

## Original Article

## Can Intensive Care Nurses Accurately Estimate Head of Bed Angle?

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### Abstract

**Background:** Ventilator-associated pneumonia (VAP) is common in intensive care units. One of the important practices for preventing VAP is the 30°–45° elevation head of bed (HOB) angle.

**Aim:** Determining whether or not intensive care nurses can determine the HOB required to prevent VAP formed the primary study objective.

**Methods:** The study was conducted with 36 intensive care nurses in an Education and Research Hospital. The data collection form developed by the researchers was used to collect demographic information in addition to the accuracy of the nurses' knowledge, practices, and estimations concerning the HOB angle required for VAP prevention. The HOB elevation estimates and accuracy of the nurses were measured by the researcher using an inclinometer.

**Results:** When asked about the recommended HOB angle to prevent VAP, 55.6% of the nurses responded with 45°, 22.2% responded with 30°–45°, and 11.1% responded with 30°. While 91.7% of the nurses used the estimation method when setting the HOB angle, only 48.5% stated that they were confident of their estimate and often set the intended HOB angle incorrectly. There were no significant relationships between the nurses' length of nursing experience or intensive care experience and nurses' accuracy when estimating the HOB angle.

**Conclusions:** The number of nurses who used the estimation method to determine the HOB angle was high, but the angle estimates were often incorrect. The importance of using an external angle indicator when setting the recommended HOB angle to avoid VAP should be emphasized in training programs.

**Key Words:** Estimation, head of bed angle, intensive care, nursing, ventilator-associated pneumonia

### Introduction

Ventilator-associated pneumonia (VAP) is one complication that may develop during mechanical ventilation (Klompas et al., 2014). It is one of the most common hospital infections in intensive care units (ICU) (Leblebicioglu et al., 2014; Venkataraman et al., 2018). VAP increases hospitalization time and increases costs. (Alp et al., 2012; Mathai et al., 2015; Luckraz et al., 2018). It has also been reported that VAP is associated with increased mortality (Tamayo et al., 2012; Inchai et al., 2015).

One of the important practices to prevent VAP is the head-of-bed (HOB) angle of 30°–45° in cases in which there are no medical contraindications (Tablan et al., 2004; American Association of

Critical-Care Nurses, 2017). However, some studies indicate that health professionals' compliance with this recommendation is low (Liu et al., 2013; Sachetti et al., 2014; Llauro-Serra et al., 2015). Knowledge and perceptions of ICU workers in addition to the method used to determine the angle may affect the level of compliance with this recommendation (Hiner et al., 2010). Estimation is one of the methods used by health professionals to determine the HOB angle (Hiner et al., 2010; Fitch et al., 2016). Studies show that the accuracy level of nurses estimating the HOB angle varies. In these studies, nurses were asked to estimate the angle set by the researchers (Dillon, Munro & Grap, 2002; Hiner et al., 2010). To the best of our knowledge, there is no study in which researchers objectively

measured and evaluated the accuracy of 30°, 45°, and 60° HOB angles set by intensive care nurses based on their own estimates. This study aimed to evaluate three parameters: (1) whether or not ICU nurses are able to determine HOB using the estimation method, (2) the accuracy of HOB 30°, 45°, and 60° elevation attempts of nurses based on their own estimates, and (3) nurses' knowledge levels concerning the recommended HOB angle to prevent VAP.

### Methods

This descriptive study was carried out in three different ICUs (cardiovascular surgery, medical, and coronary) of an Education and Research Hospital in Turkey between July and August 2017. Of the 73 nurses who worked in the ICUs in which the study was conducted, 36 nurses who cared for patients on mechanical ventilation and who volunteered to participate in the study formed the study sample.

**Data collection:** The research data were collected by the researchers using a data collection form, which was developed as a result of a literature review and consisted of three parts (Dillon et al., 2002; Hiner et al., 2010; Lyerla et al., 2010). The first part of the form involved questions about the nurses' age, sex, educational level, years of professional and intensive care experience, and the intensive care unit in which they worked. The second part included questions about the nurses' knowledge of the HOB angle that is required to prevent VAP, the actual HOB angle that they set when caring for patients on ventilation, and the methods that they used to determine the angle. This part also included a question about whether the nurses who used the estimation method thought that they had adjusted the HOB angle correctly. The third part of the form was used to record the nurses' HOB angle estimates. The measurements were made with an external inclinometer to assess the accuracy of the nurses' estimations of HOB angles. Prior to the study, the inclinometer was checked to ensure that measurements were correct as confirmed by the current bed-head angle indicator in an empty standard ICU patient bed in each ICU.

