Audit of the management of patients at high risk of carbapenemase-producing enterobacteriaceae (CPE): Are we ready?

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Abstract

Background: Incidence of carbapenemase-producing enterobacteriaceae (CPE) in the UK is increasing. In 2013, Public Health England (PHE) published a toolkit to control spread of CPE within healthcare settings.

Aim: To assess compliance to hospital CPE policy (adapted from PHE) in the identification, isolation and screening of suspected CPE patients.

Methods: Admission booklets of 150 patients were evaluated to see whether the relevant section had been completed to identify high-risk CPE patients. Where necessary, patients were interviewed or their GPs were contacted to assess their CPE risk. Additionally, 28 patients screened for CPE were audited to assess compliance to screening and isolation.

Findings: Only 23 patients out of 147 (15.6%) were risk assessed on admission. Risk status of 27 (18.4%) patients could not be assessed due to lack of data. Fifteen patients out of 28 (54%) screened for CPE were identified and isolated on admission. Ten out of 19 patients (53%) had three screens 48 h apart.

Discussion: This audit highlights difficulties in screening based on individual risk factors as the majority of patients were not screened on admission and documentation on isolation and screening was poor. More needs to be done to raise awareness of the requirements for routine assessment, isolation and screening.

Keywords

Audit, carbapenemase, enterobacteriaceae, carbapenemase-producing enterobacteriaceae (CPE)

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Introduction

Carbapenemase-producing enterobacteriaceae (CPE) is a major global public health concern due to the lack of effective antibiotics to treat infections and its propensity to cause outbreaks. Many countries around the world, such as Greece, Turkey, USA, India and China, have reported high prevalence of CPE (Public Health England, 2013). Enterobacteriaceae refers to a large group of bacteria that colonises the gut of humans without causing infections in healthy individuals. *Escherichia coli*, *Klebsiella* and *Enterobacter* are some of the species included in Enterobacteriaceae. They are common causes of urinary tract, intra-abdominal and bloodstream infections in vulnerable patients and can commonly be multi-drug resistant

(MDR). Carbapenems are a group of antibiotics that include meropenem, ertapenem, imipenem and doripenem. These antibiotics are reserved as last resort for serious infections caused by MDR bacteria such as enterobacteriaceae and *Pseudomonas*. Carbapenemases include a large group of enzymes produced by bacteria that destroy carbapenem antibiotics, thus conferring resistance to these antibiotics.

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In the UK, incidence of patients colonised and infected with CPE has increased over the last five years, with major outbreaks in North West England (Central Manchester University Hospitals NHS Foundation Trust, 2015; Findlay et al, 2016; Public Health England, 2013). In December 2013, Public Health England (PHE) published a toolkit for acute hospitals in England to help control CPE spread into (and within) health and residential care settings (Public Health England, 2013). This toolkit provides detailed guidance on early recognition of individuals who may be colonised / infected with CPE, isolation of suspected and laboratory-confirmed cases, detection of screening of suspected cases and contacts, effective treatment, early instigation of effective infection prevention and control (IPC) measures, cleaning and decontamination and communication including on discharge of patients or on medical transfer. This toolkit recommends that all patients should be routinely assessed for CPE status on admission to hospital. A suspected case is 'a patient who, in the last 12 months, has been (a) an inpatient in a hospital abroad or (b) an inpatient in a UK hospital which has problems with spread of CPE or (c) is a "previously" positive case or close contact with a person who has CPE (if known)'. It also recommends isolation and screening of all suspected cases and patients are to remain in isolation until three screens taken 48 h apart are all negative. Norfolk is largely a rural county but with popular tourist destinations such as the Norfolk Broads and Great Yarmouth. Thus, our hospital is likely to admit patients who are at high risk of having CPE. Failure to identify such patients promptly has the potential to cause a CPE outbreak. Therefore, it is vital that there is a robust hospital system in place to identify these high-risk patients.

