Original Article

Noninvasive ventilation utilization in the Kingdom of Saudi Arabia: Results of a national survey

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Abstract:

INTRODUCTION: Noninvasive ventilation (NIV) has been extensively used globally and is often administered as the first-line treatment. Currently, data regarding the utilization of NIV in the Kingdom of Saudi Arabia (KSA) is scarce. The present study aimed to assess and quantify the utilization of NIV in clinical practice across the KSA and investigate obstacles that may cause NIV underutilization.

METHODS: A web-based survey composed of a 31-item, self-administered questionnaire was developed and validated. The questionnaire was designed to obtain general information about each hospital, availability of NIV practice, use of NIV, and obstacles that can hinder NIV use in clinical settings; the survey was sent to senior respiratory therapists (RTs) of 76 hospitals. Descriptive statistics were used to analyze the data.

RESULTS: Sixty-one hospitals (80.3%) responded to the survey (47 governmental and 14 private). NIV was available in all hospitals and all the Intensive Care Units. The majority of RTs (85%) reported having a good experience with NIV, with a confidence rate of 60%; however, only 22% of the RTs had received formal training. Although NIV setup was the sole responsibility of RTs, only 69% participated in NIV management. Moreover, 72% of hospitals had an NIV setup protocol in place. However, 50% of them lacked a protocol for NIV failure. NIV protocols for specific indications were present in 64% of the hospitals: 47.2% for monitoring and 42% for weaning. The perceived efficiency of NIV practice was low in the medical wards, with a <49% success rate in 39% of the hospitals. Shortage of staff and lack of formal training were the most common reasons for NIV underutilization.

CONCLUSION: The efficiency of NIV in the KSA was low. The RTs expressed moderate confidence in administering NIV. Lack of appropriate exposure and formal training could have negative impacts on NIV practice.

Keywords:

Hospital, noninvasive ventilation, respiratory therapists, Saudi Arabia, survey, utilization

Noninvasive ventilation (NIV), which is the delivery of positive pressure ventilation to the upper airway without an invasive artificial airway, has been extensively used in clinical practice over the past two decades.[1] NIV is commonly indicated for patients with acute respiratory failure secondary to exacerbation of chronic obstructive pulmonary disease (COPD), acute cardiogenic pulmonary edema,[2] and immunocompromised states.[3] NIV is also recommended for patients with acute hypoxemic respiratory failure.[4] Moreover, several studies have shown that NIV reduces the need for endotracheal intubation, hospital stay duration, and morbidity and mortality rates.[5-7]

Despite the large body of evidence in favor of the use of NIV, there exists wide variations in the actual utilization of NIV globally.[8-13] In a large prospective NIV

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study conducted by Carlucci *et al*. over a 3-week period surveyed 42 Intensive Care Units (ICUs) in Europe revealed that NIV was administered in only 16% of cases with various respiratory failure.[14] In the UK, NIV was available in 48% of 264 hospitals, but its application varies significantly across the country.[15] Lack of knowledge and experience regarding NIV, as well as technical issues related to ventilators and interfaces might be the cause for the lower utilization of NIV.[8] Although overall NIV was underutilized, the use of such therapeutic modalities outside ICUs, including medical wards, postsurgical recovery units, and emergency rooms has increased.[16,17]

Currently, data regarding the utilization of NIV in Saudi Arabia are not available. Therefore, the aim of the present study was to assess and quantify the utilization of NIV in clinical practice in Saudi Arabia. We also sought to describe obstacles that could hinder NIV use in hospitals.

