RESEARCH ARTICLES

Impact of non-invasive ventilation and non-medical caregiver presence on nursing workload – an observational study

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ABSTRACT

Objective: To find out if non-invasive ventilation (NIV) as a ventilation modality increases the burden on nursing personnel and give suggestions how the presence of non-medical caregivers in an ICU with an extreme staff shortage can reduce nursing workload during mechanical ventilation.

Background: Although the European Union offers good quality healthcare, there are middle-income countries in the alliance that suffer from nursing staff shortage. For example, Bulgaria needs two times more nurses than it has now to meet the needs of its healthcare system. This calls for strategies that reduce nursing workload as much as possible. There is a common perception that NIV is more time-consuming for nurses compared to invasive mechanical ventilation (IMV) but only a few studies discuss the matter and none of them are settled in the unique environment where medical and non-medical caregivers provide direct patient care as a team.

Study design and methods: This is an observational study conducted in a specialised respiratory ICU with trained nurses, physiotherapists, and non-medical caregivers in a university hospital in Bulgaria. Ninety adult patients (43 on NIV and 47 on IMV) with acute respiratory failure that were on mechanical ventilation for at least five days were included. Nursing workload was measured via the Nursing Activities Score (NAS). Average and daily NAS were compared between groups. Then individual components of the score were analysed to determine which activities have the greatest impact on nursing workload.

Results: Average (39.72 ± 6.35 vs 46.08 ± 5,66, p< 0.001) and daily NAS for the first five days of mechanical ventilation and was significantly higher in the IMV group. There was a substantial drop of nurse workload with time in both groups, more significant for the patients who ventilated invasively. It occurred on the second day in both groups (NIV: p=0.005, 95%CI: 0.88-4.52; IMV: (p<0,001, 95%CI: 2.72-7.03). NIV patients required more time for monitoring but less for hygiene, fluid administration and nutrition. IMV patients also required specific care for their artificial airway and took more time for lung function improvement procedures.

Conclusion: In a setting where direct patient care is provided by both formally trained nurses and non-medical caregivers IMV was associated with a higher nursing workload than NIV.

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Implications for research, policy, and practice: In a situation with an extreme staff shortage some of the non-medical nursing activities involving patients on NIV can be potentially transferred to trained non-medical caregivers.

What is already known about the topic?

- According to the World Health Organization in 2018 there was a nurse shortage of around six million and by 2030 it will increase to 36 million. This negative trend is most prominent in low- and middle-income countries.
- There is a common perception that NIV is more time-consuming for nurses compared to IMV but only a few research groups address this matter.
- NIV may require additional time from nursing personnel mainly because of problems with mask fit, skin breakdown and maintenance of an optimal position in bed. NIV is more time-consuming in the first 48 h but then becomes much less demanding.

What this paper adds

- This is the first study where the ICU nursing workload during NIV and IMV is compared in a setting where non-medical caregivers have a substantial role in direct patient care.
- In a setting where direct patient care is provided by both formally trained nurses and non-medical caregivers IMV was associated with a higher nursing workload than NIV.
- In a situation with an extreme staff shortage some of the non-medical nursing activities involving patients on NIV (like help with self-hygiene, food, and water intake) can be potentially transferred to trained non-medical caregivers under supervision.

Keywords: Nursing staff; ICU; intensive care nursing; critical care nursing; mechanical ventilation; non-invasive ventilation

BACKGROUND

Nurses are the foundation of all modern healthcare systems. They are the ones most involved in direct patient care and the requirements towards their education and competence are constantly increasing. According to the World Health Organization in 2018 there was a nurse shortage of around six million and by 2030 it will increase to 36 million. This negative trend is most prominent in low- and middle-income countries.[1]

Although the European Union has good quality of healthcare overall, there are middle-income countries in the alliance that suffer from an extreme nursing staff shortage. Because high-income countries offer better working and living conditions many nurses from Eastern Europe choose to practice in Central and Western Europe.[2] According to the most recent data from The National Statistical Institute of Bulgaria (an Eastern European middle-income country) only 17,179 doctors and 18,352 nurses work in hospitals and there is no statistical data on how much of them are in intensive care units (ICU).[3]

