



**An-Najah National University**  
**Faculty of Graduate Studies**

**THE EFFECT OF NATIONAL EARLY  
WARNING SCORING SYSTEM (NEWS2)  
IMPLEMENTATION ON IDENTIFYING THE  
RISK OF CLINICAL DETERIORATION AND  
OUTCOMES AMONG COVID-19  
HOSPITALIZED PATIENTS**

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**This Thesis is Submitted in Partial Fulfillment of the Requirements for the Degree of  
Master of Critical Care Nursing, Faculty of Graduate Studies, An-Najah National  
University, Nablus, Palestine.**

**2022**

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## **Dedication**

All gratitude is due to Almighty Allah for blessing me with health and patience to complete this thesis. I dedicate this thesis to those who set me on the path of life, and took care of me until I became old , the owners of a fragrant biography and enlightened thoughts, for they had the first credit in attaining my higher education (my great mother and my beloved father) . May Allah prolong their lives.

## **Acknowledgements**

I would like to extend my gratitude to my awesome supervisor Dr. Jamal Qaddoumi for his confidence in me and for his diligent supervision, clear guidance, continued support and encouragement throughout this process.

I would like to appreciate the efforts of the staff at Martyrs Medical Military Complex and Palestinian Red Crescent Hospital, including resident physicians, nurses, and specialists, for helping me in the completion of this research.

Special thanks should also be given to An-Najah National University and Ibn Sina College for Health Sciences for giving me opportunity, believing in me, and giving me the right road.

It would not have been possible to complete this thesis without my parents' support and my siblings' encouragement.

To the one who has always been like the wind beneath my wings, supporting me in my career, and believing in my potentials, my dearest uncle Saleh Abo Lafah.

This achievement would have been impossible without them.

Thanks to everyone who gave me moral support for the completion of this task.

**Author**

**Islam Tukhi**

## **Declaration**

I, the undersigned, declare that I submitted the thesis entitled:

**THE EFFECT OF NATIONAL EARLY WARNING SCORING SYSTEM  
(NEWS2) IMPLEMENTATION ON IDENTIFYING THE RISK OF CLINICAL  
DETERIORATION AND OUTCOMES AMONG COVID 19 HOSPITALIZED  
PATIENTS.**

I declare that the work provided in this thesis, unless otherwise referenced, is the researcher's own work, and has not been submitted elsewhere for any other degree or qualification.

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**Signature:** \_\_\_\_\_

**Date:** \_\_\_\_\_

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**THE EFFECT OF NATIONAL EARLY WARNING SCORING SYSTEM  
(NEWS2) IMPLEMENTATION ON IDENTIFYING THE RISK OF CLINICAL  
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**ABSTRACT**

**Background:** Coronavirus disease (COVID-19), caused by the SARS-CoV-2 virus, has been declared a pandemic by the World Health Organization (WHO), and it is associated with high rates of mortality and morbidity, prolonged hospital stays, and increased needs for Intensive Care Unit (ICU) admission. It is crucial to predict clinical deterioration in COVID-19 patients.

**Objectives:** To find out the efficacy of the National Early Warning Scoring System (NEWS2) application in predicting the risk of clinical deterioration and outcomes in hospitalized patients who had COVID-19 at Martyrs Medical Military Complex and Palestinian Red Crescent hospital.

**Methods:** A quasi-experimental design was applied. A sample of 384 adult patients was divided into a research group (192 patients) and a control group (192 patients). Before and after implementation (NEWS 2), all study participants were observed until death or hospital discharge, and the results of the two patient groups were compared and assessed.

**Results:** Comparing the control group (Pre NEWS phase) to the study group (Post NEWS phase), a significant decrease was found in the mean length of hospital stay ( $8.1 \pm 5.5$  vs  $6.4 \pm 5.3$ ,  $p = 0.002$ ), as well as a reduction in the mortality rate from 38 (19.8 %) during the pre- NEWS phase to 24 (12.5 %) during the post-NEWS phase ( $p = 0.071$ ). The predictive value of NEWS was found to be an excellent predictor of admission to the ICU as indicated by an AUROC of 0.91 (95% CI: 0.87-0.96,  $p < 0.001$ ).

Also, a significant difference in the frequency of monitoring patients' vital signs was observed between the control group (Pre NEWS phase) and the study group (Post NEWS phase) following clinical deterioration ( $10.1 \pm 7.8$ (Pre NEWS2) vs  $23.4 \pm 0.7$ (Post NEWS2),  $p = <0.001$ ).

**Conclusion:** Implementation of NEWS2 showed a significant improvement in hospitalized COVID patient outcomes (length of stay, predicted ICU admissions, mortality rate and frequency of vital signs measurements, which indirectly raised the number of medical reviews following patient clinical deterioration) and this was attributed to a significant prediction of patient deterioration.

**Keywords:** COVID19; NEWS2; clinical deterioration; patient outcomes; and early warning scores.

# Chapter One

## Introduction

Coronavirus is an infectious disease that is caused by the SARS-CoV-2. This disease is also known as COVID-19. The World Health Organization (WHO) declared 2019 a pandemic year, thus putting a tremendous burden on worldwide healthcare systems. According to data from WHO, as of the end of November 2021, over 260 million have been confirmed diagnoses and over 5.2 million deaths had been confirmed. [1]

The first coronavirus case was recorded in Palestine on March 5, 2020, and the cumulative incidence of reported cases, as of November 31, 2021, exceeded 430,433.[2]

Although the majority of individuals infected with COVID-19 had modest clinical manifestations and a fair prognosis, some had more severe forms, including pneumonia, pulmonary edema, acute respiratory syndrome, multiple organ failure, and death [3].

In many studies, advancing age and comorbidities, like diabetes, obesity, heart and lung diseases have all been related to serious diseases and death [4]. The change from the moderate to the severe form of COVID can happen fast, and much research is still being done on the prognostic variables that can be used to identify individuals who are at risk of developing the severe form. [5].

Many patients were hospitalized with COVID-19 because they required respiratory support and needed critical care admission, non-invasive pressure support, or invasive ventilation, and that threatened the capacity and the flow of work of high dependency units at hospitals worldwide. Therefore, identifying these patients early is important, as failure to identify the deterioration of patient's condition may result in substantial physiological abnormalities for longer than 24 hours [6-8], as manifested by derangements in the patient's vital signs [9]. Delaying management of the deteriorated patients may result in major adverse effects and life-threatening circumstances, lengthening the hospital stay, or even causing disabling consequences. These delays are based on unanticipated hospital admissions or readmissions, increase of hospital morbidity and mortality [10].

Early detection can lead to proper care and can also reduce the need for higher acuity care, hospital lengths of stay, and admission costs, and, in some cases, even improvement of life expectancy.

Early diagnosis of clinically deteriorated patients is the cornerstone of improving patient outcomes, and this involves a number of procedures, including the collection and interpretation of vital signs, meaningful communication, and prompt and appropriate intervention from the medical team. [11]

One early intervention is to implement "track and trigger" (T&T) systems which regularly collect patients' vital sign data and grade them depending on any abnormalities.

Various systems and techniques have also been developed to detect patients at risk of deterioration. Some scoring systems award points based on the manually measured physiological variable's deviation from "normal," whilst others may react when a physiological variable exceeds a predetermined abnormal value. Complex scoring systems award points based on the physiological variable's deviation from "normal", and the sum of these points determines the score.

Even though early warning systems decrease the need to rely solely on the nurse's clinical decision-making to trigger the response and are likely to reduce discussion about nurse expectations versus physician response, they should not be used to replace clinical judgment or eliminate respect for 'nurse concern.'

According to some evidence, when early warning scores are combined with a rapid response team, they work as excellent predictors of cardiac arrest and mortality and may minimize cardiac arrests and unplanned ICU admissions. However, they have not suggested an impact on in-hospital deaths or made an improvement of patient outcomes. [12]

In the United Kingdom, an attempt was made in 2012 to enhance the evaluation and documentation of vital signs in hospitals by implementing a uniform, standardized approach on a nationwide scale.

The National Early Warning Score (NEWS) was developed from this concept. Moreover, several hospitals are increasingly utilizing earlywarning systems as screening tools for sepsis, outperforming the quick sequential (Sepsis-Related) Organ Failure Assessment (qSOFA) Score as objective approaches for determining patient deterioration and ensuring timely care. The NEWS2 is used to identify what reaction is required for a better outcome (who to contact for help, what to do till help arrives, what to prepare, and when to reevaluate).

When these systems are used in conjunction with a medical team, patients who require special attention are identified and can be examined by a specialist team, as soon as possible, thus reducing the chance of harmful outcomes [10,13,14].

In addition to this, WHO and the Royal College of Physicians (RCP) both claim that COVID-19 has a diverse clinical presentation ranging from asymptomatic transmission to life-threatening organ failure during the pandemic outbreak [1.13.15]

Many of clinical characteristics of this pandemic, such as increased respiratory rate, elevated temperature, and low systolic blood pressure [4,16], appear to be analogous to those found in other infections, making the use of NEWS or NEWS2 appealing for COVID-19 screening or monitoring.[1.13]

NEWS2 seems to be a robust predictor of COVID-19 inpatient hospital deaths. This is extremely important because it validates NEWS2's ability to support clinical judgment while also providing a standardized communication tool in a short time frame, taking into account the limited resources and operational demands hospitals had to deal with during the COVID-19 pandemic outbreak's emergency phase. [17] As a result of this, patients who are facing a clinical deterioration or who are at risk of deterioration would receive an initial assessment in a timely manner from an experienced clinical decision maker.

The purpose of this study was to quantify the effect of applying the national early warning scoring system (NEWS2) on identifying the risk of clinical deterioration and outcomes among COVID-19 hospitalized patients at Martyrs Medical Military Complex and Palestinian Red Crescent Hospital.

Many studies have shown NEWS to be a useful tool for predicting adverse events and risk classification for patients. [18].

The researcher has hypothesized that early warning system adoption by nurses will enhance patient outcomes by decreasing the risk of in-hospital morbidity, patient clinical instability, or even mortality rates, and increasing medical reviews following clinical deterioration.

### **1.1 Statement of the Problem**

Clinically, few researchers have investigated the effectiveness of traditional risk stratification strategies in SARS-CoV-2 infected patients. Although the National Early Warning Score 2 (NEWS2) is widely utilized in emergency care, no local research has evaluated its usefulness in patients with covid-19. The National Early Warning Score 2 (NEWS2) is one of the clinical risk scores that is most frequently utilized, but there is a shortage of evidence supporting its use in covid-19 patients, and there haven't been enough studies that have evaluated NEWS2 scoring ability to predict outcomes in hospitalized patients with SARS-CoV- 2 infection. Therefore, it is vital for forecasting the clinical decline in COVID-19 patients, as early identification of patients' clinical deteriorations may enhance survival rates and reduce mortality.

### **1.2 Aim and Objective of the Study**

The purpose of this study was to investigate whether or not NEWS2 is able to accurately forecast the probability of clinical deterioration and outcomes in individuals who have COVID-19.

The present study's objective is to analyze the influence of applying the national early warning score on COVID-19 patient outcomes such as patient deterioration, admission to an intensive care unit (ICU), length of hospital stay, and patient mortality.

### **1.3 Significance of the Study**

The COVID-19 pandemic, caused by the SARS-CoV-2 virus, has a high fatality rate, morbidity, longer hospital stays, and an increased requirement for intensive care admission. Improving critical care patient flow is vital for providing high-quality care in severe cases. A quick and reliable prediction model for COVID-19 patients admitted to the hospital would be valuable for providing prognostic evaluations and precise

treatment and resource allocation management. To address the obstacles that the medical team experience during the pandemic, methods that rapidly detect patients at risk of deterioration and thereby assist in guiding decision-making are urgently needed.

#### 1.4 Study Variables

- **Dependent Variables:** Patient deterioration upon physiological parameters that are included in the score; Intensive Care Unit (ICU) admission; length of hospital stays; and patient death.
- **Independent Variables:** Implementation of the National Early Warning Score (NEWS2), demographic data.

#### 1.5 Definitions of Terms

- **Conceptual Definition of Clinical deterioration:** "A dynamic decompensation state of subjective and objective determination in clinical state, susceptibility, pathogenesis, and adverse events associated with increased mortality, resuscitation, implementation of a higher level of care, and prolonged hospital admission." (Ricardo et al., 2018).
- **Operational Definition of Clinical Deterioration:** "A dynamic state experienced by a patient compromising hemodynamic stability, marked by physiological decompensation accompanied by subjective or objective findings." (Ricardo et al., 2018).
- **Conceptual Definition of Length of Hospital Stay:** The number of days a patient spends in the hospital is a relevant indicator for hospital administrators. It is also a direct indicator of the cost of treatment, and its relevance applies to all patients regardless of their final outcome. (Pereira et al., 2004).
- **Operational Definition of Length of Hospital Stay:** "The average number of hospital days spent by patients. In general, it is computed by dividing the total number of days spent by all inpatients during a year by the number of admissions or discharges." (OECD, 2022).

- **Conceptual Definition of Intensive Care Unit Admission:** “Admission to a system of care for critically ill patients that offers them specialized, intensive medical and nursing care, improved monitoring capabilities, and a range of physiologic organ support treatments to keep them alive during a period of life-threatening organ system insufficiency.” (John C. et al., 2017).
- **Operational Definition of ICU Admission:** Admission of patients with specific needs that can be only addressed in the ICU environment, such as life-supportive therapies accompanied by available clinical expertise, prioritization according to the patient’s condition, diagnosis, bed availability, changes in objective parameters at the time of referral, such as respiratory rate, the potential for the patient to benefit from interventions, and prognosis.”(Critical Care Medicine, 2016).
- **Conceptual Definition of Patient Death:** "Irreversible cessation of patient organismic functioning" ( Becker 1975; Bernat, Culver, and Gert 1981,).
- **Operational Definition of Patient Death:** “Permanent loss of consciousness and all brainstem functions caused by a permanent cessation of circulation or severe brain injuries.” ( Shemie S. D., et al., 2014).
- **Conceptual Definition of NEWS2 Score:** “NEWS2 is the most recent version of the National Early Warning Score (NEWS). It was first developed in 2012 and revised in 2017, and it advocates a system to standardize the assessment and response to acute illness.” ( Royal College of Physician , 2017).
- **Operational Definition of Implementation of NEWS2 Score:** “The NEWS is based on a straightforward aggregate scoring system in which patients' physiological data are collected and scored upon hospital admission or observation. The grading system is based on six simple physiological factors: temperature, pulse rate, oxygen saturation, respiration rate, and level of consciousness or newly acquired confusion. When a parameter is measured, it is assigned a score, the magnitude of which shows how much the parameter deviates from the norm.” (Royal College of Physician, 2017).

- **Conceptual Definition of Demographic Data:** It is defined as information regarding the characteristics of a population, including the age of the people, their sex, and the income they earn. (Demographics. (n.d.). In *Your Dictionary*. Retrieved from <https://www.yourdictionary.com/DEMOGRAPHICS>).
- **Operational Definition of Demographic Data:** This appears to be taken by asking patients and seeking information from patient files.

## 1.6 Research Question

Is NEWS2 monitoring capable of detecting clinical deterioration (length of stay, O2 usage, ICU admission, and mortality) in hospitalized COVID-19 patients?

## 1.7 Research Hypotheses

- **Null Hypothesis:** There is no statistically significant correlation at  $\alpha=0.05$  between the implementation of NEWS2 and identification of the clinical deterioration and outcomes among COVID19 hospitalized patients.
- **Alternative Hypothesis:** There is statistically significant correlation at  $\alpha=0.05$  between the implementation of NEWS2 and identification of the clinical deterioration and outcomes among COVID19 hospitalized patients.