Methods

Questionnaire

A web-based survey composed of a 31-item, self-administered questionnaire was developed and validated by a senior respiratory therapist (RT) and a senior consultant intensivist, whom expertise in NIV practice and involved in training programs in NIV management. The survey used a convenience sampling method and study took place between September 10, 2016 and March 2017. The questionnaire was designed and constructed based on the literature review on studies assessed the utilization of NIV at different settings and contained a structured response that involved multiple-choice responses and Likert scales in three separate sections. Section 1 contained respondents' demographics information (e.g., practice type, location, number of beds, experiences and training background). Section 2 contained questions about the utilization and availability of NIV in each practice. Respondents' length of experiences, role of the practitioner, and level of confidence with NIV practice were included. Other questions were related to the NIV machine (e.g., setup, type of modalities, and interfaces) and NIV practice (e.g., NIV failure management, protocols, success and failure rate). One question assessed respondents' knowledge about indications of NIV treatment (e.g., COPD exacerbation, acute cardiogenic pulmonary edema, asthma, thoracic trauma, pneumonia in immunocompromised patients, pneumonia in non-immunocompromised patients, palliation, neuromuscular diseases and postoperative respiratory failure). Section 3 was designed to assess obstacles that could hinder NIV use in clinical settings. A participation request with a link to the questionnaire was sent directly through e-mail to senior RTs in 76 hospitals nationwide. Follow-up e-mails and phone calls were conducted to remind participants to reply to the survey. Hospitals with no respiratory care departments were excluded from the study. The study was approved by the Research Ethics Committee at Prince Sultan Military College of Health Sciences (study reference IRB-2016-02-03).

Statistical analysis

Descriptive statistics (absolute values and proportions) were used to analyze responses to the survey and to summarize respondent characteristics. Bar and pie charts were used as appropriate. Data were analyzed using GraphPad Prism 7 software (GraphPad Software Inc., La Jolla, CA, USA).

Results

A total of 61 hospitals (47 government and 14 private) were surveyed, with a response rate of 80%. Table 1 presents

Table 1: Respondent characteristics

	n (%)
Geographic region	
Central	20 (32.8)
Eastern	22 (36.1)
Western	10 (16.4)
Southern	6 (9.8)
Northern	3 (4.9)
Type of practice	
Governmental	47 (77)
Private	14 (23)
Years of experience	
<10	1 (1.6)
11-15	17 (27.9)
16-20	34 (55.7)
>20	9 (14.8)
Number of beds	
<100	3 (4.9)
101-300	24 (39.3)
301-600	27 (44.3)
>600	7 (11.5)
NIV utilization	
ICUs	61 (100)
Medical wards	48 (78.3)
Surgical wards	38 (62.2)
Emergency room	36 (59.5)
Other	17 (27)
NIV modalities used	
CPAP	54 (88.5)
Pressure support ventilation	60 (98.3)
Pressure controlled	15 (24.6)
Volume controlled	0
Other	3 (4.9)
Number of NIV apparatus/hospital	
1-5	21 (34.4)
6-10	8 (13.1)
>10	32 (52.5)

CPAP=Continuous positive airway pressure, NIV=Noninvasive ventilation, ICUs=Intensive Care Units

