

## Factors Contributing to Acquire Covid-19 among Critically Ill Patients in Intensive Care Units

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### Abstract

**Background:** Coronavirus disease (Covid-19) is currently a worldwide pandemic ongoing global health emergency caused by severe acute respiratory syndrome (SARS). Critical health team have an essential role in the prevention of acquired Covid-19 in intensive care unit through applying of hospital specific covid-19 precautions. **Aim:** This study aimed to assess factors contributing to acquire covid-19 among critical ill patients in intensive care units. **Design:** A descriptive exploratory design was utilized for the conduction of this study. **Setting:** the study was carried out in intensive care units of Ain Shams University Hospital (emergency and general medicine ICU). **Study sample:** A Purposive sample of seventy five patients admitted to the previously mentioned setting. **Tools:** three tools were used to collect data consisted of patient assessment tool, precautions measures against Covid-19 observational checklist tool, and Covid-19 incidence in ICU tool. **Results:** revealed that, the majority of the studied patients acquired Covid-19 in ICU, and the application of most precautions measures against Covid-19 were not done or done incorrectly. In addition to, there were a highly statistically significant relation between acquired Covid-19 in ICU, application of precautions measures, past medical history and length of ICU stay. **Conclusion:** based on the findings of the current study, it can be concluded that: the majority of studied patients acquired Covid-19 in ICU. As well factors contributing to acquire Covid-19 among critically ill patients in ICU were non-compliance of health team to precautions measures against Covid-19, patients present, past medical history and length of stay in ICU. **Recommendations:** developing instructional guideline for improving medical health team performance regarding application of precautions measures against Covid-19. In addition to, replication of the study on larger sample selected from different areas in Egypt is recommended to obtain more generalizable data.

**Key word:** Covid-19, Factors, ICU, Critically ill.

### Introduction

Coronavirus disease (COVID-19) is infectious disease caused by the coronavirus, SARS-CoV-2, which is a respiratory pathogen. WHO first informed of this new virus from cases in Wuhan People's Republic of China on 31 December 2019. The most common symptoms of COVID-19 are fever, dry cough, and fatigue. Other symptoms that

are less common and may affect some patients include: loss of taste or smell, nasal congestion, conjunctivitis (also known as red eyes), sore throat, headache, muscle or joint pain, different types of skin rash, nausea or vomiting, diarrhea, chills and dizziness (WHO, 2020).

Symptoms are usually mild. Some people become infected but only have very mild symptoms or none at all. Symptoms of severe COVID-19 disease include:

shortness of breath, loss of appetite, confusion, persistent pain or pressure in the chest, and high temperature (above 38 °C). Other less common symptoms are: irritability, confusion, reduced consciousness sometimes associated with seizures, anxiety, depression, and sleep disorders. More severe and rare neurological complications such as strokes, brain inflammation, delirium and nerve damage. People of all ages who experience fever and/or cough associated with difficulty breathing or shortness of breath, chest pain or pressure, or loss of speech or movement should seek medical care immediately. If possible, call health care provider, hotline or health facility first, so can be directed to the right clinic (**Matt, et al., 2020**).

Most people (about 80%) recover from the disease without needing hospital treatment. About 20% of those who get COVID-19 become seriously ill and require oxygen, with 5% becoming critically ill and needing intensive care. Complications leading to death may include respiratory failure, acute respiratory distress syndrome (ARDS), sepsis and septic shock, thromboembolism, and/or multi organ failure, including injury of the heart, liver or kidneys (**Driggin, et al., 2020**). People aged 60 and over, and those with underlying medical comorbidities such as hyper tension, heart and lung problems, diabetes, obesity and cancer, are at higher risk of developing serious illness. However, anyone can get sick with COVID-19 and become seriously ill or die at any age. (**Behnood, et al., 2020**)

The time from exposure to COVID-19 to the moment when symptoms begin is, on average, 5-6 days and can range from 1-14 days. This is why people who have been exposed to the virus are advised to stay home, apart from others, for 14 days, in order to prevent the

spread of the virus, especially where testing is not easily available. Both isolation and quarantine are methods of preventing the spread of the disease. Quarantine means restricting activities and/or separating people who are not ill but may have been exposed to COVID-19. The quarantine can take place in a designated facility or at home for 14 days. Isolation means separating people who are ill with symptoms of COVID-19 and/or have tested positive. (**Huang, et al., 2020**)

In most situations, a molecular test is used to detect SARS-CoV-2 and confirm COVID19. Polymerase chain reaction (PCR) is the most commonly used molecular test. Samples are collected from the nose and/or throat with a swab. Molecular tests detect virus in the sample by amplifying viral genetic material to detectable levels. For this reason, a molecular test is used to confirm an active infection, usually within a few days of exposure and around the time that symptoms may begin. Rapid tests (sometimes known as a rapid diagnostic test – RDT) detect viral proteins (known as antigens). Samples are collected from the nose and/or throat with a swab. These tests are cheaper than PCR and will offer results more quickly, although they are generally less accurate. We are still learning about how well they perform and when to use them (**Decousus, et al., 2011**).

