

**An evaluation of a toolkit for the early detection, management and control of carbapenemase-producing Enterobacteriaceae: a cross-sectional survey of NHS acute trusts in England**

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**Running head**

Evaluation of an acute trust CPE toolkit: a cross-sectional survey

## **Abstract**

### Background

Following hospital outbreaks of carbapenemase-producing Enterobacteriaceae (CPE), Public Health England published a toolkit in December 2013 to promote the early detection, management and control of CPE colonisation and infection in acute hospital settings.

### Aim

This evaluation aimed to examine awareness, uptake, implementation and usefulness of the CPE toolkit and identify potential barriers and facilitators to its adoption in order to inform future guidance.

### Methods

A cross-sectional survey of National Health Service acute trusts was conducted in May 2016. Descriptive analysis and multivariable regression models were conducted and narrative responses were analysed thematically and informed using behaviour change theory.

### Findings

Most (92%) acute trusts had a written CPE plan. Fewer (75%) reported consistent compliance with screening and isolation of CPE risk patients. Lower prioritisation and weaker senior management support for CPE prevention were associated with poorer compliance. Awareness of the CPE toolkit was high and all trusts with patients infected or colonised with CPE had used the toolkit either as provided (32%), or to inform (65%) their own local CPE plan. Despite this, many respondents (80%) did not believe the CPE toolkit guidance offered an effective means to prevent CPE or was practical to follow.

### Conclusion

CPE prevention and control requires robust IPC measures. Successful implementation can be hindered by a complex set of factors related to their practical execution, insufficient resources and a lack of confidence in the effectiveness of the guidance. Future CPE guidance would benefit from substantive user involvement, processes for ongoing feedback and regular guidance updates.

### **Key words**

carbapenemase-producing Enterobacteriaceae, NHS acute trusts, hospitals, infection prevention and control, evaluation, guidance, screening, isolation

## Introduction

Over the past decade there have been large increases in carbapenemase-producing Enterobacteriaceae (CPE) infections globally.<sup>1,2</sup> Numerous outbreaks have been reported in Europe, especially in some southern European countries.<sup>3</sup> The UK reported a large increase in the number of CPE isolates from 2008 to 2013.<sup>3,4</sup> In England, most known CPE transmission occurs in hospital.

Published studies of CPE outbreaks have described successful control using a combination of measures, including early detection, isolation, dedicated nursing staff and enhanced infection control measures.<sup>5-8</sup> In response to a small number of CPE outbreaks in hospitals in England in 2013, Public Health England (PHE) developed a toolkit of guidance to promote the early detection, management and control of CPE colonisation and infections in acute hospitals.<sup>9</sup> A National Health Service (NHS) England Patient Safety Alert was issued concurrently with the CPE toolkit in March 2014 and requested that acute trusts have a CPE plan by June 2014.<sup>10</sup>

This survey aimed to evaluate awareness, uptake, implementation and usefulness of the CPE toolkit and to identify potential barriers and facilitators to the adoption of practices it recommends. The evaluation was informed by the behaviour change wheel framework, which describes behaviour as dependent upon factors related to capabilities, opportunities and motivation (COM-B model) and outlines intervention strategies such as guidelines and education.<sup>11</sup>

## Methods

A questionnaire was designed drawing on the key recommended practices according to the CPE toolkit and the "Attitudes Regarding Practice Guidelines" instrument to investigate awareness, uptake, implementation and usefulness of the toolkit guidelines.<sup>9,12</sup> Open-ended questions aimed to identify barriers and facilitators to implementing the CPE toolkit.

Acute hospitals in England are organised in groups, known as acute trusts, with each trust under the management of a single board. The draft questionnaire was piloted in three NHS acute trusts from March to April 2016 and then revised. Excluding the pilot trusts, the final questionnaire was sent to all NHS acute trust Chief Executives in England (n=151) to be forwarded to a board-level member of staff with strategic responsibility for infection prevention and control (IPC) to answer on behalf of the trust. Data was collected from May to June 2016 using the web based PHE Select Survey system. Survey data were downloaded and combined with trust characteristics from the Estates Return Information Collection<sup>13</sup>. Stata version 13.1 was used for data cleaning and analysis.<sup>14</sup>

