



Public Health  
England

Protecting and improving the nation's health

# **Invasive group A streptococcal outbreaks associated with community health services delivered at home, January 2018 to September 2019**

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# Background

## 1.1 Group A Streptococcus

*Streptococcus pyogenes*, also known as Group A Streptococcus (GAS), is a Gram-positive bacterium responsible for a range of diseases, predominantly affecting soft tissues and the upper respiratory tract. In its most severe form, this bacterium can cause invasive disease, characterized by entry into sterile body fluids including the blood, where mortality may reach 45% (1). Transmission is considered to primarily occur via person-to-person spread through direct skin contact or via respiratory droplets, with transmission through contaminated fomites and the wider environment playing a lesser role (2). Transmission can occur from asymptomatic carriers as well as from individuals with overt signs of infection, with throat, nose, skin and anogenital carriage all linked to healthcare-associated outbreaks (3, 4, 5, 6). Existing national public health guidelines detail the management of community invasive Group A Streptococcus (iGAS) cases and investigation of GAS infections linked to acute healthcare and maternity services; neither provide specific guidance on the investigation of cases and outbreaks linked to community health services (7).

## 1.2 Community nursing

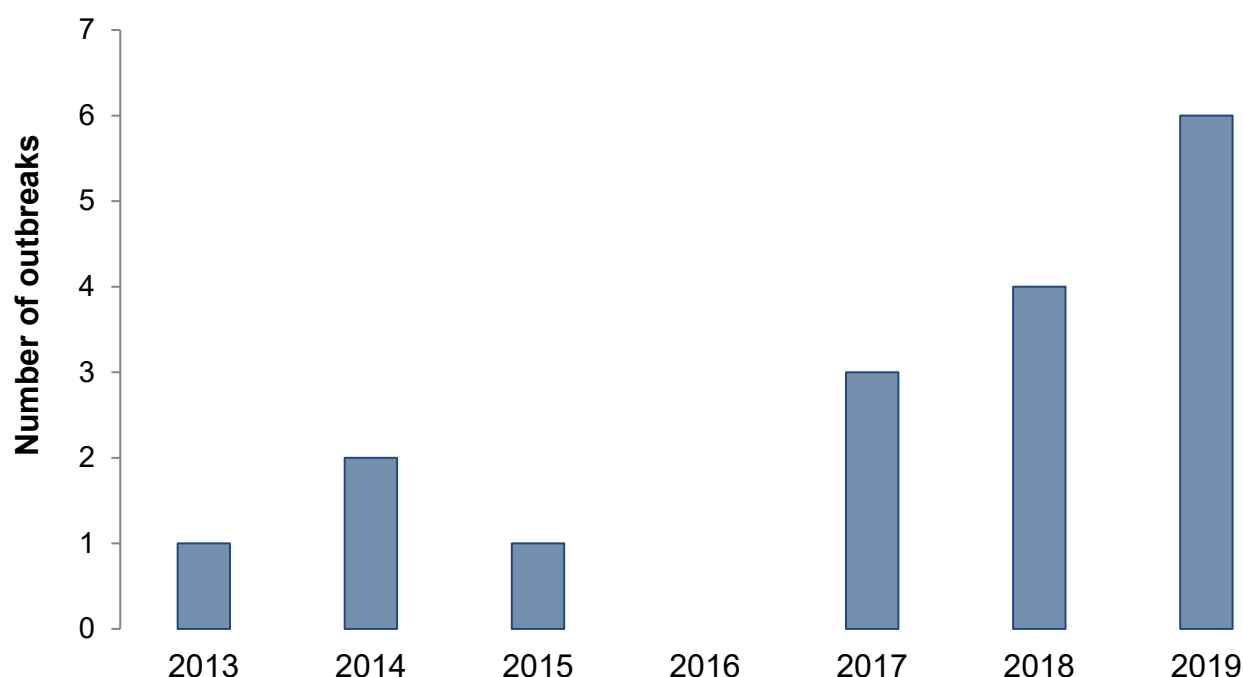
In England, a substantial proportion of community nursing is performed by practitioners travelling from patient to patient to deliver health care in the home environment. These include district nurse services (whose employees may include qualified district nurses, as well as community nurses and health care assistants), general practitioners, podiatry (chiropody), community midwives, hospital outreach ('hospital at home') and palliative care. In this study, they will be described as community health services delivered at home (CHSDH). In addition, domiciliary care may be administered by social services, private providers, charities and friends and family. This involves help with toileting, washing and dressing but not administering medical or nursing care.

Much of the CHSDH workload involves wound care; there were an estimated 10.9 million community nurse visits for this purpose in 2012 alone (8). This presents unique infection control challenges. Both the practitioner and their equipment may become contaminated directly from the patient or the patient's home and vice versa. This equipment includes medical devices, for which manufacturer's decontamination guidance should be available, and other items such as carrying bags, for which no such guidance is available. Hand hygiene facilities may be limited to those available within a patient's home such as hand soap and used towels (9), although antibacterial hand gel should be carried by the CHSDH practitioner. In the last 5 years, increased pressure on community health services has resulted in shorter visits and more visits per day, reducing time available for decontamination and potentiating contamination via fomites or inadequate hand hygiene and transmission to further patients (10).

## 1.3 CHSDH and invasive Group A streptococcal outbreaks

Since 2013 there have been increasing reports of CHSDH associated outbreaks of invasive Group A streptococcal infection (iGAS) recorded by PHE Health Protection Teams (see Figure 1). As the CHSDH case load is predominantly elderly people with limited mobility and complex healthcare needs, these outbreaks have occurred in vulnerable individuals with limited physiological reserve resulting in high mortality rates. These patients usually have many points of healthcare contact including carers, CHSDH, general practitioners, hospital clinics, hospital inpatient stays, nursing home residence and so on, so establishing the underlying source of these outbreaks is challenging. It is not routine for all health protection teams to ask about healthcare exposures when undertaking routine follow-up of community-acquired iGAS infection. Furthermore, care networks are often complex and links between cases may be difficult to ascertain meaning that linked cases may not always be identified. It is likely that CHSDH associated iGAS outbreaks are currently underestimated.

