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Incidence and diagnosis of ventilator-associated tracheobronchitis (VAT) in the intensive care unit: an international online survey

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Abstract

Introduction

Several aspects of ventilator-associated tracheobronchitis (VAT) remain poorly defined, including diagnostic criteria, overlap with ventilator-associated pneumonia (VAP) and

appropriate treatment regimens. The objective of this study was to survey reported practices in the clinical and microbiological diagnosis of VAT, and to evaluate perceptions of the impact of VAT on patient outcomes.

Methods

We developed a questionnaire comprising of: 1) Characteristics of the respondent, the ICU and hospital, 2) current clinical and microbiological diagnostic approach, 3) empirical antibiotic therapy and 4) the perception of physicians regarding the clinical impact of VAT and its implications.

Results

A total of 288 ICUs from 16 different countries answered the survey, 147 (51%) from the Latin American Group (LA) and 141 (49%) from Spain, Portugal and France (SPF group). The majority of respondents (n = 228; 79.2%) reported making the diagnosis of VAT based on clinical and microbiological criteria and 40 (13.9%) by clinical criteria alone. Approximately half (50.3%) of the respondents agreed that patients should receive antibiotics (ATB) for the treatment of VAT. Out of all respondents, 269 (93.4%) assume that a VAT episode increases ICU length of stay and this perception is greater in LA (97.3%) than in SPF group (89.4%, P <0.05). Half of the physicians considered that VAT increases the risk of mortality, and this perception is again greater in LA (58.5% versus 41.1%, P <0.05).

Conclusion

Given the possible high incidence of VAT and the perception of its importance as a risk factor for VAP and mortality, a large multicentre international prospective study would be helpful to validate a consensual definition of VAT, to determine its incidence and delineate its impact on subsequent VAP occurrence.

Introduction

Whilst mechanical ventilation (MV) is potentially life saving, it also carries significant risks and complications. Of these, Ventilator-associated pneumonia (VAP) is one of the most severe, being associated with increased morbidity and duration of MV in the Intensive Care Unit (ICU) [1,2]. Ventilator-Associated Tracheobronchitis (VAT) is believed to be an intermediate stage between colonization of the lower respiratory tract and VAP. However more recent data suggests that VAT may be a separate entity that may contribute to increased length of ICU stay and longer duration of MV [3].

Both VAP and VAT are clinically characterized by presence of fever, mucopurulent bronchial secretions and leucocytosis. In contrast to VAP, VAT does not involve the pulmonary parenchyma, and as a result does not cause radiographic pulmonary infiltrates. Accurate diagnosis of VAT is challenging, as many conditions commonly encountered in critically ill patients (such purulent secretions, pulmonary oedema or acute respiratory distress syndrome) can mimic its signs and symptoms. In contrast to VAP, the current knowledge on VAT is recent and limited to a substantially lower number of large clinical studies. Our main objectives were to document reported practices of clinical and microbiological diagnosis of VAT, and to evaluate perceptions of the impact of VAT on

patient outcomes. This will serve as a first step of an international prospective study on VAT registered under number NCT01791530 (clinicaltrials.gov).

Material and methods

Study population

Physicians with a major role in infection control practices and ICU clinical management were surveyed, with only one respondent per ICU allowed. This study was approved by the ethics committee of Corporació Sanitaria Parc Taulí, Sabadell, Spain (Ref 2013515). Informed consent was not required as the survey consisted of a voluntary anonymous response to a web-based questionnaire, with no patient data included. The web-based survey attempted to assess the responding physicians' individual perceptions of current clinical practices.

Questionnaire

We developed a web-based questionnaire with 4 parts (Additional file 1): 1) Characteristics of the respondent, and the ICU and hospital, 2) practices of clinical and microbiological diagnosis of VAT, 3) empirical antibiotic therapy used after diagnosis and 4) the perception of physicians regarding the clinical impact of VAT and the need for treatment. To evaluate diagnostic factors, we questioned investigations performed (eg. fiberoptic bronchoscopy versus less invasive techniques), culture (quantitative or semi-quantitative) and any complementary imaging studies. Regarding antibiotic use, we included questions on the nature of empirical therapy, combination use, timing of treatment commencement, and the use of inhaled antibiotic therapy for treatment of VAT. The questionnaire was concise and consisted strictly of multiple-choice questions in an attempt to improve the response rate. It was first developed in Spanish and then translated into English, French and Portuguese by the Steering Committee members. We transferred the surveys to a web platform (ClinicalRec) to collect the data, a fine-tuned, hosted web and data mining platform designed specifically to perform and analyze clinical data.

Dissemination to target group

The questionnaire was available online from January 1 to March 31, 2013. It was endorsed by SEMICYUC (Sociedad Española de Medicina Intensiva, Crítica y Unidades Coronaria), FEPIMCTI (Federación Panamericana e Ibérica de Sociedades de Medicina Crítica y Terapia Intensiva) and BRICNET (Brazilian Research in Intensive Care NETWORK. The members of the Steering Committee (local opinion leaders) were responsible for the distribution of the survey in their countries. The questionnaire was sent by e-mail to 1036 physicians, 610 (58.8%) in Spain (n = 350), Portugal (n = 50) and France (n = 210) which formed the SPF Group, and 426 in Latin American Group. Table 1 shows the number of surveys sent by country. The survey was not distributed in the USA although one participant ICU was included which was part of a research network actively collaborating with different centers in Spain.