In May 2015, our hospital admission booklet was updated to include CPE screening questions (adapted from the PHE toolkit) to enable prompt identification of patients at high risk of CPE on admission. This assessment is predominantly nurse led with IPC Nurses regularly providing mandatory infection control training to the nursing staff, which includes information on CPE. The Infection Control Doctor provides annual mandatory infection control training to medical staff in the hospital. Nurses in Pre-Operative Assessment Clinics are also reminded to routinely assess patients for CPE risk factors who will be admitted for elective surgery. Once a suspected case is identified, staff are required to liaise with the Infection Control Team for further advice on screening and isolation. In addition, microbiologists regularly reiterate to junior and senior clinicians, the need for assessment of all patients for CPE on admission. Moreover, the hospital's Operational Centre informs the Infection Control Team of all inter-hospital transfers to identify suspected patients and make necessary arrangements for screening and isolation. Despite these measures, individual risk assessment is more difficult to implement than universal screening of high-risk specialties such as the intensive care unit. This audit was undertaken to assess

compliance to our hospital CPE policy (adapted from the PHE toolkit) in the identification, isolation and screening of suspected CPE patients.

Audit standards

All of the following audit standards have a pre-set target of 100%. All of these standards are adapted from the PHE toolkit.

1. All patients must be routinely assessed for CPE risk on admission, by completion of the relevant section in the admission booklet.
2. All CPE suspected patients should be isolated on admission.
3. All CPE suspected patients should have rectal swab/stool specimen taken for CPE within 24 h of admission.
4. All suspected patients should have a total of three CPE screens, taken 48 h apart, unless they are discharged/transferred before all screens are completed or the patient declines.
5. All suspected patients should remain in isolation until they have had three negative CPE screens unless they are discharged/transferred before all screens are done or patient declines.
6. All patients positive for CPE should remain in isolation throughout their hospital stay.

Method

This audit was completed in two parts. Part 1 was to assess whether patients are routinely risk assessed on admission (Standard 1). Part 2 was to assess whether patients identified as high-risk are isolated, screened in line with Trust CPE guidelines (Standards 2–6).

Part 1. To assess compliance to Standard 1, admission booklets of 100 medical patients and 50 surgical patients were evaluated to see whether the relevant section had been completed to identify high-risk CPE patients. Where this was not completed, patients were asked if, in the last 12 months, the patient had been: (1) an inpatient in a hospital abroad; or (2) an inpatient in a UK hospital outside our region; or (3) is a 'previously' positive case or close contact with a person who has CPE (if known). If the patient was not able to answer these questions, their GPs were contacted by fax and/or phone to obtain this information.

Part 2. For Standards 2–6, 28 patients who had been screened for CPE in our hospital from August 2014 to March 2016 were included in the audit. Patient demographic details such as age, sex, details of risk assessment for CPE status and isolation details were obtained from the admission booklet and their electronic health record (e-HR).

Screening details such as timing of samples, number of samples and time to results were obtained from Laboratory Information System (Telepath).

Results

Part 1

Standard 1. Of the 100 admission records for medical patients, 16 (16%) had documented evidence of a CPE risk assessment and none were considered high-risk. Of the 50 admission records for surgical patients, three patient records were excluded due to incomplete data. Seven out of 47 surgical patients (14.9%) had documented evidence of a CPE risk assessment and one patient was considered high-risk due to hospitalisation abroad in a country with high prevalence of CPE. Thus, the sample size for analysis of part 1 data is 147. Overall, 23 of the 147 patients (15.6%) were risk-assessed for CPE on admission. Of the 124 patients who were not fully CPE risk-assessed on admission (84 medical and 40 surgical), information on CPE status was available on 97 patients (58 medical and 39 surgical). None were considered high-risk. Information of CPE status of 27 patients (26 medical and one surgical) could not be assessed due to incomplete/lack of data. This accounted for 18.4% patients (27/147) included in the audit.

Therefore, of 120 patients in whom CPE risk status was available, only one was considered high-risk for CPE. This accounted for 0.8% of patients.

Part 2

Twenty-eight patients who had been screened for CPE in our hospital from August 2014 to March 2016 were included to assess compliance to Standards 2–6.

Standard 2. Of the 28 suspected patients screened for CPE, 15 patients (54%) were isolated on admission. Isolation status of seven patients (25%) was not known, as this was not documented in patient notes. Six patients (21%) were not isolated on admission. Reasons for not isolating are not known.

