# Document details

‹ Back to results | 1 of 1



Pathogens Open Access
Volume 8, Issue 3, September 2019, Article number 151

## Comparative study of CDST & multiplex PCR to detect MBL producing gram-negative bacilli among VAP patients admitted in a public medical college hospital of Bangladesh (Article) (Open Access)

Nusrat, T.[a], Akter, N.[a], Haque, M.[b], Rahman, N.A.A.[c], Dewanjee, A.K.[d], Ahmed, S.[e], Rozario, D.T.D.[f]

[a]Department of Microbiology, Chattogram Medical College, Chattogram, 4217, Bangladesh
[b]Unit of Pharmacology, Faculty of Medicine and Defence Health, Universiti Pertahanan Nasional Malaysia, National Defence University of Malaysia, Kem Sungai Besi, Kuala Lumpur, 57000, Malaysia
[c]Department of Basic Health, Kulliyyah of Allied Health Sciences, International Islamic University Malaysia, Jalan Sultan Ahmad Shah, Bandar Indera Mahkota, Kuantan, 25200, Malaysia

View additional affiliations

## Abstract

View references (65)

Background: Ventilator-associated pneumonia (VAP) is the most common nosocomial infection in intensive care units (ICU), which accounts for 25% of all ICU infection. Documenting carbapenem-resistant gram-negative bacilli is very important as these strains may often cause outbreaks in the ICU setting and are responsible for the increased mortality and morbidity or limiting therapeutic options. The classical phenotypic method cannot provide an efficient means of diagnosis of the metallo-β-lactamases (MBLs) producer. PCR (Polymerase chain reaction) assays have lessened the importance of the phenotypic approach by detecting metallo-β-lactamase resistance genes such as NDM （New Delhi metallo-β-lactamase）, IMP （Imipenemase）, VIM （Verona integron-encoded metallo-β-lactamase）, SPM （Sao Paulo metallo-β-lactamase）, GIM (Germany imipenemase）. Objective: To compare the results of the Combined Disc Synergy Test (CDST) with that of the multiplex PCR to detect MBL-producing gram-negative bacilli. Materials and Method: A total of 105 endotracheal aspirates (ETA) samples were collected from the ICU of a public school in Bangladesh. This cross-sectional study was carried out in the Department of Microbiology, Chittagong for quantitative culture, CDST test, and multiplex PCR for $bla_{IMP}$, $bla_{VIM}$, $bla_{NDM}$ genes of MBL producers. Results: Among the 105 clinically suspected VAP cases, the quantitative culture was positive in 95 (90%) and among 95 g-negative bacilli isolated from VAP patients, 46 (48.42%) were imipenem resistant, 30 (65.22%) were MBL producers by CDST, 21 (45.65%) were identified as MBL producers by multiplex PCR. Conclusion: PCR was highly sensitive and specific for the detection of MBL producers. © 2019 by the authors. Licensee MDPI, Basel, Switzerland.

## SciVal Topic Prominence

Topic: Pneumonia, Ventilator-Associated | Pneumonia | Pneumonia HAP

Prominence percentile: 90.850

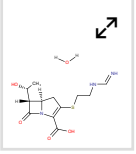


## Related documents

Ventilator associated Pneumonia a challenge in intensive care unit acquired infection
Sarkar, M. , Raj, H.J. , Ghosh, T.K.
*(2016) Bangladesh Journal of Medical Science*

Bacteriological profile of ventilator associated pneumonia (VAP) and their antibiotic susceptibility - A prospective study
Sharvani, R. , Usha, M.G.
*(2017) Journal of Pure and Applied Microbiology*

Superbugs causing ventilator associated pneumonia in a tertiary care hospital and the return of pre-antibiotic era!
Qureshi, S. , Agrawal, C. , Madan, M.
*(2015) Indian Journal of Medical*




## Author keywords

BAL | Bronchoalveolar lavage | CDST test | MBL | Metallo-β-lactamases | Multiplex PCR | VAP

**ISSN:** 20760817
**DOI:** 10.3390/pathogens8030151
**Source Type:** Journal
**Document Type:** Article
**Original language:** English
**Publisher:** MDPI AG


## References (65)

View in search results format >

All | Export | Print | E-mail | Save to PDF | Create bibliography


1 Kalanuria, A.A., Zai, W., Mirski, M.

Ventilator-associated pneumonia in the ICU (Open Access)