As you can see from these numbers, the doctor:nurse ratio in Bulgaria is 1.2.4which requires the adoption of strategic documents with measures to overcome the negative tendenciesThe solution of the existing and expected and future shortage of health professionals is essential to protect the health of the population globally. In this regard, the international migration of health professionals and the shortage of skilled health workforce, as well as the growing disparity between population needs, health care supply and demand, is a topical problem for health systems.The mobility and shortage of highly qualified specialists are characteristic of the top of the pyramid. There is a significant shortage in the medium and low levels of the pyramid of healthcare professionals and some non-medical majors. In both cases, there are internal and external imbalances, most often caused by increased migration to economic centers in the country or countries with a high standard of living. A severe shortage of nursing professionals -Bulgaria has the second-lowest ratio of nurses to population and the lowest nurse to physician ratio among all member states. (1:1,2 compared to 1:2,3 This is very low compared to the 2.8 in the UK, 3.0 in Germany and 4.0 in Switzerland.[5] The nurse:patient ratio in ICUs in Bulgaria is highly alarming – sometimes 1:5 or 1:8 even before COVID (no official statistics and no national recommendations available) compared to the standard 1:2 or 1:1 in high income countries. The demographic characteristics of Bulgarian nurses are also unfavorable. Their mean age is over 50 years. 32.7% of nurses working in the Bulgarian healthcare system are between 45 and 54 years of age and another 26.2% are between 55 and 64.[6]

Due to the nursing staff shortage in Bulgaria there are a lot of non-medical caregivers working in hospitals. They are people of non-medical background that are hired to clean the floors, toilets, beds, surfaces and equipment and to help mobile patients go to the toilet, X-ray etc. They also distribute the food and assist with the feeding of patients that are not on IMV. They receive some training by nurses locally but are not obligated to do so. With practice they learn a lot and end up helping the nurses with minor tasks that do not involve needles or specific equipment. After several years on the job a significant amount of them start attending nursing school. Some of them are medical students that want to get clinical experience and are highly motivated to learn as much as possible from the nursing personnel.

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There is a common perception that non-invasive ventilation (NIV) is more time-consuming for nurses compared to invasive mechanical ventilation (IMV) but only a few research groups address this matter.[7–13] NIV may require additional time from the nursing personnel mainly because of problems with mask fit, skin breakdown and maintenance of an optimal position in bed.[13] It appears that NIV is more time-consuming (not necessarily more than IMV) in the first 48 h of ventilation but then becomes much less demanding.[8]

This study aims to investigate the impact of ventilation modality on nursing workload in a situation with an extreme nursing staff shortage.

STUDY DESIGN AND METHODS

This is an observational single centre study conducted in a specialised pulmonology and thoracic surgery ICU in a university hospital in Bulgaria. It has seven surgical and 12 medical beds with a maximal nurse:patient ratio when all beds are occupied of 1:6. In addition there are two physiotherapists during the day shift that attend most of the patient mobilisation, and two non-medical caregivers both during the day and night shift. Two physicians are present in the ICU – one in the surgical and one in the medical division of the ICU. A senior intensive care physician is also available during the day shift.

Data was collected from January 2017 to December 2020. Ninety adult patients with various etiology of acute respiratory failure (COPD, obesity hypoventilation syndrome, bacterial and viral pneumonia, pulmonary fibrosis, mediastinitis, diaphragmatic dysfunction, myasthenia gravis and a variety of neuromuscular diseases) that were on mechanical ventilation for at least five days were included in the study. Forty three of them were on NIV and 47 on IMV.

In the NIV group there were only patients on true respiratory support. They were either on Pressure Support, Pressure Control Ventilation, Average Volume Assured Pressure Support or Intelligent Volume Assured Pressure Support. CPAP was excluded as a non-invasive ventilatory mode because it is not ventilation per se and cannot be compared to any ventilatory mode that will be applied at the beginning of invasive mechanical ventilation. IMV patients were either on Volume Control Ventilation, Pressure Control Ventilation or Pressure Regulated Volume Control.

NIV patients were not sedated in any manner. IMV patients were on a continuous midazolam infusion and bolus doses of a long-acting muscle relaxant were applied when necessary (in cases of patient-ventilator asynchrony). Cessation of sedation and spontaneous awakening trials were attempted only when the oxygenation showed improvement and remained stable for at least 24 hours.

