**Arab American University – Palestine**

**Faculty of Graduate Studies**

# Nurses' Perceptions of Using Capnography during Resuscitation of Patients in emergency department

**By**

**Ghayda' Zaid**

**Supervisor**

**Dr. Dalia Tuqan**

**"This thesis was submitted in partial fulfillment of the requirements for the Master's degree in"**

**Emergency Nursing**

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# Approval form

Nurses' Perceptions of Using Capnography during Resuscitation of Patients in Emergency Department

By:

Ghaida Zakria Yaseen Zaid

This thesis was defended successfully on 9 March 2023 and approved by:

| | Committee Member | | Signature |
|---|---|---|---|
| 1. | Dr. Dalia Tuqan | Supervisor | Dalia Tuqan |
| 2. | Dr. Ahmad Ayed | Internal Examiner | Ahmad |
| 3. | Dr. Imad Thultheen | External Examiner | Imad |

# Declaration

I am Ghayda Zaid ,I certify that this thesis submitted for the degree of master, is the result of my own research, except where otherwise acknowledged, and that this study (or any part of the same) has not been submitted for a higher degree to any other university or institution.

**Name:**

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**ID No:**

# Dedication

My study is dedicated to the Almighty Allah for preserving my life, gave me good "Health and strength to be able to do this work".

To my loving parents, who have always been a source of motivation and inspiration for me, and who have given me the strength and commitment to work with enthusiasm and determination on every task

To my supervisor and all of my family members as a mark of their support.

"To my friends for supporting and encouragement".

"To all martyrs and injuries in Palestine".

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"Also, we would like to thank all the people who contributed directly or indirectly to the development of this work". Through they be assured of our faithful friendship, love, and sincere appreciation.

**Ghayda' Zaid**

# Abstract

**Background:** Cardiac arrest creates a major threat to patients in emergency care units and is important element that may lead to a patient's death if not managed in a timely manner. Therefore, the use of capnography to enhance the outcomes of patients during cardiac arrests has been broadly studied in the literature.

**Purpose:** The purpose of this study was to examine the nurses' knowledge and use of capnography monitoring, as well as the nurses' perception use of capnography monitoring for emergency departments' patients experiencing cardiac arrest in North West Bank Hospitals

**Methods:** A cross-sectional descriptive study composed of one ninety six nurses from emergency departments of governmental hospitals in the North West Bank participated in the study, self-administered questionnaire was used for purpose of collecting data.

**Results:** The analysis revealed that the most of the partcipants 77 (80.2%) have low knowledge of capnography. Also, the partcipants' perception of capnography use was positive perception with mean was 3.4± 0.6. The correlation revealed that only the relationship was significant between knowledge of copnography and experience with capnography ($P < .05$),

**Conclusion :** The study conclude that most of the nurses had low level knowledge toward Capnography. Also, the study confirmed that the nurses had positive perception towards capnography use in emergency departments for resuscitation patients with cardiac arrest. In addition, the study indicated significant relationship between experience nurses with capnography use and knowledge of capnography .

**Keywords**: capnography, emergency department, nurse, resuscitation, cardiac arrest

# Table of Abbreviation

| Abbreviation | Explanation |
| --- | --- |
| AAUP | Arab American University Palestine |
| ACLS | Advanced Cardiovascular Life Support |
| AHA | American Heart Association |
| ANOVA | Analysis of Variance |
| CO2 | Carbon Dioxide |
| CPP | Coronary Perfusion Pressure |
| CPR | Cardiopulmonary Resuscitation |
| CW | Capnography Waveform |
| ED | Emergency Department |
| ER's | Emergency Residents |
| ETCO2 | End Tidal $CO_2$ |
| ICUs | Intensive care Units |
| M | Mean |
| MmHG | Millimeters of Mercury |
| NAP4 | 4th National Audit Project |
| NKCT | Nurses' Knowledge about Capnography Test |
| OR | Operating Room |
| Paco2 | Partial pressure of carbon dioxide |
| PACU | Post Anesthesia Care Unit |
| PCA | Patient- Controlled Anlgesia |
| ROSC | Return Of Spontaneous Circulation |
| SD | Standard deviation |
| SPSS | Statistical Package of Social Science |

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# Chapter one

# Introduction

## 1.1 Introduction

Nurses' knowledge pertaining to clinical devices, such as capnography, used for monitoring, assessing, and treating patients with heart conditions is an important factor for achieving quality patient care and organizational effectiveness (Cook & Harrop- Griffiths, 2019).

Capnography refers to ventilatory function monitoring based on the continuous measurement of exhaled (Carbon Dioxide) CO2 partial pressure (Zwerneman, 2006). Quantification of this pressure is displayed as a waveform on the monitoring screen along with a numeric value, which corresponds to the maximum CO2 pressure at the end of expiration, or (end-tidal CO2) pressure (etCO2) (Krauss & Hess, 2007; Zwerneman,2006).

Exhaled CO2 pressure can be affected by a number of respiratory, circulatory, metabolic or technical conditions, thus information provided by its measurement Needs to be correctly interpreted by clinicians (Kodali, 2013). Lower than normal (35—45 mmHg) values of ETCO2 may indicate hyperventilation, hypothermia, hypovolemia or decreased cardiac output, while values above normal are common during hypoventilation, hyperthermia, onset of sepsis, shivering, partial airway obstruction or ventilator leak (Fox, Flegal, & Kuhlman, 2009; Godden, 2011). Evaluating the arterial to ETCO2 pressure gradient is also important, considering that values above normal (1—5 mmHg) are expected in patients with chronic obstructive pulmonary disease or raise suspicion of pulmonary embolism (Park, Bendjelid, & Bonvini, 2013).

A capnography waveform normally consists of four phases: inspiratory baseline, expiratory upstroke, expiratory plateau and inspiratory downstroke (Benumof, 1998).

The quality of this waveform should be determined before accepting ETCO2 values, while its shape should be analyzed to identify abnormalities (St. John, 2003 ). Studies conducted by Linet al. (2017), Novais and Moreira (2015), and Pantazopoulos et al. (2015) alluded to the lack of nurses' knowledge in using capnography as recommended by the Advanced Cardiac Life Support (ACLS) to capture pertinent information about a patient's ETCO2 condition. They found that such low awareness of this approach presents uncertainties and poor clinical monitoring practices. Low-quality nursing practices are exemplified by the lack of awareness in using capnography when success in patient care is dependent upon the practice knowledge and use of innovative devices, such as capnography, in a clinical setting (Hamrick et al., 2017).

Similarly, Hamrick et al. (2017), Heradstveit and Heltne (2014), and Kodali and Urman (2014) linked the importance of using capnography in monitoring and gathering patient information during cardiopulmonary resuscitation (CPR) events to the critical role of nursing practitioners and the knowledge of using capnography to improve patient quality care.

## 1.2 Background

Many institutions have reviewed their CPR policy as a result of recent changes in ACLS recommendations that suggest the use of capnography during CPR, Right now, the decision to stop resuscitative measures in patients with cardiopulmonary arrest is an intuitive one. A growing body of research indicates that capnography may

provide an objective basis for assessing the patient's prognosis or stopping CPR, despite the fact that it has currently only been used to evaluate the efficiency of chest compressions during CPR. This commentary's goals are to explore the underlying physiology of capnography during CPR, examine the evidence in support of its usage, and describe potential future directions.( Kodali, B. S., & Urman, R. D. (2014)

It is commonly recognized that tracheal intubation difficulties and airway complications are more likely both outside of operating rooms and in emergency settings (Turle, S., Sherren, P. B et al., (2015)

Cardiac arrest is a major life threatening to patients in emergency care units and It is a critical factor that, if not treated promptly, can result in a patient's death. (Hartmann et al., 2015). As a result, the use of capnography to improve the outcomes of patients during cardiac arrests has been widely studied in the literature (Edelson et al., 2014; Mader, Coute, Kellogg, & Harris, 2014). The American Heart Association's (AHA) Guidelines for CPR and Emergency Cardiovascular Care (Panchal et al., 2019) recommended the use of capnography for measuring ETCO2 to assess and measure return of spontaneous circulation (ROSC).

According to Cereceda-Sánchez and Molina-Mula (2017), Capnography is a method for determining coronary perfusion pressure (CPP) and coronary blood flow. Several studies have shown the effectiveness of capnography in patients' treatment with chronic hypercapnic respiratory failure, hypoventilation, severe hypothermia, and metabolic changes clinical (Darocha et al., 2017; Cereceda-Sánchez & Molina-Mula، 2017; Chhajed et al., 2016).

