# Predictors and outcome of prolonged stay in the respiratory ICU

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***Introduction*** Prolonged ICU stay is associated with high mortality, morbidity, and costs. Understanding the predictors of prolonged stay ICU patients is helpful in improving the patients' outcomes, especially if some factors could be modified or useful in clinical decisions.

***Aim*** The aim of this study was to evaluate the characteristics, outcomes, and cost of ICU patients with a prolonged stay (≥15 days) and very long stay (≥30 days) in Ain Shams University Hospital Respiratory ICUs.

***Patients and methods*** This multidisciplinary prospective study was conducted on 213 patients admitted at the two respiratory ICUs at Ain Shams University Hospitals from May 2013 to May 2014. In addition, the relationships between residents, consultants, nurses, and patients' families are evaluated through multiple surveys.

***Results*** A total of 213 patients met the inclusion criteria in both ICUs, with a mean age of 54.7 years (minimum: 20 years; maximum: 80 years) and mean ICU stay of 23.4 days (minimum: 15 days; maximum: 60 days). Mechanical ventilation, vasopressor support, type of nutrition, BMI, tracheostomy, and Acute Physiology And Chronic Health Evaluation II Score on admission had a significant association with prolonged ICU stay and mortality.
The surveys' results showed that the nurse–physician relationship is of friendly stranger type. The residents' pitfalls were mostly the grandiosity and lack of decision taking. Most of physicians of different medical degrees had highlightened the quality of leadership as the most important cause straining the relationship with colleagues. The family members' satisfaction is correlated with the progression and length of stay of patients.

***Conclusion*** Patients with prolonged ICU stay consume the ICU resources. Studies identifying predictors of prolonged stay are essential to improve both resource utilization and the efficiency of ICU care. Personal relationship and communication skills have their impact on working environment.

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## Introduction

Prolonged ICU stay is a risk factor for increasing infection and mortality [1].

Prolonged stay is defined as length of stay (LOS) more than 15 days, as after this period the ICU complications increase. The prolonged stay of 30 days or more is considered as very long stay [2].

Predictors of prolonged stay include patient-related factors such as age, BMI, baseline comorbid illness, and Acute Physiology And Chronic Health Evaluation II Score (APACHE II) on admission [3].

The qualifications of ICU team members including physicians, nurses, and technicians are important factors in the progression of ICU patients [4]. The team work philosophy is crucial in improving the ICU patients' outcome, reducing the hospital stay, and decreasing the mortality [5].

The implementation of comprehensive unit-based safety program and avoiding ventilator-associated pneumonia protocols are designed for patients' safety and are tools to avoid medical defects and errors [6].

## Patients and methods

A multidisciplinary prospective study was conducted on patients admitted at the two respiratory ICUs at Ain Shams University Hospitals from May 2013 to May 2014.

In this study, 110 patients from Demerdash respiratory ICU and 103 patients from Ain Shams University Specialized Hospitals (ASUSHs) were included.

It was the first ICU admission during the current hospital stay for all patients. They were admitted for more than 15 days and they were older than 19 years of age.

The study was approved by the Faculty of Ethical Committee and informed consent was taken from the patients or their guardians.



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All patients were subjected to the following:

(1) History taking.
(2) Clinical examination.
(3) Laboratory workup such as complete blood count, kidney function tests, liver functions, electrolytes (sodium and potassium), imaging, and bronchoscopy when indicated.
(4) Verbal consent from the patients or their relatives to share in this thesis.
(5) APACHE II scoring system at the time of admission.

The patients were classified into two categories:

(1) Respiratory ICU patients at ASUSH.
(2) Respiratory ICU patients at Ain Shams University Hospital (Demerdash).

According to the LOS they were further classified as follows:

(1) Long-stay patients: This group includes patients who stayed in the ICU from 15 days up to 29 days.
(2) Very long-stay patients: This group includes patients who stayed in the ICU 30 days and beyond.

#### Communications

(1) Interpersonal relationship between physicians and each other's was analyzed using multiple questionnaires

    The physicians include 10 MBBCh,eight masterized, seven senior assistantlecturers, 10 lecturers, nine assistant professors and nine professors.

    Twenty nine nurses from ASUSH,and 18 nurses from Demerdash were included and questioned regarding their relationship with physicians.
(2) Only 50 first-degree relatives (who are the decision makers) in Demerdash ICU and 53 first-degree relatives in ASUSH ICU accepted to answer the family satisfaction questionnaire.
(3) Questionnaires:
    (a) Questionnaire to assess the residents and assistant lecturers' communication skills and their relationship to colleagues, senior staff, and patients' relatives and its impact on work environment and patients' care [7].
    (b) Questionnaire to assess nurse–physician relationship and its impact on patients' care (answered by nurses and residents) [5].
    (c) Questionnaire to assess the relationship between senior medical colleagues and its impact on work environment and patients' care [8].
    (d) Questionnaire to assess the family–physician and family–nurse relationship in the ICU [9].

#### Statistical methods

(1) All data were collected, summarized, and analyzed using a statistical program for the social science version 22 (SPSS 22) (IBM, United States Software Announcement, Armonk, New York, USA; SPSS Statistics V22.0).
(2) Quantitative data were expressed as mean±SD.
(3) Qualitative data were expressed as frequency and percentage.
(4) ?*t*-Value is a coefficient of independent Student's t-test to test the correlation between two scale variables.
(5) $\chi^2$ is the coefficient of the $\chi^2$-test to test the correlation between two categorical variables.
(6) Significance levels measured according to *P* value (probability).
    (a) $P>0.05$ nonsignificant (NS).
    (b) $P<0.05$ significant (S).
    (c) $P<0.01$ highly significant (HS).

## Results

#### Patients' results

Two hundred and thirteen patients were included in this study: 103 patients with long stay in ASUSH and 110 patients in Demerdash. The mean ICU stay of ASUSH patients was 24.17 days and that of Demerdash patients was 22.8 days (Table 1).

An overall 88.3% of patients (representing 91 patients) in ASUSH had a long stay and 83.6% of patients had a long stay in Demerdash, representing 92 patients (Table 2).

