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Major Article

Containment of carbapenem-resistant *Enterobacterales* colonisations and infections: Results from an integrated infection control intervention in a large hospital trust of northern Italy

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Key Words:
Antimicrobial stewardship
Rectal carriage

Purpose: We describe the results of an infection control intervention, implemented in 4 tertiary hospitals in Romagna, Italy, aiming at containing the spread of carbapenem-resistant *Enterobacterales* (CRE).
Methods: The intervention consisted of rectal screening in patients at risk for CRE; pre-emptive contact precaution waiting for screening results; timely notification of CRE identification and concomitant computerized alert; contact precaution for confirmed CRE-positive patients. We performed an interrupted time series analysis to compare the incidence of CRE bacteraemia, of other CRE infections, and CRE-positive rectal swabs in the pre and postintervention period (January 2015-July 2017 and August 2017-June 2020, respectively).
Results: 4,332 CRE isolates were collected. *Klebsiella pneumoniae* was the most represented pathogen (n = 3,716, 85%); KPC production was the most common resistance mechanism (n = 3,896, 90%). The incidence rate of CRE bacteraemia significantly decreased from 0.554 to 0.447 episodes per 10.000 patient days in the early postintervention period ($P = .001$). The incidence rate of other CRE infections significantly decreased from 2.09 to 1.49 isolations per 10.000 patient days in the early postintervention period ($P = .021$). The monthly number of rectal swabs doubled in the postintervention period and there was a significant reduction trend of CRE-positive swabs, sustained over time ($P < .001$).
Conclusions: The infection control intervention was successful in containing the spread of CRE infections and colonisations.
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BACKGROUND

The worldwide spread of carbapenem-resistant *Enterobacterales* (CRE) represents one of the biggest public health challenges worldwide.[1] CRE infections are associated with high mortality rates, prolonged hospitalizations, and increased medical costs.[2–5]

Resistance to carbapenems in CRE is mostly based on 2 main mechanisms: (1) production of carbapenemases, (2) decreased outer membrane permeability in combination with the overproduction of β-lactamases such as AmpC cephalosporinase (AmpC) and extended-spectrum β-lactamases.[6] According to the Ambler classification of β-lactamases, carbapenemases are grouped into 3 classes: class A serine β-lactamases (eg, *Klebsiella pneumoniae* carbapenemases, KPCs); class B metallo-β-lactamases (MBL, eg, New Delhi Metallo β-lactamase, NDM-1; Verona integron-encoded metallo-β-lactamase, VIM; imipenem hydrolyzing β-lactamase IMP); class D serine β-lactamases (eg, the oxacillinase OXA-48).[7] *KPCs* are the most prevalent

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carbapenemases among CRE in the majority of epidemiological contexts, particularly in Italy.[8]

KPCs are mostly produced by *K pneumoniae* (Kp), although several *Enterobacterales* can harbor them.[9] KPC-producing Kp (KPC-Kp) has the ability to spread clonally within health care institutions and can be responsible for nosocomial outbreaks.[7] In Italy, KPC-Kp strains have been first observed in 2008[10]; afterward, they showed an alarming spread.[11,12] Such a worrisome scenario called for the implementation of infection control measures, antibiotic stewardship programmes, and public awareness campaigns.[13]

International guidelines proposed specific infection control strategies to prevent CRE transmission in health care settings, including hand hygiene, contact precautions, health care personal education, timely CRE identification and notification from the laboratory, and active surveillance testing.[14–16] At the regional level, a dedicated surveillance system was organized in 2011 in Emilia-Romagna, a region situated in northern Italy; moreover, guidelines for the control of CRE were developed, and implemented in local protocols.[17]

In 2014 a multidisciplinary task force (named "Struttura di programma per la gestione del rischio infettivo ed uso responsabile degli antibiotici"—SPIAR) was established in Romagna, (a subregional area of Emilia-Romagna), aiming at improving the infectious risk management and the antimicrobial use. It includes infectious diseases specialists, microbiologists, hospital hygiene specialists, pharmacists, infectious risk nurses, and statisticians.

