Infections acquired in intensive care units (ICUs) are a major health concern worldwide, particularly in developing countries. Patients admitted to ICUs are at an increased risk for acquiring device-associated nosocomial infections (DANIs) because of their debilitated immune systems and exposure to invasive devices. Device use is recognized as creating a high risk of catheter-associated urinary tract infections (CAUTIs), central line-associated bloodstream infections (CLABSIs), and ventilator-associated pneumonia (VAP) in ICU patients. They are considered a principal threat to patient safety and are among the main causes of morbidity, mortality, and increased costs.

Data using standardized international case definitions and methodology on DANIs rates from different ICUs worldwide are published through the International Nosocomial Infection Control Consortium (INICC) network. Analysis of the data showed that DANIs were identified as the most common site of infection was ETT (39.2%), followed by urinary catheters (19%), NGTs (18%), tracheostomy tubes (11%), CVCs (10%), and chest tubes (3%). The most frequently isolated organisms were Klebsiella pneumonia, Acinetobacter baumannii, and Pseudomonas aeruginosa (30%, 20%, and 14%, respectively). Extremely high resistance rates were observed among GNB to ampicillin (99%), cefuroxime (95%), amoxicillin-clavulante (92%), and nitrofurantoin (91%). Lower levels of resistance were exhibited to amikacin (38%), imipenem (38%), and colistin (29%). About 39% of the isolates were defined as multi-drug resistant (MDR). Overall, extended spectrum β-lactamase producers were expressed in 39% of isolates mainly among K. pneumonia (88%). A. baumannii isolates exhibited extremely high levels of resistance to all antibiotics except colistin (100% sensitive). In addition, 56.3% of A. baumannii isolates were found to be MDR. P. aeruginosa isolates showed 46%–55% effectiveness to anti-pseudomonas antibiotics.

Conclusions: High rates of DANIs and the emergence of MDR organisms poses a serious threat to patients. There is a need to strengthen infection control within the ICU environment, introduce surveillance systems, and implement evidence-based preventive strategies.
pneumonia, and urinary tract infections in ICU patients.\textsuperscript{11-13} Antibiotic resistance among GNB are increasing continuously\textsuperscript{14,15} and surveillance studies across the world have demonstrated an increase in resistance especially in critically ill patients.\textsuperscript{16}

The aim of our study was to determine the distribution of DANIs and the microbiological and antibiotic resistance profiles of the infecting pathogens. To the best of our knowledge, this is the first study of its kind in Libya.

**METHODS**

Between January and December 2014, we evaluated patients who developed DANIs in the trauma/surgical intensive care unit (SICU) at Abusalim Trauma Hospital, Tripoli, Libya, which provides care for both ventilated and non-ventilated patients. The hospital is a 500-bed tertiary referral and teaching hospital and the ICU comprises of two rooms with a total of 10 beds and no barriers between patients. There are only two single isolation rooms.

A nosocomial infection was defined as an infection that developed 48 hours after admission and up to 10 days after discharge from hospital (in accordance with the CDC criteria).\textsuperscript{2,10,17} Data were obtained from ICU daily reports, microbiology laboratory reports, and patient medical charts.

All devices associated with nosocomial infections, including central venous catheters (CVCs), endotracheal tubes (ETTs), Foley’s urinary catheters, chest tubes, nasogastric tubes (NGT), and tracheostomy tubes were removed aseptically and the distal 5cm of the devices was removed and cultured using a standardized method.\textsuperscript{18} Isolated organisms were identified to the species level and tested for their susceptibility to a variety of antimicrobial agents using the BD Phoenix Automated Microbiology System (BD Diagnostic Systems, Sparks, Md, USA) and employed a Gram-negative panel, which was inoculated according to the manufacturer’s instructions. Reading and interpretation of panels was also performed according to the manufacturer’s instructions. Standardized methods were used to detect extended-spectrum ß-lactamase (ESBL) producers.\textsuperscript{19} All specimens were collected under approved ethical standards. This study was approved by the administration. Quality control was performed by testing \textit{Escherichia coli} ATCC 25922, \textit{Pseudomonas aeruginosa} ATCC 27853, and \textit{Klebsiella pneumoniae} ATCC 700603.