Critical care nurses and other health care workers are the frontline defense for applying daily infection precautions to prevent infections and transmission of Covid-19 to other patients. Nurses have the unique opportunity to directly reduce health care associated infections through recognizing and applying evidence-based procedures, hospital precautions standards and guidelines to prevent covid-19 among patients and protecting the health of the staff (**Obi, 2020**).

Precautions towards the Covid-19 fall under seven main categories hospital precautions toward covid-19 and standard precautions. Hospital precautions towards the Covid-19 fall under seven main areas first: establishment of core team, internal and external contact point, second: human, material and facility capacity, third: training procedure, communication and data protection, fourth: hand hygiene, personal protective equipment (PPE), and waste management, fifth: triage, first contact and prioritization, sixth: patient placement, patient moving in the facility, and visitor access, seventh: environmental cleaning (**European Centre for Disease Prevention and Control, 2020**).

Standard precautions are based on the concepts that all blood, urine, feces, excretion, saliva, sputum, vomits, secretions from non-intact skin, wounds and mucous membrane should be treated as potentially infectious. Standard precautions are applied to every person every time to assure that transmission of covid-19 does not occur. These precautions known as “universal precautions” includes hand hygiene, respiratory hygiene, use of personal protective equipment, proper cleansing and disinfection of used or exposed articles, prevention of sharps injury, and waste management (**Akima, et al., 2020**).

### **Significance of the study:**

Coronavirus disease (Covid-19) is currently a worldwide pandemic infectious ongoing global health emergency. On the other hand, the health care provider facing major problems related to applying Covid-19 precaution measures which influence the virus prevalence. So, this study was carried to identify factors contributing to acquire Covid-19 among critical ill patients in ICU.

### **Aim of the study:**

The aim of this study is to identify factors contributing to acquire Covid-19 among critically ill patients in ICUs.

### **Research question:**

What are the factors contributing to acquire Covid-19 among critically ill patients in ICUs?

### **Subject & Methods**

**Study design:** A descriptive exploratory design was conducted to achieve aim of this study. This type of design used when the researcher wants to describe a specific behavior as it occurs in the environment without influencing or manipulating the variables in any way (**Groves & Gray, 2018**).

**Setting:** This study was conducted in two Intensive Care Units at Ain Shams University Hospitals (Emergency and General Medicine ICU).

- Emergency ICU: it located at first floor, contains 15 beds, 6 mechanical ventilators, 15 monitors and 3 emergency cars, patients are distributed in 3 areas. The nursing staffs were 30, their nursing experience ranging from 1 year to 13 years. The qualification of most staff nurses was Technical Institution degree. The ICU was receiving 20 to 30 patients monthly with different diseases.

- General medicine ICU: it located at land floor, contains 30 beds, 20 mechanical ventilator, 30 monitors and 4 emergency cars; they are distributed in 2 main areas (ICU1& ICU2) each area distributing to 3 areas for patients. The nursing staff was 30 nurses, their nursing experience ranging from 1 year to 4 years. General medicine ICU also contains 2 cupboards for medications storage and supplies and two bathrooms for patient.

The qualification of staff nurses was Technical Institution degree and bachelor degree.

**Subjects:** A Purposive sample of 75 patients admitted to the previously mentioned setting. The sample was selected based on statistical power analysis test (the confidence level was 90% and margin of error was 5%).

**• Inclusion Criteria:** adult conscious patients who are admitted to critical intensive care units without Covid-19.

**Tools of data collection:** Three tools were used to collect necessary data to achieve the study aim. It was written in English language and filled by the researchers.

**Tool No.1: Patient assessment tool.** This tool was developed by the researchers after reviewing the related literature (Yang, et al., 2020) to assess patient health status. It included two parts:

**• Part (A):** Patient demographic characteristic: It was used to assess demographic characteristic of the studied patients as age, gender, level of education, and occupation.

