Integrating Prior Healthcare Exposure Into National Mandatory *Clostridium difficile* Infection Surveillance

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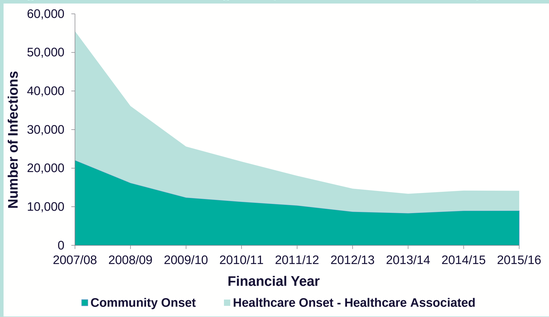
INTRODUCTION

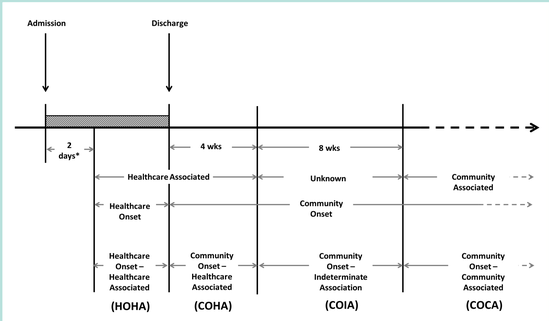
- Mandatory *Clostridium difficile* Infection (CDI) surveillance in England:-
  - Originally introduced for patients aged 65 years and over in 2004.
  - Extended to include all cases in patients aged two years and over in 2007.
    - Captures key demographics, specimen & admission dates
- Data submitted by acute Trusts (hospital groups) via real time web enabled system – Healthcare Associated Infections Data Capture System (HCAI DCS).
- All English National Health Service (NHS) Trusts are required to report all specimens that test positive within their laboratories – **this represents the complete national burden of infection**.
- Data used to determine **healthcare acquisition**, by using a 'Time to Onset' algorithm.
  - Cases are deemed to be **healthcare onset - healthcare associated (HOHA)** if all of the following are true:-
    1. Patient was an inpatient at an acute Trust
    2. Specimen was taken ≥3 days after admission at an acute Trust
- Cases that do not fulfil these criteria are **community onset (CO)**, but with this current algorithm it is not possible to determine whether the CO cases are healthcare associated or community associated.
- Since FY 2010/11, there have been a greater number of CO CDI cases than HOHA CDI cases in England (Figure 1)

Figure 1: CDI Trends in England (FY 2007/08 to FY 2015/16)



- In 2014 the Advisory Committee on Antimicrobial Resistance and Healthcare Associated Infection recommended updating the 'Time to Onset' algorithm, to align it with other recognised international definitions e.g. Center for Disease Control (CDC) and European Centre for Disease Control (ECDC)[1.,2,3].
- Two main changes to the existing algorithm:-
  1. Reducing number of days to identify HOHA cases from ≥3 to ≥2 days following admission.
  2. Addition of prior healthcare exposure to algorithm for community onset (CO) cases. CO cases are categorised based upon when the exposure occurred (Figure 2)

Figure 2: Updated 'Time to Onset' Algorithm



*CDI detected within the first 2 days of admission are considered community onset cases and categorised further based upon the patient's last discharge from a healthcare facility as per algorithm

Here we describe the changes to case distribution and the strategy to implement the new 'Time to Onset' algorithm into the English mandatory surveillance scheme and associated public reporting.

METHODS

- Three stages of development were identified and undertaken (Figure 3):-

Figure 3: Key stages of the CDI algorithm update process

1. HCAI DCS/HES Data Linkage
- Identify historical trends
- Establish/validate methodology
- Inform system development

2. HCAI DCS System Updates
- Add healthcare interaction questions
- Update to 'Time of Onset' algorithm for online reports

3. Stakeholder Engagement
- Feedback of HCAI DCS/HES linkage
- Options for public reporting (presentation, frequency etc.)