Only consecutive, non-duplicate, and GNB were included in the study. Multidrug resistant bacteria (MDR) were defined as showing resistance to three different classes of antibiotics such as fluoroquinolones, aminoglycosides, and cephalosporins.\textsuperscript{20} Infections occurring at more than one site due to different organisms in the same patient were reported as separate infection events.

The clinical outcome was assessed until hospital discharge or death. Patients were considered to have appropriate antimicrobial therapy if the isolated organism was susceptible to a previous antimicrobial regimen within the first 24 hours of clinical infection.

**RESULTS**

During the one-year study period, 363 patients were hospitalized in the ICU. The mortality rate was 29%, and 30% of discharged patients (serious cases) were transferred abroad for advanced medical treatment. A total of 79 DANIs were identified during the study period; their distribution is shown in Table 1.

VAP, CLABSI, and CAUTI were studied. The leading DANI was ETT (39%), followed by Foley’s urinary catheters (19%), NGT (18%) tracheostomy tubes (11%), CVCs (10%), and chest tubes (3%). The most frequently isolated organisms were \textit{K. pneumonia}, \textit{A. baumannii}, and \textit{P. aeroginosa} (30%, 20%, and 14%, respectively). Other isolates included: \textit{Serattia marcescens}, \textit{E. coli}, \textit{Providencia stuartii}, and \textit{Enterobacter aerogenes}. All \textit{E. cloacae} isolates were associated in ETT. Similarly \textit{Proteus mirabilis} were mainly isolated from NGTs.

There was a variable degree of resistance against commonly used antibiotics. Extremely high resistance rates were observed to ampicillin (99%), cephalothin (95%), cefuroxime (95%), amoxicillin-clavulante (92%), and nitrofurantoin (91%). High levels of resistance were detected in third generation cephalosporines ceftriaxone (85%) and ceftazidine (73%), cefepime (70%), and fluoroquinolones ciprofloxacin (73%) and levofloxacin (73%). High rates of resistance were also demonstrated to cefoxitin (84%), ertapenem (79%), azteronam (77%), gentamicin (72%), piperacillin-tazobactam (66%), trimethoprim-sulfamethoxazole (56%), and meropenem (49%). On the other hand, lower levels of resistance were exhibited to amikacin (38%), ampicillin, cefuroxime, and azteronam (92%).
imipenem (38%), and colistin (29%). Overall MDR were detected in 39% of isolates. ESBL producers were expressed in 39% of isolates mainly K. pneumonia (88%) and K. ozaenae (100%). The pattern of resistance of the three most commonly isolated GNB, K. pneumonia, A. baumannii, and P. aeruginosa, can be seen in Table 2.

A. baumannii isolates exhibited extremely high level of resistance to all tested antibiotics (75–100%), except colistin (100% sensitive). Out of 16 isolates, nine (56%) were found to be MDR. Resistance of K. pneumonia isolates to imipenem (17%) and amikacin (25%) antibiotics were the least compared to the majority of other tested antibiotics

Table 1: Distribution of DANIs and related microorganisms.

| Microorganisms   | n (%) | Devices n (%) |
|------------------|-------|---------------|
|                  |       | ETT 31 (39)   | CAUTI 15 (19) | NGT 14 (18) | Tracheostomy 9 (11) | CVC 8 (10) | Chest tube 2 (3) |
| K. pneumonia     | 24 (30) | 8 | 5 | 5 | 3 | 2 | 1 |
| A. baumannii     | 16 (20) | 6 | 6 | 3 | 0 | 1 | 0 |
| P. aeruginosa    | 1 (14) | 5 | 1 | 1 | 4 | 0 | 0 |
| Pro. mirabilis   | 6 (8) | 1 | 0 | 3 | 0 | 2 | 0 |
| E. cloacae       | 4 (5) | 4 | 0 | 0 | 0 | 0 | 0 |
| Ser. marcescens  | 4 (5) | 3 | 0 | 0 | 0 | 0 | 1 |
| K. ozaenae       | 4 (5) | 0 | 1 | 0 | 2 | 1 | 0 |
| Other            | 10 (13) | 4 | 2 | 2 | 0 | 2 | 0 |