In accordance with national and regional recommendations, in August 2017 SPIAR coordinated the implementation of an integrated infection control intervention, in order to contain the spread of CRE in Romagna. The aim of this study was to analyze the impact of this intervention on the incidence of CRE colonization and infection in hospitalized patients.

METHODS

Study setting, design, and procedures

Romagna is a subregional area of Emilia-Romagna, with around 1.110.000 inhabitants, including 3 districts (Forlì-Cesena, Ravenna, and Rimini). The Public Health Care System of Romagna (AUSL Romagna) includes 4 tertiary hospitals, 12 secondary hospitals or primary care centers, 80 long-term care facilities, 14 accredited private hospitals, and 1 Institute for Cancer Treatment and Research, for a total of 4,000 beds. There are 3 infectious disease units, and a centralized microbiology laboratory.

The study intervention was implemented in the 4 tertiary hospitals of AUSL Romagna (Cesena, Forlì, Ravenna, Rimini). These hospitals are characterized by a different epidemiological profile: in 2017 the percentage of CRE over the totality of *Enterobacterales* (isolated from all kinds of clinical samples), was 2% in Cesena and Forlì Hospitals, 3% in Rimini Hospital, and 23% in Ravenna Hospital.[18]

The intervention started in August 2017. January 2015 to July 2017 was considered as a preintervention period, while August 2017 to June 2020 was considered as a postintervention period, for a total of 66 months of surveillance.

The intervention consisted in:

1. Active screening for CRE, based on cultures of rectal swabs, obtained from patients admitted at any hospital ward, who showed at least one risk factor for CRE colonization. The rapid identification of CRE risk factors was performed by the physician firstly admitting the patient, filling in a checklist (shown in Appendix A) expressly introduced in the medical record. The completion of the checklist was compulsory for the physician, in order to be able to further fully access the medical file at patient admission for in-hospital care. In case of identification of risk factors, it was automatically generated a warning note for nurses, containing the prescription of a rectal swab.
2. Pre-emptive instauration of contact precautions (eg, wearing of gowns and gloves before any patient care) and functional contact isolation (ie, physical separation from the other patients to minimize the possibility of contact) for patients who underwent rectal swab, while microbiological results were pending. Contact isolation measures are illustrated in Appendix B.
3. Timely notification (within 24-48 hours) by the laboratory of CRE identification.
4. Introduction of a computerized alert indicating patients with previous and/or current CRE colonization/infection. This information was automatically shared within all the health care facilities of Romagna.
5. Use of contact precautions for CRE colonized and infected patients.
6. Use of single patient rooms (whenever available) or functional contact isolation, for CRE colonized and infected patients.
7. Increased dedicated personnel in Ravenna hospital (1 infectious disease physician, 2 infection risk nurses).
8. Implementation of staff education about prevention of CRE transmission, with special regard to hand hygiene and minimization of device use (eg, central venous catheters and urinary catheters). The educational methods included written protocols, lectures and practical labs. Moreover, a monthly report on the trend of CRE infection and colonizations was diffused.

Definitions

CRE was defined as *Enterobacterales* that are resistant to any carbapenem, and/or with a documented production of carbapenemases.[14] CRE rectal colonization was defined as CRE identification from the rectal swab, in the absence of symptoms and signs of invasive infection. CRE bacteraemia was defined as CRE identification from one or more blood samples. Other CRE-positive cultures from specimens other than blood and rectal swab (eg, urine, bronchoalveolar lavage, tracheal aspirate, wound exudate, surgical specimens, catheter tip, cerebrovascular fluid, and culture from other sites) were defined as other clinical samples.

Microbiology

Rectal swab specimens, screened for CRE carriage, were plated onto a selective chromogenic media bi-plate CHROMID CARBA SMART (bioMérieux) for the isolation of CRE strains. The plates were incubated at 37 °C for 18 hours and then examined for growth. All suspected colony was further identified using the Vitek MS MALDI-ToF (bioMérieux). Species identification was followed by a molecular test (Xpert Carba-R test) to detect the presence of carbapenemase gene sequences from pure colonies (KPC, NDM, VIM, IMP-1, and OXA-48).