Nursing workload was measured with the Nursing Activities Score (NAS). It is one of the most widely accepted methods for nurse workload measurement. It includes 23 activities that are scored according to the average time each one of them requires to be fulfilled. It is stated that it represents 81% of nursing activities. NAS is commonly used in studies in the field of intensive care because its biggest advantage is that it is not dependent on the severity of the pathology.[14]

The NAS was measured and recorded for every patient individually at an interval of 24h (every two nursing shifts) during the first five days of mechanical ventilation. The NAS score was computed based on all of the items in the score as described in the official NAS score paper by Miranda et al.[14] The daily NAS score values with their corresponding nursing equivalents were compared within (as a dynamic measure for nursing workload) and between groups (day by day comparison). Then an average NAS value and average nursing equivalent were computed from these five daily NAS values and daily nursing equivalents for each individual patient. These average numbers were compared between groups in order to give a full perception of the average nursing workload during the first five days of mechanical ventilation. Then individual components of the NAS score were analysed to determine which activities have the greatest impact on nursing workload.

Data was processed and statistically analysed with IBM SPSS package v.25. Descriptive statistics were calculated for continuous variables. Student's t-test was used for unpaired continuous variables, with chi-square and Fisher's exact tests (where chi-square was not suitable) for categorical variables. One-way repeated measures ANOVA was performed on paired continuous variables. As some of the data was non-parametric, a two-step transformation to normality was used in order to transform it into parametric data. $P < 0.05$ was considered statistically significant.

RESULTS

The study included 43 patients on NIV and 47 on IMV. Their mean age, gender distribution and time spent on mechanical ventilation did not differ significantly between groups, but patients on IMV had a longer ICU stay than those on NIV (Table 1).

During the study a total of 450 individual NAS measurements (215 for the NIV and 235 for the IMV group) were recorded. After conducting a statistical analysis, as described in the Study design and Methods section, it was discovered that the average NAS (39.72 ± 6.35 vs 46.08 ± 5.66, $p < 0.001$) and nursing equivalents (0.4 ± 0.06 vs 0.46 ± 0.06, $p < 0.001$) for the first five days of mechanical ventilation were both significantly higher in the IMV compared to the NIV group. The daily NAS was also higher in the IMV group for every single day as well as the corresponding nursing equivalents (Table 2).

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TABLE 1: SOCIODEMOGRAPHIC DATA

	NIV	IMV	p
Age	60.70 ± 9.36	56.12 ± 16.16	0.11
Gender	Male: 26 (49.06%)	Male: 17 (45.95%)	0.77
	Female: 27 (50.94%)	Female: 20 (54.05%)	
Days on ventilation	10.7 ± 6.68	16.89 ± 14.55	0.257
Days in ICU	15.67 ± 11.5	25.24 ± 16.56	0.003

TABLE 2: NAS WITH THE CORRESPONDING NURSING EQUIVALENTS ACCORDING TO VENTILATION MODE

	NIV	IMV	p
Nursing Activities Score			
NAS on day 1	41.97 ± 5.63	50.14 ± 8.71	< 0.001
NAS on day 2	39.70 ± 7.69	44.55 ± 6.69	0.002
NAS on day 3	39.96 ± 7.38	44.57 ± 6.97	0.003
NAS on day 4	39.05 ± 7.94	44.63 ± 8.21	0.002
NAS on day 5	38.01 ± 7.68	46.57 ± 6.93	< 0.001
Average NAS	39.72 ± 6.35	46.08 ± 5.66	< 0.001
Paired ANOVA p comparing the trend in daily NAS	**0.001**	**< 0.001**	
Nursing Equivalents			
Nursing Equivalents on day 1	0.42 ± 0.06	0.50 ± 0.09	< 0.001
Nursing Equivalents on day 2	0.4 ± 0.08	0.47 ± 0.07	0.002
Nursing Equivalents on day 3	0.4 ± 0.08	0.45 ± 0.07	0.004
Nursing Equivalents on day 4	0.39 ± 0.09	0.45 ± 0.08	0.003
Nursing Equivalents on day 5	0.38 ± 0.08	0.47 ± 0.07	< 0.001
Average Nursing Equivalents	**0.4 ± 0.06**	**0.46 ± 0.06**	**< 0.001**