(2014) *Critical Care*, 18 (2), art. no. 208. Cited 148 times.
http://ccforum.com/content/18/2/208
doi: 10.1186/cc13775

View at Publisher

2 Haque, M., Sartelli, M., McKimm, J., Bakar, M.A.

Health care-associated infections – An overview (Open Access)

(2018) *Infection and Drug Resistance*, 11, pp. 2321-2333. Cited 32 times.
http://www.dovepress.com/infection-and-drug-resistance-journal
doi: 10.2147/IDR.S177247

View at Publisher

3 Bhadade, R., Harde, M., DeSouza, R., More, A., Bharmal, R.

Emerging trends of nosocomial pneumonia in intensive care unit of a tertiary care public teaching hospital in Western India

(2017) *Annals of African Medicine*, 16 (3), pp. 107-113. Cited 4 times.
http://www.annalsafrmed.org/backissues.asp
doi: 10.4103/aam.aam_7_17

View at Publisher

4 Hassan, Z.M., Wahsheh, M.A.

Knowledge level of nurses in Jordan on ventilator-associated pneumonia and preventive measures

(2017) *Nursing in Critical Care*, 22 (3), pp. 125-132. Cited 9 times.
http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1478-5153/issues
doi: 10.1111/nicc.12273

View at Publisher

5 Dey, A., Bairy, I.
Incidence of multidrug-resistant organisms causing ventilator-associated pneumonia in a tertiary care hospital: A nine months' prospective study

(2007) *Annals of Thoracic Medicine*, 2 (2), pp. 52-57. Cited 34 times.

View at Publisher

6 Luna, C.M., Aruj, P., Niederman, M.S., Garzón, J., Violi, D., Prignoni, A., Ríos, F., (...), Menga, G.
Appropriateness and delay to initiate therapy in ventilator-associated pneumonia (Open Access)

(2006) *European Respiratory Journal*, 27 (1), pp. 158-164. Cited 173 times.
doi: 10.1183/09031936.06.00049105

View at Publisher

7 Scholte, J.B.J., Van Dessel, H.A., Linssen, C.F.M., Bergmans, D.C.J.J., Savelkoul, P.H.M., Roekaerts, P.M.H.J., Van Mook, W.N.K.A.
Endotracheal aspirate and bronchoalveolar lavage fluid analysis: Interchangeable diagnostic modalities in suspected ventilator-associated pneumonia? (Open Access)

(2014) *Journal of Clinical Microbiology*, 52 (10), pp. 3597-3604. Cited 18 times.
http://jcm.asm.org/content/52/10/3597.full.pdf+html
doi: 10.1128/JCM.01494-14

View at Publisher

8 Khilnani, G.C., Arafath, T.K., Hadda, V., Kapil, A., Sood, S., Sharma, S.K.
Comparison of bronchoscopic and non-bronchoscopic techniques for diagnosis of ventilator associated pneumonia

(2011) *Indian Journal of Critical Care Medicine*, 15 (1), pp. 16-23. Cited 17 times.
doi: 10.4103/0972-5229.78218

View at Publisher

9 Koenig, S.M., Truwit, J.D.
Ventilator-associated pneumonia: Diagnosis, treatment, and prevention (Open Access)

(2006) *Clinical Microbiology Reviews*, 19 (4), pp. 637-657. Cited 207 times.
doi: 10.1128/CMR.00051-05

View at Publisher

10 Shin, Y.M., Oh, Y.-M., Kim, M.N., Shim, T.S., Lim, C.-M., Lee, S.D., Koh, Y., (...), Hong, S.-B.
Usefulness of quantitative endotracheal aspirate cultures in intensive care unit patients with suspected pneumonia (Open Access)

(2011) *Journal of Korean Medical Science*, 26 (7), pp. 865-869. Cited 8 times.
http://www.jkms.org/Synapse/Data/PDFData/0063JKMS/jkms-26-865.pdf
doi: 10.3346/jkms.2011.26.7.865

View at Publisher

11 Zaccard, C.R., Schell, R.F., Spiegel, C.A.

Efficacy of bilateral bronchoalveolar lavage for diagnosis of ventilator-associated pneumonia (Open Access)

(2009) *Journal of Clinical Microbiology*, 47 (9), pp. 2918-2924. Cited 14 times.
http://jcm.asm.org/cgi/reprint/47/9/2918
doi: 10.1128/JCM.00747-09

