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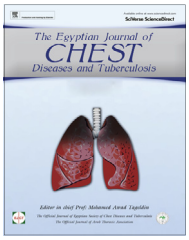

ORIGINAL ARTICLE

Analysis of ventilator associated pneumonia (VAP) studies in Egyptian University Hospitals

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KEYWORDS

VAP – Ventilator associated pneumonia;
Incidence;
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Abstract *Background:* Ventilator associated pneumonia (VAP) is a dynamic disease caused by a wide spectrum of pathogens and associated with morbidity and mortality.

Purpose: The study concerned with an analysis of VAP studies done in Egyptian University Hospitals in the last 10 years to describe the magnitude of the problem of VAP as a complication of mechanical ventilation, and to explore its predictors and most common causative organisms.

Methods: To identify relevant published studies we searched the medical literature for articles done in Egypt published during the past 10 years, using midline PubMed and Google scholar, where the full text articles were downloaded. We also searched the thesis discussed and passed (Registered) at the website of the Egyptian Universities libraries consortium visiting the website of the supreme council of Egyptian Universities.

Results: Most of the 37 studies on which analysis were done were concerned with the risk factors, causative organisms, and incidence. The most common risk factors were leukopenia, thrombocytopenia, high CRP, metabolic acidosis, nasal endotracheal intubation, re-intubation, prior antibiotic use, and contaminated ICU environment with lack of infection control measures, use of antacids and H2 blocker, corticosteroids use, and coma. The most common causative organisms were *Pseudomonas aerogenosa*, *Klebsiella*, *Escherichia coli*, *Staphylococcus aureus*, *Acinetobacter*, *Candida* and *Proteus*.

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Conclusion: It is important to establish large-scale multi center national studies to explore incidence of VAP, all possible risk factors (whether preventable or non preventable), causative organisms, and mortality due to VAP and its economic aspect.

Introduction

Ventilator-associated pneumonia (VAP) is defined as nosocomial pneumonia in mechanically ventilated patients which develops more than 48 h after initiation of mechanical ventilation (MV). VAP is divided into early onset VAP which occurs within 5 days of mechanical ventilation and late onset VAP which develops five or more days after initiation of mechanical ventilation. The importance of segregating VAP into early and late is that, the pathogenesis, microorganisms responsible and outcome in these two groups are different and so the therapeutic implications also differ (1).

VAP arises when there is bacterial invasion of the pulmonary parenchyma in a patient receiving mechanical ventilation. Inoculation of the formerly sterile lower respiratory tract typically arises from aspiration of secretions, colonization of the aerodigestive tract, or use of contaminated equipment or medications. Risk factors for VAP include prolonged intubation, enteral feeding, witnessed aspiration, paralytic agents, underlying illness and extremes of age (2).

The risk factors for VAP can be divided into three categories: host related, device related, and personnel related. Host-related risk factors include preexisting conditions such as immunosuppression, chronic obstructive lung disease, and acute respiratory distress syndrome. Other host-related factors include patients' body positioning, level of consciousness, number of intubations, and medications, including sedative agents and antibiotics (3).

The pathogenesis of ventilator-associated pneumonia usually requires two important processes to take place: bacterial colonization of the aerodigestive tract and the aspiration of contaminated secretions into the lower airway (4).

The diagnosis of VAP is a clinical suspicion. The most accepted clinical definition for suspicion of pneumonia is currently the presence of a pulmonary infiltrate on chest radiograph plus two of the following three criteria: leukocytosis or leukopenia, purulent respiratory secretions and fever or hypothermia. This approach has good sensitivity but poor specificity and the next step is to obtain samples of the lower respiratory tract for microbiological tests (5).

Since VAP is a critical and life saving issue in ICU, and there were little studies handling this important infection, with seldom little or no analysis or specific data reported about it, we did this systematic review study analyzing VAP studies done in Egyptian University Hospitals in the last 10 years to describe the magnitude of the problem of VAP in Egypt exploring its predictors and its most common causative organisms.