As regards sex, the ASUSH group included 103 patients. An overall 59.2% were male (representing 61 patients) and 40.8% were female (representing 42 patients). The Demerdash group included 110 patients. An overall

**Table 1 The mean ICU days of Ain Shams University Specialized Hospital and Demerdash patients**

| Admission (days) | *N* | Minimum | Maximum | Mean | SD |
|---|---|---|---|---|---|
| Ain Shams University Specialized Hospital | 103 | 15.00 | 60.00 | 24.17 | 8.38232 |
| Demerdash | 110 | 15 | 55 | 22.8 | 8.03 |

**Table 2 The distribution of the patients according to days of admission**

| Days of admission | |
|---|---|
| Length of stay | *n* (%) |
| Ain Shams University Specialized Hospital | |
| Long stay (15–29 days) | 91 (88.3) |
| Very long stay (>30 days) | 12 (11.7) |
| Total | 103 (100.0) |
| Demerdash | |
| Long stay | 92 (83.6) |
| Very long stay | 18 (16.4) |
| Total | 110 (100.0) |

60.9% were male (representing 67 patients) and 39.1% were female (representing 43 patients) (Table 3).

The ASUSH patient group had a higher mean age of 56.7 years compared with the Demerdash group with a mean age of 52.8 years (Table 4).

The highest percentage of very long stay ASUSH patients (staying more than 30 days) was the age groupbetween 61and 70 years of age. It includes five patients. However, in the Demerdash group, patients between 51 and 60 of age representing 23 (25%) patients and patients between 61 and 70 years of age representing 21 (22.8%) patients had a long and very long stay more than the other age groups (Table 5).

In ASUSH, there was an increase in the mean number of days with increased BMI where the seven morbidly obese patients had the longest mean ICU stay of 32 days. In the Demerdash group, the one morbidly obese patient had the longest mean ICU stay of 30 days (Table 6).

The distribution of Demerdash patients as regards APACHE II score shows that APACHE score 15–19 has the largest number as regards the long hospital stay representing 22 patients and very long hospital stay representing six patients (Fig. 1). However, the distribution of ASUSH patients as regards the APACHE II score shows that patients with score (15–19) had a mean stay of 22 days and those with a score of 25–29 had a mean stay of 20 days (Fig. 2).

An overall 50.5% (representing 46 patients) of long-stay patients had oral feeding in ASUSH. No patient with very long hospital stay was on oral feeding. However, in the Demerdash group, 58.8% of very long-stay patients, representing 10 patients, were on Ryle feeding (Table 7).

As regards the correlation between cause of admission and fate of Demerdash ICU patients, 19 (17.27%)

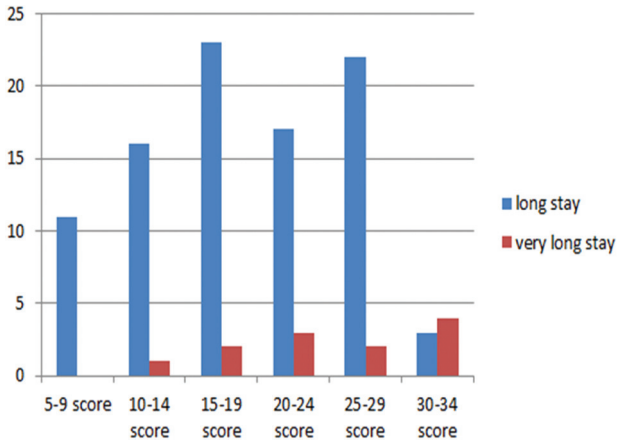
**Table 3 Sex distribution of the selected cases**

| Patient groups | Ain Shams University Specialized Hospital [*n* (%)] | Demerdash [*n* (%)] | Total [*n* (%)] |
|---|---|---|---|
| Male | 61 (59.2) | 67 (60.9) | 128 (58.7) |
| Female | 42 (40.8) | 43 (39.1) | 85 (41.3) |
| Total | 103 | 110 | |

**Table 4 Age distribution of the selected cases**

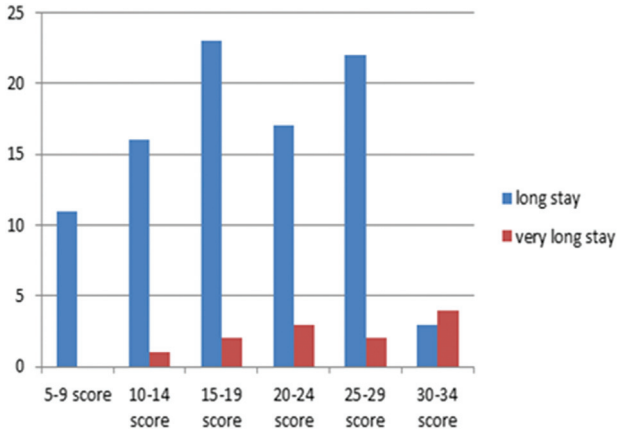
| Patient group | *N* | Mean age | SD |
|---|---|---|---|
| Ain Shams University Specialized Hospital | 103 | 56.73 | 11.79229 |
| Demerdash | 110 | 52.85 | 15.87723 |

**Figure 1**




The distribution of Demerdash patients as regards *APACHE II* score. APACHE score 15–19 has the largest number as regards the long stay representing 22 patients and very long representing six patients hospital stay. APACHE II, Acute Physiology And Chronic Health Evaluation II Score.

**Figure 2**




The distribution of ASUSH patients as regards the APACHE II score. Patients with score 15–19 had a mean stay of 22 days and those with score 25–29 had a mean stay of 20 days. APACHE II, Acute Physiology And Chronic Health Evaluation II Score; ASUSH, Ain Shams University Specialized Hospitals.