**• Part (B):** Patient medical data: It was used to assess medical data. It included admission medical diagnosis, past medical history, and length of ICU stay.

**Tool No. 2: Precautions measures against Covid-19 observational checklist tool.** This tool adopted from (European Centre for Disease Prevention and Control, 2020), it was used by the researchers to assess application of Covid-19 precautions measures against Covid-19 by health team for patients in ICU. It contains seven main items as follow:

1. Availability of medical health team (9 steps) and key internal and external contact points (7 steps).

2. Human, material and facility capacity. Including: stock management (5 steps), human capacity (15 steps), facility and material (20 steps), and laboratory capacity (3 steps).

3. Receiving training procedures, communication and data protection. Including: training procedure (7 steps), internal communication (6 steps), external communications (5 steps), and data protection (3 steps).

4. Hand hygiene (4 steps), personal protective equipment (4 steps), and waste management (3 steps).

5. Triage, first contact and prioritization. Including: general (4 steps), tele-triage (2 steps), and first contact at the hospital (7 steps).

6. Patient placement (8 steps), patient moving patients in the facility (4 steps), and visitor access (7 steps).

7. Environmental cleaning (5 steps).

**Scoring system:** each procedure done to the patient was given (1) degree, while the procedure not done/done incorrectly to the patient was given zero.

**Tool No. 3: Covid-19 incidence in ICU tool.** This tool was developed by the researchers after reviewing the related literature (Zhou & YU, 2020). It was used to monitor incidence of Covid-19 in ICU for critically ill patients. It includes patients' sign and symptoms of Covid-19, and lab investigations.

**Validity and reliability:** testing validity of Covid-19 incidence in ICU tool and patient medical data tool were reviewed by a panel of seven experts from critical care nursing staff at faculty of

nursing Ain Shames University to ascertain their face and content validity and relevance. Testing reliability of proposed tool was done statistically by alpha-Cronbach test were (0.882) which perceptively that indicate high reliability of the used tool.

**Pilot study:** the pilot study was carried out on 10% of the studied sample who were later excluded from the study sample and substituted with other cases to test the applicability, clarity and efficacy of the tools and to estimate the time needed for data collection. The tool was modified according to the results of the pilot study.

### **Ethical consideration:**

**Protection of Human Rights:** for ethical reasons, a primary permit was granted from the hospital director to apply this study. Also at the initial interview, each patient was informed about the aim of the study and its importance. The researchers emphasized that participation in the study is entirely voluntary, and anonymity and confidentiality were assured through coding the data. Oral approval consent was taken from each patient who agreed to participate in the study; also they were assured that they have the right to withdraw from the study at any time. As well as the obtained information was used only for the purpose of the study.

**Field work:** The current study was carried out through preparation, and implementation phase.

### **1.Preparatory Phase:**

- At the beginning, the researchers developed patient assessment tool & Covid-19 incidence in ICU tool based on reviewing the recent and related literature while precautions measures against Covid-19 observational checklist tool was an

adopted tool to assess factors contributing to acquire Covid-19 among patients in intensive care units.

### **2. Implementation phase:**

Data collection for this study was carried out in the period from first July to the end of September 2020. The researchers were available in the morning and afternoon shift four days per week by rotation. They began with assessing patients' demographic characteristics and medical data that took 10 min for every patient in addition to the researchers used observational checklist (tool No.2) to assess application of Covid-19 precautions measures against Covid-19 by health team for patients in ICU during medical team routine care for every patient. Finally, Covid-19 incidence in ICU (tool No.3) to assess incidence of Covid-19 among patients was filled by the researchers after 14 days of patient admission that took about 20 minutes to be collected.

**Statistical analysis:** All data were collected, coded, tabulated and subjected to statistical analysis. Statistical analysis is performed by statistical package SPSS version 21, also Microsoft office Excel is used for data handling and graphical presentation. Quantitative variable are described by the mean, standard deviation (SD), while qualitative categorical variables are described by percentage and proportions. Descriptive statistics are used to analyze the response to individual items and the respondents' characteristics. Chi-square and P-value test used to test the relation.

### **Results**

**Table 1.** Showed the frequency distribution of studied patients regarding demographic characteristics. Regarding age, the mean  $\pm$  SD of studied patients were  $48.29 \pm 16.22$ . As regarding to

gender, the results revealed that 52.0% of studied patients were male. In relation to the level of education, 62.7% of them were read & write/ secondary school. While regarding occupation of studied patients, 26.7 % were working in medical field while 73.3 of studied patient were not working in medical field.

