



Public Health
England

Protecting and improving the nation's health

Algorithms for the local response to cases of STEC infection v2.0

Updated 29.07.2021

Algorithms for the local response to cases of STEC infection

Since 2013, many local NHS laboratories have introduced real-time Polymerase Chain Reaction (RT-PCR) testing kits as a gastrointestinal (GI) screening panel for faecal samples where infectious disease is suspected. These PCR GI panels include primers that detect Shiga toxin (*stx*) genes (*stx1* and/or *stx2*) that are possessed by all STEC. The introduction of *stx* PCR tests by a diagnostic laboratory is likely to lead to an increase in the number of STEC infections detected (O157 and non-O157) and consequently an increased number of notifications to local Health Protection Teams (HPTs).

Local *stx* PCR positive but culture negative samples should be sent to the Gastrointestinal Bacteria Reference Unit (GBRU) for further investigation and various non-O157 STEC serogroups may be identified. Referral of local culture negative samples is especially important for children aged 5 years and under, and those with bloody diarrhoea and Haemolytic Uraemic Syndrome (HUS).

The ultimate aim of the public health response is to prevent disease and transmission associated with STEC infections. This is relatively rapid and straightforward for STEC O157 infections because, following an *stx* PCR positive result, local laboratories can proceed to test for and isolate O157 strains: reports of presumptive *E. coli* O157 infections are usually available within 3 days of specimen collection, enabling the public health response to be commenced quickly.

In contrast, *E. coli* O157 is not grown from the vast majority of *stx* PCR positive specimens and since local laboratories cannot routinely isolate non-O157 STEC, there is a delay in confirmation with full laboratory results. For the majority of non-O157 STEC, serotype and *stx* subtypes are reported by GBRU about 2-3 weeks after the HPT is first informed of the case. The exception is STEC O26:H11; a PCR assay confirming a culture positive STEC O26:H11 result has been implemented at GBRU. This confirmed result is available 1-2 days after the PCR *stx1/stx2* profile result on the faecal specimen has been reported.

The public health response aims to prioritise those cases most likely to be infected with viable non-O157 STEC that have the potential to cause severe clinical outcomes, especially those that lead to hospitalisation.

In the interim, local PCR and culture results, followed by GBRU in-house PCR results may be available. The following algorithms have therefore been divided into 3 stages based on this process to provide HPTs with guidance on how to respond to cases when each new piece of information becomes available.

The aim is to provide a proportionate public health response that protects the public's health whilst taking into consideration the workload implications for HPTs/local authorities, without imposing unnecessary restrictions on individuals.

The three algorithms are based on laboratory results as they become available as follows:

- Stage 1 - Diagnostic laboratory results (PCR and culture) and clinical history (HUS/bloody diarrhoea)
- Stage 2 – GBRU in-house PCR results (*stx* and *E. coli* attachment and effacing (*eae*) gene)
- Stage 3 – GBRU serogroup/serotype including *stx* subtypes

The algorithms should be used for the investigation of single cases and is colour coded for public health management as follows:

- Red – full / majority of public health actions recommended
- Amber – limited public health actions recommended
- Green – warn and inform public health actions only, or no public health actions
- Blue – questions for decision making process
- White – information only

The algorithms cover HUS and all STEC infections (O157 and non-O157). The STEC O157 public health management is described in the first part of this guidance and you will find references to HUS and O157 results in the algorithm sections that follow. This is to give a complete picture of results that come back to HPTs, but will direct you to the STEC O157 public health management where appropriate.

The algorithms should be used in conjunction with the following sections of this guidance as appropriate:

- **Section 2 - Public health management of STEC O157 (pages 33-38)**
- **Section 3 – The principles of the public health management of *stx* PCR positive results and non-O157 STEC (pages 41-44)**

Stage 1

Note 1

STEC ALGORITHM

Local culture *E. coli* O157 positive
OR
Clinical history of HUS
OR
Symptomatic contact with epi link to another case with HUS or HUSEC strain including *E. coli* O157/ O26

Note 2

stx PCR positive, local culture *E. coli* O157 negative

Note 3

Symptomatic contact with epi link to another case with potential HUSEC strain

Note 4

Symptomatic contact with epi link to another case with lower risk strain

Note 5

Case has HUS or there is epi link to a case associated with other HUSEC strain/ STEC O26?