View at Publisher

12 Prats, E., Dorca, J., Pujol, M., Garcia, L., Barreiro, B., Verdaguer, R., Gudiol, F., (...), Manresa, F.

Effects of antibiotics on protected specimen brush sampling in ventilator-associated pneumonia (Open Access)

(2002) *European Respiratory Journal*, 19 (5), pp. 944-951. Cited 43 times.
doi: 10.1183/09031936.02.00239302

View at Publisher

13 Li, Y., Gong, Z., Lu, Y., Hu, G., Cai, R., Chen, Z.

Impact of nosocomial infections surveillance on nosocomial infection rates: A systematic review (Open Access)

(2017) *International Journal of Surgery*, 42, pp. 164-169. Cited 6 times.
http://www.elsevier.com/wps/find/journaldescription.cws_home/705107/description#description
doi: 10.1016/j.ijsu.2017.04.065

View at Publisher

14 McCann, E., Srinivasan, A., Andrew DeRyke, C., Ye, G., DePestel, D.D., Murray, J., Gupta, V.

Carbapenem-nonsusceptible Gram-negative pathogens in ICU and non-ICU settings in US hospitals in 2017: A multicenter study (Open Access)

(2018) *Open Forum Infectious Diseases*, 5 (10). Cited 17 times.
https://academic.oup.com/ofid
doi: 10.1093/ofid/ofy241

View at Publisher

15 Porwal, R., Gopalakrishnan, R., Rajesh, N.J., Ramasubramanian, V.

Carbapenem resistant Gram-negative bacteremia in an Indian intensive care unit: A review of the clinical profile and treatment outcome of 50 patients

(2014) *Indian Journal of Critical Care Medicine*, 18 (11), pp. 750-753. Cited 12 times.
http://www.ijccm.org/
doi: 10.4103/0972-5229.144021

View at Publisher

16 Dortet, L., Poirel, L., Nordmann, P.

Worldwide dissemination of the NDM-Type carbapenemases in Gram-negative bacteria (Open Access)

(2014) *BioMed Research International*, 2014, art. no. 249856. Cited 211 times.
http://www.hindawi.com/journals/biomed/
doi: 10.1155/2014/249856

View at Publisher

17 Codjoe, F.S., Donkor, E.S.
Carbapenem resistance: A review
(2017) *Med. Sci*, 6. Cited 59 times.

18 Petersen-Morfin, S., Bocanegra-Ibarias, P., Morfin-Otero, R., Garza-González, E., Perez-Gomez, H.R., González-Diaz, E., Esparza-Ahumada, S., (...), Rodriguez-Noriega, E.
New delhi metallo-beta-lactamase (Ndm-1)-producing klebsiella pneumoniae isolated from a burned patient
(2017) *American Journal of Case Reports*, 18, pp. 805-809. Cited 4 times.
http://www.amjcaserep.com/download/index/idArt/903992
doi: 10.12659/AJCR.903992
View at Publisher

19 Caliendo, A.M., Gilbert, D.N., Ginocchio, C.C., Hanson, K.E., May, L., Quinn, T.C., Tenover, F.C., (...), Infectious Diseases Society of America (IDSA)
Better tests, better care: improved diagnostics for infectious diseases.
(2013) *Clinical infectious diseases : an official publication of the Infectious Diseases Society of America*, 57 Suppl 3, pp. S139-170. Cited 265 times.

20 Aydemir, O., Aydemir, Y., Ozdemir, M.
The role of multiplex PCR test in identification of bacterial pathogens in lower respiratory tract infections (Open Access)
(2014) *Pakistan Journal of Medical Sciences*, 30 (5). Cited 11 times.
http://www.pjms.com.pk/index.php/pjms/article/download/5098/2659
doi: 10.12669/pjms.305.5098
View at Publisher

21 Dogonchi, A.A., Ghaemi, E.A., Ardebili, A., Yazdansetad, S., Pournajaf, A.
Metallo-β-lactamase-mediated resistance among clinical carbapenem-resistant Pseudomonas aeruginosa isolates in northern Iran: A potential threat to clinical therapeutics (Open Access)
(2018) *Tzu Chi Medical Journal*, 30 (2), pp. 90-96. Cited 7 times.
http://www.tcmjmed.com/backissues.asp
doi: 10.4103/tcmj.tcmj_101_17
View at Publisher