ETT: endotracheal tubes; CAUTI: catheter-associated urinary tract infection; NGT: nasogastric tubes; CVC: central venous catheters.

Table 2: Percentage of resistance rates of major isolates associated with DANIs

| Antibiotic            | Organisms (percentage resistance) |
|-----------------------|-----------------------------------|
|                       | K. pn. n=24 | K. oz. n=4 | A. ba. n=16 | P. ae. n=11 | E. cl. n=4 | Pr. mi. n=6 | Se. ma. n=4 | Others n=10 |
| Amikacin              | 25 | 0 | 81 | 36 | 0 | 17 | 0 | 50 |
| Gentamicin            | 79 | 100 | 100 | 64 | 0 | 50 | 75 | 50 |
| Ertapenem             | 92 | 100 | 94 | 100 | 25 | 17 | 25 | 60 |
| Imipenem              | 17 | 25 | 94 | 36 | 0 | 33 | 0 | 40 |
| Meropenem             | 50 | 75 | 94 | 46 | 0 | 17 | 0 | 30 |
| Cephalothin           | 92 | 0 | 100 | 100 | 100 | 83 | 100 | 100 |
| Cefuroxim             | 92 | 100 | 100 | 100 | 100 | 67 | 100 | 90 |
| Cefotixin            | 70 | 75 | 100 | 100 | 100 | 33 | 100 | 50 |
| Cefazidim             | 92 | 100 | 100 | 55 | 0 | 17 | 25 | 80 |
| Ceftriaxon            | 92 | 100 | 100 | 100 | 0 | 67 | 75 | 70 |
| Cefepine              | 83 | 100 | 100 | 46 | 25 | 33 | 25 | 50 |
| Azitronam             | 92 | 100 | 100 | 64 | 0 | 17 | 75 | 60 |
| Ampicillin           | 100 | 100 | 100 | 100 | 100 | 83 | 100 | 100 |
| Amoxicillin/clavulanic | 92 | 100 | 100 | 100 | 100 | 50 | 100 | 90 |
| Piperacillin/tazobactam | 88 | 100 | 100 | 46 | 0 | 0 | 0 | 40 |
| Colistin              | 25 | 0 | 0 | 0 | 25 | 100 | 100 | 50 |
| Trimeroprim-sulfamethoxazole | 59 | 0 | 75 | 64 | 0 | 67 | 0 | 60 |
| Nitrofurantant        | 83 | 100 | 100 | 100 | 50 | 83 | 100 | 60 |
| Ciprofl oxacin        | 83 | 100 | 100 | 55 | 25 | 67 | 25 | 70 |
| Levofloxacin          | 79 | 100 | 94 | 55 | 25 | 67 | 0 | 70 |

K. pn.: K. pneumonia; K. oz.: K. ozaenae; A. ba.: A baumannii; P. ae.: P. aeruginosa; E. cl.: E. cloacae; Pr. mi.: Pro. mirabilis; S. ma.: Ser. Marcescens.
(79%–100%). ESBL producers were detected in 21 out of 24 (88%) isolates of K. pneumonia. The anti-pseudomonas antibiotics, which include cefepime, piperacillin-tazobactam, and ceftazidime showed effectiveness to P. aeruginosa isolates (46%, 46%, and 55%, respectively). Only four of 11 (36%) P. aeruginosa isolates were considered MDR.