## 1.8 Literature Review

COVID-19 has been labeled a pandemic since early 2020. While the great majority of SARS-CoV-2 infections are asymptomatic or mild, a small minority develop a severe illness that can be deadly despite the best available treatment. [67] In some European, American, and Chinese studies, hospital mortality ranged from (17% to 23.4 %) for all hospitalized COVID-19 patients [21-25].

Approximately 15% to 20% of COVID 19 hospitalized patients require ICU care or die from the disease [19, 21]. In many studies, ageing and co-morbid conditions like diabetes, obesity, cardiovascular disease, and lung disease have been linked to serious illness and death. [67]. As a result of these complicated circumstances, there was an urgent need to adapt diagnoses and therapy as the pandemic progressed, implying that the use of trustworthy methods for identifying patients who were far more likely to experience a clinical decline could be helpful. Instead, in situations when a short period

of time between patient assessments is required, simple, efficient, and, if feasible, noninvasive and continuous scoring must be implemented in order to screen the patient at a scheduled time approach .[68]

In numerous areas of medicine, the development of clinical prediction models is prevalent. [69]. In 2000, acute hospitals implemented Early Warning Scores for the first time. Today, they are widely used in a variety of clinical contexts as they provide extremely valuable information to help characterize the clinical risk of deterioration more precisely, and thereby facilitate risk stratification. In spite of the fact that 99 % of acute hospitals utilize EWS to monitor patients (NCEPOD, 2015), there has been little progress over the past decade in identifying and responding to patients who are deteriorating. [70]

In developed nations, EWS systems have been established and widely used with the objective of identifying clinical deterioration as soon as possible [59]. They are common in Australia, the United States, and the Netherlands [71].

The availability of critical care differs throughout developing countries [72]. Overcrowding, a lack of resources, and a lack of staff make it difficult to efficiently monitor the physiological variables required for the installation and validation of EWS in hospital wards .Patients in low-income countries usually differ in terms of how their illnesses present and take different patterns.

Despite the lack of data, studies evaluating EWS under diverse conditions show a wide range of performance [73].

EWSs are clinical decision-making tools that are used in ICUs, non-ICU settings, ED, and, more recently, they have been used in pre-hospital care and nursing homes [49, 50, 51]. The benefit of this type of score is the ability to detect clinical deterioration early, which permits its application in many health systems with worldwide implementation [52, 53, 54]. The National Institute for Health and Clinical Excellence in UK hospitals mandates the use of the National Early Warning Score (NEWS), recently modified to NEWS2, as a standard of care (RCP) 2012; 2017). (NICE, 2007). The EWS Score correlates to a graded escalation reaction when calculated. Ward nurses are urged to identify patients who are deteriorating and to contact Rapid Response Teams (RRT) as soon as possible. [74]

RRT, also known as Critical Care Outreach, can provide enhanced system evaluation and rescue of deteriorating patients before irreversible deterioration and cardiac arrest occur.

Early Warning Scores have outstanding clinical matchmaking in which they have been employed in Emergency Departments (ED). These scores are based on weighted averages of clinical and vital signs that are regularly assessed in every patient, including temperature, blood pressure, heart rate, and oxygen saturation, level of consciousness, use of supplemental oxygen, and/or age [75].

Two studies explored ICU/HDU admission. ICU admission was shown to be substantially linked with NEWS above or below 7 and Fisher's exact test at T0 which represented arrival in ED ( $p = 0.003$ ), T1 which indicated an hour after arrival in ED with a  $p$ -value of ( $p 0.001$ ), and T2 which indicated transfer to general ward/ICU ( $p 0.046$ ). Smith et al. (2013) found that NEWS had a higher AUROC [95 % CI] of 0.857 [0.847-0.868] when compared to the other 33 EWS available (AUROC [95 % CI] 0.827 (0.814-0.84)).

Two studies that identified a connection between increased EWS and LOS [60,76] found that in-hospital LOS was significantly lower after EWS usage, dropping from 4.55 days (95 % CI 4.34-4.76) in the pre-intervention period to 4.11 days (95%CI 3.92-4.30;  $p = 0.004$ ) in the post-intervention period.

A NEWS2 score of  $>7$  more than doubled the median length of stay compared to a score of 0-4, and NEWS was significantly correlated with length of hospital stay among all hospital stay time period.[60].

One study showed that using an EWS chart improved the documentation of vital signs and increased the average number of patient observations per nurse shift over the duration of a 6-day post-intervention period as compared to the pre-intervention period(0.9376 [95%CI], 0.8921-0.9231;  $p 0.001$ ).

This was used as a proxy marker of care quality [76]. Prior to the intervention period, measurements of oxygen saturation, consciousness level, and respiratory rate were virtually nonexistent. Following the intervention period, the number of O2 saturation observation sets increased by up to 27%, the consciousness level by 23% , and the respiratory rate by 18%.

De Meester (2013) [76] established a connection between high EWS and significant adverse outcomes, such as re-surgery. In a cohort study of 4,247 patients, 6-day postoperative re-surgery cases decreased from 141 to 78 cases (95 % [CI]: 9.5-27.2;  $p = 0.007$ ) after the implementation of EWS nurse observations and escalation protocol, demonstrating improved patient outcomes and increased identification of postoperative complications.

There is a correlation between the use of EWS and decreased mortality. Smith et al. (2013) [59] demonstrated that NEWS outperformed the other 33 EWS in identifying individuals with a higher risk of death than the other 33 EWS. AUROCs (95 % of confidence intervals) for NEWS for death within 24 hours were 0.894 (0.887-0.902), compared to 0.813 (0.802-0.824) and 0.858 (0.849-0.867) for the remaining 33 EWS.

Two studies have investigated the relationship between EWS and cardiac arrest. According to Nishijima et al. (2016) [77], cardiac arrest cases declined dramatically from 5.2 to 2.05 after the implementation of EWS ( $p < 0.01$ ). Smith et al. (2013) [59] suggest that NEWS do not perform better than the other 33 available EWS for cardiac arrest alone. The AUROC (95 % of CI) for NEWS for cardiac arrest within 24 hr was 0.722 (0.685–0.759) compared to 0.611 (0.568–0.654)–0.710 (0.675–0.745) for the other 33 EWS.

Several trials of acute medical hospitalizations have validated NEWS and NEWS2 monitoring in inpatient settings to predict adverse clinical outcomes such as cardiac arrest, ICU admission, and mortality. [26,59], Additional research has demonstrated that a single measurement of NEWS2 at the time of presentation to hospital emergency departments may be able to predict critical clinical outcomes such as severe sepsis, ICU admission, hospital length of stay, and death rates. In addition, it has been demonstrated that pre-hospital NEWS2 assessment by ambulance personnel can predict ICU admission and death. NEWS2 has seen widespread uptake across the NHS in England –

at present 100% of ambulance trusts and 76% of acute trusts are using NEWS2, with other early warning scores in place in other areas. [13]

Some experts have advised using NEWS2 with caution in conjunction with clinical examinations when triaging COVID patients. [13].

Such risk classification may facilitate quicker decision-making and enable treating physicians to devote more resources, attention, and time to patients with a high-risk of catastrophic results. NEWS2 incorporates oxygenation criteria such as hypoxia and the need for supplemental oxygen, which are crucial in the evaluation of COVID-19 patients. All of these factors make NEWS2 a promising indicator for further study as a possible predictor of severe illness and mortality among COVID-19 patients.

## **Chapter Two**

### **Methodology**

#### **2.1 Study Design**

Among hospitalized COVID 19 patients, a retrospective control/ prospective intervention group quasi-experimental research design was utilized.

#### **2.2 Site and Setting**

This study was performed at inpatient units in COVID-19 Martyrs Medical Military Complex and Palestinian Red Crescent Society Hospital, which also functioned as a certified testing and treatment facility for COVID-19 and which provided highly specialized medical care for extremely ill COVID patients and included a general acute medical ward and medical ICUs among other medical specialties. The general ward had a nursing staffing ratio of 6 patients per nurse.

#### **2.3 Population**

About 384 adult male and female patients who satisfied the inclusion criteria were divided into two groups: the research group (Post-NEWS2) (192 patients) and the control group (Pre-NEWS2) (192 patients).

#### **2.4 Sample and Sampling**

All adult COVID-19 patients admitted to both COVID centers and those who satisfied the criteria for inclusion were enrolled in the study during the study time periods: July-November 2021 for the Pre-NEWS sample and December 2021-March 2022 for the Post-NEWS phase). These patients were observed daily for improvement or deterioration. The researcher categorized patient outcomes until death or discharge. The sample was selected using the following formula, with a 95 % level of significance and a margin of error of 0.05:

$$n = z^2 * p(1-p) / e^2 * N$$

$$n = (1.96)^2 / 4(0.05)^2 = 384.16$$

Where  $P$  was the proportion of the population predicted to be 0.5,  $e$  was the margin of error,  $N$  was the size of the population, and  $z$  was the z-score associated with the selected significance level. The equation yielded a sample size of  $n=384.16$ .

## **2.5 Inclusion Criteria**

By RT-PCR, SARS-CoV-2 was detected in all adult patients admitted to our research with a confirmed diagnosis of COVID-19.

## **2.6 Exclusion Criteria**

Patients who were younger than 18 years old, pregnant women, and those with spinal cord injuries, non-COVID patients, and patients who were readmitted to the unit during the trial were excluded from the study. The NEWS should not be applied to children or pregnant women since their physiological response to acute illness may be affected. Due to functional abnormalities in the autonomic nervous system, spinal cord injury patients may not be able to rely on the NEWS (especially tetraplegia and severe paralysis), these criteria were developed in accordance with the Royal College of Physicians' 2017 standards.

## **2.7 Validity and Reliability**

The researcher consulted experts from the medical departments of An-Najah National University, from the Arab- American University, and Martyrs Medical Military Complex; all agreed to review my assessment tool without editing.

In 2012, the United Kingdom made an attempt to enhance the evaluation, monitoring, and recording of vital signs in hospitals by adopting a consistent system. This was done in an effort to improve patient care with a standardized approach based on a national basis. This approach was known as the National Early Warning Score (NEWS) [10].

Numerous hospitals are increasingly utilizing EWS systems as sepsis screening tools [2,11,13], outperforming the quick Sequential (Sepsis- Related) Organ Failure Assessment (qSOFA) Score[14,15,16,17] as thematic techniques to identify patient deterioration and ensure prompt access to care.

The subsequent decision-making process is based on the NEWS2 Score (who to contact for assistance, what to do till aid arrives, what to prepare, and when to reevaluate the situation). It also provides a uniform observation system for patient care continuity across wards.

When these EWS are combined with the medical staff, individuals who require particular care are identified and can receive early treatment from a specialized team, minimizing the risk of problems. [Hammond NE,et al .2013] [10].

The use of NEWS or NEWS2 for screening or monitoring seems tempting because several of the clinical traits of COVID-19 are similar to those of other illnesses, such as increased respiratory rate, high temperature, and low systolic blood pressure [4,16].

NEWS2 seems to be a reliable indicator of in-hospital mortality for COVID-19 patients. This is of utmost importance, notably in light of the restricted resources and challenging pressures hospitals encounter during the emergency phase of the COVID-19 pandemic. NEWS2 can assist clinical decision making and provide a standardized communication tool that is logistically feasible within a short time frame. It can ensure that patients, who are deteriorating or at danger of deterioration, receive an immediate evaluation by a medical decision [17].

## **2.8 Study Protocol**

### **Pre-intervention**

For two weeks, using lectures, group discussions, and clinical scenarios, the researcher taught and monitored an educational program where nurses practiced using and implementing the NEWS system.

### **Education Program**

The researcher educated nurses for two weeks on how to apply the NEWS system through lectures, group discussion, and clinical situations. The program's goals were to create a framework for communication among healthcare professionals and aid in knowing the physiological measurements, the rationale behind the measurement, and vital sign abnormalities.

The program covered the advantages of NEWS, the way of its work, and reasons for its use; the score of physiological parameters and its thresholds and triggers, and its clinical response. The score consists of six physiological measures, including respiratory rate, oxygen saturation, pulse rate, systolic blood pressure, body temperature, and consciousness or new confusion.

A score is assigned to each individual observation. When all six scores are combined together, the overall NEWS is generated, which is configured to activate when a patient is seriously ill or has abnormal physiology. Each physiological parameter is assigned a score, with the value of the score representing how much the parameter deviates from the norm.

A NEWS2 score of 5 or 6 is regarded as a critical threshold that may signal clinical worsening and should necessitate an immediate reaction by a physician or team with expertise in assessing and treating severely unwell patients.

An increased NEWS score does not establish a diagnosis, but it does assist in identifying the risky patient who requires immediate clinical assessment in a systematic manner. The risk levels are classified as low, low-medium, medium, or high, with suggestions for appropriate clinical responses and the need for more intensive treatment. It also provides a consistent monitoring system and continuity of treatment for patients between wards. Trends in a patient's clinical response can be monitored by regularly recording the score, providing early notifications of clinical deterioration, and when early warning systems are used in close collaboration with the medical team, the patients are identified as needing special consideration and can be treated right away by a specialist team, lowering the potential for adverse outcomes. (NHS England 2019).

**Figure 2.1**

*NEWS2's scoring system. Reproduced with permission from the Royal College of Physicians. National Early Warning Score (NEWS) 2: Standardizing the assessment of the severity of acute illness in the NHS. A working party's report has been updated. RCP, 2017.*

Chart 2: NEWS thresholds and triggers

NEW score	Clinical risk	Response
Aggregate score 0–4	Low	Ward-based response
Red score Score of 3 in any individual parameter	Low–medium	Urgent ward-based response*
Aggregate score 5–6	Medium	Key threshold for urgent response*
Aggregate score 7 or more	High	Urgent or emergency response**

\* Response by a clinician or team with competence in the assessment and treatment of acutely ill patients and in recognising when the escalation of care to a critical care team is appropriate.

\*\*The response team must also include staff with critical care skills, including airway management.