Statistical analysis

The incidence of CRE colonization, bacteraemia and positivity of other clinical samples was expressed per 10.000 patient and days. An interrupted time series (ITS) analysis was performed.[19] Time (expressed in trimesters) was considered as the independent variable and CRE colonization, bacteremia, and positivity of other clinical samples as dependent variables. The segmented regression model included an intercept, a baseline trend, a level change after the beginning of the intervention (early effect), and a trend change after the beginning of the intervention (trend sustained over time). Results were expressed as estimate coefficient ± standard error (SE).

The ITS was first performed analysing the whole population of patients. Therefore, patients were disaggregated (in accordance with the local prevalence of CRE) in 2 subpopulations, namely Ravenna Hospital on one hand and Cesena-Forlì-Rimini Hospital on the other hand. The ITS was then performed for each of these subpopulations.

The threshold for statistical significance was set at $P < .05$. All tests were two-tailed. Statistical analysis was performed with STATA 17.2 (StataCorp).

RESULTS

Microbiology

During the study period, 4,332 CRE isolates were collected, 2,139 preintervention and 2,193 postintervention. The most represented pathogen was *K pneumoniae* (n = 3,716, 85%) followed by *E coli* (n = 370, 9%) and *E cloacae* (n = 140, 3%) (Table 1).

KPC production was the most common resistance mechanism (n = 3,896, 90%) followed by MBL (n = 353, 8%) and OXA-48 (n = 92, 2%) production.

CRE were isolated: from blood culture in 143 (6.7%) of cases preintervention and 135 (6.2%) of cases postintervention; from other clinical samples in 556 (26.0%) of cases preintervention and 407 (18.6%) of cases postintervention; from rectal swabs in 1,440 (67.3%) of cases preintervention and 1,649 (75.2%) of cases postintervention.

Table 1
Carbapenem-resistant *Enterobacterales* collected during the pre (n = 2,139) and postintervention (n = 2,193) period: pathogens, associated carbapenemases, and sources of isolation

Pathogen	Preintervention n (%)	Postintervention n (%)
Klebsiella pneumoniae		
Total isolates	**1,907 (89)**	**1,809 (83)**
Source of carbapenem-resistant isolates		
– Rectal swabs	1,243 (65.2%)	1,341 (74%)
– Blood cultures	136 (7.2%)	105 (5.8%)
– Urine	358 (18.8%)	230 (13%)
– BAL/BAS fluids	82 (4.8%)	69 (3.8%)
– Other specimens*	79 (4%)	63 (3.5%)
Resistance mechanisms		
– KPC	1,833 (96)	1,733 (96)
– MBL	66 (3)	41(2)
– OXA-48	8 (1)	35 (2)
Escherichia coli		
Total isolates	**143 (7)**	**227 (10)**
Source of carbapenem-resistant isolates		
– Rectal swabs	119 (83.2%)	199 (87.7%)
– Blood cultures	5 (3.5%)	6 (2.6%)
– Urine	12 (8.4%)	17 (7.5%)
– BAL/BAS fluids	2 (1.4%)	2 (0.9%)
Other specimens*	5 (3.5%)	3 (1.3%)
Resistance mechanisms		
– KPC	109 (76)	171 (75)
– MBL	22 (15)	29 (13)
– OXA-48	12 (8)	27 (12)
Other *Enterobacterales*		
Total isolates	**98 (4)**	**157 (7)**
Source of carbapenem-resistant isolates		
– Rectal swabs	78 (79.6%)	109 (69.4%)
– Blood cultures	2 (2%)	13 (8.3%)
– Urine	4 (4.1%)	13 (8.3%)
– BAL/BAS fluids	5 (5.1%)	11 (7%)
– Other specimens*	9 (9.2%)	11 (7%)
Resistance mechanisms		
– KPC	74 (75)	28 (18)
– MBL	22 (22)	121 (77)
– OXA-48	2 (3)	8 (5)

KPC, *Klebsiella pneumoniae* carbapenemases; *MBL*, metallo-beta-lactamases; *BAL*, bronchoalveolar lavage; *BAS*, bronchoaspirate.
Bold values refer to the number and percentage of isolated pathogens.
*Wound exudate, surgical specimens, catheter tip, cerebrovascular fluid, cultures from other sites.