**Figure 1. Reported iGAS infection outbreaks associated with CHSDH, England**



## 1.4 Increase in outbreaks

GAS infections are increasing in England, Wales and Northern Ireland with a 111% increase in reported Group A streptococcal bacteraemia between 2014 and 2018 (11). Over the same period there was a disproportionate rise in identified CHSDH iGAS outbreaks, from 2 outbreaks in 2014 to 6 outbreaks in 2019. The reason for this is unclear; increased awareness and reporting of CHSDH GAS transmission may have played a small role in increasing ascertainment, but is unlikely to account for so large and rapid a rise. Community nursing

services have undergone considerable change in the last 10 years. On the background of an aging population requiring increased community health support, there has been a 46% fall in qualified district nurses since 2010 (12). There has also been increased reliance on the charitable, social enterprise and private sectors. A recent report by The King's Fund cited concerns from staff over the quality and safety of district nursing care and reported wound care as particularly likely to be deprioritized in busy periods (5). There is only one paper reporting a CHSDH associated iGAS outbreak (13) although there are many reports from long term care facilities and outpatient facilities including wound, podiatry and cosmetic surgery clinics (14, 15).

A meeting convened by PHE in May 2019 to discuss these outbreaks commented on their large size, long duration and the complexity of interactions with CHSDH teams, which may be outside traditional NHS structures. The meeting recommended a formal review of previous outbreaks to inform future guidelines on their public health management. This work took place between August and November 2019 and predates the COVID-19 pandemic.

## 2. Methods

This study describes CHSDH associated iGAS outbreaks occurring in England between January 2018 and September 2019, to identify challenges facing each outbreak control team (OCT) and make recommendations for future investigations and management.

Specific objectives include:

1. To collect numerical data regarding invasive, non-invasive and colonized cases, together with mortality rates.
2. To describe the methods used to investigate each outbreak including patient, CHSDH and environmental screening, and findings from each investigation.
3. To describe control measures implemented.
4. To record *emm* type and sequencing data (where available).
5. To describe the registered nursing providers and other care givers involved in each outbreak.

### 2.1 Data collection

Outbreaks were identified by interrogating HPZone and the Streptococcal Reference Laboratory Outbreak dataset for CHSDH-associated iGAS outbreaks. Healthcare associated infection (HCAI) Leads in each PHE Centre were also directly approached to identify any outbreaks not identified from querying HPZone.

Outbreaks detected between 1 January 2018 and 30 September 2019 involving 2 or more cases of iGAS infection of the same *emm* gene type, linked to the same defined CHSDH service, were included. Outbreaks in which other exposures offered a more plausible route of transmission were excluded.

The chair of each OCT, or other nominated individual, was interviewed over Skype to collect data using a standardized interview protocol.

Data were recorded in MS Excel. All data were managed as confidential with patient identifiable data stored in encrypted format on a shared network drive with access restricted to members of the study team, in line with PHE's information governance policy. This study was performed by PHE as part of its legal obligation to collect and process information about communicable disease surveillance and control under Section 251 of the NHS Act 2006. No further ethical approval was required.

Published findings are masked to prevent deductive disclosure of patients, outbreaks or services.

## 2.2 Operational definitions

### Invasive Group A streptococcal infection (iGAS)

Isolation of GAS from a normally sterile site, either by PCR or culture. For this study, iGAS also includes GAS infections where GAS has been isolated from a normally non-sterile site in combination with a severe clinical presentation, such as streptococcal toxic shock syndrome (STSS) or necrotizing fasciitis (7).

### Group A streptococcal infection (GAS)

Isolation of GAS from a non-sterile site in combination with clinical symptoms attributable to bacterial infection including fever greater than or equal to 38°C, sore throat, wound infection or cellulitis. This excludes cases of invasive or severe disease.

### Group A streptococcal carriage

Isolation of GAS from a non-sterile site with no symptoms attributable to infection with this microorganism.

### Community health services delivered at home (CHSDH)

Community health services, including district nursing teams, general practitioners, podiatry (chiropody), community midwifery, hospital outreach and palliative care, which provide medical or nursing care within a patient's home.

## 3. Findings

### 3.1 Characteristics of outbreaks

Ten outbreaks that met the inclusion criteria were identified between 1 January 2018 and 30 September 2019. Six outbreaks remained open on 30 September 2019. The outbreaks were distributed around England, occurring in all 4 PHE regions and in 6 of 9 PHE centres. Three PHE centres experienced more than one outbreak.

In these 10 outbreaks, there were a total of 96 iGAS cases and 28 attributable deaths (case fatality rate, CFR, 29%; Table 1). The CFR is higher than previously recorded in community iGAS cases; a 2010 to 2011 study recorded a CFR of 11% in community iGAS cases in the UK, although the odds of dying were significantly higher in cases 75 years and over. (16)

Outbreaks varied in size with between 2 and 39 (median 6.5) cases of iGAS. Non-invasive GAS cases were not systematically recorded or investigated in all outbreaks but 4 outbreaks identified a total of 104 patients whose bacterial swabs cultured GAS (median 3.5, range 1 to 95). 91% of these came from a single outbreak. It is not possible to distinguish GAS carriage from GAS infection in these patients.

Outbreaks lasted for a variable period of time. There was a median of 199 days (range 3 to 517) between the specimen dates of the first and last identified case in each outbreak (Figure 2). There were often long intervals between identified sequential cases linked by epidemiology or whole genome sequencing (WGS) (median 20.5 days, range 1 to 225; Figure 3).

In 9 outbreaks for which individual patient data were available (n= 57), cases had a median age of 82 (range 42 to 100) and 72% were female. 53 (93%) had been cared for by CHSDH services.

Four cases (7%) did not receive direct care from CHSDH services. These comprised of:

1. The husband of a CHSDH-associated iGAS case.
2. The wife of a gentleman receiving CHSDH care who had no evidence of GAS infection.
3. A case that had no known contact with other outbreak cases or CHSDH services but who was linked to the outbreak by WGS.
4. A case with the same outbreak *emm* type but on which WGS was not performed. As this case had *emm*89, a common iGAS *emm* type, this may not have been part of the CHSDH outbreak.

These cases illustrate that CHSDH iGAS outbreaks can spread beyond patients cared for by CHSDH teams, posing a risk to the wider community.

