Journal of Hospital Infection 97 (2017) 59–63

Available online at www.sciencedirect.com

Journal of Hospital Infection

journal homepage: www.elsevierhealth.com/journals/jhin

Short report

Contribution and limits of clinical specimens for the screening of intestinal multi-drug-resistant bacteria in view of laboratory automation

A. Geraud de Galassus [a], F. Cizeau [a], A. Agathine [a], C. Domrane [a], D. Ducellier [a], V. Fihman [a], J-W. Decousser [a,b,*]

[a] Laboratory of Bacteriology and Infection Control, Department of Microbiology, Assistance Publique–Hôpitaux de Paris, University Hospital Henri Mondor, Créteil, France
[b] University Paris East Créteil, Créteil, France

ARTICLE INFO

Article history:
Received 1 April 2017
Accepted 1 June 2017
Available online 6 June 2017

Keywords:
ESBL
VRE
CPE
Screening
Carriage
Clinical specimen
Laboratory
Diagnosis

SUMMARY

The detection of multi-drug-resistant bacteria carriers constitutes a race against time for infection preventionists. Alongside standard analysis for diagnostic purposes and a rectal screening strategy, the authors tested a heavy-loaded selective method against 562 clinical specimens from 439 patients to detect extended-spectrum beta-lactamase-producing (ESBL) or carbapenemase-producing Enterobacteriaceae (CPE) and vancomycin-resistant enterococci (VRE). The approach identified five more specimens positive for ESBL-producing Enterobacteriaceae than standard analysis, and six out of nine known VRE/CPE carriers (three new CPE/VRE strains were also identified in this cohort). In view of the ongoing automation of laboratories, this approach focusing on urine and stool specimens may be an alternative or complementary approach to dedicated rectal screening.

Introduction

After antimicrobial stewardship, prevention of cross-transmission is the cornerstone in the battle against multi-drug-resistant bacteria (MDR-B); emerging extensively-drug-resistant bacteria (eXDR-B), such as carbapenemase-producing Enterobacteriaceae (CPE) and vancomycin-resistant enterococci (VRE), present a particular challenge [1]. At the time of hospital admission of a putative carrier, infection control measures should be implemented as soon as possible, preferably during the first 48 h of hospitalization, to prevent secondary cases [2]. Among MDR-B, the worldwide spread of extended-spectrum beta-lactamase (ESBL)-producing Enterobacteriaceae in both community and hospital

* Corresponding author. Address: Laboratory of Bacteriology and Infection Control, Department of Microbiology, Assistance Publique–Hôpitaux de Paris, University Hospital Henri Mondor, 94000 Créteil, France.
E-mail address: jean-winoc.decousser@aphp.fr (J-W. Decousser).

http://dx.doi.org/10.1016/j.jhin.2017.06.001
0195-6701/

settings has led to questions regarding the contribution, cost and return on investment of universal screening at admission [1]. A mandatory targeted screening strategy for eXDR-B has been implemented in France to identify, as quickly as possible, carriers among patients who have previously been hospitalized abroad [3]. This programme appears to be efficient, decreasing the number of associated outbreaks and the number of secondary cases, when aggressive barrier precautions are implemented pre-emptively [2]. Nevertheless, compliance with such targeted screening is incomplete because of factors such as lack of time and/or interest of medical prescribers, the need to obtain rectal swabs that may be upsetting for patients, and language barriers that hamper explanations to the patient concerning the reasons and objectives of screening. Due to the paramount importance of early identification of carriers, several alternative or additional strategies have been proposed, including a nurse-led strategy to screen high-risk patients, and routine screening of clinical specimens sent to the laboratory for infection diagnosis purposes [4,5]. To address the latter, this study evaluated the putative contribution of testing routine clinical specimens for intestinal MDR-B using a standard protocol or a dedicated heavy-loaded selective method; the results were compared with the results from routine rectal screening programme. Finally, this paper discusses the findings in view of the ongoing automation of clinical bacteriology laboratories.