Incidence of CRE bacteraemia

The incidence rate of CRE bacteraemia was 0.554 episodes per 10.000 patient days during the preintervention period, with a significantly increasing baseline trend (estimate coefficient ± standard error: 0.054 ± 0.017, $P = .005$). It significantly decreased to 0.447 episodes per 10.000 patient days in the early postintervention period (estimate coefficient ± standard error: −0.592 ± 0.152, $P = .001$). In the last year of the postintervention follow-up period, the incidence of CRE bacteraemia showed an increasing trend, but it was not statistically significant ($P = .141$) (Fig. 1A and 2A).

In Ravenna Hospital, the incidence rate of CRE bacteraemia had a significantly increasing baseline trend before the intervention (estimate coefficient ± standard error: 0.153 ± 0.036, $P = .001$). It decreased significantly in the postintervention period, with both an early effect and a decreasing trend sustained over time (estimate coefficient ± standard error: −0.930 ± 0.329, $P = .011$ and −0.170 ± 0.052, $P = .004$, respectively).

There were no significant changes between the pre and postintervention period in the subpopulation of patients from Cesena-Forlì-Rimini Hospitals.

Incidence of other CRE infections

The incidence rate of other CRE infections was 2.09 isolations per 10.000 patient days during the preintervention period, and it was stable over time. It significantly decreased to 1.49 isolations per 10.000 patient days in the early postintervention period (estimate coefficient ± standard error: −1.520 ± 0.603, $P = .021$). Thereafter it remained stable over time.

In Ravenna Hospital, the incidence rate of other CRE infections significantly decreased in the postintervention period. There was not an early effect of the intervention, but the reduction trend was sustained over time (estimate coefficient ± standard error: −0.601 ± 0.148, $P = 0.001$).

There were no significant changes between the pre and postintervention period in the subpopulation of patients from Cesena-Forlì-Rimini Hospitals (Fig. 1B and 2B).

Incidence of CRE-positive rectal colonization

The monthly mean of rectal swabs realized increased from 2,000 swabs per month in the preintervention period, to 4,005 swabs per month in the postintervention period. The monthly mean percentage of positive rectal swabs declined from 4.7% in the preintervention period, to 2% in the postintervention period.

The incidence rate of CRE rectal colonization was 5.545 episodes per 10.000 patient days during the preintervention period, with a significantly increasing baseline trend (estimate coefficient ± standard error: 0.463 ± 0.156, $P = 0.008$). It significantly increased to 6.084 episodes per 10.000 patient days in the postintervention period. In the postintervention period, there was a significant reduction trend, which was sustained over time (estimate coefficient ± standard error: −1.161 ± 0.220, $P < .001$).

In Ravenna Hospital, the incidence rate of CRE-positive rectal swabs had a significantly increasing baseline trend before the intervention (estimate coefficient ± standard error: 1.527 ± 0.312, $P < .001$). It significantly decreased in the postintervention period. There was not an early effect of the intervention, but the reduction trend was sustained over time (estimate coefficient ± standard error: −2.950 ± 0.4431, $P < .001$) (Fig. 1C and 2C).

