Australian Government
Department of Health

2022 · Volume 46

Communicable Diseases Intelligence

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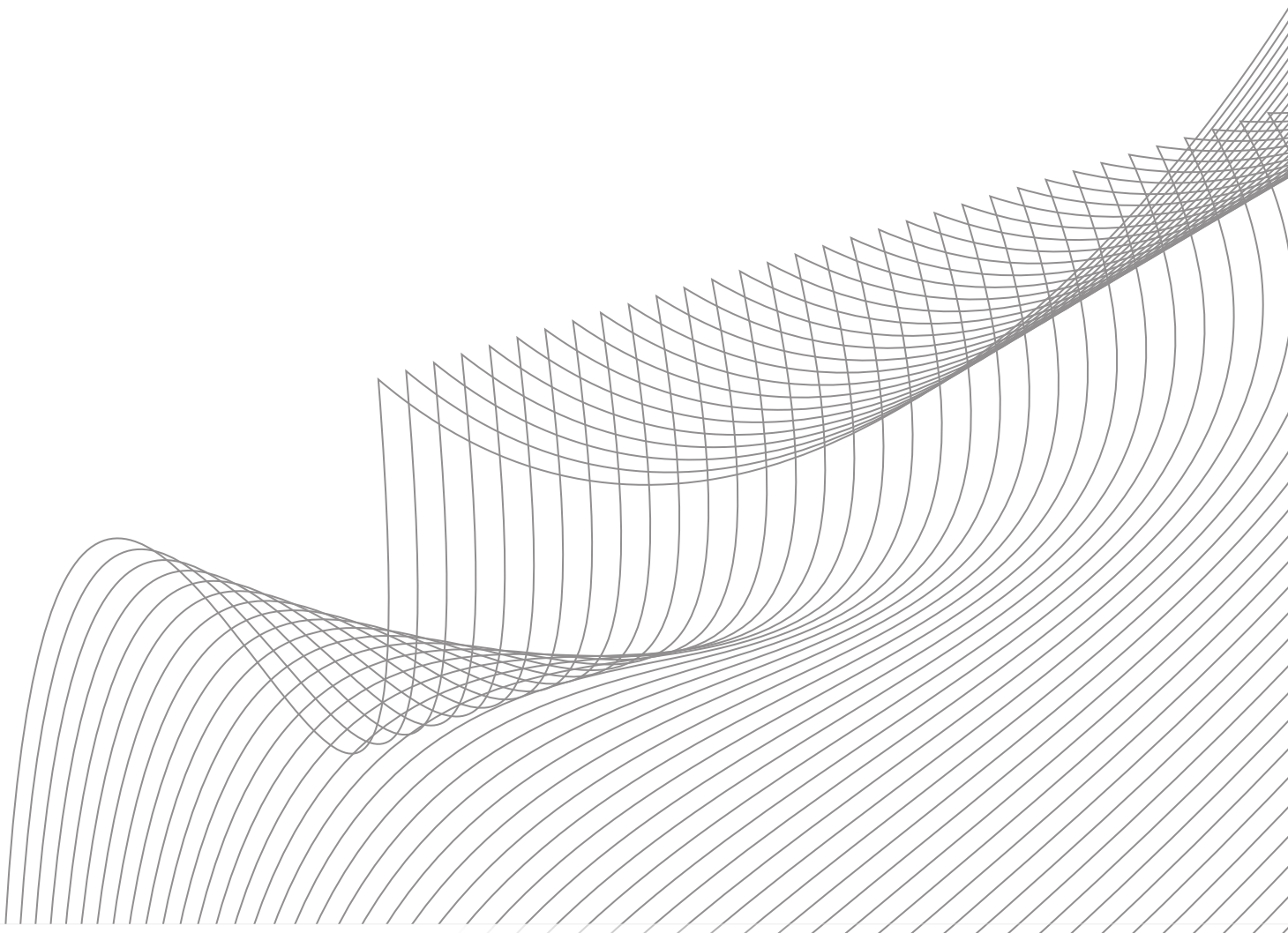

https://doi.org/10.33321/cdi.2022.46.35
Electronic publication date: 23/6/2022
http://health.gov.au/cdi

Communicable Diseases Intelligence
ISSN: 2209-6051 Online

This journal is indexed by Index Medicus and Medline.

