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Major Article

Universal versus targeted additional contact precautions for multidrug-resistant organism carriage for patients admitted to an intensive care unit

Michel Djibré MD [a,*], Samuel Fedun MD [a], Pierre Le Guen MD [a], Sophie Vimont PD, PhD [b,c], Mehdi Hafiani MD [a,c], Jean-Pierre Fulgencio MD [a], Antoine Parrot MD [a], Michel Denis MD [d], Muriel Fartoukh MD, PhD [a,c]

[a] Unité de Réanimation et USC médico-chirurgicale, Hôpital Tenon des Assistance Publique-Hôpitaux de Paris, Paris, France
[b] Service de Bactériologie-Hygiène, Hôpital Tenon, Assistance Publique-Hôpitaux de Paris, Paris, France
[c] Sorbonne Universités, UPMC Univ, Paris, France
[d] Service de Maladies Infectieuses et Tropicales, Hôpital Tenon, Assistance Publique-Hôpitaux de Paris, Paris, France

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Background: Although additional contact precautions (ACPs) are routinely used to reduce cross-transmission of multidrug-resistant organisms (MDROs), the relevance of isolation precautions remains debated. We hypothesized that the collection of recognized risk factors for MDRO carriage on intensive care unit (ICU) admission might be helpful to target ACPs without increasing MDRO acquisition during ICU stays, compared with universal ACPs.

Materials and Methods: This is a sequential single-center observational study performed in consecutive patients admitted to a French medical and surgical ICU. During the first 6-month period, screening for MDRO carriage and ACPs were performed in all patients. During the second 6-month period, screening was maintained, but ACP use was guided by the presence of at least 1 defined risk factor for MDRO.

Results: During both periods, 33 (10%) and 30 (10%) among 327 and 297 admissions were, respectively, associated with a positive admission MDRO carriage. During both periods, a second screening was performed in 147 (45%) and 127 (43%) patients. Altogether, the rate of acquired MDRO (positive screening or clinical specimen) was similar during both periods (10% [n = 15] and 11.8% [n = 15], respectively; $P = .66$).

Conclusions: The results of our study contribute to support the safety of an isolation-targeted screening policy on ICU admission compared with universal screening and isolation regarding the rate of ICU-acquired MDRO colonization or infection.

During the past decade, the prevalence of multidrug-resistant organisms (MDROs) has dramatically increased in Europe and worldwide, both in the hospital and the community. This increase is mainly due to the dissemination of extended spectrum β-lactamase-producing Enterobacteriaceae (ESBLE), and to a lesser extent to emerging extensively drug-resistant organisms such as glycopeptide-resistant *Enterococcus* sp (GRE) and carbapenem-resistant Enterobacteriaceae.[1,2] Moreover, MDRO colonization is a recognized risk factor (RF) for developing MDRO infection.[3,4] Infections caused by MDROs are reputed to be associated with a poor prognosis, with a greater rate of antimicrobial therapy failures,[5,6] a more prolonged hospital length of stay, and a higher mortality rate.[7,8] The recommendations for the prevention of cross-transmission of the French Society of Hospital Hygiene do not advocate a routine screening policy for MDRO, either on intensive care unit (ICU) admission or during ICU stay, except during outbreaks. The Centers for Disease Control and Prevention international recommendations[9] endorse additional contact precautions (ACPs) (wearing gown and gloves) in case of MDRO colonization or infection. However, those recommendations may not be implemented in a timely fashion to minimize cross-transmission, if MDRO carriage is not routinely screened for. Although ACPs are routinely used to control the spread of MDROs, the relevance of isolation precautions remains debated,[10,11] resulting in a great heterogeneity of practices in ICUs.[12] Many uncontrolled

* Address correspondence to Michel Djibré, MD, Hôpital Tenon, Assistance Publique–Hôpitaux de Paris, 04 rue de la Chine, 75020 Paris, France.
E-mail address: michel.djibre@tnn.aphp.fr (M. Djibré).
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series have provided mixed results favoring ACP effectiveness.[13-16] Two recent cluster randomized controlled trials conducted in medical and surgical ICUs[17,18] did not find significant differences between universal preemptive ACPs and standard precautions (SPs), alone or with universal gloving, in the acquisition of methicillin-resistant *Stapylococcus aureus* (MRSA) or GRE. The difficulty in analyzing the effectiveness of ACPs is due to the multimodal nature of the measures used to limit MDRO spread:[19] hand hygiene compliance,[20] surfaces cleaning,[21] presence of individual lavatories,[22] use of single rooms, and type of unit (ICU or other unit). The use of ACPs is typically associated with psychological and financial drawbacks, and possibly lower quality of care, although these data have been recently questioned.[23,24] Additional costs may be observed when human resources or materials are required.[25]

RFs for MDRO carriage or infection (especially ESBLE) have been described,[26-28] but a clinical tool to guide isolation is still lacking, resulting in a delayed implementation of ACPs of 24 to 96 hours according to the techniques used.[29,30]

We hypothesized that the collection of recognized risk factors for MDRO carriage on ICU admission might be helpful to target ACPs without increasing MDRO acquisition during ICU stay compared with universal ACPs.