**DISCUSSION**

Infection control measures that include intensive surveillance can reduce the incidence of nosocomial infections. Therefore, standards of institutional HAI surveillance and infection control have been adopted in developed countries.16,21

The overall mortality was 29% due to the fact that the majority of patients suffered gunshot wounds, blasts and blunts. The mortality rate of our trauma/SICU patients was higher than Thailand (20%).22 In Ethiopia, the mortality rate among patients (aged 21–30 years old) admitted to SICU was 9%.23 A meta-analysis reported lower trauma mortality rate (13%) than that found in our study.24 The incidence and mortality rates of VAP vary due to several factors, such as the study population, time of onset, causative organisms, and appropriate antibiotic therapy.25 Our patients were ventilated for the majority of their time in the ICU. However, we were unable to determine a relationship between nosocomial infections of ventilated and non-ventilated patients. Our ventilated trauma patients had higher rates of ETT (39%) compared to other device infections. This finding was in keeping with the higher incidence rate in trauma patients reported by the CDC.16 Trauma patients had a higher occurrence of VAP (63%) than non-trauma patients (38%). The most frequently detected DANIs for ETT was K. pneumonia (26%) followed by A. baumannii (19%) and P. aeruginosa (16%), these isolates are commonly isolated from VAP infection. Similar results were found in previous studies.12,26-29 A recent study showed that the VAP incidence of mixed medical-SICUs in Thailand, GNB were the most common organisms particularly A. baumannii, P. aeruginosa, and K. pneumoniae, which were comparable with our results.30

It is estimated that 80,000 infections related to CVC occur in ICU patients each year and these infections are associated with a mortality rate as high as 25%.31 In a study carried out in Brazil, 6% of admitted patients suffered from CVC infection.32

K. pneumoniae, Acinetobacter, and P. aeruginosa were the three most common organisms associated with CVC infection in SICU.31,34 In this study, 10% of DANIs were related to CLABSI and K. pneumonia accounted for 25%.

Patients on NGT might be predisposed to colonization by Proteus and Pseudomonas spp. within 48–72 hours.35 Similarly, our study noted that Prot. mirabilis was the main encountered organism along with Klebsiella, Acinetobacter and Pseudomonas. The main isolates associated with CAUTI were Acinetobacter (40%) and Klebsiella (33%). Pseudomonas was the predominant organism in a SICU in Turkey.28

Extremely high resistance rates to ampicillin, cephalothin, cefuroxime, amoxicillin-clavulante, and nitrofurantoin (91.1%–99.0%) were observed. Lower levels of resistance were exhibited to amikacin, imipenem, and colistin (29%–38%), but amikacin was broadly active; 39% of the isolates were defined as MDR. Overall ESBL producers were expressed in 39% of isolates mainly among K. pneumonia (88%) and K. ozaenae (100%) isolates.

Our results show that the high level of resistance was quite problematic in the ICU. The high resistance rates might be associated with antibiotic abuse and prolonged ICU stays.36 A. baumannii isolates exhibited extremely high levels of resistance to all antibiotics (75–100%) with the exception of colistin. In addition, 56% of A. baumannii isolates were considered MDR. Our data support previous results that indicated an alarming pattern of antibiotic resistance to A. baumannii, particularly in the ICU setting, and is frequently associated with outbreaks of VAP.37 The high rate of resistance to ESBL producers in K. pneumonia (88%) was similar to that in other developing countries reported by the INICC, where the rate of ceftazidime resistance was 92%.3,28 Both of those rates were much higher than those reported by the National Healthcare Safety Network (NHSN) in the US (6%).39 Resistance of P. aeruginosa to imipenem was 36% similar to that reported by the INICC (37%) and lower than Egypt (56%).2,38 The anti-pseudomonas antibiotics (cefe/imipenem, piperacillin-tazobactam, and ceftazidime) showed effectiveness to P. aeruginosa isolates (46%, 46%, and 55%, respectively). Only four of 11 (36%) P. aeruginosa isolates were considered as MDR. Similar results were demonstrated in other ICU settings.28,40 The high rates of antimicrobial resistance