Communicable Diseases Network Australia
Communicable Diseases Intelligence contributes to the work of the Communicable Diseases Network Australia.
http://www.health.gov.au/cdna

Communicable Diseases Intelligence (CDI) is a peer-reviewed scientific journal published by the Office of Health Protection and Response, Department of Health. The journal aims to disseminate information on the epidemiology, surveillance, prevention and control of communicable diseases of relevance to Australia.

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http://www.health.gov.au/cdi

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Original Article

Public health response following an iGAS outbreak in a residential aged care facility in Queensland

Jai C Van Zeeland, Heshani Rupasinghe, Megan K Young

Abstract

During an 18-day period, beginning in April 2020, three residents with invasive group A streptococcal infections (iGAS) were reported at a single residential aged care facility (RACF) in Brisbane's northern geographical region. All three cases were hospitalised with severe illness; two of the cases died as a result of the illness. The Metro North Public Health Unit (PHU) led the public health investigation and response, targeting infection control measures and offering chemoprophylaxis to all 142 staff and 119 residents at the facility. The outbreak was declared over in June, after 30 days of no new cases. Isolates from all three cases were shown to have identical strain typing, *emm89*. The benefits and challenges of implementing mass chemoprophylaxis in this setting are discussed.

Keywords: Group A; mass chemoprophylaxis; invasive; outbreak; streptococcal disease; residential facility; aged care

Introduction

Group A *Streptococcus pyogenes* (GAS) colonises the throat, skin and anogenital tract. In a vulnerable host, GAS can cause localised disease like pharyngitis and impetigo but it can also invade normally sterile sites and cause life-threatening invasive group A streptococcus (iGAS) infection. GAS is transmissible from person to person via respiratory droplets or by direct contact with carriers who may be asymptomatic.[1] Household, institutional and child-care contacts of iGAS cases have an increased risk of iGAS.[2] The overall mortality of iGAS in Australia is 7%;[1] however, iGAS outbreaks in residential aged care facilities (RACFs) are associated with a significantly higher case fatality rate of 25%-60%.[3]

Approaches to iGAS case and outbreak management vary widely internationally, and within different jurisdictions within Australia. In Queensland, probable and confirmed cases of iGAS are notifiable under the *Public Health Act 2005*.[4] The incidence of iGAS notifications in Queensland between 2006 and 2015 was 4.5 per 100,000 population per year.[1] Public health interventions aim to prevent onward transmission by ensuring case isolation and appropriate antibiotic treatment and by identifying and advising close contacts who may be at greater risk of acquiring invasive disease. Chemoprophylaxis for close contacts of iGAS infection, to eliminate nasopharyngeal carriage and transmission, remains controversial as reflected in variations in guideline recommendations.[2] The Queensland Health Guidelines advise chemoprophylaxis for mother-baby pairs in the neonatal period and in a confirmed iGAS outbreak. There is currently no vaccine for GAS.

The Queensland Health guidance definition of iGAS outbreaks is outlined in Box 1. A suspected outbreak becomes a confirmed outbreak if the cases are matched through identical molecular typing. Confirming molecular typing prior to chemoprophylaxis has rationale based around the diversity of strains of iGAS, the varying evidence of the effectiveness of mass chemoprophylaxis, the potential complications

Box 1: Queensland Health guidance for public health units: definition of iGAS outbreaks[1]

Suspected iGAS outbreak: two or more cases of invasive Group A Streptococcal disease that are epidemiologically linked[a] (particularly aged care, childcare, hospitals or maternity wards) that occur within a 3 month period.