Note 6

Note 7

Yes

No

Case has bloody diarrhoea or hospitalised?

Note 9

Yes

No

Case reports bloody diarrhoea or hospitalisation?

Note 10

Yes

No

Are there Symptomatic Contacts?

No

Yes

PH actions:

- If HUS and *stx* PCR positive define as CONFIRMED otherwise define as PROBABLE case
- Follow STEC O157 management (Section 2 of guidance)

PH actions:

- Define as PROBABLE case
- Complete STEC questionnaire
- Give hygiene advice and warn further tests being done
- Exclude all cases until 48 hours symptom free
- For cases in risk group B start clearance, exclude until GBRU results or clearance achieved, whichever is sooner
- For cases in risk groups A,C,D – carry out risk assessment
- Identify contacts

Define as PROBABLE case

Wait for GBRU in-house PCR result usually available about 8 days after initial frontline laboratory report to HPT or 11 days after original sample collected

4

Go to Stage 2

- ## PH actions:
- Arrange diagnostic sample
 - Give hygiene advice
 - Exclude contact until 48 hours symptom free

Case is 5 yrs and under?

No

Yes

Define as POSSIBLE case
Send PCR letter and leaflet to case with copy to GP

- Define as POSSIBLE case
- Contact guardian by phone
- Give hygiene advice
- Exclude case until 48 hours symptom free
- Ask about potential transmission

Case makes contact with HPT after receiving letter

Case reports bloody diarrhoea or hospitalisation?

Note 10

Yes

No

Are there Symptomatic Contacts?

No

Yes

PH actions:

- If HUS and *stx* PCR positive define as CONFIRMED otherwise define as PROBABLE case
- Follow STEC O157 management (Section 2 of guidance)

PH actions:

- Define as PROBABLE case
- Complete STEC questionnaire
- Give hygiene advice and warn further tests being done
- Exclude all cases until 48 hours symptom free
- For cases in risk group B start clearance, exclude until GBRU results or clearance achieved, whichever is sooner
- For cases in risk groups A,C,D – carry out risk assessment
- Identify contacts

Define as PROBABLE case

Wait for GBRU in-house PCR result usually available about 8 days after initial frontline laboratory report to HPT or 11 days after original sample collected

4

Go to Stage 2

- ## PH actions:
- Arrange diagnostic sample
 - Give hygiene advice
 - Exclude contact until 48 hours symptom free

Case is 5 yrs and under?

No

Yes

Define as POSSIBLE case
Send PCR letter and leaflet to case with copy to GP

- Define as POSSIBLE case
- Contact guardian by phone
- Give hygiene advice
- Exclude case until 48 hours symptom free
- Ask about potential transmission

Case makes contact with HPT after receiving letter

Case reports bloody diarrhoea or hospitalisation?

Note 10

Yes

No

Are there Symptomatic Contacts?

No

Yes

Stage 1

Note 1

There are several ways potential STEC infections are reported to the HPT:

- Local culture *E. coli* O157 positive
- Notification of HUS
- Symptomatic contact with an epidemiological link to another case with HUS, or culture confirmed O157 STEC, or culture confirmed non-O157 STEC belonging to HUSEC strain (*stx2a/2c/2d* and *eae/aggR*) or STEC O26
- Local *stx* PCR positive, but local culture negative for *E. coli* O157
- Symptomatic contact with an epidemiological link to another case with culture confirmed potential HUSEC strain (*stx2* and *eae*) or STEC O26
- Symptomatic contact with an epidemiological link to another case infected with culture confirmed lower risk STEC strain (non *stx2a/2c/2d*)

For notifications of infective bloody diarrhoea, **unless** there is a known epidemiological link to a case with HUSEC/potential HUSEC strain/ STEC O26 infection, public health action can usually wait until the local diagnostic laboratory culture results are known. If local laboratories are using PCR, initiation of public health action should follow locally agreed arrangements.

Note 2

Local culture *E. coli* O157 positive OR history of HUS

- Define case as PROBABLE
- Full public health actions as per O157 management for case and contacts are recommended

Rationale

Most cases of diarrhoea associated HUS are caused by STEC belonging to HUSEC strains.