Launch of Updated National Surveillance

2017

1. HCAI DCS/Hospital Episode Statistics (HES) Linkage:-

- Results of data linkage used to ascertain historical trends at national, regional and acute Trust (local) level and to provide data on where prior interactions occur.
- CDI episodes data collected linked to HES inpatient care dataset (FY 2007/08 to FY 2015/16) using key identifiers (NHS number and DoB) for 12 months prior to positive specimen date.
- CDI episodes then categorised according to updated 'Time to Onset' algorithm (HOHA, COIA, COHA, COCA, (Figure 2)).
- A comparison of HOHA CDI cases from existing versus updated 'Time to Onset' algorithms using FY 2015/16 data was also undertaken (from ≥3 to ≥2 days following admission).
- Future linkage with HES will produce data which can be used for validation of ongoing surveillance.

2. HCAI DCS System Updates

- Mechanism for the routine/timely capture of prior healthcare interactions is a key component of the surveillance update process. This is not possible using DCS/HES linkage due to inherent delays in availability of HES data (subject to delays of up to six months).
- Results of the DCS/HES analysis used to inform adapted question structure on the DCS.

3. Stakeholder Engagement

- Discussion with relevant stakeholders (e.g. Department of Health, Regional representatives, NHS Trusts, local Commissioners etc.) ensures that surveillance/associated outputs reflect the needs of both the NHS and the wider health economy.
  - Opportunity for those supplying the data to help shape the development of surveillance.
  - Allows users to discuss how they will use the data which will help inform the outputs that need to be produced.
- Helps to agree/establish clear methodology for public reporting of surveillance data – provides opportunity to ensure that nuances of the updated algorithm are adequately conveyed.

RESULTS

- Reducing the number of days used in the time to onset algorithm from 3 to 2 days serves to increase the number of HOHA cases (Table 1).

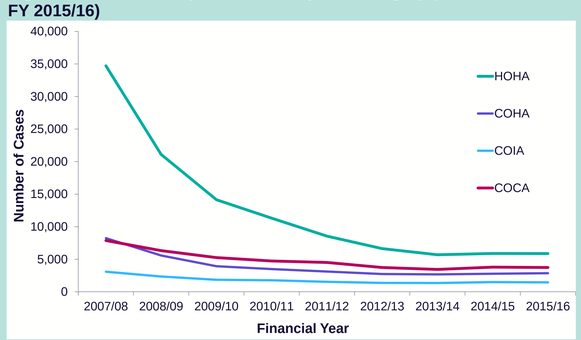
Table 1: Comparison of 'Hospital Onset' cases under existing and new 'Time to Onset' Algorithms (FY 2007/08 to FY 2015/16)

Financial year	Total cases	Time to onset ≥3 days post-admission n (%)	Time to onset ≥2 days post-admission n (%)	% increase in patient episodes
2007/08	53,915	33,103 (61%)	34,912 (65%)	3.4
2008/09	35,359	19,879 (56%)	21,269 (60%)	3.9
2009/10	25,170	13,187 (52%)	14,269 (57%)	4.3
2010/11	21,313	10,392 (49%)	11,424 (54%)	4.8
2011/12	17,702	7,684 (43%)	8,631 (49%)	5.3
2012/13	14,476	5,991 (41%)	6,688 (46%)	4.8
2013/14	13,164	5,036 (38%)	5,743 (44%)	5.4
2014/15	13,934	5,236 (38%)	5,951 (43%)	5.1
2015/16	13,906	5,165 (37%)	5,903 (42%)	5.3

RESULTS

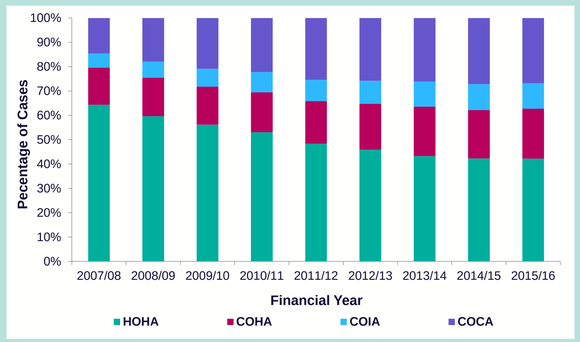
1. HCAI DCS/HES Linkage:-

Figure 4: Number of reported cases by CDI Category (FY 2007/08 to FY 2015/16)



- Between FY 2007/08 and FY 2015/16, there has been a 74% decrease in counts of CDI (Figure 1).
- Reducing the number of days used in the time to onset algorithm from 3 to 2 days serves to increase the number of HOHA cases by approximately 5%.
- All categories experienced reductions in counts over the 9 year period; however, the greatest declines were seen among HOHA (85% decline, from 34,703 to 5,868) (Figure 4).
- This has resulted in marked changes in the distribution of cases across algorithm categories between 2007/08 and 2015/16 (Figure 5).