Table 1 Survey response rate

Country	Total of sent surveys, n (%)	Responses, n (%)
Spain	350 (33.8)	92 (26.3)
France	210 (20.3)	32 (15.2)
Portugal	50 (4.8)	17 (34.0)
Brazil	182 (17.6)	61 (33.5)
Colombia	60 (5.8)	22 (38.6)
Argentina	50 (4.8)	17 (34.0)
Chile	30 (2.9)	12 (40.0)
Ecuador	20 (1.9)	12 (60.0)
Peru	20 (1.9)	7 (35.0)
Mexico	20 (1.9)	1 (5.0)
Venezuela	10 (0.9)	4 (40.0)
Uruguay	10 (0.9)	4 (40.0)
Bolivia	10 (0.9)	4 (40.0)
Guatemala	8 (0.8)	2 (25.0)
Costa Rica	5 (0.5)	1 (20.0)
USA	1 (0.1)	1 (100)

Statistical analysis

Descriptive statistics were used to characterize the study sample. We used Chi Square and Mann–Whitney tests to compare survey characteristics of study participants and to make comparisons by country and region. Data was processed using the Statistical Package of Social Sciences (SPSS) 13.0.1 standard version (IBM, Chicago, USA). Response rates and sample characteristics were analysed using descriptive statistics. In descriptive data analysis, proportions (percentages) were reported. Statistical significance was defined as $p < 0.05$.

Results

A total of 288 ICUs from 16 different countries replied to the survey, representing a response rate of 27.8% (288/1036). Fifty-one percent (n = 147) were from the Latin American Group and 141 (49%) from the SPF group (Figure 1). The number of individual responses per country is shown in Table 1. The main characteristics of the respondents and the ICUs were compared and are also presented in Table 2. In the SPF group as compared to Latin American group (LA), more hospitals were in a public health system, with greater numbers of beds and were more frequently University-associated. However, the only ICUs with more than 50 beds were reported in LA. There was no significant statistical difference when comparing the response of physicians according to the type of ICU (University vs. non-University ICU), nor when comparing the number of ICU beds (less or more than 20).

Figure 1 ICUs percentage according to the country of origin that responded to the survey out of a total of 288 responses.

Table 2 Characteristics of the respondents, and ICU setting

Characteristics	Global (n = 288)	SPF Group (n = 141)	Latin American Group (n = 147)	p-value *
	n,(%)	n,(%)	n,(%)	
Number of beds in ICU				
> 50 beds	11 (3.8)	-----	11 (7.5)	0.003
21-50 beds	79 (27.4)	40 (28.4)	39 (26.5)	0.82
10-20 beds	140 (48.6)	80 (56.7)	60 (40.8)	0.01
<10 beds	58 (20.1)	21 (14.9)	37 (25.2)	0.04
ICU type				
General	278 (96.5)	137 (97.2)	141 (95.9)	0.79
Cardiac Surgery	3 (1.0)	----	3 (2.0)	0.26
Neurotrauma	2 (0.7)	----	2 (1.4)	0.49
Surgical	2 (0.7)	2 (1.4)	----	0.46
Respiratory	2 (0.7)	1 (0.7)	1 (0.7)	1.00
Trauma	1 (0.3)	1 (0.7)	----	0.98
Number of beds in Hospital				
>500 beds	103 (35.8)	79 (56.0)	24 (16.3)	<0.001
201-500 beds	107 (37.2)	55 (39.0)	52 (35.4)	0.60
100-200 beds	50 (17.4)	7 (5.0)	43 (29.3)	<0.001
<100 beds	28 (9.7)	----	28 (19.0)	<0.001
Hospital type				
Public	188 (65.3)	133 (94.3)	55 (37.4)	<0.001
Private	78 (27.1)	5 (3.5)	73 (49.7)	<0.001
Mixed	22 (7.6)	3 (2.1)	19 (12.9)	0.002
Academic Degree				
University	190 (66.0)	104 (73.8)	86 (58.5)	0.009
No University	98 (34.0)	37 (26.2)	61 (41.5)	0.009

(* all comparisons were made between Spain, Portugal and France (SPF) and Latin American groups).

Diagnosis of VAT

Almost all (99.7%) of the respondents considered that ventilated patients are at risk of developing VAT. One-hundred and two respondents (35.5%) considered that VAT is more frequent in all ICU ventilated patients irrespective of the type of admission diagnosis. Eighty-nine (30.9%) respondents considered that patients admitted because of medical conditions are at higher risk of VAT, followed by neurological (n = 53; 8.4%) and surgical (n = 20; 7.0%) patients.