## 1.3 Problem statement

Nursing assessment is a crucial part of patient monitoring. Emergency care nurses are at the frontlines of patient care, so it is critical to establish if nurses regard capnography as successful and beneficial in their care delivery. Capnography is one of the monitoring devices that is quickly available and not frequently utilized in the emergency situations. Considering that capnography has long been used in clinical settings and its use has been expanding (Kodali, 2013), there is a remarkable lack of studies and instruments for evaluating healthcare professionals' knowledge about capnography from the literature. However, Leppink, O'Sullivan, and Winston (2016) noted that despite the existence and widespread use of capnography in practice improvement, many nurses still show some levels of uncertainty due to the lack of the information regarding the use and effectiveness of this technology by nurses in improving the quality of their patient care. The major concern for healthcare practitioners is to minimize the negative impact created by the uncertainties and the lack of knowledge by nurses in using capnography. This relationship between nurses' knowledge to use capnography in clinical settings and its impact on patient care remains understudied (Kodali, 2013; Whitaker & Benson, 2016).

Despite the widespread international acceptance, and use of capnography, capnography is apparently rarely available or used in Palestine. Only the setting that capnography available in Palestine is in post anesthesia care units. Thus, the purpose of this study was to examine the nurses' knowledge and use of capnography monitoring, as well as the nurses' perception use of capnography monitoring for emergency departments' patients experiencing cardiac arrest in North West Bank Hospitals.

## 1.4Significance of the study

This study may serve as the foundation for future research and practice development in this field. The findings of this study could have also role to improvement of capnography practice methodologies and enhanced the quality of patient outcomes in emergency settings.

Furthermore, the study filled in the bridges in the literature by correlating the data provided by quantitative studies of capnography and the nurses' knowledge of the topic as well as its application within the present emergency departments setting. As such, the results of this study are critical for a variety of stakeholders, including nurses, managers patients, and the health industry.

Overall, the study provided valuable information in support of nursing education and training in capnography, which will help to advance the practice and improve population health.

## 1.5 Purpose of the study

The purpose of this study was to examine the nurses' knowledge and use of capnography monitoring, as well as the ;nurses' perception use of capnography monitoring for emergency departments' patients( ED's patients) experiencing cardiac arrest in North West Bank Hospitals

## 1.6 Research questions

This study addressed the following research questions:

1. Is the nurses' knowledge of capnography mean scores high in emergency departments in North West Bank hospitals؟
2. Is the nurses' perception use of capnography monitoring high for emergency departments' patients experiencing cardiac arrest in North West Bank Hospitals؟
3. Are there significant relationship between selected nurses' demographic characteristics and their knowledge of capnography mean scores in emergency departments in North West Bank hospitals?

## 1.7 Variables

**Dependent variables:** nurses' Knowledge and perception use of capnography.

**Independent variables**: Demographic characteristics: age, gender, qualification degree, years of experience, years worked in emergency department, length of experience with capnography, experience with capnography on intubated patients in the emergency department, and any experience of capnography outside of the ED.

## 1.8 Conceptual and operational definitions

### Nurses' knowledge of capnography

Nurses' awareness about capnography techniques and benefits, as well as their competence about technical equipment use and ETCO2 levels interpretation (Lin et al., 2017; Pantazopoulos et al., 2015). The study used the Nurses' Knowledge about Capnography Test (NKCT) tool developed by Kiekkas et al. (2016) to evaluate nurses' knowledge.

“A 5-point Likert scale was used to determine the level of positive or negative feelings associated with the use of capnography and its perceived value, with higher scores representing more positive attitudes”

**Nurses**: nurses are professional licensed registered nurses who are employed in the emergency department.

### 1.9 Summary

Overall, CPR is an essential process in emergency care settings, and additional techniques could increase the chances of survival. The rates of people suffering from cardiac arrest annually are high, while the rate of survivors is low. Capnography has been shown to be a valuable addition to the standard CPR procedures in monitoring the patient's condition and predicting adverse events. The examination of the available data revealed the need to examine the nurses’ knowledge and use of capnography monitoring, as well as the nurses’ perception use of capnography monitoring for emergency departments’ patients experiencing cardiac arrest in North West Bank Hospitals. Furthermore, the previous research also demonstrated the importance of examining the nurses’ knowledge and perception toward capnography in CPR and their utilization of these concepts in practice.

# Chapter Two

# Literature Review

## 2.1 Introduction

This chapter presented the studies about the nurses' knowledge and perception use of capnography monitoring for emergency departments' patients experiencing cardiac arrest. The literature review provided important information that help in forming this study, guide the research questions, and ensure a clear understanding of the topic.

Pup-med, Google Scholar, Science Direct and Sci-hub databases were used for nurse knowledge Perceptions articles, by using the keywords (capnography, nurses, Capnography in ER, Capnography during Resuscitation, Nurses' Perceptions of Using Capnography in emergency department, nurse knowledge about capnocraphy, capnography in intensive care units, Nurses' Perceptions of Using Capnography during Resuscitation of Patients in emergency department).

## 2.2 Clinical indications of capnography

Capnography has been recognized in the literature as superior to standard monitoring required such as non-invasive blood pressure, pulse or heart rate monitoring, pulse oximetry, and respiratory rate during CPR (Bullock et al., 2017; Chicote et al. 2019).

The need for promoting safety of surgical patients against the risk of life-threatening adverse events, such as respiratory depression, airway obstruction and pulmonary embolism, has led to the inclusion of capnography among standard monitoring within the Operating Room (OR) (Odom-Forren, 2011). Capnography use is also warranted in the Post anesthesia Care Unit (PACU) for patients with obesity,

obstructive sleep apnea, chronic pulmonary diseases, difficult airway management and major thoracic/abdominal operations (Chung et al., 2011; Pantazopulus et al., 2015). In addition, Capnography demonstrates benefit in cardiac arrest, procedural sedation, mechanically ventilated patients, and patients with metabolic academia (Long et al., 2017).

Stites et al. (2017) revealed that capnography could reduce the number of opioid-induced respiratory issues. The clinical setting observed by the authors implemented the utilization of capnography, and the outcomes suggested a statistically significant improvement in patient-controlled analgesia (PCA) efforts. Considering the respiratory-depressive effect of sedative or opioid drugs, capnography can be further recommended during patient-controlled analgesia or the performance of minimally invasive procedures in endoscopy, radiology or cardiology suites under sedation ( Kodali, 2013). A meta-analysis of studies on adverse respiratory events during procedural sedation revealed that respiratory depression was 17 times more likely to be detected when capnography was used (Waugh, Epps, & Khodneva, 2011). It is also worth noticing that, compared with pulse oximetry, capnography allowed significantly more effective and earlier detection of respiratory depression in studies conducted on both postoperative orthopedic patients and those undergoing upper endoscopy (Hutchison & Rodriguez, 2008; Vargo et al., 2002).

Cereceda-Sánchez and Molina-Mula (2017) reviewed the prospects of using capnography in the ED setting for detecting metabolic changes in patients. They performed a systemic literature review and examined 17 studies focusing on the specifics of capnography. The findings suggested that this tool is efficient and cost-effective, which further demonstrated the need to develop and implement strategies

promoting the use of it in the hospital setting (Cereceda-Sánchez & Molina- Mula, 2017).

Historically, capnography has been used in the Intensive Care Unit (ICU) and the Emergency Department (ED), primarily for the assessment of endotracheal, gastric and small bowel tube placement, along with prompt identification of endotracheal tube dislodgement or circuit disconnection (Johnson & Abraham, 2015; Ahrens & Sona, 2003; Kindopp, Drover, & Heyland, 2001). Capnography use has also been suggested during inter-hospital or intra-hospital patient transfers for timely detection of adverse events (Kodali, 2013; Odom-Forren, 2011). Finally, there is evidence to support capnography use during CPR, for evaluating the efficacy of chest compressions, identifying the return of spontaneous circulation and predicting patient outcomes (Grmec & Klemen, 2001; Scarth & Cook, 2012; Whitaker, 2011).

Cook and Garrop-Griffinth (2019) argued that the utilization of capnography in varied clinical settings can serve as a measure for preventing deaths. The authors formed their conclusions on a study of contemporary practices applied in hospitals. Their results suggested that a large percentage of individuals are dying due to misplaced tubes or esophageal intubation, which can be prevented by using capnography (Cook & Garrop- Griffinth, 2019). The common reasons cited by the authors are the failure to use capnography and the lack of education about this tool that would allow medical personnel to use it in case of emergencies.