Standard 3. Of the 28 patients, four patients had the wrong samples sent (anus swabs instead of rectal swabs). In five patients, there was no documented reason as to why CPE screening had not taken place. Thus, 9/28 patients (32%) were not screened appropriately. Four patients were not screened as they refused screening/discharged within 24 h/had a recent negative specimen. Therefore, only 15 patients (54%) had rectal swab/stool specimen taken for CPE within 24 h of admission.

Standard 4. Nine patients met the exclusion criteria and were therefore excluded. Of the 19 suspected patients included in this audit standard, ten suspected patients (53%) completed a total of three CPE screens 48 h apart. Seven

suspected patients (37%) did not complete three CPE screens due to sample timing errors (not taken 48 h apart), while there was no reason documented for the remaining two patients who did not complete three CPE screens.

Standard 5. Six patients were excluded from this standard as they refused screening/ had been discharged/ had negative screens recently. Therefore, 22 suspected patients were included in this audit standard. Eight patients (36.3%) remained in isolation until they had three negative screens. The isolation status of the remaining 14 patients was not known, as there was no documentation.

Standard 6. Of the 28 suspected CPE patients, two tested positive for CPE. Both patients remained in isolation rooms until discharge.

Discussion

In the first part of this audit, a majority of patients (>84%) did not have a documented risk assessment for CPE on admission. In some of these cases, it may be possible that a risk assessment was undertaken but not documented as patient is not perceived as high-risk. The majority of patients who are admitted to our hospital are elderly with an average age of > 80 years, so it may not be possible to risk assess all patients on admission due to dementia, confusion, etc. CPE risk status could not be determined in 18.4% of patients included in the audit despite attempts to contact GP surgeries. Therefore, it is a challenge to assess all patients routinely on admission. However, in patients where it was possible to assess CPE risk status, the majority of patients were still not risk-assessed for CPE. This is a grave concern as high-risk patients may not be screened for CPE or isolated as recommended by the PHE CPE toolkit. This means proactive infection control strategies are unlikely to be implemented to prevent CPE outbreaks and therefore relying on reactive infection control measures, once CPE cases are identified to prevent further spread. This audit highlights the difficulty in performing individual risk assessment as only 15.6% of patients had risk assessment done on admission. Although CPE is covered in mandatory infection control training, regular reminders to nurses and doctors on the importance of routine CPE assessment on admission and documentation of risk assessment/isolation status in patient records will help improve compliance. This could be done through display of posters on wards, emails and screensavers.

Although the prevalence of high-risk patients admitted to our hospital is not known, we found that, of 120 patients in whom risk status for CPE was available, only one patient was considered to be high-risk. This accounts for 0.8% of patients included in the audit. This patient tested negative by culture for CPE on all three screening specimens. A point prevalence survey at Royal Free London identified

19.4% of admissions as high-risk for CPE (Scott and Mack, 2014). It is not known what proportion of these patients were positive for CPE. Another study (Otter et al., 2016) found that 64.5% of patients had at least one risk factor for CPE during a four-month study period but only 0.1% of admissions had carriage of CPE with hospitalisation abroad as the most significant risk factor. This is extremely low prevalence of CPE despite a large number of high-risk patients. We do not have reasons to believe that our local prevalence would be higher than a large tertiary hospital in London that treats more high-risk, complicated patients. In contrast, a study by Poole et al. (2016) in a Manchester hospital found a prevalence of 11% in a point prevalence screening where there is endemic spread. We would recommend that a prospective point prevalence survey be undertaken to determine true prevalence of high-risk patients admitted to our hospital. This can be combined with a study to determine carriage of CPE in patients by sampling all patients admitted to hospital during a defined period to identify hidden burden of CPE.