Methodological approach

This analysis includes both narrative review and systematic review.

Narrative review

Data concerning VAP were collected from published reviews, original research, editorials and textbooks. Literatures were identified through computer-based search from relevant search websites and electronic data bases (e.g. PubMed and Google scholar) and hand-based search in medical libraries. Only literatures written in English were included.

Systematic review

Search strategy (literature search)

To identify the relevant analysis, we searched the thesis discussed and passed (Registered) at the website of the Egyptian Universities libraries consortium (http://www.mans.edu e.g.) visiting the website of the supreme council of Egyptian Universities. To identify relevant published studies we searched the medical literature for articles published during the past 10 years, using midline PubMed and Google scholar, where the full text articles were downloaded.

Study selection

All studies with VAP in the title were included, whether descriptive, analytic or interventional in design. To be included in the review studies have to cite any of the following:

(1) Incidence/prevalence of VAP.
(2) Risk factors of VAP.
(3) Causative organisms of VAP.

Data abstraction

The abstracted data included the name of university, investigator/author, year of publication/acceptance of thesis, study design, age of study population, sample size, incidence of VAP, risk factors and causative organisms. Study design was judged and evaluated by the supervisors.

Results

By searching different web sites besides visiting the libraries of some of the Egyptian Universities we collected the material of our study. We searched the Website of Mansoura University, visiting the website of the supreme council of Egyptian Universities and then Egyptian Universities Libraries Consortium. By visiting the libraries of some Egyptian Universities we found 31 studies on VAP.

Then we searched PubMed, Google and Google Scholar sites with titles VAP in Egypt and Analysis of VAP, we found six scientific researches of VAP in Egypt in three Egyptian

Table 1 Incidence/proportion of VAP in Egyptian University hospitals.

University	Author	No. of patients	Age group	Design	Incidence
Mansoura	Abd El-Kader [1]	97	1 month–18 ys.	Descriptive cross sectional study	22.6%
Ain Shams	Abd El-Kader [2]	40	1–8 ys.	Descriptive cross sectional study	75%
Alexandria	Soliman [3]	75 *3 groups - Normal saline - CHX - CHX/COL	19–75 ys.	Interventional study	Over all 33.3% • N.saline = 52.0% • CHX = 28.0% • CHX/COL = 20.0%
Ain Shams	Abdel-Gawad et al. [4]	252	Mean age; 16.6 ± 20.5 month	Cohort prospective study	50%
Alexandria	Tayel [5]	110	Neonates (2–8 days)	Cross sectional descriptive study	68.1%
Alexandria	Abou El-Abbas [6]	206	1–75 ys.	Descriptive cross sectional study	16%
Alexandria	Khamis [7]	60 HME = 30 and HH = 30	16–77 ys.	Interventional study	HME = 56.7% HH = 63.3%
Ain Shams	Mohammed [8]	107	18–75 ys.	Descriptive cross sectional study	55.1%

CHX, chlorhexidine; HME, heat moisture exchanger.
CHX/COL, chlorhexidine/colistin; HH, heated humidifier.

Universities, Alexandria, Cairo and Ain Shams. The 37 VAP studies are as the following, 28 studies were thesis, three studies were essay and six studies were researches/papers and published in scientific journals. We already had 33 studies from 37 which were potentially legible for analysis. Four studies were not found in the libraries. From the 33 studies 17 studies were included in our study and 16 studies were excluded for different reasons as being essay, intervention study concerning other aspects of VAP.

The point of view of every study was exactly the methodology and the result as regards the causative organisms, risk factors and incidence of VAP. The 17 studies were sorted as the following: nine studies concerned with the causative organisms of VAP (with two studies from them concerned also with risk factors), eight studies concerned with incidence and causative organisms (with two studies from them concerned also with risk factors).

Table 1 shows the incidence/proportion of VAP in Egyptian University hospitals. The age of the patients ranged from 2 days to 77 years. Eight studies concerned with incidence of VAP in three Universities; Alexandria (four studies), Ain Shams (three studies) and Mansoura (one study). Incidence of VAP ranged from 16% to 75%, with the lowest ratio in Alexandria and the highest one in Ain Shams University. Five of the studies were descriptive cross sectional, with two interventional and one cohort prospective study.