Descriptive analysis and multivariable regression models were conducted to identify factors associated with awareness, uptake, implementation and usefulness of the CPE toolkit. Multinomial logistic (ML) regression was used for the nominal categorical outcome, and logistic (L) regression for the binary outcomes. Details of the model building approach are in Appendix A. All questions were independently double-coded to assign the most appropriate behaviour change wheel category (capability, opportunity or motivation).<sup>11</sup> Narrative responses to open-text questions were entered into an excel spreadsheet and analysed thematically using an iterative, stepped process based on the framework approach.<sup>15</sup>

A post-survey non-response study was conducted using two approaches to test the hypothesis that respondent trusts would be more 'engaged' in CPE detection, management and control than non-respondent trusts. Firstly, engagement was assessed by surveying local PHE centres to determine whether each of the acute trusts in their area had developed a written CPE plan and the extent to which the trust was engaged in CPE prevention, management and control. Secondly, data on NHS acute trusts' use of the PHE Electronic Reporting System (ERS) for the enhanced surveillance of CPE were extracted from the June 2016 monthly summary report. Data on ERS use for respondent and non-respondent trusts were compared using Fisher's exact test.

Sampling bias was not considered for this study because all NHS acute trusts in England were invited to participate.

## Results

### *Sample characteristics*

Ninety-nine out of 151 NHS acute trusts completed the questionnaire (66%). The sample was representative of NHS acute trusts in England by commissioning region and size/type of trust. Individual respondents held senior positions within their trust and had organisational responsibility for IPC. Participating trusts did not differ significantly from those not participating in their level of engagement in CPE, as reported by PHE centres, or their use of the ERS (Appendix B Table B1, Table B2).

### *CPE context*

The reported number of CPE colonisations and infections experienced by acute trusts between May 2011 and May 2016 is in Table I. There was a statistically significant association between the number of CPE colonisations and infections [ $p \leq 0.001$ ]. However, as the number of CPE colonisations was higher and more dispersed across trusts, we therefore only used CPE colonisations as the *a priori* proposed effect modifier in the multivariable analysis. In a sensitivity analysis conducted to test for effect modification by CPE infections, no evidence of such an effect was found. Frequencies of the main outcome measures of awareness, uptake, implementation and usefulness of the CPE toolkit are in Table II. All except one respondent (99%) mentioned the CPE toolkit when asked if they knew of any official guidelines for CPE prevention and management. The majority of trusts had a written plan for the identification and management of CPE ( $n=91$ ).

The distribution of the proposed explanatory factors used in the multivariable regression models are in Appendix C, Table C1. Factors associated with awareness, implementation, usefulness and uptake of the CPE toolkit are in Tables III and IV and briefly described below.

### *Awareness*

Although awareness among respondents of the CPE toolkit was high (99%) fewer (75%) were very or extremely familiar with its content. Respondents who estimated that CPE infections are rare in England ( $n=33$ ) had a two and a half times higher odds of being less familiar (slightly or moderately) with the contents of the CPE toolkit compared with those who did not consider CPE infections to be rare in England (Table III).

### *Implementation*

Respondents who felt that 'staff have enough time to conduct CPE risk assessments and screening' ( $n=39$ ) had a four-times higher odds of reporting lower levels of CPE screening by frontline staff ('rarely or sometimes' versus 'often or always'). A lack of strong senior management support for CPE screening ( $n=22$ ) was also associated with lower levels of CPE screening by frontline staff. Compared with trusts where CPE prevention was a high priority, those where CPE prevention was not a high priority, had more than eight times higher odds of inconsistent (rarely/sometimes) isolation of CPE risk patients compared with consistent isolation (often or always).

### *Usefulness*

Respondents who reported their trust had sufficient numbers of single rooms (with ensuite) to isolate CPE risk patients had a lower odds of agreeing that the CPE toolkit is an effective means to prevent CPE. Respondents who felt that staff have enough time to conduct CPE risk assessment and screening had lower odds of reporting the CPE toolkit is not practical to use.