**Table 5 Relation between age group and length of admission**

| Length of stay in Ain Shams University Specialized Hospital | Age (years) [*n* (%)] | | | | | |
|---|---|---|---|---|---|---|
| | 20–30 | 31–40 | 41–50 | 51–60 | 61–70 | 71–80 |
| 15–29 days | 1 (1.1) | 8 (8.8) | 17 (18.7) | 30 (33.0) | 30 (33.0) | 5 (5.5) |
| 30 days or more | 2 (16.7) | 0 (0.0) | 1 (8.3) | 3 (25.0) | 5 (41.7) | 1 (8.3) |
| Total | 3 | 8 | 18 | 33 | 35 | 6 |
| $\chi^2$=11.1 | | | *P*=0.04 (S) | | | |
| Length of stay in Demerdash | | | | | | |
| 15–29 days | 8 (8.7) | 11 (12) | 17 (18.5) | 23 (25) | 21 (22.8) | 12 (13) |
| 30 days or more | 1 (5.6) | 3 (16.7) | 2 (11.1) | 5 (27.8) | 4 (22.2) | 3 (16.7) |
| Total | 9 | 14 | 19 | 28 | 25 | 15 |
| $\chi^2$=12.1 | | | *P*=0.03 (S) | | | |

S, significant.

**Table 6 BMI correlation to admission days**

| BMI | Ain Shams University Specialized Hospital | | | | Demerdash | | | |
|---|---|---|---|---|---|---|---|---|
| | *N* | Mean (days) | SD | *P* | *N* | Mean (days) | SD | *P* |
| Underweight | 10 | 26 | 9.5 | 0.04 (S) | 9 | 27.89 | 9.778 | 0.04 (S) |
| Normal | 38 | 22.02 | 5.1 | | 59 | 21.78 | 6.783 | |
| Overweight | 30 | 23.4 | 6.4 | | 28 | 24.39 | 9.215 | |
| Mild obesity | 11 | 25.2 | 12.37 | | 6 | 18.00 | 3.033 | |
| Moderate | 7 | 26.7 | 14.9 | | 7 | 21.43 | 10.470 | |
| Morbid | 7 | 32 | 9.7 | | 1 | 30.00 | 0.00 | |
| Total | 103 | 24.17 | 8.38 | | 110 | 22.81 | 8.031 | |

S, significant.

**Table 7 The correlation between type of nutrition and length of stay**

| Length of stay | Nutrition in Ain Shams University Specialized Hospital [*n* (%)] | | | | | Nutrition in Demerdash [*n* (%)] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Oral | Ryle | Total parenteral nutrition | Ryle and Parenteral | Total | Oral | Ryle | Total parenteral nutrition | Ryle and Parenteral | Total |
| Long stay | 46 (50.5) | 9 (9.9) | 2 (2.2) | 34 (37.4) | 91 (100.0) | 36 (38.7) | 9 (9.7) | 1 (1.1) | 47 (50.5) | 93 (100.0) |
| Very long stay | 0 (0.0) | 10 (83.3) | 0 (0.0) | 2 (16.7) | 12 (100.0) | 2 (11.8) | 3 (17.6) | 2 (11.8) | 10 (58.8) | 17 (100.0) |
| Total | 46 (44.7) | 19 (18.4) | 2 (1.9) | 36 (35.0) | 103 (100.0) | 38 (34.5) | 12 (10.9) | 3 (2.7) | 57 (51.8) | 110 (100.0) |
| | $\chi^2$=14.2*P*=0.01 (S) | | | | | $\chi^2$=16.3*P*=0.01 (S) | | | | |

S, significant.

patients presented with respiratory acidosis, out of whom 14 cases improved. In ASUSH ICU, 15 (14.6%) patients presented with the same diagnosis and 10 cases improved (Table 8).

Concerning the relation between the baseline comorbid illness and the fate, in Demerdash ICU 15 (13.63%) patients were presented with diabetes mellitus; 10 cases improved and five cases died. However, in ASUSH ICU, 21 (26.2%) cases out of 27 cases with a history of diabetes mellitus improved (Table 9).

In the ASUSH group, those who were on mechanical ventilation (MV) and noninvasive ventilation (NIV) representing two patients had a higher mean stay of 37 days. In the Demerdash group, patients who were on MV and NIV representing four patients had a higher mean stay of 30 days (Table 10).

In Demerdash, patients who were on tracheostomy, representing 30 patients, had a mean±SD of 28.4±11.3 days in comparison with those who did not (representing 80 patients), with a mean±SD of 20.6±4.9 days. In the ASUSH patient group, those who were on tracheostomy had a mean±SD of 29.96±11.7 days in comparison with 22.2±5.8 days in the nontrachesotomized group (Table 11).

An overall 88.7% (representing 70 patients) of survivors in Demerdash were not on vasopressor compared with 67.75% (21 patients) of deceased patients. In ASUSH, 90% of nonsurvivors (representing 27 patients) were on

**Table 8 Correlation between causes of admission and fates of patients**

| Cause of admission | Fate Ain Shams University Specialized Hospital [*n* (%)] | | | Fate Demerdash [*n* (%)] | | |
|---|---|---|---|---|---|---|
| | Improved | Died | Total | Improved | Died | Total |
| Metabolic and respiratory acidosis | 3 (4.1) | 1 (3.3) | 4 (3.9) | 5 (6.3) | 3 (9.7) | 8 (7.27) |
| Severe asthma | 4 (5.5) | 1 (3.3) | 5 (4.9) | 4 (5.1) | 1 (3.2) | 5 (4.54) |
| Disturbed conscious level | 10 (13.7) | 5 (16.7) | 15 (14.6) | 7 (8.9) | 2 (6.5) | 9 (8.18) |
| Respiratory acidosis | 10 (13.7) | 5 (16.7) | 15 (14.6) | 14 (17.7) | 5 (16.1) | 19 (17.2) |
| DKA | 6 (8.2) | 1 (3.3) | 7 (6.8) | 5 (6.3) | 2 (6.5) | 7 (6.36) |
| Acute respiratory failure secondary to pneumonia | 8 (11.0) | 7 (23.3) | 15 (14.6) | 12 (15.2) | 6 (19.4) | 18 (16.36) |
| Pulmonary oedema | 4 (5.5) | 2 (6.7) | 6 (5.8) | 3 (3.8) | 2 (6.5) | 5 (4.54) |
| Atrial fibrillation | 6 (8.2) | 2 (6.7) | 8 (7.8) | 3 (3.8) | 3 (9.7) | 6 (5.45) |
| Septicemia | 4 (5.5) | 2 (6.7) | 6 (5.8) | 6 (7.6) | 2 (6.5) | 8 (7.27) |
| Hepatic encephalopathy | 5 (6.8) | 1 (3.3) | 6 (5.8) | 5 (6.3) | 1 (3.2) | 6 (5.45) |
| Lung collapse | 2 (2.7) | 1 (3.3) | 3 (2.9) | 1 (1.3) | 1 (3.2) | 2 (1.82) |
| Hypertension pulmonary oedema | 2 (2.7) | 0 (0.0) | 2 (1.9) | 1 (1.3) | 1 (3.2) | 2 (1.82) |
| Pulmonary embolism | 5 (6.8) | 0 (0.0) | 5 (4.9) | 2 (2.5) | 0 (0.0) | 2 (1.82) |
| Hemoptysis | 4 (5.5) | 2 (6.7) | 6 (5.8) | 7 (8.9) | 1 (3.2) | 8 (7.27) |
| Stridor | 0 (0) | 0 (0) | 0 (0) | 4 (5.1) | 1 (3.2) | 5 (4.54) |
| $\chi^2$=7.04*P*=0.9 (NS) | | | | $\chi^2$=5.9*P*=0.9 (NS) | | |