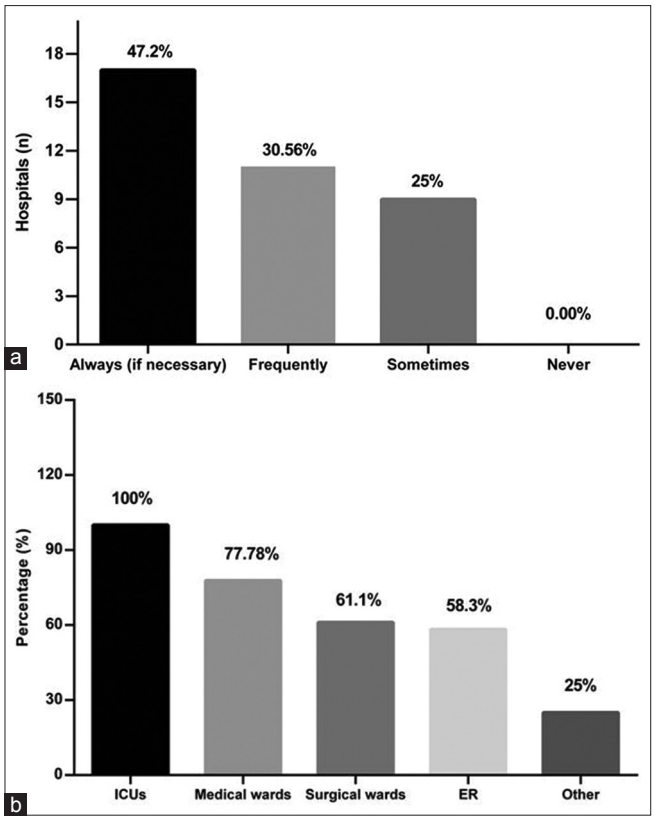

Figure 1: (a) The frequency of noninvasive ventilation utilization in the hospitals. (b) The utilization of noninvasive ventilation in different hospital units

the respondent characteristics. NIV was available in all surveyed hospitals. Figure 1a illustrates the frequency of NIV utilization in the hospitals. NIV was accessible in all ICUs, 78% of medical wards, 61% of surgical wards, 58% of emergency departments, and 25% of other areas. Figure 1b illustrates the utilization of NIV in different hospital units.

The survey data showed that only 28% of hospitals did not have an NIV setup protocol in place. Interestingly, 72% of the hospitals had a setup protocol, but 50% of them had no protocol for NIV failure. However, 64% of hospitals had NIV protocols for specific indications such as weaning (42%) and monitoring (47%).

The perceived efficiency of NIV practice was low for the medical wards, with a success rate of <49% in 39% of the hospitals. Shortage of staff and lack of formal training were the most common reasons for NIV underutilization [Figure 2]. NIV was identified as a first-line option for patients with COPD exacerbation and acute cardiogenic pulmonary edema in 92% and 89% of cases, respectively. Figure 3a shows the respondents' knowledge of the indications for NIV application.

Skin lesions due to the face mask and lack of patient compliance were considered the most common complications associated with NIV, at 81.1% and 78.4%,

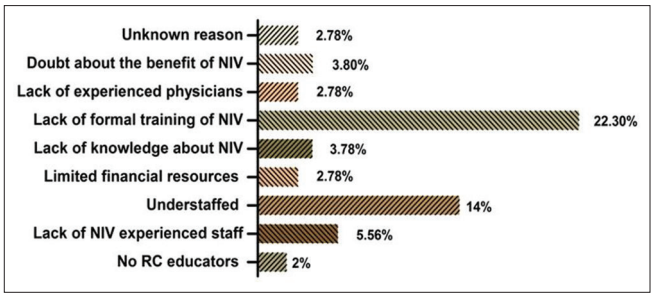

Figure 2: The most common reasons for noninvasive ventilation underutilization

respectively. Based on their experience, the respondents reported the most common causes of NIV failure in medical wards as deterioration in gas exchange and level of conciseness [Figure 3b]. Furthermore, 85% of RTs reported a favorable experience with NIV, with a confidence rate of 60% when faced with a patient requiring NIV [Figure 4]. However, only 22% of RTs had received formal training. Although NIV setup was the sole responsibility of the RTs in all hospitals, only 69% played a role in NIV management.

Discussion

To the best of our knowledge, this study represents the first attempt to present data regarding NIV utilization in Saudi Arabia. The data showed that NIV was available in all hospitals that responded to the survey and was very commonly utilized in ICUs and less frequently in emergency rooms. NIV was commonly utilized for COPD, cardiogenic pulmonary edema, and postoperative patients. The data also showed a variation among hospitals regarding the utilization of NIV protocols.