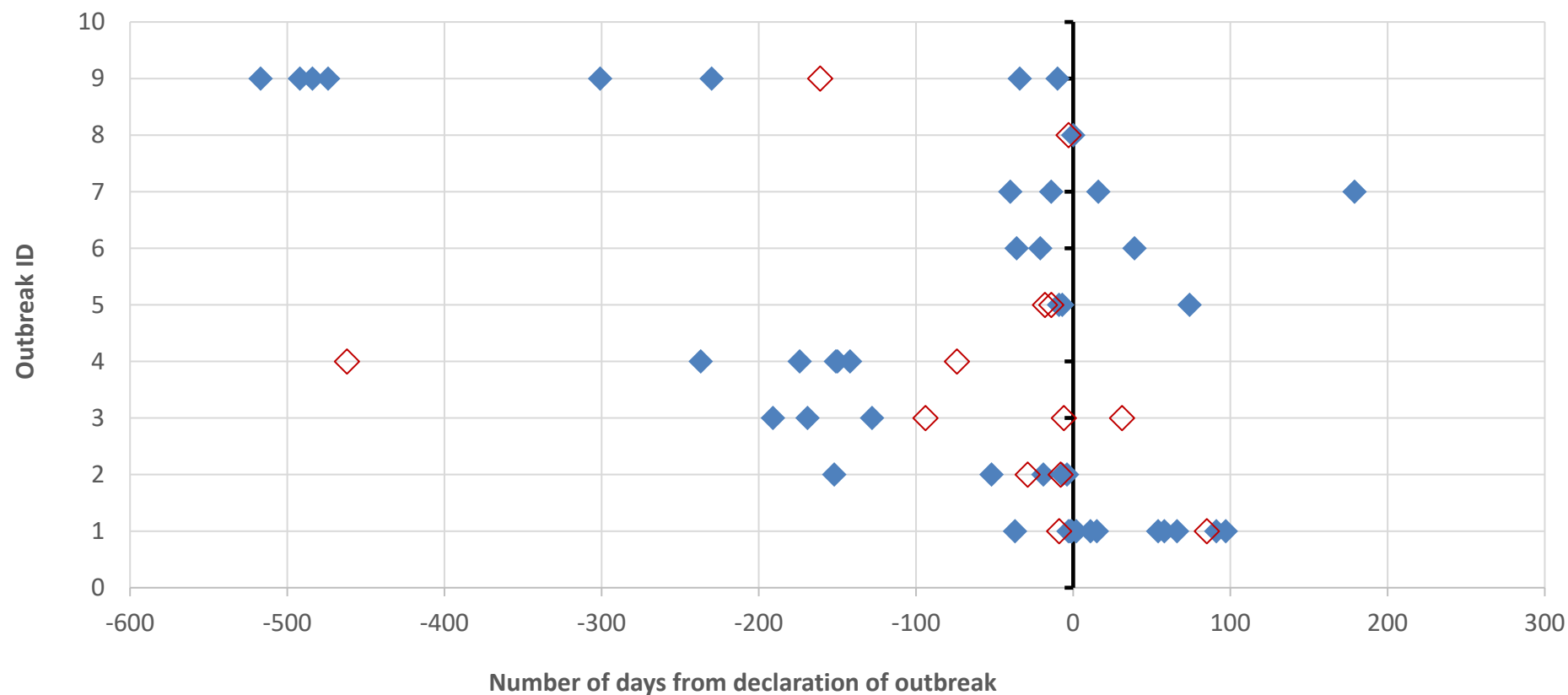


**Table 1. Summary of iGAS outbreaks associated with CHDS, England 2018 to 2019**

<b>Outbreak ID</b>	<b>Number of iGAS cases</b>	<b>Number of non-invasive GAS cases*</b>	<b>Number of deaths</b>	<b>Time between first and last case (days)</b>	<b>Number of recurrent infections</b>	<b>Number of cases without identified CHSDH input</b>
1	14	2	2	136	2	1
2	7	1	2	148	0	0
3	6	0	3	222	0	0
4	7	0	2	388	0	0
5	5	5	2	179	0	2
6	3	0	0	75	1	0
7	4	0	0	219	0	0
8	2	0	1	3	0	0
9	9	1	1	507	0	0
10	39	95	15	487	0	1
<b>Total</b>	<b>96</b>	<b>104</b>	<b>28</b>		<b>3</b>	<b>4</b>