Lui et al. (2016) considered the value of accumulating data about ETCO2 during patient resuscitation in out-of-hospital cardiac arrest cases. The authors performed a cross-sectional study of adults and found that the information that capnography provides can diagnose cardiac arrest and help nurses to determine a patient’s state. Their findings aligned with those of Elola et al. (2019), Sheak et al.

(2015) and Gong, Lu, Zhang، Zhang, and Li (2015). This study showed how one's knowledge of circulation can help with CPR, and the researchers noted that capnography is essential in such procedures، further strengthening the place of this tool in resuscitation efforts.

### 2.3 Applying capnography during resuscitation

Capnography has several roles at cardiac arrest:

- "Confirmation that the airway is patent and present within the trachea"
- "Monitoring ventilation rate during CPR and avoiding hyperventilation"
- "Assessing adequacy of chest compressions during CPR"
- "Identifying return of spontaneous circulation (ROSC) during CPR"
- "Prognostication during CPR (Soar et al., 2015)"

Capnography can be used to reduce chest compressions when resuscitating patients. This methodology was developed by Leturiondo et al. (2019) and Merckx، Lambert, Cantineau, and Duvaidestin (1992) and incorporated capnography-based chest monitoring tailored for the purposes of cardiopulmonary resuscitation. The issue with the approach currently used in medical establishments is that chest compressions affect the accuracy of automated ventilation detection, which can endanger the patient (Merckx et al., 1992). Leturiondo et al. (2018) developed an algorithm that considered this issue and allowed for detecting insufficiencies in patient ventilation. Hence, the accuracy of results and reliability of capnography affected the outcomes of resuscitation efforts (Ruiz de Gauna et al., 2018). This methodology suggested that while applying capnography during resuscitation helps improve the patient state, more

developments and evidence-based research are required to develop practice improvements (Ruiz de Gauna et al., 2018).

### 2.4 Importance of personnel's knowledge about capnography

Despite the undoubted benefits of capnography, monitoring technologies are only as good as the user who interprets the information provided (Stefanik et al., 2021). "In this context, appropriate capnography application depends on the knowledge and clinical skills of healthcare professionals. Nurses should be capable of understanding how capnography functions and what it measures, as well as of correctly interpreting its readings and waveforms. It seems thus plausible that limited personnel's knowledge about capnography can be detrimental for patient care، since this is expected to hinder personnel from identifying pathologic conditions or adverse events that affect patient ventilation or circulation, or even result in false safety sense, which could prevent timely interventions and negatively affect patient outcomes". Studies have reported unfamiliarity with or incorrect use of monitoring equipment to be among the leading causes of equipment-related patient safety incidents in ICU settings (Thomas & Galvin، 2008; Welters, Gibson, Mogk, & Wenstone, 2011). In this context, patient harm might have been avoided in this case by identifying personnel knowledge gaps concerning monitoring equipment use and providing proper education and training.

Education on capnography is a vital as it has been shown to ensure that medical professionals can interpret capnography traces adequately (Kerslake & Kelly, 2016). Additionally, education has been shown to improve nurses' attitudes and perceptions of capnography use during CPR (Kerslake & Kelly, 2016).

## 2.5 Nurses' knowledge about capnography

Nurses and factors relating to their work have a direct impact on patient outcomes, and improvement of practice approaches or hospital environments have been shown to enhance health related metrics in patients (Darocha et al., 2017). It has been suggested that a variety of factors, including the availability of capnography tools in hospitals, skills that help nurses to use and interpret waveforms, personnel perceptions of the technique, and the overall attitude of a healthcare organization, affect the practice of using capnography in the emergency settings (Jaffe, 2017; Darocha et al., 2017).

Assessment of death associated with failure to apply innovative tools, such as capnography, can provide insight into the severity of the problem of nurses' negative perceptions. Pantazopoulos et al. (2015) argued that only 20% of patients who receive resuscitation survive despite the recent advancements in the techniques and technology application used to monitor the process and improve the outcomes. Outside the hospital، the statistics suggested a survival rate of only 10% , Hence، determining the issues that contribute to the high mortality and possible best practices to help reduce the number of adverse incidents can provide guidelines for medical practitioners for capnography use (Pantazopoulos et al., 2015).

Cereceda-Sánchez and Molina-Mula (2017) conducted a systematic study to assess the use of capnography in detecting metabolic alterations in spontaneously breathing patients in emergency and critical care settings. Most studies found a significant association between capnography readings and blood biomarkers, indicating the use of this measure in detecting individuals at risk of severe metabolic alteration in a quick, cost-effective, and accurate manner.

Czy, Lekiewicz, and Czy (2018) carried out a cross-sectional study to assess paramedics' knowledge of capnometry and capnography. The findings demonstrated a paucity of experience and knowledge among emergency medical service providers in the use of instruments to monitor end-expiratory carbon dioxide concentration (EtCO2).

Clark et al. (2018) studied nurses' attitudes about capnography monitoring. The findings revealed variation in the valuation of capnography, as well as variable degrees of acceptability of its usage. The mean for the reported impact of capnography use on patient safety was 3.86, whereas the perceived danger of eliminating capnography was 2.57. The degrees of urgency associated with apnea alarms (mean 3.57, SD 1.57) were lower than those associated with oxygen saturation violation alerts (mean 3.67, SD 1.32). The importance of pulse oximetry monitoring was considered to be substantially greater than that of capnography monitoring (mean 1.76, SD 1.34), where "1" represented pulse oximetry as more important and "5" represented capnography as more important. According to the findings of the study, nurse acceptance of capnography monitoring is a challenging outcome to accomplish. To achieve greater success with similar monitoring, better accounting for external and internal impacts on nurse perceptions and values is needed.

A cross-sectional study was carried out in a hospital emergency department to measure the level of knowledge among emergency room residents (ERs) and investigate the relationship between knowledge and practice of capnography waveforms (CW). In this study, 48 emergency room residents participated. The mean knowledge and practice scores were 5.691.82 and 4.401.8, respectively. There was no association between knowledge and practice (r=0.186, p=0.207) (Chee et al., 2021).

Langhan et al. (2015) performed a qualitative study to analyze the reasons for the limited application of capnography in acute care regions, as well as the facilitators and challenges to its implementation. Semi-structured interviews were conducted with a sample consisting of physicians and nurses from the ED and ICU. The data was analyzed using grounded theory, iterative data analysis, and a constant comparative approach to create ideas and develop theories inductively. Nineteen clinicians from five hospitals were questioned, according to the findings. Six themes emerged: variability in capnography use among acute care units; personal experiences influencing capnography use; availability and accessibility of capnography equipment; the impact of capnography on patient care; the evidence supporting capnography use; and variable knowledge about capnography. Within each subject, there were both barriers and facilitators to employ. The study revealed a wide range of responses to capnography and identified characteristics that encourage or discourage its usage. This information can be used to influence future implementation plans. A planned approach to increase use, reduce obstacles, and broaden implementation has the potential to have a significant influence on the use of capnography in acute care settings with the objective of enhancing patient care.

## 2.6 Nursing perception towards capnography use

Wide variations among medical staff have been shown to exist in the understanding and acceptance of capnography (Langhan et al., 2015). Despite the existence and widespread use of capnography in practice improvement، many nurses still show some levels of uncertainty due to the reduced awareness in the knowledge and application of capnography in clinical settings (Leppink, O'Sullivan, and Winston, 2016).

The perceptions of users towards new technology are critical factors in its acceptance and successful implementation (Taherdoost, 2019). Nursing acceptance of capnography monitoring is a difficult endpoint to achieve. There is a need for better accounting for the external and internal influences on nurse perceptions and values to have greater success with the implementation of similar monitoring (Clark et al., 2018).

Sahyoun, Siliciano, and Kessler (2018) and Duckworth (2017), Hamrick et al. (2017) suggest that the providers in the United States do not perceive capnography as a potent tool for examining the return of spontaneous circulation and have a neutral view of this tool in the context of resuscitation, despite evidence suggesting the efficiency of this method. Hence, the issue is global, and the availability of capnography tools does not result in the application of them by medical personnel. Kerslake and Kelly (2016) stated that "failure to use capnography in patients dependent on artificial airways caused 70% of ICU-related airway deaths in the 4th National Audit Project (NAP4) (p. 178). One aspect of the issue is the perception of this tool and the knowledge that allows nurses to use it in emergencies such as CPR. Evidence provided by Clarke et al. (2018) suggests that a large percentage of the observed medical professionals avoid using capnography on the floor since they do not understand the benefits.

