Short Report

Knowledge, attitudes and self-reported practices of healthcare professionals on Carbapenemase Producing Enterobacterales (CPE): A cross sectional study

Shaini Paul Mathew [a], Karin O'Sullivan [b, *], Margaret McCann [b]

[a] Infection Prevention and Control, Tallaght University Hospital, Ireland
[b] School of Nursing & Midwifery, Trinity College Dublin, Ireland

S U M M A R Y

A self-administered validated questionnaire was used to assess the knowledge, attitude and self-reported practices among 109 healthcare professionals in an acute hospital in Ireland on Carbapenemase Producing Enterobacterales. Respondents mean knowledge and self-reported practices scores of CPE were 11.27 ($\pm$2.076) and 6.35 ($\pm$.846), respectively. Nurses self-reported practice scores were significantly higher than doctors ($P<$.001). The mean positive attitude score towards CPE management was 10.06 ($\pm$1.252).

This study demonstrated that healthcare professionals were knowledgeable on the topic of CPE, however there was deficiency in some aspects of knowledge that is relevant to control of CPE transmission.

Introduction

Antimicrobial resistance is a global threat to public health [1] with one such group of resistant bacteria being Carbapenemase Producing Enterobacterales (CPE) [2]. CPE, a cause of healthcare-associated infections, can be transmitted from person to person through contaminated hands, equipment and environment. The prevalence of CPE continues to rise with the number of reported CPE cases increasing by 26% between 2017 and 2018, in Ireland alone [3]. This noted increase may be due to increased surveillance and screening since CPE was declared a national public health emergency in 2017. CPE bloodstream infections are also on the rise [3] illustrating the potential negative impact a diagnosis of CPE may have on the health of an individual. Colonisation with CPE is also a risk to patient wellbeing with a systematic review that included 10 studies (n=1806 patients) observing a 16.5% risk of CPE infection in those already colonized with CPE [4].

The costs involved in managing CPE are substantial with estimates from the United States ranging from $22,484 to $66,031 per single case [5]. Similar high costs are noted in the United Kingdom where a hospital outbreak involving 40 patients over a 10-month period was estimated to cost £1.1 million [6]. To reduce the burden of CPE on patients and on health service

* Corresponding author. School of Nursing and Midwifery, Trinity College Dublin, 24 D'Olier St, Dublin 2, Ireland, 01-896 3298.
E-mail address: kosulli7@tcd.ie (K. O'Sullivan).

expenditure, healthcare facilities have implemented various measures to control CPE including antimicrobial stewardship, infection prevention and control measures, and education and training of healthcare personnel. Existing research on staff knowledge, practices and attitudes mainly focuses on clinicians [7−9]. A study [7] evaluating infection control personnel perceptions of Multi Drug Resistant Organisms (MDRO) noted that the significance of CPE was not known and emphasised the need for targeted education. As healthcare professionals play a major role in the prevention of CPE transmission it is important to gain insight into their knowledge and identify any education needs on this emerging MDRO. The purpose of our study was to explore healthcare professionals' knowledge, attitudes and self-reported practices on CPE in a healthcare setting in Ireland.

Methods

The study hospital, a 562-bed adult acute teaching hospital employs over 3000 staff. Using a cross-sectional descriptive study design, an electronic survey designed by the research team examined registered healthcare professionals' knowledge, attitudes and self-reported practices on CPE. The sample (n=1660) included physicians, nurses and health and social care professionals (Physiotherapists, Occupational Therapists, Dieticians, Speech and Language Therapists and Radiographers). The design of the survey was informed by the literature and included multiple-choice questions assessing knowledge (15 items) and self-reported practices (8 items) while a Likert type scale (11 items) evaluated participants attitudes to CPE. Content validity was assessed by six clinicians. Internal consistency of the attitudes scale was measured, with a Cronbach alpha value of 0.794 (based on n=101 who provided complete data).

The survey, undertaken between 15/02/2021 and 13/04/2021, used Qualtrics software (Qualtrics, Provo, YT) accessed through a weblink and a QR code. Following Research Ethics Committee approval (REC: 2020-03 List 11), invitations were issued via a gatekeeper by email and poster advertisement. The electronic survey required participants consent prior to completing the survey.