Symptomatic contact with an epidemiological link to another case with HUS, OR culture confirmed STEC of HUSEC strain, including O157 (*stx2a/2c/2d* and *eae/aggR*) / STEC O26

- Define case as PROBABLE
- Full public health actions as per O157 management for case and contacts are recommended

Rationale

There is evidence of potential transmission of HUSEC strain between the case and this symptomatic contact.

Note 3

Local *stx* PCR positive, local culture *E. coli* O157 negative

This is the usual result received by HPT and is the usual starting point of the response. Result may be received by phone call or SGSS import to HPZONE.

- Clinical and demographic information should be reviewed.

Rationale

Stx PCR tests are very sensitive and specific. If positive DNA containing *stx* genetic material is present. The test does not distinguish between viable and dead non-viable organisms or even free *stx*-bacteriophages in the faeces. To date the experience of HPTs regularly receiving these results is that GBRU does not confirm STEC infection in about 30% of specimens. STEC strains are isolated from 40% of specimens and 20% of specimens are *stx* positive but STEC is not recoverable.

Note 4

Symptomatic contact with an epidemiological link to another case with potential HUSEC strain (*stx2* and *eae* regardless of *stx1*)

- Follow the actions for cases with history of bloody diarrhoea ([Note 8](#)).

Rationale

The case associated with this symptomatic contact may not subsequently be confirmed by GBRU to be a HUSEC strain. The implementation of pragmatic precautions (exclusion while symptomatic and providing hygiene advice) and the completion of the STEC questionnaire (information about potential transmission and contacts) aims to balance the risk of transmission against imposing restrictions on the case that may not be necessary.

Note 5

Symptomatic contact with an epidemiological link to another case with lower risk strain (non *stx2a/2c/2d*)

Define case as PROBABLE

- Arrange diagnostic sample, give hygiene advice, provide PCR letter/leaflet if not already done and exclude until minimum of 48 hours symptom free
- Public health actions determined by diagnostic result.

Rationale

There is an epi link to another case with a lower risk strain. The likelihood of serious illness or outbreaks is low, manage like other non STEC gastrointestinal infections.

Note 6

Local *stx* PCR positive, local culture *E. coli* O157 negative with history of HUS or epidemiological link to case infected with HUSEC strain/ STEC O26

- *Stx* PCR positive and HUS, define case as CONFIRMED or
- Epidemiological link, define case as PROBABLE
- Full public health actions as per O157 management for case and contacts are recommended.

Rationale

Current case is *stx* PCR positive **and** is a contact of another case infected with a HUSEC strain. There is evidence of possible transmission.

or case of diarrhoea associated HUS (D+ HUS), most cases of D+ HUS are caused by a HUSEC strain of STEC.

Note 7

Local *stx* PCR positive, local culture *E. coli* O157 negative no history of HUS and no epidemiological link to case infected with HUSEC strain

- Review history for features of severe disease – bloody diarrhoea or admission for acute diarrhoeal illness. Depending on local arrangements this information may be on laboratory request form or provided by reporting clinician/microbiologist.
- In the absence of this information the HPT should consider contacting the clinician who arranged for the test to confirm the history.

[Note 8](#)

Local *stx* PCR positive, local culture *E. coli* O157 negative with history of bloody diarrhoea

History of bloody diarrhoea or admission with acute diarrhoeal illness has been reported on the laboratory result report or by the clinician/microbiologist:

- Define case as PROBABLE
- Complete STEC questionnaire
- Provide hygiene advice (written if possible) and warn case that further tests are being done on the sample
- Exclude all cases until 48 hours symptom free
- If case is in risk group B consider commencing clearance once 48 hrs symptom free **and** exclude until GBRU in-house PCR is known **or** clearance achieved, whichever is sooner ([Table 6](#))
- If case is in risk group A,C,D do not automatically exclude case, carry out risk assessment ([Table 6](#))
- If there are symptomatic contacts arrange single diagnostic sample, give hygiene advice and exclude them until 48 hours symptom free
- Wait for GBRU in-house PCR result, available around 11 days after sample collected **before** starting public health actions for asymptomatic contacts in risk groups A-D ([Table 7](#))

Rationale

Although the case has bloody diarrhoea, most isolates are **NOT** subsequently confirmed by GBRU to be viable STEC belonging to HUSEC strains. However bloody diarrhoea is more frequently associated with infection with HUSEC strains. The implementation of pragmatic precautions (exclusion while symptomatic and providing hygiene advice) and the completion of the STEC questionnaire (information about potential transmission and contacts) aims to balance the risk of transmission against imposing restrictions on the case that may not be necessary.