The majority of respondents (n = 228; 79.2%) make the diagnosis of VAT on the basis of both clinical and microbiological criteria. Forty (13.9%) reported using clinical criteria alone, and 19 (6.6%) consider it as a diagnosis of exclusion. Endotracheal aspirates (ETA) were reported to be the most frequently utilized technique for diagnosis of VAT (59.4%), followed by bronchoalveolar lavage (BAL) in 13.9% and multiple sampling techniques (12.2%). BAL and mini-BAL techniques were more frequently employed by the Latin American group, while multiple sample techniques were more commonly used be the SPF group (Table 3), with 47.6% (n = 137) use any bronchoscopic technique for diagnosis of VAT (Table 4). While the use of bronchoscopic techniques are part of routine practice in only 3.1% of respondents, in 35.8% it is used when the chest x-ray (CXR) is not conclusive, and in 8.7% when antibiotic treatment is started. Similarly, more than 50% of physicians requested a CT

scan to confirm or exclude the diagnosis of VAT, 2.4% as routine practice, and 48.3% when CXR is inconclusive (Table 4).

Table 3 Techniques used for the diagnosis of Ventilator-associated Tracheobronchitis

Technique	Global (n = 288)	SPF Group (n = 141)	Latin American Group (n = 147)	p-value*	OR (95%CI)*
	n (%)	n(%)	n (%)		
Endotracheal aspirate (ETA)	171 (59.4)	87 (61.7)	84 (57.1)	0.50	ND
Bronchoalveolar lavage (BAL)	40 (13.9)	12 (8.5)	28 (19.0)*	0.01	0.4(0.2-0.8)
ETA plus other techniques	35 (12.2)	27 (19.1)	8 (5.4)*	0.001	4.1(1.7-10.3)
Mini-BAL	21 (7.3)	4 (2.8)*	17 (11.6)*	0.009	0.2(0.07-0.08)
Protected Specimen Brush (PSB)	4 (1.4)	3 (2.1)	1 (0.7)	0.58	ND
No response	17 (5.9)	8 (5.7)	9 (6.1)	1.00	ND

(* all comparisons were made between Spain, Portugal and France (SPF) and Latin American Groups. OR = Odds Ratio, CI = Confidence interval; ND = Not determined).

Table 4 Microbiological techniques and complementary studies used to the diagnosis of Ventilator-associated tracheobronchitis

Questions	Global (n = 288)	SPF Group (n = 141)	Latin American Group (n = 147)	p-value	OR (95%CI)
	n (%)	n (%)	n (%)		
Quantitative cultures					
Yes	217 (75.3)	97 (68.8)*	120 (81.6)	0.01	0.5 (0.3-0.9)
No	66 (22.9)	42 (29.8)*	24 (16.4)	0.01	2.2 (1.9-3.9)
NR	5 (1.7)	2 (1.4)	3 (2.0)	1.00	ND
Gram stain technique					
Yes	116 (40.3)	62 (44.0)	54 (36.7)	0.25	ND
No	170 (59.0)	78 (55.3)	92 (62.6)	0.25	ND
NR	2 (0.7)	1 (0.7)	1 (0.7)	1.00	ND
Bronchoscopy for the diagnosis of VAT					
Never	151 (52.4)	73 (51.8)	78 (53.1)	0.92	ND
Only when the chest x-ray is not conclusive	103 (35.8)	50 (35.5)	53 (36.1)	1.00	ND
Only if I decide to start ATB	25 (8.7)	13 (9.2)	12 (8.2)	0.91	ND
Always	9 (3.1)	5 (3.5)	4 (2.7)	0.95	ND
CT scan for the diagnosis of VAT					
Never	142 (49.2)	82 (58.2)*	60 (40.8)	0.005	2.0 (1.2-3.3)
Only when the chest x-ray is not conclusive	139 (48.3)	58 (41.1)*	81 (55.1)	0.02	0.5 (0.3-0.9)
Always	7 (2.4)	1 (0.7)	6 (4.1)	0.14	ND

(*all comparisons were made between Spain, Portugal and France (SPF) and Latin American Groups. OR = Odds Ratio, CI = Confidence interval; ND = Not determined; NR = No response).

Although the majority of respondents (n = 276; 95.8%) use microbiological findings to guide antibiotic treatment, more than half (n = 170; 59.0%) do not perform a Gram stain on the respiratory sample. Sixty-six (22.9%) reported not to request quantitative cultures of respiratory secretions as routine practice, and this occurred more frequently in the SPF group (Table 4).

Treatment of VAT

Approximately half (50.3%) of the respondents agreed that patients diagnosed with VAT should receive antibiotics (ATB). Only 24.3% (n = 70) routinely prescribed antibiotics, whilst 42.0% (n = 121) only prescribed antibiotics in the presence of hemodynamic instability. Conversely, 26% (n = 75) of physicians considered that VAT should not be treated with ATB and 7.6% (n = 22) answered to ignore the most appropriate decision for treatment.. A total of 90.3% (n = 260) of the responders indicated that the duration of MV helped in the decision of ATB treatment, however only the 50% of them indicated this option in the survey in regard to the best treatment option for VAT (Table 5).