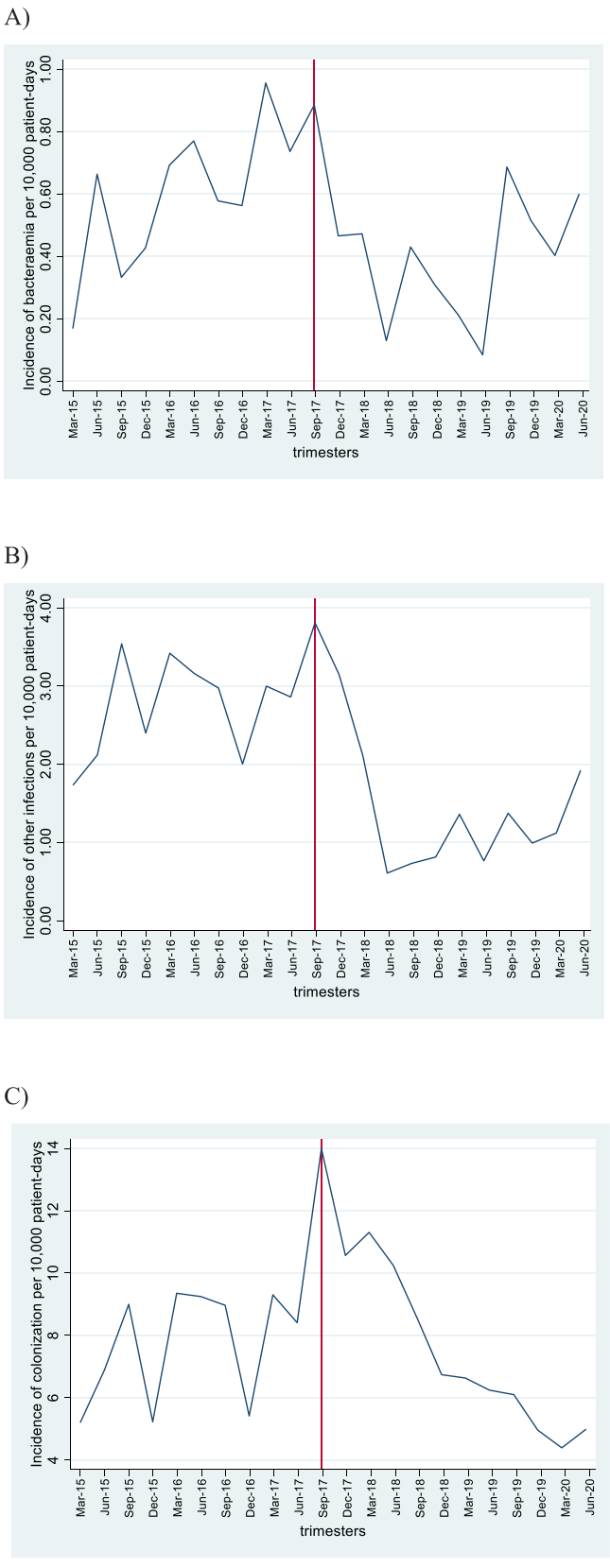

Fig. 1. Incidence rate of carbapenem-resistant *Enterobacterales* during the pre and postintervention period, with regard to (A) Bacteraemia. (B) Other infections. (C) Colonization. The vertical line indicates the intervention.