As regards risk factors of VAP, there were three descriptive cross sectional studies in Mansoura (two studies) and Alexandria (one study) and one case control study in Tanta University, in Pediatrics and adults explored the risk factors of VAP. The study of Tayel [5] in Alexandria University in Neonates (2–8 days) concluded the most common risk factors of VAP were gestational age less than 33.3 weeks, birth weight less than 1.405 kg, leukopenia, thrombocytopenia, high CRP and metabolic acidosis. The second study of Shalaby [10] in Tanta University in Neonatal and Pediatric ICU at Tanta University concluded the most common risk factors of VAP as nasal endotracheal tubes, re-intubation, prior antibiotic use, colonized health care workers with MRSA and contaminated ICU devices. The third study of Seweilam [9] in Mansoura University, identified the risk factors as the following; prior antibiotic use, duration of mechanical ventilation, reintubation, use of antacids and H2 blockers, corticosteroids use and coma. The fourth study of Abd El-Kader [1] in Mansoura University reported that long duration of pediatric ICU admission (more than 17 days) and long duration of mechanical ventilation (more than 12 days) are the risk factors of VAP as in Table 2.

As regards the causative organisms of VAP, 17 studies were concerned; 10 in Alexandria, three in Mansoura, three in Ain Shams and one in Tanta Universities. Most of the studies were descriptive cross sectional; 10 studies, with four interventional studies, two case control studies and one cohort prospective study. Age ranged from 1 day to 85 years. The samples were ETA, BAL, sputum and throat swab.

From the previous tables (Table 1,2,3) we observed that the most common causative organisms were *Pseudomonas aerogenosa*, *Klebsiella*, *Escherichia coli*, *Staphylococcus aureus*, *Acinetobacter*, *Candida* and *Proteus* followed by MRSA, *Streptococci*, Polymicrobial, Coagulase Neg. Staph., VRSA, OSSA, ORSA, Citrobacter, MSSA, Gm −ve NLF, *Enterobacter aerogenosa*, *Diphtheria* and *Enterococcus fecalis*. The most common causative organisms were gram negative bacilli, gram positive cocci and gram negative enteric cocci and mostly MDR pathogens.

Discussion

Ventilator associated pneumonia is a dynamic disease caused by a wide spectrum of pathogens and associated with morbidity and mortality. It accounts for up to 60% of all Healthcare-Asso-

Table 2 Risk factors associated with VAP in Egyptian Universities.

University	Author	No. of patients	Age group	Design	Risk factors
Mansoura	Abd El-Kader [1]	97	1 month–18 ys.	Descriptive cross sectional study	1. Long duration of pediatric ICU admission (more than 17 days) 2. Long duration of mechanical ventilation (more than 12 days)
Mansoura	Seweilam [9]	95	1–85 ys.	Descriptive cross sectional study	1. Prior antibiotic use 2. Duration of mechanical ventilation 3. Reintubation 4. Use of antacids and H2 blockers 5. Corticosteroids use 6. Coma
Tanta	Shalaby [10]	52 (42: cases, 10: control)	1 day–18 ys.	Case control study	1. Nasal endotracheal tubes 2. Re-intubation 3. Prior antibiotic use 4. Colonized health care workers with MRSA 5. Contaminated ICU devices

ciated Infections, 10–28% of critical care patients and increases length of ICU stay by 28% [21]. Prevalence estimates of VAP vary between 6 and 52 cases per 100 patients, depending on the population studied (Joseph et al., 2010).

In order to appropriately categorize the causative agent or mechanism it is usually recommended to obtain a culture prior to initiating mechanical ventilation as a reference. As such, many of the typical symptoms of pneumonia will either be absent or unable to be obtained. Two strategies exist for diagnosing VAP. One strategy collects cultures from the trachea of people with symptoms of VAP plus a new or expanding infiltrate on chest X-ray. The other is more invasive and advocates a bronchoscopy plus bronchoalveolar lavage (BAL) for people with symptoms of VAP plus a new or expanding infiltrate on chest X-ray [13].