Table 5 Antibiotic treatment of Ventilator-associated tracheobronchitis

Questions	**Gobal (n = 288)**	**SPF Group (n = 141)**	**Latin American Group (n = 147)**	**p-value***	**OR(95%CI)***
	n (%)	**n (%)**	**n (%)**		
All VAT patients should receive ATB treatment?					
Yes	121 (42.0)	59 (41.8)	62 (42.2)	1.00	ND
No	75 (26.0)	31 (22.0)	44 (29.9)	0.16	ND
Only in patients with cardiovascular failure	70 (24.3)	41 (29.1)	29 (19.7)	0.08	1.6(0.9-2.9)
Unknown	22 (7.6)	10 (7.1)	12 (8.2)	0.90	
Which is the most appropriate treatment for VAT?					
Broad-spectrum IV ATB	84 (29.2)	37 (26.2)	47 (32.0)	0.34	ND
Narrow-spectrum IV ATB	20 (6.9)	15 (10.6)	5 (3.4)	0.002	3.3(1.1-10.9)
Select ATB according to MV days	145 (50.3)	74 (52.5)	71 (48.3)	0.55	ND
Nebulized ATB	6 (2.1)	2 (1.4)	4 (2.7)	0.71	ND
Broad-spectrum IV ATB + nebulized ATB	7 (2.4)	1 (0.7)	6 (4.1)	0.14	ND
Never	26 (9.0)	12 (8.5)	14 (9.5)	0.92	ND
Which is the most appropriate option for treatment of VAT?					
IV ATB in monotherapy	180 (62.5)	99 (70.2)	81 (55.1)	0.01	1.9(1.1-3.2)
IV ATB in combination	60 (20.8)	20 (20.6)	31 (21.1)	0.16	ND
IV ATB + Nebulized ATB in monotherapy	27 (9.4)	7 (5.0)	20 (13.6)	0.02	0.3(0.1-0.8)
IV ATB + Nebulized ATB in combination	16 (5.6)	2 (1.4)	14 (9.5)	.006	0.1(0.02-0.6)
No reply *Timing to start ATB treatment?*	5 (1.7)	4 (2.8)	1 (0.7)	0 0.34	ND
< 12 h	211 (73.3)	96 (68.1)	115 (78.2)	0.07	0.5(0.3-1.0)
13-24 h	44 (15.3)	23 (16.3)	21 (14.3)	0.75	ND
> 24 h	24 (8.3)	17 (12.1)	7 (4.8)	0.04	2.7(1.01-7.5)
Never ATB treatment	9 (3.1)	5 (3.5)	4 (2.7)	0.95	ND
ATB duration					
7-10 days	25 (8.7)	7 (5.0)	18 (12.2)	0.04	0.3(0.1-0.9)
7-10 day but de-escalation	167 (58.0)	84 (59.0)	83 (56.5)	0.67	ND
14 days	1 (0.3)	0	1 (0.7)	1.00	ND
Until clinical resolution	22 (7.6)	13 (9.2)	9 (6.1)	0.44	ND
< 7 days	71 (24.7)	35 (24.8)	36 (24.5)	1.00	ND
No reply	2 (0.7)	2 (1.4)	0	0.90	ND

(*all comparisons were made between SPF and Latin American groups. OR = Odds Ratio, CI = Confidence interval; ND = Not determined).

Intravenous (IV) monotherapy (62.5%) is the first choice of ATB treatment for VAT, and was more frequently supported by the SPF group, followed by IV ATB combination (20.8%) and then IV and nebulized ATB. The use of nebulized ATB is more frequently reported by the Latin American group compared to the SPF group (Table 5).

The majority of respondents (73.3%) started ATB treatment within 12 hours of VAT diagnosis. Initiation of treatment after 24 hours of VAT diagnosis was more commonly reported by the SPF group (12.1%) as compared to the Latin American group (4.8%). More than half (66.7) indicated they favoured ATB treatment with a duration between 7–10 days. Half of the respondents preferred to de-escalate therapy when the results of microbiology tests are available. Surprisingly, only 24% indicated a preference for a short course of ATB treatment (<7 days). The empiric antimicrobial regimens for early and late-onset VAT are shown in Figures 2 and 3, respectively.

Figure 2 Empiric antibiotic therapy for Early Ventilator-associated tracheobronchitis. (CBP:carbapenem; PTZ:Piperacillin/Tazobactam; FQ:Fluoroquinolones; CEF3 PS: Third generation Pseudomonal cephalosporins; CEF3 NPS: Third generation non-Pseudomonal cephalosporins; AMK: Amikacin; AMC: amoxicillin/clavulanate; Vanco: vancomycin).

Figure 3 Empiric antibiotic therapy for Late Ventilator-associated tracheobronchitis. (CBP:carbapenem; PTZ:Piperacillin/Tazobactam; FQ:Fluoroquinolones; CEF3 PS: Third generation Pseudomonal cephalosporins; CEF3 NPS: Third generation non-Pseudomonal cephalosporins; AMK: Amikacin; AMC: amoxicillin/clavulanate; Vanco: vancomycin).

Impact of VAT

Finally, 94.1% (n = 274) of respondents believe that the development of VAT is associated with longer duration of MV. Two hundred and sixty nine (93.4%) assume that a VAT episode is associated with increased ICU length of stay and this perception is greater in the LA group (97.3%) as compared to the SPF group (89.4%, $p < 0.05$). Half of the physicians considered that VAT increases the risk of mortality, and this perception is again greater in the LA group as compared to the SPF group (58.5% vs. 41.1%, $p < 0.05$).