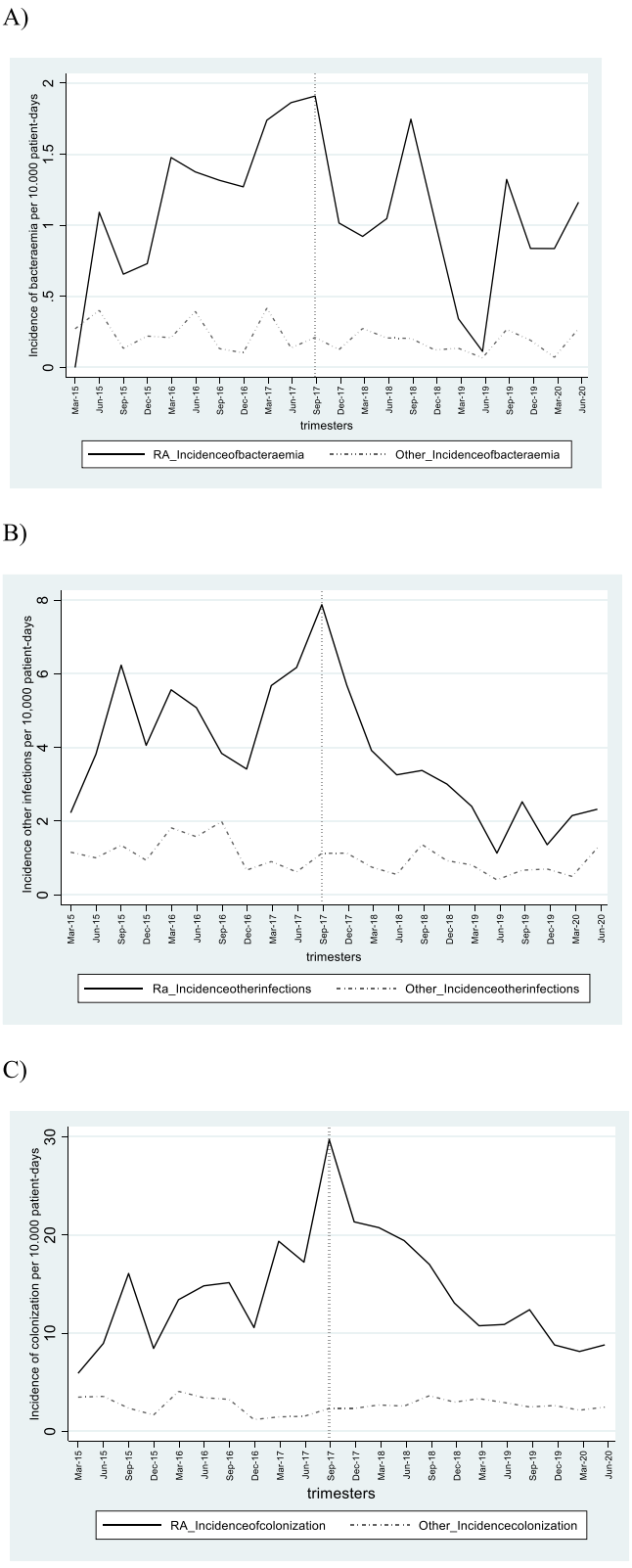

Fig. 2. Incidence of carbapenem-resistant *Enterobacterales* during the pre and post-intervention period, in different Hospitals of AUSL Romagna, with regard to (A) Bacteraemia. (B) Other infections. (C) Colonization. The dotted vertical line indicates the intervention. The black line indicates Ravenna Hospital; the dash-dotted line indicates Cesena-Forlì-Rimini Hospitals.

There were no significant changes between the pre and post-intervention period in the subpopulation of patients from Cesena-Forlì-Rimini Hospitals.

DISCUSSION

In the last decade, CRE became endemic in Italy, even if detailed data showed significant differences of their incidence at regional and even subregional level.[20–22] In 2017, the European Centre for Disease Prevention and Control (ECDC) conducted a visit to Italy to discuss antimicrobial resistance issues. The ECDC confirmed Italy to be one of the European States with the highest levels of multidrug-resistant organisms and stressed the urgent need for specific measures (at national, regional, and local levels) to improve infection control and reduce antibiotic consumption.[22] In November 2017, the Italian Ministry of Health launched a three-year National Plan to fight antimicrobial resistance. The Plan aimed at reducing the incidence of antibiotic-resistant microorganism associated-infections and the incidence of health care–associated infections.[23] The recommendations issued in Emilia-Romagna region in 2011 managed to reduce CPE transmission but with heterogeneous results locally: compliance with regional guidelines was lower in the Ravenna area, generating the need for a strengthened and more targeted intervention in Romagna.[17] The bundle for the containment of CRE spread that we described in this study was implemented in AUSL Romagna in 2017, in accordance with the objectives of the National Plan. It was designed accordingly to the operational framework proposed by the ECDC,[16] and required a relevant organizational effort, in order to coordinate infectious diseases specialists, infection control nurses, microbiologists, pharmacists, statisticians, and technicians. The intervention was associated with a significant reduction in the incidence of CRE bacteraemia and CRE isolation from other clinical samples (other than blood samples and rectal swabs). Moreover, the intervention was associated with a declining incidence of positive rectal swabs in hospitalized patients. These results are consistent with those obtained by other infection control programs realized both in Italy and abroad.[24–29] One strength of our intervention was that the active screening of patients at risk for MDR pathogens was not limited to high-risk setting (such as Intensive Care Units, Haematology wards, or Transplant unit). The screening was performed in all hospital wards and it was based on risk factors for MDR pathogens, which were easy to identify for all clinicians, and based on solid evidence.[30] Moreover, the compulsory nature of the screening procedure (ie, the clinician was obliged to fill-in the checklist for identifying patients to screen) assured adherence to the program.