DKA, diabetic ketoacidosis

**Table 9 Correlation between baseline comorbid illness and the fate**

| Baseline comorbid illness in Ain Shams University Specialized Hospital | Fate Ain Shams University Specialized Hospital | | | Fate of Demerdash | | |
|---|---|---|---|---|---|---|
| | Improved | Died | Total | Improved | Died | Total |
| Renal Impairment | 4 | 2 | 6 | 4 | 2 | 6 |
| Atrial fibrillation | 5 | 2 | 7 | 1 | 0 | 1 |
| Liver impairment | 12 | 4 | 16 | 9 | 1 | 10 |
| Heart failure | 3 | 3 | 6 | 3 | 3 | 6 |
| Cor pulmonale | 3 | 1 | 4 | 11 | 4 | 15 |
| Hypertension | 18 | 9 | 27 | 13 | 6 | 19 |
| Diabetes | 21 | 6 | 27 | 10 | 5 | 15 |
| Peptic ulcer | 3 | 1 | 4 | 1 | 1 | 2 |
| Electrolyte imbalance | 2 | 2 | 4 | 2 | 3 | 5 |
| Polycythemia | 2 | 1 | 3 | 3 | 1 | 4 |
| Stroke | 3 | 5 | 8 | 2 | 2 | 4 |
| Anemia | 0 | 2 | 2 | 2 | 1 | 3 |
| Dementia | 0 | 3 | 3 | 0 | 3 | 3 |
| Rheumatoid arthritis | 3 | 1 | 4 | 3 | 1 | 4 |
| Ischemic heart disease | 6 | 1 | 7 | 10 | 2 | 12 |
| Deep venous thrombosis | 3 | 0 | 3 | 1 | 0 | 1 |
| Kyphoscolosis | 2 | 0 | 2 | 3 | 0 | 3 |
| Renal dialysis | 0 | 1 | 1 | 2 | 1 | 3 |
| Bed sores | 1 | 2 | 3 | 0 | 0 | 0 |
| Cellulitis | 1 | 0 | 1 | 0 | 0 | 0 |
| Oblique inguinal hernia | 0 | 0 | 0 | 2 | 1 | 3 |
| None | 2 | 1 | 3 | 6 | 0 | 6 |
| Others | 2 | 1 | 3 | 0 | 0 | 0 |
| Total | 73 | 30 | 103 | 79 | 31 | 110 |
| *P*=0.09 (NS) | | | | *P*=0.07 (NS) | | |

vasopressors, whereas only five survivors were on vasopressors (Table 12).

### Questionnaires' results

Twenty-eight consultants answered the survey, 10 lecturers, nine assistant professors, and nine professors. Their answers were correlated to their academic degrees. They were all insisting on the importance of a good working environment and its impact on patient outcome (Table 13).

The relation between the family members' survey and LOS was statistically nonsignificant (Table 14).

**Table 10 Correlation between the mode of ventilation and length of stay**

| Mode of ventilation | Ain Shams University Specialized Hospital | | | Demerdash | | |
|---|---|---|---|---|---|---|
| | *N* | Mean (days) | SD | *N* | Mean (days) | SD |
| None | 19 | 21.68 | 6.01 | 22 | 23.87 | 5.61 |
| Mechanical ventilation | 61 | 25.63 | 9.38 | 65 | 27.73 | 8.78 |
| Noninvasive ventilation | 21 | 20.95 | 4.55 | 19 | 22.95 | 5.35 |
| Mechanical ventilation and noninvasive ventilation | 2 | 37 | 4.24 | 4 | 30 | 4.34 |
| Total | 103 | 24.17 | 8.38 | 110 | 24.7 | 6.02 |
| *P*=0.008 (HS) | | | | *P*=0.001 (HS) | | |

HS, highly significant.

**Table 11 Correlation between the tracheostomy and length of stay**

| Days of admission of tracheostomized patients | *N* | Mean (days) | SD | *P* |
|---|---|---|---|---|
| Demerdash | | | | |
| Yes | 30 | 28.47 | 11.392 | 0.000 (HS) |
| No | 80 | 20.69 | 4.965 | |
| Ain Shams University Specialized Hospital | | | | |
| Yes | 26 | 29.96 | 11.72 | 0.000 (HS) |
| No | 77 | 22.22 | 5.81 | |

HS, highly significant.

**Table 12 Correlation between the use of vasopressor and fate of patients**

| Fate | Vasopressor [*n* (%)] | | | | | |
|---|---|---|---|---|---|---|
| | Ain Shams University Specialized Hospital | | | Demerdash | | |
| | No | Yes | Total | No | Yes | Total |
| Improved | 68 (93.2) | 5 (6.8) | 73 (100.0) | 70 (88.7) | 9 (11.3) | 79 (100) |
| Died | 3 (10.0) | 27 (90.0) | 30 (100.0) | 10 (32.25) | 21 (67.75) | 31 (100) |
| Total | 71 (68.9) | 32 (31.1) | 103 (100.0) | 80 (72.73) | 30 (27.27) | 110 (100) |
| | $\chi^2$=68.6*P*=0.000 (HS) | | | $\chi^2$=40.1*P*=0.000 (HS) | | |

HS, highly significant.

