Research Paper

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Frequency, Etiology and Timing of Unexpected Sudden Deaths in the Intensive Care Unit: A Single Center Retrospective Study

Medical Science

KEYWORDS : mortality, intensive care unit, unexpected, medical error, sudden death

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ABSTRACT

Objective: To evaluate the characteristics of unexpected sudden mortalities (USMs) observed at an intensive care unit (ICU) in terms of patient demographics and frequency, etiology and timing of deaths

Methods: A total of 1424 patients who admitted to ICU between 1 January 2011 and 31 December 2012 were included in this retrospective study conducted at a 20-bed capacity ICU that works as closed system within a 345-bed training and research hospital. Of 1424 patients, overall mortality was determined to occur in 249 patients (mean(SD) age: 60.4(22.4) years, ranged 1-105 years, 57.0% were females) including 19 patients with USMs during ICU hospitalization. Patients with mortality (overall, USMs and expected mortalities) were evaluated in terms of data on patient demographics, reasons for referal to ICU, predictable mortality scores of APACHE II and SOFA, admission diagnosis, type of admission as well as the time period (08.00-17.00 or 17.00-08.00) and the day (weekdays/weekend) of deaths.

Results: USM was noted in 7.6% of patients (mean(SD) age: 68.5(24.8) years, 52.6% were males). Main reasons for ICU admission were post-operative surgery (26.3%) and pulmonary disease (21.1%). Overall, most of USMs was determined to occur on weekdays (73.7%) and within 17.01-08.00 o'clock (63.2%). Hypercarbia and severe asidosis (31.6%) secondary to airway problems and endotracheal tube obstruction with secretion (21.1%) were the two common factors likely to underlie USMs. Mean(SD) age (p=0.015), SpO2 (p=0.000), heart rate (p=0.036), body temperature (p=0.000), mean arterial pressure (p=0.012) and length of stay at ICU (p=0.009) were significantly higher, while APACHE (p=0.036) and SOFA (p=0.001) scores were significiantly lower among patients with USMs compared with patients with expected mortalities.

Conclusion: The present single center restrospective study revealed that USMs constitute approximately 7.6% of overall mortalities in ICU, while occurring almost invariably occur due to failure to maintain a secure airway and thence could be avoided.

Introduction

Mortality rates in intensive care unit (ICU) was reported to range from 6.4% to 40% in critically ill patients despite intensive care medicine.[1] In various studies, diagnosis for admittance to ICU, application of invasive processes and treatment type, severity score of illness and the length of the duration in ICU were reported amongst the risk factors for mortality.[2,3]

Alhough various scoring systems are available to calculate severity of illnesses and to predict mortality rates amongst patients admitted to ICU, including Acute Physiologic And Chronic Health Evaluation (APACHE) II, Sequential Organ Failure Assessment (SOFA) and Glaskow Coma Scale (GCS) scores,[4] unexpected sudden mortalities (USMs) are still observed during the treatment of patients admitted to ICU.

Occurrence of USMs beyond the predictable mortality rates is generally perceived as an doubtful, sorrowful and worrisome event both for the healthcare professionals and the patient relatives besides arousing considerable curiosity in terms of underlying causes and sometimes lead to medicolegal problems.[5]

The present study was designed to evaluate the characteristics of USMs observed at an ICU in terms of patient demographics and frequency, etiology and timing of deaths.

Methods

Study population and design

A total of 1424 patients who admitted to ICU between 1 January 2011 and 31 December 2012 were included in this retrospective single-center study conducted at a 20-bed capacity ICU that works as closed system within a 345-bed training and research hospital. Of 1424 patients, overall mortality was determined to occur in 249 patients (mean(SD) age: 60.4(22.4) years, ranged 1-105 years, 57.0% were females) including 19 patients with USMs during ICU hospitalization.

In accordance with the criteria for USMs, the presence of USM was considered for patients without hypotension (MAP<70 mmHg), hypertension (MAP>106 mmHg), desaturation (SpO_2<%90), high fever (urinary bladder temperature>38.3°C) or hypothermia (urinary bladder temperature<35°C), inotropic medication needs, bradycardia (heart rate<50/min), severe tachycardia (heart rate>120/min) and arrhythmia causing hemodynamic disorder in their records of an hour before their death.