Discussion

This is the first international survey that has aimed to evaluate perceptions of impact and self-reported practices in the diagnosis and treatment of VAT. We consider that the present survey is relevant to increase current knowledge of VAT. There are several conflicting results regarding the clinical implications of VAT, and the present survey provides a path towards meaningful research questions for future clinical studies. The main conclusions of the present study are that VAT is perceived as a common complication of MV in ICU patients; it is a diagnosis based not only on clinical criteria but also on non-invasive techniques and microbiological confirmation; and that half of physicians surveyed use systemic antibiotics to treat VAT as they believe that VAT is associated with a longer duration of mechanical ventilation and longer ICU length of stay.

The true incidence of VAT is not currently known. VAT is recognized by the US Centers of Disease Control and Prevention/National Healthcare Safety Network (CDC/NHSN) [4] as an individual clinical entity. As the clinical relevance of VAT seems to be increasing, it is necessary to further delineate its incidence in a study that applies a widely accepted definition. A large multicentre international study is planned in order to answer some of the questions presented in this survey. The goal of the present survey was to determine the importance of VAT and physicians attitudes based on the answers taken from 288 ICUs in Europe and Latin America.

The majority of respondents (>90%) to the present survey agreed that patients under mechanical ventilation have a significant risk of developing VAT, and they perceived that this risk was even higher in medical patients. This finding is in opposition to that of the study by Malacarne et al. [5], who in a prospective epidemiological study conducted in 71 Italian ICUs with 9493 consecutive patients found that surgical patients were more likely to develop VAT than medical patients (odds ratio (OR) of 1.64). According to the current definition, as recently published by the CDC, a diagnosis of VAT is made if there is absence of pneumonia in the X-ray and at least 2 of the following findings: 1) fever (> 38°C) 2) cough, 3) new or increased production of sputum, 4) rhonchi, 5) wheezing, and at least one of the following a) Positive culture obtained by deep tracheal aspirate or bronchoscopy and b) Positive laboratory test on respiratory secretions [4].

Similarly, the European Respiratory Society (ERS), European Society of Clinical Microbiology and Infectious Diseases (ESCMID) and European Society of Intensive Care Medicine (ESICM) taskforce requires a positive culture of respiratory secretions as a mandatory item in the diagnosis of VAT [6]. In the present survey, almost 80% of physicians routinely diagnosed VAT with the assistance of microbiological studies, with a minority (13.9%) relying solely on clinical assessment. As expected, non-invasive techniques were more frequently preferred to obtain samples and achieve microbiological confirmation. Although the use of quantitative cultures of respiratory secretions could be helpful to differentiate VAT from colonization, invasive techniques are not mandatory for VAT diagnosis. It was therefore surprising that invasive techniques are utilized by almost half of respondents. This finding is more frequent in the Latin American group than the SPF group.

The subjectivity and variability inherent in interpretation of chest X-rays in mechanically ventilated patients makes chest imaging ill-suited for inclusion in a definition algorithm to be used for the potential purposes of public reporting, inter-facility comparisons, and pay-for-reporting and pay-for-performance programs. Several authors [7,8] have proposed the use of CT lung scans and this recommendation is followed by half of the respondents to the survey. Nevertheless, it is important to consider whether a CT scan for this purpose is cost effective and safe for critically ill patients. Ventilated patients are at high risk for complications en route, and in addition transport outside the ICU has been reported to be an independent risk factor for VAP (odds ratio, 2.9; 95% confidence interval, 1.4-5.7) [8,9]. A recent observational cross-sectional study of adult patients attending the emergency department found that chest X-rays demonstrated poor sensitivity and positive predictive value for detecting pulmonary opacities when compared to chest CT for routine clinical care [10,11]. It remains unclear if the use of chest CT is cost-effective or even necessary for the management of suspected VAT.

The antibiotic treatment of VAT remains controversial [12]. In the survey, half of the respondents reported that the duration of mechanical ventilation is an important factor to

consider when deciding on administration of antibiotics to patients with VAT. The use of antibiotics in VAT has been evaluated in 2 recent Randomized Controlled Trials (RCT). Palmer et al. [13] found faster weaning and less use of systemic ATB when nebulized antibiotics were administered. Nseir et al. [14] found a lower mortality rate and more MV free-days. Although the administration of aerosolized ATB in patients with uncomplicated VAT is an attractive approach, it is only reported by the minority of the respondents. In our survey this practice is more frequent in Latin America. Well-designed prospective studies are needed in order to further delineate the best therapeutic approach for suspected VAT.

We acknowledge limitations to the present survey. First, the present study may have a bias selection as VAT may represent an important clinical entity for respondents. Second, although we sought to survey the ICU physician most involved in the decision-making process related to ICU infections, it may represent the personal opinion of the respondents and may not reflect hospital or country-wide policies. Third, we could not be completely sure that respondents were not using VAT and VAP answers in an interchangeable fashion. However, questions about VAT were formulated with closed answers and questions related to VAP were made in order to avoid confusion and misinterpretation between these two entities. Fourth, we recognize that self-reported practices in a survey may not reflect actual practice of the respondents, a limitation inherent to the nature of all surveys. Finally, this survey comes from only 3 European and 13 Latin American countries, and thus cannot represent the opinions of these entire communities.