Concerning the nurses' questionnaire, it was conducted on 29 nurses from ASUSH including 23 diploma, one institute, and five faculty graduated nurses. The questionnaire of the nurse relationship to doctor in the Demerdash unit was conducted on 18 nurses including five diploma, 11 institute, and two faculty. Their replies were correlated to their educational level. They showed that the civility and mutual respect with the physicians as long as the nurses' involvement in decision taking improves the working environment and the patients' outcome (Table 15).

As regards the questionnaire that was conducted upon 10 MBBCh residents, eight masterized and seven senior assistant lecturers, most of them concluded that the strain in relationship between physician and seniors has its impact on the working environment (Table 16).

### Descriptive data

The distribution of administrative data and medical personnel in both units was almost equal. The archive in ASUSH is computerized, whereas that in Demerdash is not. There were regular family meetings with the unit director in ASUSH, whereas in Demerdash it was not on regular basis. Nurses-to-patients ratio is better in ASUSH than in Demerdash, especially in night shift (Table 17).

The comparison between Demerdash and ASUSH ICU facilities and resources did not show much difference apart from bronchoscopy unit, which is available in Demerdash ICU (Table 18).

## Discussion

The study was conducted upon 110 patients admitted in Demerdash s' RICU and 103 patients admitted in ASUSHs 'RICU. Patients' ages ranged from 25 to 80 years with a mean age of 56.73 years in ASUSH. In Demerdash, the patients' ages ranged from 28 to 75 years with a mean age of 52.85 years. These demographic data are matched with the study of

**Table 13 Consultants' survey**

| Variables | Scientific degree [*n* (%)] | | | $\chi^2$ | *P* |
|---|---|---|---|---|---|
| | Lecturer | Assistant Professor | Professor | | |
| Importance of environment | | | | | |
| Yes | 10 (100) | 9 (100) | 9 (100) | – | – |
| No | – | – | – | | |
| Negative effect | | | | | |
| Yes | 10 (100) | 7 (80) | 9 (100) | 3.46 | 0.1 (NS) |
| No | – | 2 (20) | | | |
| Organizational factors that strain senior relationship | | | | | |
| Competition | 1 (10) | 2 (22.2) | 2 (22.2) | 1.3 | 0.5 (NS) |
| Inequality | 1 (10) | 0 (0) | – | 9.9 | 0.2 (NS) |
| Pay | 2 (20) | 3 (33.3) | 2 (22.2) | 5.1 | 0.005 (S) |
| Scarce resources | 2 (20) | 2 (22.2) | 2 (22.2) | 9.08 | 0.01 (S) |
| Bias | 3 (30) | 1 (11.1) | 3 (33.3) | 2.5 | 0.007 (HS) |
| Boundaries | 1 (10) | – | – | 2.5 | 0.2 (NS) |
| Personal factors that strain senior relationship | | | | | |
| Competitiveness | 1 (10) | 1 (11.1) | 2 (22.2) | 2.3 | 0.3 (NS) |
| Leadership | 2 (23.0) | 2 (22.2) | 2 (22.2) | 2.5 | 0.01 (S) |
| Criticism handle | 1 (10) | 0 (0) | 1 (11.1) | 1.3 | 0.5 (NS) |
| Anger handle | 0 (0) | 2 (22.2) | – | 1.3 | 0.5 (NS) |
| Different therapeutic approach | 2 (20) | 1 (11.1) | 2 (22.2) | 2.8 | 0.01 (S) |
| Error tracer | 1 (10) | 1 (11.1) | – | 8.6 | 0.2 (NS) |
| Joiner versus loner | 0 (0) | 1 (11.1) | – | 1.8 | 0.4 (NS) |
| Innovators versus conservative | 2 (20) | 1 (11.1) | – | 3.4 | 0.1 (NS) |
| Team versus individuals | 1 (10) | – | 2 (22.2) | 4.05 | 0.1 (NS) |
| Resident pitfall | | | | | |
| Pulmonology not first choice | 1 (10) | 2 (22.2) | – | 4.7 | 0.09 (NS) |
| Does not do | 1 (10) | 1 (11.1) | 3 (33.3) | 0.8 | 0.6 (NS) |
| Grandiose | 2 (20) | 3 (33.3) | – | 3.78 | 0.1 (NS) |
| Can not make decision | 3 (30) | 3 (30) | 3 (33.3) | 13.9 | 0.001 (HS) |
| Fawning | 2 (20) | – | 2 (22.2) | 4.05 | 0.1 (NS) |
| Desperate | – | – | – | – | – |
| Paranoid | 1 (10) | – | 1 (11.1) | 6.68 | 0.03 (S) |

HS, highly significant; S, significant. $\chi^2$ :Chi-Square Statistic. *P*-Value in Statistical Hypothesis Tests A small *P*-value (typically $\leq 0.05$) indicates strong evidence against the null hypothesis, so you reject the null hypothesis. A large *P*-value ($> 0.05$) indicates weak evidence against the null hypothesis.

Peigne *et al.* [10], who studied the treatment intensity, age, and outcome in medical ICU patients in 18 medical ICUs in public teaching hospitals from 2004 to 2015. The mean age of patients was 55.5 years.

The highest percentage of patients staying more than 30 days in ASUSH belonged to the age group 61–70 years (41.7% 5 patients). However, in Demerdash, patients in the age groups 51–60 years and 61–70 had a long (15–29 days) and very long stay (≥30 days) more than the other age groups. The ASUSH results are matched with Cabrera *et al.* [11], who found that 45% of patients in the age group 61–70 years had a longer stay compared with other age groups. Demerdash unit results go with Garland *et al.* [12], who found that the 60% of patients who had a longer stay were between 61 and 70 years of age.

In ASUSH, there was an increase in the mean days with increased BMI where the morbid obesity had the longest mean ICU stay. In the Demerdash group, there was an increase in mean days with increased BMI where the morbid obesity had the longest mean ICU stay. These data matched with Delsol *et al.* [7], who reported that LOS of morbid obese and underweight patients was much higher than that in normal weight, overweight, and mildly obese patients.

As regards the correlation between APACHE II score in ASUSH and LOS, patients with score 30–34 had a mean±SD stay of 31.2±10.4 days. These results are in agreement with Naved *et al.* [3], who reported that 66% of patients with score 30 had a prolonged stay than those with other scores.