Patients with mortality (overall, USMs and expected mortalities) were evaluated in terms of data on patient demographics, reasons for referal to ICU, predictable mortality scores of APACHE II and SOFA, admission diagnosis, type of admission (emergency or elective) as well as the time period (08.00-17.00 or 17.00-08.00) and the day (weekdays/weekend) of deaths.

Characteristics of our ICU

Both surgical and medical patients are refered to our 20-bed ICU where the staff is composed of two specialists, three assistant doctors, one nurse for each patient, three technicians and four sanitation workers during working hours (08.00-17.00) on

weekdays, while of one nurse for three patients, one or two assistant doctors, one technician and one sanitary worker after 17.00 p.m (17.00-08.00). Specialist doctor is responsible for the operation room and the ICU. At weekends, one nurse per five patients works on 12-h shifts, one assistant doctor and one specialist work continuously for 24 hours. In the routine practice, daily progress, physiological and laboratory parameters, any new complication or additional diagnosis that arise during the ICU stay are documented on a daily basis by one of two senior intensivists, as is the cause of death in all patients who died in the ICU.

Statistical analysis

Statistical analysis was made using computer software (SPSS version 20.0, SPSS Inc. Chicago, IL, USA). Distribution of variables was controlled via Kolmogorov Smirnov test. In the analysis of quantitative data, independent samples t-test and Mann-Whitney U-test were used; while in the analysis of qualitative data, chi-square test was used. . Data were expressed as "mean (standard deviation; SD)", minimum-maximum and percent (%) where appropriate. $p<0.05$ was considered statistically significant.

Results

Demographic and clinical characteristics of patients died (overall mortality, n=249)

Of 1429 patients admitted to the ICU at our hospital between January 2011 and 31 December 2012, 249 patients [mean age: 60.4 (SD: 22.4, ranged 1-105 years); 57.0% were males] died leading mortality rate of 17.5% after mean 10.5 days (SD:17.2, ranged 1hour to 137 days) of length of stay at ICU. Main reasons for ICU admission were successful CPR (20.1%) and postoperative surgery (19.3%) (Table 1).

Demographic and clinical characteristics of patients with USMs (n=19)

USM was noted in 19 (7.6%) patients (mean(SD) age: 68.5(24.8) years, 52.6% were males) after mean(SD) 13.4(12.2) days of length of stay at ICU. Main reasons for ICU admission were postoperative surgery (26.3%) and pulmonary disease (21.1%). Overall, most of USMs was determined to occur on weekdays (73.7%) and within 17.01-08.00 o'clock (63.2%). Hypercarbia and severe asidosis secondary to airway problems (31.6%) and endotracheal tube obstruction with secretion (21.1%) were the two common factors likely to underlie USMs (Table 2).

Comparison of EMs and USMs in terms of demographic and clinical parameters

Mean(SD) age (p=0.015), SpO2 (p=0.000), heart rate (p=0.036), body temperature (p=0.000), mean arterial pressure (p=0.012) and length of stay at ICU (p=0.009) were significantly higher, while APACHE (p=0.036) and SOFA (p=0.001) scores were signficiantly lower among patients with USMs compared with patients with expected mortalities (Table 3).

Discussion

Although deaths in ICU, are not sudden and unexpected but natural deaths which leads to track of mortality rate via calculation of the possibility of mortality within the first hours of admission in a patient accepted to the ICU,[5] USMs still occur in ICUs, though rarely.[6]

The two most important risk factors for death in the ICU were presence of either central nervous system failure (31.4%) or cardiovascular failure (20.2%).[7] Although in general populations, most sudden and unexpected deaths have been attributed to cardiac disease with coronary heart disease accounting for the majority of deaths, problems related with failure to maintain a secure airway have been indicated as the main reason for death among critically ill patients hospitalized at ICU.[8]

While sudden cardiac death may also be pronounced in coronary care units and critical care environments that cater for acute and critically ill patients,[9] USMs were reported to be not uncommon in palliative care units which highlights the importance of discussions on CPR to reduce the risk of inappropriate resuscitation attempts or, conversely, to ensure that CPR is not withheld when it is appropriate.[9]

Accordingly, USMs occurred by 7% of deaths occurred during ICU hospitalization in the present study and none of patients died due to cardiac arrest failure, while failure to maintain a secure airway was the primary reason underlying deaths.