Conclusion

VAT is recognized as a frequent complication of mechanical ventilation. However, subjective components within VAT definition and diagnosis may impact the reliability and accuracy of case identification. VAT represents a clinical entity that is closer to the clinical reality than more strict criteria usually considered in most clinical published studies. Given the perceived increasing incidence of VAT and its importance as a possible risk factor for VAP and other adverse outcomes, a large multicentre international prospective study, with standardized clinical and microbiologic criteria for VAT diagnosis, needs to be performed. This should aim to validate an accepted definition of VAT, determine its incidence, and further delineate its impact on clinically relevant outcomes.

Key messages

- Ventilator-Associated Tracheobronchitis is perceived as a frequent complication of mechanical ventilation.
- The diagnosis of Ventilator-Associated Tracheobronchitis is usually based on a combination of clinical and microbiological criteria.
- More than half of respondents did not perform a Gram stain on the respiratory sample and one out of four did not request a sample for quantitative culture in the diagnosis of Ventilator-Associated Tracheobronchitis.
- Half of physicians reported prescribing broad-spectrum systemic antibiotics for the treatment of Ventilator-Associated Tracheobronchitis.
- The majority of physicians believed that Ventilator-Associated Tracheobronchitis is associated with a longer duration of mechanical ventilation and longer ICU length of stay.

Abbreviations

ATB, Antibiotic; ATB, Antibiotics; BAL, Bronchoalveolar lavage; CT, Computed tomography; CXR, Chest x-ray; CDC, Centers of disease control and prevention; ESCMID, European society of clinical microbiology and infectious diseases; ESICM, European society of intensive care medicine; ETA, Endotracheal aspirate; ICU, Intensive care unit; ICU, Intensive care unit; LA, Latin America; MV, Mechanical ventilation; NHSN, National healthcare safety network; ERS, European respiratory society; RCT, Randomized controlled trials; VAP, Ventilator-associated pneumonia; VAT, Ventilator-associated tracheobronchitis

Competing interests

The authors have no conflict of interest to disclose.
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IM-L, AR, PP, JS, SN and DC assisted in the design of the study, coordinated patient recruitment, analyzed and interpreted the data, and assisted in writing the paper. TAVEM group made important contributions to the acquisition and analysis of data. IML, PP, JS, SN and DC were involved in revising the manuscript critically for important intellectual content. IM-L and AR made substantial contributions to the concept, design, analysis and interpretation of data and revised the final manuscript version. All authors read and approved the final manuscript. IM-L acted as guarantor of/person responsible for the entire manuscript.

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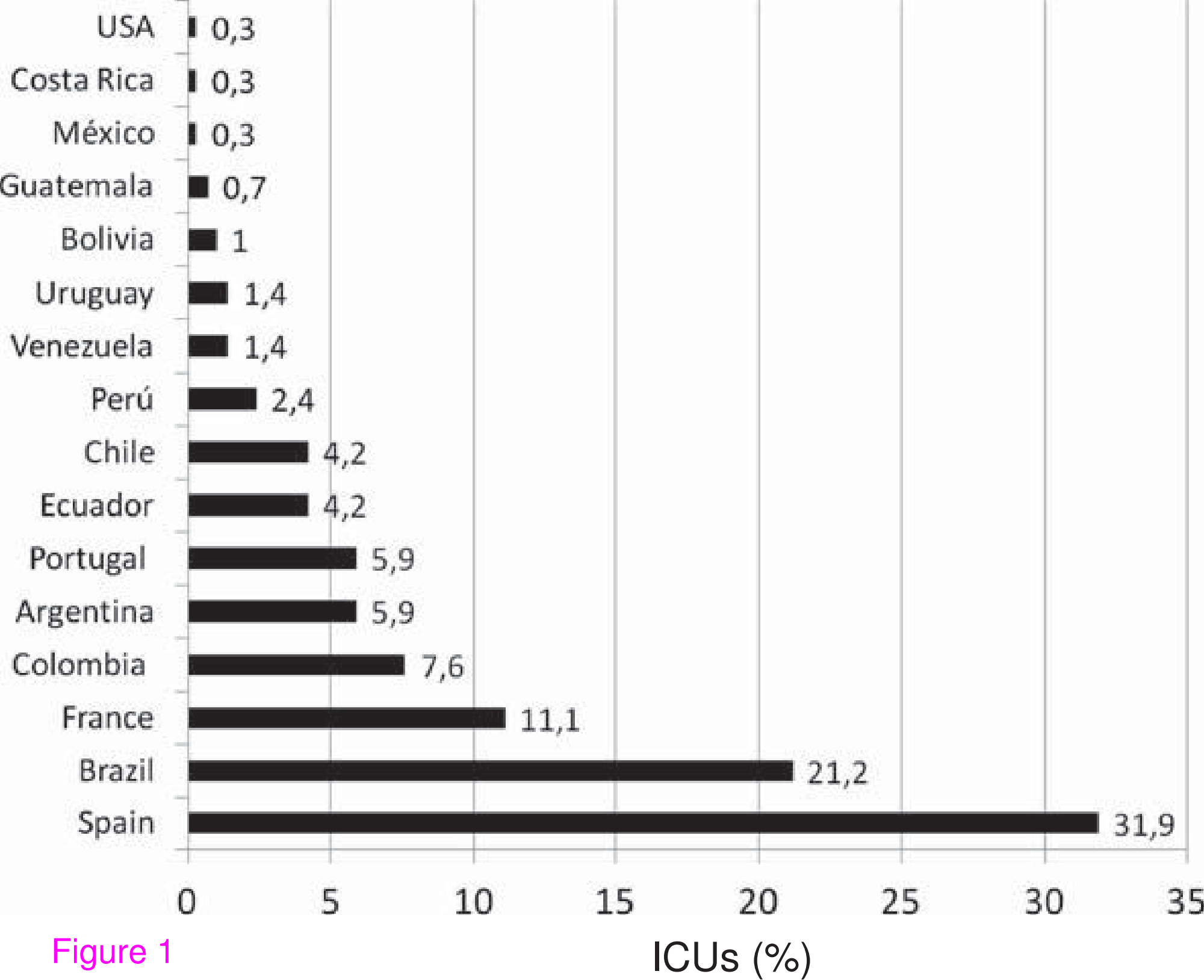
Additional file