At present, routine assessment on admission for CPE risk status is predominantly nurse-led with screening questions printed on the admission booklet. Doctors are also reminded about the need for routine assessment of all admissions at their mandatory infection prevention and control training sessions. A study in Singapore (Chia et al., 2016) found that nurse-led screening and assessment were more effective than doctor-led implementation in identifying and screening patients at high risk for carbapenem-resistant enterobacteriaceae on admission but the reasons for this were not clear. Although, screening questions are printed in admission booklet, it can easily be missed as it is not prominently displayed. Moreover, doctors overlook this section as the screening questions are printed within the nurse admission section of the booklets and are therefore unlikely to enquire about CPE risk. We would recommend that CPE screening questions in the admission booklet should be made more prominent to ensure nurses screen all patients. Additionally, CPE screening questions should be added to doctor's clerking section of the booklet. Doctors and nurses should be prompted to document CPE risk assessment by completing these screening questions.

In the second part of the audit, we examined patient records of 28 patients that had been screened for CPE over a period of 20 months. Fifteen patients (54%) were isolated on admission and 15 patients (54%) had a rectal swab/stool specimen taken for CPE within 24 h of admission. Otter et al. (2016) found that only 6.2% of high-risk patients were isolated in single rooms by the clinical services when 64% of patients should have been isolated and only 13% of high-risk patients were screened. Reasons for poor compliance are not known. Higher compliance in our hospital is likely to be due to low number of high-risk patients identified routinely. We have a limited number of isolation rooms with en-suite facilities. There is significant pressure on these

isolation rooms as patients with other infections such as *Clostridium difficile* also require isolation. Although, at current low levels, it may be feasible to isolate all high-risk patients; it will be a significant burden to isolate all high-risk patients if prevalence increases in the future. This may require revisiting risk factors to balance identification of high-risk patients and pre-emptive isolation. In addition, future strategy of the hospital should include provisions for increasing isolation rooms with en-suite facilities as requirements for such facilities will increase with time due to rising antimicrobial resistance rates. There is already debate about PHE toolkit recommendations due to the burden it places on laboratories and isolation rooms. An analysis (Venanzio et al., 2015) suggested that an alternative strategy of screening high-risk specialties would account for less than one-third of the demand required by the PHE toolkit criteria. We would recommend PHE review the CPE toolkit due to the burden on isolation rooms and laboratories to provide recommendations that can be implemented more easily.

Only ten out of 28 high-risk patients had three CPE screens taken 48 h apart. Nine patients were discharged or died or transferred or completed screening prior to admission or declined screens. There were seven patients who did not complete three CPE screens due to sampling timing errors but they had at least one CPE screen performed. Eight out of 22 patients (36%) were isolated until three screens taken 48 h apart were negative. Isolation status of the remaining 14 patients (64%) was not known as there was no clear documentation. Comprehensive record-keeping by nursing and medical staff is an essential tool for communication between healthcare professionals and there is a professional and legal duty to keep accurate, clear records. Therefore, this should be addressed in mandatory training as well as in an educational campaign targeted for CPE.

Until July 2016, we used a culture-based method for CPE screening. Since July 2016, CPE screening is based on molecular detection which has reduced turnaround time to a few hours from 48 h for a negative result and five days for a positive result. Thus, rapid results enable us to utilise limited isolation rooms more efficiently. It is also debatable whether three screens are needed when a very sensitive method is used to detect CPE. This would also reduce the burden on limited side rooms as patients could come out of isolation earlier due to need for lesser number of screens. However, the optimum number of screens to exclude/confirm CPE is not known. Further research is required in this area. In the meantime, guidance from PHE requires updating to account for molecular testing.

Of 28 patients who had been screened for CPE, two patients were found to have CPE. Both patients remained in isolation until discharge. Both patients had risk factors for CPE on admission. One had been hospitalised in a London hospital and the other in a hospital in Egypt. One was not

identified as high-risk on admission and therefore had the potential to cause an outbreak.

It is important to disseminate findings of this audit to nurses and doctors to raise awareness of the importance of control of CPE spread into and within hospital. Feedback is a useful tool to influence health professional behaviour. We would like to recommend a multifaceted educational campaign through posters displayed on wards, computer screen savers, teaching sessions and newsletter for staff. This campaign should include current status of antimicrobial resistance, information on CPE, reinforcement of need for assessment of risk status on admission, documentation of risk assessment/isolation of patient in patient's records, correct method and timing of sampling for detection of CPE and early liaison with IPC team/microbiologists for further advice on IPC measures and treatment advice.