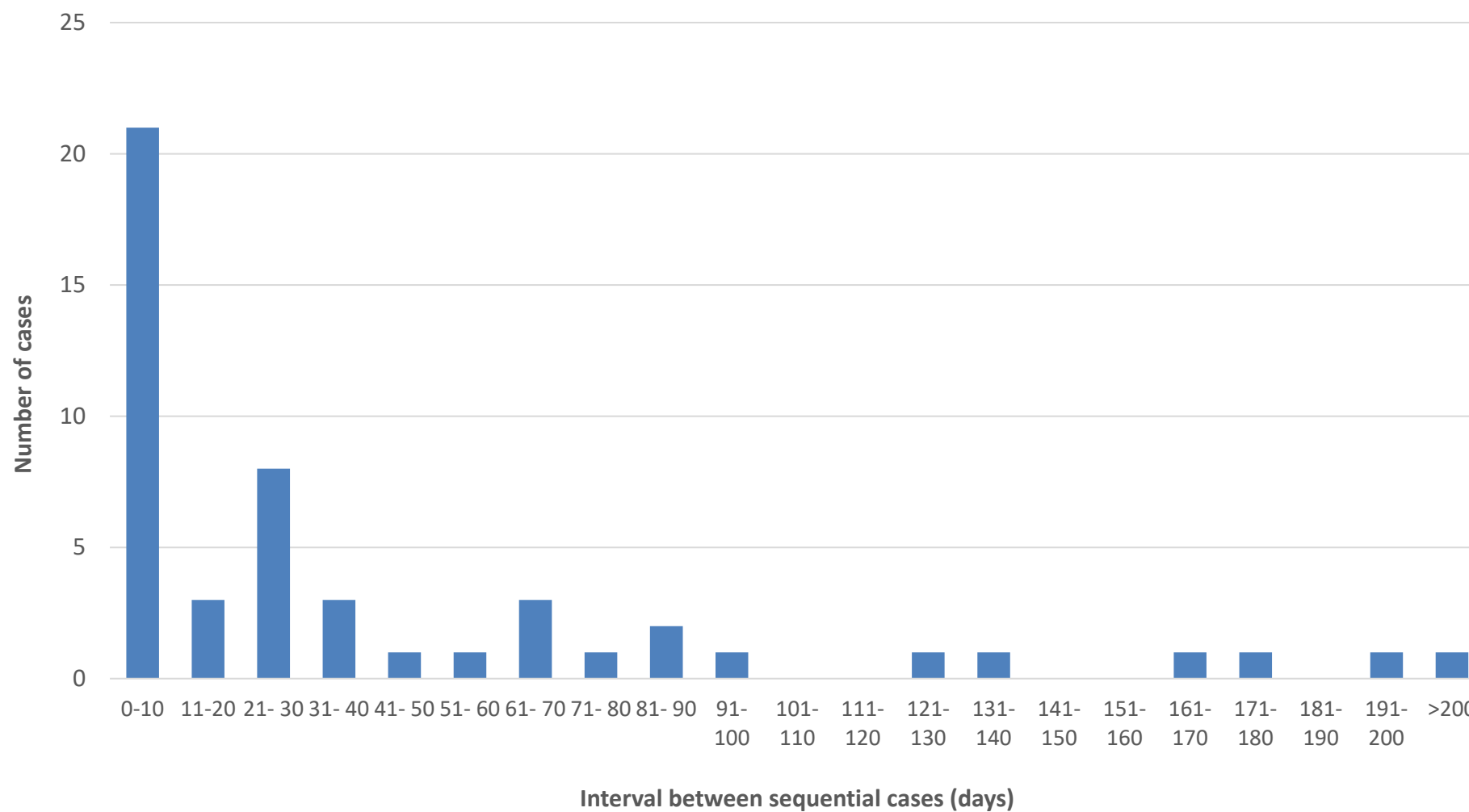
\* including infection and carriage

**Figure 2. Timeline showing dates of diagnosis of each iGAS case in relation to the date the CHDSH-associated outbreak was declared, England 2018 to 2019**



The vertical black line indicates the date that the outbreak was declared. Blue diamonds represent cases. Red outline diamonds represent cases who died. Data not available for outbreak 10 (39 cases, 15 deaths).

**Figure 3. Interval between sequential iGAS cases in CHDSH-associated outbreaks, England 2018 to 2019.**



Data not available for outbreak 10.

## 3.2 Recognition of outbreaks

There were delays in recognition and declaration of outbreaks.

Nine outbreaks were identified by local health protection teams through statutory notification of individual iGAS cases. In the 8 outbreaks for which data are available, a median of 4.5 iGAS cases (range 2 to 11) and 38.5 days (range 3 to 506) occurred before the outbreak was declared.<sup>1</sup> Some of these cases were only identified after investigating teams looked back through notified iGAS cases and re-investigated a CHSDH link.

One outbreak was not recognised by the local health protection team but was identified by the reference laboratory amongst controls used for Whole Genome Sequencing (WGS) of isolates to assist in the investigation of another outbreak. This uncovered an outbreak involving 7 cases and 2 deaths, over a period of 388 days. The last case was notified 74 days before the outbreak was identified and no further cases were identified in the subsequent 60 days. This outbreak was caused by an *emm89* type *S. pyogenes* the second commonest type causing iGAS in the UK during that period.

Reasons for delay in identification of these outbreaks include the following elements, singularly or in combination:

### 1. Delays in establishing *emm* type

90 of 96 isolates were sent for *emm* typing. The remaining 6 were not available to be sent. There were some delays in sending isolates from referring laboratories to the reference laboratory for typing, with a median 7 days (range 3 to 21) between the date the sample was taken and receipt of an isolate at the reference laboratory. 71% of isolates were typed within the expected 6-day turnaround time (TAT) at the reference laboratory (median TAT 5 days, range 2 to 10 days) (17) and 99% of reports were issued to the local HPT as well as the referring hospital. In total, there was a median 12 days (range 5 to 24) between the date that the sample was taken and the *emm* type reported. This is a considerable period and may have resulted in delays to identification of outbreaks.

### 2. Common *emm* types

Six of 10 outbreaks were caused by the 2 commonest iGAS *emm* types 1 and 89. In outbreaks where individual cases were not initially linked to CHSDH exposure, it may have been difficult to identify that an outbreak was occurring amongst sporadic cases of common *emm* types.

### 3. No standardised recording of *emm* types

Recognition of multiple cases of the same *emm* type was fallible because *emm* types were not consistently recorded and reviewed by HPTs and HPZone does not link cases of the same *emm* type automatically. There is no national system in place for regular review of *emm* types.

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<sup>1</sup> Investigating teams were asked for the specific date that they declared the outbreak.

#### 4. Long intervals between cases

19% (18) cases occurred more than 30 days after the previous identified case. These long intervals between some cases meant that the need to investigate a possible epidemiological link was missed.

#### 5. No routine enquiry of community healthcare exposures

Some health protection teams did not routinely enquire about CHSDH care in the follow-up of community iGAS cases and so the epidemiological link between cases was missed. Extant national GAS guidance requires investigation of links to acute and maternity care but not to community care. This guidance predates recognition of CHSDH iGAS outbreaks. (7, 18)

#### 6. Overlap with residential care

19 of 48 patients lived in residential care or sheltered accommodation. Residential care was often the initial focus of investigation and CHSDH services were only investigated once this was excluded.

## 3.3 Outbreak investigation

### 3.3.1 Obtaining information

During initial outbreak investigation, all teams attempted to obtain information from the CHSDH teams involved. Eight investigating teams reported finding this a difficult process.

Specifically, investigating teams reported difficulties in (number of teams given in brackets):

1. Initiating meaningful contact with CHSDH teams and getting them to engage with the investigation (n=2).
2. Establishing the number, type and routines of CHSDH HCWs (8).
3. Establishing which HCWs had seen a case in the 7 days before illness (8).
4. Establishing whether students or other staff members had accompanied HCWs during visits (8).

Obtaining this information was time consuming and hindered the investigating team's ability to identify HCWs who may have cared for more than one iGAS case. It also contributed to delays in taking swabs and providing prophylaxis to HCW in at least 3 outbreaks.

Most investigating teams thought that delays were due to poor record keeping and time pressures on already overstretched CHSDH (4). In 2 outbreaks, investigating teams commented that CHSDH services did not appropriately prioritise provision of information. In 2 outbreaks, it was felt that CHSDH services were purposefully obstructing or delaying the investigation to protect the reputation of their service.

“I was unprepared for the barriers. We were just trying to make sure nobody else died and I was unprepared for the organisational barriers. I just couldn’t quite believe that progress took longer because of these. We did find ways around it but it took time.”