Physiological parameter	Score						
	3	2	1	0	1	2	3
Respiration rate (per minute)	≤8		9–11	12–20		21–24	≥25
SpO <sub>2</sub> Scale 1 (%)	≤91	92–93	94–95	≥96			
SpO <sub>2</sub> Scale 2 (%)	≤83	84–85	86–87	88–92 ≥93 on air	93–94 on oxygen	95–96 on oxygen	≥97 on oxygen
Air or oxygen?		Oxygen		Air			
Systolic blood pressure (mmHg)	≤90	91–100	101–110	111–219			≥220
Pulse (per minute)	≤40		41–50	51–90	91–110	111–130	≥131
Consciousness				Alert			CVPU
Temperature (°C)	≤35.0		35.1–36.0	36.1–38.0	38.1–39.0	≥39.1	

NEWS KEY		NAME: Lily Manga	D.O.B. 3/7/1970	ADMISSION DATE: 10/12/2016
DATE		12/12/12/12		DATE
TIME		11:30/1230		TIME
RESP. RATE	≥25		3	≥25
	21-24		2	21-24
	12-20		1	12-20
	9-11		1	9-11
≤8		3	≤8	
SpO <sub>2</sub>	≥96		1	≥96
	94-95		2	94-95
	92-93		3	92-93
	≤91		3	≤91
Inspired O <sub>2</sub> %	%	2	%	
TEMP	≥39°		2	≥39°
	38°		1	38°
	37°		1	37°
	36°		1	36°
	≤35°		3	≤35°
NEW SCORE uses Systolic BP  BLOOD PRESSURE	230		3	230
	220			220
	210			210
	200			200
	190			190
	180			180
	170			170
	160			160
	150			150
	140			140
	130			130
	120			120
	110			110
	100		1	100
	90		2	90
	80		3	80
70		3	70	
60		3	60	
50		3	50	
HEART RATE	>140		3	140
	130		2	130
	120		2	120
	110		1	110
	100		1	100
	90		1	90
	80		1	80
	70		1	70
	60		1	60
	50		1	50
	40		1	40
	30		3	30
Level of Consciousness	Alert	A A		Alert
	V / P / U		3	V / P / U
BLOOD SUGAR		5 5		B'l'd Sugar
TOTAL NEW SCORE		? ?		TOTAL SCORE
Additional Parameters	Pain Score	0 0		Pain Score
	Urine Output	? ?		Urine Output
Monitoring Frequency	FOUR EVERY HOUR			Monitor Freq
Escalation Plan Y/N n/a	Y Y			Escal Plan
Initials	SBMJ SBMJ			Initials

NEWS score	Frequency of monitoring	Clinical response
0	Minimum 12 hourly	<ul style="list-style-type: none"> <li>Continue routine NEWS monitoring</li> </ul>
Total 1–4	Minimum 4–6 hourly	<ul style="list-style-type: none"> <li>Inform registered nurse, who must assess the patient</li> <li>Registered nurse decides whether increased frequency of monitoring and/or escalation of care is required</li> </ul>
3 in single parameter	Minimum 1 hourly	<ul style="list-style-type: none"> <li>Registered nurse to inform medical team caring for the patient, who will review and decide whether escalation of care is necessary</li> </ul>
Total 5 or more Urgent response threshold	Minimum 1 hourly	<ul style="list-style-type: none"> <li>Registered nurse to immediately inform the medical team caring for the patient</li> <li>Registered nurse to request urgent assessment by a clinician or team with care competencies in the care of acutely ill patients</li> <li>Provide clinical care in an environment with monitoring facilities</li> </ul>
Total 7 or more Emergency response threshold	Continuous monitoring of vital signs	<ul style="list-style-type: none"> <li>Registered nurse to immediately inform the medical team caring for the patient – this should be at least at specialist registrar level</li> <li>Emergency assessment by a team with critical care competencies, including practitioner(s) with advanced airway management skills</li> <li>Consider transfer of care to a level 2 or 3 clinical care facility, ie higher-dependency unit of ICU</li> <li>Clinical care in an environment with monitoring facilities</li> </ul>

**Fig 2. Call-out thresholds and frequency of observations and suggested seniority of responder.**  
Reproduced with permission from the Royal College of Physicians, London. ICU = intensive care unit

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## Post-Intervention

The intervention group (post NEWS) collected data from December 2021 to March 2022. The NEWS system was established as a new chart for observations in the intervention group's (post-NEWS) (192 patients) research context, and clients' socio-demographic data, patient history, and observations checklist, including clinical condition changes, were gathered again. All research participants were tracked until mortality or hospital discharge. During follow-up, information on length of stay, ICU admission, discharge status, and frequency of vital sign monitoring were collected.

The researcher compared and evaluated the results of the patients in the study (post-NEWS) and the control group (pre-NEWS).

## 2.9 Study Instrument

### Part 1

The patient's medical record, age, gender, admittance diagnosis, prior medical history, patient score, hospital stay duration, and admission date were extracted for the medical and demographic data sheets.

## **Part 2**

NEWS2 is a scale that has the ability to "monitor and trigger." It is an aggregate scoring system with multiple factors that measures from 0 to 3 the deviation from expected normal levels of respiratory rate, oxygen saturation, systolic blood pressure, heart rate, body temperature, and degree of awareness. This is how the AVPU concept evaluates awareness : A = alert, V = verbal stimuli reaction, P = pain stimuli response, U = unresponsive. Three points are awarded for the possibility of consciousness-level alteration. Each of these features is assigned a score; the scores are tallied together, and the eventual addition of additional oxygen increases the score by two points. The correlation between the patient's clinical risk and the total score points is as follows: Low- risk (aggregate score 1 to 4)-Immediate assessment by ward nurse within 6 hours to determine a change in frequency of monitoring or escalation of clinical treatment, moderate risk (score of more than 5 or 3 in any single parameter) urgent evaluation by ward-based nurse hourly and recheck with other nurse or doctor to discover the cause and to decide on modification in monitoring frequency or escalation of clinical care, and high- risk score (7 or more)-indicates that the NEWS escalation protocol will be started when the nurse contacts the physician in charge of a patient who requires an immediate assessment by the critical care team, typically resulting in patient transfer to higher-dependency care settings.

The escalation procedure assists clinicians in making clinical decisions. Recommendations are forwarded regarding the level of qualifications required for the condition, the evaluation interval, the level of treatment, and the activation of a Medical Emergency Team (MET).

## **Part 3**

A patient outcome observational checklist was subdivided into primary outcomes. Patient deterioration represented the physiological parameters that were included in the NEWS measures. The use of oxygen support therapy, vaccination status, and the frequency of monitoring or any added special concerns or medical reviews by the health care providers and secondary outcomes included ICU admission, length of hospital stay, and mortality. Each patient in the trial group received it. These data were used daily after utilizing the NEWS compared to the documented patient clinical condition, use of oxygen support therapy, vaccination status, frequency of monitoring, length of hospital

stay, admission to ICU, and discharge states of the patient's (alive/death) for the control pre-NEWS implementation phase group.

### **2.10 Data Analysis Plan**

Application Version 25 of the Statistical Package for the Social Sciences (SPSS) was used to tabulate and analyze the data after data collection was complete. The quantitative data were reported using means and standard deviations. The independent samples t-test was used to assess group homogeneity and compare the mean frequency of patient monitoring in both groups. The significance level was established at 5% ( $P = 0.05$ ).

The homogeneity of two groups in terms of patient outcomes and NEWS escalation categories was assessed using the chi-square proportional test.

Using a post hoc Chi-square test, it was determined which groups were substantially distinct.

The ability of NEWS2 to predict outcomes was examined using Receiver Operating Characteristic Curves (ROC).

To ensure that differences in baseline gender and age between groups don't really affect results, logistic multiple and single linear regression analysis were performed. To evaluate how the implementation affected various outcomes, ANOVA tests were conducted.

### **2.11 Ethical Consideration**

An IRB was obtained from the University Research Committee (check Appendix A). Participants were informed of the purpose, methodology, benefits, and nature of the study. Patients were advised that their participation in the study was entirely voluntary and that all data would be encoded to ensure their privacy and anonymity.

They were permitted to stop their participation at any time and without explanation. Then, a formal request for authorization was submitted.

## Chapter Three

### Results

#### 3.1 Introduction

This chapter reports the results of the hospitalized Covid-19 patients. It also reports the relationship between the independent and dependent variables of both groups: post-NEWS 2 study group and the pre-NEWS2 control group. It also reports the effects of the NEWS2 implementation in identifying the risk of clinical deterioration. The chapter concludes with a comparison between the control (pre-NEWS2) and study (post-NEWS2) groups. .

**Table 3.1**

*Comparison between the number of patients in the control (pre NEWS2) and study (post NEWS2) groups.*

Control Group (pre NEWS2)		Study Group (post NEWS2)		$\chi^2$	p
n	%	n	%		
192	100.0	192	100.0	0.00	1.000

Table B.1 (Appendix B) shows the characteristics of patients in both phases.

In this study, the patients in the control (pre- NEWS2) group were slightly but not significantly older than those in the study (post- NEWS2) group, as shown in Table B.1, Appendix B and Figure 3.1.

The mean age of patients in the pre-NEWS phase was  $62.1 \pm 13.9$  years and the mean age of patients in the post-NEWS phase was  $58.1 \pm 17.7$  years ( $p = 0.015$ ). On the other hand, more patients were 60 years and older ( $p = 0.040$ ) in the pre-NEWS phase compared to those admitted during the post-NEWS phase.

Patients in both groups did not differ significantly ( $p > 0.05$ ) in terms of gender, chronic kidney diseases, chronic liver diseases, chronic lung diseases, and cardiovascular diseases. The distribution of vaccinated and unvaccinated patients was also similar in both phases. However, more patients were 60 years and older ( $p = 0.040$ ), had diabetes mellitus ( $p = 0.010$ ), hypertension ( $p = 0.010$ ), and autoimmune diseases ( $p = 0.008$ ) in the pre-NEWS phase compared to those admitted during the post-NEWS phase.

During the pre-NEWS phase, 38 (19.8%) patients died compared to 24 (12.5%) during the post-NEWS phase ( $p = 0.071$ ). Of the patients admitted during the pre-NEWS phase, 49 (25.5%) required admission to the ICU compared to 57 (29.7%) during the post-NEWS phase ( $p = 0.424$ ). In the pre-NEWS phase, more patients received low flow oxygen compared to those who were admitted during the post-NEWS phase ( $p < 0.001$ ). However, the patients in both phases did not differ in terms of receiving high flow nasal cannula ( $p = 0.060$ ), NIPPV ( $p = 1.000$ ), and mechanical ventilation ( $p = 0.354$ ). However, more patients stayed in the hospital for 6 days or more in the pre-NEWS phase in comparison with those admitted during the post-NEWS phase ( $p = 0.002$ ). The mean duration of hospital stay in the pre-NEWS phase was  $8.1 \pm 5.5$  days and the mean duration of hospital stay in the post-NEWS phase was  $6.4 \pm 5.3$  days ( $p = 0.002$ ).

### **3.2 Association between patient deterioration and outcomes with different variables in the pre-NEWS phase**

Table B.2, Appendix B shows associations between patient deterioration based on oxygen usage, and admission to ICU, and outcomes based on the length of hospitalization and hospital discharge status in the pre-NEWS phase. Receiving high flow nasal cannula, mechanical ventilation, and staying in the hospital for 6 days and more were not significantly associated with any of the variables like age, gender, vaccination status, diabetes, cancer, hypertension, chronic liver disease, chronic kidney disease, autoimmune disease, or cardiovascular disease. However, receiving low flow O<sub>2</sub> was associated with having cancer ( $p = 0.002$ ) and chronic liver disease ( $p = 0.008$ ). Receiving NIPPV was not associated with chronic lung disease ( $p = 0.047$ ). Admission to the ICU was significantly associated with having cancer ( $p = 0.002$ ) and chronic liver disease ( $p = 0.021$ ). Discharged dead was associated with older age ( $p = 0.009$ ), autoimmune disease ( $p = 0.020$ ), and cardiovascular disease ( $p = 0.020$ ).

### **3.3 Relationship between patient deterioration and outcomes and variables in the post-NEWS phase**

Table B.3, Appendix B shows associations between patient deterioration based on oxygen usage, AND admission to ICU, and outcomes based on length of stay in hospital and hospital discharge status with different variables in the post-NEWS phase. Receiving low flow O<sub>2</sub> was associated with older age ( $p = 0.001$ ), diabetes ( $p = 0.001$ ),

and hypertension ( $p = 0.006$ ). Receiving high flow nasal cannula was significantly associated with older age ( $p = 0.011$ ), diabetes ( $p = 0.004$ ), and hypertension ( $p < 0.001$ ). Furthermore, receiving NIPPV was significantly associated with older age patients ( $p < 0.001$ ), male patients ( $p = 0.018$ ), diabetes ( $p = 0.047$ ), and hypertension ( $p = 0.025$ ). Receiving mechanical ventilation was significantly associated with older age ( $p < 0.001$ ). Staying 6 days or more was significantly associated with older age ( $p = 0.041$ ), diabetes ( $p = 0.004$ ), hypertension ( $p < 0.001$ ), and cardiovascular disease ( $p = 0.029$ ). Admission to the hospital was significantly associated with older age ( $p < 0.001$ ), male patients ( $p = 0.027$ ), diabetes ( $p < 0.001$ ), hypertension ( $p < 0.001$ ), chronic liver disease ( $p = 0.005$ ), and cardiovascular disease ( $p = 0.012$ ). Discharged dead was associated with older age ( $p < 0.001$ ) and cancer ( $p = 0.026$ ).

### **3.4 Relationship between NEWS scores and variables**

Student's *t*-test and ANOVA showed that the mean NEWS scores were higher for patients who were 60 years and older ( $p < 0.001$ ), had diabetes ( $p < 0.001$ ), hypertension ( $p < 0.001$ ), h cardiovascular disease ( $p = 0.011$ ), received low flow oxygen ( $p = 0.001$ ), NIPPV ( $p < 0.001$ ), mechanical ventilation ( $p < 0.001$ ), were admitted to the ICU ( $p < 0.001$ ) and discharged dead ( $p < 0.001$ ). There was a positive correlation between age and NEWS score (Pearson's  $r = 0.473$ ,  $p < 0.001$ ). Additionally, there was a positive correlation between NEWS scores and length of hospital stay (Pearson's  $r = 0.184$ ,  $p < 0.001$ ). Associations are shown in Table B.4, Appendix B.

The variables that were significantly associated in the Student's *t*-tests were included in a multiple linear regression model to identify the significant predictors of high and low NEWS scores. Table 6 shows that high NEWS scores were significantly predicted by the need to receive NIPPV ( $p = 0.013$ ), stay in the hospital for 6 or more days ( $p = 0.013$ ) be admitted to the ICU ( $p = 0.006$ ), and be discharged dead ( $p < 0.001$ ).

**Table 3.2***Multiple linear regressions to identify significant predictors of high and low NEWS scores*

Variable	Unstandardized Coefficients	SE	Standardized Coefficients	t	p
Age	0.25	0.24	0.06	1.07	0.287
Diabetes	0.14	0.25	0.03	0.58	0.565
Hypertension	-0.06	0.26	-0.01	-0.24	0.813
Chronic liver disease	-0.15	0.36	-0.02	-0.41	0.681
Cardiovascular disease	0.34	0.25	0.07	1.39	0.167
Low flow O2	0.46	0.25	0.08	1.84	0.068
High flow nasal cannula	0.29	0.33	0.06	0.90	0.368
NIPPV	1.35	0.54	0.20	2.52	0.013
Mechanical ventilation	-0.79	0.66	-0.10	-1.20	0.231
Length of hospital stay	0.60	0.24	0.13	2.51	0.013
ICU	1.03	0.38	0.21	2.75	0.006
Discharged alive	-3.20	0.48	-0.46	-6.73	< 0.001

### 3.5 Sensitivity of the NEWS scores to prediction of deterioration and outcomes of patients

Table 3.3 shows results of the ROC curve analyses.

**Table 3.3**

*ROC curve analyses the sensitivity of the NEWS scores to prediction of deterioration and outcomes of patients*

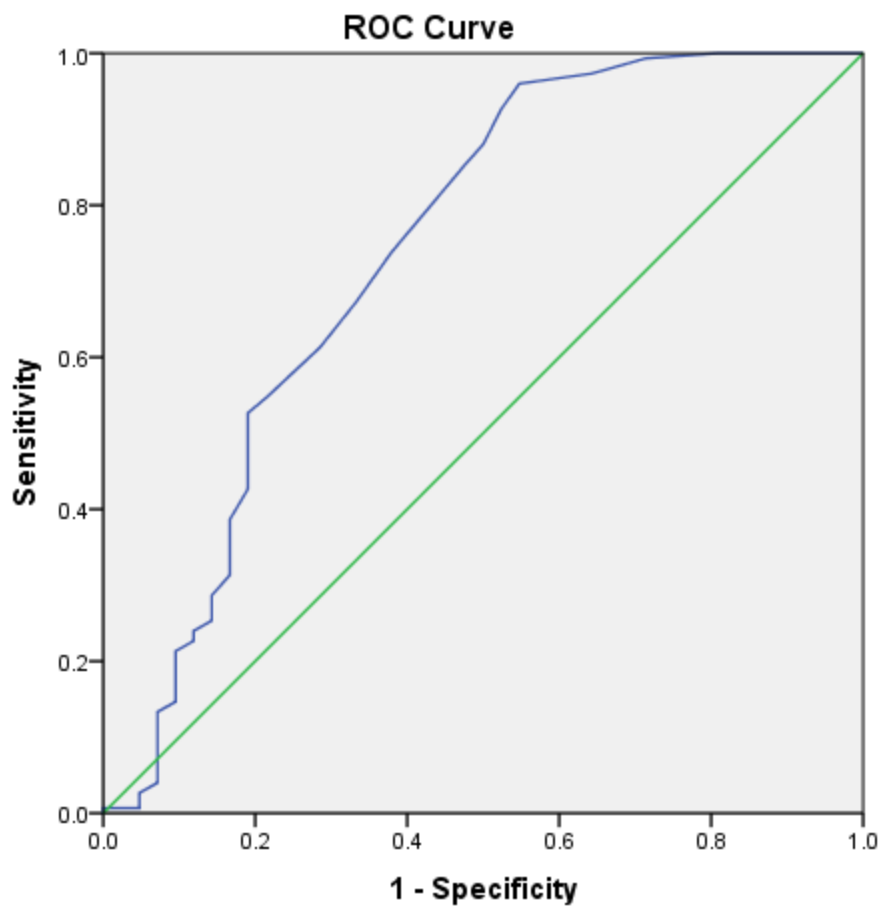
Variable	AU C	SE	p	95% CI		Proposed cutoff point	Sensitivity	1 - specificity
				Lower	Upper			
Low flow O2	0.74	0.05	< 0.001	0.64	0.84	3.7	0.527	0.190
High flow nasal cannula	0.87	0.03	< 0.001	0.82	0.92	5.0	0.561	0.096
Mechanical ventilation	0.94	0.03	< 0.001	0.88	1.00	6.3	0.882	0.103
Hospital stay $\geq$ 6 days	0.78	0.03	< 0.001	0.72	0.85	4.5	0.550	0.188
ICU	0.91	0.02	< 0.001	0.87	0.96	4.7	0.702	0.104
Mortality	0.96	0.02	< 0.001	0.92	1.00	5.9	0.875	0.089

Using ROC curve analyses, the mean NEWS scores, during the patient's hospital stay, were a good predictor of the need for low flow O<sub>2</sub> as indicated by an AUROC of 0.74 (95% CI: 0.64-0.84, p < 0.001).