22 Lund, M., Petersen, M.B., Jørgensen, A.L., Paulmann, D., Wang, M.
Rapid real-time PCR for the detection of IMP, NDM, VIM, KPC and OXA-48 carbapenemase genes in isolates and spiked stool samples
(2018) *Diagnostic Microbiology and Infectious Disease*, 92 (1), pp. 8-12. Cited 4 times.
www.elsevier.com/locate/diagmicrobio
doi: 10.1016/j.diagmicrobio.2018.04.002
View at Publisher

23 Fallah, F., Borhan, R.S., Hashemi, A.
Detection of bla (IMP) and bla (VIM) metallo-β-lactamases genes among Pseudomonas aeruginosa strains
(2013) *Int. J. Burns Trauma*, 3, pp. 122-124. Cited 35 times.

24 Hong, D.J., Bae, I.K., Jang, I.-H., Jeong, S.H., Kang, H.-K., Lee, K.
Epidemiology and characteristics of metallo-ß-lactamase-producing Pseudomonas aeruginosa (Open Access)

(2015) *Infection and Chemotherapy*, 47 (2), pp. 81-97. Cited 81 times.
http://www.icjournal.org/Synapse/Data/PDFData/0086IC/ic-47-81.pdf
doi: 10.3947/ic.2015.47.2.81

View at Publisher

25 Craven, D.E., Chroneou, A., Zias, N., Hjalmarson, K.I.
Ventilator-associated tracheobronchitis; the impact of targeted antibiotic therapy on patient outcomes

(2009) *Chest*, 135 (2), pp. 521-528. Cited 109 times.
http://www.chestjournal.org/content/135/2/521.full.pdf+html
doi: 10.1378/chest.08-1617

View at Publisher

26 Medcalculator
(2019) *Free Statistical Calculator: Diagnostic Test Evaluation Calculator*
https://www.medcalc.org/calc/diagnostic_test.php

27 Ali, S.Q., Zehra, A., Naqvi, B.S., Shah, S., Bushra, R.
Resistance pattern of ciprofloxacin against different pathogens (Open Access)

(2010) *Oman Medical Journal*, 25 (4), pp. 294-298. Cited 23 times.
http://www.omjournal.org/
doi: 10.5001/omj.2010.85

View at Publisher

28 (2019) *Performance Standards for Antimicrobial Disk Susceptibility Tests, 29Th Ed.* Cited 149 times.
CLSI Supplement M100: Wayne, PA, USA

29 Jing, X., Zhou, H., Min, X., Zhang, X., Yang, Q., Du, S., Li, Y., (...), Zhan, Y.
The simplified carbapenem inactivation method (SCIM) for simple and accurate detection of carbapenemase-producing gram-negative bacilli
(2018) *Front. Microbiol.*, 9, p. 2391. Cited 5 times.

30 Hodiwala, A., Dhoke, R., Urhekar, A.D.
Incidence of mettalo-beta-lactamase producing pseudomonas, acinetobacter & enterobacterial isolates in hospitalized patients
(2013) *IJPBS*, 3, pp. 79-83. Cited 6 times.

31 Khosravi, Y., Loke, M.F., Chua, E.G., Tay, S.T., Vadivelu, J.
Phenotypic detection of metallo-β-lactamase in imipenem-resistant pseudomonas aeruginosa (Open Access)

32 Yong, D., Lee, K., Yum, J.H., Shin, H.B., Rossolini, G.M., Chong, Y.
Imipenem-EDTA disk method for differentiation of metallo-β-lactamase-producing clinical isolates of Pseudomonas spp. and Acinetobacter spp. (Open Access)

(2002) *Journal of Clinical Microbiology*, 40 (10), pp. 3798-3801. Cited 314 times.
doi: 10.1128/JCM.40.10.3798-3801.2002

View at Publisher

33 Sachdeva, R., Sharma, B., Sharma, R.
Evaluation of different phenotypic tests for detection of metallo-β-lactamases in imipenem-resistant Pseudomonas aeruginosa
(2017) *J. Lab. Physicians.*, 9, pp. 249-253. Cited 5 times.

34 Mehta, A., Prabhu, T.
Detection and characterization of metallo-β-lactamases producing Pseudomonas aeruginosa clinical isolates at a tertiary care
(2016) *Int. J. Res. Med. Sci.*, 4, pp. 4084-4088. Cited 2 times.