**Figure 1.** Showed that, 60% of studied patients were admitted to emergency intensive care unit and 40% of them were admitted to general medicine intensive care unit.

**Table 2.** This table showed the frequency distribution of studied patients according to their admission medical diagnosis. The result revealed that 46.7% of studied patients had respiratory disorders. While cardiovascular disorders represent 14.7%. Meanwhile 16% & 13.3 % of studied patients had infectious disorders and gastrointestinal disorders respectively.

**Table 3.** This table showed the frequency distribution of studied patients according to their past medical history and length of ICU stay. Regarding past medical history; 64% of the studied patients had DM and 53.3% of them had hypertension. 46.7% and 26.7% of studied patients had respiratory disorders and cardiovascular disorders respectively. While 17.3% of them had immunity disorders. In relation to length of ICU stay, 66.7% of studied patients were stay in ICU two weeks and more, while 33.3% of them were stay less than two weeks in ICU.

**Table No.4:** This table showed frequency distribution regarding application of Covid-19 precautions measures against acquired Covid-19 in ICU by health team for studied patients. The current study revealed that application of precautions for patients who acquired

Covid-19 were not done/done incorrectly (75%, 83.3.0%, & 91.7%) for receiving training procedures, medical health team availability, hand hygiene, waste management, and triage respectively

**Table 5.** This table revealed the frequency distribution of studied patients according to Covid-19 signs & symptoms. The result revealed that 86.7% had fever & 80% of studied patients had (shortness of breath, loss of smell, and loss of taste) respectively. While 84% of them had muscle ache/pain. Meanwhile 66.7%, 64%, 60% & 60% of studied patients had headache, fatigue, cough, and sore throat respectively.

**Table 6:** This table revealed the frequency distribution of the studied patients according to their lab investigations. Regarding CBC the result revealed that 66.7% of studied patients had abnormal level (elevated WBCs level), 53.3% had abnormal level of D-dimmer and 66.7% of them had positive RT-PCR test. As regarding to CT-chest, 53.3% of studied patients had abnormal CT-chest.

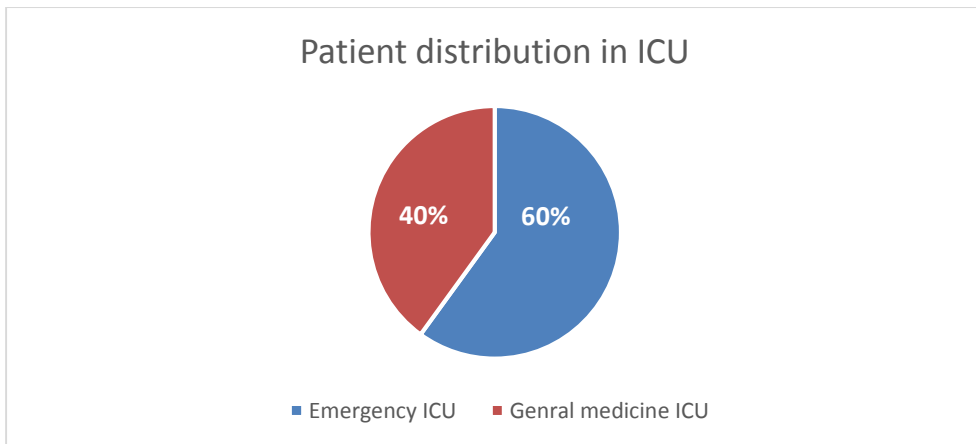
**Figure 2.** Showed that, 80% of studied patients were acquired ICU Covid-19. While, 20% of them were not acquired ICU Covid-19.

**Table 7.** This table revealed that there was highly statistically significant relation between incidence of Covid-19 in ICU and application of precautions measures against Covid-19 at P-value <0.05.

**Table 8.** This table revealed that there was highly statistically significant relation between incidence of Covid-19 in ICU and patient past medical history and length of ICU stay at P-value <0.05.