Using NEWS scores of 3.7, a cutoff point could accurately predict 52.7% of the cases with probability of false positive of 19.0%.

**Figure 3.1**

*ROC curve for patients receiving low flow O<sub>2</sub> using mean NEWS scores*



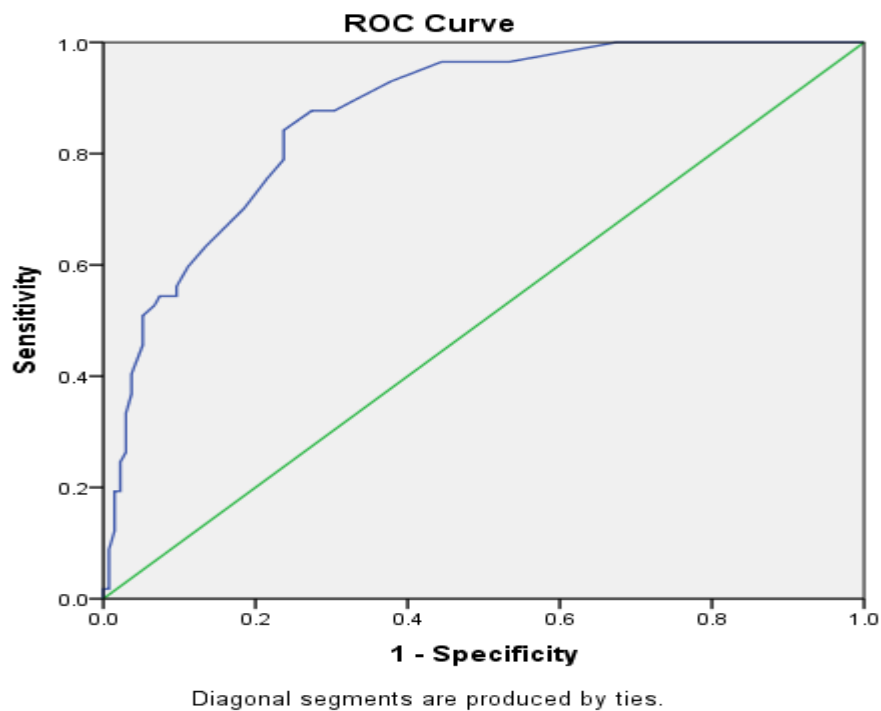
Diagonal segments are produced by ties.

The mean NEWS score during the patient's hospital stay were a very good predictor of the need for high flow nasal cannula as indicated by an AUROC of 0.87 (95% CI: 0.82-0.92,  $p < 0.001$ ).

Using NEWS scores of 5.0 as a cutoff point could accurately predict 56.1% of the cases with false positive probability of 9.6%. The ROC curve is shown in Figure 3.2.

**Figure 3.2**

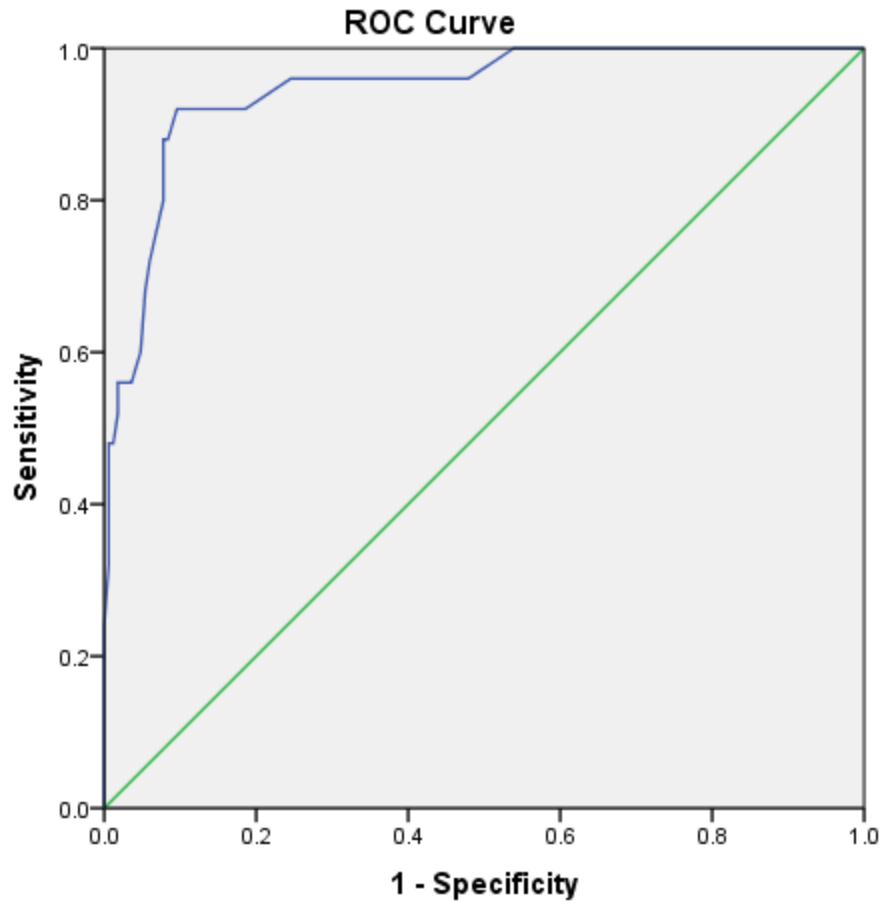
*ROC curve for patients receiving high flow nasal cannula using mean NEWS scores*



The mean NEWS score during the patient's hospital stay were an excellent predictor of the need for NIPPV as indicated by an AUROC of 0.95 (95% CI: 0.90- 0.99,  $p < 0.001$ ). Using NEWS scores of 5.7. as a cutoff point could accurately predict 92.0% of the cases with false positive probability of 9.6%. The ROC curve is shown in Figure 3.3.

**Figure 3.3**

*ROC curve for patients receiving NIPPV using mean NEWS scores*

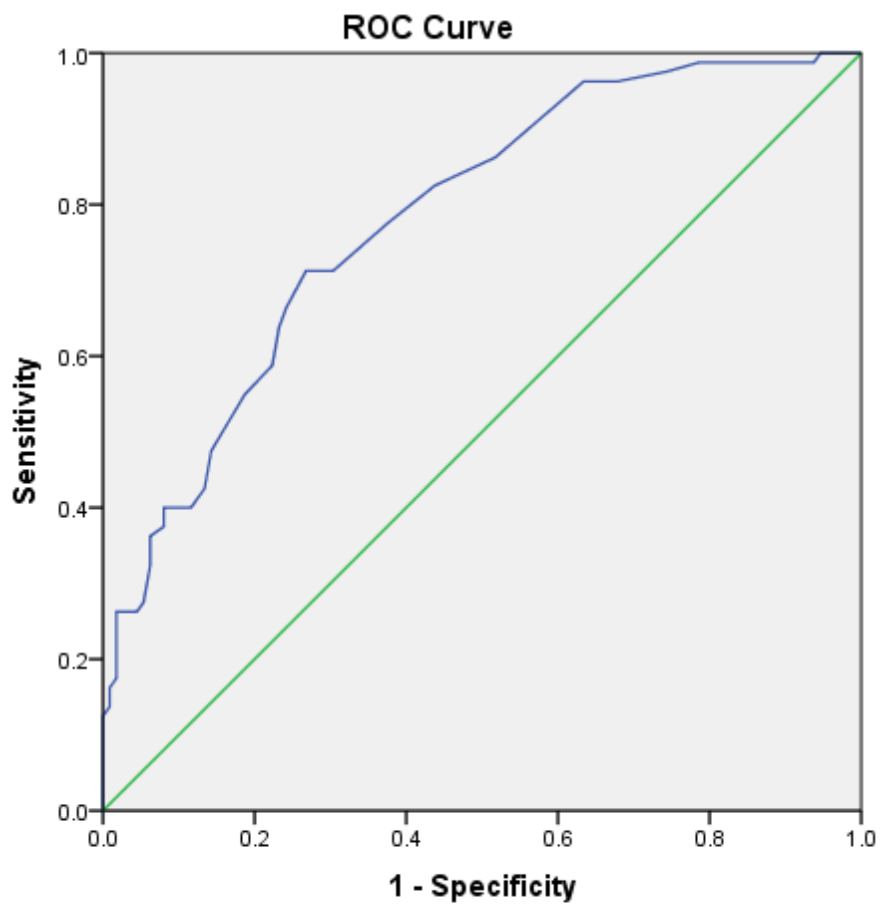


Diagonal segments are produced by ties.

The mean NEWS scores, during the patient's hospital stay, were a good predictor of staying in the hospital for 6 or more days as indicated by an AUROC of 0.78 (95% CI: 0.72-0.85,  $p < 0.001$ ). Using NEWS scores of 4.5 as a cutoff point could accurately predict 55.0% of the cases with false positive probability of 18.8%.

**Figure 3.4**

*ROC curve for patients staying in the hospital for 6 days or more using mean NEWS scores*



Diagonal segments are produced by ties.

### **Effect of implementing NEWS2 on the overall length of hospital stay of patients admitted to the hospital with signs and symptoms of COVID-19 infection**

There was no statistically significant difference in the length of ICU stay between patients in the control group (pre- NEWS2) and patients in study (post- NEWS2) group as shown in Table 3.4.

**Table 3.4**

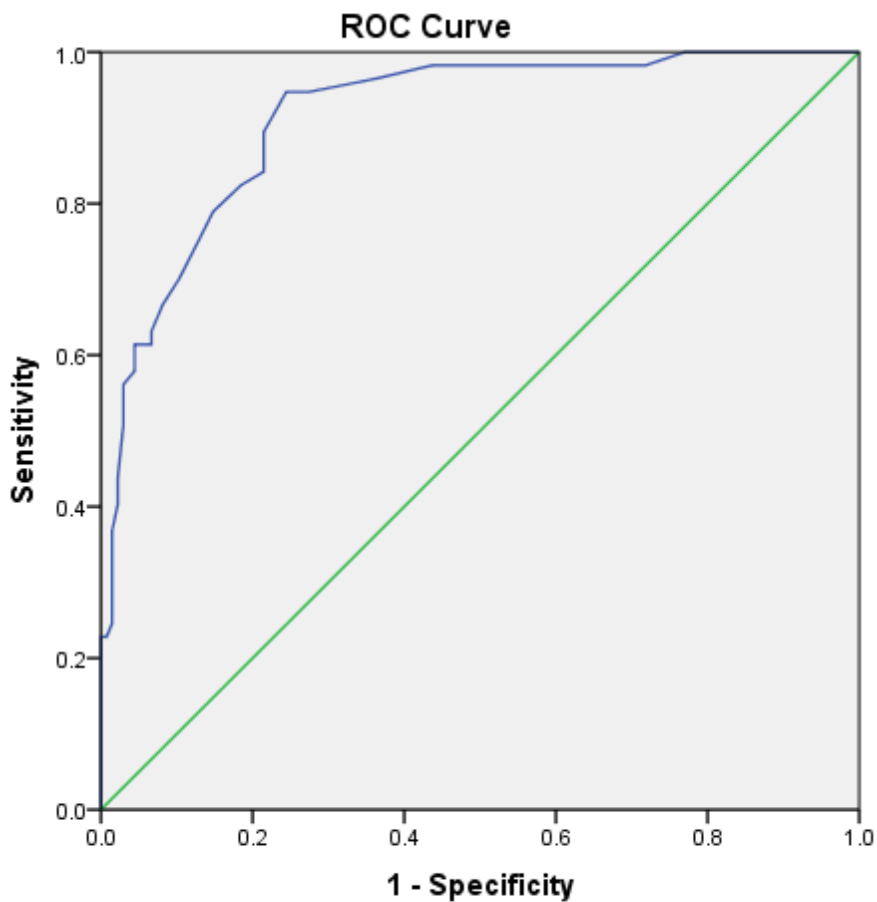
*Comparison between length of ICU stay for patients in the control (pre NEWS2) and study (post NEWS2) groups*

Variable	Control Group (pre NEWS2) (n = 192)	Study Group (post NEWS2) (n = 192)	p
Length of ICU stay (days), Mean $\pm$ SD	2.7 $\pm$ 5.4	2.4 $\pm$ 5.0	0.639

The mean NEWS scores during the patient's hospital stay were an excellent predictor of admission to the ICU as indicated by an AUROC of 0.91 (95% CI: 0.87-0.96,  $p < 0.001$ ). Using NEWS scores of 4.7 as a cutoff point could accurately predict 70.2% of the cases with probability of false positive of 10.4%.

**Figure 3.5**

*ROC curve for patients admitted to the ICU using mean NEWS scores*

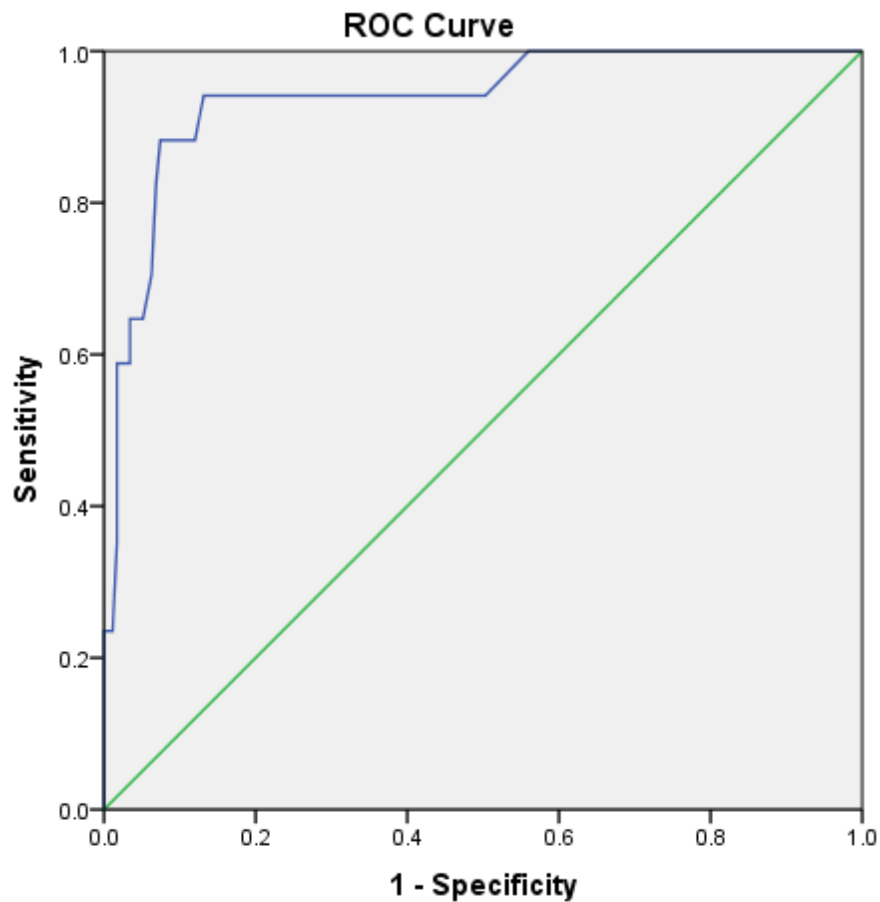


Diagonal segments are produced by ties.