## 2.7 Summary

A notable gap in the research is the absence of information that would offer an understanding of nurses' awareness of capnography and attitudes about utilizing this tool. Prior studies on the issue investigated the frequency and characteristics of nurses utilizing capnography and concluded that, despite guidelines, this equipment is rarely

used during CPR. This gap in practice prompted the development of this study, which investigated nurses' knowledge and capnography usage during CPR. The majority of the studies reviewed concentrate on the benefits of employing capnography and the technicalities of its application.

Additionally, the literature demonstrated that there existed a gap in nurses' knowledge on capnography use, leading to negative perceptions on the tool's usefulness, which further demonstrated the need for the study which assessed how changes in nurses' knowledge about capnography affected ROSC.

# Chapter Three

# Methodology

## 3.1 Introduction

This study seeks to examine the nurses' knowledge and use of capnography monitoring, as well as the nurses' perception use of capnography monitoring for emergency departments' patients experiencing cardiac arrest in the North West Bank Hospitals. This section describes the methods and research design used, the study population, data collection, data analysis, validity, and reliability of the data collected. It also entails the sampling method, the inclusion and the exclusion basis, and an explanation of the data collection tools used in the study.

## 3.2 Study design

This study was a cross-sectional descriptive study. This was selected because it allowed for comparisons between various populations groupings at the same time. Data can be gathered without interfering with the study environment. The cross-sectional research design makes it easier to collect reliable and accurate data that clearly describes the variables.

## 3.3 Study setting

The study was conducted on nurses who work in the emergency epartments in the governmental hospitals in the North West Bank districts (Jenin, Tubas, Talkarm, Qalqeliah, Nablus, and Salfeet). The study was conducted from December 2021 to July 2022.

### 3.4 Study population and sample

The targeted participants of the study were all nurses working in the emergency departments in the North West Bank governmental hospitals (Khaleel Sulaiman, Thabet Thabet, Rafedia, Al-Watani, Tubas/Turkey, Darweesh Nazzal, and Yaser Arafat hospitals). According to the nursing department in the Palestinian Ministry of Health, the total number of nurses who work in the emergency departments in the targeted hospitals is 116 approximately.

The sample of this study was consecutive sample (nonprobability sample) that can be considered as the best of all nonprobability samples because it included all the subject that are available which makes sample a better , and avoided bias in the selection process , so all nurses who are working in the emergency departments were enrolled in the study.

### 3.5 Inclusion criteria

- Nurses who approved to participate in the study.
- Nurses who provide direct care to patients.
- Full time nurses

### 3.6 Exclusion criteria

- Nurses who didn't work in emergency department.
- Part time nurses

### 3.7 Study Instrument

A self-administered questionnaire was used to collect the data from the participants. The questionnaire consisted of three parts (Appendix A):

1. Demographic data: The demographic variables of the participants included age, gender, qualification degree, years of experience, years worked in emergency department, length of experience with capnography, experience with capnography on intubated patients in this emergency department, and any experience of capnography outside of this emergency department .
2. The Nurses' Knowledge about Capnography Test (NKCT). The NKCT was used to collect the required data on the nurses' knowledge of capnography. This tool was developed by Kiekkas et al. (2016) and included 30 correct and wrong statements about capnography. The items are separated into four groups: principles of capnography function, conditions affecting ETCO2 pressure, conditions affecting capnography waveform, and indications for capnography use (Kiekkas et al., 2016).
3. Concerning the NKCT, reliability has already been evaluated. Kiekkas et al. (2016) note that they applied internal consistency and item analysis to determine the reliability of the instrument. Kuder-Richardson 20 coefficient was used based on the type of the test (dichotomous choices). Point-biserial correlation index was also applied, yielding the results from 0.168 (poor item discrimination) to 0.833 (excellent item discrimination), with most items (28 out of 30) having either good or acceptable discriminatory value (Kiekkas et al., 2016).
4. The scores were transformed into percentage scores by dividing the scores obtained by the respondents with the possible maximum scores and multiplied by 100. The sum score of each outcome was assessed based on Bloom's cut off point (Bloom, 1956).

5. Based on the sum scores, level of knowledge was classified into low level knowledge (less than 60%), moderate level knowledge (60–80%) and high level knowledge (80–100%).
6. Participant's perceptions about capnography use in the emergency department: The scale will be developed by the researcher after critical appraisal of the literature. The scale included 13 items rated on five Lkert scale (strongly disagree to strongly agree). The mean of total scores were classified to positive or negative according to the mean where is below 3 negative and above 3 positive.

### 3.8 Validity and Reliability

The instrument's validity was proven by delivering the questionnaire to five professionals with experience in clinical and academic nursing. These experts assessed the full questionnaire and provided feedback and ideas on its content. On the basis of the feedback of the experts, no certain changes were made to the questionnaire. Those five specialists assisted with word selection and assessed each section. They stated that the questionnaire's content in general was clear and unambiguous, but they indicated that some words were difficult. Their Arabic translations are provided in brackets alongside them.

The reliability of the instrument was also established via piloting the tool to examine whether the, The NKCT and perceptions about capnography had internal consistency. The researcher conducted piloting on 30 nurses who completed the questionnaire, where Cronbach's alpha was 0.91 for the entire scale. Cronbach's alpha coefficient was 0.82 for perceptions about capnography scale. The internal consistency of the scales was high.

### 3.9 Pilot study

A pilot study was conducted on 30 participants. They were provided with a clear explanation of the study and its objectives. The pilot study was done to ask them about the difficulties, the average time to fill out the questionnaire, and their opinion of the questionnaire. The participants consider it clear, without comments, and the time ranges between 10-15 minutes to complete the questionnaire. The participants were excluded from the actual study.

### 3.10 Data collection

After gaining permission from Arab American University and the Ministry of Health to perform the study, the researcher visited the hospitals and talked with the matron of nurses and the chief nurse of the emergency department. The researcher outlined the objectives of the study to them and requested that they produce a list of nurses' names and schedule duties to fulfill them. In addition, the researcher described the study's aims to the nurses. The nurse who consented to participate provided informed consent before completing the questionnaire in English.

### 3.11 Ethical considerations

The Arab American University and the Palestinian Ministry of Health both granted ethical approval. Prior to the study, each participant was given a consent form. Voluntary participation and refusing to participate causes no harm for nurses. There was no mention of the participants' names or personal information. All data was kept private and was only used for research purposes. Each participant was given a thorough description of the study's aims and tools. There was ample time for questions.

### 3.12 Data analysis

Data were analyzed using the Statistical Package of Social Science (SPSS, Version 23; SPSS Inc., Chicago, Illinois). Descriptive statistics for all parameters included in this analysis were performed. These analyzes included distributions of means and standard deviations (SD). and correlation also were performed to verify if there is a significant difference Capnography use and selected demographic characteristics

# Chapter Four

# Results

## 4.1 Introduction

This chapter deals with the data collected for analysis. The statistical method allowed the investigator to deduce, analyze, coordinate, measure, evaluate, and convey the numerical information. The aim of data analysis is to provide answers to questions about the study. The data analysis strategy comes directly from the question n, the design of the data collection process, and the level of measurement of the data. This chapter edits, tabulates, analyzes, and interprets the data collected.

This chapter expresses the findings concerning The purpose of this study was to examine the nurses' knowledge and use of capnography monitoring, as well as the nurses' perception use of capnography monitoring for emergency departments' patients experiencing cardiac arrest in the North West Bank Hospitals

Statistical analyses were directed to explore three research questions.

1. Is the nurses' knowledge of capnography mean scores high in emergency departments in North West Bank hospitals?
2. Is the nurses' perception use of capnography monitoring high for emergency departments' patients experiencing cardiac arrest in North West Bank Hospitals?
3. Are there significant relationship between selected nurses' demographic characteristics and their knowledge of capnography mean scores in emergency departments in North West Bank hospitals?

## 4.2 Reliability

The Kuder-Richardson 20 coefficient for nurses' knowledge of canpgraphy was 0.79 and Cronbach's alpha perceptions towards capnography use =0.91. This indicating that the internal consistency reliability of the scales were acceptable.

## 4.3 Response rate

The nurses in the current study are composed of all nurses working in the emergency departments in the governmental hospitals in the North West Bank / Palestine. Ninety six out of 116 questionnaires (82.2% response rate) were completed and returned by the nurses.

From an organizational point of view, the response rate obtained for this research was good; as such, the findings should include more reflective details about the nursing population.