The research data were collected using a face-to-face interview method. The application took about 20 to 25 minutes. First, the nurses' demographic information and responses to the questions evaluating their knowledge and practice regarding VAP were recorded in the data

collection form. The nurses were then asked to make HOB angle predictions. A standard ICU bed with a healthy volunteer was used for nurses to make their HOB angle predictions. The volunteer laid in the supine position (with the head of the bed angle being 0°). The nurse was then asked to adjust the HOB angle to 30° based on her own estimation without using any external tools. After the nurse made the adjustment, an objective measurement of HOB angle was performed by the researcher who was using the inclinometer. After the first measurement, the head of the bed angle was set back to 0°. Then the nurse adjusted the HOB angle to an estimated 45°. The HOB angle was measured again by the researcher using the inclinometer. Finally, the head of the bed angle was adjusted to 0° once again. The nurse, based on her own estimation, adjusted the HOB angle to 60°, and the HOB angle was measured by the researcher using the inclinometer. All readings were recorded. The nurses did not use any external tools indicating the HOB angle while they were making the adjustments. Devices showing the HOB angle available on the beds were hidden during the implementation. The objective measurements made by the researcher were not shown to the nurses.

**Statistical methods:** Statistical analysis of the data was performed in computer environment using SPSS 15.00 for Windows (SPSS Inc., Chicago, IL, USA). Mean  $\pm$  standard deviation, number, and percentage were used to present descriptive statistics. Chi-square and Fisher's exact test was used to compare categorical data. The statistical significance level was set at  $p < 0.05$ .

**Ethical approval:** Approval from the ethics committee (the date of approval and number: 12.04.2017/1396) and permission from the institution were obtained for the study. Each ICU nurse who volunteered to participate in the study was informed about the research and provided verbal and written consent. The study was conducted in accordance with the principles of the Helsinki Declaration.