The mean NEWS score, during the patient's hospital stay, were an excellent predictor of the need for mechanical ventilation as indicated by an AUROC of 0.94 (95% CI: 0.88-1.00,  $p < 0.001$ ). Using NEWS scores of 6.3, as a cutoff point, could accurately predict 88.2% of the cases with a false positive probability of 10.3%.

**Figure 3.6**

*ROC curve for patients receiving mechanical ventilation using mean NEWS scores*

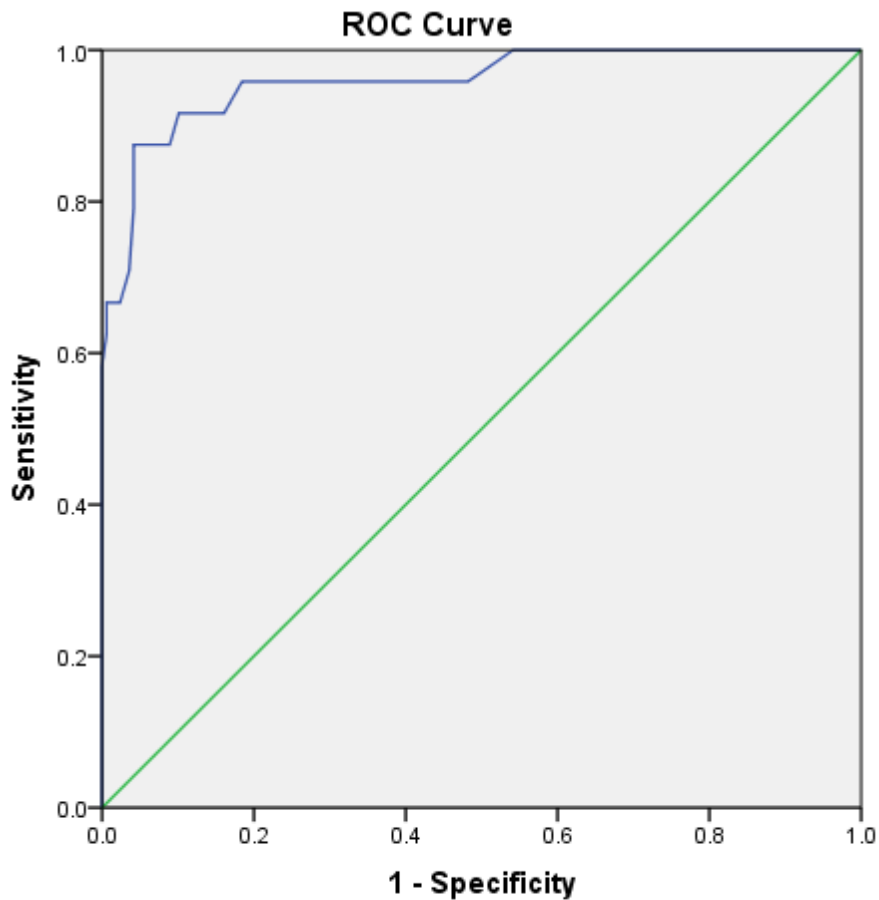


Diagonal segments are produced by ties.

The mean NEWS scores, during the patient's hospital stay, were an excellent predictor of mortality as indicated by an AUROC of 0.96 (95% CI: 0.92-1.00,  $p < 0.001$ ). Using NEWS scores of 5.9, as a cutoff point, could accurately predict 87.5% of the cases with false positive probability of 8.9%.

**Figure 3.7**

*ROC curve for patients' mortality using mean NEWS scores*



Diagonal segments are produced by ties.

### **3.6 Classification of patients into NEWS score categories**

Table 3.5 shows the classification of patients, admitted during the post-NEWS phase, into low, medium, and high-risk categories based on their NEWS scores measured at admission, and on the other time intervals (6hrs, 12hrs, 24hrs and 48 hrs after their admission to the hospital). Of the 192 patients, 112 (58.3%) were classified as low-risk, 56 (29.2%) were classified as medium-risk, and 24 (12.5%) were classified as high-risk.

**Table 3.5***Classification of patients into NEWS score categories*

NEWS score category	NEWS2 scores measured at admission		NEWS2 scores measured at 6 hrs		NEWS2 scores measured at 12 hrs		NEWS2 scores measured at 24 hrs		NEWS2 scores measured after 48 hrs		Based on average NEWS score	
	n	%	n	%	n	%	n	%	n	%	n	%
Low-risk (monitor every 4-6 h)	112	58.3	114	59.4	126	65.6	137	71.4	154	80.2	143	74.5
Medium-risk (monitor every 1 h)	56	29.2	45	23.4	33	17.2	28	14.6	16	8.3	26	13.5
High-risk (monitor continuously)	24	12.5	33	17.2	33	17.2	27	14.1	22	11.5	23	12.0

### 3.7 Relationship between assigned NEWS score categories and variables of patients

Table B.5, Appendix B shows associations between the assigned NEWS score categories and the variables of the patients. More patients were assigned to medium- and high-risk categories when they were 60 years and older ( $p < 0.001$ ), had diabetes ( $p = 0.002$ ), hypertension ( $p < 0.001$ ), and did not have chronic kidney disease ( $p = 0.049$ ). Additionally, patients in the medium- and high-risk categories received more high flow nasal cannula ( $p < 0.001$ ), NIPPV ( $p < 0.001$ ), stayed 6 days and more in hospital ( $p < 0.001$ ), received mechanical ventilation ( $p < 0.001$ ), were admitted to the ICU ( $p < 0.001$ ) and were discharged dead ( $p < 0.001$ ).

### 3.8 Frequency of patient monitoring

#### Effect of implementing NEWS2 on the frequency of monitoring of vital signs of the patients in the general ward per day without being admitted to the ICU

In this study, the implementation of NEWS2 significantly increased ( $p < 0.001$ ) the frequency of monitoring the patients' vital signs, respiratory rate, level of consciousness per day in the general ward before their admission to the ICU compared to the pre NEWS2 phase as shown in Table 3.6 and Figure 3.8.

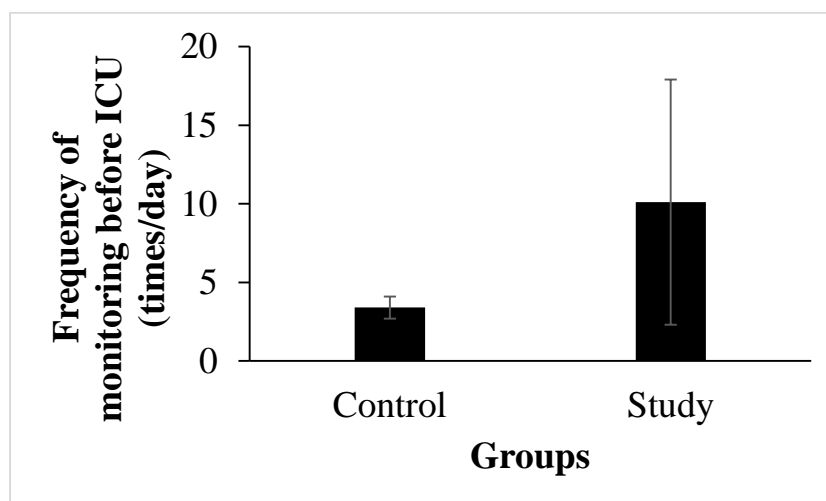
**Table 3.6**

*Comparison between the frequency of monitoring vital signs, respiratory rate, level of consciousness per day in general ward without being admitted to the ICU in the control (pre NEWS2) and study (post NEWS2) groups*

Variable	Control Group (pre NEWS2) ( $n = 192$ )	Study Group (post NEWS2) ( $n = 192$ )	p
Frequency of monitoring of vital signs, respiratory rate, level of consciousness per day in general ward/out of ICU per day, Mean $\pm$ SD	$3.4 \pm 0.7$	$10.1 \pm 7.8$	$< 0.001$

**Figure 3.8**

*Comparison between the frequency of monitoring in the general ward before the patients' admission to the ICU for patients in the control (pre NEWS2) and study (post NEWS2) groups*



Similarly, there was an increase in the frequency of monitoring vital signs, respiratory rate, level of consciousness per entire hospital length of stay for patients in the control (pre NEWS2) and study (post NEWS2) groups as shown in Table 3.7. However, this increase was not statistically significant ( $p = 0.060$ ).

**Table 3.7**

*Comparison between frequency of monitoring vital signs, respiratory rate, level of consciousness per entire hospital length of stay in the control (pre NEWS2) and study (post NEWS2) groups*

Variable	Control Group (pre NEWS2) (n = 192)	Study Group (post NEWS2) (n = 192)	p
Frequency of monitoring vital signs, respiratory rate, level of consciousness per entire hospital length of stay	81.8 ± 131.0	107.7 ± 138.2	0.060

### **Association between mortality and ICU admission**

In both phases, admission to the ICU was significantly associated with mortality ( $p < 0.001$ ). However, the mortality rates in both phases were not significantly different ( $p = 0.071$ ) as shown in Table 3. 8.

**Table 3.8***Relationship between mortality and ICU admission in both phases*

Phase	Admitted to the ICU	Discharged alive				$\chi^2$	p
		No		Yes			
		n	%	n	%		
Pre-NEWS phase	No	12	6.3	131	68.2	45.87	< 0.001
	Yes	26	13.5	23	12.0		
Post-NEWS phase	No	3	1.6	132	68.8	43.92	< 0.001
	Yes	21	10.9	36	18.8		

## **Chapter Four**

### **Discussion and Conclusion**

To the best of the researcher's knowledge, most studies have not directly addressed the impact of EWS systems in identifying clinical deterioration and the outcome of COVID-19 hospitalized patients.

This current research has shown that patients who were at least 60 years old or older had higher mean NEWS scores. This makes sense, considering that NEWS2 and age both indicate an increasing length of hospital stay, an increased number of ICU admissions, and mortality. This study findings support findings of I.Y. Kim et al.(2020) [78], who found that NEWS at the time of ED admission was considerably associated with in-hospital mortality among patients over the age of 65. Statistics from China and Italy showed that the case fatality rate of COVID-19 increased rapidly with age, going from 0.4 percent in patients who were in their 40s or younger to 14.8-220.2 percent in patients who were in their 80s or older. This research has demonstrated the same thing. According to research conducted in both France and the United States [Chen. et al,2021][79], it was found that hospitalizations, admissions to intensive care units (ICU), and deaths all rose with increasing age. This also concurs with the findings of a study conducted in Palestine by Marraqa et al., (2021) [65]. In this study, it was found that among those who passed away, as a result of COVID, the mean age at death was  $65.17 \pm 18.66$  years, ranging from 39 days to 80 years old, and the majority of fatalities occurred in the elderly population who were 60 years or older (OR = 52.0 [30.5–89.7],  $P < 0.001$ ).

There were no gender disparities in the findings of this study between males and females in each group (pre-news), and (post news) in terms of both duration of stay and mortality. However, in terms of post-NEWS phase admission to the intensive care unit, it was significantly connected to gender/male ( $p = 0.027$ ). Student's t-test and ANOVA showed that the mean NEWS scores were higher for male patients but they were not statistically significant ( $p < 0.083$ ). That was similar to 80.

In various investigations, gender and age of patient have been found as risk factors for ICU admission and mortality. A previous investigation into the influence of sexual identity and age on the clinical course of COVID-19 found that younger males had a significantly increased risk of death [80]. As a result, gender is associated with greater severity and death. According to the Palestinian Ministry of Health records (2020), 221 men were affected in the West Bank and Gaza Strip (representing 64.6% of the total) as opposed to 121 females (representing 35.4% of the total). This gender variable, as well as the greater rates of males suffering from most diseases, may be attributed to a general demographic phenomenon of men having a shorter life expectancy than women in Palestine and across the world despite the fact that there no statistically significant difference has been found between the ages of males and females in terms of the median age of each subgroup. Other investigations have found that Covid-19 affects around 2:1 more men than women. [4,16,79]. Another study has found that the male sex is significantly associated with COVID-19 mortality [81]. Other cohorts from China, Italy, Denmark, and the United States similarly demonstrated greater COVID-19-related mortality in men [38,79,82, 83, 84,]. The underlying processes might include sex chromosomes-related immune response, different lifestyles, such as alcohol consumption, tobacco usage, lack of hand hygiene, and obesity, and higher rates of comorbidities in men [84]. In this research, a longer length of time spent in the hospital was found to be substantially related with diabetes, hypertension, and cardiovascular disease. Admission to the ICU was distinctly attributed to diabetes, hypertension, chronic liver disease, and cardiovascular disease. However, the other variables were not associated with ICU admission. This research findings are in line with those reported by Kumar et al., who found that diabetes was associated with a severity score of an OR of 2.75 (95 % CI: 2.09–3.62) and a mortality score of an OR of 1.90 (95 % CI: 1.37–2.64). Both of these scores were calculated, using OR. Diabetes mellitus (DM) was found to be linked with mortality (relative risk [RR] 2.12 [1.44, 3.11],  $p < 0.001$ ; I<sup>2</sup>: 72%) and the severity of the COVID-19 infection (relative risk [RR] 2.45 [1.79, 3.35],  $p < 0.001$ ; I<sup>2</sup>: 45%). [4].

Patients suffering from diabetes also had a higher risk of experiencing adverse outcomes from other common illnesses, such as SARS-CoV and MERS-CoV, as was highlighted in earlier outbreaks. [12,85].

Unlike COVID-19, SARS-CoV infection is where much of the knowledge comes from. This connection has been linked to a compromised innate immune system as a result of chronic hyperglycemia, a pro-inflammatory condition with an excessive and inappropriate cytokine response, and underlying pro-thrombotic hypercoagulability [12, 85].

In order to determine whether or not hypertension is linked to the severity of COVID-19 or mortality rates associated with the condition, Pranata et al. conducted a meta-analysis on hypertension using data from 6,560 participants drawn from 30 different studies that were published in PUBMED and other databases. The authors found that individuals who had been diagnosed with hypertension had higher mortality rate (RR 2.21 (1.74, 2.81),  $p < 0.001$ ) and COVID-19 severity (RR 2.04 (1.69, 2.47),  $p < 0.001$ ). However, it's possible that the association between hypertension and negative outcomes from COVID-19 infection was due to the fact that these individuals were older and had a greater number of comorbidities. [86].

It was also found that the increase in the length of hospital stay and ICU admissions was due to cardiovascular disease which included coronary and peripheral arterial diseases.

Although the majority of studies identified cardiovascular disease as a considerable risk factor for these outcomes, the strength of this connection varied, probably as a result of variations in the diagnosis and the severity of illness. However, some writers only included individuals with coronary heart disease or failure. The pathogenic process, associated to oxidative stress, inflammation, and a pro-thrombotic state, is part of the intricate mechanism underlying the onset of cardiovascular disease with atherosclerosis [87]. Individuals with type 2 diabetes, obesity, and hypertension had these same mechanisms that resulted in vascular remodeling and damage [86].