OCT chair

### 3.3.2 Use of whole genome sequencing (WGS)

WGS was considered in 8 of 10 outbreaks. It was requested in 7 outbreaks and performed in 6. As previously stated, one outbreak was identified by WGS alone. WGS was useful in outbreak investigation for the following reasons (number of outbreaks given in brackets):

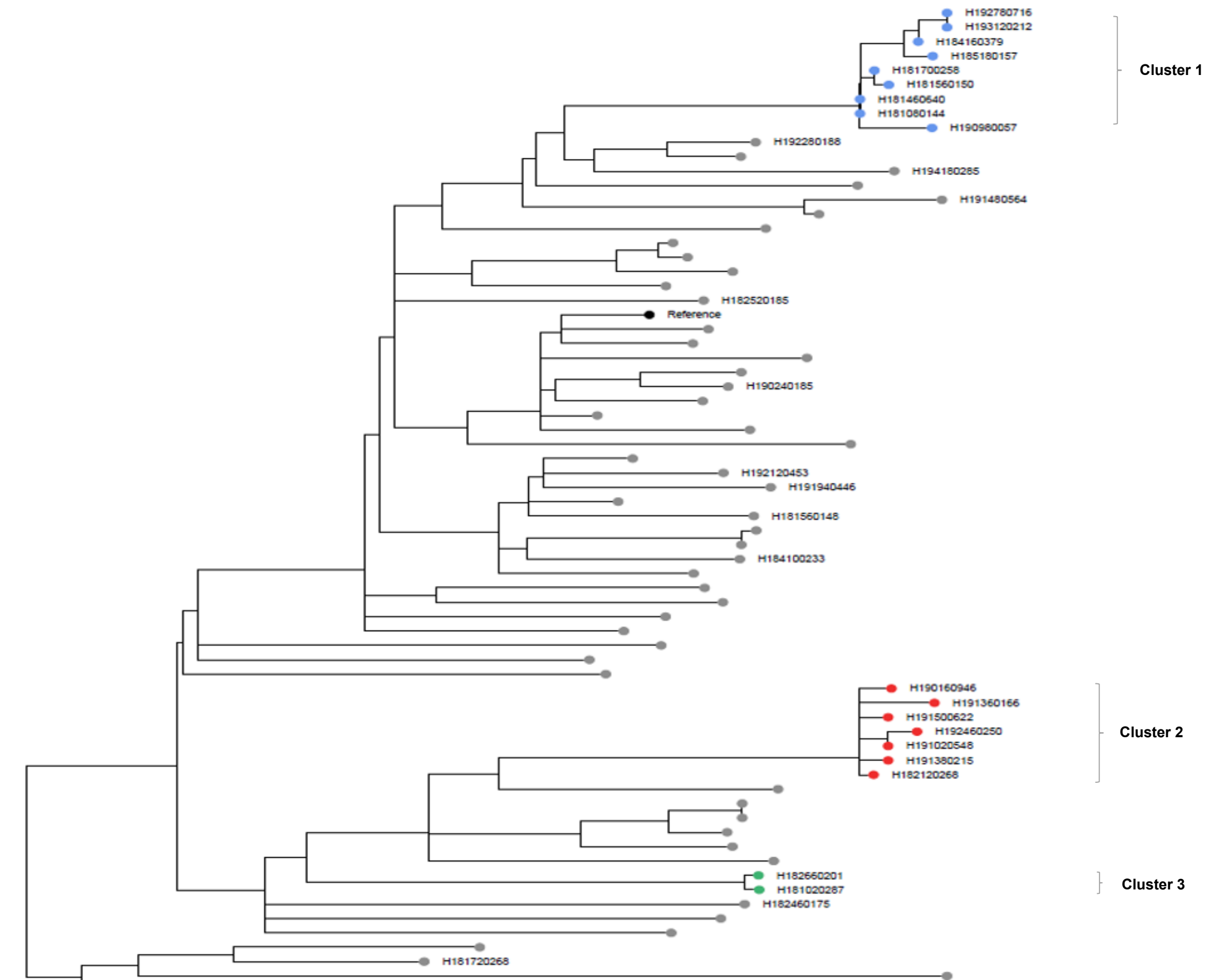
1. WGS provided confirmation that epidemiologically linked cases formed a genomic cluster (n=7).
2. WGS identified that at least one case of the same *emm* type with epidemiological links to the outbreak did not cluster with other cases, allowing the case or cases to be excluded from further investigation (3).
3. WGS confirmed that 2 sequential cases, cared for by the same CHSDH team, with long intervals between them (more than 5 months) clustered genomically and were likely part of the same outbreak (2).
4. WGS identified an undetected outbreak amongst the sequencing controls used to investigate another outbreak (1; see Figure 4).

Figure 4 provides an illustration of a phylogenetic tree derived from WGS analysis and its use in identifying community iGAS outbreaks. The tree provides an assessment of the genetic diversity of GAS strains assessed, with 3 community iGAS clusters evident:

1. Cluster 1: 8 of 9 isolates fall within a 5 SNP single-linkage threshold.
2. Cluster 2: 7 clustered isolates identified amongst background cases during WGS investigation of cluster 1. Investigation by HPT revealed 6 of 7 cases had been cared for by a different CHSDH service to cluster 1.
3. Cluster 3: 2 clustered cases identified amongst background cases during WGS investigation of cluster 1. No known CHSDH link.

Cluster 1 was suspected to be associated with CHSDH services. Clusters 2 and 3 were identified amongst background cases of the same *emm* type from the same region.

**Figure 4. Maximum likelihood tree showing 3 community iGAS clusters**



### 3.3.3 Screening healthcare workers

All 10 outbreaks screened CHSDH HCW. The aim of this was to identify HCW who may have acted as a common source and therefore pose an ongoing risk to patients through transmission of GAS. Investigating teams found this a time consuming and resource intense process, which did not progress the investigation. CHSDH screening data are not available for outbreak 10. In the remaining 9 outbreaks, a total of 366 HCWs were screened by bacterial throat swab (median 22, 3 to 160 per outbreak). Seven outbreaks had at least 2 rounds of screening. The first screen was generally confined to nurses known to be in direct contact with cases; variable criteria for targeting HCWs for screening were used in each outbreak. Second and third screens were performed when further HCW contacts were identified or when further iGAS cases occurred. In 7 outbreaks, HCW were asked for screening swabs of any wounds or skin breaks. In 3 outbreaks, enhanced screening of any piercings, the perineum or vagina took place in a small number of HCW with negative throat swabs but strong epidemiological links to cases. Two investigating teams reported that HCW were resistant to screening being performed.

Most studies report the rate of GAS throat carriage in healthy adults to be 1% or less (19, 20, 21, 22, 23). Of 411 HCW identified for screening, 366 were screened, 344 swabs reached the laboratory and only one HCW (0.36%) had GAS cultured by throat swab. This single positive isolate was not typed and so it is unclear whether it was linked to the associated outbreak. Typing was not performed due to Occupational Health refusal to disclose the name of the HCW, preventing the HPT being able to request typing through the microbiology laboratory. Extant national guidelines recommend that typing be performed on all positive screening swabs, but that a positive screening swab should be considered indicative of the likely source of transmission until typing is available (7).