**Table no.1: Frequency and percentage distribution of studied patients regarding demographic characteristics (n=75).**

| Patients' demographic characteristics | (N=75) | %           |
|---------------------------------------|--------|-------------|
| <b>Age group (years):</b>             |        |             |
| • 20- < 35 Years                      | 9      | 12.0        |
| • 35- <50 Years                       | 18     | 24.0        |
| • 50- ≥ 65 Years                      | 48     | 64.0        |
| Mean± SD                              |        | 48.29±16.22 |
| <b>Gender:</b>                        |        |             |
| • Male                                | 39     | 52.0        |
| • Female                              | 36     | 48.0        |
| <b>Level of education:</b>            |        |             |
| • Read & write/ secondary education   | 47     | 62.7        |
| • Higher education                    | 28     | 37.3        |
| <b>Occupation:</b>                    |        |             |
| • Work in medical field               | 20     | 26.7        |
| • Not work in medical field           | 55     | 73.3        |



**Figure No. 1: Percentage distribution of studied patients according to their ICU (n=75)**

**Table No. 2: Frequency distribution of studied patients according to their admission medical diagnosis (n=75)**

| Admission medical diagnosis  | (N=75) | %    |
|------------------------------|--------|------|
| • Respiratory disorders      | 35     | 46.7 |
| • Cardiovascular disorders   | 11     | 14.7 |
| • Gastrointestinal disorders | 10     | 13.3 |
| • Postoperative              | 2      | 2.6  |
| • Metabolic disorders        | 5      | 6.7  |
| • Infectious diseases        | 12     | 16   |

**Table No. 3: Frequency distribution of studied patients according to their past medical history and length of ICU stay (n=75)**

| Past medical history          | (N=75) | %    |
|-------------------------------|--------|------|
| <b>Past Medical History*:</b> |        |      |
| • Respiratory disorders       | 35     | 46.7 |
| • Cardiovascular disorders    | 20     | 26.7 |
| • DM                          | 48     | 64   |
| • Hypertension                | 40     | 53.3 |
| • Immunity disorders          | 13     | 17.3 |
| • Others                      | 17     | 22.7 |
| <b>Length of ICU stay:</b>    |        |      |
| • Less than two weeks         | 25     | 33.3 |
| • $\geq$ Two weeks            | 50     | 66.7 |

\* Patients may have more than one disease



**Table No. 4: Frequency distribution regarding application of precautions measures against acquired Covid-19 in ICU by health team for studied patients (n=75)**

| Application of precautions measures against Covid-19                             | Covid-19 Acquired ICU (n=60) |      |          |      | Covid-19 Non-Acquired ICU (n=15) |      |          |      |
|--|------------------------------|------|----------|------|----------------------------------|------|----------|------|
|  | Done                         |      | Not Done |      | Done                             |      | Not Done |      |
|  | No                           | %    | No       | %    | No                               | %    | No       | %    |
| Availability of medical health team and key internal and external contact points | 10                           | 33.3 | 50       | 83.3 | 10                               | 66.7 | 5        | 33.3 |
| Human, material and facility capacity  | 17                           | 28.3 | 43       | 71.7 | 8                                | 53.3 | 7        | 46.7 |
| Receiving training procedures, communication and data protection                 | 15                           | 25   | 45       | 75   | 2                                | 13.3 | 13       | 86.7 |
| Hand hygiene, personal protective equipment, and waste management                | 10                           | 33.3 | 50       | 83.3 | 4                                | 26.7 | 11       | 73.3 |
| Triage, first contact and prioritization   | 5                            | 8.3  | 55       | 91.7 | 12                               | 80   | 3        | 20   |
| Patient placement , patients moving in the facility , and visitor access         | 15                           | 25   | 45       | 75   | 3                                | 20   | 12       | 80   |
| Environmental cleaning   | 54                           | 90   | 6        | 10   | 15                               | 100  | 0        | 0.0  |

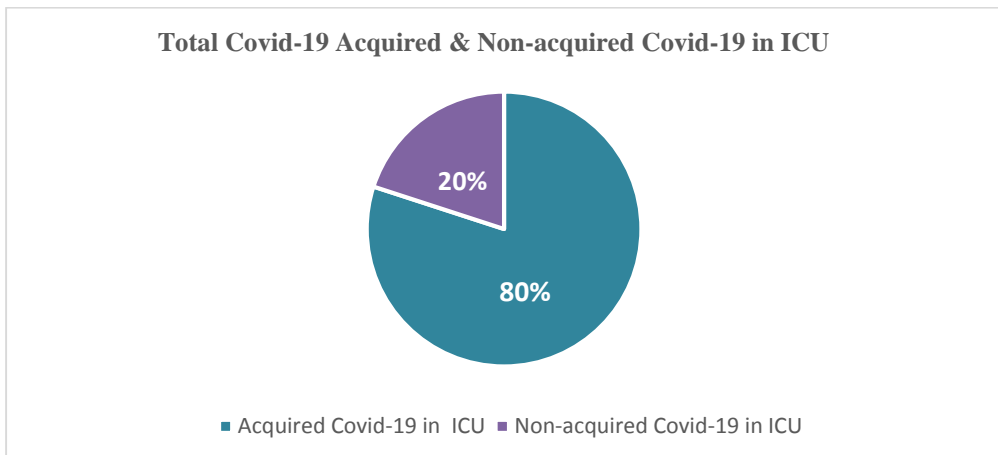
**Table No. 5: Frequency distribution of studied patients according to Covid-19 signs & symptoms (n=75)**