However, reporting sufficient numbers of isolation rooms was associated with higher odds of agreeing that the CPE toolkit is not practical to use. Additionally, this association was significantly stronger in trusts that had experienced greater numbers of CPE colonisation in the past five years ( $\geq 11$ ) compared with fewer CPE colonisations (0-10). Reporting their trust had sufficient numbers of isolation rooms was also associated with a nearly five times higher odds of agreeing that the CPE toolkit does not meet the specific needs of the trust. Trusts reporting that other trust guidelines did not conflict with the CPE guidance had a lower odds of agreeing that the CPE toolkit does not meet the specific needs of the trust.

### *Uptake*

Having sufficient numbers of isolation rooms was also associated with a significantly lower risk of having implemented a CPE plan later (10 months or more) rather than earlier (within nine months) following the launch of the CPE toolkit (Table IV).

### *Challenges to implementation of the toolkit*

In the narrative responses, maintaining awareness of CPE prevention among staff was highlighted as a challenge to implementation, particularly for trusts with no or low numbers of CPE cases. In contexts deemed low risk, it was felt that senior staff may not prioritise CPE and hence it “slips off the radar” of busy frontline staff.

Respondents highlighted difficulties associated with the recommended screening approach of taking three rectal swabs 48 hours apart whilst maintaining isolation. In particular, the length of time before declaring a patient CPE negative was seen as impractical within an acute hospital where patients are likely to have been discharged prior to that.

Maintaining staff training on CPE was stated as a challenge, both for regular and bank staff.

Insufficient resources were recurrently mentioned as a challenge to implementation, including laboratory capacity, pressure on beds, use of agency staff, limited isolation facilities and IPC team capacity.

A lack of confidence in the CPE toolkit guidance was also evident. The toolkit was criticised for containing ambiguous and contradictory information. The risk assessment guidance was considered unsuitable for frontline staff in particular the risk countries, which became out-of-date quickly. Respondents were aware of the limited CPE-specific evidence relating to isolation, personal protective equipment and environmental cleaning approaches.

## **Discussion**

There was a good response to the survey. Responding trusts were representative of NHS acute trusts in England and there was no significant difference in engagement in CPE between responding and non-responding trusts. However, questionnaires were completed by individual senior staff and as such may be liable to subjective bias.

Most trusts had experience of managing patients colonised and/or infected with CPE, although the number varied widely. Survey respondents had trust-wide responsibility for IPC and are therefore likely to have experienced CPE cases even in contexts with low numbers, whereas only frontline staff from wards that have admitted CPE positive patients will have such experience (COM-B domains: physical opportunity and reflective motivation). Assuming that experiencing CPE cases has an impact on staff opportunity and motivation to implement guidelines, we might expect to see lower levels of compliance with CPE preventive behaviour at the frontline compared with the trust level. Indeed this was the case, as compliance with the development of a local trust written CPE plan (trust level target behaviour) was high (92%), compared with the consistent execution of CPE preventive behaviours by frontline staff (75%). This is concordant with other studies that found poor compliance with IPC policy at the frontline was associated with staff not deeming the IPC activities to be appropriate or the patients to be at risk or to warrant

such IPC measures.<sup>16</sup> Albeit, some caution is required as the measure of frontline staff compliance we used was subjective.

Respondents' narrative answers additionally highlighted challenges associated with CPE prevention in low CPE contexts. Continuing with the proposed operation of reflective motivation, respondents who believed CPE infections to be rare had a lower level of familiarity with the CPE toolkit contents. This may have been influenced by a lack of opportunity to use the CPE toolkit guidance if respondents had experienced few or no cases. Another important opportunity factor (physical and social) was the trust's organizational culture. Lower prioritisation of CPE prevention and limited senior management support for CPE screening and isolation within a trust were associated with a poorer compliance with CPE preventive behaviours at the frontline. Positive leadership has been found to be a prerequisite for effective IPC behavior.<sup>17</sup> Further implementation hindrances included high work pressures and staff turnover, insufficient isolation facilities, staff shortages, laboratory capacity, pressure on beds and small IPC teams, many of which have been noted in previous studies.<sup>17</sup> Reiterating the importance of opportunity factors in the implementation of the CPE toolkit, 60% of trusts mentioned one or more opportunity factor (physical and/or social) as a hindrance.