In ASUSH unit, four cases were suffering from metabolic and respiratory acidosis as a cause of admission. Three (75%) cases had improved and one (25%) case died representing 0.9% of total cases. In Demerdash unit, eight cases were suffering from

**Table 14 Satisfaction of the family members' survey and the length of stay**

| Questions | Answers | Ain Shams University Specialized Hospital (days) | *t* | *P* | Answers | Demerdash (days) | *t* | *P* |
|---|---|---|---|---|---|---|---|---|
| Inclusion in decision making | Yes | 26.2±10.2 | –0.3 | 0.7 (NS) | Yes | 22.08±7.3 | –0.7 | 0.4 (NS) |
| | No | 25.2±9.7 | | | No | 23.5±6.67 | | |
| Communication with nurses | Yes | 24.4±6.4 | –0.9 | 0.3 (NS) | Yes | 23.1±8.3 | 0.3 | 0.7 (NS) |
| | No | 27.1±12.1 | | | No | 22.4±4.4 | | |
| Emotional support offered | Yes | 26.1±10 | 0.2 | 0.7 (NS) | Yes | 21.4±4.5 | –1.6 | 0.09 (NS) |
| | No | 25.3±10 | | | No | 24.7±9.07 | | |
| Answering questions about the patients' condition | Yes | 25.3±9.5 | –0.3 | 0.7 (NS) | Yes | 22.2±6.08 | –0.7 | 0.4 (NS) |
| | No | 26.3±10.6 | | | No | 23.7±8.06 | | |
| Regular meeting with unit director | Yes | 27.1±11.6 | 1.3 | 0.1 (NS) | Yes | 23.02±6.8 | 0.3 | 0.7 (NS) |
| | No | 23.2±5.9 | | | No | 22.3±7.3 | | |
| Satisfied about the level of service | Yes | 27.1±11.5 | 1.12 | 0.2 (NS) | Yes | 23.5±8.03 | 1.02 | 0.3 (NS) |
| | No | 24±7.4 | | | No | 21.3±3.5 | | |
| Enough time to decide | Yes | 24.4±11 | –0.75 | 0.4 (NS) | Yes | 22.8±6.5 | –0.05 | 0.9 (NS) |
| | No | 26.6±9.3 | | | No | 22.8±7.2 | | |
| Allowed visit time | Yes | 21.7±9.5 | –1.27 | 0.2 (NS) | Yes | 22.2±6.44 | –0.71 | 0.4 (NS) |
| | No | 26.5±9.9 | | | No | 23.6±7.6 | | |
| Appropriate place of visit | Yes | 27.8±8.3 | 1.07 | 0.2 (NS) | Yes | 22.5±6.3 | –0.2 | 0.8 (NS) |
| | No | 24.6±10.6 | | | No | 23±7.3 | | |

*P*-Value in Statistical Hypothesis Tests A small *P*-value (typically ≤ 0.05) indicates strong evidence against the null hypothesis, so you reject the null hypothesis. A large *P*-value (> 0.05) indicates weak evidence against the null hypothesis.

**Table 15 Nurses' survey**

| Questions | Nurses' scientific degree [*n* (%)] | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Ain Shams University Specialized Hospitals | | | | | Demerdash | | | | |
| | Diploma | Institute | Faculty | $\chi^2$ | *P* | Diploma | Institute | Faculty | $\chi^2$ | *P* |
| Civility and respect in interaction | | | | | | | | | | |
| Yes | 23 (100) | 1 (100) | 5 (100) | – | – | 4 (80) | 10 (90.9) | 2 (100) | *0.69* | 0.7 (NS) |
| No | | | | | | 1 (20) | 1 (9.1) | – | | |
| Solving patients-related problems | | | | | | | | | | |
| Yes | 23 (100) | 1 (100) | 5 (100) | – | – | 3 (60) | 10 (90.9) | 2 (100) | *2.8* | 0.2 (NS) |
| No | | | | | | 2 (40) | 1 (9.1) | – | | |
| Listening with respect | | | | | | | | | | |
| Yes | 8 (34.8) | 0 | 5 (100) | *7.9* | 0.01 (S) | 1 (20) | 9 (81.8) | 2 (100) | *7.03* | 0.03 (S) |
| No | 15 (62.5) | 1 (100) | 0 | | | 4 (80) | 2 (18.2) | | | |
| Embarrassing attitude | | | | | | | | | | |
| Yes | | | | – | – | 1 (20) | 1 (9.1) | | *0.6* | 0.7 (NS) |
| No | 23 (100) | 1 (100) | 5 (100) | | | 4 (80) | 10 (90.9) | 2 (12.5) | | |
| Asking questions related to the patients' condition | | | | | | | | | | |
| Yes | 23 (100) | 1 (100) | 5 (100) | – | – | 5 (100) | 11 (100) | 2 (11.1) | *10.2* | 0.4 (NS) |
| No | | | | | | – | – | – | | |
| Answering questions related to patients' clinical condition | | | | | | | | | | |
| Yes | 23 (100) | 1 (100) | 5 (100) | – | – | 5 (100) | 11 (100) | 2 (11.1) | *12.2* | 0.8 (NS) |
| No | | | | | | – | – | – | | |
| Nurse–physician personal interaction | | | | | | | | | | |
| Collegial | 4 (17.4) | 0 | 2 (40) | *13.16* | 0.04 (S) | 1 (20) | 2 (18.8) | 1 (50) | *1.14* | *0.5* |
| Friendly/stranger | 19 (82.6) | 1 (100) | 1 (20) | | | 3 (60) | 7 (63.6) | 1 (50) | *1.12* | *0.4* |
| Collaborative | – | – | 1 (20) | | | 1 (20) | 1 (9.09) | – | *0.69* | 0.7 (NS) |
| Student/teacher | – | – | 1 (20) | | | 1 (20) | 1 (9.09) | – | *10.2* | 0.3 (NS) |
| Hostile | – | – | – | | | – | – | – | | |

S, significant. $\chi^2$: Chi-Square Statistic. *P*-Value in Statistical Hypothesis Tests A small *P*-value (typically ≤ 0.05) indicates strong evidence against the null hypothesis, so you reject the null hypothesis. A large *P*-value (> 0.05) indicates weak evidence against the null hypothesis.