| Covid-19 signs & Symptoms | (N=75) | %    |
|---------------------------|--------|------|
| • Fever                   | 65     | 86.7 |
| • Cough                   | 48     | 64   |
| • Shortness of breathing  | 60     | 80   |
| • Sore throat             | 45     | 60   |
| • Diarrhea                | 38     | 50.7 |
| • Fatigue                 | 48     | 64   |
| • Loss of smell           | 60     | 80   |
| • Loss of taste           | 60     | 80   |
| • Headache                | 50     | 66.7 |
| • Muscle Ache/ pain       | 63     | 84   |

\* Patients may have more than one signs & symptoms

**Table No.6: Frequency distribution of studied patients according to their lab investigations (n=75)**

| Patients' Lab investigation | (N=75) | %    |
|-----------------------------|--------|------|
| <b>CBC:</b>                 |        |      |
| • Normal                    | 25     | 33.3 |
| • Abnormal                  | 50     | 66.7 |
| <b>D-Dimer:</b>             |        |      |
| • Normal                    | 35     | 46.7 |
| • Abnormal                  | 40     | 53.3 |
| <b>RT-PCR Test:</b>         |        |      |
| • Positive                  | 50     | 66.7 |
| • Negative                  | 25     | 33.3 |
| <b>CT- chest:</b>           |        |      |
| • Normal                    | 35     | 46.7 |
| • Abnormal                  | 40     | 53.3 |



**Figure No.2: percentage distribution of total number of ICU acquired & non acquired Covid-19 among studied patients (n=75)**

**Table No.7: Relation between overall patients' acquired & non-acquired Covid-19 in ICU and application of precautions measures against Covid-19 (n=75)**

| Application of precautions measures in ICU-against Covid-19                      | Acquired Covid-19 in ICU (n= 60) |      | Non-acquired Covid-19in ICU (n=15) |      | X <sup>2</sup> | p- value |
|--|----------------------------------|------|------------------------------------|------|----------------|----------|
|  | No                               | %    | No                                 | %    |                |          |
| Availability of medical health team and key internal and external contact points |                                  |      |                                    |      |                |          |
| • Done   | 50                               | 83.3 | 10                                 | 66.7 | 15.43          | 0.001*   |
| • Not Done   | 10                               | 16.7 | 5                                  | 33.3 |                |          |
| Human, material and facility capacity  |                                  |      |                                    |      |                |          |
| • Done   | 19                               | 31.7 | 13                                 | 86.7 | 13.54          | 0.059*   |
| • Not Done   | 41                               | 68.3 | 2                                  | 13.3 |                |          |
| Receiving training procedures, communication and data protection                 |                                  |      |                                    |      |                |          |
| • Done   | 17                               | 28.3 | 1                                  | 6.7  | 14.22          | 0.002*   |
| • Not Done   | 43                               | 71.7 | 14                                 | 93.3 |                |          |
| Hand hygiene, personal protective equipment, and waste management                |                                  |      |                                    |      |                |          |
| • Done   | 50                               | 83.3 | 5                                  | 33.3 | 14.10          | 0.009*   |
| • Not Done   | 10                               | 16.7 | 10                                 | 66.7 |                |          |
| Triage, first contact and prioritization   |                                  |      |                                    |      |                |          |
| • Done   | 55                               | 91.7 | 12                                 | 80   | 16.35          | 0.005*   |
| • Not Done   | 5                                | 8.3  | 3                                  | 20   |                |          |
| Patient placement , patient moving patients in the facility , and visitor access |                                  |      |                                    |      |                |          |
| • Done   | 20                               | 33.3 | 12                                 | 80   | 14.29          | 0.0006*  |
| • Not Done   | 40                               | 66.7 | 3                                  | 20   |                |          |
| Environmental cleaning   |                                  |      |                                    |      |                |          |
| • Done   | 36                               | 60   | 14                                 | 93.3 | 13.40          | 0.051*   |
| • Not Done   | 24                               | 40   | 1                                  | 6.7  |                |          |