Patients with cardiovascular sickness had a greater chance of dying from infections with other coronavirus species, such as SARS-CoV and MERS-CoV [85]. Investigations are now being conducted to discover the mechanism behind the relationship between cardiometabolic factors and severity of COVID-19. A few possible explanations of the elevated cardiovascular disease prevalence in older persons were a functionally weakened immune system, and an enhanced ACE2 receptor (angiotensin-converting enzyme-2) expression [87]. Type 2 diabetes, hypertension, and cardiovascular disease

may be attributed to an increased risk of COVID-19 severe symptoms by a process mediated by the ACE2 receptor.

As the renin-angiotensin-aldosterone system (RAAS) is engaged and the angiotensin-converting enzyme 2 (ACE2) receptor is expressed in several tissues, through this receptor, coronaviruses can bind to their target cells. [86].

Angiotensin-converting enzyme homolog of ACE2 receptor decreases the vasoconstriction caused by the renin-angiotensin system as well as the pro-inflammatory effects of angiotensin II by converting it to angiotensins 1 to 7. When SARS-CoV-2 binds to the ACE2 receptor, the post-receptor signaling pathways can change, which can cause vasoconstriction. A pro-inflammatory reaction and endothelial dysfunction can cause cardiac damage and prothrombotic processes. [88].

Additionally, this research has showed that pre-existing chronic liver illness was present as a risk factor but not substantially associated with ICU admission.

This concurs with findings in recent studies done by Singh and Khan (2020) who noticed that underlying liver disease was associated with a high relative risk for death (RR, 2.8; % CI, 1.9–4.0; P-value 0.001) but didn't touch the condition's association with ICU admission. Boettler and colleagues (2020) demonstrated that individuals with chronic liver illness did not show a high prevalence among COVID-19 cases (<1 %). They claimed that people with chronic liver diseases were not particularly sensitive to obtaining SARS-CoV-2 infection.

Additionally, the underlying causes of chronic liver disease, the severity of hepatic fibrosis, and the existence of cirrhosis may all increase the risk of severe COVID-19 in these individuals. According to Boettler et al., 2020, there was little or no evidence to indicate that chronic viral hepatitis could modify the course of SARS-CoV-2 infection. In this study, the researcher has found that the greatest risk of death was substantially linked with having cancer ( $p = 0.026$ ). However, the other variables, such as autoimmune, chronic kidney diseases, etc..., were not associated with mortality. This corresponds to cancer being higher than diabetes and hypertension in mortality risk alone, showing that the most important risk factor to address is pre-existing cancer disease. Related literature indicates that people with COVID-19 have a higher mortality risks while their cancer is active. According to the systemic effects of cancer, immune

suppression following chemotherapy, treatment-related cardiovascular, renal, and pulmonary toxicities, as well as the presence of comorbidities, patients with cancer may be at a higher risk of complications and mortality from COVID-19 [89]. It was discovered that cancer patients with COVID-19 had a mortality rate ranging from 13% to 28%. Some studies have found that patients with cancer had a higher risk of severe events and in-hospital mortality.[90,91].

A comprehensive, well-executed study, using information from 1, 590 patients and data from 575 hospitals in China, produced a clinical score for diagnosing "critical illness" in patients hospitalized with COVID-19 and validated it in 710 patients.[92]. It was found that age and a history of cancer were indicators of clinical deterioration, which is consistent with the findings of this research

In this study, vaccination among COVID hospitalized patients had no statistically significant effects on hospital LOS, lowering the risk of ICU admission, or decreasing mortality. This is in line with another study where the research found no difference in the probability of ICU admission or mortality in completely vaccinated COVID patients compared to unvaccinated COVID patients. [93].

In contrast (Whittaker R, et al. 2021 [94]), found that vaccinated individuals between the ages of 18 and 79 had shorter hospital stays and were less likely to be admitted to intensive care units.

Patients who were not hospitalized in intensive care did not have a longer hospital stay, and there was no difference in the risk of mortality between vaccinated and unvaccinated patients. This might be explained by variations in research populations, environments, and design. In this study, the researcher compared vaccinated and unvaccinated patients.

However, vaccination programs are developing, and further research is required to determine how vaccine type, time since immunization, and dosage intervals influence patient outcomes in vaccinated groups. Despite research indicating that mRNA vaccines are beneficial against hospitalized COVID-19 patients for at least 6 months following vaccination,[95], the duration of protection following the initial two-dose mRNA vaccination regimens and the effects of booster doses require ongoing research.

Although the NEWS2 method assesses supplemental oxygen as a binary variable, it cannot distinguish between different rates of oxygen supply. The Royal College of Physicians (RCP) has verified this issue, stating that any increase in oxygen therapy among COVID-19 patients should prompt a physician assessment and increased monitoring. [13]. While it has been established that oxygen supplementation is an independent risk factor for new coronavirus pneumonia escalating to a serious situation, there were no previous studies that have shown the association between NEWS and supplemental oxygen therapy. Some studies have established a link between the oxygen saturation measures in the score as a predictive physiological parameter for death in patients with COVID-19 infection. Liu et al. (2020) [68] found that the oxygen saturation level had a good predictive performance for predicting death.

El-Hamshari Y et al.(2021) conducted a study at Martyrs Medical Military Complex, one of the COVID hospitals, in which our study was conducted in. ICU admission was recommended if the patient met ICU admission criteria: hemodynamic instability or increase of acute respiratory failure demanding an increase in oxygen therapy from low flow oxygen to nasal cannula, simple facemask, non-rebreather mask (NRB), or mechanical ventilation. Receiving ICU-level care depends mainly on patients' advanced requirement for oxygen, such as HFOT, NIPPV, or IMV, but some of the patients were monitored outside the ICU on medical floors due to a lack of ICU beds. Patients' oxygen treatment was increased, moving from NRB to high flow oxygen therapy to non-invasive positive pressure ventilation ( NIPPV).

With the patient's or his/her family's consent , intubation and IMV were considered if none of these interventions succeeded in raising oxygenation to  $> 90\%$  and if the patient continued to have worsening breathing difficulties.

In all fields of practice, it is vital to identify patients whose conditions are deteriorating. In this investigation, the NEWS2 showed strong discrimination in predicting the combined outcome of the patient's admission to the intensive care unit (ICU), the patient's need for intensive respiratory support as an enormous sign of deterioration, lengthening hospital stay, and in-hospital death.

The high sensitivity of the NEWS2 could ensure the use of the NEWS2 as a sensitive tool for assessing COVID-19 patients upon hospital admission. Additionally, this study results showed that using ROC curve analyses, the mean NEWS score, during the patient's hospital stay was a good predictor of the need for low flow O<sub>2</sub> as indicated by an AUROC of 0.74 (95% CI: 0.64-0.84,  $p < 0.001$ ). Using NEWS scores of 3.7 as a cutoff point could accurately predict 52.7% of the low flow O<sub>2</sub> cases with a probability of false-positive of 19.0%. The mean NEWS score during the patient's hospital stay was a very good predictor of the need for high flow o<sub>2</sub> as indicated by an AUROC of 0.87 (95% CI: 0.82-0.92,  $p < 0.001$ ). Using NEWS scores of 5.0 as a cutoff point could accurately predict 56.1% of the high flow oxygen cases with a probability of false-positive of 9.6%. The mean NEWS score during the patient's hospital stay was an excellent predictor of the need for NIPPV as indicated by an AUROC of 0.95 (95% CI: 0.90- 0.99,  $p < 0.001$ ). Using NEWS scores of 5.7 as a cutoff point could accurately predict 92.0% of the NIPPV cases with a probability of false-positive of 9.6%. The mean NEWS score during the patient's hospital stay was an excellent predictor of the need for mechanical ventilation as indicated by an AUROC of 0.94 (95% CI: 0.88-1.00,  $p < 0.001$ ). Using NEWS scores of 6.3 as a cutoff point could accurately predict 88.2% of the mechanically ventilated cases with a probability of false-positive of 10.3%.

The results of the study showed that there were statistically significant differences between the study post-NEWS group and the control pre- NEWS group for the frequency of vital sign measurement. The number of vital signs measurements varied much like in the control group. In other words, before implementing the NEWS, vital signs could be taken twice or once during a shift by the staff .They typically only measured two parameters, but after implementing NEWS, the mean number of vital signs monitored increased noticeably in the study group as they measured all vital sign parameters in accordance with NEWS standards.

This was also observed in other studies that saw excellent surveillance as the first crucial step in spotting patients who were worsening and managing their care efficiently [74].

Vital signs are crucial in hospital wards for identifying patients who are at risk of deteriorating [9,85]. Vital sign measuresthat are abnormal could be a sign of inadequate tissue oxygenation, which in turn can cause multi organs to malfunction and increase

the risk of hospital death [ Hogan H, et al,2012]. Early identification of these abnormal vital signs may enable prompt and effective therapy, reduce organ dysfunction, and decrease mortality.[ 85 ]. Without routine monitoring and recording of vital signs, early detection is impossible. [8] However, this may have taken place due to the introduction of the rapid response system. [79]. According to the WHO 2020 guidelines, "Patients hospitalized with COVID-19 require routine monitoring of vital signs and, where feasible, utilization of early warning scores that permit early diagnosis and escalation of therapy for the deteriorating patient. The education program and nurses' increased awareness of the significance of vital sign readings are two explanations that might account for the increase in the frequency of all vital sign measurements. This is consistent with other studies. [96,97]. Additionally, the hospital administration approves the study's application and it is necessary that the staff figure out the total NEWS after every single set of observations. As a result, placing a higher focus on the recording of vital signs in order to acquire a final score might be helpful for staff nurses in communicating with the medical team in a more succinct way.

Regarding this study it was found that the mean NEWS score during the patient's hospital stay was a good predictor of staying in the hospital for 6 days or more as indicated by an AUROC of 0.78 (95% CI: 0.72-0.85,  $p < 0.001$ ). Using NEWS scores of 4.5 as a cutoff point could accurately predict 55.0% of the cases with a probability of false-positive of 18.8%. The mean NEWS score during the patient's hospital stay was an excellent predictor of admission to the ICU as indicated by an AUROC of 0.91 (95% CI: 0.87-0.96,  $p < 0.001$ ).

Using NEWS scores of 4.7 as a cutoff point could accurately predict 70.2% of the cases with a probability of false-positive of 10.4%. Like worldwide hospital policies, most ICU admissions were estimated to take 2.0 days from hospital admission. In this study, the mean NEWS score during the patient's hospital stay was an excellent predictor of mortality as indicated by an AUROC of 0.96 (95% CI: 0.92-1.00,  $p < 0.001$ ). Using NEWS scores of 5.9 as a cutoff point could accurately predict 87.5% of the cases with a probability of false-positive of 8.9%.

These findings were in line with a few small cohort studies that looked at the predictive value of baseline NEWS2 and other clinical scoring systems in predicting clinical outcomes in COVID-19 patients based on a single measurement at the time of hospital

admission. In a Chinese study of 654 COVID-19 admissions, the baseline NEWS2 had a better prediction of mortality than CURB-65 (0.85 [0.81-0.89]) and performed better than qSOFA (0.73 [0.69-0.78]) with a ROCAUC of 0.81 (95 % CI 0.77-0.85). In Korean study done by Jang 2020, of 110 COVID-19 inpatient, using a baseline threshold of NEWS, over or equal to 5 did result in a poor predictive value of 0.98 but a positive predictive value of 0.59 for a future event. The baseline (original) NEWS anticipated an event (defined as ICU admission and/or death) with ROCAUC 0.92 (95 % CI 0.84–1.00) vs 0.76 (0.62–0.90) for qSOFA. An event is defined as ICU admission and/or death. The baseline NEWS2 had a ROCAUC of 0.79 (95% CI 0.66–0.91) in a Norwegian study of 66 inpatients [Myrstad M,2020]. It predicted a composite adverse outcome of inpatient death and/or ICU admission. This was in comparison with qSOFA's ROCAUC of 0.62 (0.45–0.81) and CURB-65's ROCAUC of 0.58 (0.41–0.76), respectively. The prognostic qualities of NEWS2 for admission to the intensive care unit were similarly established in 68 patients with severe COVID-19 by Gidari et al. in 2020 [59] (AUROC = 0.90 (CI,0.82-0.97)). "Serious events" were classified as any of the following occurring while the patient was hospitalized. These include death, unexpected transfer to an ICU, or the start of non-invasive ventilation. With equivalent AUROC scores for predicting serious events of 0.837 (0.748-0.943) for admission NEWS and 0.846 (0.735-0.939) for admission, NEWS modified by age [98].

According to Covino et al.(2020), NEWS was the most reliable indicator of ICU admission within 48 hours and 7 days of emergency department entrance with AUROC = 0.802 (0.756-0.844 and 0.783 (0.73-50.826), respectively .The greatest AUROC values for predicting in-hospital death, according to Liu et al research (2020) [68], were determined to be NEWS 0.882 (0.847-0.916) and NEWS2 0.880 (0.845-0.914). However, according to Knight et al. (2020), the AUROC for NEWS with in-hospital mortality as an outcome was 0.654 (0.645-0.662). These and this study findings, therefore, suggest that NEWS has a good modest predictive value, which would help in prioritizing a huge attribution number of patients with COVID-19 who subsequently deteriorate.

The NEWS risk categorization may exist because it provides a quick and easy approach to spotting patients who are deteriorating using a united surveillance system that directs themedical personnel to patients according to priority.

This opinion is consistent with research that was carried out by Ludikhuizen et al. (2012)[99]. They discovered that EWS, set up on the decline in vital signs noted at least once in the 48 hours prior to an adverse event occurrence, might have identified more than 80% of patients with urgent cases.

In order to study the effect of implementing the NEWS on the LOS, the researcher compared the two patient groups and concluded that the overall mean length of hospital stay after implementing the score was decreased, as the mean duration of hospital stay in the pre-NEWS phase, was  $8.1 \pm 5.5$  days and the mean duration of hospital stay in the post-NEWS phase was  $6.4 \pm 5.3$  days ( $p = 0.002$ ).

These findings were in line with those obtained in studies carried out in countries other than China, which revealed that the median length of stay in hospitals varied from 4 to 21 days, but in China, the median length of stay in hospitals ranged from 4 to 53 days. However, , an Egyptian quasi-experimental study carried out by Badr MN et al.(2021) [19] found that there were no statistically significant changes between the total duration of hospital stay prior to or after the adoption of NEWS, with a mean of  $5 \pm 3$  vs  $4 \pm 4$  p - values with  $p = 0.07$ .

In order to study the effect of implementing the NEWS on mortality rate, this study found a decrease in mortality rate in the intervention group but without detectable statistical variations between the study and the control groups. However, there was a decrease in the overall death cases from 38/192[19.8%] before NEWS2 implementation to 24/192 [12.5%] after NEWS2 implementation with a p - value of  $p = 0.07$ . The mortality rate in the present study was less than the reported mortality for all hospitalized COVID-19 patients in some European, American, and Chinese studies, with a percentage ranging between 17% to 23.4% [38-43].

Additionally, (Farenden et al.,(2017) [99], this conclusion is supported by a study that revealed no statistically significant differences between deaths and outcomes before and after NEWS implementation. In contrast, a 2011 study by Moon et al. showed a substantial reduction in in-hospital mortality following the deployment of the EWS system (52 % vs. 42 %;  $p = 0.05$ ).

There is currently no reliable prognostic score that can be used to predict clinical outcomes in patients who have COVID-19, regardless of whether they are treated in an inpatient or outpatient setting, according to recent systematic studies by Zhang K,2021[100] .