Confirmed iGAS outbreak: two or more cases of invasive Group A Streptococcal disease that are epidemiologically linked[a] (particularly aged care, childcare, hospitals or maternity wards) that occur within a 3 month period and are identical on molecular typing.

a An epidemiological link exists where cases occur in a physical or geographical context and a plausible mode of transmission accounts for infection spreading between people, AND when one person is likely to have been infectious AND at least one person has an illness which starts within the incubation period after contact with the infectious person.

of chemoprophylaxis and the amount of logistical work required to coordinate such a public health response.

GAS is typically genotyped using the M protein gene (*emm*). Worldwide, over 240 different *emm* types have been identified, those responsible for the majority of invasive disease cases can be reduced to just six, including *emm89*.[5]

Although chemoprophylaxis is advised in a confirmed iGAS outbreak in Queensland, there is emphasis in the guidelines that outbreak prevention and management should focus on enhanced surveillance for further cases in addition to addressing environmental contamination and serious breaches in infection control. Chemoprophylaxis is not considered to be a substitute for good infection control.[1]

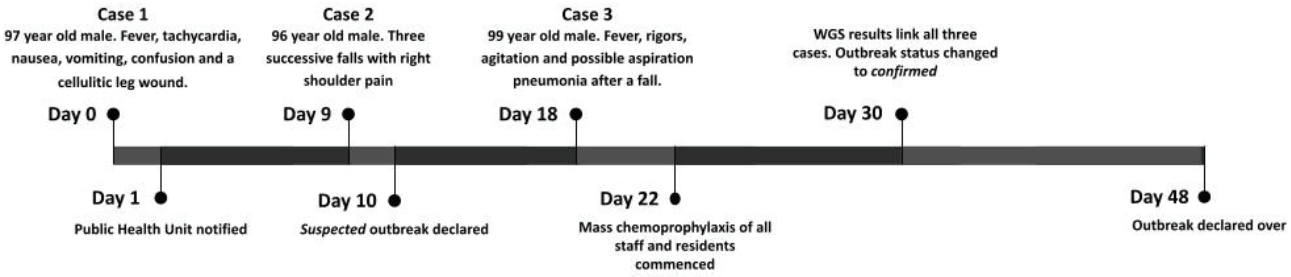
In April 2020, multiple residents with iGAS were notified from a single RACF to a large metropolitan public health unit (PHU) in Brisbane's northern geographical region. Here we describe the progress of the PHU response which ultimately culminated in the establishment of a confirmed outbreak and administration of mass chemoprophylaxis to all 142 staff and 119 residents across six wings. The benefits and challenges of implementing mass chemoprophylaxis in this large institutional setting are discussed to inform future practice. Ethics approval was not required as outbreak identification and management are part of PHU core business and undertaken within the auspices of the Queensland *Public Health Act 2005*. The facility provided written consent for publication.

Outbreak description and public health response

Three cases of iGAS were identified and notified over the course of the outbreak (Figure 1). From a clinical perspective, all three cases had multiple medical co-morbidities and blood cultures collected on admission for all three cases became positive for GAS within 5-10 hours of incubation. Case 1 recovered and was discharged after a two-day admission while cases 2 and 3 died as inpatients within 1–4 days of admission.

The PHU was notified of each of the laboratory results electronically via the Notifiable Conditions System (NoCS) within 24–48 hours of the positive GAS results. After notification of the first case, the PHU contacted the RACF manager to risk-assess for further potential cases and to ensure that appropriate infection control procedures were in place. No further cases were identified and there were no significant concerns regarding any other staff or residents with symptoms suggestive of local or invasive GAS. The RACF facilitated GAS-specific education for their staff; environmental cleaning was undertaken by an external provider; and nurses were re-educated on hand hygiene and wound care techniques. They were advised to maintain

Figure 1: Outbreak timeline



heightened vigilance of signs and symptoms of GAS and iGAS in other staff and residents for the subsequent 30 days.