There are several limitations of our audit. First, it is a small audit with only 150 patients in the first part and 28 patients in the second part of the audit. However, the number of patients in the second part is limited by the number of patients we have screened so far. Second, due to the retrospective nature of audit and poor documentation, we were not able to obtain all the necessary information. This lack of data could have affected compliance to Standards 2–6. A much larger, prospective audit can address both these limitations by real-time collection of required information.

In conclusion, this audit highlights difficulties around screening based on individual risk factors as majority of patients were not screened on admission. However, once a patient is identified as high-risk for CPE, at least half of patients are isolated and screened appropriately. This audit also highlights poor documentation related to isolation and screening.

Key recommendations to improve compliance to our local CPE policy are summarised below.

1. Make CPE screening questions in the admission booklet more prominent to ensure nurses screen all patients and add CPE screening questions on doctor's clerking section of the booklet.
2. Regular reminders to nurses and doctors on the importance of routine CPE assessment on admission and documentation of risk assessment/isolation status in patient records.
3. Disseminate findings of audit to nurses and doctors to provide feedback to raise awareness of the importance control of CPE spread into and within hospital.
4. An educational campaign to improve CPE screening compliance through posters, screen savers, teaching sessions and newsletter for staff.
5. Undertake a prospective point prevalence survey to determine true prevalence of high-risk patients admitted to our hospital.

Once the above have been successfully implemented, the audit standards will be re-audited to assess the impact of these recommendations and identify and further areas of improvement that may be required.

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References

- Central Manchester University Hospitals NHS Foundation Trust. *Infection Prevention and Control Annual Report 2014/2015*. Available at: <https://www.cmft.nhs.uk/media/1425693/infection%20control%20report.pdf> (accessed 1 October 2016).
- Chia G, Qi KJ, Marimuthu K, Fong PB and Ang B. (2016) Identifying patients at high risk for carbapenem-resistant enterobacteriaceae at admission: nurse-led or doctor-led? *Infection Control & Hospital Epidemiology* 37: 238–239.
- Findlay J, Hopkins KL, Doumith M, Meunier D, Wiuff C, Hill R, Pike R, Loy R, Mustafa N, Livermore DM and Woodford N. (2016) KPC enzymes in the UK: an analysis of the first 160 cases outside the North-West region. *Journal of Antimicrobial Chemotherapy* 71: 1199–1206.
- Otter JA, Dyakova E, Bisnauthsing KN, Querol-Rubiera A, Patel A, Ahanonu C, Tosas Auguet O, Edgeworth JD and Goldenberg SD. (2016) Universal hospital admission screening for carbapenemase-producing organisms in a low-prevalence setting. *Journal of Antimicrobial Chemotherapy* 71: 3556–3561.
- Poole K, George R, Decaene V, Shankar K, Cawthorne J, Savage N, Welfare W and Dodgson A. (2016) Active case finding for carbapenemase-producing Enterobacteriaceae in a teaching hospital: prevalence and risk factors for colonization. *Journal of Hospital Infection* 94: 125–129.
- Public Health England. (2013) Acute trust toolkit for the early detection, management and control of carbapenemase-producing Enterobacteriaceae. London: PHE. Available at: <https://www.gov.uk/government/publications/carbapenemase-producing-enterobacteriaceae-early-detection-management-and-control-toolkit-for-acute-trusts>.
- Scott J and Mack D. (2014) Assessing the burden of carbapenemase producing organisms from inter hospital patient transfers and from patients receiving healthcare abroad. Abstracts published at Infection Prevention 2014, Glasgow. *Journal of Infection Prevention* 15: S4. Available at: http://bjj.sagepub.com/content/15/1_suppl/S3.full.
- Venanzio V, Gharbi M, Moore LS, Robotham J, Davies F, Brannigan E, Galletly T and Holmes AH. (2015) Screening suspected cases for carbapenemase-producing Enterobacteriaceae, inclusion criteria and demand. *Journal of Infection* 71: 493–495.