As recommended by current guidelines,[14,15] this infection control program was associated with educational activities and the progressive implementation of an antimicrobial stewardship (AMS) program. Indeed, it has been demonstrated that AMS programs significantly reduce the incidence of infections and colonisations with antibiotic-resistant bacteria, with an even higher efficacy when combined with infection control measures.[31] The AMS program implemented in AUSL Romagna encompassed several measures, such as the publication of antibiotic treatment guidelines for non-ICU and ICU wards and for surgical prophylaxis; audit and feedback activities about prescription appropriateness and antibiotic consumption; restricted prescription for critical antibiotics; revised procedure for blood culture sampling, in order to reduce contaminations. In terms of carbapenem consumption, these interventions achieved in the 2017 to 2020 period a substantial stabilization, rather than a reduction (data not shown, available upon request). These findings underline that AMS intervention deserves to be associated with infection control measures, in order to achieve an effect on the incidence of MDR pathogens.

As detailed in the Results section, the intervention had a rapid effect in decreasing the prevalence of CRE bacteraemia and CRE isolation from other clinical samples. This result was particularly encouraging for bacteraemia, considering that there was a significant increasing trend before the intervention. Thereafter, following the initial significant decrease, both incidences remained stable (Fig 1). Thus, we can argue that this positive effect was triggered in particular by the improved and more systematic application of infection control measures, with reduced intrahospital transmission of CRE.

The effect of the intervention on the incidence of CRE-positive rectal swabs is more complex to interpret, since the screening criteria changed because of the intervention, and the total number of swabs doubled in the postintervention period. This explains why the incidence rate of CRE-positive rectal swabs per 10.000 patients increased in the post-intervention period. However, in the postintervention period, the monthly mean percentage of positive rectal swabs halved; most importantly, there was a significant decreasing trend of positive swabs, sustained over time (Fig 1). The reduction of carriers has a less evident clinical impact in the short period, but it may play a pivot role in a sustained improvement of local epidemiology.

The analysis of the subpopulations of patients coming from Ravenna Hospital versus Cesena-Forlì-Rimini Hospitals showed some very interesting findings. As outlined in the Setting section, Ravenna Hospital has a markedly superior prevalence of CRE, compared with the other Hospitals, although these tertiary hospitals share a substantially similar range of clinical activities, including medical, surgical, and intensive care wards. The study intervention was efficacious in Ravenna Hospital with regard to CRE bacteraemia, CRE isolation from other clinical samples and CRE-positive rectal swabs. To the contrary, there was substantially no impact in Cesena-Forlì-Rimini. Coherently with this finding, the local epidemiology Report showed that in the 2017 to 2020 period the percentage of *Enterobacterales* being carbapenem-resistant decreased from 23% to 11% in Ravenna, while it remained stable (between 2% and 4%) in Cesena, Forlì and Rimini Hospitals.[18] These findings may suggest that such a strict, work- and time-consuming interventions are particularly needed and worthwhile in a context of high prevalence of CRE.

This study has some limitations, which need to be acknowledged. Due to the nonrandomized nature and the before and after design, we cannot assume that the preintervention and the postintervention populations had the same characteristics. However, since the overall activities and profile of the included hospitals did not undergo significant changes during the study period, we can presume that the case mix remained comparable. For feasibility reasons, the screening of potential CRE carriers was based on relatively few risk factors; thus, we may have missed some carriers not fulfilling those criteria. Moreover, the study was concluded in June 2020, so it substantially did not include the Severe Acute Respiratory Syndrome – CoronaVirus 2 pandemic; in this way, we assured a better homogeneity of pre and postintervention practices and case mix, but at the same time we did not evaluate the possible impact of the pandemic on the evaluated outcomes.