All trusts with a CPE plan had used the toolkit to develop their local plan. Despite this a high proportion of respondents did not have confidence in either the effectiveness or practicability of the toolkit. Counter-intuitively, trusts that reported having a sufficient number of isolation rooms had a higher odds of stating the toolkit was not effective or practical to use. This association was stronger in trusts with higher numbers of CPE colonisations. There was evidence that trusts with a sufficient number of isolation rooms had greater experience of implementing the CPE toolkit as they were more likely to have implemented their CPE plan within nine-months of the toolkits launch, compared with 10 to 22 months. This greater experience of implementation may have contributed to the stronger, more negative views about the toolkit. Similarly trusts with more CPE cases would also have greater experience of using the CPE in practice. The impracticability of the recommended CPE screening approach was mentioned by a number of respondents and may in part account for the negative beliefs about the toolkit guidance. Specific difficulties highlighted with CPE screening were associated with short hospital stays and admission pathways through emergency departments.

The evaluation aimed to capture trust level experiences and we sampled one senior representative from each NHS acute trust in England. However, to gain a more comprehensive picture of the issues around implementation of the CPE toolkit additional research is required incorporating the views and experiences of frontline staff and non-NHS acute trusts. Additionally, the views and experiences of patients of being CPE positive and CPE prevention are under-researched. Using the behaviour change wheel framework highlighted the importance of 'opportunity' and 'motivation' factors in the pathway from IPC guidance recommendations to implementation.<sup>11 12</sup> However, these pathways are likely to incorporate multiple dimensions operating across different timeframes and contexts and therefore further research is required to identify the relative influence of specific factors on specific behaviour outcomes.

### *Conclusions*

The CPE toolkit was based on the best evidence available at the time indicating that the prevention and control of CPE requires robust IPC measures, although since its publication further evidence and guidelines have been published.<sup>18-21</sup> However, successful implementation of such measures can be hindered by a complex set of factors related to their practical execution, insufficient resources and a lack of confidence in the effectiveness of the guidance.<sup>22</sup> The results suggest there are direct relationships between opportunity factors and behaviour, such as levels of senior management support and compliance with CPE prevention at the frontline. In addition, opportunity factors may also operate via their impact on reflective motivation, such as experience of CPE cases influencing staff evaluation of the necessity of CPE prevention and subsequent compliance with IPC behaviour. Use of this behaviour change theory has facilitated a deeper understanding of some of the complex and multifaceted influences on behaviour and could be used to inform the development of more effective approaches to implementation of guidance.

The heterogeneity of acute trusts and the changing landscape of resources and CPE within hospitals in England pose an ongoing challenge to the implementation of rigorous IPC guidance. Together with evidence-based CPE prevention, future guidance requires a greater focus on advising and assisting guidance users in their application. In addition, acknowledgement of the heterogeneity of local contexts, resources and organisational structures in future CPE guidance may help to facilitate local adaptation and implementation and instil confidence in those guidelines.<sup>23</sup> To facilitate this requires substantive user involvement, processes for ongoing feedback and regular updating of guidance.

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**Table I**

**Estimated numbers of patients colonised or infected with CPE seen in acute trusts (n=99) between May 2011 - May 2016**

| Range of CPE cases seen | Colonisations* | Infections* |
|-------------------------|----------------|-------------|
| None                    | 6              | 32          |
| 1-10                    | 51             | 50          |
| 11-50                   | 25             | 10          |
| 51-100                  | 6              | 0           |
| >100                    | 4              | 1           |
| Don't know              | 7              | 6           |