Our study concerned with the analysis of VAP studies done in Egyptian University Hospitals in the last 10 years to describe the magnitude of the problem of VAP in Egypt, and also to explore its predictors and its most common causative organisms.

Depending on the data, incidence in these ICUs ranges from 16% to 75%. In comparison with incidence of VAP World Wide, 10–28% and in the United States 9–27% [20], incidence of VAP in our ICUs is about 2.5 times more. The highest incidence, 75% was noted in Ain Shams University and the lowest incidence, 16% was in Alexandria University, while the incidence in Mansoura University was 22.6%.

As regards the risk factors of VAP we found four descriptive cross sectional studies by Tayel [5], Shalaby [10], Seweilam [9] and Abd El-Kader [1] that explored the most common risk factors in their ICUs (in neonates, childhood and adult). Tayel [5] concluded the most common risk factors that were host related as low Gestational age, low birth weight, leukopenia, thrombocytopenia, high CRP, and metabolic acidosis. Shalaby [10] concluded their risk factors, host related risk factors as nasal endotracheal intubation, re-intubation and prior antibiotic use, personal related risk factors as colonized health care workers with MRSA and device related risk factors as contaminated ICU environment with lack of infection control measures. Sweilam [9] concluded risk factors which were host related as prior antibiotic use, duration of mechanical ventilation, reintubation, use of antacids and H2 blocker, corticosteroids use and coma. While Abd El-Kader [1] mentioned two host related risk factors; long duration of ICU admission and long duration of mechanical ventilation. In comparison with studies concluding the common risk factors of VAP, a Logistic regression analysis done by Lippincott and Wilkins (2011) identified three factors significantly associated with ventilator-associated pneumonia caused by any one of the multidrug-resistant bacterial strains: emergency intubation, aspiration and Glasgow coma score of nine or less. While Grammatikos et al. [13] concluded the Risk factors for infection with an MDR strain; ventilation for more than 5 days, recent hospitalization (last 90 days), residence in a nursing home, treatment in a hemodialysis clinic, and prior antibiotic use (last 90 days).

As regards the causative organisms, the etiological agents of VAP may differ according to patients, units, hospitals or countries. The main epidemiological patterns may not only vary from unit to unit, but also in a given unit over the course of time and this is true for their associated susceptibility patterns. Thus, reported differences can frequently be explained by local specificities [16].

In our study, there were 17 studies involved in the causative organisms of VAP; 10 in Alexandria, three in Mansoura, three in Ain Shams and 1 in Tanta Universities. Most of them were cross sectional studies with some interventional, case control and cohort prospective studies.

The most common causative organisms of VAP finally from all the studies were *P. aerogenosa*, *Klebsiella*, *E. coli*, *Staph. aureus*, *Acinetobacter*, *Candida* and *Proteus*. Other organisms found were; methicillin-resistant *Staph. aureus* (MRSA), *Streptococci*, Polymicrobial, Coagulase Neg. *Staphylococci*, vancomycin-resistant *S. aureus* (VRSA), oxacillin sensitive *Staph. aureus* (OSSA), oxacillin resistant *S. aureus* (ORSA), Citrobacter, methicillin sensitive *Staph. aureus* (MSSA), Gm −ve NLF, *Enterobacter aerogenosa*, Diphtheria and *Enterococcus fecalis*.

From these results we noted that the most common causative organisms are mostly MDR pathogens and non MDR pathogens are less likely as a cause. These were in agreement with Loscalzo et al. [14] who concluded MDR pathogens as

Table 3 Causative organisms of VAP in Egyptian Universities.