**REFERENCES**

1. Abdulaziz Zorgani, et al. (2015). OMAN MED J, VOL 30, NO 4, JULY 2015

2. Similar results were demonstrated in other ICU settings.
identified in the present study might be attributed to the lack of antibiotic use policies and guidelines in the majority of hospitals in Libya. As in most developing countries, administrative and financial support is lacking, which results in limited funds and resource availability to deal with infection control. In this ICU setting, guidelines on specific infection control practices are not adhered to adequately, infection control surveillance is not conducted, and hospital accreditation is not mandatory. Our study had several limitations including that the data was not enough to reflect the whole country and different types of ICUs. Additionally, DANI rates per 1,000 device-days and DANI’s mortality rates were not demonstrated.

**CONCLUSION**

High rates of DANI’s and the emergence of MDR organisms poses a threat to physicians and patients alike. With limited therapeutic options, there is a need to strengthening infection control measures within the ICU, introduce surveillance systems, and implement evidence-based preventive strategies against nosocomial infections.

**Disclosure**

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**REFERENCES**

1. Rosenthal VD, Guzman S, Orellano P. Nosocomial infections in medical-surgical intensive care units in Argentina: attributable mortality and length of stay. Am J Infect Control 2003 Aug;31(5):291-295.
2. Rosenthal VD, Maki DG, Graves N. The International Nosocomial Infection Control Consortium (INICC): goals and objectives, description of surveillance methods, and operational activities. Am J Infect Control 2008 Nov;36(9):e1-e12.
3. Digiovine B, Chenoweth C, Watts C, Higgins M. The attributable mortality and costs of primary nosocomial bloodstream infections in the intensive care unit. Am J Respir Crit Care Med 1999 Sep;160(3):976-981.
4. Mesiano ER, Merchán-Hamann E. Bloodstream infections among patients using central venous catheters in intensive care units. Rev Lat Am Enfermagem 2007 May-Jun;15(3):453-459.
5. Laupland KB, Zygun DA, Doig CJ, Bagshaw SM, Svenson LW, Fick GH. One-year mortality of bloodstream infection-associated sepsis and septic shock among patients presenting to a regional critical care system. Intensive Care Med 2005 Feb;31(2):213-219.
6. Aly NY, Al-Mousa HH, Al Asar SM. Nosocomial infections in a medical-surgical intensive care unit. Med Princ Pract 2008;17(5):373-377.
7. Neidell MJ, Cohen B, Furuya Y, Hill J, Jeon CY, Glied S, et al. Costs of healthcare- and community-associated infections with antimicrobial-resistant versus antimicrobial-susceptible organisms. Clin Infect Dis 2012 Sep;55(6):807-815.
8. Rosenthal VD, Maki DG, Salomao R, Moreno CA, Mehta Y, Higuera F, et al; International Nosocomial Infection Control Consortium. Device-associated nosocomial infections in 55 intensive care units of 8 developing countries. Ann Intern Med 2006 Oct;145(8):582-591.
9. Sallam SA, Arafa MA, Razek AA, Naga M, Hamid MA. Device-related nosocomial infection in intensive care units of Alexandria University Students Hospital. East Mediterr Health J 2005 Jan-Mar;11(1-2):52-61.
10. Garner JS, Jarvis WR, Emori TG, Horan TC, Hughes JM. CDC definitions for nosocomial infections, 1988. Am J Infect Control 1988 Jun;16(3):128-140.
11. Rosenthal VD, Maki DG, Jamulitrat S, Medeiros EA, Todi SK, Gomez DY, et al; INICC Members. International Nosocomial Infection Control Consortium (INICC) report, data summary for 2003-2008, issued June 2009. Am J Infect Control 2010 Mar;38(2):95-104, e2.