**Table No. 8: Relation between overall patients' acquired & non-acquired Covid-19 in ICU and their past medical history and length of ICU stay (n=75)**

| Factors contributing to ICU-acquired Covid-19 | Covid-19 acquired ICU (n= 60) |      | Covid-19 Non-acquired ICU (n=15) |      | X <sup>2</sup> | p. value |
|---|-------------------------------|------|----------------------------------|------|----------------|----------|
|   | No                            | %    | No                               | %    |                |          |
| <b>Past Medical History:</b>                  |                               |      |                                  |      |                |          |
| • Respiratory disorders                       | 35                            | 58.3 | 0                                | 0    | 3.54           | 0.049*   |
| • Cardiovascular disorders                    | 10                            | 16.7 | 10                               | 16.7 |                |          |
| • DM  | 40                            | 50   | 8                                | 53.3 |                |          |
| • Hypertension                                | 30                            | 50   | 10                               | 66.7 |                |          |
| • Immunity disorders                          | 10                            | 16.7 | 3                                | 20   |                |          |
| • Others                                      | 4                             | 6.7  | 13                               | 86.7 |                |          |
| <b>Length of ICU stay:</b>                    |                               |      |                                  |      |                |          |
| • Less than one week                          | 12                            | 31.7 | 13                               | 86.7 | 2.06           | 0.0001*  |
| • ≥ One week                                  | 45                            | 68.3 | 8                                | 53.3 |                |          |

## Discussion

Coronavirus disease (Covid-19) is currently a worldwide pandemic ongoing global health emergency caused by severe acute respiratory syndrome (SARS). Critical health team have an essential role in the prevention of ICU acquired Covid-19 through applying of hospital specific covid-19 precautions (WHO, 2020).

Regarding age of studied patients, the current study revealed that about two third of the studied patents were  $50 \geq 65$  years old age. From the researcher point of view, the numbers of elderly people were high in the study as the burden of comorbid and chronic disease rise with age. This finding agree with (Xu, et al., 2020) who conducted a study titled "Pathological findings of COVID-19 associated with acute respiratory distress syndrome" and found that more than half of studied patients were more than fifty years. This finding disagree with (Herridge et al., 2018) who conducted a study titled "one year outcomes in survivors of the acute respiratory distress syndrome at four university medical surgical ICUs in Toronto" and showed that more than half of the studied patients were less than fifty years.

In relation to gender, the current study revealed that more than half of studied patients were males. From the researchers point of view, the numbers of critically ill male patients were high in the study because of the immunological effect of sex hormone on incidence of critical illness as estrogen hormone improve the heart, hepatic and immunity function and decrease number of illness in female than in male. This finding agreed with (Delitter et al., 2018) who conducted a study titled "Risk for the development of polyneuropathy and myopathy in critical ill patients at the ICU of the St. Elisabeth

Hospital-Tiburg" and mentioned that more than half of studied patients were males.

While, this finding disagreed with (Brauner et al., 2013) who conducted a study titled " Effect of physical therapy on muscle strength, respiratory muscle and functional parameters in patients with intensive care unit acquired weakness " which illustrated that more than two third of studied patients were females.

Regarding type of intensive care unit, the current study showed that more than half of studied patients were admitted to the emergency intensive care unit. This finding agreed with (Damm 2015) who conducted a study titled" Long term outcomes after critical illness" and found that more than two third of studied patients were admitted to the emergency intensive care unit and one third of them were admitted to the surgical ICU.

In relation to admission medical diagnosis of studied patients, the current study revealed that the incidence of cardiovascular, respiratory and metabolic disorders were common, more than one third of studied patients had respiratory disorders, less than one fifth of them had cardiovascular disorders and a minority of them had immunity and infectious disorders. From the researcher point of view, the incidence of cardiovascular, respiratory and metabolic disorders were high among studied patients due to increase percentage of old aged patients in this study.

These findings were supported by (Mehrholtz, et al., 2015) who conducted a study titled "First result about recovery of walking function in patients with intensive care unit acquired weakness from the general weakness syndrome therapy cohort study at post-acute ICU and rehabilitation units in Germany" and found that less than one fifth of studied patients

had cardiovascular disorders. At the same line (**Chlan, et al., 2015**) who conducted a study titled "Peripheral Muscle Strength and Correlates of Muscle Weakness in Patients Receiving Mechanical Ventilation at the University of Minnesota, Minneapolis-Minnesota" and reported that more than one third of studied patient had respiratory disorders on admission and a minority of them had infectious disorders. While more than one quarter of them had cardiovascular disorders.