Causative organisms	Specimens	Design	Age group	No. of patients	Authors	University
Direct smear 1. Gram +ve cocci 43.8% 2. Gram −ve 40.6% 3. Mixed infection 15.6%BACTEC 9050 aerobic culture 1. *Staphylococci* 40.6% 2. Gram negative 46.9% 3. Mixed +ve and −ve 12.5%BAL culture by ordinary methods 1. *Staphylococci* 37% 2. Gram negative bacilli 43.8% 3. Mixed growth 15.6% 4. Anthracoid 3.1%	BAL	Descriptive cross sectional study	18–60 ys.	32	Moawad [18]	Mansoura
1. *Pseudomonas aerogenosa* 21.05% 2. *Staph. aureus* 15.8% 3. Polymicrobial 15.8% 4. Gm negative organisms 26.3%	ETA	Descriptive cross sectional study	1 month–18 ys.	97	Abd El-Kader [1]	Mansoura
61.1% positive for organisms. 1. *Klebsiella pneumoniae* 30.9% 2. *Pseudomonas aerogenosa* 22.5% 3. *Staphylococcus aureus* 21.2% 4. *E. coli* 12.8% 5. *Proteus* spp. 9.8% 6. *Citrobacter* spp. 2.8%	ETA	Descriptive cross sectional study	1–85 ys.	95	Seweilam [9]	Mansoura
1. *Enterobacter* spp. 25% 2. *Pseudomonas* spp. 22.5% 3. *Staph. aureus* 15% 4. Coagulase −ve Staph 7.5% 5. *Candida* spp. 10% 6. *Citrobacter* spp. 5% 7. *Klebsiella* spp. 5% 8. *E. coli* 5% 9. *Erwinia* spp. 5%	BAL and ETA	Descriptive cross sectional study	1–8 ys.	40	Abd El-Kader [2]	Ain Shams
CHX group 1. *Klebsiella* 3.29% 2. *Pseudomonas* 2.19% 3. *Candida* 0.36% 4. *Proteus* 0.71% 5. OSSA 0.36% 6. ORSA 1.44%Sewak group 1. *Klebsiella* 0.71% 2. *Pseudomonas* 1.09% 3. *Candida* 0.36% 4. *Proteus* 0.36% 5. OSSA 0.36% 6. ORSA 0.36%	ETA	Interventional study	5–70 ys.	40; * Sewak vs. CHX	Abd El-wahed [11]	Alexandria
1. *Pseudomonas* 41.7% 2. *E. coli* 4.2% 3. *Proteus* 12.5% 4. *Klebsiella* 8.3% 5. *Acinetobacter* 4.2% 6. *Streptococci* 18.8% 7. MSSA 6.3% 8. MRSA 6.3% 9. VRSA 2.1%	QEA	Descriptive cross sectional study	2–80 ys.	48	Khalil [15]	Alexandria

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Table 3 (*continued*)