Despite the lack of published statistics on NEWS2's effectiveness in controlling COVID-19 patient's clinical deterioration, This study showed that NEWS2 was good in predicting deteriorating patients based on their oxygen requirement, with a sensitivity of 0.527 and specificity of 0.190, 0.561, 0.986, 0.920, 0.986, 0.103 for LFO, HFO2, NIPPV, and mechanical ventilation (IMV) respectively.

Regarding this study outcomes, NEWS2 performed well in predicting the lengthening of hospital stays with a sensitivity of 0.550 and a specificity of 0.188, ICU admissions with of 0.702 and a specificity of 0.104, and mortality with a sensitivity of 0.875 and a specificity of 0.089, based on the results of the study itself.

A small French research of 27 COVID-19 hospitalizations conducted by Meylan S, et al.2020 [101], a modified version of the ViEWS score (similar to NEWS2) was able to predict deterioration 12 hours before ICU admission with a sensitivity of 94% and a specificity of 78%. This presentation of the NEWS2 and the combined outcome may provide a predictive measure of the number of "triggers" that would be generated at different NEWS values, allowing hospitals to evaluate the outcomes of selecting any particular NEWS value as the trigger for a specific clinical intervention.

Nevertheless , the fact that there is little or no high-quality data confirming trends in the myriads of scoring systems established to predict clinical deterioration should be an important contribution to evidence-based practice.

#### **4.1 Strength of the Study**

During the COVID pandemic, the researcher included all of the patients who were diagnosed with COVID-19 and admitted to the hospital, with the exception of those who met RCP-recommended exclusion criteria. We collected comprehensive data on vital signs since hospital admission, covering all and every aspect of the NEWS2 score. Also, the commitment from the medical team to using the score was high and this indicates that the implementation of the score was easy, applicable, was based on a

physiological variable, and it enhanced the flow of patient monitoring in a cost-effective manner.

## **4.2 Limitations**

It is important to spell out some of this study's limitations. First, because the sample was taken from a single geographic region in Palestine, in a relatively short review time, and the post-NEWS data was gathered only 3 months after the introduction of the score, the research findings are less likely to be generalized. Second, not all ward patients required to be admitted to the intensive care unit, based on their NEWS score, were admitted immediately to ICU. Third, it's possible that the patient's nursing staff was called first, delaying some ICU admissions when the ICU team wasn't available or there was a shortage of ICU beds. Fourth, because patients were not followed up after being discharged from the hospital and the study's outcomes were restricted to a hospital stay, consequently, 28 days and 90 days of mortalities were not provided. Also, this was a double-center study in the same geographical area, which limits its generalization. Finally, a potential problem of using a control group is the risk bias caused by other concurrent changes. It could be helpful to improve predictive performance by supplementing the score parameters with additional measures such as laboratory blood tests. Instead of creating a new early warning score, which would imply a larger sample size and an external validation cohort, the purpose was to investigate the utility of the existing NEWS2 rating system in the context of the COVID-19 as it is already used in medical care., therefore, this study is expected to add value to the body of research.

## **4.4 Conclusions**

In the light of the study findings, it can be stated that the adoption of NEWS2 was associated with a significant prediction of patient deterioration and showed a significant improvement in hospitalized COVID patient outcomes (decreased the length of hospital stay, predicted ICU admissions, and modest decrease of mortality rate), and increase of the frequency of vital signs measurements ,which indirectly raised the number of medical reviews following the patient's clinical deterioration ,Also, the medical team's commitment to using the score was high. This indicates that the implementation of the score was easy, applicable, was based on a physiological variable, and it enhanced the flow of patient monitoring in a cost-effective manner.

### 4.3 Recommendations

- For excellent and beneficial patient outcome in implementation of NEWS2, the hospitals should adhere to the Royal College of Physicians' recommendation guidelines in future clinical practice.
- NEWS2 should be utilized to enhance the following:
  - There should be acute-illness severity evaluation
  - There should be clinical deterioration identification
  - There should be initiation of a prompt and competent clinical response
- NEWS 2 should be used in hospitals for both the initial diagnosis of acute illness and the ongoing monitoring of a patients' health during their hospital stay. The trends in a patients' clinical responses can be observed by regularly recording their NEWS score to provide early warning of potential clinical deterioration and serve as a trigger for clinical care escalation. These trends would also provide direction on the patients' recovery and return to stability, allowing for a reduction in the frequency and intensity of clinical surveillance prior to patients' discharge.
- According to the severity of the acute illness for hospitalized or pre-hospital patients, the NEWS2 should be used to determine the urgency of the clinical response and the clinical competence of the respondent (s) A mobile ICU becomes necessary
- If the attending healthcare expert believes that escalating the patient's treatment is warranted, the clinical concern should always take precedence over the NEWS.
- The clinical response of NEWS on the patient chart should be recorded to provide a continuous record of actions taken in response to changes in the NEWS and serve as a reminder to escalate care if necessary.

- Clinical decisions should be discussed with the patients or their families and should be documented in the clinical notes where healthcare teams determine whether the routine recording of data for the NEWS is appropriate or not. Patients on an end-of-life care pathway are a case in point.
- The NEWS2 should be used to inform the frequency of clinical monitoring and it should be recorded on the NEWS chart.
- The NEWS2 should be utilized as a decision-support tool to aid in decision-making with regard to the most appropriate clinical setting for ongoing care, including access to clinical monitoring in hospitals, like monitored beds, with staff trained in airway management and resuscitation skills to interpret and respond appropriately in a reasonable time frame.
- Education, training, and documentation skills in the use of NEWS2 should be an obligatory requirement for all healthcare workers involved in the assessment and monitoring of critically ill patients.

## List of Abbreviations

Abbreviation	Meaning
EWS	Early Warning Score
NEWS	National Early Warning Score
NEWS2	National Early Warning Score Two
LOS	Length of Stay
AUROC	Area Under Receiver Operator Characteristic Curve
WHO	World Health Organization
IRB	Institutional Review Board
SPSS	Statistical Package for the Social Sciences
NNU	An-Najah National University
HDU	High Dependency Unit
AVPU	Alert, Voice, Pain, Unresponsive
ED	Emergency Department
ICU	Intensive Care Unit
UK	United Kingdom
RCP	Royal College of Physicians
DOH	Department of Health
MET	Medical Emergency Team
COVID-19	Coronavirus Disease 2019
SARS	Severe Acute Respiratory Syndrome
SARS-CoV-2	coronavirus 2
MERS-CoV	Middle East Respiratory Syndrome Coronavirus
PCR	Polymerase Chain Reaction
RT	Rapid Test
VS	Vital-signs
hrs	Hours
RRT	Rapid Response Team
Spo2	Non- Invasive Oxygen Saturation
T&T	Track and Trigger
qSOFA	Sequential Organ Failure Assessment

NICE	The National Institute for Health and Care Excellence
NHS	National Health Service
CURB-65	Accurate severity assessment is crucial to the initial management of community-acquired pneumonia (CAP). (confusion, uremia, respiratory rate, BP, age $\geq$ 65 years)
LFOT	Low Flow O2 Therapy
NRB	Non-rebreather Mask
HFOT	High Flow O2 Therapy
NIPPV	Non-Invasive Positive Pressure Ventilation.
IMV	Invasive Mechanical Ventilation
DM	Diabetes Mellitus

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## Appendices

### Appendix A

#### IRB Approval Letter

An-Najah National University  
Faculty of Medicine & Health  
Sciences  
Institutional Review Board



جامعة النجاح الوطنية  
كلية الطب وعلوم الصحة  
لجنة أخلاقيات البحث العلمي

Ref: Mas, March 2022/25

**IRB Approval Letter**

**Title of Research:**

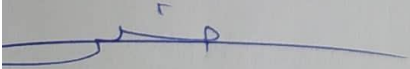
**The effect of national early warning scoring system (NEWS2) implementation in identifying the risk of clinical deterioration and outcomes among COVID 19 hospitalized patients. A quasi experimental study.**


**Submitted by:**  
*Islam Tukhi.*

**Supervisor:**  
Jamal Qaddumi

**Approved:**  
14<sup>th</sup> March, 2022

Your Study Title “**The effect of national early warning scoring system (NEWS2) implementation in identifying the risk of clinical deterioration and outcomes among COVID 19 hospitalized patients. A quasi experimental study.**” reviewed by An-Najah National University IRB committee and was approved on. 14<sup>th</sup> March 2022

  
**Hasan Fitian, MD**  
**IRB Committee Chairman**



●○ REDMI NOTE 8  
∞ AI QUAD CAMERA



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الرقم: ٢٠٢٢/٣٠/١٤٤٢  
التاريخ: ٢٠٢٢/٣/٢٨

الأخ مدير عام الادارة العامة للمستشفيات المحترم،،،  
تعبية واحترام،،،

الموضوع: تسهيل مهمة بحث

يرجى التكرم بتسهيل مهمة الطالب: اسلام محمد سالم طوخي - ماجستير تمريض

العناية المكثفة- جامعة النجاح، لعمل بحث الماجستير بعنوان:

"The effect of national early warning scoring system (NEWS2) implementation  
in identifying the risk of clinical deterioration and outcomes among COVID  
19 hospitalized patients. A Quasi-experimental study"

حيث ستقوم الطالبة بجمع معلومات (بعد اخذ موافقة رئيس قسم التخدير والانعاش في  
المشفى)، مع العلم أن مشرف الدراسة: د. جمال القدومي.

وذلك في:

- مجمع الشهداء الطبي العسكري - مستشفى الهلال الاحمر الفلسطيني/ نابلس

على ان يتم الالتزام بالمحافظة على اخلاقيات البحث العلمي وسرية المعلومات.  
على ان يتم الالتزام بجميع تعليمات واجراءات الوقاية والسلامة الصادرة عن وزارة الصحة بخصوص  
جائحة كورونا، وتحت طائلة المسؤولية. وابرار شهادة التطعيم قبل دخول مرافق وزارة الصحة.  
على ان يتم تزويد الوزارة بنسخة PDF من نتائج البحث، التعهد بعدم النشر لحين الحصول على موافقة  
وزارة الصحة. مع الاحترام،،،



نسخة: مدير دائرة التمريض والقبالة المحترمة/ جامعة النجاح

**Appendix B**  
**Tables of Study**

**Table B.1**

*Characteristics of patients included in the pre-NEWS (n = 192) and post-NEWS (n = 192) phases of the study.*

Variable	Pre-NEWS		Post-NEWS		$\chi^2$	p
	n	%	n	%		
Age (years)						
< 60	78	40.6	99	51.6	4.62	0.040
≥ 60	114	59.4	93	48.4		
Gender						
Female	98	51.0	105	54.7	0.51	0.540
Male	94	49.0	87	45.3		
Vaccination Status						
Did not receive any doses	101	52.6	101	52.6	0.00	1.000
Received one dose	67	34.9	67	34.9		
Received two doses	24	12.5	24	12.5		
Received two doses and a booster dose	0	0.0	0	0.0		
Had diabetes mellitus						
No	89	46.4	115	59.9	7.07	0.010
Yes	103	53.6	77	40.1		
Had hypertension						
No	71	37.0	119	62.0	24.00	0.010
Yes	121	63.0	73	38.0		
Had chronic kidney disease						
No	172	89.6	183	95.3	4.51	0.052
Yes	20	10.4	9	4.7		
Had cancer						
No	180	93.8	166	86.5	5.72	0.025
Yes	12	6.3	26	13.5		
Had chronic liver disease						
No	174	90.6	174	90.6	0.00	1.000
Yes	18	9.4	18	9.4		
Had autoimmune disease						
No	155	80.7	174	90.6	7.66	0.008
Yes	37	19.3	18	9.4		
Had chronic lung disease						
No	176	91.7	178	92.7	0.14	0.850
Yes	16	8.3	14	7.3		
Had cardiovascular disease						
No	132	68.8	130	67.7	0.05	0.913

Yes	60	31.3	62	32.3		
Use of low flow oxygen (sPO2 < 94%)						
No	10	5.2	42	21.9	22.78	< 0.001
Yes	182	94.8	150	78.1		
Use of high flow nasal cannula						
No	152	79.2	135	70.3	3.99	0.060
Yes	40	20.8	57	29.7		
Use of non-invasive positive- pressure ventilation (NIPPV)						
No	166	86.5	167	87.0	0.02	1.000
Yes	26	13.5	25	13.0		
Length of hospital stay (days)						
< 6	80	41.7	112	58.3	10.67	0.002
≥ 6	112	58.3	80	41.7		
Use of mechanical ventilation						
No	178	92.7	175	91.1	0.32	0.354
Yes	14	7.3	17	8.9		
Admitted to the intensive care unit						
No	143	74.5	135	70.3	0.83	0.424
Yes	49	25.5	57	29.7		
Discharged alive						
No	38	19.8	24	12.5	3.77	0.071
Yes	154	80.2	168	87.5		

**Table B.2**

*Associations between patient deterioration and outcomes with variables in the pre-NEWS phase*

Variable	Low flow O <sub>2</sub>				High flow nasal cannula				NIPPV				Mechanical ventilation				Length of stay ≥ 6 days				ICU				Discharged alive			
	No	Yes	χ <sup>2</sup>	p	No	Yes	χ <sup>2</sup>	p	No	Yes	χ <sup>2</sup>	p	No	Yes	χ <sup>2</sup>	p	No	Yes	χ <sup>2</sup>	p	No	Yes	χ <sup>2</sup>	p	No	Yes	χ <sup>2</sup>	p
<b>Age (years)</b>																												
< 60	3	75	0.49	0.533	61	17	0.07	0.857	70	8	1.21	0.293	75	3	2.31	0.163	39	39	3.75	0.073	64	14	3.96	0.063	8	70	7.52	0.009
≥ 60	7	107			91	23			96	18			103	11			41	73			79	35			30	84		
<b>Gender</b>																												
Female	3	95	1.86	0.206	81	17	1.48	0.286	85	13	0.01	1.000	90	8	0.23	0.783	45	53	1.49	0.244	77	21	1.76	0.191	18	80	0.26	0.718
Male	7	87			71	23			81	13			88	6			35	59			66	28			20	74		
<b>Vaccination status</b>																												
Did not receive any dose	8	93	3.50	0.171	80	21	1.36	0.490	85	16	1.15	0.531	94	7	0.06	0.971	37	64	3.50	0.168	74	27	0.18	0.945	20	81	3.65	0.160
Received one dose	2	65			55	12			59	8			62	5			34	33			51	16			10	57		
Received two doses	0	24			17	7			22	2			22	2			9	15			18	6			8	16		
Received two doses and a booster dose	0	0			0	0			0	0			0	0			0	0			0	0			0	0		
<b>Had diabetes mellitus</b>																												
No	3	86	1.17	0.344	70	19	0.03	1.000	76	13	0.16	0.833	84	5	0.69	0.579	41	48	1.32	0.304	71	18	2.45	0.137	13	76	2.81	0.105
Yes	7	96			82	21			90	13			94	9			39	64			72	31			25	78		
<b>Had hypertension</b>																												
No	4	67	0.04	1.000	55	16	0.20	0.714	64	7	1.31	0.283	65	6	0.22	0.775	29	42	0.03	0.881	56	15	1.14	0.309	13	58	0.16	0.713
Yes	6	115			97	24			102	19			113	8			51	70			87	34			25	96		
<b>Had chronic kidney disease</b>																												
No	8	164	1.03	0.309	138	34	1.13	0.380	146	26	3.48	0.081	158	14	1.75	0.369	69	103	1.63	0.235	130	42	1.06	0.415	33	139	0.38	0.556
Yes	2	18			14	6			20	0			20	0			11	9			13	7			5	15		
<b>Had cancer</b>																												
No	6	174	20.40	0.002	143	37	0.13	1.000	156	24	0.11	1.000	167	13	0.02	1.000	80	100	9.14	0.004	139	41	11.34	0.002	34	146	1.47	0.259
Yes	4	8			9	3			10	2			11	1			0	12			4	8			4	8		
<b>Had chronic liver disease</b>																												
No	6	168	11.59	0.008	141	33	3.91	0.065	150	24	0.10	1.000	161	13	0.09	1.000	77	97	5.11	0.042	134	40	6.23	0.021	32	142	2.28	0.209
Yes	4	14			11	7			16	2			17	1			3	15			9	9			6	12		
<b>Had autoimmune disease</b>																												
No	8	147	0.00	1.000	122	33	0.10	0.826	132	23	1.16	0.309	142	13	1.42	0.312	63	92	0.35	0.582	111	44	3.48	0.091	36	119	5.98	0.020
Yes	2	35			30	7			34	3			36	1			17	20			32	5			2	35		
<b>Had chronic lung disease</b>																												
No	8	168	1.87	0.198	141	35	1.14	0.333	155	21	4.65	0.047	163	13	0.03	1.000	74	102	0.13	0.796	132	44	0.30	0.765	36	140	0.58	0.537
Yes	2	14			11	5			11	5			15	1			6	10			11	5			2	14		
<b>Had cardiovascular disease</b>																												
No	8	124	0.62	0.511	107	25	0.92	0.444	116	16	0.73	0.495	124	8	0.94	0.373	58	74	0.90	0.430	101	31	0.92	0.374	20	112	5.73	0.020
Yes	2	58			45	15			50	10			54	6			22	38			42	18			18	42		