- Percentages not shown as numbers equivalent to 100%

**Table II**

**Awareness, uptake, implementation and usefulness of the acute trust CPE toolkit**

|  | Acute Trusts (N=99)* |
|--|----------------------|
| <b>AWARENESS</b>   |                      |
| If heard of toolkit, how familiar with content?                              |                      |
| Not at all familiar/ Slightly familiar                                       | 7                    |
| Moderately familiar  | 17                   |
| Very familiar  | 43                   |
| Extremely familiar   | 30                   |
| Not applicable   | 2                    |
| <b>UPTAKE</b>  |                      |
| Timing of adoption of a local written CPE plan following toolkit launch      |                      |
| Pre-CPE toolkit (2010-2013)  | 13                   |
| Early adopters (2014)  | 47                   |
| Late adopters (2015-2016)  | 25                   |
| Plan – no date   | 6                    |
| Not stated   | 8                    |
| Toolkit used to develop local policy for identification & screening for CPE? |                      |
| Yes, used as provided  | 31                   |
| Yes, used to inform own procedures   | 65                   |
| No/Don't know  | 3                    |
| Toolkit used to develop local policy for isolation for CPE?                  |                      |
| Yes, used as provided  | 32                   |
| Yes, used to inform own procedures   | 64                   |
| No/Don't know  | 3                    |
| <b>IMPLEMENTATION</b>  |                      |
| Do frontline staff screen for CPE on admission?                              |                      |
| Never/Rarely   | 5                    |
| Sometimes  | 25                   |
| Often  | 41                   |
| Always   | 27                   |
| Don't know   | 1                    |
| Do frontline staff isolate patients suspected of having CPE on admission?    |                      |
| Never/Rarely   | 4                    |
| Sometimes  | 17                   |
| Often  | 30                   |
| Always   | 44                   |
| Don't know   | 4                    |
| <b>USEFULNESS</b>  |                      |
| Following the toolkit is an effective means to prevent CPE                   |                      |
| Strongly disagree  | 35                   |
| Somewhat disagree  | 44                   |
| Neither agree or disagree  | 5                    |
| Somewhat agree   | 7                    |
| Strongly agree   | 4                    |
| Don't know   | 4                    |
| The toolkit does not meet the specific needs of our acute trust              |                      |
| Strongly disagree  | 6                    |
| Somewhat disagree  | 29                   |
| Neither agree or disagree  | 7                    |
| Somewhat agree   | 35                   |
| Strongly agree   | 22                   |
| It is not practical to follow the toolkit guidance                           |                      |
| Strongly disagree  | 8                    |
| Somewhat disagree  | 24                   |
| Neither agree or disagree  | 9                    |
| Somewhat agree   | 32                   |
| Strongly agree   | 26                   |

- Percentages not shown as numbers equivalent to 100%

**Table III**

**Factors associated with awareness, implementation and usefulness of the CPE acute trust toolkit**

| Outcome   | Risk Factor  | Reference group                              | Odds Ratio                             | 95% Confidence Interval |
|---|--|--|--|-------------------------|
| <b>AWARENESS</b>  |  |  |  |                         |
| FAMILIARITY WITH CONTENT OF CPE TOOLKIT<br>(slightly/moderately <i>versus</i> very/extremely)     | CPE infections are rare in England                   | Neither/Somewhat/<br>Strongly agree          | Strongly/<br>Somewhat disagree         | 2.57<br>1.00, 6.62*     |
| <b>IMPLEMENTATION</b>   |  |  |  |                         |
| DO FRONTLINE STAFF SCREEN FOR CPE? <sup>a</sup><br>(rarely/sometimes <i>versus</i> often/always)  | Staff have enough time to risk assessment and screen | Neither/Somewhat/<br>Strongly agree          | Strongly/Somewhat<br>disagree          | 4.12<br>1.34, 12.67**   |
|   | Strong senior management support-id and screening    | Strongly/Somewhat<br>disagree/Neither        | Somewhat/Strongly<br>agree             | 4.02<br>1.08, 15.07*    |
| DO FRONTLINE STAFF ISOLATE FOR CPE? <sup>b</sup><br>(rarely/sometimes <i>versus</i> often/always) | CPE prevention high priority in our acute trust      | Strongly/Somewhat<br>disagree/Neither        | Somewhat/Strongly<br>agree             | 8.55<br>1.77, 41.26***  |
| <b>USEFULNESS</b>   |  |  |  |                         |
| EFFECTIVE MEANS TO PREVENT CPE <sup>c</sup><br>(agree/neither <i>versus</i> disagree)             | Have sufficient isolation rooms with ensuite         | Somewhat/Strongly agree                      | Neither/somewhat/<br>Strongly disagree | 0.15<br>0.03, 0.80**    |
|   | Strong senior management support-id and screening    | Strongly/Somewhat<br>disagree/Neither        | Somewhat/Strongly<br>agree             | 1.55<br>0.37, 6.58      |
| NOT PRACTICAL TO FOLLOW <sup>d</sup><br>(agree <i>versus</i> neither/disagree)                    | Staff have enough time to risk assessment and screen | Somewhat/Strongly<br>agree/Neither           | Strongly/Somewhat<br>disagree          | 0.06<br>0.02, 0.25***   |
|   | Strong senior management support-id and screening    | Strongly/Somewhat<br>disagree/Neither        | Somewhat/Strongly<br>agree             | 0.35<br>0.10, 1.30      |
|   | CPE colonisations 0 to 10 cases                      | Somewhat/Strongly agree                      | Neither/Somewhat/<br>Strongly disagree | 1.40<br>0.37, 5.35*     |
|   | Have sufficient isolation rooms with ensuite         | Neither/Somewhat/<br>Strongly disagree       |  | 0.16<br>0.03, 0.85*     |
|   | CPE colonisations ≥11 cases                          | Have sufficient isolation rooms with ensuite | Somewhat/Strongly agree                |                         |
| DOES NOT MEET SPECIFIC NEEDS OF TRUSTS <sup>e</sup><br>(agree <i>versus</i> neither/disagree)     | Other guidelines we use conflict with the toolkit    | Strongly/Somewhat<br>disagree/Neither        | Somewhat/Strongly<br>agree             | 0.29<br>0.08, 1.04*     |
|   | Strong senior management support-id and screening    | Strongly/Somewhat<br>disagree/Neither        | Somewhat/Strongly<br>agree             | 0.42<br>0.11, 1.61      |
|   | Have sufficient isolation rooms with ensuite         | Somewhat/Strongly agree                      | Strongly/Somewhat<br>disagree/Neither  | 4.74<br>1.40, 16.04**   |