When compared the scores inside of the groups as series of measurements a drop of nursing workload with time in both groups was revealed. A more significant difference was noted in the set of patients that were ventilated invasively (p for the NIV group – 0.01 and <0.001 for the IMV group). After conduction of a post-hoc analysis we discovered that the significant drop of NAS occurred on the second day in both groups (NIV: p=0.005, 95%CI: 0.88-4.52; IMV: (p<0,001, 95%CI: 2.72-7.03, Figure 1 and 2). A slight increase of NAS was observed on day 5 in the IMV group, but the difference did not reach statistical significance (p=0.12, 95%CI: -4.43-0.51).

After conducting a series of statistical tests comparing the impact of individual nursing activities, it was discovered that NIV patients required more time for monitoring but less for hygiene needs attendance, fluid administration, enteral and parenteral nutrition. IMV patients also required specific care for their artificial airway and took more time for lung function improvement procedures, such as, thorax physiotherapy, incentive spirometry, inhalation therapy and especially intratracheal suctioning. Also, in the IMV group more specific procedures inside the ICU were performed on days one, four and five.

Surprisingly, there was no difference between the nurse assistance needed by physiotherapists for mobilisation of both patient categories regardless of the fact that some of them were extremely overweight, both physiotherapists at the time of data collection were female and there is no equipment in this particular ICU facilitating rehabilitation or patient movement/lifting of any sort.

Part of the results from the analysis of the impact of individual nursing activities on the daily NAS are presented in Table 3. Omitted items from the NAS score were insignificant for this report but were included in the computation of the scores. They are not reported here because they either included 100% or 0% of both groups for the whole study period and statistical analysis could not be performed on them (e.g. none of the patients in the whole study had a pulmonary arterial catheter), so in the domain of Cardiovascular support [14]. Left atrium monitoring: pulmonary artery catheter, 0% of both groups received points for all five days. A complete version of Table 3 with the omitted items is presented in Supplement 1, Appendix 1.

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TABLE 3: NAS ANALYSIS BY ITEM – ONLY DISCUSSION-WORTHY COMPONENTS INCLUDED N (%)