NIV utilization in ICUs has gained much attention. Several studies have discussed the increased use of NIV in clinical practice. However, NIV utilization has been shown to vary across European countries, with increased use in some countries such as Italy.[3] However, the utilization rate has been shown to be lower in other countries such as the United Kingdom[16,17] and North America.[8] Similarly, a French study reported a significant increase in NIV utilization in 70 ICUs over the past 5 years. The NIV utilization rate increased from 16% to 24% in ventilated patients and 35%–52% in newly ventilated patients.[18] In contrast, in German ICUs, NIV utilization rate was only 10% in majority of the units;[19] while in the United States in the New England, NIV utilization rate in acute care hospitals was found to be 20%.[5] A previous international report that investigated 349 ICUs across 23 countries showed a significant increase in NIV utilization. NIV use doubled in 2004 compared to the rate in 1998 in subgroups of patients such as those with COPD and congestive heart failure. This led to a

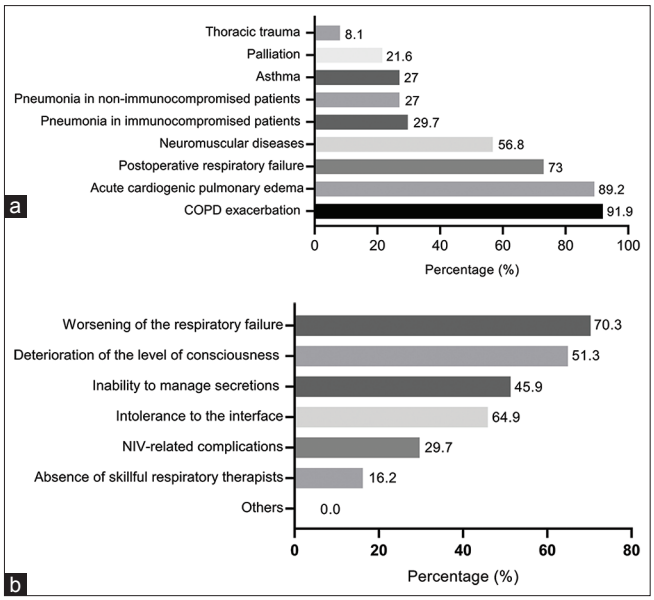

Figure 3: (a) The respondents' knowledge of the indications for noninvasive ventilation application. (b) The most common causes of noninvasive ventilation failure in medical wards

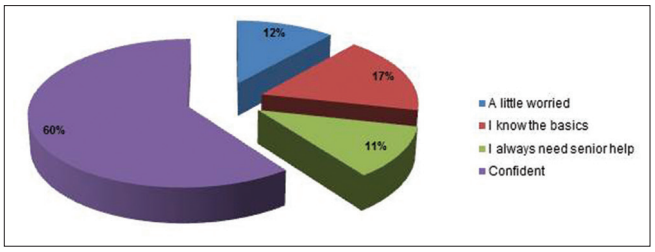

Figure 4: Respondents' confidence rate when faced with a patient requiring noninvasive ventilation

50% reduction in the utilization of invasive mechanical ventilation, which was considered a first-line ventilation modality, in these subgroups.[1] NIV was also associated with lower mortality rates, lower need for intubation, and significant improvement in blood gases after 1 h of application.[20,21] In a Saudi study conducted by Khalid *et al*. to evaluate the outcomes of NIV initiations for respiratory distress patient on the general wards, showed early use of NIV by rapid response teams significantly reduced the need for intubation.[22] The present data showed that NIV utilization was a common practice in all ICUs. However, our survey was neither designed nor intended to identify the reasons for increased utilization in ICUs. Nevertheless, one can speculate that evidence-based medicine has translated into practice. This was true for utilization of NIV for COPD[5,7,23] and cardiogenic pulmonary edema[2,24] patients, as has been demonstrated in the present data.