35 Mohanam, L., Menon, T.
Coexistence of metallo-beta-lactamase-encoding genes in Pseudomonas aeruginosa (Open Access)

(2017) *Indian Journal of Medical Research, Supplement*, 146, pp. 46-52. Cited 5 times.
http://icmr.nic.in/ijmr/2017/july_supp/7.pdf
doi: 10.4103/ijmr.IJMR_29_16

View at Publisher

36 Mishra, S., Upadhyay, S., Sen, M.R., Maurya, A.P., Choudhury, D., Bhattacharjee, A.
Genetic acquisition of NDM gene offers sustainability among clinical isolates of Pseudomonas aeruginosa in clinical settings (Open Access)

(2015) *PLoS ONE*, 10 (1), art. no. e0116611. Cited 5 times.
http://www.plosone.org/article/fetchObject.action?uri=info:doi/10.1371/journal.pone.0116611&representation=PDF
doi: 10.1371/journal.pone.0116611

View at Publisher

37 Joshi, P.R., Acharya, M., Kakshapati, T., Leungtongkam, U., Thummeepak, R., Sitthisak, S.
Co-existence of bla $_{OXA-23}$ and bla $_{NDM-1}$ genes of Acinetobacter baumannii isolated from Nepal: Antimicrobial resistance and clinical significance (Open Access)

(2017) *Antimicrobial Resistance and Infection Control*, 6 (1), art. no. 21. Cited 16 times.
http://www.aricjournal.com/
doi: 10.1186/s13756-017-0180-5

View at Publisher

38 Feldman, C., Richards, G.
Appropriate antibiotic management of bacterial lower respiratory tract infections [version 1; referees: 2 approved] (Open Access)

39 Dey, A., Bairy, I.
Incidence of multidrug-resistant organisms causing ventilator-associated pneumonia in a tertiary care hospital: A nine months' prospective study

(2007) *Annals of Thoracic Medicine*, 2 (2), pp. 52-57. Cited 34 times.

View at Publisher

40 Baselski, V., Klutts, J.S.
Quantitative cultures of bronchoscopically obtained specimens should be performed for optimal management of ventilator-associated pneumonia (Open Access)

(2013) *Journal of Clinical Microbiology*, 51 (3), pp. 740-744. Cited 10 times.
http://jcm.asm.org/content/51/3/740.full.pdf+html
doi: 10.1128/JCM.03383-12

View at Publisher

41 Jourdain, B., Novara, A., Joly-Guillou, M.-L., Dombret, M.-C., Calvat, S., Trouillet, J.-L., Gibert, C., (...), Chastre, J.
Role of quantitative cultures of endotracheal aspirates in the diagnosis of nosocomial pneumonia

(1995) *American Journal of Respiratory and Critical Care Medicine*, 152 (1), pp. 241-246. Cited 126 times.
http://ajrccm.atsjournals.org/
doi: 10.1164/ajrccm.152.1.7599831

View at Publisher

42 Pugin, J., Auckenthaler, R., Mili, N., Janssens, J.-P., Lew, P.D., Suter, P.M.
Diagnosis of ventilator-associated pneumonia by bacteriologic analysis of bronchoscopic and nonbronchoscopic 'blind' bronchoalveolar lavage fluid

(1991) *American Review of Respiratory Disease*, 143 (5 I), pp. 1121-1129. Cited 775 times.

View at Publisher

43 Rajasekhar, T., Anuradha, K., Suhasini, T., Lakshmi, V.
The role of quantitative cultures of non-bronchoscopic samples in ventilator associated pneumonia

(2006) *Indian Journal of Medical Microbiology*, 24 (2), pp. 107-113. Cited 22 times.

View at Publisher

44 Azarudeen, M., Sharma, B.S., Jain, P.K., Goyal, A.K., Malhotra, B.
Study of quantitative bacterial cultures of non-bronchoscopic samples in ventilator-associated pneumonia
(2018) *Int. J. Contemp. Pediatr.*, 5, pp. 1837-1843.