**Table B.3**

*Associations between patient deterioration and outcomes with variables in the post-NEWS phase*

Variable	Low flow O2				High flow nasal cannula				NIPPV				Mechanical ventilation				Length of stay ≥ 6 days				ICU				Discharged alive							
	No	Yes	$\chi^2$	p	No	Yes	$\chi^2$	p	No	Yes	$\chi^2$	p	No	Yes	$\chi^2$	p	No	Yes	$\chi^2$	p	No	Yes	$\chi^2$	p	No	Yes	$\chi^2$	p				
Age (years)																																
< 60	31	68	10.65	0.001	78	21	7.03	0.011	95	4	14.55	0.000	99	0	19.86	0.000	65	34	4.51	0.041	80	19	10.79	0.001	1	98	24.67	0.000				
≥ 60	11	82			57	36			72	21			76	17			47	46			55	38			23	70						
Gender																																
Female	26	79	1.13	1.130	78	27	1.75	0.206	97	8	5.97	0.018	99	6	2.83	0.126	64	41	0.65	0.463	81	24	5.18	0.027	9	96	3.27	0.082				
Male	16	71			57	30			70	17			76	11			48	39			54	33			15	72						
Vaccination status																																
Did not receive any dose	17	84	3.83	0.162	71	30	0.00	1.000	86	15	1.69	0.469	90	11	1.16	0.588	57	44	0.37	0.856	69	32	0.45	0.814	17	84	4.42	0.110				
Received one dose	17	50			47	20			61	6			63	4			40	27			49	18			4	63						
Received two doses	8	16			17	7			20	4			22	2			15	9			17	7			3	21						
Received two doses and a booster dose	0	0			0	0			0	0			0	0			0	0			0	0			0	0						
Had diabetes mellitus																																
No	35	80	12.29	0.001	90	25	8.68	0.004	105	10	4.74	0.047	108	7	2.72	0.122	77	38	8.77	0.004	95	20	20.77	0.000	10	105	3.79	0.073				
Yes	7	70			45	32			62	15			67	10			35	42			40	37			14	63						
Had hypertension																																
No	34	85	8.21	0.006	96	23	16.09	0.000	109	10	5.89	0.025	111	8	1.76	0.200	84	35	19.34	0.000	100	19	28.23	0.000	11	108	3.03	0.114				
Yes	8	65			39	34			58	15			64	9			28	45			35	38			13	60						
Had chronic kidney disease																																
No	41	142	0.64	0.687	129	54	0.06	1.000	159	24	0.03	1.000	166	17	0.91	0.610	107	76	0.03	1.000	130	53	0.98	0.454	22	161	0.81	0.605				
Yes	1	8			6	3			8	1			9	0			5	4			5	4			2	7						
Had cancer																																
No	38	128	0.74	0.457	117	49	0.02	1.000	146	20	1.02	0.345	153	13	1.58	0.256	98	68	0.25	0.672	117	49	0.02	1.000	17	149	5.69	0.026				
Yes	4	22			18	8			21	5			22	4			14	12			18	8			7	19						
Had chronic liver disease																																
No	39	135	0.31	0.768	119	55	3.28	0.102	149	25	2.96	0.136	157	17	1.92	0.233	101	73	0.06	1.000	117	57	8.39	0.005	24	150	2.82	0.135				
Yes	3	15			16	2			18	0			18	0			11	7			18	0			0	18						
Had autoimmune disease																																
No	40	134	1.34	0.371	121	53	0.53	0.593	151	23	0.06	1.000	159	15	0.13	1.000	102	72	0.06	1.000	120	54	1.61	0.282	22	152	0.04	1.000				
Yes	2	16			14	4			16	2			16	2			10	8			15	3			2	16						
Had chronic lung disease																																
No	41	137	1.91	0.203	124	54	0.49	0.561	154	24	0.46	0.699	162	16	0.06	1.000	102	76	1.07	0.403	123	55	1.71	0.238	23	155	0.39	0.702				
Yes	1	13			11	3			13	1			13	1			10	4			12	2			1	13						
Had cardiovascular disease																																
No	33	97	2.90	0.096	95	35	1.47	0.240	114	16	0.18	0.819	119	11	0.08	0.790	83	47	5.03	0.029	99	31	6.58	0.012	16	114	0.01	1.000				
Yes	9	53			40	22			53	9			56	6			29	33			36	26			8	54						

**Table B.4***Relationship between NEWS scores and variables*

Variable	n	%	Mean	SD	p
Age (years)					
< 60	99	51.60	3.3	1.5	< 0.001
≥ 60	93	48.40	5.0	2.7	
Gender					
Female	105	54.70	3.9	2.2	0.083
Male	87	45.30	4.5	2.4	
Vaccination status					
Did not receive any dose	101	52.60	4.5	0.2	0.052
Received one dose	67	34.90	3.6	0.2	
Received two doses	24	12.50	4.2	0.5	
Received two doses and a booster dose	0	0.00	n/a	n/a	
Had diabetes mellitus					
No	115	59.90	3.6	2.0	< 0.001
Yes	77	40.10	4.9	2.5	
Had hypertension					
No	119	62.00	3.6	2.1	< 0.001
Yes	73	38.00	5.0	2.4	
Had chronic kidney disease					
No	183	95.30	4.1	2.3	0.145
Yes	9	4.70	5.2	3.0	
Had cancer					
No	166	86.50	4.1	2.3	0.332
Yes	26	13.50	4.6	2.3	
Had chronic liver disease					
No	174	90.60	4.3	2.4	0.043
Yes	18	9.40	3.1	1.0	
Had autoimmune disease					
No	174	90.60	4.2	2.3	0.418
Yes	18	9.40	3.7	2.4	
Had chronic lung disease					
No	178	92.70	4.1	2.4	0.466
Yes	14	7.30	4.6	1.5	
Had cardiovascular disease					
No	130	67.70	3.9	2.2	0.011
Yes	62	32.30	4.8	2.4	
Use of low flow oxygen (sPO2 < 94%)					
No	42	21.90	3.2	2.7	0.001
Yes	150	78.10	4.4	2.1	
Use of high flow nasal cannula					
No	135	70.30	3.3	1.7	< 0.001

Yes	57	29.70	6.2	2.4	
Use of non-invasive positive-pressure ventilation (NIPPV)					
No	167	87.00	3.6	1.6	< 0.001
Yes	25	13.00	8.1	2.4	
Length of hospital stay (days)					
< 6	112	58.30	3.2	1.5	< 0.001
≥ 6	80	41.70	5.4	2.6	
Use of mechanical ventilation					
No	175	91.10	3.7	1.8	< 0.001
Yes	17	8.90	8.6	2.5	
Admitted to the intensive care unit					
No	135	70.30	3.2	1.3	< 0.001
Yes	57	29.70	6.5	2.4	
Discharged alive					
No	24	12.50	8.5	2.3	< 0.001
Yes	168	87.50	3.5	1.5	

**Table B.5***Relationship between the assigned NEWS score categories and variables*

Variable	Low-risk		Medium-risk		High-risk		$\chi^2$ /Fisher	p
	n	%	n	%	n	%		
Age (years)								
< 60	86	66.7	12	9.3	1	0.8	25.0	< 0.001
≥ 60	57	44.2	14	10.9	22	17.1		
Gender								
Female	84	65.1	9	7.0	12	9.3	5.2	0.068
Male	59	45.7	17	13.2	11	8.5		
Vaccination status								
Did not receive any dose	69	53.5	16	12.4	16	12.4	5.4	0.237
Received one dose	56	43.4	7	5.4	4	3.1		
Received two doses	18	14.0	3	2.3	3	2.3		
Received two doses and a booster dose	0	0.0	0	0.0	0	0.0		
Had diabetes mellitus								
No	96	74.4	10	7.8	9	7.0	12.2	0.002
Yes	47	36.4	16	12.4	14	10.9		
Had hypertension								
No	100	77.5	12	9.3	7	5.4	16.3	< 0.001
Yes	43	33.3	14	10.9	16	12.4		
Had chronic kidney disease								
No	139	107.8	24	18.6	20	15.5	5.2	0.049
Yes	4	3.1	2	1.6	3	2.3		
Had cancer								
No	126	97.7	20	15.5	20	15.5	2.4	0.298
Yes	17	13.2	6	4.7	3	2.3		
Had chronic liver disease								
No	126	97.7	25	19.4	23	17.8	4.3	0.137
Yes	17	13.2	1	0.8	0	0.0		
Had autoimmune disease							0.0	
No	127	98.4	26	20.2	21	16.3	3.2	0.219
Yes	16	12.4	0	0.0	2	1.6		
Had chronic lung disease								
No	134	103.9	22	17.1	22	17.1	2.8	0.231

Yes	9	7.0	4	3.1	1	0.8		
Had cardiovascular disease								
No	103	79.8	14	10.9	13	10.1	4.8	0.091
Yes	40	31.0	12	9.3	10	7.8		
Use of low flow oxygen (sPO2 < 94%)								
No	36	27.9	3	2.3	3	2.3	3.6	0.174
Yes	107	82.9	23	17.8	20	15.5		
Use of high flow nasal cannula								
No	120	93.0	11	8.5	4	3.1	53.3	< 0.001
Yes	23	17.8	15	11.6	19	14.7		
Use of non-invasive positive-pressure ventilation (NIPPV)								
No	141	109.3	18	14.0	8	6.2	79.1	< 0.001
Yes	2	1.6	8	6.2	15	11.6		
Length of hospital stay (days)								
< 6	97	75.2	13	10.1	2	1.6	29.4	< 0.001
≥ 6	46	35.7	13	10.1	21	16.3		
Use of mechanical ventilation								
No	142	110.1	22	17.1	11	8.5	63.3	< 0.001
Yes	1	0.8	4	3.1	12	9.3		
Admitted to the intensive care unit								
No	124	96.1	9	7.0	2	1.6	76.1	< 0.001
Yes	19	14.7	17	13.2	21	16.3		
Discharged alive								
No	2	1.6	5	3.9	17	13.2	90.0	< 0.001
Yes	141	109.3	21	16.3	6	4.7		



جامعة النجاح الوطنية

كلية الدراسات العليا

تأثير تنفيذ نظام تسجيل الإنذار المبكر الوطني (NEWS2) في تحديد  
مخاطر التدهور السريري والنتائج بين مرضى كورونا في المستشفيات

إعداد

اسلام محمد سالم طوخي

إشراف

د. جمال القدومي

قدمت هذه الرسالة استكمالاً لمتطلبات الحصول على درجة الماجستير في ترميز العناية المكثفة، من كلية الدراسات العليا، في جامعة النجاح الوطنية، نابلس - فلسطين.

2022

# تأثير تنفيذ نظام تسجيل الإنذار المبكر الوطني (NEWS2) في تحديد مخاطر التدهور السريري والنتائج بين مرضى كورونا في المستشفيات

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## الملخص

**المقدمة:** تم الإعلان عن مرض فيروس كورونا، الناجم عن فيروس SARS-CoV-2 جائحة من قبل منظمة الصحة العالمية (WHO)، ويرتبط هذا المرض بارتفاع معدلات الوفيات، والإقامة المطولة في المستشفى، وزيادة الحاجة إلى وحدة العناية المركزة (ICU). من الأهمية بمكان أن تكون قادرًا على التنبؤ بالتدهور السريري لمرضى كوفيد 19.

**الأهداف:** تهدف هذه الدراسة لمعرفة مدى فاعلية تطبيق النظام الوطني لتسجيل الإنذار المبكر (NEWS2) في التنبؤ بمخاطر التدهور السريري والنتائج الخاصة بالمرضى في المستشفيات والذين أصيبوا بكوفيد-19 في مجمع الشهداء الطبي العسكري ومستشفى الهلال الأحمر الفلسطيني.

**الطريقة:** تم تطبيق تصميم شبه تجريبي حيث تم تقسيم عينة من 384 مريضاً بالغاً إلى مجموعة تجريبية (192 مريضاً) ومجموعة ضابطة (192 مريضاً). قبل وبعد تنفيذ النظام الوطني لتسجيل الإنذار المبكر (NEWS 2)، تمت متابعة جميع المشاركين في الدراسة حتى الوفاة أو الخروج من المستشفى، وتمت مقارنة وتقييم نتائج مجموعتي المرضى.

**النتائج:** عند مقارنة مجموعة المرضى في (مرحلة ما قبل تنفيذ النظام المبكر) بمجموعة الدراسة (مرحلة ما بعد تنفيذ النظام)، كان هناك انخفاضاً كبيراً في متوسط مدة الإقامة المرضى في المشفى ( $8.1 \pm$  5.5 يوم مقابل  $6.4 \pm 5.3$  يوم ،  $p = 0.002$ )، بالإضافة إلى انخفاض في معدل الوفيات من حالة وفاة 38 (19.8%) خلال مرحلة ما قبل تنفيذ النظام، إلى 24 حالة بنسبة (12.5%) خلال مرحلة ما بعد تنفيذ النظام بمستوى دلالة ( $p = 0.071$ )، في المقابل أظهرت القيمة التنبؤية ل تطبيق النظام الوطني لتسجيل الإنذار المبكر مؤشراً ممتازاً للقبول في وحدة العناية المركزة كما هو مبين من قبل AUROC من 0.91 (95% CI: 0.87-0.96 ،  $p > 0.001$ ). أيضاً، لوحظت زيادة كبيرة في وتيرة مراقبة العلامات الحيوية للمرضى بين المجموعة الضابطة (مرحلة ما قبل تنفيذ النظام) ومجموعة الدراسة (مرحلة ما بعد تنفيذ النظام) بعد التدهور السريري (من  $7.8 \pm 10.1$  عملية قياسي مرحلة ما قبل تطبيق النظام الوطني لتسجيل الإنذار المبكر مقابل  $0.7 \pm 23.4$  عملية بعد تطبيقه).

**الخلاصة:** أظهر تطبيق النظام الوطني لتسجيل الإنذار المبكر تحسناً كبيراً في نتائج مرضى كوفيد في المستشفى من حيث (مدة الإقامة، والقبول المتوقع لوحدة العناية المركزة، ومعدل الوفيات، وتكرار قياسات العلامات الحيوية، مما أدى بشكل غير مباشر إلى زيادة عدد المراجعات الطبية بعد التدهور السريري للمريض وتم ربطه ب تنبؤ كبير بتدهور حالة المريض).

**الكلمات المفتاحية:** كوفيد 19، النظام الوطني لتسجيل الإنذار المبكر، التدهور السريري، نتائج المرضى، درجات الإنذار المبكر.