The present data showed that all hospitals confirmed the availability of NIV. However, NIV was implemented in only 47% of situations where it should be used. There were several reasons to explain NIV underutilization. The lack of appropriate formal training, unavailability of trained and experienced staff, and shortage of staff were the main reasons. Our data were consistent with those of several previous studies. In 2009, a large survey conducted in Veteran Affairs Hospitals in the USA revealed that NIV was widely available but underutilized and applied in both monitored (ICU, stepdown, emergency department) and unmonitored (ward) settings. The barriers for appropriate NIV utilization included lack of knowledge, experience, and shortage of staff.[2] Similarly, lack of knowledge, shortage of staff, and inadequate equipment were reported in another regional survey.[8] In addition, NIV might be considered a relatively new treatment modality, and its implementation in respiratory failure treatment may be hindered by the need for acquisition of technology and training of key personnel.[16]

Although the majority of NIV studies were conducted in ICUs, some evidence showed that NIV can be successfully used in other unclosed environments such as medical wards and emergency rooms. Plant *et al*.[16] reported a 20% reduction in mortality rate and a more rapid improvement in blood pH with early administration of NIV for mildly and moderately acidotic COPD patients in the general ward. Fiorino *et al*.[25] reported a high efficacy of NIV for the treatment of patients with hypercapnic acute respiratory failure admitted to the general ward. The present data showed that the NIV utilization rate in the medical ward was 78%, although with a success rate of <49% in 39% of the surveyed hospitals. Although NIV was studied in general wards,[16] caution measures should be considered when NIV is initiated. Kaul *et al*. study on NIV utilization in 233 UK hospitals in the management of acute COPD, showed increased rate of in-hospital mortality by 26% and 37% at 90 days compared to those not receiving NIV.[26] The increased rate of mortality can be due to many factors such as sudden deterioration to patient condition due to lack of close monitoring, enough staffing,[27,28] poor patient selection,[27] and inexperienced or trained staff in using NIV implementation.[21,26]

Multiple randomized trials compared standard therapy alone to standard therapy plus NIV in patients with acute respiratory failure in emergency room settings and found that NIV improved outcomes when any of the following modes were used: assist control,[5] pressure support ventilation,[7] or bilevel positive pressure airway therapy.[29] The present data showed that NIV was not utilized in almost half of the emergency rooms. This rate could be improved through training and experience with NIV. Hess *et al*.[2] reported that 90% of RTs and 60% of physicians utilize NIV in the emergency room setting; in that study, 60% of RTs reported that NIV "takes no additional time" in the emergency room.

Respiratory care is a well-established profession in Saudi Arabia.[30,31] However, recent national surveys showed a significant shortage of RTs in hospitals.[31] Therefore, NIV underutilization in emergency rooms might be attributable to the shortage of RTs.

Although our data show that RTs were the frontline providers for NIV setup, only 69% were actually involved in NIV management. Brochard *et al*.[7] showed that NIV efficacy was only moderate when RTs were involved compared to when physicians were involved, who tended to show a more optimistic view. Improving learning skills and NIV clinical experience have been shown to result in better success rates.[2] Nevertheless, although the majority of RTs had experience with NIV, only 21% had formal training. Such lack of training can explain the moderate confidence rate of 60%.

Limitations of this study

This survey was designed to assess only the practice of NIV utilization over a fixed period. Attitudes and perception toward NIV practice were not the focus of our study. We invited only senior RTs to participate in our survey because we believe that they were well oriented with NIV application in their practices. Another limitation was that physicians were not included; however, this would be an interesting topic to pursue in the future to better understand NIV utilization. Finally, the data presented in our study may be not generalizable to other populations.

Conclusion

The present findings provide important insights to the utilization of NIV in the Kingdom of Saudi Arabia and factors that may contribute to low NIV efficiency. With the substantial clinical benefits of NIV, improved teaching of such practice in curriculums, training programs, increased staffing, especially with the use of NIV outside ICUs, and guidelines are essential to increase the knowledge, confidence, and improving competence of NIV implementation. One method to do this would be to integrate NIV scenarios into simulation-based learning which may lead to higher rates of utilization and success. As evidence supporting the clinical benefits of NIV, strategies to improve care of NIV-treated patients, enhancement of its safety, and appropriate use by health-care providers should evolve and be formally evaluated with follow-up assessments, surveys, and observational research studies.

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Conflicts of interest

There are no conflicts of interest.

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