Regarding past medical and length of ICU stay of studied patients, the current study revealed that less than one third of studied patients had a history of cardiovascular and less than half of them had respiratory disorders. These findings were agreed with (**Bhatraju et. al., 2020**) who conducted a study titled "Covid-19 in critically ill patients in the Seattle region - case series " and reported that the most common medical history of studied patients was cardiovascular and respiratory disorders.

Regarding application of precautions measures against Covid-19 in ICU, the current study revealed that application of precautions measures for patients who acquired Covid-19 were not done or done incorrectly for receiving training procedures, availability of medical health team, hand hygiene, waste management, and triage in emergency and general medicine ICU. From the researchers observations and point of view, the application of precautions measures were not done or done incorrectly for patients who acquired Covid-19 due to increased flow of patients admission in comparison with the short number of nursing and medical staff; one nurse assigned to care for two or three patients in the same time which affect the quality of care provided to those patients and also, they had not received training courses regarding importance of

applications of those precautions measures in addition to ICU were not prepared enough to deal with this pandemic illness.

This finding also was inconsistent with (**Yu, et al., 2018**) who conducted a study titled "Analysis of high risk factors of intensive care unit acquired infection in patients with sepsis at Hospital of Kunming Medical University–China" and found that one quarter of the studied patients had ICU-acquired infection.

Regarding signs and symptoms of studied patients, the current study revealed that the majority of studied patients had fever, shortness of breath, loss of smell, loss of taste and muscle ache/pain. Meanwhile about two third of studied patients had headache, fatigue, cough, and sore throat. This may be due to this is the common sign and symptoms of Covid-19. These findings were agreed with (**Matt et. al., 2020**) who conducted a study titled "Characteristics and Outcomes of 21 Critically Ill Patients with COVID-19 in Washington State" who found that, more than three quarters had shortness of breath , more than half had fever ,and near than half had cough.

Regarding lab investigations of studied patients, the current study showed that more than two third of studied patients had abnormal level of CBC and had positive RT-PCR test, and more than half of patients had abnormal level of D-dimer and abnormal CT-chest. These findings were in agreement with (**Testa et al., 2020**) who conducted a study titled "Direct oral anticoagulant plasma levels' striking increase in severe COVID-19 respiratory syndrome patients treated with antiviral agents: the Cremona experience" and reported that D-dimer were abnormal in most cases. Also, this result disagree with (**Helms, et al., 2020**) who conduct a study titled " High risk of thrombosis in patients with severe SARS-CoV-2

infection: a multicenter prospective cohort study" and reported that CT-chest were abnormal in two thirds of patient.

Regarding the incidence of ICU acquired Covid-19, the current study revealed that the majority of studied patients acquired Covid-19. From the researcher point of view, the incidence of ICU acquired Covid-19 were high as the majority of studied patients were old age with comorbidities illness, stay in ICU more than two weeks, malnourished and applications of Covid-19 precautions measures by medical health team were not done or done incorrectly so, all these factors increased patients risk to acquire Covid-19. This finding was supported by (Bellosta et al., 2020) who conducted a study titled " Acute limb ischemia in patients with COVID-19" and reported that comorbid illness is a major factors contributing in developing Covid-19 among patients in ICU.

Regarding relation between applications of precautions measures against Covid-19 and incidence of Covid-19 among studied patients in ICU, the current study revealed that there was a highly statistically significant relation between application of precautions measures against Covid-19 and incidence of Covid-19 in ICU. This result may be due to non-compliance of health team to apply precautions measures against Covid-19 in ICU and as a result of that there was increased incidence of Covid-19 among medical health team.

Regarding relation between overall patients acquired & non-acquired Covid-19 in ICU and their past medical history and length of ICU stay, there was highly statistically significant relation between incidence of Covid-19 and patient past medical history and length of ICU stay. These result may be due to that most of studied patients were elderly people with

comorbid and chronic disease and stayed more than two weeks in the ICU.

### **Conclusion:**

Based on the findings of the current study, it can be concluded that: the majority of studied patients acquired Covid-19 in ICU. As well Factors contributing to acquire Covid-19 among critically ill patients in ICU were non-compliance of health care team to precautions measures against Covid-19, patients present, past medical history and length of stay in ICU.

### **Recommendations:**

Developing instructional guideline for improving medical health team performance regarding application of precautions measures against Covid-19. In addition to, replication of the study on larger sample selected from different areas in Egypt is recommended to obtain more generalizable data.

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No

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