Following notification of Case 2, the PHU contacted the RACF to gather further information and sought to establish the possibility of an outbreak. Case 2 was in the same wing of the facility as Case 1, along with 20 other residents, suggesting an epidemiological link. Following the Queensland Health Guidance for Public Health Units definition for outbreaks (Box 1), a suspected outbreak was declared. An outbreak management team (OMT) led by the RACF was formed and convened daily throughout the outbreak. Cohorting of all staff in the affected wing was recommended and communal activities were ceased. Chemoprophylaxis was not advised at this point; however, it was being considered if the molecular typing showed a matching strain.

The PHU noted that Case 3 resided in a separate wing of the facility and had no direct interaction with the previous two cases. Breaches in infection control measures, suboptimal hand hygiene and wound care techniques, in addition to staff movement across the facility, were considered as possible means of ongoing transmission. The RACF OMT identified 18 residents with wounds actively being managed by nursing staff and facilitated swabs from all wounds. Nil residents or staff with pharyngitis were identified. Screening throat swabs were not collected from staff or residents.

Without strain typing results, the outbreak was still defined as 'suspected' upon notification of Case 3 as per the Queensland Health Guidance. However, the PHU recommended that all staff and residents, irrespective of which area or wing they worked or resided, be offered antibiotic chemoprophylaxis with antibiotic choice and dose as detailed in Table 1. Considerable thought was given before recommending mass chemoprophylaxis. The likelihood that the outbreak would be 'confirmed' was felt to be high, given the cross-facility involvement despite increased infection control measures already in place. It was acknowledged that Queensland Health guidelines recommend that all staff and residents commence antibiotics simultaneously[1] and that there would be logistical difficulties and potential harms from unnecessary or ill-coordinated antibiotic prophylaxis. Consideration was also given to the number, and level of engagement, of general practitioners (GPs) with the RACF, and to the RACF's engagement and willingness to participate. The aim of mass chemoprophylaxis was to eliminate carriage in the potential source(s), thereby interrupting any further transmission within the facility.

The RACF agreed with advice to proceed with mass chemoprophylaxis. The PHU helped to facilitate the process by speaking with the residents' GPs directly, as well as by providing written advice to distribute to all residents and staff. It was emphasised in communications that the antibiotics were only one part of controlling the transmission of the bacteria, and that ongoing hygiene measures were also essential. A meeting was held between the PHU, the GPs and the RACF to discuss timing of mass prophylaxis to ensure a coordinated approach. The local pharmacy was also an important stakeholder and confirmed availability of the antibiotics. Prophylaxis commenced four days

Table 1: Recommended chemoprophylaxis for iGAS contacts[1]

Antibiotic	Dose	Indications
Phenoxymethylpenicillin	Adult: 500 mg orally, 12-hourly for 10 days Child: 15 mg/kg up to 500 mg orally, 12-hourly for 10 days	No hypersensitivity to penicillins
Benzathine penicillin	Adult: 900 mg IM as a single dose Child (single dose): 3 to 6 kg: 225 mg IM 6 to 10 kg: 337.5 mg IM 10 to 15 kg: 450 mg IM 15 to 20 kg: 675 mg IM 20 kg or more: 900 mg IM	No hypersensitivity to penicillins Adherence to oral medication a concern Oral therapy is not tolerated NB: Dose may be difficult to obtain and administration may be challenging
Cephalexin	Adult: 1 g orally, 12-hourly for 10 days Child: 25 mg/kg up to 1 g orally, 12-hourly for 10 days	Mild penicillin intolerance No immediate hypersensitivity to penicillin
Azithromycin	Adult: 500 mg orally, daily for 5 days Child: 12 mg/kg orally, daily for 5 days	Immediate hypersensitivity to penicillin Organism is sensitive to erythromycin
Clindamycin	Adult: 300 mg orally, 12-hourly for 10 days	Immediate hypersensitivity to penicillin Organism is not sensitive to erythromycin Organism is sensitive to clindamycin