Causative organisms	Specimens	Design	Age group	No. of patients	Authors	University
Control group 1. *Klebsiella* 20% 2. *Pseudomonas* 6.7% 3. Gm −ve NLF 13.3% 4. *Acinetobacter* 13.3% 5. ORSA 0.0% 6. OSSA 6.7% 7. *E. coli* 20% 8. *Streptococcus pneumonia* 20% Hydrocortisone group 1. *Klebsiella* 6.7% 2. *Pseudomonas* 6.7% 3. Gm −ve NLF 20% 4. *Acinetobacter* 13.3% 5. ORSA 6.7% 6. OSSA 6.7% 7. *E. coli* 26.7% 8. *Streptococcus pneumonia* 13.3%	QEA	Intervention study	28–85 ys.	30 @15: control group and 15: Hydrocortison group	Morsi (2008)	Alexandria
1. *Pseudomonas aerogenosa* 33.3% 2. *Staph. aureus* 26.2% 3. *Klebsiella pneumoniae* 16.7% 4. Co-agulase Neg. Staph. 7.1% 5. Polymicrobial 7.1% 6. Citrobacter 2.4% 7. *Proteus* 2.4% 8. *Candida* 2.4% 9. *Streptococcus pneumoniae* 2.4%	ETA	Case control study	1 day–18 ys.	52 (42: cases, 10: control)	Shalaby [16]	Tanta
Gram +ve organisms 1. Saline group: 57.2% vs. 2. CHX group: 21.4% vs. 3. CHX/COL group: 21.4%Gram –ve organisms 1. Saline group: 54.5% vs. 2. CHX group 36.4% vs. 3. CHX/COL group 18.1%	Throat swab	Interventional study.	19–75 ys.	75 #3 groups: - Saline - CHX - CHX/COL	Soliman [9]	Alexandria
1. *Klebsiella* 43.75% 2. *Acinetobacter* 31.25% 3. *Staphylococcus aureus* 12.5% 4. Enterococci 12.5% Ain Shams	BAL	Cohort prospective study	Mean age;	16.6 ± 20.5 month	252	Abdel-Gawad et al. [10]
1. *Candida* spp. 23.3% 2. *Pseudomonas aerogenosa* 21.6% 3. Polymicrobial 20% 4. *Staphylococcus aureus* 16% 5. *Acinetobacter* spp. 8.3% 6. *Proteus* spp. 6.6% 7. *Klebsiella* spp. 6.6% 8. *E. coli* spp. 5% 9. Coagulase-negative Staphylococci 1.6% 10. Diphtheroids 1.6%	ETA	Descriptive cross sectional study	1.5–85 ys.	60 VAP cases vs. 30 non VAP cases	Asser [12]	Alexandria
1. *Klebsiella* 28.5% 2. *Pseudomonas* 14.2% 3. *Acinetobacter* 12.3% 4. *E. coli* 4.1% 5. Polymicrobial 10.2% 6. MRSA 4.1% 7. *Enterococcus fecalis* 4.1% 8. *Staphylococcus aureus* 2% 9. *Candida* 14.2%	ETA	Descriptive cross sectional study	Neonates (2–8 days)	110	Tayel [5]	Alexandria

Table 3 (*continued*)

Causative organisms	Specimens	Design	Age group	No. of patients	Authors	University
1. *Pseudomonas* species 45.0% 2. Methicillin sensitive *Staphylococcus* species 5.0% 3. *Acinetobacter* species 20.0% 4. *Klebsiella aerogenes* 10.0% 5. *E. coli* 20.0%	BAL	Descriptive cross sectional study	16–56 ys.	20	Zidan [22]	Alexandria
1. *Candida* 23.3% 2. *Pseudomonas aerogenosa* 21.6% 3. *Staph. aureus* 16.0% 4. *Acinetobacter* 8.3% 5. Proteus spp. 6.6% 6. *Klebsiella* 6.6% 7. *E. coli* 5.0% 8. Co-agulase Neg. Staph. 1.6% 9. Diphtheroid 1.6%	ETA	Case control study	18–85 ys.	90 (60: cases, 30: control)	Mokhless et al. [19]	Alexandria
1. *Acinetobacter* 51.5% 2. *P. aerogenosa* 18.2% 3. *Klebsiella pneumonia* 15.1% 4. *E. coli* 6.1% 5. *Enterobacter aerogenes* 3% 6. *S. aureus* 15.1% 7. Coagulase −ve Staph. 15.1% 8. *Candida* 12.1%	BAL	Descriptive cross sectional study	1–75 ys.	206	Abou El-Abbas [6]	Alexandria
HME group 1. *Pseudomonas* 23.1% 2. *Streptococci* 7.7% 3. MRSA 10.3% 4. Contamination 15.4% 5. *Acinetobacter* 11.5% 6. *Candida* 7.7% 7. *Klebsiella* 11.5% 8. Polymicrobial 3.8% 9. *E. coli* 3.8% 10. *Staphylococci* 0.0%HH group 1. *Pseudomonas* 27.6% 2. *Streptococci* 0.0% 3. MRSA 10.3% 4. Contamination 17.2% 5. *Acinetobacter* 13.8% 6. *Candida* 3.4% 7. *Klebsiella* 13.8% 8. Polymicrobial 3.4% 9. *E. coli* 3.4% 10. *Staphylococci* 6.9%	Sputum	Intervention study	16–77 ys.	60; −30 (heat moisture exchanger group) and 30 (heated humidifier group)	Khamis [7]	Alexandria
BAL (single species) 1. *E. coli* 8.6% 2. *Acinetobacter* species 2.9% 3. VRSA 2.9% 4. MRSA 31.4% 5. *Klebsiella* 11.4% 6. *Staphylococcus aureus* 2.9% 7. *Pseudomonas* 11.4%(Mixed infection) 1. *Klebsiella* spp. and *Candida* spp. 2.9% 2. *Klebsiella* spp. and methicillin-resistant *Staphylococcus aureus* 5.7% 3. *Klebsiella* spp. and *S. aureus* 5.7% 4. *Klebsiella* spp. and *Pseudomonas* spp. 2.9% 5. *Pseudomonas* spp. and *Candida* spp. 2.9% 6. No growth 8.6%ETA (single species) 1. *E. coli* 7% 2. MRSA 16.3% 3. *Candida* 2.3% 4. *Klebsiella* 7% 5. *Staphylococcus aureus* 4.6% 6. *Pseudomonas* 9.3%(Mixed species)	BAL and ETA	Descriptive cross sectional study	18–75 ys.	107	Mohammed [8]	Ain Shams