Note about confirmation of STEC

If local diagnostic laboratories **do not** routinely send *stx* PCR positive, local culture *E. coli* O157 negative samples to GBRU, HPTs are advised to agree criteria with local laboratories for sending samples to GBRU for in-house PCR and culture.

Suggested criteria:

- Cases with HUS
- Cases with bloody diarrhoea (with no other obvious cause)
- Cases hospitalised with acute diarrhoeal illness
- Cases aged 5 years and under (up to 6th birthday)
- HPT has information to suggest there is a potential outbreak

Note about hospitalisation

Hospitalisation for acute diarrhoeal illness may be an indicator of illness severity and risk of subsequent development of HUS. However, analysis of local HPT data has not shown that a history of hospitalisation is a reliable indicator of severe STEC infection. Most cases with a history of hospitalisation are admitted for other reasons and developed diarrhoeal symptoms during the admission or were screened as part of *C. difficile* control procedures. Analysis of national data to explore this is in progress.

Note 9

Local *stx* PCR positive, local culture *E. coli* O157 negative no evidence of severe illness

Where there is no evidence of severe illness:

- Define case as POSSIBLE
- If the case is aged 5 years and under it is recommended to make contact by phone with parent/guardian to confirm history and carry out a rapid risk assessment ([Appendices II](#)).
- Provide written information to case (or parent/guardian) and copy to the GP ([Appendices III and IV](#))
- No other public health actions recommended at this stage
- Wait for GBRU in-house PCR and culture results

Rationale

There is a large amount of evidence showing that young children are particularly susceptible to acquiring and transmitting STEC infections and that they are also at greater risk of developing severe forms of infection eg HUS.

Note 10

Local *stx* PCR positive, local culture *E. coli* O157 negative patient reports bloody diarrhoea