after the onset of Case 3 and 22 days into the suspected outbreak. To provide further support to the RACF, two clinical staff from the PHU met with the RACF manager and quality control lead on site after the onset of Case 3. The visit was helpful in determining the overall layout and staff movements at the RACF and reinforced the decision that the benefits of mass chemoprophylaxis outweighed the risks, as it became clear that effective and ongoing cohorting of both staff and residents would be difficult to achieve.

In total, 99% of staff (n = 140/142) and 97% of residents (n = 115/119) completed their antibiotic course. Logistically, mass chemoprophylaxis proved to be challenging due to the significant number of staff and residents, and the need to tailor antibiotic prescribing given contra-indications in the context of residents with complex medical needs. The cooperation and engagement of GPs assisted greatly in overcoming these difficulties. Another challenging aspect was that, at various times, some staff members, residents and family members of residents expressed concerns about taking the antibiotics. Clear, concise and consistent communication from the PHU and RACF, addressing their concerns, were able to alleviate these fears, resulting in the excellent overall uptake. No antibiotic-related adverse events were reported to the PHU.

Approximately 30 days after the notification of Case 1, it was confirmed that all three cases had isolates that were molecular type *emm89*. Following Queensland Health guidelines, the outbreak classification was changed from suspected to confirmed. Furthermore, two wound swabs were also positive for GAS, and were also confirmed to be strain type *emm89*. Both of these residents lived in the same wing as Cases 1 and 2. The RACF were informed of the results although this did not have any impact on public health recommendations. The outbreak was declared over 30 days after the onset of Case 3 when no further suspect or confirmed cases had arisen. No further iGAS cases at the RACF had been notified at the time of this report, more than 12 months later.

Discussion

The management of the confirmed iGAS outbreak in an institutional RACF setting included mass chemoprophylaxis after careful consideration of the feasibility, risks and benefits of such an intervention. However, central and foremost to the control of the outbreak

was effective communication and collaboration between the PHU and RACF staff, residents and families, and GPs. Equally, outbreak management success was felt largely due to detailed attention to, and reaffirming the importance of, infection control. One of the challenges of introducing mass chemoprophylaxis was felt to be that it could easily be misinterpreted by the recipients as being superior to, or used in lieu of, infection control.

Basic infection control principles, which might be considered the mainstay approach to iGAS outbreak control, are universally accepted as essential to both contain and prevent outbreaks.[6] Primarily, this encompasses frequent and rigorous hand washing with soap and water or an alcohol based sanitiser, and accessibility to hand washing facilities. Good wound care techniques should also be targeted, as it is well established that receiving skin and wound care is associated with increased risk of local and invasive GAS infection.[7] Limited data support the presence of GAS on environmental surfaces including carpet, upholstery fabrics and curtains as a contributing factor to transmission, and furthermore, that this contamination is only eliminated once enhanced environmental cleaning is implemented.[8] In six reports of iGAS outbreaks in the literature, suboptimal infection control practices were identified as the major contributing factor in all except one.[3,9–12] Commonly mentioned interventions included hand hygiene; identifying breaches in wound care and improving staff wound care technique; and environmental cleaning. Respiratory droplet precautions were perhaps a notable omission, not mentioned as an iGAS infection control intervention in any of the sighted reports.