Given the variability in chosen defitions and the severity of acute problems, the comparions of studies in terms of mortality rates of ICU patients has been considered challenging.[10,11] Undoubtedly, there is a good correlation between the APACHE II score and risk of death in large groups of patients, but the individual mortality risk predicted by the score varies considerably with the underlying diagnosis.[12] Considered to be superior as compared to other scoring systems,[13] the value of APACHE II score in monitoring quality of care and for conducting clinical studies has been proven as it enables comparison of outcomes among groups of critically ill patients.[14]

In a past study concerning causes of death in intensive care patients with a low APACHE II score, hemodynamic insufficiency as a consequence of shock related to low cardiac output or low blood pressure was the main cause of death, while respiratory insufficiency was reported as the predominant cause of death in patients with an APACHE II score ≤15 who eventually died.[6]

Notably in our study population both APACHE and SOFA scores were significantly lower in patients with USMs as compared to the patients with expected mortalities which emphasize that deaths in the USM group to be rather less expected mortalities. Nonetheless it should be noted that given the hemodynamic data and SpO_2 levels 1-hour before sudden death it seems likely to make an early diagnosis of obstruction of the orotracheal or tracheostomy tube or accidental extubation. Moreover based on APACHE scores in particular, it seems also likely to predict mortality which would prevent occurrence of such a large number of sudden deaths related to the difficulty of maintaining a secure airway in the present study.

We encountered USMs in the second week of the patients' stay in the ICU, hence we consider that, USMs generally occur in the further days of the patients' stays in ICUs. As the first hours of treatment are so crucially important, it is conceivable that outcome after intensive care admission depends, at least partially, on the time of the day the patient is admitted.[15] However, no difference was reported in hospital mortality rates between patients admitted to the ICU during daytime hours and patients admitted during off hours after adjustment for illness severity[16,17]Accordingly, it was speculated that if intensivists are continuously present in the ICU during daytime and present when necessary during off hours this is sufficient to avoid a quality gap during off hours.[18] Ideally, critical care services have to be organized in such a way that optimal treatment is available to all patients day and night.[19] However, availability and quality of personnel and technology are often different during daytime hours as compared to off hours.[20]

Higher incidence of USMs within off hours and on weekdays in our study population seems to be linked to the organizational differences in the course of hours and different days regarding the number of medical specialists and the relationship nurse per patient in our ICU.

It seems evident that the decline of attention in assistance from

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a ratio of 1:1 to a 1:3 ratio in the evening and night hours can represent a source of the problems, while on weekends when a relationship nurse / patient ratio of 1:5 seems intolerable.

Indeed, while the types and variety of ICUs may differ from hospital to hospital, all ICUs have the responsibility to provide services and personnel that will ensure optimal care to critically ill patients.[21] As ours, teritiary care centers require an on-site physician for 24 hrs/day who can manage emergencies, can secure the airway, can establish rapid intravenous access, is qualified in Advanced Cardiac Life Support (ACLS), and, if not subspecialty trained in critical care medicine. As in our ICU, in the closed system, care is quickly provided by an ICU-based team of critical care physicians, nurses, pharmacists, respiratory therapists, and other health professionals.

Accordingly, based on the likelihood of predictability of USMs via vital signs 1-h prior to death and APACHE scores along with the decline of attention in assistance in the evening and night hours, our findings signify that the internal dynamics in the present ICU should be re-evaluated, maintaining a constant level of care via providing a better balance care at day and night.

Indeed, respiratory problems, such as laryngospasm and airway obstruction are more frequent in medical and surgical wards. Besides, modern critical care enables normalizing physiology with successful management of previously unsurvivable short or long term physiological situations with the help of advent of extracorporeal life support and transplantation medicine.[22] Hence, while deaths related to airway problems are obviously "unexpected" in this regard, it seems difficult to understand how their identification is possible in the ICU. Nevertheless our findings emphasize identification of deaths due airway problems in the ICU which are preventable and not considered among the well-known etiologies of USMs and thereby unexpected even in terms of USMs encountered in the clinical practice.