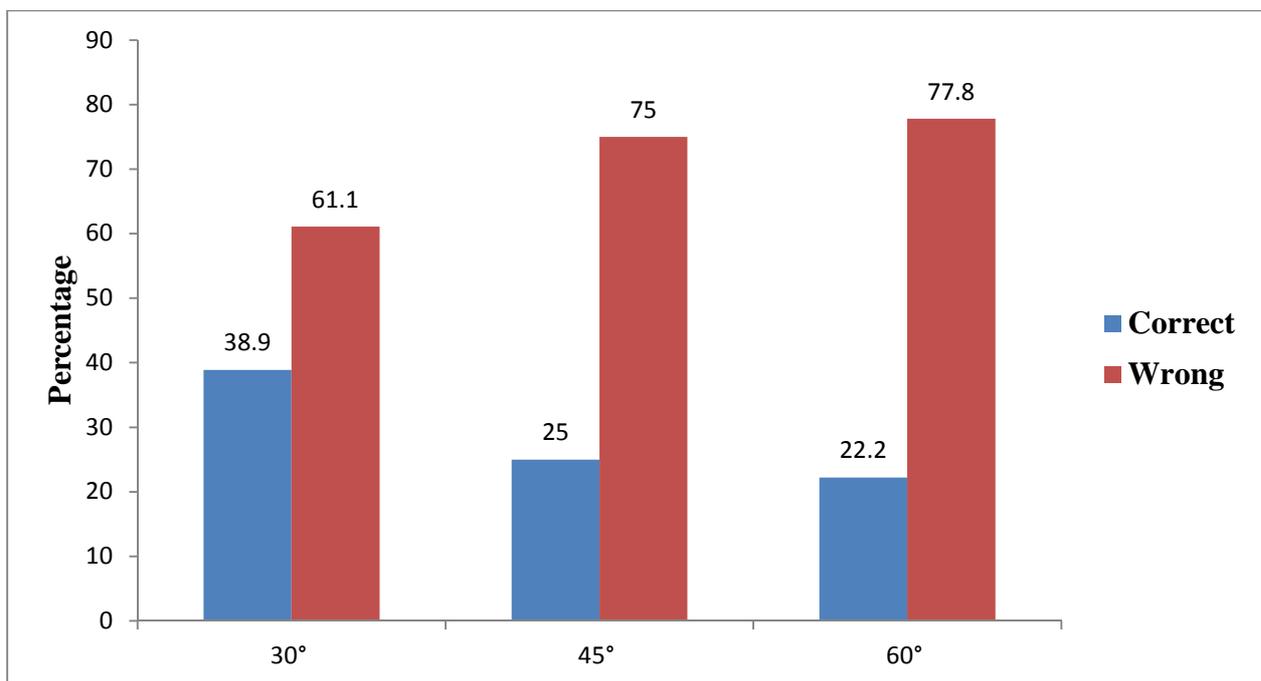
### Results

The mean age of the intensive care nurses was  $28.03 \pm 7.20$  (minimum=22, maximum=48). All of them were female, 97.2% had a bachelor's degree, and 2.8% had an associate degree. Over half (58.3%) of the nurses worked in the medical

ICU, 22.2% in the cardiovascular surgery ICU, and 19.4% in the coronary ICU.

The mean number of years of professional nursing experience was  $6.53 \pm 8.45$  years (minimum=1, maximum=30); 55.6% had less than five years of experience and 44.4% had five

or more years of experience. The year of ICU experience of the nurses was  $4.22 \pm 6.55$  years (minimum=1, maximum=30), 69.4% had less than five years of experience, and 30.6% had five or more years of experience.



**Figure 1.** The accuracy of head of bed angles elevation attempts of nurses based on their own estimates

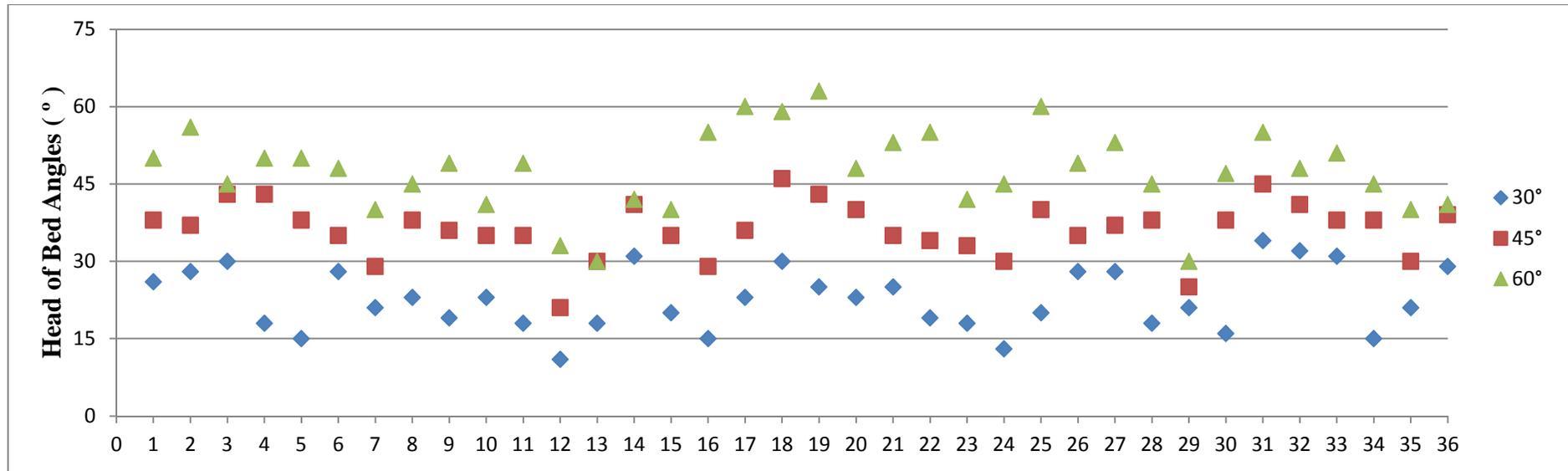


Figure 2. 30°, 45°, and 60° head of bed angles set by intensive care nurses based on their own estimates (n=36)