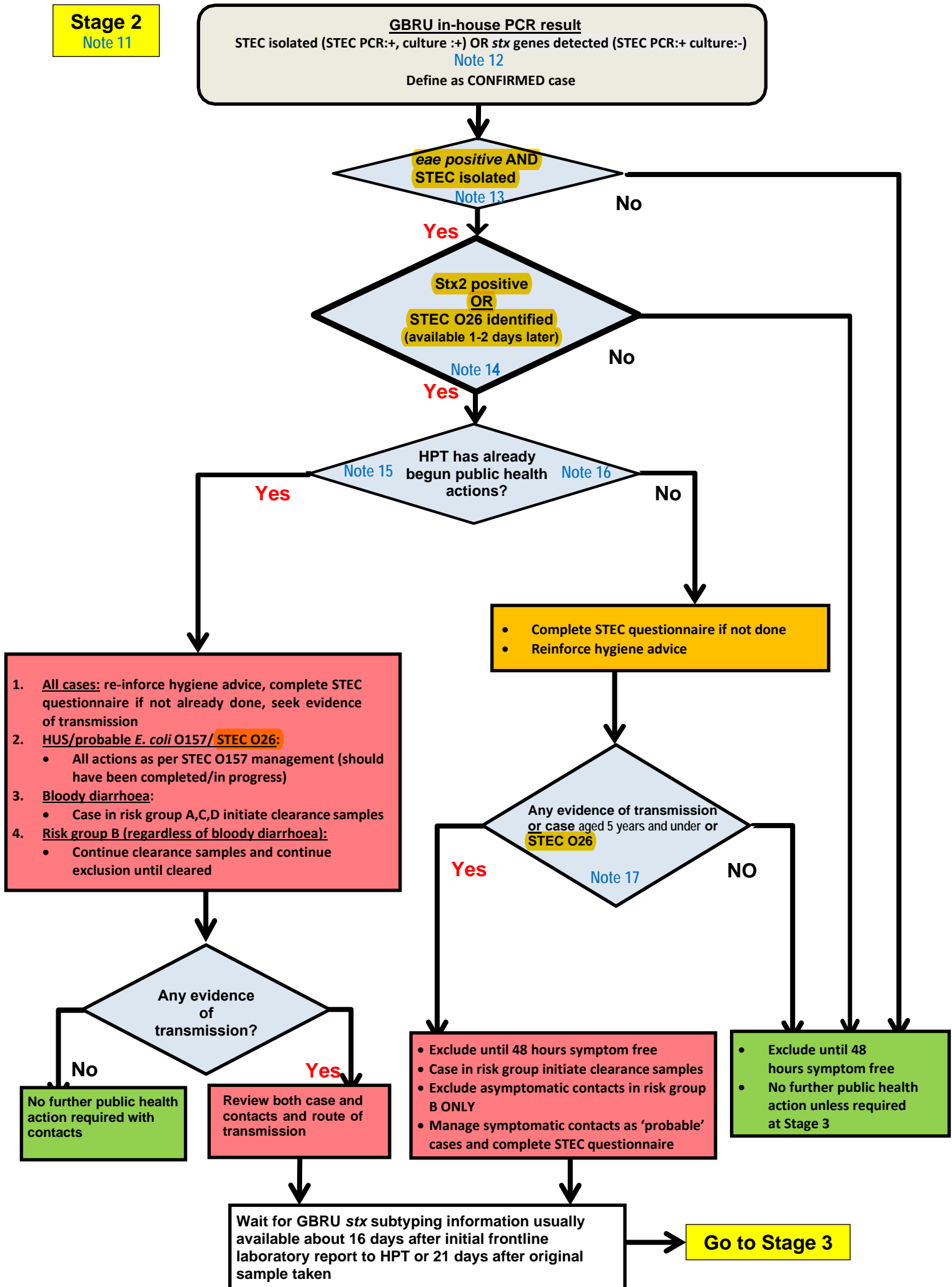
If case makes contact with HPT and reports bloody diarrhoea or admission with acute diarrhoeal illness:

- Manage as a potential HUSEC strain as per [Note 8](#) above.

If case reports that contacts have been symptomatic

- Arrange single diagnostic sample, give hygiene advice and exclude contact until 48 hours symptom free

Stage 2
Note 11



Stage 2

Note 11

Detection of *stx* and *eae* genes in a specimen does not indicate the viability of the organism. It is the combination of both *stx* and *eae* gene profile **and** culture result from GBRU which is most useful in directing public health actions. In stage 2, the possession of *stx2* **and** *eae* is used to identify infections caused by potential HUSEC strains.

Note 12

GBRU in-house PCR results

At this stage the GBRU in-house PCR results are reported on GDW and include the *stx* and *eae* results ([Appendix I](#)):

STEC isolated (STEC PCR:+ culture:+) – this indicates that STEC is present and viable and an isolate is available for WGS.

STX genes detected (STEC PCR:+ culture:-) – this indicates that STEC is present but the negative culture indicates that the organism is not viable or the numbers are too low to isolate

STEC NOT isolated (STEC PCR:- culture:-) – this indicates that STEC is not present. It is important to note that between 30 to 40% of *stx* PCR positive results are not confirmed by GBRU, which may be due to a variety of reasons which include:

- DNA degrades quickly in faecal samples, the inherent turn-around time between local lab testing and GBRU testing can affect detection.
- Local diagnostic laboratories perform direct DNA extraction from the sample, whereas GBRU does an overnight broth enrichment step. If the bacteria are viable and multiply the enrichment step increases the amount of DNA present, if the bacteria are dead enrichment actually dilutes the DNA.
- Pathogens are not evenly distributed throughout a faecal sample
- Commercial PCR assays may be more sensitive than the GBRU PCR assay. There has not been a direct comparison of performance.

Note on PCR results

Be aware that the PCR result is from DNA extracted from a faecal sample. The combination of positive *stx1/stx2/eae* genes may be derived from more than one strain of STEC and non-STEC pathogens in that sample.