Conversely, the significance and effectiveness of both mass and targeted chemoprophylaxis in interrupting transmission of GAS varies within current literature. A 2012 UK paper, which investigated management of 20 iGAS outbreaks in UK aged care facilities, concluded that, based on the available data, there was no clear evidence that prophylactic chemoprophylaxis is an effective outbreak management tool. The authors conceded that more systematic data may be required to inform future policy.[8] Four years later, another UK RACF review attributed the introduction of mass chemoprophylaxis, in addition to improvement in infection control practices, as the likely reason for no further iGAS cases.[12] When managing an iGAS outbreak in a comparable metropolitan PHU in Queensland Australia in 2016, an expert advisory group recommended mass chemoprophylaxis within one wing of the facility and yet experienced an additional iGAS case within the same wing after the intervention, albeit one month later.[3] One report, of a 36-month outbreak in a RACF in the USA, identified mass chemoprophylaxis alone (and not in combination with remedying infection control inadequacies), as the intervention which finally interrupted transmission.[14]

Unlike mass chemoprophylaxis, in which all staff and residents within a facility (or subset of a facility) are prescribed antibiotics, 'targeted' or 'selective' chemoprophylaxis refers to screening for GAS carriage and only selectively treating those who return a positive GAS sample. One benefit of this approach is that implementation would likely be less challenging than experienced by the PHU. However, available evidence supporting effectiveness is not strong. In a 2019 New Zealand report, targeted chemoprophylaxis was implemented and was thought to have played a role in preventing some cases; yet, following a second phase, it was acknowledged that targeted chemoprophylaxis as a standalone approach was insufficient. Notably, mass chemoprophylaxis was not introduced even after this second phase.[10] When considering a targeted approach, it should be acknowledged that performing throat swabs and awaiting results may result in untimely delays prior to the commencement of chemoprophylaxis. The best available evidence suggests that the highest risk for iGAS transmission between household contacts is considered to be in the first seven days, and additionally, that antibiotics should be administered as soon as possible following exposure.[2] Even a 24–48 hour wait pending swab results could leave contacts at greater risk of invasive disease. Another point for

consideration, not found in the cited literature, is that a targeted approach may adversely affect staff or residents who test positive for GAS. For example, a nurse who had attended wound care of a confirmed iGAS case may feel responsible for transmission if they are subsequently found to be positive for GAS carriage. This might be especially impactful if fatalities resulted from any presumed breach.

Though this outbreak was guided by traditional epidemiological links and by the use of strain *emm* typing, in more recent years published literature reveals an increased usage of whole genome sequencing (WGS) as an investigative tool in iGAS outbreaks. WGS has been shown to be more effective, more accurate, and faster for identifying *emm* gene types in GAS isolates than traditional *emm* typing.[15] A 2019 USA study cites WGS as a major factor in differentiating between intra-facility transmission (i.e. poor infection control) and introduction of other strains from the community.[9] In the previously-cited 2016 UK outbreak where no cases were reported after mass chemoprophylaxis, WGS was identified, in combination with epidemiological factors, as essential for triggering the timely response.[12] In the outbreak we have described here, *emm* typing results were not known for approximately a month. If these results were waited upon prior to escalating outbreak management, this may have negatively impacted ultimate control. Undoubtedly, the shorter turnaround times offered by WGS will play a key role in guiding both future iGAS outbreak detection and response including decisions regarding mass chemoprophylaxis.

While it is generally accepted that mass chemoprophylaxis is not intended to be a replacement for good infection control in halting iGAS outbreaks, the experiences of others documented in the literature suggest that more prolonged outbreaks can be associated with either no chemoprophylaxis or targeted chemoprophylaxis alone. Nonetheless, the current evidence is not conclusive on the role of mass chemoprophylaxis as an intervention for iGAS outbreaks. We have reported here a positive experience with mass chemoprophylaxis as one of the interventions contributing to control of an iGAS outbreak in a local RACF. However, as demonstrated, mass chemoprophylaxis can be a challenging undertaking. The decision to commence mass chemoprophylaxis should be, in conjunction with jurisdictional guidelines, reliant upon a thorough public health risk assessment, utilising available investigative tools, and on careful consideration of the unique characteristics of the outbreak.

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