Figure 5: Percentage of reported cases by each CDI category (2007/08 to FY 2015/16)



- Percentage of cases classified as HOHA has declined by 34% over 9 years
- Percentage of cases classified as community onset (CO) has increased across all three categories over the same time period, by 35% among COHA and by 91% in both COIA and COCA.

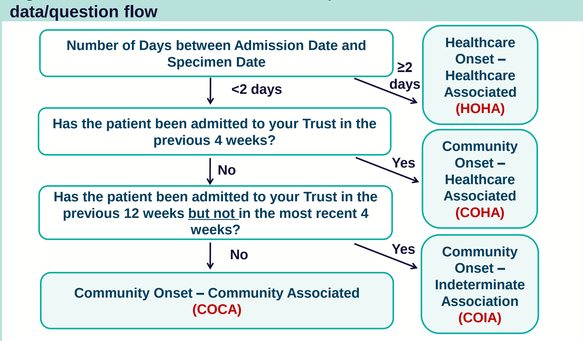
Assessing only 'Within Trust' Healthcare Interactions:-

- 87% of CO cases with a prior healthcare interaction had at least one interaction within the same Trust that reported the CDI to the surveillance scheme.
- Distribution of cases among the three CO categories varies slightly according to whether the algorithm only assess the prior healthcare interactions to those occurring within the Trust originally reporting the case ('within Trust' cases only) or interactions at any Trust.
- Excluding interactions outside of the Trust that reported the CDI, reduces the percentage of cases classified as COHA (17% vs. 20%) and increases the percentage classified as COCA (21% vs. 16%).

2. HCAI DCS System Updates:-

- Given the high percentage of prior healthcare interactions that occur 'within Trust' identified via HCAI DCS/HES linkage additional questions and data flows were added to the system to allow Trusts to self report 'within Trust' interactions (Figure 6).

Figure 6: HCAI DCS – 'Time to Onset' & prior healthcare interaction data/question flow



3. Stakeholder Engagement:-

- A self report approach facilitates the more timely collection of surveillance data than would be possible using data linkage with HES due to inherent delays in availability of HES data (subject to delays of up to six months).
- Although stakeholders welcomed the proposed updates to surveillance there were some concerns in terms of:-
  - Continuity of the historical surveillance time series.
  - Replacement of tried/tested surveillance with an 'unknown'.
  - How the revised categories would tie in to associated performance management initiatives and related assessment.
- The intention is to begin publishing data according to the revised algorithm in parallel with existing surveillance until such time as a new time series has been established and data quality can be fully assessed/verified to a satisfactory extent (exact timeline to be determined via user engagement groups).
- Results of the HCAI DCS/HES linkage will be made available to NHS acute Trusts, providing indication of the breakdown of CDI cases (HOHA, COIA, COHA, COCA).

CONCLUSIONS

- As a greater percentage of CDI cases in England are CO, the new algorithm categorisation will provide a clearer picture of current epidemiology to allow for the design and implementation of new interventions to further reduce CDI in England.
- While HES data represent the 'gold standard' for information on inpatient activity across the NHS in England, it is subject to delays of up to six months. This makes the use of such linkage data less suitable for prospective, real-time routine CDI surveillance, associated public reporting and local investigations into cases of CDI.
- Linkage indicates that 87% of CO cases with prior healthcare contacts had at least one of these interactions 'within Trust'. This provides support for limiting surveillance to 'within Trust'.
- Details of 'within Trust' interactions in the 4 and/or 12 weeks prior to a CDI is readily available to the reporting Trust. A self-report strategy for reporting interactions is thus both possible and favoured. This approach provides data on prior interactions faster than via linkage. Routine (annual) linkage will however continue as a way of quality assuring self-reported data.
- The intention is that CDI surveillance using the revised algorithm will be rolled out in **2017**.

ACKNOWLEDGEMENTS

Mandatory CDI surveillance involves the co-operation of colleagues across the entire English NHS and wider health service.

We thank all NHS acute Trusts and laboratories who have contributed data to the mandatory surveillance scheme.

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