Note 13

***eae* positive AND STEC isolated**

- For all combinations of *stx1 and/ or stx2* **and** *eae* results, change case definition to CONFIRMED
- For all *eae negative* cases there are no public health actions until STAGE 3 results are known beyond ensuring case is excluded until 48 hours symptom free.
- If STEC is not isolated there are no public health actions usually recommended until Stage 3 beyond ensuring case is excluded until 48 hours symptom free.

Note 14

stx 2 positive or STEC O26 identified

- At the reference lab, a new PCR test has been added as an additional step to identify serogroup O26:H11 after a STEC organism has been isolated on culture. This can take 1-2 days after the stx result is ready. HPTs are advised to wait for the O26 results especially for stx1 and eae positive cases before stopping public health actions commenced already or closing the case.
- If STEC is isolated the organism is viable, and because it possesses genes for *stx2a* and *eae* it is also a potential HUSEC strain.
- All STEC O26 cases should be followed up, even with a non HUSEC profile.
- In summary, If the result is positive for both *stx2* and *eae* and organism is viable **OR** STEC O26 identified (regardless of stx1 or stx2), go to the next question in the algorithm.
- If *stx2* is negative and STEC O26 not identified, there are no public health actions usually recommended until Stage 3 beyond ensuring case is excluded until 48 hours symptom free.

Note 15

Case is already known to HPT and public health actions have been commenced

For cases with a history of HUS or probable *E. coli* O157 full public health actions are likely to have begun and may have been completed prior to the GBRU PCR result. If there is a history of bloody diarrhoea some public health actions are likely to have begun particularly if the case is in a risk group.

ALL cases:

- Change case definition to CONFIRMED
- Re-assess evidence of transmission. Potentially a further incubation period has passed since initial contact with the case

HUS/probable *E. coli* O157/ STEC O26:

- All actions as per STEC O157 management should have been completed or are in progress, including providing advice and the possible exclusion and screening of contacts (**Table 7**)

Cases with bloody diarrhoea:

- Review public health actions, including providing advice and the possible exclusion and screening of:
 - asymptomatic contacts in risk groups A,C,D (**Note 8**)(**Table 7**)
 - symptomatic contacts (**Table 7**)

Children < 6yrs of age (risk group B) regardless of symptoms:

- If already excluded continue until clearance has been achieved
- If **NOT** already excluded carry out risk assessment to determine need for exclusion until clearance has been achieved (**Table 6**). However if there is evidence of transmission exclude until cleared.

Rationale

The STEC is viable and a potential HUSEC strain. It may not have produced serious symptoms in this case, but if the case is shedding there is still the potential for transmission particularly if the case is a young child. Some strains appear to cause more severe disease in secondary cases.

Note 16

Public health actions not started

If the HPT was not previously aware of the case, but identified it from GDW or from initial clinical history the case had been assessed to be low risk:

- Case is defined as CONFIRMED
- Complete the STEC questionnaire if not already done
- Re-inforce hygiene advice that may have been provided to the case in the letter/leaflet
- Assess for evidence of transmission
 - if there is NO evidence of transmission exclude case until 48 hours symptom free, but there are no further public health actions for the case or their contacts
 - if there is evidence of transmission then follow up is recommended.

Rationale

This case is infected with a potential HUSEC strain (serogroup/serotype and *stx2* subtype not yet known)/ STEC O26. An assessment of potential transmissibility is advised, even though the strain has not caused severe illness in this case.