Notably, in a past study concerning airway management complications during anaesthesia, in intensive care units and in emergency departments in the UK, of 36 ICU cases, 18 patients were reported to die and 4 to suffer permanent neurological injury as a result of the airway complications categorized as failed or oesophageal intubation, accidental extubation, including tracheostomy; and problems during transfer.[23] The fact that ICUs are increasingly staffed by physicians whose primary specialty is not anaesthesia and thereby who lacks advanced airway skills as well as the lack of back-up plan for patients with challenging airways have been identified amongst the potential responsible problems.[23]

The airway management outside of the operating room has been consdiered challenging with well-documented hazards.[24-26] Given that majority of airway complications could have been prevented through more effective systems, better preparation and good communication,[23] our findings support the statement that unexpected deaths are often not only explained by the natural course of the underlying disease but can also occur secondary to several dysfunctions of the care system, which necessitates development of organizational measures by healthcare systemts to prevent these avoidable events.[27]

In this regard we performed a debriefing with the staff including all assistants, specialists, nurses and the auxiliary staff working on day and night concerning our findings related to USMs. The importance of central computerized systems in the patient safety and video alarm systems were reviewed with emphasis on data on complications to be well documented and detailed further in the patient forms. The hospital management was requested to increase the number of staff in the hospital and to schedule more flexible shift hours for the staff to be able to rest.

Certain limitations to this study should be considered. First limitation is the failure to conduct post-mortem autopsy for USMs which prevents to detect any curable complication omitted in these patients.[28] Second limitation is the single center, retrospective design and small sample size of the study which limits generalizability of our findings.

In conclusion, the present single center restrospective study revealed that USMs constitute approximately 7.6% of overall mortalities in ICU, while occurring almost invariably occur due to failure to maintain a secure airway and thence could be avoided. Higher incidence of USMs within off hours on weekdays emphasize the causative role of the decline of attention in assistance in the evening and night hours which indicate the need for internal dynamics in the our ICU to be re-evaluated, maintaining a constant level of care via providing a better balance care at day and night.

Table 1. Demographic and clinical characteristics of patients with mortality (n=249)

Age (year) , Mean(SD; min-max)	60.4(22.4; 1-105)
Gender, n(%)	
Female	142(57.0)
Male	107(43.0)
Height (cm), Mean(SD)	161.0(16.1)
Weight (kg), Mean(SD)	69.4(16.9)
Reason for ICU admission, n(%)	
Succesfull CPR	50(20.1)
Postoperative surgery	48(19.3)
Endstage cancer disease	32(12.3)
Multitrauma	27(10.8)
Cerebrovascular disease	25(10.0)
Pulmonary disease	20(8.0)
Renal failure	15(6.0)
Ischemic heart diseases	9(3.6)
Infectious/Sepsis	9(3.6)
Others	14(5.6)
Pancreatitis	6(2.4)
Burn injured patient	3(1.2)
Status epilepticus	2(0.8)
Local anesthetic toxicity	1(0.4)
Eclampsia	1(0.4)
Anaphylaxis	1(0.4)
Type of admissionin ICU, n(%)	
Emergency	217(87.2)
Elective	32(12.9)
APACHE score, Mean (SD)	30.0(6.9)
SOFA score, Mean (SD)	10.7(3.1)
Airway maintenance, n(%)	
Tracheostomy	58(23.3)
Orotracheal intubation	183(73.5)
Nasotracheal intubation	7(2.8)
None	1(0.4)
Mechanical ventilation, n(%)	

Yes	242(97.3)
No	7(2.7)
Causes of death, n(%)	
Septic shock	85(32.4)
MODS	48(18.9)
Cardiogenic shock	41(16.2)
Renal failure	20(8.2)
Central nervous system failure	24(12.2)
ARDS	11(3.9)
Failure to maintain a secure airway	20(8.2)
Day of the death, n(%)	
Weekdays	173 (69.5)
Weekend	76(30.5)
Time of the death, n(%)	
08:01-17:00	89(35.7)
17:01-08:00	160(64.3)
Length of stay at ICU (days, mean(SD; min-max)	10.5(17.2;1hour-137days)

Table 2. Demographic and clinical characteristcis of patients with SUMs (n= 19)