Data analysis

Analysis was performed using IBM SPSS V26 (IBM Corp., Armonk, N.Y, USA) with categorical data summarised using frequencies and percentages, and continuous data summarised using means and standard deviation. Scoring for the Attitudes scale was divided into 'Positive attitudes' (Agree, Strongly Agree), and 'Not Positive Attitudes' (Neither Agree nor Disagree, Disagree, Strongly Disagree). Due to the low numbers of respondents from other disciplines only nurses and doctors score related tests are reported as 'Discipline'. Fischer's Exact test and Chi Square were used to explore associations between discipline and scores while mean differences were examined using the Mann Whitney U Test. Statistical significance was set at 0.05. Missing values were not included. Not all respondents provided an answer for each question; analysis was based on valid responses.

Results

The study response rate was 6.5% (n=109). The majority of respondents were nurses (n=83, 76.1%) followed by doctors (n=18, 16.5%) (Table I). Of respondents that identified their title (n=107), these were registered nurses (n=34, 31.7%), nurse managers (n=32, 29.9%), specialist nurses (n=11, 10.2%) and advanced nurse practitioners (n=4, 3.7%). Medical respondents included consultant/registrars (n=9, 8.4%), senior house doctors (n=5, 4.6%) and interns (3.7%, n=4). Respondents worked in medical (58.8%, 53/90) and surgical settings (22.2%, n=20/90), with an additional 6.6% (n=6/90) working across both areas. Other clinical settings included outpatients (3.3%, n=3), theatre (3.3%, n=3), the critical care unit (2.2%, n=2), the emergency department (1%, n=1) and 'other' (2.2%, n=2).

Healthcare professionals mean knowledge score of CPE was 11.27 ($\pm$2.076). Table II outlines the overall number of correct responses for each of the 15 items assessed. Overall, 96.3% of respondents (n=105/109) received knowledge scores >50% with 52.3% (n=55) of those scoring $\geq$80%. There was no significant difference in the mean knowledge scores between nurses and doctors ($U = 620$, $z = -1.145$, $P = .252$) with 94% of doctors (n=17/18) and 98% of nurses (n=81/83) achieving scores >50%. The lower knowledge scores were linked to Items 6, 7, 11, 13, 14, and there were no significant associations between discipline (nurses and doctors) and knowledge scores for these items.

Self-reported practices (8 items) and related scores for each item are set out in Table II. Based on 7 items (Item 6a relates to nursing only) there was a mean score of 6.35 ($\pm$.846) across all disciplines. Self-reported practice scores (7 items) for nurses (mean rank = 55.03) were significantly higher than for doctors (mean rank = 28.38), $U = 329$, $z =$

Table I
Characteristics of participants

	N (%)
Age	109[a]
20−39	49 (45%)
40−59	58 (53.2%)
>60	2 (1.8%)
Highest level of qualification	107[a]
Undergraduate level	29 (27.1%)
Postgraduate level	73 (68.2%)
Other	5 (4.7%)
Professional category	109[a]
Medical Doctor	18 (16.5%)
Nurse	83 (76.1%)
Nutritional and Dietetics	3 (2.8%)
Physiotherapist	4 (3.7%)
Radiographer	1 (0.9%)
Years working at hospital	109[a]
<3 years	41 (37.6%)
3−10 years	29 (26.6%)
>10 years	39 (35.7%)
Time since qualification	108[a]
<3 years qualified	8 (7.4%)
3−10 years qualified	22 (20.3%)
>10 years qualified	78 (72.2%)

[a] Analysis based on this population number.