## 4.4 Participants' Characteristics

The findings revealed that the mean of the participants' age was 30.7±6.4 and the range was between 21 and 52 years. Approximately two third 66(68.8%) were males and staff nurses. Also, 67(69.8%) have bachelor's degrees in nursing. The mean of the partcipants' experience was 8.2±6.1 years. In addition, the participants experience in the targeted emergency department was 4.9±4.7) year and 1.1±1,8 year had experience with capnography. Only, 33(34.4%) of the participants reported that they have you used capnography on intubated patients in this emergency department or had experience with capnography outside of this emergency department, as seen in table (4-1).

**Table 4-1: "Demographic characteristics of the participants" (N=96)**

| Characteristics | | M (SD) | N (%) |
|---|---|---|---|
| Age /year | | 30.7(6.4)<br>Range=21-52 years | |
| Gender | Male | | 66(68.8) |
| | Female | | 30(31.3) |
| Educational level | Diploma | | 27(28.1) |
| | Bachelor | | 67(69.8) |
| | Master and above | | 2(2.1) |
| Job position | Practical nurse | | 28(29.2) |
| | Staff nurse | | 66(68.8) |
| | Head nurse | | 2(2.1) |
| Experience/Year | | 8.2(6.1) | |
| Experience in the targeted emergency department/ year | | 4.9(4.7) | |
| "How long have you had experience with capnography"?/ year | | 1.1(1.8) | |
| "Have you used capnography on intubated patients in this emergency department"? | Yes | | 33(34.4) |
| | No | | 63(65.6) |
| "Have you had experience with capnography outside of this emergency department"? | Yes | | 33(34.4) |
| | No | | 63(65.6) |

*M= Mean, SD= standard deviation*

Approximately two third 66(68.8%) were males and staff nurses, as seen in figure 1.

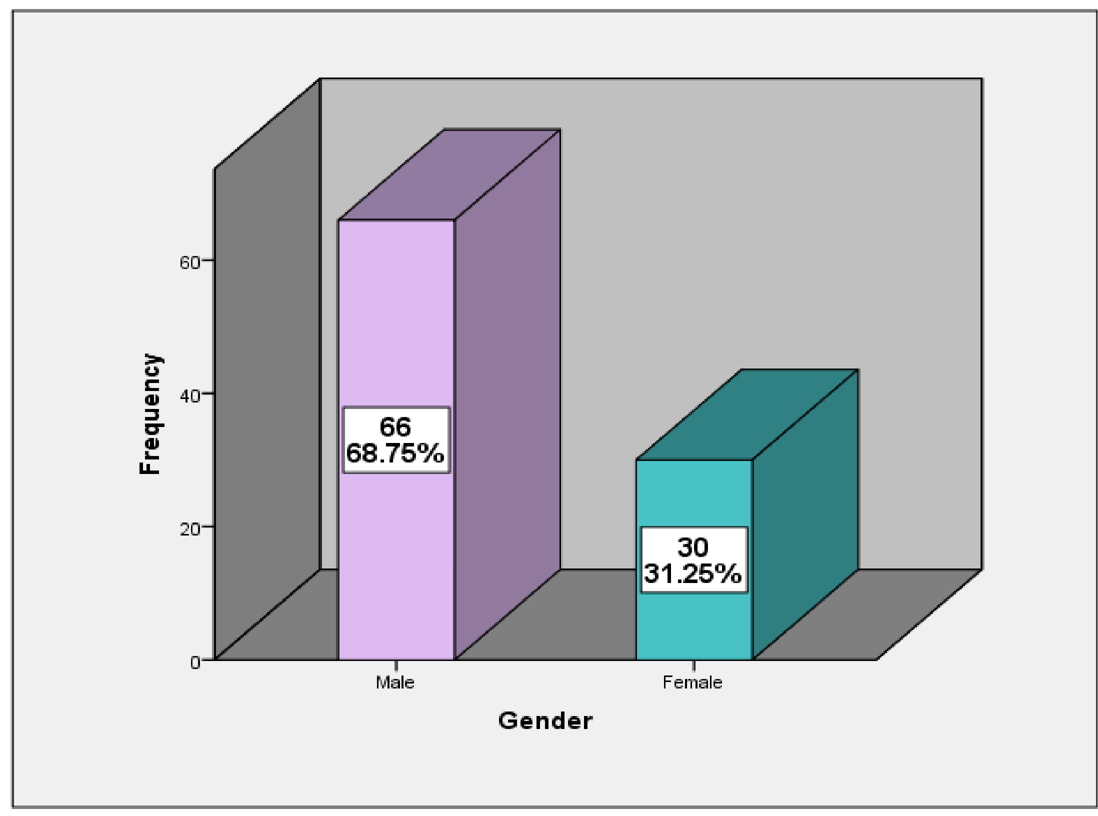


**Figure (4-1): Distribution of the participants regarding gender**

Also, the analysis revealed that 67(69.8%) of the partcipants have bachelor's degrees in nursing, as seen in figure 1

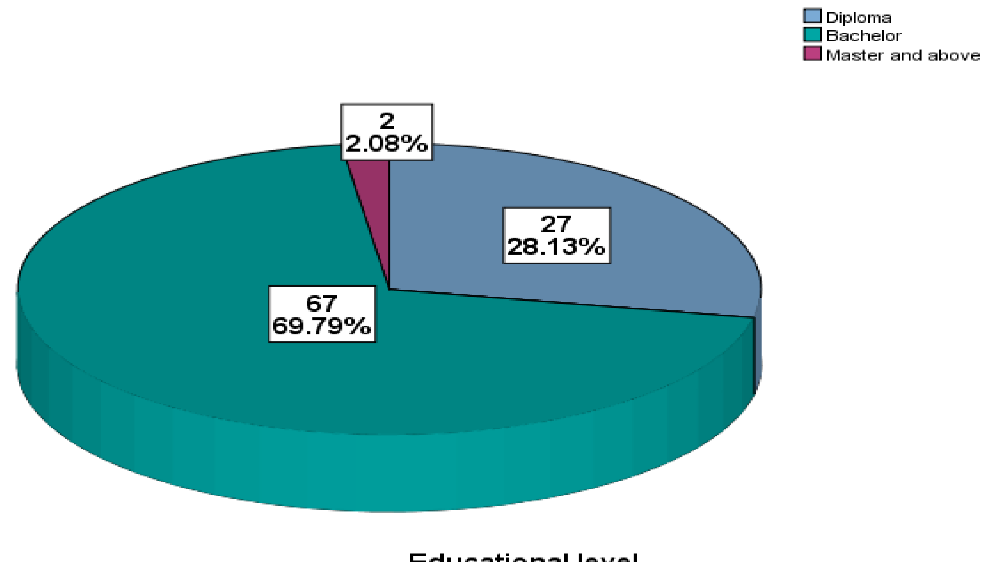


**Figure (4-2): Distribution of the participants regarding educational level**

The analysis revealed that the most of the partcipants 77 (80.2%) have low knowledge of capnography, as seen in (Figure 4-3)