12. Rhomberg PR, Fritsche TR, Sader HS, Jones RN. Antimicrobial susceptibility pattern comparisons among intensive care unit and general ward Gram-negative isolates from the Mucopenem Yearly Susceptibility Test Information Collection Program (USA). Diagn Microbiol Infect Dis 2006 Sep;56(1):57-62.
13. Lockhart SR, Abramson MA, Beckmann SE, Gallagher G, Riedel S, Diekema DJ, et al. Antimicrobial resistance among Gram-negative bacilli causing infections in intensive care unit patients in the United States between 1993 and 2004. J Clin Microbiol 2007 Oct;45(10):3352-3359.
14. Chopra I, Schofield C, Everett M, O’Neill A, Miller K, Wilcox M, et al. Treatment of health-care-associated infections caused by Gram-negative bacteria: a consensus statement. Lancet Infect Dis 2008 Feb;8(2):133-139.
15. van Duijn PJ, Dautzenberg MJ, Oostdijk EA. Recent trends in antibiotic resistance in European ICUs. Curr Opin Crit Care 2011 Dec;17(6):658-665.
16. National Nosocomial Infections Surveillance System. National Nosocomial Infections Surveillance (NNIS) System Report, data summary from January 1992 through June 2004, issued October 2004. Am J Infect Control 2004 Dec;32(8):470-485.
17. Horan TC, Andrus M, Dudeck MA. CDC/NHSN surveillance definition of health care-associated infection and criteria for specific types of infections in the acute care setting. Am J Infect Control 2008 Jun;36(5):309-332.
18. Maki DG, Weise CE, Sarafin HW. A semiquantitative culture method for identifying intravenous-catheter-related infection. N Engl J Med 1977 Jun;236(23):1305-1309.
19. Clinical and Laboratory Standards Institute. 2012. Performance standards for antimicrobial susceptibility testing. Twenty-second Informational Supplement. CLSI/NCCLS M100–S22. Wayne, PA: Clinical and Laboratory Standards Institute.
20. Magiorakos AP, Srinivasan A, Carey RB, Carmeli Y, Falagas ME, Giske C, G, et al. Multidrug-resistant, extensively drug-resistant and pandrug-resistant bacteria: an international expert proposal for interim standard definitions for acquired resistance. Clin Microbiol Infect 2012 Mar;18(3):268-281.
21. Barrett SP. Infection control in Britain. J Hosp Infect 2002 Feb;50(2):106-109.
22. Chittawatanarat K, Jaipakdee W, Chotinriramit N, Chandacham K, Jiraphaophanan T. Microbiology, resistance patterns, and risk factors of mortality in ventilator-associated bacterial pneumonia in a Northern Thai tertiary-care university based general surgical intensive care unit. Infect Drug Resist 2014;7:203-210.
23. Seyoum N, Biluts H, Zemenfes D, Chane W, Seme A. Review of morbidity and mortality among patients admitted to the Surgical Intensive Care Unit at Tikur Anbessa Specialized Teaching Hospital, Ethiopia. Ethiop Med J 2014 Feb;52(2):77-85.

24. Melsen WG, Rovers MM, Groenwold RH, Bergmans DC, Camus C, Bauer TT, et al. Attributable mortality of ventilator-associated pneumonia: a meta-analysis of individual patient data from randomised prevention studies. Lancet Infect Dis 2013 Aug;13(8):665-671.

25. American Thoracic Society; Infectious Diseases Society of America. Guidelines for the management of adults with hospital-acquired, ventilator-associated, and healthcare-associated pneumonia. Am J Respir Crit Care Med 2005 Feb;171(4):388-416.

26. Tukenmez Tigen E, Dogru A, Koltka EN, Unlu C, Gura M. Device-associated nosocomial infection rates and distribution of antimicrobial resistance in a medical-surgical intensive care unit in Turkey. Jpn J Infect Dis 2014;67(1):5-8.