45 Lipovy, B., Rihová, H., Gregorova, N., Hanslianova, M., Zaloudikova, Z., Kaloudova, Y., Brychta, P.
Epidemiology of ventilator-associated tracheobronchitis and ventilator-associated pneumonia in patients with inhalation injury at the burn centre in Brno (Czech Republic)

(2011) *Annals of Burns and Fire Disasters*, 24 (3), pp. 120-125. Cited 14 times.
http://www.medbc.com/annals/review/vol_24/num_3/text/vol24n3p120.pdf

46 Goel, V., Hogade, S.A., Karadesai, S.G.
Ventilator associated pneumonia in a medical intensive care unit: Microbial aetiology, susceptibility patterns of isolated microorganisms and outcome (Open Access)

(2012) *Indian Journal of Anaesthesia*, 56 (6), pp. 558-562. Cited 10 times.
http://www.ijaweb.org/article.asp?issn=0019-5049;year=2012;volume=56;issue=6;spage=558;epage=562;aulast=Goel;type=2
doi: 10.4103/0019-5049.104575

View at Publisher

47 Ranjan, N., Chaudhary, U., Chaudhry, D., Ranjan, K.P.
Ventilator-associated pneumonia in a tertiary care intensive care unit: Analysis of incidence, risk factors and mortality

(2014) *Indian Journal of Critical Care Medicine*, 18 (4), pp. 200-204. Cited 20 times.
doi: 10.4103/0972-5229.130570

View at Publisher

48 Bonten, M.J.M., Kollef, M.H., Hall, J.B.
Risk factors for ventilator-associated pneumonia: From epidemiology to patient management (Open Access)

(2004) *Clinical Infectious Diseases*, 38 (8), pp. 1141-1149. Cited 141 times.
doi: 10.1086/383039

View at Publisher

49 Arumugam, S.K., Mudali, I., Strandvik, G., El-Menyar, A., Al-Hassani, A., Al-Thani, H.
Risk factors for ventilator-associated pneumonia in trauma patients: A descriptive analysis
(2018) *World J. Emerg. Med.*, 9, pp. 203-210. Cited 5 times.

50 Ali, H.S., Khan, F.Y., George, S., Shaikh, N., Al-Ajmi, J.
Epidemiology and outcome of ventilator-associated pneumonia in a heterogeneous ICU population in Qatar (Open Access)

(2016) *BioMed Research International*, 2016, art. no. 8231787. Cited 8 times.
http://www.hindawi.com/journals/biomed/
doi: 10.1155/2016/8231787

View at Publisher

51 Panchal, C.A., Oza, S.S., Mehta, S.J.
Comparison of four phenotypic methods for detection of metallo-β-lactamase-producing Gram-negative bacteria in rural teaching hospital
(2017) *J. Lab. Physicians*, 9, pp. 81-83. Cited 3 times.

52 Solanki, R., Vanjari, L., Subramanian, S., Aparna, B., Nagapriyanka, E., Lakshmi, V.
Comparative evaluation of multiplex PCR and routine laboratory phenotypic methods for detection of carbapenemases among gram negative Bacilli (Open Access)

(2014) *Journal of Clinical and Diagnostic Research*, 8 (12), pp. DC23-DC26. Cited 12 times.
http://www.jcdr.net/articles/PDF/5322/10794_CE%28Ra%29_F%28Sh%29_PF1%28SNAK%29_PFA%28Sh%29.pdf

53 Khosravi, Y., Loke, M.F., Chua, E.G., Tay, S.T., Vadivelu, J.
Phenotypic detection of metallo-β-lactamase in imipenem-resistant pseudomonas aeruginosa (Open Access)

(2012) *The Scientific World Journal*, 2012, art. no. 654939. Cited 13 times.
doi: 10.1100/2012/654939

View at Publisher

54 Picão, R.C., Andrade, S.S., Nicoletti, A.G., Campana, E.H., Moraes, G.C., Mendes, R.E., Gales, A.C.
Metallo-β-lactamase detection: Comparative evaluation of double-disk synergy versus combined disk tests for IMP-, GIM-, SIM-, SPM-, or VIM-producing isolates (Open Access)

(2008) *Journal of Clinical Microbiology*, 46 (6), pp. 2028-2037. Cited 92 times.
doi: 10.1128/JCM.00818-07

View at Publisher

55 Ranjan, S., Banashankari, G.S., Babu, P.R.
Evaluation of phenotypic tests and screening markers for detection of metallo-β-lactamases in clinical isolates of Pseudomonas aeruginosa: A prospective study
(2015) *Med. J. DY Patil Univ.*, 8, pp. 599-605. Cited 5 times.

