were clear and well-balanced. The guidance was updated in a timely manner with input from IMT experts. The algorithms were also deemed very useful.
- The quality of the epidemiological updates and reports were described as regular, timely, helpful, adaptable, comprehensive, high-quality, easy to follow, excellent (including comparisons with other Member States).
- Finally, the iGAS IMT was referred as model for future IMTs.
- The AAR also identified opportunities for improvement as feedback from IMT representatives was based heavily on the impact of the iGAS upsurge on the public health service and there was insufficient opportunity to articulate the effect on the whole health system during meetings.
- Late implementation of the DRA impacted on the frequency of the meetings, which could had been reduced earlier if the DRA had been introduced at the onset of the IMT
- In terms of representativeness, it was noted that the number of experts in adult medicine could have been increased due to the upsurge seen in adults.
- A few issues regarding communications were mentioned including being more reactive than strategic. Mostly, the lack of a nominated communications lead/director to coordinate the communications strategy and implementation was highlighted as essential for future IMTs.
- The timing of and change to a more sensitive case definition in the middle of the upsurge confused laboratory staff, public health teams and clinicians and it was felt that changes in guidance could have been communicated more effectively to clinicians.
- There was variation in reporting practice between laboratories and staff shortages in the Irish meningitis and sepsis reference laboratory (IMSRL) which impacted the turnaround times for sample analysis.
- The collection, analysis and report of epidemiological data required a lot of effort across the HPSC Micro team. Other work of this team was impacted to a certain extent due to staff constraints in the HPSC. Another difficulty identified in data processing was the lack of compliance with data reporting rule sets when inputting data by a few PHAs.
- Lastly, the clinical governance for informing patients, identification of contacts in-hospital and the role of Occupational Health was not clear throughout the incident.

Appendix 5 – Timeline of Significant iGAS Incident Events 2022-2023