\*≤0.05 \*\* ≤0.01 \*\*\* ≤0.001

<sup>a</sup> Adjusted for: CPE prevention high priority in our acute trust, Commissioning Region, No. of CPE colonisation

<sup>b</sup> Adjusted for: Strong senior management support-id and screening, Staff have enough time to risk assessment and screen

<sup>c</sup> Adjusted for: Cost of identifying & screening outweigh the benefits, Professional discipline, Commissioning Region

<sup>d</sup> Adjusted for: most hospitals in England have id and screening policy, Commissioning Region, Size/type of trust

<sup>e</sup> Adjusted for: Commissioning Region, Costs outweigh the benefits, CPE prevention a high priority in the trust and trust size/type.

**Table IV**

**Factors associated with timing of implementation of acute trust CPE plan**

| <b>UPTAKE: TIMING OF IMPLEMENTATION OF A CPE PLAN<sup>a</sup></b> |   |                               |  |                               |         |
|---|---|-------------------------------|--|-------------------------------|---------|
|   | <b>Pre-CPE toolkit plan<br/>versus early plan</b> |                               | <b>Late plan<br/>versus early plan</b> |                               |         |
|   | Relative<br>Risk Ratio                            | 95%<br>Confidence<br>Interval | Relative<br>Risk Ratio                 | 95%<br>Confidence<br>Interval | P-value |
| <b>Have sufficient isolation rooms with ensuite</b>               |   |                               |  |                               |         |
| Neither/somewhat/strongly disagree                                | 1.00  |                               | 1.00                                   |                               |         |
| Somewhat /Strongly agree  | 0.29  | 0.07,<br>1.22                 | 0.30                                   | 0.10, 0.90                    | 0.03    |

<sup>a</sup> Adjusted for: Number of CPE colonisations

## Appendix A

### Regression model building approach

The association between each exposure variable and each outcome was examined and single variable models with an association of  $p \leq 0.25$  based on the Likelihood Ratio Test (LRT) and fitting the Bradford Hill plausibility concept were selected for use in the multivariable ML or L regression models. Independent variables were entered into the model sequentially in order of statistical significance with the most significant selected first and thereafter in order of decreasing significance. Potential explanatory variables were retained in the model if there was evidence they additionally explained the outcome using the LRT with a cut-point of  $p\text{-value} \leq 0.05$ . Substantially confounding variables were also retained regardless of their statistical significance. A variable was considered substantially confounding if the measure of association of one or more of the variables remaining in the model changed by 15% or more. Effect modification was considered once each final model had been developed and for those models where the interaction was deemed to be theoretically important. Only pairwise interactions were tested due to the relatively small sample size. Pairwise interaction variables were derived between proposed effect modifiers and independent variables. Interaction variables were entered into the model after independent variables had been tested and either excluded or retained. A potential interaction term was retained in the model if there was evidence that it additionally explained the outcome using a LRT with a cut-point of  $p\text{-value} \leq 0.05$ .