Age (year) , Mean(SD; min-max)	68.5(24.8)
Gender, n(%)	
Female	9(47.4)
Male	10(52.6)
Height (cm), Mean(SD)	159.4(22.2)
Weight (kg), Mean(SD)	71.3(22.0)
Reason for ICU admission, n(%)	
Postoperative surgery	5(26.3)
Pulmonary disease	4(21.1)
Endstage cancer disease	2(10.5)
Multitrauma	2(10.5)
Cerebrovascular disease	2(10.5)
Succesfull CPR	1(5.3)
Renal failure	1(5.3)
Others	2(10.5)
Status epilepticus	1(5.3)
Local anesthetic toxicity	1(5.3)
Type of admissionin ICU, n(%)	
Emergency	16(84.2)
Elective	3(15.8)
APACHE score, Mean (SD)	25.5(9.1)
SOFA score, Mean (SD)	7.9(2.2)
Airway maintenance, n(%)	
Tracheostomy	6(31.6)
Orotracheal intubation	10(52.6)
Nasotracheal intubation	3(15.8)
None	
Mechanical ventilation, n(%)	
Yes	12(63.2)
No	7(36.8)
Possible grounds of USM, n(%)	
Hypercarbia and severe asidosis	6(31.6)
Endotracheal tube (ETT) obstruction with secretion	4(21.1)
Tracheostomy tube (TT) malposition	3(15.8)
TT obstruction with secretion	2(10.5)
TT obstruction with foreign body	1(5.3)
ETT obstruction with luminal kinking	1(5.3)
Severe bronchospasm	1(5.3)
Occluded HME device	1(5.3)
Day of the death, n(%)	
Weekdays	14(73.7)
Weekend	5(26.3)
Time of the death, n(%)	
08:01-17:00	7(36.8)
17:01-08:00	12(63.2)
Length of stay at ICU (days)	13.4(24.8)
USMs:Unexpected sudden mortalities; HME: Heat and moisture exchanger	

Table 3. Comparison of EMs and USMs in terms of demographic and clinical parameters

		Mortality (n=249)		p value
		EMs (n=230)	USMs (n=19)	
Age (year), Mean(SD)		59.7(22.1)	68.5(24.8)	0.015
Gender, n(%)	Female	98(42.6)	9(47.4)	0.687
	Male	132(57.4)	10(52.6)	
Height (cm)		161.1(15.5)	159.4(22.3)	0.654
Weight (kg)		69.2(16.0)	71.3(22.0)	0.454
APACHE score, Mean(SD)		30.3(6.6)	25.6(9.1)	0.036
SOFA score, Mean(SD)		83.0(12.8)	7.9(2.2)	0.000
Time of the death, n(%)	08.00-17.00	87(37.8)	7(36.8)	0.902
	17.01-07.59	143(62.2)	12(63.2)	
Day of the death, n(%)	Weekdays	159(69.1)	14(73.7)	0.679
	Weekend	71(30.9)	5(26.3)	
Vital signs (1-h prior to death)		Mean(SD)		
SpO2 (%)		83.0(12.8)	96.4(2.7)	0.000
Heart rate (bpm)		84.4(34.7)	97.7(19.6)	0.036
Body temperature (°C)		36.5(1.0)	36.9(0.5)	0.000
Mean arterial pressure (mmHg)		17.3(22.9)	68.9(24.6)	0.012
Length of stay at ICU (days)		10.3(17.5)	13.4(24.8)	0.009
EMs: Expected Mortalities; USMs: Unexpected Sudden Mortalities; ICU: Intensive Care Unit (t test/ Mann-Whitney u test/ Chi-square test)				