Methods

Study design

Over the course of seven weeks (April/May 2016), all clinical specimens received at the Bacteriology Laboratory, Henri Mondor Hospital Group, Créteil, France — a 4000-bed tertiary care teaching hospital — were collected from patients covered by the mandatory targeted screening for eXDR-B [3]. Patients were informed of their participation in the study. Only specimens from non-sterile sites were subsequently studied. Urine samples were collected on V-Monovette with boric acid (Sarstedt AG & Co, Nümbrecht, Germany), wound samples were collected using the Copan Liquid Amies Elution Swab Collection and Transport System (Eswab, Copan Diagnostics, Brescia, Italy), and other specimens were taken on sterile receptacles without additives.

Microbiological study

Standard management of clinical specimens

Samples were first processed by standard laboratory methods, based on the recommendations of the European Society of Clinical Microbiology and Infectious Diseases [6]. They were inoculated on non-selective agar plates using a WASP instrument (Copan Diagnostics, Brescia, Italy) [7]. The limit of detection of the WASP instrument was 1 colony-forming unit (cfu)/90 μL (equivalent to 12 cfu/mL). For urine and ESwab samples, patterns based on a 10-μL loop were used, whereas for bronchopulmonary samples, a 30-μL-loop protocol was implemented after a manual volume-to-volume dilution with mucolytic SL solution (Copan Diagnostics) [7].

Selective heavy-loaded protocol for clinical specimens

Two hundred microlitres of each specimen was plated manually on to selective plates using disposable sterile rakes. The following selective agar plates were tested to detect ESBL-producing Enterobacteriaceae, CPE and VRE, respectively: chromID VRE, ESBL, CARBA and OXA-48 (bioMérieux, Craponne, France). Numbers of bacteria growing were assessed quantitatively, and expressed as cfu/mL.

Routine rectal eXDR screening protocol

The results of routine eXDR-B rectal screening using the Eswab tubes and chromID VRE, CARBA and OXA-48 selective plates were collected in parallel throughout each patient's stay.

Bacterial and resistance gene identification

Bacterial identification was performed using matrix-assisted laser desorption ionization—time of flight mass spectrometry according to the manufacturer's recommendations (Andromas, Beckman Coulter, Villepinte, France). Resistance genes in CPE and VRE were detected by polymerase chain reaction using the Cepheid Xpert vanA/vanB and the Carba-R assays (Cepheid, Sunnyvale, CA, USA); the targeted genes were *van*A, *van*B, bla_{KPC}, bla_{NDM}, bla_{VIM}, bla_{OXA-48} (including variants as $bla_{OXA-181}$) and bla_{IMP-1}. The assays were run on the GeneXpert platform (Cepheid) in accordance with the manufacturer's instructions.

Performance evaluation

The rate of ESBL-producing Enterobacteriaceae carriage and ESBL species distribution were established for routine microbiological analysis and the specific heavy-loaded protocol. The carriage rate and types of eXDR-B detected by routine microbiological analysis, the specific heavy-loaded protocol and eXDR-B rectal screening were compared.

Laboratory automation: costs and consequences

For the two most frequent clinical specimens (i.e. urine and stool specimens), the authors measured the inoculation time of the WASP instrument for the standard protocol and for the standard protocol supplemented with selective agar plates, as described previously (chromID VRE, ESBL, CARBA and OXA-48), and the new chromID CARBA SMART plate that is a media bi-plate combining the CARBA and the OXA-48 screening medium. Moreover, the possibility of enhancing the inoculated volume upto 90 μL per plate was tested. The additional cost of each protocol related to consumption of screening agar plates was calculated.

Results

During the study period, 562 clinical specimens from 439 patients and 33 different wards were tested according to the study flow diagram (Figure 1). The specimen types examined were as follows: urine (66%), stool (10%), respiratory tract specimens (8%), bile (4%) and other (12%). The heavy-loaded selective method detected ESBL-producing Enterobacteriaceae four times more often than the standard protocol: 8% (44/562) vs 1.6% (9/562) (Table I). Although all ESBL-positive urine samples were identified using the standard protocol,