Note 17

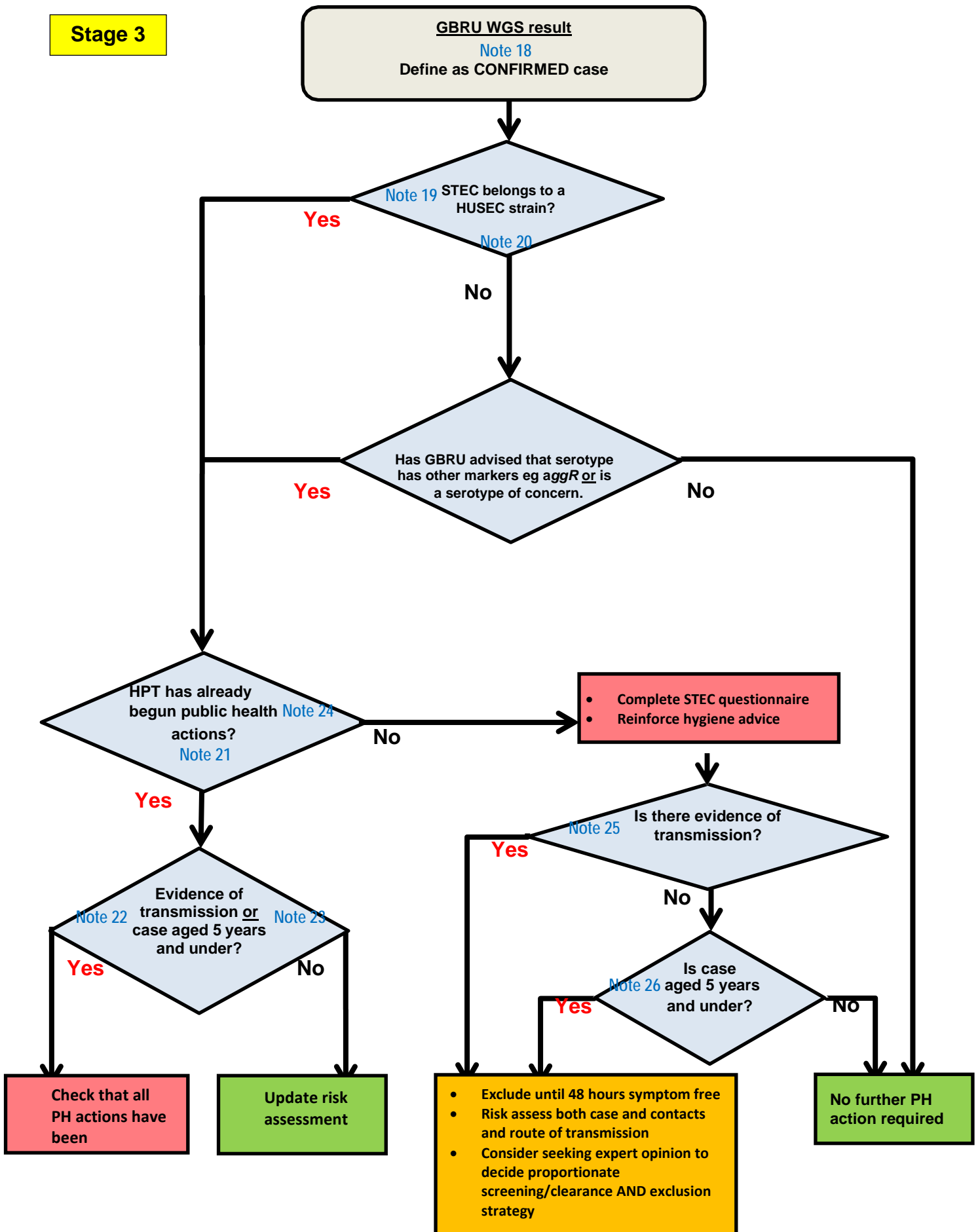
There is evidence of transmission or the case is aged 5 years and under and infected with potential HUSEC strain or STEC O26

- If case is in risk group B carry out risk assessment to determine need for exclusion until clearance has been achieved (**Table 6**). However if there is evidence of transmission exclude until cleared.
- If case is in risk group A,C,D carry out risk assessment to determine need for exclusion until clearance has been achieved (**Table 6**)
- Asymptomatic contacts in risk group B, carry out a risk assessment to determine need for exclusion until screening has been achieved (**Table 7**). If there is a difficulty in obtaining a screening sample or evidence of transmission, consider exclusion until screened
- Asymptomatic contacts in risk group A,C,D screening not recommended (**Table 7**)
- Symptomatic contacts
 - manage as a PROBABLE case
 - arrange single diagnostic specimen and exclude until 48 hours symptom free
 - if symptomatic contact is in risk group A-D continue to exclude until the diagnostic/screening result is known (**Table 7**)

Rationale

Children aged 5 years and under can shed STEC for prolonged periods and onwards transmission is not uncommon and if a case has symptomatic contacts assume that transmission may have occurred.