	Day 1			Day 2			Day 3			Day 4			Day 5		
	NIV	IMV	p	NIV	IMV	p	NIV	IMV	p	NIV	IMV	p	NIV	IMV	p
1. Monitoring and titration															
1a. Hourly vital signs, regular registration of fluid balance	0 (0)	20 (42.6)	< 0.001	0 (0)	40 (85.1)	< 0.001	0 (0)	39 (83)	< 0.001	0 (0)	38 (80.9)	< 0.001	1 (23.3)	38 (80.9)	< 0.001
1b. Present at bedside and continuous observation or active for 2 h or more	10 (23.3)	18 (38.3)	0.124	21 (48.8)	6 (12.8)	< 0.001	30 (69.8)	6 (12.8)	< 0.001	34 (79.1)	7 (14.9)	< 0.001	32 (74.4)	7 (14.9)	< 0.001
1c. Present at bedside and active for 4 h or more	33 (76.7)	9 (19.1)	< 0.001	22 (51.2)	1 (2.1)	< 0.001	14 (32.6)	2 (4.3)	< 0.001	9 (20.9)	2 (4.3)	0.016	10 (23.3)	2 (4.3)	0.008
2. Laboratory, biochemical and microbiological investigations	33 (76.7)	37 (78,7)	0.822	16 (37.2)	32 (68.1)	0.003	21 (48.8)	33 (70.2)	0.039	22 (51.2)	26 (55.3)	0.693	20 (46.5)	34 (72.3)	0.012
4. Hygiene procedures															
4a. Performing usual hygiene procedures	6 (14)	42 (89.4)	< 0.001	8 (18.6)	42 (89.4)	< 0.001	9 (20.9)	40 (85.1)	< 0.001	11 (25.6)	39 (83)	< 0.001	9 (20.9)	35 (74.5)	< 0.001
4b. Performance of hygiene procedures took > 2 h	0 (0)	6 (12.8)	0.15	2 (4.7)	7 (7.8)	0.289	3 (7)	7 (14.9)	0.233	2 (4.7)	8 (17)	0.062	2 (4.7)	12 (25.5)	0.006
5. Care of drains	0 (0)	5 (10.6)	0.57	0 (0)	4 (8.5)	0.118	0 (0)	5 (10.6)	0.057	0 (0)	4 (8.5)	0.118	0 (0)	5 (10.6)	0.057
6. Mobilization and positioning															
6a. Performing procedure(s) up to three times per 24 h	1 (2.3)	1 (2.1)	0.949	2 (4.7)	1 (2.1)	0.5	6 (14)	3 (6.4)	0.232	6 (14)	4 (8.5)	0.412	5 (11.6)	4 (8.5)	0.622
6b. Performing procedure(s) more frequently than three times per 24 h, or with two nurses	0 (0)	0 (0)	*	0 (0)	0 (0)	*	2 (4.7)	0 (0)	0.135	1 (2.3)	0 (0)	0.293	1 (23.3)	0 (0)	0.293
7. Support and care of relatives and patient, including procedures such as telephone calls, interviews, counseling															
7a. Support and care of either relatives or patient for about 1 h in any shift	4 (9.3)	7 (14.9)	0.419	4 (9.3)	5 (10.6)	1.000	3 (7)	3 (6.4)	1.000	3 (7)	4 (8.5)	1.000	4 (9.3)	4 (8.5)	1.000
7b. Support and care of either relatives or patient for 3 h or more in any shift	0 (0)	1 (1.1)	1.000	0 (0)	1 (1.1)	1.000	0 (0)	1 (1.1)	1.000	0 (0)	1 (1.1)	1.000	0 (0)	0 (0)	*
Ventilatory support															
10. Care of artificial airways: ETT or tracheostomy cannula	0 (0)	47 (100)	< 0.001	0 (0)	47 (100)	< 0.001	0 (0)	47 (100)	< 0.001	0 (0)	47 (100)	< 0.001	0 (0)	47 (100)	< 0.001
11. Treatment for improving lung function	17 (39.5)	47 (100)	< 0.001	16 (37.2)	47 (100)	< 0.001	16 (37.2)	47 (100)	< 0.001	18 (41.9)	47 (100)	< 0.001	18 (41.9)	47 (100)	< 0.001

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TABLE 3: NAS ANALYSIS BY ITEM – ONLY DISCUSSION-WORTHY COMPONENTS INCLUDED N (%) (CONTINUED)

	Day 1			Day 2			Day 3			Day 4			Day 5		
	NIV	IMV	p	NIV	IMV	p	NIV	IMV	p	NIV	IMV	p	NIV	IMV	p
Cardiovascular support															
12. Vasoactive medication	11 (25.6)	11 (23.4)	0.81	12 (27.9)	14 (29.8)	0.844	10 (23.3)	13 (27.7)	0.632	9 (20.9)	17 (36.2)	0.111	5 (11.6)	12 (25.5)	0.092
13. Fluid administration > 3 L/m2/day	4 (9.3)	20 (42.6)	< 0.001	7 (16.3)	29 (61.7)	< 0.001	8 (18.6)	25 (53.2)	0.001	7 (16.3)	23 (48.9)	0.001	6 (14)	22 (46.8)	0.001
Metabolic support															
19. Treatment of complicated metabolic acidosis/alkalosis	3 (7)	5 (10.6)	0.716	0 (0)	2 (4.3)	0.495	1 (2.3)	0 (0)	0.478	1 (2.3)	0 (0)	0.478	0 (0)	0 (0)	*
20. Intravenous hyperalimentation	0 (0)	5 (5.6)	0.028	0 (0)	9 (19.1)	0.002	1 (2.3)	7 (14.9)	0.036	2 (4.7)	7 (14.9)	0.106	2 (4.7)	8 (17)	0.62
21. Enteral feeding	0 (0)	18 (38.3)	< 0.001	1 (2.3)	36 (76.6)	< 0.001	1 (2.3)	37 (78.7)	< 0.001	3 (7)	38 (80.9)	< 0.001	2 (4.7)	41 (87.2)	< 0.001
Specific interventions															
22. Specific ICU interventions	2 (4.7)	47 (100)	< 0.001	2 (4.7)	7 (14.9)	0.106	1 (2.3)	4 (8.5)	0.201	1 (2.3)	11 (23.4)	0.003	0 (0)	8 (17)	0.005