56 Meletis, G., Exindari, M., Vavatsi, N., Sofianou, D., Diza, E.
Mechanisms responsible for the emergence of carbapenem resistance in Pseudomonas aeruginosa

(2012) *Hippokratia*, 16 (4), pp. 303-307. Cited 50 times.
http://www.hippokratia.gr/images/16-4/pdf/16,303-307.pdf

57 Martins, A.F., Borges, A., Pagano, M., Dalla-Costa, L.M., Barth, A.L.
False-positive results in screening for metallo-β-lactamase are observed in isolates of Acinetobacter baumannii due to production of oxacilinases (Open Access)

(2013) *Brazilian Journal of Infectious Diseases*, 17 (4), pp. 500-501. Cited 3 times.
doi: 10.1016/j.bjid.2013.01.010

View at Publisher

58 Begum, N., Shamsuzzaman, S.M.
Emergence of carbapenemase-producing urinary isolates at a tertiary care hospital in Dhaka, Bangladesh (Open Access)

(2016) *Tzu Chi Medical Journal*, 28 (3), pp. 94-98. Cited 8 times.
http://www.health.elsevier.com
doi: 10.1016/j.tcmj.2016.04.005

View at Publisher

59 Poirel, L., Lagrutta, E., Taylor, P., Pham, J., Nordmann, P.
Emergence of metallo-β-lactamase NDM-1-producing multidrug-resistant Escherichia coli in Australia (Open Access)

(2010) *Antimicrobial Agents and Chemotherapy*, 54 (11), pp. 4914-4916. Cited 193 times.
http://aac.asm.org/cgi/reprint/54/11/4914

60 Nasrin, T., Jilani, M.S.A., Barai, L., Haq, J.A.
Metallo-ß-lactamase producing Pseudomonas species in a tertiary care hospital of Dhaka City
(2010) *Bangladesh J. Med. Microbiol.*, 4, pp. 43-45. Cited 5 times.

61 Islam, M.A., Talukdar, P.K., Hoque, A., Huq, M., Nabi, A., Ahmed, D., Talukder, K.A., (...), Endtz, H.P.
Emergence of multidrug-resistant NDM-1-producing Gram-negative bacteria in Bangladesh

(2012) *European Journal of Clinical Microbiology and Infectious Diseases*, 31 (10), pp. 2593-2600. Cited 43 times.
doi: 10.1007/s10096-012-1601-2

View at Publisher

62 Sugawara, Y., Akeda, Y., Hagiya, H., Sakamoto, N., Takeuchi, D., Shanmugakani, R.K., Motooka, D., (...), Hamada, S.
Spreading patterns of NDM-producing Enterobacteriaceae in clinical and environmental settings in Yangon, Myanmar (Open Access)

(2019) *Antimicrobial Agents and Chemotherapy*, 63 (3), art. no. e01924-18. Cited 6 times.
https://aac.asm.org/content/aac/63/3/e01924-18.full.pdf
doi: 10.1128/AAC.01924-18

View at Publisher

63 Ahmad, N., Khalid, S., Ali, S.M., Khan, A.U.
Occurrence of $bla_{NDM}$ variants among enterobacteriaceae from a neonatal intensive care unit in a Northern India hospital (Open Access)

(2018) *Frontiers in Microbiology*, 9 (MAR), art. no. 407. Cited 8 times.
https://www.frontiersin.org/articles/10.3389/fmicb.2018.00407/full
doi: 10.3389/fmicb.2018.00407

View at Publisher

64 Kumarasamy, K.K., Toleman, M.A., Walsh, T.R., Bagaria, J., Butt, F., Balakrishnan, R., Chaudhary, U., (...), Woodford, N.
Emergence of a new antibiotic resistance mechanism in India, Pakistan, and the UK: A molecular, biological, and epidemiological study (Open Access)

(2010) *The Lancet Infectious Diseases*, 10 (9), pp. 597-602. Cited 1831 times.
doi: 10.1016/S1473-3099(10)70143-2

View at Publisher

65 Khatun, M.N., Farzana, R., Lopes, B.S., Shamsuzzaman, S.M.
Molecular characterization and resistance profile of nosocomial Acinetobacter baumannii in intensive care unit of tertiary care hospital in Bangladesh

(2015) *Bangladesh Medical Research Council Bulletin*, 41 (2), pp. 101-107.
http://www.banglajol.info/index.php/BMRCB/article/view/29991/20103

View at Publisher

Haque, M.; Unit of Pharmacology, Faculty of Medicine and Defence Health, Universiti Pertahanan Nasional Malaysia, National Defence University of Malaysia, Kem Sungai Besi, Kuala Lumpur, Malaysia;
email:runurono@gmail.com