Stage 3



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Stage 3

[Note 18](#)

GBRU WGS results

- Define case as CONFIRMED (if case not previously reported)

The *stx* subtypes *stx2a/stx2c/stx2d* are strongly associated with risk of HUS, particularly if positive for *eae* or *aggR* gene. Currently *aggR* is not routinely reported on GDW. From the preliminary analysis of the national data, approximately 14% of isolates with *stx2a/2c/2d* are *eae* negative. The proportion of these that were *aggR* is not known.

[Note 19](#)

Serotype has the *stx* subtype *stx2a/2c/2d* (HUSEC strain)

- It is recommended that all isolates with *stx2a/2c/2d* regardless of *eae*, should be followed up for public health action.
- GBRU can provide the *aggR* result on GDW2.
- All STEC O26 cases should be followed up, even with a non HUSEC profile.

[Note 20](#)

Serotype has a non HUSEC strain profile

Bacteria are constantly evolving and there have been documented instances when an *E. coli* strain of low pathogenicity has acquired *stx* genes eg STEC O26:H11 (*stx1a, eae*) acquired *stx2a* genes to become (*stx1a, stx2a, eae*) which significantly increased pathogenicity or EAEC O104:H4 (*aggR*) which also acquired *stx2a* genes and became (*stx2a, aggR*) causing a Europe wide outbreak with a high proportion of HUS cases in adults.

[Note 21](#)

Serotype has the *stx* subtype *stx2a/2c/2d* (HUSEC strain) and the HPT has commenced public health actions

If the strain has the *stx* subtype *stx2a/2c/2d* (HUSEC strain) and the STEC questionnaire has already been completed:

- For cases with HUS / bloody diarrhoea / probable O157/ O26 STEC public health actions will probably have been completed
 - Check that all public health actions have been completed.
- For cases in risk groups it is possible that there may be some outstanding public health actions particularly if the initial GBRU result in Stage 2 was *stx2* but negative for *eae*.
 - Review public health actions already completed and complete STEC questionnaire if not already done
 - Review risk assessment. Seek advice from NIS about *aggR* status and the risk presented by the serotype, consider the time period since original sample was submitted/disease onset date.
- For all other cases there are no further public health actions.

[Note 22](#)

Case in risk group B or there is evidence of transmission

If there is evidence of transmission **or** the case is in risk group B:

- Review all public health actions to ensure that they have been completed
- If no evidence of transmission close case.

[Note 23](#)

Case not in risk group B and no evidence of transmission

- If there is **NO** evidence of transmission and the case is **not** in risk group there are no further public health actions
- If the case is in risk group A,C,D follow guidance in [Table 6](#).

[Note 24](#)

Serotype has the *stx* subtype *stx2a/2c/2d* (HUSEC strain) and the HPT has not begun public health response For all cases:

- Complete the STEC questionnaire
- Reinforce hygiene advice verbally and in writing

If there is evidence of transmission:

- Exclude case and symptomatic contacts until 48 hours symptom free
- Complete risk assessment for case and symptomatic contacts and potential route of transmission
- Consider obtaining expert opinion from NIS taking into account the risk presented by the serotype, the time period since original sample was submitted/disease onset date, and risk assessment information for both case and symptomatic contacts to determine if further public health actions are recommended.

[Note 25](#)

There is evidence of transmission

- Exclude case and symptomatic contacts until 48 hours symptom free
- Complete risk assessment for case and symptomatic contacts and potential route of transmission
- Consider obtaining expert opinion from NIS taking into account the risk presented by the serotype, the time period since original sample was submitted/disease onset date, and risk assessment information for both case and symptomatic contacts to determine if further public health actions are recommended.

[Note 26](#)

Risk group B and no evidence of transmission

- Exclude case and symptomatic contacts until 48 hours symptom free. Alternatively, if exclusion is not appropriate as the child has been in the setting all this time, advise for a clearance specimen to be taken as an alternative to exclusion, as this will provide reassurance that the child has not been infectious during this time.
- Complete risk assessment for case and contacts and route of transmission
- Seek advice from NIS taking into account the risk presented by the serotype, the time period since sample was submitted/disease onset date, and risk assessment information for both case and symptomatic contacts; to determine if further public health actions are advisable.