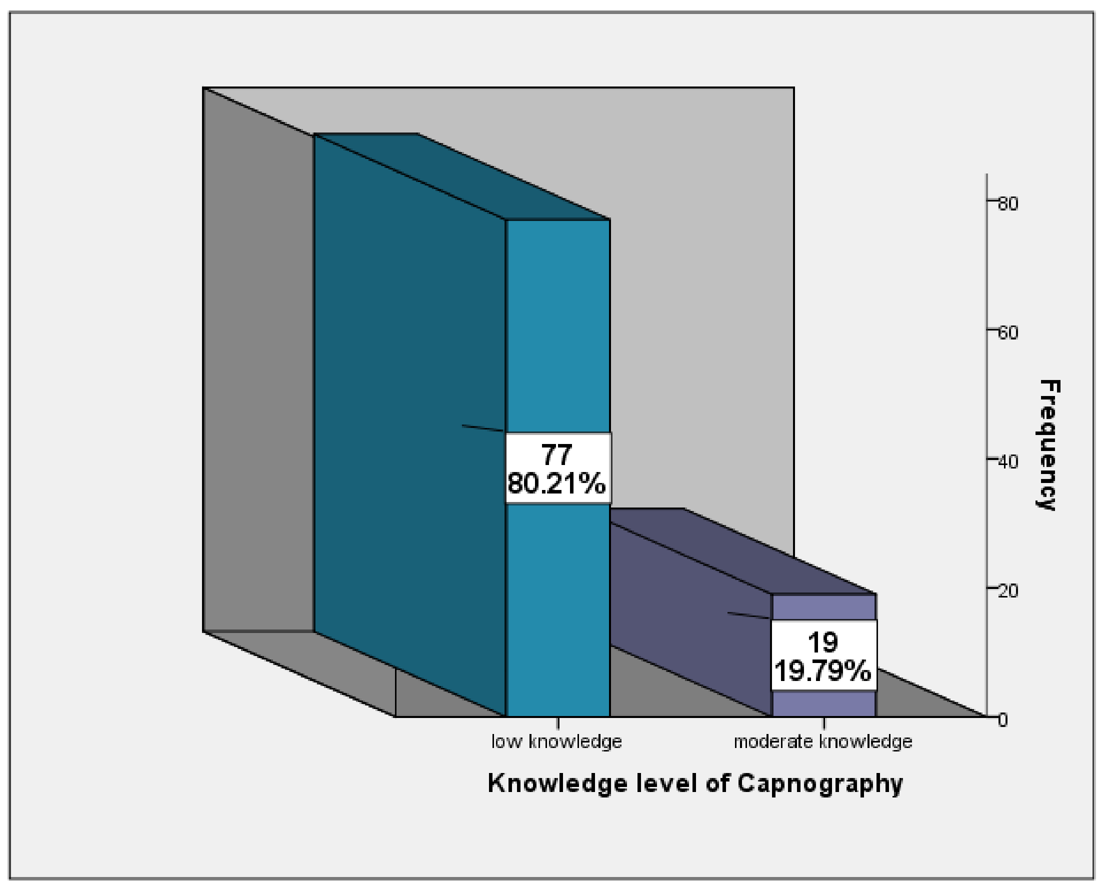


**Figure (4-3): knowledge level of the participants regarding Capnography**

The analysis revealed that the total participants' knowledge of copnography was less than the half (47.8±8.6). Regarding the subscales of the knowledge of copnography, the highest subscale mean 56.1 ±15.4 was the Conditions affecting capnography waveform subscale, followed with Indications for capnography use was 51.9±22.1, Conditions affecting end-tidal CO2 pressure was 46.9 ±15.4, and then Principles of capnography function was 39.4±14.3.

Also, the analysis of the items revealed that the majority of the participants 77(80.2%) answered correctly the item "Normal values of end-tidal CO2 pressure range between 35 and 45 mmHg". Surprising, only 13.5% of the participants answered the item Capnography refers to the measurement of exhaled CO2 partial pressure during the expiratory phase or respiration correctly, as seen in (Table 4-2).

**Table 4-2: Nurses' Knowledge about Capnography (N=96)**

| | | **M(SD)** | **Correct N(%)** |
|---|---|---|---|
| | **Total knowledge** | 50.5 (8.8) | |
| | **Principles of capnography function** | 48.3 (14.8) | |
| **1.** | "Capnography refers to the measurement of exhaled CO2 partial pressure during the expiratory phase or respiration" | | 13 (13.5) |
| **2.** | "Normal values of end-tidal CO2 pressure range between 35 and 45 mmHg" | | 77(80.2) |
| **3.** | "The major disadvantage of directly measuring CO2 (mainstream analysis) is that it can be used only in intubated patients" | | 57(59.4) |
| **4.** | "Capnography provides real-time, or minimally delayed, readings" | | 47(49.0) |
| **5.** | "The major disadvantage of sampling exhaled CO2 through a tube to a distant analyzer is that the endotracheal tube can be pulled" | | 30(31.3) |
| **6.** | "Capnography is an indicator of adequacy of ventilation" | | 64(66.7) |
| **7.** | "Capnography is based on the emission of infrared radiation by CO2 molecules" | | 45(46.9) |
| 8. | The "sampling port should be kept upright to avoid the effect of v on CO2 pressure measurements" | | 46(47.9) |
| 9. | "The normal arterial to end-tidal CO2 gradient is 5—10 mmHg" | | 38(39.6) |
| | **Conditions affecting end-tidal CO2 pressure** | 46.9 (15.4) | |
| 10. | "Pulmonary embolism is generally followed by end-tidal CO2 pressure increase" | | 39(40.6) |
| 11. | "A gradual decrease of end-tidal CO2 pressure is expected in patients who become hypothermic" | | 65(67.7) |
| 12. | "Decreased end-tidal $CO_2$ pressure levels are expected in septic patients" | | 35(36.5) |
| 13. | "Partial airway obstruction leads to decreased end-tidal $CO_2$ pressure" z | | 30(31.3) |
| 14. | "A large increase of end-tidal $CO_2$ pressure may be an early sign of malignant hyperthermia" | | 62(64.6) |
| 15. | "Arterial to end-tidal $CO_2$ gradient is lower than normal in patients with chronic obstructive pulmonary disease" | | 41(42.7) |
| 16. | "A decreased arterial to end-tidal CO2 gradient is expected in pulmonary embolism" | | 35(36.5) |
| 17. | "End-tidal $CO_2$ pressure is affected by blood loss" | | 53(55.2) |
| | **Conditions affecting capnography waveform** | 56.1 (15.4) | |
| 18. | "A normal capnography waveform includes three expiratory phases" | | 18(18.8) |
| 19. | "A sudden decrease of capnography waveform to zero levels possibly indicates ventilator circuit disconnection" | | 74(77.1) |
| 20. | "The presence of a cleft in the waveform plateau indicates | | 57(59.4) |

| | | | |
|---|---|---|---|
| | spontaneous ventilation due to neuromuscular blockade recovery” | | |
| 21. | “Patients with asthma generally have normal capnography waveforms” | | 63(65.6) |
| 22. | “A rise in the baseline of capnography waveform above zero indicates” inadvertent patient extubation | | 37(38.5) |
| 23. | “Capnography waveform provides information about patient respiratory rate” | | 59(61.5) |
| 24. | “Evaluating quality of capnography waveform is necessary for accepting the numeric values of end-tidal CO2 pressure” | | 69(71.9) |
| | **Indications for capnography use** | 51.9(22.1) | |
| 25. | “Pulse oximetry provides much earlier warning for respiratory depression than capnography” | | 37(38.5) |
| 26. | “The use of capnography is recommended for patients who receive high opioid doses” | | 69(71.9) |
| 27. | “Capnography provides valid readings only in intubated patients” | | 33(34.4) |
| 28. | “Wide use of capnography can be justified only in the operating room” | | 40(41.7) |
| 29. | “Capnography can be used for guiding the correct placement of nasogastric tubes” | | 51(53.1) |
| 30. | “The assessment of circulatory status during cardiopulmonary resuscitation can be conducted with capnography” | | 69(71.9) |

*M= Mean, SD= standard deviation*

According to the partcipants’ perception of capnography use, the analysis revealed that the perception have positive perception with mean was 3.4± 0.6. Also, nurses indicated “the capnography contributes to improving the safety of patient care” was the highest mean item (4.1±0.7), whereas “the capnography equipment is readily available” was used the lowest mean item (2.9±1.1), as seen in (Table 4-3).

**Table 4-3: perception of capnography use among nurses (N=96)**

| | **M(SD)** |
|---|---|
| “I am attracted to employment settings that use technology” | 3.5(1.1) |
| The capnography equipment easy to set up | 3.0(1.0) |
| The capnography equipment is readily available | 2.9(1.1) |
| The ETCO2 values are accurate | 3.7(8.0) |
| The capnography is easy to interpret | 3.1(1.0) |
| The capnography equipment interferes with patient care | 3.3(1.0) |
| The ETCO2 values assist in patient assessment | 3.4(.9) |

| | |
|---|---|
| "The capnography an efficient means of monitoring a patient's ventilator status during transport" | 3.4(1.0) |
| "The capnography contributes to improving the safety of patient care" | 3.6(1.0) |
| "I recommend availability of capnography to other emergency departments" | 3.6(1.0) |
| "I am aware of the limitations of capnography use" | 3.3(.9) |
| The capnography contributes to quality patient care | 4.1(.7) |
| "I am aware of the clinical rationale for the use of capnography" | 3.3(1.0) |
| Total perception | 3.4(0.6) |

*M= Mean, SD= standard deviation*

According to relationship between Participants' Knowledge of capnography and Selected Demographic Characteristics, the results of the Pearson correlation test and biserial correlation test revealed that only the relationship was significant between knowledge of copnography and experience with capnography ($P < .05$), as seen in (Table 4-4).