REFERENCE

1. Mayr DV, Dünser WM, Greil V, et al. Causes of death and determinants of outcome in critically ill patients. Critical Care 2006; 10: R154 | 2. Craven DE, Kunches LM, Lichtenberg DA, et al. Nosocomial infection and fatality in medical and surgical intensive care unit patients. Arch Intern Med 1988; 148: 1161-8 | 3. Vincent JL, Bihari DJ, Suter PM, et al. The prevalence of nosocomial infection in intensive care units in Europe. Results of the European Prevalence of Infection in Intensive Care (EPIC) study. JAMA 1995; 274: 639-41 | 4. Gortzis GL, Sakellaropoulos F, Ilias I, Stamoulis K, Dimopoulou I. Predicting ICU survival: A meta-level approach. BMC Health Services Research 2008; 8: 157 | 5. Lee AL, Stephens SL, Fligner LC, et al. Autopsy utilization in medicolegal defense of anesthesiologists. Anesthesiology 2011; 115: 713–7 | 6. Van Berkel A, Van Lieshout J, Hellegering J, Van der Hoeven JG, Pickkers P. Causes of death in intensive care patients with a low APACHE II score. The Netherlands Journal of Medicine 2012; 70 (10): 455-9 | 7. Resche-Rigon M, Azoulay E, Chevret S. Evaluating mortality in intensive care units: contribution of competing risks analyses. Critical Care 2006; 10: R5 | 8. Penuelas O, Frutos-Vivar F, Esteban A. Unplanned extubation in the ICU: a marker of quality assurance of mechanical ventilation. Critical Care 2011; 15: 128 | 9. Wilcock A, Crosby V. Sudden and unexpected death in a palliative care unit. British Med J 2009; 338: b2343 | 10. Bueno-Cavanillas A, Delgado-Rodriguez M, Lopez-Luque A, et al. Influence of nosocomial infection on mortality rate in an intensive care unit. Crit Care Med 1994; 22: 55-60 | 11. Garrouste-Orgeas M, Timsit FJ, Aurelien Vesin A, et al. Selected medical errors in the intensive care unit. Results of the IATROREF Study: Parts I and II. Am J Respir Crit Care Med 2010; 181: 134–142 | 12. Booth FV, Short M, Shorr AF, et al. Application of a population-based severity scoring system to individual patients results in frequent misclassification. Crit Care 2005; 9: 522-9 | 13. Del Bufalo C, Morelli A, Bassein L, et al. Severity scores in respiratory intensive care: APACHE II predicted mortality better than SAPS II. Respir Care 1995; 40: 1042-7. | 14. Knaus WA, Draper AE, Wagner DP, et al. APACHE II: a severity of disease classification system. Crit Care Med 1985; 13: 818-29 | 15. Iapichino G, Corbella D, Minelli C, et al. Reasons for refusal of admission to intensive care and impact on mortality. Intensive Care Med. 2010; 36: 1772-9 | 16. Latif A, Rawat N, Pustavoitau A, Pronovost PJ, Pham JC. National study on the distribution, causes, and consequences of voluntarily reported medication errors between the ICU and non-ICU settings. Crit Care Med. 2013; 41 (2): 389-98 | 17. Meynaar AI, Van der Spoel IJ, Rommes HJ, Van Spreuwel-Verheijen M, Bosman JR, Spronk EP. Off hour admission to an intensivist-led ICU is not associated with increased mortality. Critical Care 2009; 13: R84 | 18. Luyt CE, Combes A, Aegerter P, et al. Mortality among patients admitted to intensive care units during weekday day shifts compared with "off" hours. Crit Care Med 2007; 35: 3-11 | 19. Haupt TM, Bekes EC, Brilli JR, et al. Guidelines on critical care services and personnel: Recommendations based on a system of categorization of three levels of care. Crit Care Med 2003; 31 (11): 2677-83 | 20. Barnett MJ, Kaboli PJ, Sirio CA, Rosenthal GE. Day of the week of intensive care admission and patient outcomes: a multisite regional evaluation. Med Care 2002; 40: 530-9 | 21. Jennane N, Madani N, OuldErrkhis R, et al. Incidence of medication errors in a Moroccan medical intensive care unit. Int Arch Med 2011; 4 (32): 1-7 | 22. Baruch M, Messer B. Criteria for intensive care unit admission and severity of illness. Surgery (Oxford) 2012;30:225-231. Review | 23. Woodall NM, Benger JR, Harper JS, Cook TM. Airway management complications during anaesthesia, in intensive care units and in emergency departments in the UK. Trends Anaesth Crit Care 2012; 2:58-64. Review | 24. Schwartz DE, Matthay MA, Cohen NH. Death and other complications of emergency airway management in critically ill patients: a prospective investigation of 297 tracheal intubations. Anaesthesiology 1995;82:367-76 | 25. Nolan JP, Kelly FE. Airway challenges in critical care. Anaesthesia 2011;66(Suppl. 2):81e92 | 26. Cook T, Behringer EC, Benger J. Airway management outside the operating room: hazardous and incompletely studied. Curr Opin Anaesthesiol 2012;25:461-9. Review. | 27. Boulain T, Runge I, Delorme N, Bouju A, Valéry A. Patients Hospitalized in General Wards via the Emergency Department: Early Identification of Predisposing Factors for Death or Unexpected Intensive Care Unit Admission-A Historical Prospective. Emerg Med Int 2014;2014:203747. | 28. Winters B, Custer J, Galvagno SM Jr, et al. Diagnostic errors in the intensive care unit: a systematic review of autopsy studies. BMJ Qual Saf 2012; 21 (11): 894-902 |