Table II
Knowledge, self-reported practices and attitude assessment

A. Knowledge (15 items)			
Item	Question - correct answer	*n*	N (%) Correct response
1.	The new terminology CPE (Carbapenemase Producing Enterobacterales) replaces CRE (Carbapenem Resistant Enterobacteriaceae). **Ans: *Yes***	109	80 (73.4%)
2.	CPE colonisation can be detected most commonly by - **Ans: *rectal swab or faeces sample***	109	108 (99.1%)
3.	CPE is a multi-drug - **Ans: resistant *bacteria***	109	100 (91.7%)
4.	CPE is most commonly transmitted through the air. **Ans: *No***	109	100 (91.7%)
5.	CPE is termed as a superbug because it is resistant to the carbapenem group of antibiotics such as meropenem. **Ans: *Yes***	109	98 (89.9%)
6.	The colonisation of CPE is most often treated with antibiotics. **Ans. *No***	109	66 (60.6%)
7.	Which of the following transmission-based precaution signage is used in this hospital for a patient colonised with CPE? **Ans: *Enhanced contact precautions***	108	57 (52.8%)
8.	What is the single most effective way to prevent the spread of CPE- **Ans: *Hand Hygiene***	109	100 (91.7%)
9.	A true CPE contact is a patient who has — **Ans: *shared a multi-bed area with a CPE colonised patient* and *shared toilet facilities with a CPE colonised patient*.**	109	85 (78%)
10.	CPE screening for all inpatients in this hospital should be taken — **Ans: *within 24 hours of admission*.**	109	93 (85.3%)
11.	CPE OXA 48 and CPE KPC can be cohorted in a shared patient room. **Ans: *No***	108	38 (35.2%)
12.	A patient who is CPE colonised should always be isolated in a single room with ensuite facilities if admitted to this hospital. **Ans: *Yes***	108	101 (93.5%)
13.	Which of the following samples are appropriate when screening for CPE in a patient with a colostomy? **Ans: *Stoma Swab*.**	109	43 (39.4%)
14.	A patient who is a true CPE Contact no longer needs isolation on enhanced contact precautions if the patient has a negative screen for CPE — **Ans. *After 28 days from the date of contact*'**	108	60 (55.6%)
15.	Using gloves gives complete protection against the spread of CPE. **Ans. *No***	109	100 (91.7%)

B. Self-Reported Practices (8 Items)			
Item	Question and correct answer	*n*	N (%)
1a.	A patient with newly detected CPE was informed of the result. The patient asks you the next day, "What should I do different when I go home?". What education will you provide? **Ans: *Pay attention to good hand hygiene especially after use of toilet***	107	105 (98.1%)
2a.	It is important to disclose CPE colonisation to another facility before transfer of the patient. **Ans: *Yes***	108	107 (99.1%)
3a.	A patient with CPE colonisation became upset seeing staff gowning up while attending to his needs. How will you explain why you are gowning to the patient? **Ans: *We take these steps to protect you and others***	108	105 (97.2%)
4a.	Who is responsible for informing patients regarding their CPE colonisation? **Ans: *Medical Team***	108	99 (91.7%)
5a.	After using shared equipment on a patient who is CPE colonised, what should happen next? **Ans: *Clean and disinfect the equipment***	108	107 (99.1%)
6a.	Which of the below products are recommended for daily hygiene needs of patients colonised with CPE during the hospital admission? **Ans: *4% Chlorhexidine/Octenisan*'**	82	38 (46.3%)
7a.	A patient who is a true CPE Contact is no longer considered as a true CPE Contact when the — **Ans: *Patient has four negative screens at least one week apart from the date of exposure***	108	69 (63.9%)
8a.	How do you check the infection control status of a patient? **Ans: *KEY system***	108	94 (87%)

C. Attitude assessment (likert scale 11 items)

Item Questions	N	Strongly Disagree n (%)	Disagree n (%)	Neither agree nor disagree n (%)	Agree n (%)	Strongly Agree n (%)
1b. Hand hygiene is an important practice to prevent transmission of CPE	108	-	-	-	4 (3.7%)	104 (96.3%)
2b. There is a risk of transmission of CPE from colonised patients to other patients	108	-	-	1 (0.9%)	18 (16.7%)	89 (82.4%)
3b. I always know what precautions to use if a patient is colonised with CPE	108	3 (2.8%)	7 (6.5%)	13 (12%)	36 (33.3%)	49 (45.4%)
4b. I feel it is important to check the infection status of the patient on admission	106	-	-	1 (0.9%)	14 (13.2%)	91 (85.8%)
5b. Appropriate infection control measures help protect me from contracting infections	108	-	1 (0.9%)	1 (0.9%)	14 (13%)	92 (85.2%)
6b. I believe it is important to screen for CPE	105	-	1 (1.0%)	5 (4.8%)	20 (19%)	79 (75.2%)
7b. I feel it is important to offer hand hygiene to patients after toileting and before meals	108	-	-	-	5 (4.6%)	103 (95.4%)
8b. It is important that my shared patient equipment is decontaminated after each use	107	-	-	-	7 (6.5%)	100 (93.5%)
9b. I know where to look for information on CPE for patients and families	107	5 (4.7%)	15 (14%)	9 (8.4%)	26 (24.3%)	52 (48.6%)
10b. I know where to look for up to date information on CPE to inform myself and my colleagues	106	4 (3.8%)	13 (12.3%)	11 (10.4%)	28 (26.4%)	50 (47.2%)
11b. The potential consequences of CPE infection for the patient is severe so I need to take appropriate precautions as per hospital policy	108	-	-	5 (4.6%)	18 (16.7%)	85 (78.7%)