Despite only identifying one HCW carrier, network analyses identified individual HCWs as the only link between cases once other factors (including domiciliary care) had been investigated and excluded. Furthermore, 5 investigating teams were told of HCW experiencing symptoms compatible with GAS infection (median 2, range 1 to 12) in the run up to or during the outbreak.

Possible explanations for HCWs identified as the only link between cases but with negative screening swabs:

#### 1. Colonised HCW may not have been screened

- a. **Failure to identify HCWs for screening** Network analysis may have failed to identify all CHSDH HCW in contact with a case. Specifically, it was difficult to establish whether student HCWs had been present at home visits.
- b. **Failure to screen identified HCWs** Of 411 HCW identified for screening, 366 were screened. Teams noted that HCW who were not screened were predominantly staff on annual, sick or maternity leave when the screening took place, together with bank staff who no longer worked with the team.



## 2. Screening swabs may have failed to identify HCW carriage

- a. **Delays to swabbing HCW** There were delays of up to 6 weeks between the OCT deciding that HCW should be screened and swabs being taken. Delays were predominantly due to agreeing who should be swabbed, who should take the swabs, and where and when the swabs should be taken. As GAS infection or carriage may be transient the period of infection or carriage may have been missed.
- b. **Poor swabbing technique** Although bacterial culture from throat swab has a sensitivity of 90% to 95%, this is influenced by swabbing technique. In 2 outbreaks, HCWs either self-swabbed or swabbed each other due to a lack of occupational health support. This may have affected technique.
- c. **GAS carriage at sites other than throat** HCW may carry GAS in wounds, areas of skin breakdown or in the perineum or vagina without carrying it in their throats. Enhanced screening was not performed in all outbreaks. Additionally, HCW may have not disclosed personal areas of skin breakdown, particularly in the absence of occupational health support or privacy in the setting where screening took place.
- d. **Lost samples** In one outbreak, 22 swabs were lost in transit between the community and microbiology laboratory.
- e. **Intermittent detectability and low bacterial density** There is the potential for different amounts of bacterial carriage to be present over time, and hence for both infectivity and detectability to change over time.

## 3. HCW may not have been carriers

- a. **Contaminated HCW** HCW may have become contaminated with GAS by contact with a case or colonised patient and then, in the absence of effective infection control practices, transmitted the bacteria onwards without developing infection or becoming carriers.
- b. **Contaminated medical equipment or kit** medical equipment or HCW kit may have become contaminated in a similar way and acted as a vehicle for transmission.

### Box 1. Barriers to investigation

Teams identified the following as key barriers to investigating CHSDH iGAS outbreaks:

1. Difficulty getting information from CHSDH services (n=8).
2. Lack of occupational health support (6).
3. Logistical difficulties in swabbing or treating CHSDH HCW (5).
4. Communication difficulties between organisations (2).
5. Provider agenda (2).
6. Insufficient staff to investigate outbreak (2).
7. Lack of local *emm* surveillance (2).

### 3.3.4 Patient screening

Three outbreaks systematically screened patient wounds for GAS carriage. Patient screening data were not available for outbreak 10. In the 2 outbreaks for which data were available, 107 patients were screened with no positives identified.

Seven outbreaks did not perform patient wound screening. The principal reason given was that there were a large number of patients on CHSDH wound care pathways and swabbing all wounds would be logistically challenging.

In 4 outbreaks, CHSDH HCW were actively encouraged to send wounds swabs from any wound that was suspected to be infected. It is unclear how many swabs were sent for this indication. Six swabs were positive (from 2 outbreaks) but these were not *emm* typed so cannot be directly linked to the outbreaks. One investigating team noted that results from swabs taken by CHSDH HCW were returned to the patient's GP and were not communicated to HCW or HPT. The failure to definitively establish whether these infections were linked to the outbreak makes this data difficult to interpret, resulting in uncertainty regarding ongoing risk and the effectiveness of control measures. It also dilutes the evidence linking exposure to subsequent infection.

### 3.3.5 Environmental screening

Environmental screening was undertaken in 2 outbreaks. Samples were taken from communal areas at the CHSDH team base including equipment storerooms as well as a number of mobile items that were taken in and out of patients' homes including iPads, bags, Doppler machines and blood pressure cuffs. The total number of environmental swabs taken is unknown.

There was a single positive swab taken from the handle of a bag. It is unclear whether this represents a route of transmission or a fomite contaminated by a patient, HCW or the environment. However, following this the CHSDH team involved did change HCW bags to a standardised hard bag which could be more easily decontaminated.

## 3.4 Outbreak management

### 3.4.1 Infection control interventions

Investigating teams advised about infection control interventions but these were implemented by community infection control teams. As a result, investigating teams did not have complete information on which measures had been instigated in each outbreak.

Four investigating teams visited CHSDH community bases to review infection control procedures. Two of these teams went on house visits with HCWs to review infection control procedures in one or more patient homes.

Interventions recommended by investigating teams included (number of outbreaks given in brackets):

1. Reviewing infection control procedures (n=10).
2. Infection control training for HCWs (6).
3. Changes in equipment (3) - replacement of fabric bags with hard bags which were easier to clean (3), introduction of plastic crates to store equipment in car boots (1).
4. Change in personal protective equipment (1) - introduction of long aprons for wound care.
5. Changes to decontamination practices (2), including introduction of new standard operating procedures to disinfect difficult to clean equipment.
6. Enhanced cleaning of CHSDH bases (2) - a further 3 teams did not formally recommend this but were aware that CHSDH bases had been cleaned and re-organised prior to their visit.
7. Enhanced cleaning of HCW cars (1).
8. Cohorting of nurses (1) - nurses were restricted to caring for a defined set of patients and were barred from bank work in other services.

### 3.4.2 Use of antibiotics in HCW

Seven outbreaks gave antibiotics to HCW with the aim of interrupting transmission through decolonising staff with potential occult carriage.

In 6 outbreaks, targeted penicillin V prophylaxis was given to symptomatic HCWs or HCW who had been in direct contact with a case (median 2, range 1 to 3). This occurred early on in outbreak investigations, often before complete information was available about which HCW had seen which patient.

When further cases occurred, 5 outbreaks administered mass prophylaxis to CHSDH HCWs. Data are not available for outbreak 10. In the 4 outbreaks for which data were available, a total of 139 HCWs received prophylaxis (median 26 per outbreak, range 22 to 65). There were no further cases in 3 of 4 outbreaks once mass prophylaxis was administered to CHSDH HCW.