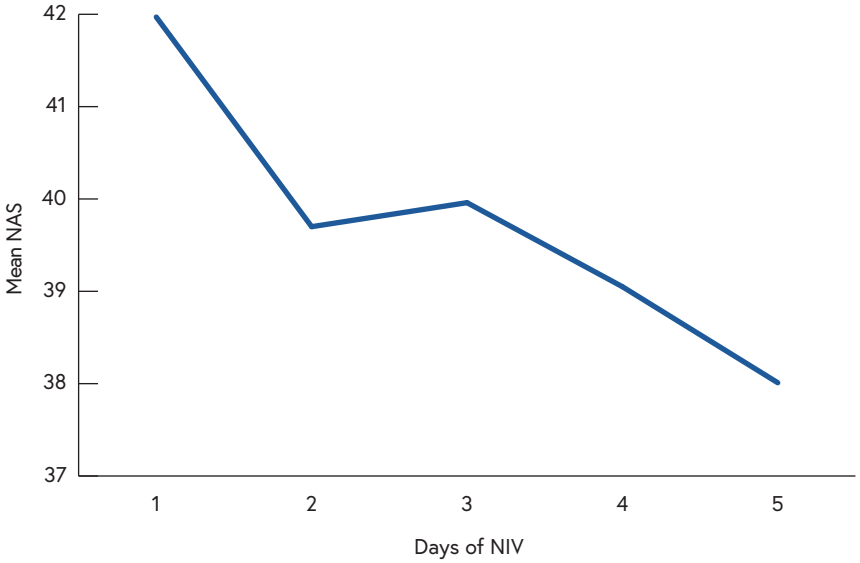

FIGURE 1: TREND OF THE DAILY NAS IN THE NIV GROUP

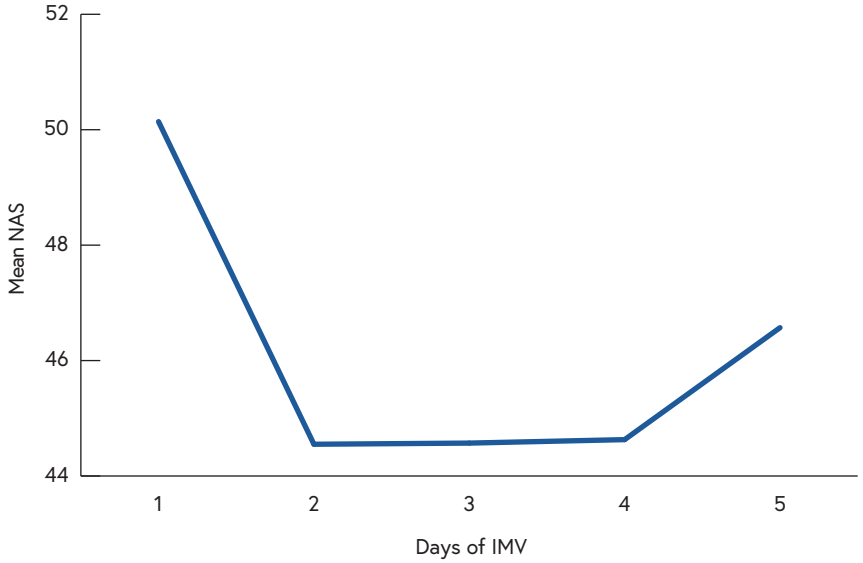

FIGURE 2: TREND OF THE DAILY NAS IN THE NIV GROUP

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DISCUSSION

After publication of the first study that compared the nursing workload between patients on NIV and IMV a statement that NIV was more burdensome on the nursing personnel spread widely across ICUs.[7] On the surface this assumption may seem true because most of the patients on NIV are fully conscious, scared and often have a lot of complaints regarding the mask and headgear fit, maintenance of an optimal position in bed, feeding problems, difficulty communicating, disturbed sleep, and feeling of loneliness.[13] A significant amount of NIV patients need sedation on order to improve mask and ventilation tolerance, otherwise, nurses will spend extra time at the patient's bedside in order to fix these problems constantly.[15]