## Appendix B

**Table B1**  
**Comparing trust CPE plan and engagement by survey response**

| Characteristics             | Survey responder<br>(n=86)  |      | Non-responder<br>(n=47) |      |
|-----------------------------|-----------------------------|------|-------------------------|------|
|                             | n                           | %    | n                       | %    |
| Trust has a CPE plan?       |                             |      |                         |      |
| <b>Yes</b>                  | 76                          | 88.4 | 38                      | 80.9 |
| <b>No</b>                   | 10                          | 11.6 | 9                       | 19.2 |
|                             | <i>p-value*</i>             |      |                         | 0.30 |
| Trust fully engaged in CPE? |                             |      |                         |      |
| <b>Yes</b>                  | 65                          | 75.6 | 34                      | 72.3 |
| <b>No</b>                   | 11                          | 12.8 | 3                       | 6.4  |
| <b>Don't know</b>           | 10                          | 11.6 | 10                      | 21.3 |
|                             | <i>p-value*</i>             |      |                         | 0.24 |
|                             | <i>p-value*<sup>a</sup></i> |      |                         | 0.54 |

\*Fisher's exact test

<sup>a</sup> excluding 'don't know' group

**Table B2**  
**ERS status (June 2016) by commissioning region and size/type of trust for survey responders and non-responding trusts**

|                            | TRUST ERS STATUS |      |                               |      |                           |      |                              |      |                |      |                               |      |                           |      |                              |      |
|----------------------------|------------------|------|-------------------------------|------|---------------------------|------|------------------------------|------|----------------|------|-------------------------------|------|---------------------------|------|------------------------------|------|
|                            | Survey responder |      |                               |      |                           |      |                              |      | Non-responder  |      |                               |      |                           |      |                              |      |
|                            | Not Registered   |      | Not registered but submitting |      | Registered and submitting |      | Registered and no submission |      | Not Registered |      | Not registered but submitting |      | Registered and submitting |      | Registered and no submission |      |
|                            | n                | %    | n                             | %    | n                         | %    | n                            | %    | n              | %    | n                             | %    | n                         | %    | n                            | %    |
| Commissioning Region       |                  |      |                               |      |                           |      |                              |      |                |      |                               |      |                           |      |                              |      |
| <b>London</b>              | 1                | 4.0  | 4                             | 12.9 | 8                         | 22.9 | 0                            | 0.0  | 4              | 25.0 | 3                             | 18.8 | 3                         | 18.8 | 1                            | 14.3 |
| <b>Midlands &amp; East</b> | 13               | 52.0 | 10                            | 32.3 | 5                         | 14.3 | 0                            | 0.0  | 4              | 25.0 | 5                             | 31.3 | 6                         | 37.5 | 1                            | 14.3 |
| <b>North</b>               | 3                | 12.0 | 13                            | 41.9 | 16                        | 45.7 | 3                            | 37.5 | 2              | 12.5 | 7                             | 43.8 | 5                         | 31.3 | 1                            | 14.3 |
| <b>South</b>               | 8                | 32.0 | 4                             | 12.9 | 6                         | 17.1 | 5                            | 62.5 | 6              | 37.5 | 1                             | 6.3  | 2                         | 12.5 | 4                            | 57.1 |
| Size/type <sup>a</sup>     |                  |      |                               |      |                           |      |                              |      |                |      |                               |      |                           |      |                              |      |
| <b>Large</b>               | 2                | 8.0  | 9                             | 29.0 | 6                         | 17.1 | 3                            | 37.5 | 5              | 31.3 | 4                             | 25.0 | 6                         | 37.5 | 0                            | 0.0  |
| <b>Medium</b>              | 8                | 32.0 | 3                             | 9.7  | 10                        | 28.6 | 2                            | 25.0 | 3              | 18.8 | 0                             | 0.0  | 5                         | 31.3 | 3                            | 42.9 |
| <b>Small</b>               | 8                | 32.0 | 8                             | 25.8 | 3                         | 8.6  | 2                            | 25.0 | 5              | 31.3 | 4                             | 25.0 | 2                         | 12.5 | 3                            | 42.9 |
| <b>Specialist/Multi</b>    | 4                | 16.0 | 5                             | 16.1 | 4                         | 11.4 | 1                            | 12.5 | 2              | 12.5 | 3                             | 18.8 | 0                         | 0.0  | 1                            | 14.3 |
| <b>Teaching</b>            | 3                | 12.0 | 6                             | 19.4 | 12                        | 34.3 | 0                            | 0.0  | 1              | 6.3  | 5                             | 31.3 | 3                         | 18.8 | 0                            | 0.0  |