Three outbreaks commented that HCW were resistant to taking antimicrobial prophylaxis. Two main reasons were identified. Firstly, HCW did not appreciate the need to take antibiotics if their screening swab was negative. Secondly, HCW were concerned about developing antimicrobial resistant bacteria from the 10-day prophylactic course of penicillin V. Investigating teams found these concerns difficult to address and commented that it would be useful to have further guidance together with educational leaflets on this topic.

### 3.4.3 Treatment of patients

One outbreak gave targeted decolonising treatment to patients who had GAS identified on systematic screening of wounds. Data regarding the total number treated together with follow up swabs is not available for this outbreak.

## 3.5 Source and transmission of outbreaks

Investigating teams could not definitively establish the source and mode of transmission. Specifically, a single HCW in contact with all iGAS cases was not identified in any outbreak.

The common hypothesis was that an infected or colonised patient or HCW was the source. They then transmitted GAS to other patients through HCW(s) who became infected or colonised and who in turn transmitted the bacteria on. The role of fomites in transmission is unclear. All of this must have occurred in the context of ineffective infection control processes for onward transmission to occur.

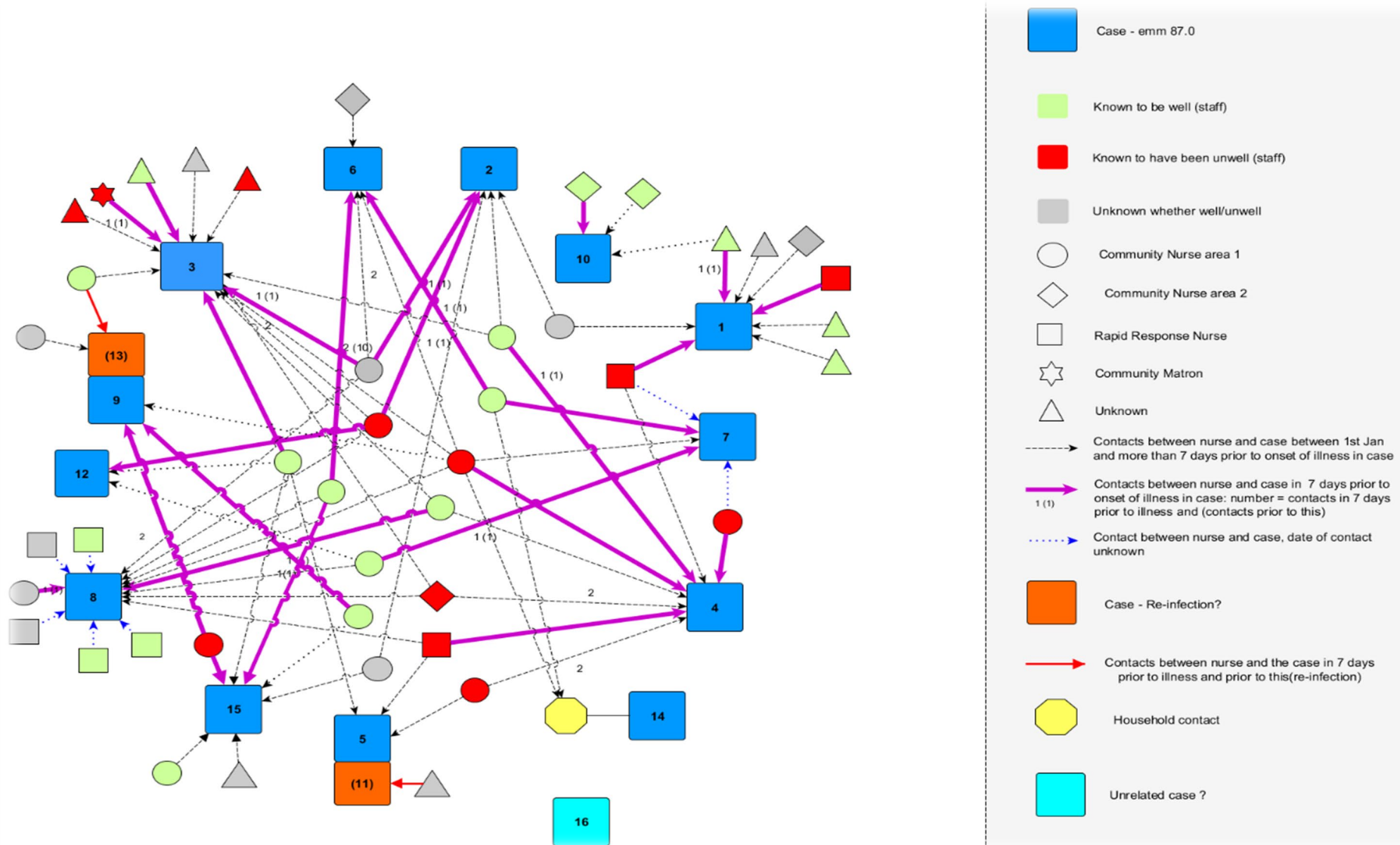
One outbreak identified a likely index case. The patient was admitted to hospital with community onset iGAS. He had no prior CHSDH input. Following discharge, he received wound care from multiple HCW in a CHSDH team. Subsequent iGAS cases occurred in predominantly housebound elderly people cared for by the same CHSDH team. HCW were screened but all swabs were negative. No further common link was found between cases.

In another outbreak, one asymptomatic HCW screened positive on throat swab for GAS. The HCW had been in contact with some but not all cases of iGAS so was unlikely to be the only mode of transmission.

In a third outbreak, environmental screening identified a bag which screened positive for GAS of the same *emm* type as the outbreak. This may have been colonised through contact with an infected patient, HCW or environment but it is unclear whether fomites represent the dominant mode of transmission within this outbreak given its extended duration and continuation after stringent precautions were introduced.

Figure 5 provides a sample network analysis diagram constructed during an CHSDH outbreak investigation, outlining which nurses had contact with cases during their exposure period.

**Figure 5. Sample network diagram of contacts between nurses and cases in a CHSDH associated iGAS outbreak**



## 3.6 Time to termination of outbreaks

In 4 outbreaks, the last recognised case occurred before the outbreak was declared. These outbreaks likely self-terminated due to improved infection control initiated by CHSDH teams themselves, before the HPTs became involved. Two of these outbreaks occurred in a region in which there was a large ongoing CHSDH associated outbreak. One OCT chair outbreak commented that previous experience in dealing with a CHSDH associated iGAS outbreak facilitated rapid termination of that outbreak. The second outbreak, which lasted 388 days, was recognised 74 days after the last case occurred.