Although we measured an increased time for monitoring and assistance of the patients during NIV, the overall NAS in NIV patients is lower compared to IMV because several other factors are compensating. Looking at nursing workload as a whole, not just at this one component, different authors have stated that NIV is equally,[8,11] or sometimes less burdensome than IMV for the nursing staff.[10,12]

As is evident by the analysis of individual items of the NAS, NIV patients needed less assistance by nurses with their hygiene needs, food and water intake, because these duties were directed towards non-medical caregivers. Also, NIV patients do not have an artificial airway that must be cared for and do not need some specific ICU procedures like endotracheal intubation or tracheostomy placement. In a situation with an insufficient number of nurses supervised, non-medical caregivers can take care of most of the needs of compliant NIV patients, without the direct involvement of a nurse or a physician.

In a situation where thousands of nurses are needed and none can be trained rapidly, a solution must be found in order to maintain an acceptable level of patient care. Hiring non-medical caregivers and recruiting medical students can potentially take some of the burden off the shoulders of nurses. Studies on the role of non-medical caregivers in in-hospital patient care are limited but we were able to discover only one publication regarding an in-hospital non-medical caregiver program and it was based in an operating theatre[16] Therefore, further research is needed on the potential role of non-medical caregivers on patient safety, nurse workload, and quality of care.

The most concerning matter with the suggestion of inclusion of non-medical personnel in direct patient care is patient safety. Without a properly trained caregiver there is a probability of infliction of involuntary damage or omission of important symptoms because of lack of knowledge. Such a situation is realistic but research shows that increased workload on healthcare personnel can also be a cause of an increased frequency of medication errors and adverse events.[17] In fact, formal medical education is not a guarantee for a higher patient safety culture because many medical schools do not offer classes on patient safety.[18] Of course, there is no doubt that there is some form of patient safety education in nursing schools that are not officially labeled as such. Therefore, students might not pay enough attention to it. This is why we think that patient safety should be implemented officially as part of each clinical nursing class and be included in the examination curriculums.

One limitation of our study is the fact that we did not test if severity of the disease in our patient cohort had an impact on the NAS. We did not do it because in the original article where NAS as first described, the authors state that the score is independent from the severity of the pathology. On the other hand, later studies discovered that surgical diagnosis, emergency, trauma, COVID-19, high APACHE scores and a longer hospital stay tend to increase the NAS.[19–22]

Although this could be true, we wanted to make a comparison only of the ventilation modality as a sole factor for nurse workload increase or decrease. Because of the same reason we included both patients with hypoxemic, as well as with hypercapnic respiratory failure. In a lot of ICUs they do not use NIV for severe hypoxemic respiratory failure because of high failure rates,[23] but in our facility we conduct a NIV trial for all compliant patients that fulfill a set of criteria unrelated to the level of hypoxemia. As future research we may do an analysis on different patient related factors on nursing workload on a new set of patients with acute respiratory failure either only in NIV or IMV in order to exclude the bias of different ventilatory modalities.

Another limitation of the study is the practice of our unit to avoid sedation of patients on NIV. This has some advantages and some disadvantages. The most prominent advantage is the mobility of the patient, so help is provided exclusively to female nursing personnel with hygiene tasks that involve heavy lifting. Also, the risk of aspiration is minimised and the patient can alert the team if something does not feel right. On the other hand, if a fully conscious patient experiences a certain level of discomfort with NIVthen more attention from the nurses mainly for mask repositioning and assistance with eating is required. If you examine the data from Table 3, you can see that our nurses do in fact spend a lot of time at the bedside of NIV patients monitoring and ensuring compliance. Studies by other research groups also agree with this finding.[8,9,13] If patients on NIV were sedated, the nursing workforce would have been lower.

CONCLUSION

In a setting where direct patient care is provided by both formally trained nurses and non-medical caregivers, IMV was associated with a higher nursing workload than NIV. Patients on NIV tend to need more frequent monitoring but less assistance by nurses with their hygiene and nutritional needs, as they do not have an artificial airway that must be cared for and do not need some specific medical procedures at all.

IMPLICATIONS FOR RESEARCH, POLICY, AND PRACTICE

In a situation with an extreme staff shortage, some of the non-medical nursing activities involving patients on NIV can be potentially transferred to trained non-medical caregivers under supervision. Further research is needed on the impact of these non-medical caregivers on patient safety and quality of care.

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