Additional_file_1 as PDF

Additional file 1 Survey submitted for the TAVeM group. Web-based questionnaire for the Ventilator-Associated Tracheobronchitis (VAT) in the Intensive Care Unit International Online Survey.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0,3
México
0,3
Guatemala
0,7
Bolivia
1
Uruguay
1,4
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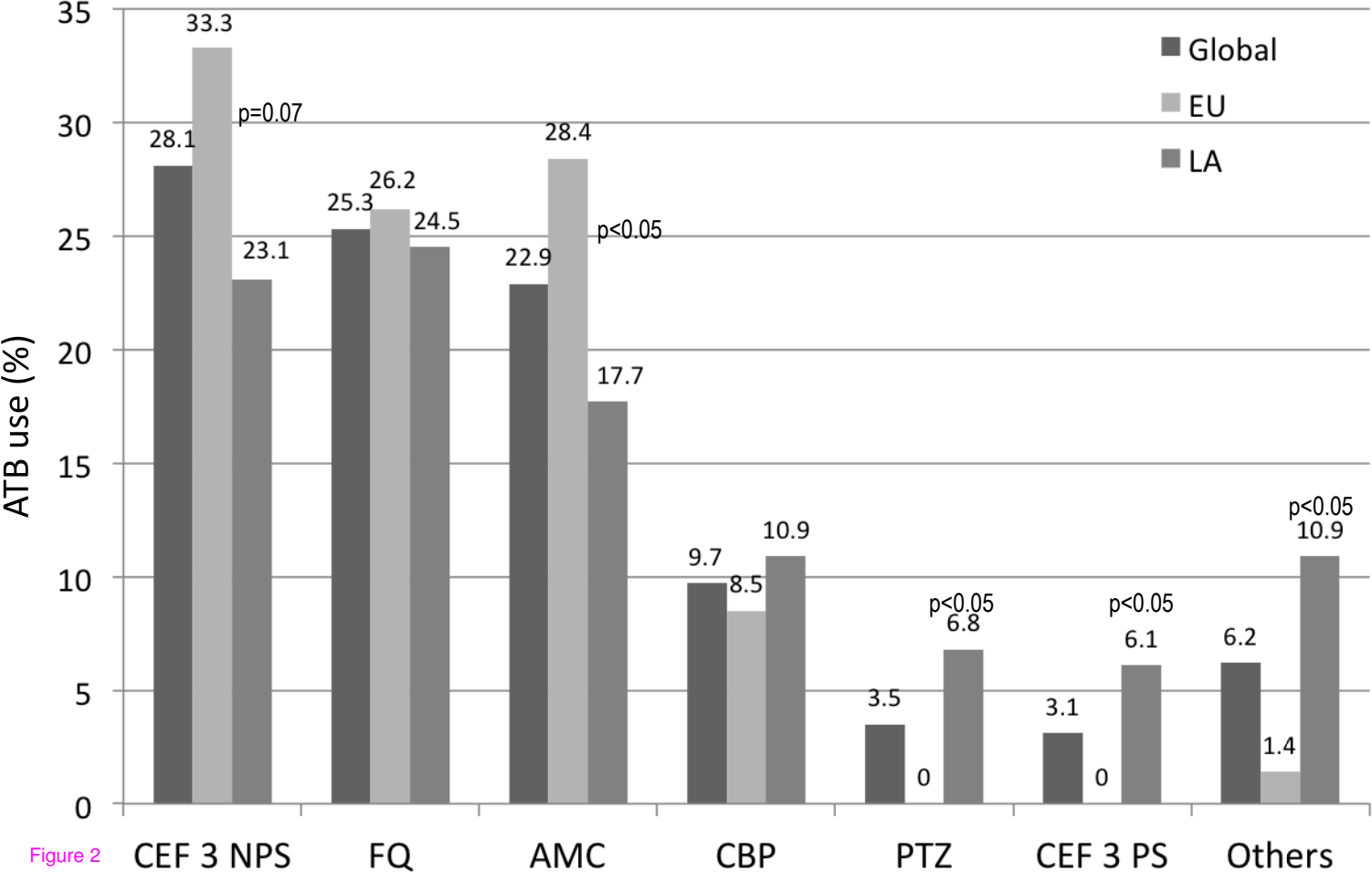
Perú
2,4
Chile
4,2
Ecuador
4,2
Portugal
5,9
Argentina
5,9
Colombia
7,6
France
11,1
Brazil
21,2
Spain
31,9
0
5
10
15
20
25
30
35
ICUs (%)