**Table 4-4. Correlating factors of nurses knowledge about capnogaphy use**

| **Factors** | **R** | **p-value** |
|---|---|---|
| **Age** | - 0.107 | .300 |
| "How long have you been a registered nurse" | - 0.142 | .166 |
| "How long have you worked in this emergency department"؟ | 0.188 | .067 |
| "How long have you had experience with capnography" | 0.203 | .048 |
| | **p.b.r** | **p-value** |
| Gender | - 0.086 | .403 |
| "Have you used capnography on intubated patients in this emergency department؟" | - 0.046 | .654 |
| "Have you had experience with capnography outside of this emergency department؟" | .0.046 | 0.658 |
| "Educational level" | 0.036 | .728 |

"Correlation is significant at the 0.01 level (2-tailed)".**
"Correlation is significant at the 0.05 level (2-tailed)".*

# Chapter Five

# Discussion, Recommendation, and Conclusion

## 5.1 Introduction

In this chapter, discussion, conclusions, and recommendations will be explained. The conclusion will be formulated according to the purpose of the study. “The purpose of this study was to examine the nurses’ knowledge and use of capnography monitoring, as well as the nurses’ perception use of capnography monitoring for emergency departments’ patients experiencing cardiac arrest in the North West Bank Hospitals.”

## 5.2. Discussion

Nurses’ knowledge pertaining to clinical devices used for monitoring, assessing، and treating patients with heart conditions is an important factor for achieving quality of patient care and organizational effectiveness (Cook & Harrop-Griffiths, 2019). Measurement of ETCO2 level was a non-invasive method, recommended in the ACLS guidelines of the AHA for monitoring the resuscitation process for patients with cardiac arrest (Lui et al., 2016). Nurses have an important role in measurement of ETCO2 level. Nurses have an ability to assess ETCO2 waveforms helps distinguish equipment malfunction from changes in the patient’s condition (Farhat et al., 2019).

The results of this study indicated that nurses’ knowledge of capnography was low. These results were consistent with previous studies. Studies conducted by Lin et al. (2017), Novais and Moreira (2015), and Pantazopoulos et al. (2015)alluded to the

lack of knowledge among nurses in using capnography as recommended by the ACLS to capture pertinent information about a patient's end-tidal carbon dioxide (ETCO2) condition. These researchers found that such low awareness of this approach presents uncertainties and poor clinical monitoring practices.

Chee et al. (2021) found in their study that understanding the relevance of the Capnography waveforms findings and subsequent clinical management was poor. The study conducted to assess the adequacy of knowledge among 48 ER's in Malaysia. Also, the results of this study was consistent with Czyż et al. (2018) who reported that Emergency Medical Service providers have lack of knowledge and experience in use of devices to measure end expiratory carbon dioxide concentration (EtCO2). In addition, a mixed method study conducted by Langhan et al. (2014) reported that while several participants' exuded confidence and comfort with their knowledge about capnography, we observed significant knowledge gaps irrespective of comfort level. One physician repeatedly stated that capnography was a measure of oxygenation.

This study revealed that only 33(34.4%) of the participants reported that they have you used capnography on intubated patients in this emergency department or had experience with capnography outside of this emergency department. Probable reasons included EtCO2 is not an important vital sign in Palestine, it is not widely available throughout the country, and Partial pressure of Carbon dioxide (PaCO2 )level is available in arterial blood gases test.

However, the results of this study was inconsistent with Wylie et al. (2019) who reported in their study that the knowledge around capnography and its usage was

good in most areas. The study was conducted on qualified paramedics in a private ambulance service in South Africa.

The literature suggested that capnography can significantly improve the practices of resuscitation and CPR (Haines, 2017; Kerslake & Kelly, 2016; Panchal et al., 2019). According to the European Resuscitation Council, capnography use enables the detection of ROSC "without pausing continuous chest compressions thereby improving quality of resuscitation and preventing the potential harm caused by administering a further bolus of adrenaline after ROSC" (as cited in Kerslake & Kelly, 2016, p. 180). Therefore, nurses must possess the knowledge regarding capnography to use it appropriately during resuscitation activities and must have the ability to recognize vital signs associated with ROSC.

Whitaker and Benson (2016) indicated that approximately 74% of deaths could be prevented if capnography monitoring were implemented as standard practice. The primary goal of this strategy is to improve patient safety. Hence, Whitaker and Benson (2016) also recommended using a standardized protocol and providing nurses with additional training. Such education would fill the gaps in knowledge and understanding of the interpretation of capnography.

According to perception of nurses towards capnography use, the results of this study indicated that nurses' perception was positive. However, their knowledge of capnography scores did not reflect their positive perception. These results were supported by previous studies that assessed nurses' attitudes regarding capnography use. Clark et al. (2018) found that the mean for the level of perceived impact of capnography use on patient safety was 3.86.

Also, the current study revealed a significant relationship between knowledge of capnography and experience of using capnography. The results of the current study were consistent with Iyer et al. (2015) who reported that previous experience using capnography have been shown to demonstrate a higher comfort level with its use.

### 5.3 Recommendations of the study

Keeping in view of the results of the current study, the researcher recommends the following recommendations:

- Additional lecture and training for nurses should be given by governmental Hospitals to increase nurse's knowledge about uses, perception of capnography during CPR in emergncy department
- Capnography guidelines and policies should be made available by health policy makers.
- Future studies should look at a wider range of participants, including nurses from different units and locations, acknowledging their work experience and specialization.
- Also recommended that healthcare providers receive education on the value of capnography use for ICU CPR codes. As demonstrated in the review of literature, such training is important because it broadens nurses' scope of knowledge and provides new information on the use of capnography.

### 5.4. Limitations of the study

The current study has some limitations. The study relied on a self-reported questionnaire, which could lead to reporting bias due to the respondent's interpretation

of the questionnaire or desire to express their experiences. The cross-sectional design of the study does not allow for the identification of true cause-and-effect relationships. Additionally, the data was collected from North West Bank hospitals. Therefore, the generalizability of the findings might be affected and may not represent the perceptions of nurses in other districts of Palestine

.

## 5.5 Strengths of the study

The response rate was high. This study also marked as the first study in the West Bank hospitals among nurses studying the nurses' knowledge of capnography use.

## 5.6 Conclusion

Based on the results of this study, most of the nurses had low level knowledge toward Capnography. Also, the study confirmed that the nurses had positive perception towards capnography use in emergency departments for resuscitation patients with cardiac arrest. In addition, the study indicated significant relationship between experience nurses with capnography use and knowledge of capnography.

Further education in the interpretation of waveform capnography is needed and may proof of value for the nurses and medical staff in understanding and utilizing waveform capnography to its optimal potential in the Palestine health settings

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**Appendixes**

# Appendix A

## Questionnaire

**Part One: Demographic data**

Age _____

Gender _____ Female _____ Male

How long have you been a registered nurse? _____ Years

How long have you worked in this emergency department? _____ Years

How long have you had experience with capnography? _____ Years

Have you used capnography on intubated patients in this emergency department?
Yes
No

Have you had experience with capnography outside of this emergency department?
Yes
No ___

Educational level practical nurse
Staff nurse
Head nurse

**PART Two: Nurses' Knowledge about Capnography Test (NKCT) Items**

| | | True | False |
|---|---|---|---|
| | **Principles of capnography function** | | |
| **1** | Capnography refers to the measurement of exhaled CO2 partial pressure during the expiratory phase or respiration | | |
| **2** | Normal values of end-tidal CO2 pressure range between 35 and 45 mmHg | | |
| 3 | The major disadvantage of directly measuring CO2 (mainstream analysis) is that it can be used only in intubated patients | | |
| 4 | Capnography provides real-time, or minimally delayed, readings | | |
| **5** | The major disadvantage of sampling exhaled CO2 through a tube to a distant analyzer is that the endotracheal tube can be pulled | | |
| **6** | Capnography is an indicator of adequacy of ventilation | | |
| **7** | Capnography is based on the emission of infrared radiation by CO2 molecules | | |
| 8 | The sampling port should be kept upright to avoid the effect of water vapor pressure measurements | | |
| 9 | The normal arterial to end-tidal CO2 gradient is 5—10 mmHg | | |

**Conditions affecting end-tidal CO2 pressure**

| | |
|---|---|
| 10. | Pulmonary embolism is generally followed by end-tidal CO2 pressure increase |
| 11. | A gradual decrease of end-tidal CO2 pressure is expected in patients who become hypothermic |
| 12 | Decreased end-tidal $CO_2$ pressure levels are expected in septic patients |
| 13 | Partial airway obstruction leads to decreased end-tidal $CO_2$ pressure |
| 14 | A large increase of end-tidal $CO_2$ pressure may be an early sign of malignant hyperthermia |
| **15.** | Arterial to end-tidal $CO_2$ gradient is lower than normal in patients with chronic obstructive pulmonary disease |
| 16. | A decreased arterial to end-tidal CO2 gradient is expected in pulmonary embolism |
| 17. | End-tidal $CO_2$ pressure is affected by blood loss |