Over half (55.6%) of the nurses answered the question regarding the recommended HOB angle to prevent VAP in case of no medical contraindication with 45°, 22.2% with 30°–45°, 11.1% with 30°, 8.3% with 60°, and 2.8% stated that they did not know the recommended angle (the question was asked as an open-ended question to avoid biasing the nurses; and the values included each other since it was an open-ended question). In the absence of a medical contraindication, 44.4% of the nurses stated that they set the HOB angle to 45°, 30.6% to 30°–45°, 13.9% to 30°, 5.6% to 30°–60°, 5.6% to 45°–60° when caring for patients under mechanical ventilation. 91.7% of the nurses stated that they used the estimation method to determine the HOB angle, 2.8% used sometimes estimation and sometimes angle gauge, and 5.6% used angle gauge. Of the nurses who used the estimation method, 48.5% reported that they thought that they adjusted the HOB angle correctly using the estimation method, while 51.5% did not think that they made the correct adjustment.

Many of the nurses were observed to adjust the HOB angle using the estimation method. The nurses correctly ( $\pm 5^\circ$ ) estimated the HOB angle 38.9% of the time for 30°, 25% of the time for 45°, and 22.2% of the time for 60° (Figure 1). The nurses were often unable to adjust the HBO to the intended angle correctly using estimation, and these estimates were generally lower than they should have been (Figure 2).

There was no significant relationship between the nurses' length of nursing experience and their accuracy of estimating the 30°, 45°, and 60° HOB angle ( $\chi^2=0.707$ ,  $p=0.40$ ;  $\chi^2=0.00$ ,  $p=1.00$  and  $\chi^2=0.129$ ,  $p=1.00$  respectively.). There was no significant relationship between the nurses' length of ICU experience and their accuracy of estimating the 30°, 45°, and 60° HOB angle ( $\chi^2=0.043$ ,  $p=1.00$ ;  $\chi^2=0.044$ ,  $p=1.00$  and  $\chi^2=0.150$ ,  $p=1.00$  respectively.).

## Discussion

Results from the study indicated that almost all of the ICU nurses used the estimation method to determine the HOB angle. Contrary to our finding, Fitch et al. (2016) reported that only 6% of nurses always used the estimation method when adjusting the HOB angle. Hiner et al. (2010) noted that about a third of clinicians used the estimation method to determine the HOB

angle. The findings from our study suggest that the importance of using an objective angle indicator when adjusting the HOB angle should be emphasized in training programs for intensive care nurses. Angle gauges available on many intensive care beds can be used to adjust the HOB angle. In addition, some instruments have been suggested in the literature as an alternative to the angle indicators available on ICU beds (Williams, Chan & Kelly, 2008; Wolken et al., 2012; Thomas, 2017).

Hiner et al. (2010) conducted a study with 175 clinicians, 89 of whom were nurses, and found that half of the nurses correctly predicted the HOB angle. Dillon et al. (2002) conducted a study with 67 nurses and reported that the nurses were able to accurately predict HOB angle. In these studies, participants were asked to estimate the HOB angle that the researchers had previously set. In our study, the nurses were first asked to estimate and adjust the HOB angle, and the objective measurements were then made by the researchers, and the estimation accuracy was evaluated. In our study, the accurate estimation level of the nurses of 30°, 45°, and 60° angles was low. This finding can indicate that ICU nurses should also be aware of the possibility that their estimated HOB angle adjustments may be wrong.

In the present study, accurate estimation of the HOB angle had no significant relationship with years of nursing experience and/or years of ICU experience. Findings obtained by Dillion et al. (2002) were similar to our findings. These findings suggest that nurses should not rely on their estimations based on their professional and intensive care experience when adjusting the HOB angle.

One of the limitations of our study was the small sample size. Furthermore, the results of the study cannot be generalized to all intensive care nurses as they were obtained from intensive care nurses working in a single institution. Another limitation was that the HOB angle estimates were evaluated for a single measurement only.

**Conclusion:** It was found that most ICU nurses used the estimation method when adjusting the recommended HOB angle to prevent VAP, but the HOB angle estimates were mostly incorrect. We recommended that the education programs for ICU nurses should emphasize the importance of not relying on their estimates, and nurses

should always use an external angle indicator when adjusting the HOB angle. Studies in which multiple estimation measurements are made for an angle and having larger sample sizes are needed.

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