27. Meric M, Willke A, Caglayan C, Toker K. Intensive care unit-acquired infections: incidence, risk factors and associated mortality in a Turkish university hospital. Jpn J Infect Dis 2005 Oct;58(5):297-302.

28. Dogru A, Sargin F, Celik M, Sagirolgu AE, Goksel MM, Sayhan H. The rate of device-associated nosocomial infections in a medical surgical intensive care unit of a training and research hospital in Turkey: one-year outcomes. Jpn J Infect Dis 2010 Mar;63(2):95-98.

29. Rechaaipichitkul W, Phondongnok S, Bourpoern J, Chaimanee P. Causative agents and resistance among hospital-acquired and ventilator-associated pneumonia patients at Srinagarind Hospital, northeastern Thailand. Southeast Asian J Trop Med Public Health 2013 May;44(3):490-502.

30. Wararak P, Kiratsin P, Thamlkitkul V. Hospital-acquired pneumonia and ventilator-associated pneumonia in adults at Siriraj Hospital: etiology, clinical outcomes, and impact of antimicrobial resistance. J Med Assoc Thai 2010 Jan;93(Suppl 1):S126-S138.

31. Centers for Disease Control and Prevention (CDC). Vital signs: central line-associated blood stream infections—United States, 2001, 2008, and 2009. MMWR Morb Mortal Wkly Rep 2011 Mar;60(8):243-248.

32. Mesiano ER, Merchán-Hamann E. Bloodstream infections among patients using central venous catheters in intensive care units. Rev Lat Am Enfermagem 2007 May-Jun;15(3):453-459.

33. Khorvash F, Abbasi S, Meidani M, Shakeri M. Prevalence and antimicrobial susceptibility pattern of isolated microorganisms from central venous catheters in ICU patients. Adv Biomed Res 2014;3:102.

34. Cheewinmethasiri J, Chittawatanarat K, Chandakham K, Jirapongchareonlap T, Chotirosniramit N. Microbiology, risk factors and mortality of patients with intravenous catheter related blood stream infections in the surgical intensive care unit: a five-year, concurrent, case-controlled study. J Med Assoc Thai 2014 Jan;97(Suppl 1):S93-S101.

35. Segal R, Pogoreliuk I, Dan M, Baumochl Y, Leibovitz A. Gastric microbiota in elderly patients fed via nasogastric tubes for prolonged periods. J Hosp Infect 2006 May;63(1):79-83.

36. Planquette B, Timis T, Misset BY, Schwebel C, Azoulay E, Adrie C, et al; OUTCOMEREA Study Group. Pseudomonas aeruginosa ventilator-associated pneumonia. predictive factors of treatment failure. Am J Respir Crit Care Med 2013 Jul;188(1):69-76.

37. Ayrault-Thévenot S, Huart C, Mimoz O, Taoufiq M, Laland C, Bousseau A, et al. Control of multi-drug-resistant Acinetobacter baumannii outbreaks in an intensive care unit: feasibility and economic impact of rapid unit closure. J Hosp Infect 2012 Dec;82(4):290-292.

38. El-Kholy A, Saded T, Gaber M, Younan MA, Hateim MM, El-Sayed H, et al. Device-associated nosocomial infection rates in intensive care units at Cairo University hospitals: first step toward initiating surveillance programs in a resource-limited country. Am J Infect Control 2012 Aug;40(6):e216-e220.

39. Edwards JR, Peterson KD, Mu Y, Banerjee S, Allen-Bridson K, Morell G, et al. National Healthcare Safety Network (NHSN) report: data summary for 2006 through 2008, issued December 2009. Am J Infect Control 2009 Dec;37(10):873-805.

40. Senbayrak Akay S, Inan A, Cevan S, Ozaydin AN, Cohanoglou N, Ozyurek SC, et al. Gram-negative bacilli causing in-fecions in an intensive care unit of a tertiary care hospital in Istanbul, Turkey. J Infect Dev Ctries 2014 May;8(5):597-604.