**Table 16 Residents and assistant lectures' survey**

| Variables | Scientific degree [*n* (%)] | | | $\chi^2$ | *P* |
|---|---|---|---|---|---|
| | MBBCh | Master | Senior assistant lecturers | | |
| Good environment | | | | | |
| Yes | 10 (100) | 7 (87.5) | 7 (100) | *0.7* | 0.6 (NS) |
| No | 0 | 1 (12.5) | 0 | | |
| Similar experience and culture | | | | | |
| Yes | 10 (100) | 7 (87.5) | 7 (100) | *0.7* | 0.6 (NS) |
| No | 0 | 1 (12.5) | | | |
| Clear ICU protocol | | | | | |
| Yes | 6 (60) | 3 (37.5) | 5 (71.4) | *0.5* | 0.7 (NS) |
| No | 4 (40) | 5 (62.5) | 2 (28.5) | | |
| Good leadership | | | | | |
| Yes | 4 (40) | 4 (50) | 0 | *1.9* | 0.3 (NS) |
| No | 6 (60) | 4 (50) | 7 (100) | | |
| Strain relationship in between the same category | | | | | |
| Duty Rota's | 6 (60) | 3 (21.4) | 0 | *14.3* | 0.07 (NS) |
| Choosing vacations | – | 3 (37.5) | 4 (57.1) | | |
| Covering abstinences | – | – | 3 (42.8) | | |
| Postponing patients examination | – | 3 (37.5) | – | | |
| Competition to occupy the least stressful job | 3 (30) | 2 (25) | – | | |
| Do you deal with difficult consultant | | | | | |
| Yes | 4 (40) | 5 (62.5) | 3 (42.8) | *0.5* | 0.7 (NS) |
| No | 6 (60) | 3 (37.5) | 5 (62.5) | | |
| Reason of difficult consultant | | | | | |
| Indecisive and disorganized | 10 (100) | 1 (12.5) | – | *4.7* | 0.3 (NS) |
| Controllers | – | 6 (75) | 7 (100) | | |
| Poor teacher | – | 1 (12.5) | – | | |
| Strain relationship with seniors | | | | | |
| Different therapeutic approaches | – | 4 (50) | 4 (57.1) | *17.2* | 0.06 (NS) |
| Quality of leadership | 4 (40) | 1 (12.5) | | | |
| Inability to deal with anger | 3 (30) | – | – | | |
| Prejudice versus tolerance | – | 1 (12.5) | – | | |
| Controllers | 3 (30) | 2 (25) | – | | |
| Quick responders | – | – | 3 (42.8) | | |
| Take history from mechanical ventilation patients | | | | | |
| Yes | 6 (60) | 7 (87.5) | 7 (100) | *4.6* | 0.09 (NS) |
| No | 4 (40) | 1 (12.5) | – | | |
| Meeting unit director | | | | | |
| Yes | 10 (100) | 6 (75) | – | *5.7* | 0.05 (NS) |
| No | – | 2 (25) | 7 (100) | | |
| Families meet residents | | | | | |
| Yes | 10 (100) | 5 (62.5) | 7 (100) | *2.42* | 0.2 (NS) |
| No | 0 | 3 (37.5) | – | | |
| Explanation to family | | | | | |
| Yes | 10 (100) | 8 (100) | 7 (100) | – | – |
| No | – | – | | | |
| Patients reassurance | | | | | |
| Yes | 10 (100) | 8 (100) | 7 (100) | – | – |
| No | – | – | | | |
| ICU family visit | | | | | |
| Yes | 4 (40) | 4 (50) | 4 (57.1) | *0.28* | 0.8 (NS) |
| No | 6 (60) | 4 (50) | 3 (42.8) | | |

$\chi^2$: Chi-Square Statistic. *P*-Value in Statistical Hypothesis Tests A small *P*-value (typically $\leq 0.05$) indicates strong evidence against the null hypothesis, so you reject the null hypothesis. A large *P*-value ($> 0.05$) indicates weak evidence against the null hypothesis.

metabolic and respiratory acidosis as a cause of admission. Five (62.5%) cases improved and three (37.5%) cases died representing 2.7% of total cases. These results are matched with Gruenberg *et al.* [8], who stated that the percentage of survivors was 65% and that of nonsurvivors was 35% of total patients.

**Table 17 Ain Shams University Specialized Hospital ICU unit and Demerdash ICU unit administrative data and medical personnel distribution**

| | Ain Shams University Specialized Hospitals unit | Demerdash unit |
|---|---|---|
| Administrative | | |
| Implementation of CUSPs | + | + |
| ICU construction | 2 connected locations. One is for critical care rooms and the other is for intermediate care roomsRooms are divided by walls in critical care unit and intermediate units | 2 centers: 1 critical care center and one center of intermediate careThe beds are not separated by walls. The nurse observes all the patients at the same time |
| Archive | Available and computerized | Not computerized |
| ICU team | | |
| ICU team consists of | 3 residents, one assistant lecturer, and unit director | 3 residents, one assistant lecturer, and unit director |
| Night shift ICU team | 1 assisstant lecturer and 1 resident | 1 assisstant lecturer and 1 resident |
| Daily unit director rotation | + | + |
| Regular family member meetings with unit director | + | – |
| Infection control program | | |
| Infection control program | + | + |
| Rotation of infection control team regularly | + | + |
| Availability of isolation area | Patient can be isolated in his or her room | Evacuation of a center is needed to isolate a patient |
| Nursing staff | | |
| Nursing staff | 23 diploma, 1 institute, and 5 faculty graduated nurses | 5 diploma, 11 institute, and 2 faculty graduated nurses |
| Shift A nurse-to-patient ratio | 1 : 1 or 1 : 26 nurses, 2 faculty graduated nurses and 1 assistant nurse | 1 : 16 nurses, 1 assistant nurse, 2 faculty graduated nurses |
| Shift B nurse-to-patient ratio | 1 : 25 nurses, 1 faculty graduated nurse | 1 : 24 nurses and 1 assistant nurse |
| Shift C nurse-to-patient ratio | 1 : 24 nurses, 1 faculty graduated nurse | 1 : 33 nurses and 1 or 2 assistant nurses |

CUSPs, comprehensive unit-based safety programs.