<sup>a</sup> Size/type of acute trust categories are those used by the Health and Social Information Centre (HSCIC) and are mutually exclusive.

## Appendix C

**Table C1**

**Proposed explanatory factors associated with uptake, awareness, implementation and usefulness of the acute trust CPE toolkit**

| Explanatory factors  | Acute Trusts<br>(N=99)* |
|--|-------------------------|
| Our Trust has not had to worry about CPE infections  |                         |
| <i>Somewhat /strongly disagree</i>   | 61                      |
| <i>Neither / somewhat / strongly agree</i>   | 38                      |
| Our trust does not have to worry about future CPE infections (excluding n=2 Don't Know)                |                         |
| <i>Strongly / somewhat disagree</i>  | 93                      |
| <i>Somewhat agree / strongly agree</i>   | 4                       |
| CPE is a serious issue for hospitals in England (excluding n=3 Don't Know)                             |                         |
| <i>Strongly disagree / neither</i>   | 9                       |
| <i>Somewhat / strongly agree</i>   | 87                      |
| CPE infections are rare in England (excluding n=6 Don't Know)  |                         |
| <i>Strongly / somewhat disagree</i>  | 60                      |
| <i>Neither / somewhat / strongly agree</i>   | 33                      |
| Most hospitals in England have id and screening policy (excluding n=3 Don't Know)                      |                         |
| <i>Strongly / somewhat disagree / neither</i>  | 23                      |
| <i>Somewhat / strongly agree</i>   | 73                      |
| Most hospitals in England have policy for managing CPE (excluding n=3 Don't Know)                      |                         |
| <i>Strongly / somewhat disagree / neither</i>  | 22                      |
| <i>Somewhat / strongly agree</i>   | 74                      |
| CPE prevention high priority in our acute trust (NB.categories reversed)                               |                         |
| <i>Somewhat / strongly agree</i>   | 87                      |
| <i>Strongly / somewhat disagree / neither</i>  | 12                      |
| Costs of identifying & screening outweigh the benefits (excluding n=5 Don't Know)                      |                         |
| <i>Strongly / somewhat disagree</i>  | 56                      |
| <i>Neither / somewhat / strongly agree</i>   | 38                      |
| Have sufficient isolation rooms with ensuite (excluding n=1 Don't Know)                                |                         |
| <i>Strongly / somewhat disagree</i>  | 45                      |
| <i>Neither/ somewhat /Strongly agree</i>   | 53                      |
| Staff have enough time to do risk assessments and screening  |                         |
| <i>Strongly / somewhat disagree</i>  | 60                      |
| <i>Neither/ somewhat /Strongly agree</i>   | 39                      |
| Do not have access to rapid lab testing for CPE (excluding n=3 Don't Know)                             |                         |
| <i>Strongly / somewhat disagree</i>  | 52                      |
| <i>Neither/ somewhat /Strongly agree</i>   | 44                      |
| Strong senior management support for id and screen (NB.categories reversed) (excluding n=2 Don't Know) |                         |
| <i>Somewhat / strongly agree</i>   | 75                      |
| <i>Strongly / somewhat disagree / neither</i>  | 22                      |
| Other guidelines we use conflict with the toolkit (NB.categories reversed) (excluding n=3 Don't Know)  |                         |
| <i>Somewhat / strongly agree</i>   | 72                      |
| <i>Strongly / somewhat disagree / neither</i>  | 24                      |
| CPE champion within trust? (excluding n=1 Don't Know)  |                         |
| Yes  | 45                      |
| No   | 53                      |

- Percentages not shown as numbers equivalent to 100%