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Table 3 (*continued*)

Causative organisms	Specimens	Design	Age group	No. of patients	Authors	University
1. *Klebsiella* and MRSA 9.3%						
2. *Klebsiella* and *S. aureus* 4.6%						
3. *Klebsiella* and *Pseudomanas* 2.3%						
4. *Klebsiella* and *E. coli* 2.3%						
5. *Klebsiella* and *Candida* 2.3%						
6. *Pseudomonas* and *Staphylococcus aureus* 2.3%						
7. *Candida* and MRSA 4.6%						
8. *E. coli* and VRSA 2.3%						
9. *E. coli* and *Staphylococcus aureus* 2.3%						
10. No growth 20.9%						

HME group, heat moisture exchanger; HH group, heated humidifier.
Control group, included 15 patients received conventional therapy.
Hydrocortisone group, included 15 patients received conventional therapy the same as the control group plus the hydrocortisone therapy.

the most common causative organisms of VAP such as *E. coli*, MSSA, *Klebsiella*, *Proteus*, *Haemophilus influenzae* and *Enterobacteriaceae*.

In identifying organisms in early onset and late onset VAP, Abd El-Kader [2] conducted a study at the Pediatric Intensive Care Unit (PICU) in Children's Hospital at Ain Shams University and concluded that *S. aureus* was the most common microorganism isolated in early onset VAP while *Pseudomonas* species and *Enterobacteriaceae* species were the most common organisms isolated in late onset VAP.

As regards the role of distinct pathogens, including *Legionella* spp., anaerobes, fungi and viruses, the so-called commensals, were frequently addressed as nonpotentially pathogenic micro-organisms (non-PPM). Asser [12] concluded that these pathogens may be more common than originally thought, but their role has not been settled and this was in agreement with Marik et al. [17] who draw the attention toward the possibility of these agents as being causative organisms for VAP that clinicians should take into account such microorganisms and consider them during empirical therapy.

We faced some difficulties during this work in collecting materials such as unavailability of electronic data base as studies found cited on websites were only the title of the study with the name of the author and abstract of the study. Moreover we faced some vague study design, small sample size, different study designs preventing us from getting statistical result from data and controversy between study content and study design, We try hard to collect as much as possible from the studies done in VAP to get specific, universal, clear and approved data for preventing the problem of VAP, decreasing its magnitude and enriching its management, but study limitations did not give us a chance of that hopeful target and force us to get individual results of the three parameters of our study; incidence, risk factors and most common causative organisms of VAP one by one. So we recommend to establish a large-scale multi center national study to explore incidence of VAP, all possible risk factors (whether preventable or non preventable), causative organisms, mortality due to VAP and its economic aspect, and also to develop an indexing system for all these in Egyptian Universities with key words according to MeSH.

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