CONCLUSIONS

This study reported the effect of the implementation, in a large hospital area of Northern Italy, of an integrated infection control intervention, mainly based on active and systematic screening of patients at risk for CRE pathogens, and consequent contact isolation of carriers. This intervention was able to contain the spread of CRE-related infections and colonisations, particularly in the setting of Ravenna Hospital, where the preintervention incidence of CRE was higher.

APPENDIX A

Checklist for the identification of risk factors for carriage of carbapenem-resistant *Enterobacteriaceae* (CRE).

The physician who admits the patient identifies the risk factors listed below. The presence of at least one risk factor calls for rectal swab screening.

New admissions.

- Patient admitted to any hospital, long-term care facility, rehabilitation facility, residential homes for elderly, in the last 6 months
- Immunosuppressed patient who received chemotherapy in the last 6 months
- Patient treated with broad-spectrum antibiotics (cephalosporins, fluoroquinolones, carbapenems) in the last 3 months
- Patient known to be colonized/infected by CRE
- None of the above conditions (negative checklist)

Transfers from other wards/facilities

- Patient transferred from another ward after an hospitalization longer than > 90 days
- Patient who underwent surgery in the previous ward
- Patient treated with broad-spectrum antibiotic therapy (cephalosporins, fluoroquinolones, carbapenems) in the previous ward for at least 5 days
- Patient transferred from intensive care unit after a hospitalization longer than 48 hours
- None of the above conditions (negative checklist)

APPENDIX B

Contact isolation measures for patients infected/colonized by carbapenem-resistant *Enterobacterales* or waiting for rectal swab results.

Source isolation.

- Single room (gold standard—provide this solution when possible).
- Isolation by cohort (if there are several positive cases with the same microorganism, eg, epidemic cluster). It entails placing all positive cases in the same room.
- Spatial/functional isolation. It entails creating an area within a multibed room exclusive for the infected and colonized patient, with physical separation from the other patients to minimize the possibility of contact. Prefer placement with patients at low risk for acquiring multidrug-resistant germs. In this case, take the following precautions:

– Arrange a support in the patient's area containing the necessary essential material;
– Minimize stocks of disposable material;
– Organize care activities in order to reduce the frequency of entrances and exits from the patient's area;
– Avoid placing the medical records or the Personal Computer on the surfaces of the patient unit as they are potential vehicles for the transmission of microorganisms.

Hand hygiene.

Respect the WHO (World Health Organization) 5 moments for hand hygiene through the use of hydroalcoholic gel. Remember that, after contact with spore-producing germs (eg, *Clostridioides difficile*) or parasitic diseases, it is necessary to wash your hands with simple soap and water after removing the gloves.

Barrier clothing/personal protective equipment.

- Gloves: indicated for contact with the patient or with his environment/equipment, excluding activities with a low risk of contamination for which it is sufficient to practice hand hygiene.
- Coat: indicated only for carrying out care maneuvers at risk of transmission that involve direct physical contact, for example, hygienic care, physiotherapy.

Devices/ facilities

Whenever possible, use disposable material and equipment or assign multipurpose material for each patient (eg, pulse oximeter, stethoscope, etc.). If these aids are to be used for other patients, proceed with adequate reconditioning according to current procedures and as indicated in the technical data sheet.

Environmental hygiene

Chlorine derivative 2,700 parts per million at the end of care activities (in addition to the scheduled environmental cleaning steps).

Information/health education

- Inform and report the presence of microorganism(s) transmissible by contact within the Medical Record so that other services adopt the appropriate precautionary measures;
- Provide guidance to patients, caregivers and visitors on general hygiene rules, for example, hand hygiene, respiratory hygiene, correct management of toilets if not dedicated (use supporting tools such as information brochures).

Management of waste and linen at infective risk

Only materials at risk of transmitting infections should be disposed of in containers for infectious waste and linen. Materials not contaminated by infectious biological fluids that are produced in the rooms of patients placed in isolation for multidrug-resistant organisms and which must therefore be disposed of in the black bag are not hazardous waste with an infectious risk.

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