MATERIALS AND METHODS

Ethics

This study was approved by all participating wards. No ethical approval was necessary for this observational study that includes routine care according to the French law.

Study design

We conducted a sequential study during 2 consecutive 6-month periods in a 20-bed medical and surgical ICU of a French university-affiliated hospital. Our ICU has only single rooms and individual washing basins. Gloves, gowns, sinks, and bins are available inside the rooms, whereas alcohol-based handrub solution is available inside and outside each room and on the entire unit (hallways, medical offices, nurse monitoring stations, and maintenance room).

During the first period (June-November 2012), rectal swabs were routinely obtained on admission, and were associated with preemptive ACPs pending the results of cultures that were obtained 48 to 72 hours thereafter. Polymerase chain reaction methods were not used in our hospital.

During the second period (February-August 2013), all consecutively admitted patients were systematically screened on admission with a rectal swab, but preemptive ACPs were implemented only for patients having at least 1 RF for MDRO carriage. A priori defined, selected RFs were collected from the patient or his or her relatives and from the medical records: exposure to antibiotics within the preceding 3 months, hospitalization within the preceding year, admission of another hospital department with a hospital stay of more than 5 days, immunosuppression (defined by the existence of HIV, active cancer, or immunosuppressive therapy), chronic dialysis, transfer from rehabilitation, long-term-care unit or nursing home, and travel abroad within 1 year. A risk index (RI) was calculated by the sum of RFs. When RI was ≥1, preemptive isolation with ACPs was associated with SPs. Otherwise, SPs alone were performed.

During both periods, a rectal swab was performed on admission, searching for ESBLE or carbapenem-resistant Enterobacteriaceae carriage. Due to a very low infection rate with MRSA or GRE in our ICU, corresponding screening was guided by the presence of individual RFs.

The SPs included hand hygiene, protective gowns, and gloves in case of risk of contact with blood or body fluids, and gloves in case of lesions on a health care worker's hands. The ACPs included hand hygiene at room entrance and exit, wearing gowns during contact with patient and bodily fluids, wearing gloves as part of SPs, and door signs at the room entrance stating "isolation screening" or "isolation confirmed." Oral information was given to the patients and relatives. The ACPs were maintained in case of screening or clinical sample for MDROs, on admission or during hospitalization. A weekly screening for MDROs by rectal swab was performed.

Eligibility

Patients who did not have MDRO screening on admission, and patients who were already known carriers, either infected or colonized with MDROs, were not included.

Measurements

Demographic and clinical characteristics were collected during both periods, including age, sex, comorbidities, main reason for ICU admission, Simplified Acute Physiology Score II score, ICU length of stay, and mortality.

Bacteriologic samples, screening, and clinical specimens included date of collection, MDRO culture results, bacterial species identification, and resistance type. A positive screening or clinical specimen for MDROs was considered imported when the sample was taken before the first 72 hours of ICU admission; otherwise, it was acquired.

All swabs and clinical samples were analyzed at the Tenon Hospital Microbiology Laboratory according to a standardized protocol following the recommendations of the French National Society for Microbiology (European Manual of Clinical Microbiology 2012). The results were available on the hospital intranet and communicated by telephone within 48 hours. There was neither intervention between the 2 periods to improve hand hygiene compliance, nor changes in barrier precaution procedures or in hospital or ICU antibiotic stewardship programs.

Statistical analysis

The primary outcome was the rate of MDRO acquisition during ICU stay. Results are reported as median and interquartile range (25th-75th) and numbers and percentages for quantitative and qualitative variables, respectively, unless otherwise stated. Demographic characteristics and clinical data were analyzed using the χ^2 test or the Fisher exact test for categorical data, and the nonparametric Mann Whitney *U* test for continuous variables.

Crude associations between each potential predictor and MDRO carriage were quantified by the odds ratio and the corresponding 95% confidence intervals. Predictors analyzed included the baseline characteristics and the clinical characteristics and laboratory values on ICU admission. The variables stratified in several classes were dichotomized into binary variables, according to their distribution in univariate analysis and their clinical relevance. *P* values < .05 were considered statistically significant. Independent predictors of MDRO carriage were then determined using multivariate logistic regression models. The number of events per variable entered in the final multivariate model averaged a ratio of 1 to 10 to avoid overfitting. Variables entered in the multivariate model were associated with a *P* value ≤ .20 in the univariate analysis. A goodness-of-fit test (Hosmer-Lemeshow) and the area under the receiver operating characteristic curve were performed to assess calibration and discrimination of the model. For isolation strategies based on the presence of one or more RFs, sensitivity, specificity, negative predictive value, and positive predictive value were calculated. Stata software (StataCorp, College Station, TX) was used for analysis.