**Table 18 Ain Shams University Specialized Hospital ICU unit and Demerdash ICU unit facilities**

| | Ain Shams University Specialized Hospitals | Demerdash |
|---|---|---|
| Laboratory services | Not in the unit but 24/7 hospital lab is available | |
| Portable radiograph | As a part of hospital services | Available at the unit |
| Ultrasonography | Available at the unit | Available at the unit |
| ECG | As a part of hospital services | Available at the unit |
| ABG analyzer | Available at the unit | Available at the unit |
| Bronchoscopy | As a part of hospital services in day shifts only | Available at the unit in day shifts only |
| Equipped renal dialysis or imaging units for ventilated patients | Available | Not available |
| Hemodialysis machine in the ICU | Not available | Not available |
| Portable echocardiography | Available | Available |
| ICU pharmacy | As a part of hospital pharmacy and available for 24/7 | Unit pharmacy |
| Medication availability | Not all medications are available 24/7 | Not all medications are available 24/7 |
| Clinical pharmacist | Not available | Not available |
| Sterilization unit | As a part of the hospital service. Not in the unit | |
| Visit lounge for critical care patients | Visit through a glass window in a corridor without seats | |
| Visit lounge for intermediate care patients | Inside the patient rooms | Inside the center |
| Physiotherapist | Available at regular basis | Irregular |
| Comanagement | Not available | Not available |

Fifteen patients were admitted due to acute respiratory failure secondary to pneumonia in ASUSH. However, eight (53.4% cases) improved, whereas seven (46.6%) cases died. In Demerdash unit, 18 cases were admitted due to the same cause. Out of 18 cases, 12 (66.67%) cases improved, whereas six (33.33%) cases died. These results are in agreement with Hamel *et al.* [9], who

reported that 52% of cases suffering from respiratory failure survived, whereas 48% died.

Considering the LOS and type of nutrition, 83.3% of very long-stay patients had Ryle feeding in ASUSH, whereas in the Demerdash group 58.8% of very long-stay patients were on Ryle and parenteral nutrition. These results are in agreement with Soguel *et al.* [13], who recorded that 75% of very long-stay patients were on parenteral nutrition and 60% of long-stay patients were on Ryle feeding.

In the ASUSH group, patients who were on MV and NIV had a higher mean stay of 37 days in comparison with those only on MV with a mean stay of 25.6 days. In the Demerdash group, patients who were on MV and NIV had a higher mean stay (30 days). Those on MV only stayed for 27.7±8.7. These results are in agreement with Rose *et al.* [14], who stated that patients on MV and NIV had higher mean±SD number of days (15±7), whereas those on MV only stayed for fewer (20±3) days.

Twenty-eight consultants have answered the senior colleagues' survey, and were all insisting on the importance of a good working environment and its impact on the patient's outcome. Bias, payment, and scarce resources were very important organizational factors straining the relationships as concluded by most of senior staff members. As regards the opinion of senior colleagues about the resident pitfalls, most of the senior colleagues concluded that the residents are not decision makers and grandiose.

These results are in agreement with Wujtewicz *et al.* [15]. It was found that bias and payment were important organizational factors straining the relationship. The most notable resident pitfall was that they are not decision makers probably due to lack of self-confidence in their medical opinions. This can be improved through continuous medical learning and interactive rounds with senior staff members.

As regards the nurses' questionnaire conducted in ASUSH and Demerdash, the majority of the nursing staff (82.6% in ASUSH, 60% of Demerdash nurse staffing, as well as 60% of residents) declared that their relationship with the doctors is a friendly/stranger relationship. Most of the diploma nurses concluded that the doctor never listens to their suggestions. The faculty graduated nurses thought that doctors listen to them and take their opinion into consideration.

These results are in agreement with Siedlecki and Hixson [5], who reported that 60% of nurses described the relationship as a friendly/stranger one, as well as 69% of physicians.

Regarding the factors that strain relationship between senior colleagues, assistant lecturers and residents, it was concludedthat quality of leadership has its impact upon the teamwork and the outcome of RICU patients. These results are in agreement with Gauntlett and Laws [16], who stated that the quality of leadership is the corner stone of all medical team member relationship.

Masterized residents and assistant lecturers replied differently; 57.1% thought that different therapeutic approach was the most important cause, which represents differences in medical opinion and experiences. These results are in agreement with Garelick and Fagin [17], who concluded that disagreement about the different therapeutic approaches is the nucleus of all.

There were no available portable hemodialysis machines in both units and no facility to perform hemodialysis to ventilated patients in Demerdash due to lack of well-equipped unit to these cases. These results are not matched with Collier and Davenport [18], who concluded that regular hemodialysis for critical patients improves the morbidity, reduces infections, and reduces LOS. The researcher stressed on the importance of the availability of either a portable machine or transportation [18].

Clinical pharmacist is not available in both units. This is not matched with Chant [19], who concluded that clinical pharmacist in ICU is crucial as the patients are on a big list of medications with drug-to-drug interactions and many diseases affecting the pharmacokinetics and dynamics of the drugs.

Bronchoscopy unit is available inside the Demerdash ICU unit but in ASUSH it is available as a separate unit away from the ICU. In both units, the bronchoscopy is not available 24/7. These results disagreed with Du *et al.* [20], who insisted on the availability of bronchoscopy during night shifts because it is needed urgently for patients with collapse and reduced $FiO_2$.

## Conclusion

From the current study, it was concluded that the patients of the long stay and very long stay groups

consume most of the ICU resources. Mildly obese, overweight, and normal weight patients had a better outcome as regards the fate and LOS. This is called the obesity paradox. However, the oral feeding with balanced nutrition is the optimum root to feed the patients.

APACHE II score should be filled for every patient admitted to the ICU as there is a strong correlation with APACHE II score and fate of patients.

The working environment depends greatly on the relationships between nurses, residents, and senior staff members. Lack of comanagement system delays the delivery of specialized consultations to the needed patients.

Clinical pharmacists have a great role to reduce drug-to-drug interaction and guide the physician to avoid and/or substitute the medications in special circumstances.

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