The investigating team thought this outbreak terminated because CHSDH teams had paid more attention to infection control policies following recent CHSDH iGAS outbreaks in neighbouring areas.

In the remaining 6 outbreaks, there was a median 130 days (31-181 days) between outbreak declaration and the last identified case. Once established, outbreaks took a long time to control.

## 3.7 Occupational health provision

Eight outbreaks requested occupational health support to swab HCW, provide antibiotics and in some cases to provide psychological support to HCW.

Although all 8 of these CHSDH services had occupational health provision in place, 6 investigating teams reported that their services were inadequate. The following barriers were reported:

### 1. Screening swabs

Four OH services were unable to perform screening swabs, resulting in delays to swabs being taken. In 2 outbreaks, this resulted in nurses self-swabbing, or swabbing each other. This may have resulted in false negatives, either through poor swab technique or failure to declare skin lesions which should have been swabbed. In 2 outbreaks, infection control teams took on this duty.

### 2. Prescribing antibiotics

Five OH services were unable to prescribe antibiotics. This resulted in delays whilst OH services or other services (GP, infection control team and so on) were commissioned to do this.

### 3. Logistical difficulties

In one outbreak, nurses had to have individual OH appointments at a site distant to their place of work. It took almost a month to complete all appointments.

## 3.8 Involvement of national team

The national team were involved in the management of 7 outbreaks. This included advising on investigation, control measures and use of WGS in the outbreak.

### Box 2. Learning points

Teams highlighted the following as their main learning points from these outbreaks (number of teams making recommendation given in brackets):

1. WGS was very useful and allowed cases to be definitively included or excluded from the outbreak (n=4).
2. All community iGAS cases should be investigated for links with CHSDH (4).
3. Early discussion with the national team was useful to guide investigation and management (3).
4. *Emm* type should be monitored to identify clusters at local or national level (2).
5. CHSDH iGAS outbreaks are time consuming to investigate. It is vital to have enough HPT staff to ensure adequate investigation (2).
6. Screening CHSDH HCWs is time consuming and does not help investigation. Mass prophylaxis without screening may be advisable (2).
7. An early site visit improves the communication and relationship with the HPT (1).
8. Early handover of the IMT chair to the NHS trust facilitates investigation and infection control interventions (1).



## 4. Recommendations

### 4.1 PHE

1. We recommend that all community iGAS cases, including those occurring in nursing or residential homes, should be investigated for links to CHSDH.
2. We recommend that WGS should be performed on all iGAS isolates referred to the reference laboratory.
3. We recommend that HPTs systematically record and regularly review the *emm* types of all iGAS cases in their locality to allow early detection of potential outbreaks.
4. We recommend that PHE Colindale strengthen their regular review of *emm* types by region to provide support to HPTs in early identification of iGAS clusters by time and place.
5. We suggest that HPTs should involve the national team early in investigation of suspected CHSDH iGAS outbreaks to gain expert advice.
6. We suggest that the OCT consider a site visit to the CHSDH base, both to identify breaches in infection control and to build a relationship with the CHSDH team.
7. We recommend that screening for carriage should not be relied upon to exclude CHSDH HCW with strong epidemiological links to cases from further investigation or prophylaxis. The sensitivity of screening is poor.
8. We recommend that screening for carriage should not delay implementation of other interventions, including prophylactic antibiotics.
9. We recommend that all screening swabs which culture GAS should be sent for typing, and whole genome sequencing if they are of the same *emm* type as the related outbreak. A positive screening swab is highly suggestive of transmission.
10. We recommend that a member of the OCT should visit the CHSDH site in person if antimicrobial prophylaxis is considered. They should explain the rationale for this, together with the limited risk of isolates developing antimicrobial resistance and HCW should be given written information regarding this. This is to promote compliance.



## 4.2 Commissioners

11. Commissioners should ensure providers are aware of their obligations to co-operate fully and quickly with outbreak investigations.
12. Commissioners should ensure that CHSDH services have occupational health services in place that are able to provide rapid support outbreak investigations by performing screening and prescribing antimicrobials.

## 4.3 Providers

13. We recommend that providers have robust infection control policies in place including policies for decontamination of all items that are taken into a patient's home.
14. We recommend that providers keep accurate records documenting all HCW-patient interactions, including the presence of students during visits. These records should be easily accessible and facilitate mass extraction of data to aid outbreak investigation.
15. We recommend that providers promptly supply information regarding HCW-patient interactions when requested as part of an outbreak investigation.
16. We recommend that providers have occupational health services in place that are able to fully support outbreak investigations through screening, prescribing and provision of information, advice and psychological support.

## 5. Further Work

Our understanding of GAS transmission in CHSDH settings is limited. Further work is needed to understand transmission of GAS in the home environment and how to limit its spread, particularly given the nature of procedures undertaken which will expose wounds, providing a potential portal of entry for bacteria. Use of surgical masks during wound care may provide benefit in reducing risk of transmission.

Screening HCW with bacterial swab and culture failed to identify carriers or where transmission occurred. Further molecular tools for detecting carriage should be evaluated in the context of health care associated outbreaks. These may offer greater sensitivity to detect carriage and faster results, facilitating early implementation of control measures.

WGS was instrumental in identifying and characterising these outbreaks. Further analysis should be undertaken to establish whether routine WGS of all iGAS samples would be cost-effective and allow for early detection of outbreaks.

## 6. Conclusion

In the last 5 years, CHSDH associated iGAS outbreak have become a regular occurrence affecting all PHE regions. Some of these outbreaks have been small, quickly identified and rapidly controlled by attention to infection control procedures, initiated by the CHSDH services themselves. However, others have been very large, lasting over a year, with high case fatality rates. They have been difficult to control despite changes in infection control practices, kit and mass prophylaxis of HCW.

No outbreaks could be traced to a single positive HCW; the only commonality through these outbreaks has been the CHSDH provider. Despite extensive investigation, including WGS and HCW, patient and environmental swabbing, it has not been possible to establish routes of transmission. Network analyses and review of the positive findings in these outbreak investigations as a whole suggest transmission occurs as a combination of carriage, which may be missed by screening, and transient contamination of HCWs, kit or other fomites.

The same barriers were identified by many investigating teams, specifically difficulty in getting information from CHSDH services, lack of occupational health support, logistical difficulties in swabbing and prophylaxing HCW and difficulty in communicating between organisations.

Controlling these outbreaks would be aided by early recognition through careful enquiry of links between iGAS cases and CHSDH services, together with *emm* type monitoring and appropriate use of WGS. Improved communication between HPTs and CHSDH services, together with prompt occupational health support, would help aid their rapid resolution.

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