### Conditions affecting capnography waveform

| | |
|---|---|
| 18. | A normal capnography waveform includes three expiratory phases |
| 19. | A sudden decrease of capnography waveform to zero levels possibly indicates ventilator circuit disconnection |
| 20. | The presence of a cleft in the waveform plateau indicates spontaneous ventilation due to neuromuscular blockade recovery |
| 21. | Patients with asthma generally have normal capnography waveforms |
| 22. | A rise in the baseline of capnography waveform above zero indicates inadvertent patient extubation |
| 23. | Capnography waveform provides information about patient respiratory rate |
| 24. | Evaluating quality of capnography waveform is necessary for accepting the numeric values of end-tidal $CO_2$ pressure |

| | Indications for capnography use |
|---|---|
| 25. | Pulse oximetry provides much earlier warning for respiratory depression than capnography |
| 26. | The use of capnography is recommended for patients who receive high opioid doses |
| 27. | Capnography provides valid readings only in intubated patients |
| 28. | Wide use of capnography can be justified only in the operating room |
| 29. | Capnography can be used for guiding the correct placement of nasogastric tubes |
| 30. | The assessment of circulatory status during cardiopulmonary resuscitation can be conducted with capnography |

**PART Three: Please rate how strongly you agree or disagree with each of the following statements by placing a check mark in the appropriate box.**

| Item | Strongly disagree | disagree | Neutral | agree | Strongly agree |
|---|---|---|---|---|---|
| I am attracted to employment settings that use technology | | | | | |
| The capnography equipment easy to set up | | | | | |
| The capnography equipment is readily available | | | | | |
| The ETCO2 values are accurate | | | | | |
| The capnography is easy to interpret | | | | | |
| The capnography equipment interferes with patient care | | | | | |
| I find ETCO2 values assist in patient assessment | | | | | |
| The capnography an efficient means of monitoring a patient's ventilator status during transport | | | | | |
| The capnography contributes to improving the safety of patient care | | | | | |
| I recommend availability of capnography to other emergency departments | | | | | |
| I am aware of the limitations of capnography use | | | | | |
| The capnography contributes to quality patient care | | | | | |
| I am aware of the clinical rationale for the use of capnography | | | | | |

# Appendix B


State of Palestine
Ministry of Health
Education in Health and Scientific Research Unit

دولة فلسطين
وزارة الصحة
وحدة التعليم الصحي
والبحث العلمي


Ref.: ………………
Date:………………

الرقـــم: ٢٠٢٢/٨٠٩/٤٦١
التـاريخ: ٢٠٢٢/٥/١٩

**الأخ مدير عام الادارة العامة للمستشفيات المحترم،،،**

**تحية واحترام،،،**

**<u>الموضــوع: تسهيل مهمة بحث</u>**

يرجى التكرم بتسهيل مهمة الطالبة: **غيداء زكريا ياسين زيد، ماجستير تمريض طوارئ- الجامعة العربية الامريكية،** لعمل بحث بعنوان:

" Nurses' Perceptions of Using Capnography during Resuscitation of Patients in emergency department "

حيث ستقوم الطالبة بجمع معلومات من خلال تعبئة استبانة الدراسة من الممرضين/ات، وذلك في:

- **مستشفى رفيديا – مستشفى الوطني- مستشفى جنين- مستشفى طولكرم**
- **مستشفى طوباس – مستشفى قلقيلية – مستشفى سلفيت**

وذلك تحت اشراف د. داليا طوقان.

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. وابراز 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،،،**

**د. عبد الله القواسمي**
**رئيس وحدة التعليم الصحي والبحث العلمي**

نسخة: عميد كلية الدراسات العليا المحترم/ الجامعة العربية الامريكية


Telfax.:09-2333901 scientificresearch.dep@gmail.com 09-2333901 :تلفاكس

# Appendix C

Arab American University

Faculty of Graduate Studies

الجامعـــة العربيـــة الأمريكيـــة

كلية الدراسات العليا


2022-3-20

الى من يهمه الامر

تسهيل مهمة بحثية

تحية طيبة وبعد،

تهديكم كلية الدراسات العليا في الجامعة العربية الأمريكية أطيب التحيات، وبالإشارة الى الموضوع أعلاه، تشهد كلية الدراسات العليا في الجامعة أن الطالبة **غيداء زكريا ياسين زيد** والتي تحمل الرقم الجامعي 202012872هي طالبة ماجستير في الجامعة العربية الامريكية تخصص تمريض طوارىء، وتعمل على دراسة بحثية بعنوان:

" ادراك الممرضين لاستخدام مقياس ثاني أكسيد الكربون أثناء انعاش المرضى بقسم الطوارئ " تحت إشراف الدكتورة داليا طوقان، نأمل من حضرتكم الايعاز لمن يلزم لمساعدتها للحصول على المعلومات اللازمة للدراسة، علماً أن المعلومات ستستخدم لغاية البحث فقط، وقد أعطيت هذه الرسالة بناءً على طلبها.

وتفضلوا بقبول فائق الاحترام،،،

عميد كلية الدراسات العليا

د. نوار قطب

Jenin Tel: +970-4-2418888 Ext.:1471,1472 Fax: +970-4-2510810 P.O. Box:240
Ramallah Tel: +970-2-2941999 Fax: +970-2-2941979 Abu Qash - Near Alrehan
E-mail: FGS@aaup.edu ; PGS@aaup.edu Website: www.aaup.edu

**Appendix D**

KIEKKAS PANAGIOTHS <kiekkpan@otenet.gr>

To: Ahmad Juma Ibraheem Ayed

Fri 3/10/2023 12:19 PM

Thank you for your interest in our work. From pur part, you have every permission to use this scale.

Good luck with your study.

P. Kiekkas, Professor

Στις 2023-03-10 11:09, Ahmad Juma Ibraheem Ayed έγραψε:

> Dear Dr. Kiekkas
>
> My student in nursing master program need the permission to use your scale of "assessment ofnurses' knowledge on capnography" . we will make proper citation
>
> Best regards,
>
> Dr. Ahmad Ayed

# ملخص الدراسة


**خلفية الدراسة**

يشكل توقف القلب تهديدًا كبيرًا للمرضى في وحدات الرعاية الطارئة وهو عامل مهم يمكن أن يؤدي إلى وفاة المريض إذا لم تتم معالجته في الوقت المناسب. نتيجة لذلك، تمت دراسة استخدام الكبنوغرافي لتحسين نتائج المرضى أثناء توقف القلب على نطاق واسع في الأدبيات.

**هدف الدراسة:** كان الغرض من هذه الدراسة هو فحص معرفة الممرضات واستخدامهم لرصد كابنوغرافي، بالإضافة إلى استخدام تصور الممرضات لرصد كابنوغرافيا لمرضى أقسام الطوارئ الذين يعانون من توقف القلب في مستشفيات شمال الضفة الغربية.

**طريقة البحث:** دراسة وصفية مقطعية مكونة من ست وتسعين ممرضة من أقسام الطوارئ في المستشفيات الحكومية في شمال الضفة الغربية. أجريت الدراسة من خلال استبيان ذاتي.

**النتائج:** أظهر التحليل أن معظم المشاركين 77 (80.2٪) لديهم معرفة منخفضة بالتصوير الكبنوجرافي. أيضًا، كان تصور المشاركين لاستخدام الكابنوغرافيا تصورًا إيجابيًا بمتوسط كان 3.4 ± 0.6. وأظهر الارتباط أن العلاقة فقط كانت ذات دلالة إحصائية بين معرفة علم التصوير الفوتوغرافي والخبرة مع استعمال الكبنوغرافي (<.05).

**الاستنتاج**

خلصت الدراسة إلى أن معظم الممرضات لديهم مستوى منخفض من المعرفة اتجاه الكابنوغرافيا. كما أكدت الدراسة أن لدى التمريض تصور إيجابي تجاه استخدام كابنوغرافيا في أقسام الطوارئ لإنعاش مرضى السكتة القلبية. بالإضافة إلى ذلك، أشارت الدراسة إلى وجود علاقة ذات دلالة إحصائية بين الممرضين ذوي الخبرة مع استخدام كابنوغرافيا ومعرفة كابنوغرافيا.


**الكلمات المفتاحية:** كابنوغرافيا، قسم الطوارئ، ممرضة، إنعاش، سكتة قلبية