-3.889, $P < .001$. Of the two low scoring items (6a and 7a), only 46.3% answered Item 6a (nursing only) correctly (n=38/82). There was no significant association between discipline (nurses and doctors) and Item 7a.

Table II also provides detail on healthcare professionals attitudes to CPE (11 items). Respondents mean 'Positive Attitude' score was 10.06 (±1.252). Overall, all healthcare professionals had a 'positive attitude' score >50% and when examined based on a cut off of 80%, a significantly higher proportion of nurses (91.6%, n=76) than doctors (58.8%, n=10) scored ≥80% ($P = .002$). There were three items with lower positive scores, (3b, 9b, 10b). Associations between discipline and 'attitudes score' (positive/not positive) were examined and a significant difference was found in all three. For Item 3b, 84.3% (n=70) of nurses, and 58.8% (n=10) of doctors had positive attitudes, $P = .040$. Regarding Item 9b, 85.4% (n=70) of nurses and 35.3% (n=6) of doctors had positive attitudes, $P < .001$, and for Item 10b, 85.2% (n=69) of nurses and 41.2% (n=7) of doctors scored positively, $P < .001$.

Discussion

CPE is a pathogen of concern in our health care system and community. As hospital-based healthcare professionals are at the frontline of patient prescribing, care and infection related risk assessment, it is important to determine their CPE related knowledge, attitudes and practices. As far as we can tell this is the first study of its kind in Ireland.

Our data showed that overall, healthcare professionals were knowledgeable on the topic of CPE. Scores were comparatively high in relation to other studies assessing CPE knowledge [7–9], although these studies focused on physicians only. A lower scoring item of note related to the statement that the colonisation of CPE is most often treated with antibiotics. CPE is a colonising organism and treatment is indicated only if there is infection associated with the organism. The unnecessary usage of antimicrobials has been a key factor in the emergence of antimicrobial resistance. Insufficient knowledge on appropriate CPE related antibiotic use was also evident in the literature [8]. Other lower scoring knowledge items in this study related to cohorting of patients with differing CPE strains, isolation guidelines, appropriate screening samples for patients with colostomy, and precaution signage.

Overall, good CPE management related practices were found among healthcare professionals. Low scoring practices related to compliance with use of chlorhexidine wash for daily hygiene needs within nursing, and procedures for identifying when patients are no longer considered true CPE contacts. Positive attitude scores were high overall with nurses scoring particularly well (91.6% scored ≥80%). Precaution awareness and the location of information on CPE for healthcare workers, patients and families were among the lower scoring attitude related topics, with nurses scoring significantly higher than their physician counterparts on all of these items.

A limitation of this study was the low response rate. The low response rate may have been due to the survey being released just prior to the emergence of the 3rd surge of COVID-19 in Ireland, having been postponed twice due to earlier waves. Reduced survey response rates during the COVID-19 pandemic have been reported in other healthcare research contexts [10]. Although this survey was completed in one acute hospital it does inform the methodology for conducting a national survey

that will provide a more generalisable understanding of the topic in the Irish context. A strength of our study was the inclusion of nurses allowing for comparison at the level of discipline. This study will help focus education provision and inform where education should be targeted in a way that the learning needs of different healthcare professional groups are met. This study will also help in emphasising information provided during formal infection prevention and control education and orientation training programmes.

Conflicts of interest statement

The authors have no conflicts of interest to declare.

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