Figure 1


ATB use (%)
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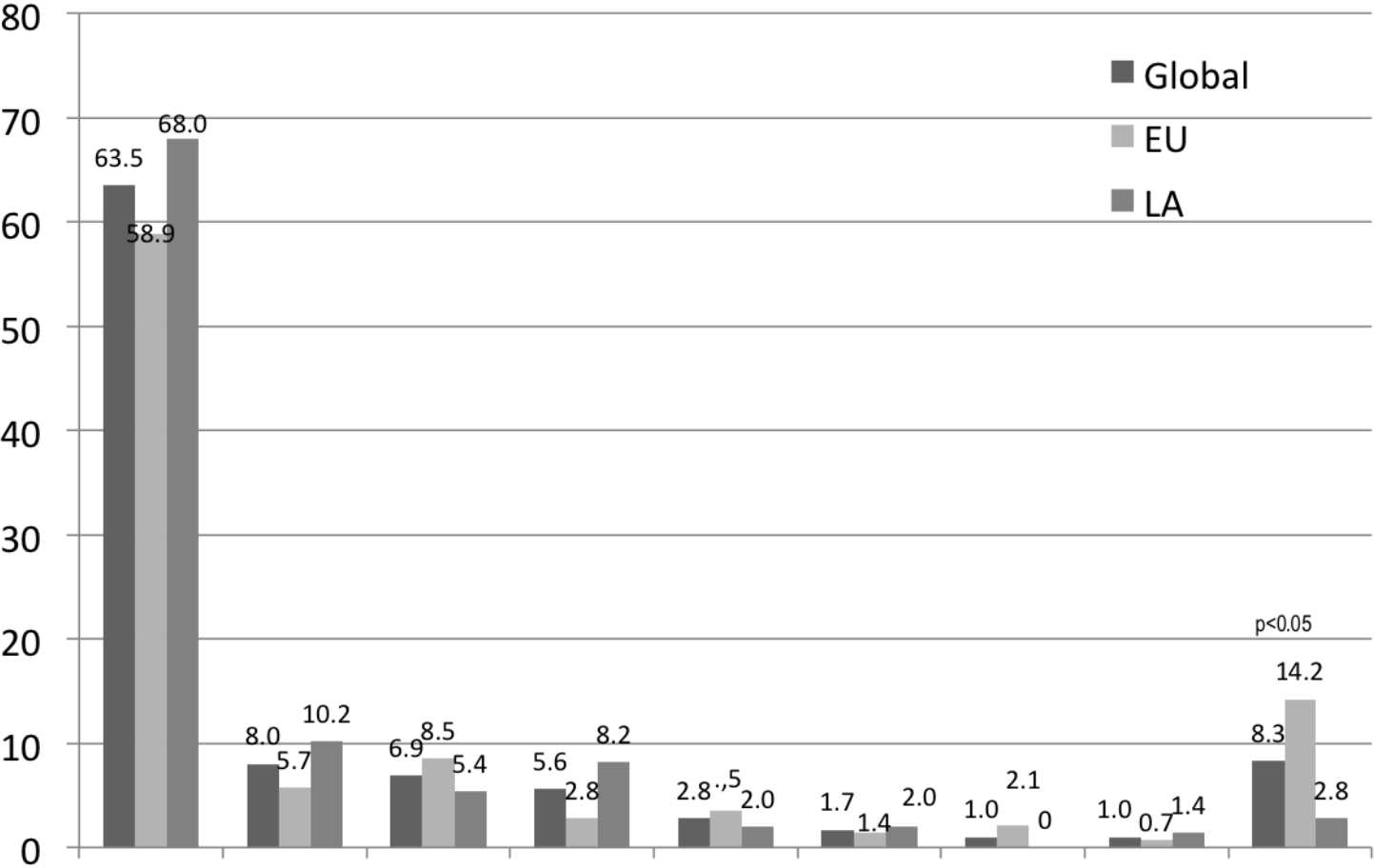
30
25
20
15
10
5
0
Global
EU
LA
28.1
33.3
p=0.07
23.1
25.3
26.2
24.5
22.9
28.4
p<0.05
17.7
9.7
8.5
10.9
3.5
0
p<0.05
6.8
3.1
0
p<0.05
6.1
6.2
1.4
p<0.05
10.9
CEF 3 NPS
FQ
AMC
CBP
PTZ
CEF 3 PS
Others

Figure 2


Global
EU
LA
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70
60
50
40
30
20
10
0
63.5
58.9
68.0
8.0
5.7
10.2
6.9
8.5
5.4
5.6
2.8
8.2
2.8
2.5
2.0
1.7
1.4
2.0
1.0
2.1
0
1.0
0.7
1.4
p<0.05
8.3
14.2
2.8
CBP
PTZ
FQ
CEF 3 PS
CEF 3 NPS
AMK
AMC
Vanco
Others

Figure 3

Additional files provided with this submission:

Additional file 1: 1812879655104858_add1.pdf, 48K
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