Journals Pub

International Journal of
Nursing Critical Care

ISSN: 2581-6209
Volume 10, Issue 1, 2024
DOI (Journal): 10.37628/IJNCC

https://journalspub.com/journal/ijncc/

Research IJNCC

A Quasi-experimental Study to Evaluate the Impact of Nurse-led Intervention to Prevent Ventilator-associated Pneumonia in Critically-ill Patients at Selected ICU of Pt. B. D. Sharma PGIMS University of Health Science, Rohtak

Monika Kumari[1,*], Rajpati Amrawat[2]

Abstract

Background: *Healthcare professionals and patients encounter numerous challenges in dealing with emerging treatment methods and their effects. Intensive care units experience a significantly higher rate of hospital-acquired infections than regular hospital wards. These include infections related to catheters, pneumonia associated with ventilators, and infections at surgical sites. Such nosocomial infections lead to increased death rates, illness, and medical expenses. Prolonged hospital stays, extended intensive care unit stays, and increased mechanical ventilation duration are evident in affected patients. The use of invasive devices stands out as a major risk factor for nosocomial infections in intensive care units, emphasizing the importance of adhering to preventive measures. The commitment of intensive care unit staff to evidence-based infection control measures plays a critical role in mitigating nosocomial infections. It is imperative to implement preventive strategies founded on sound evidence to curb the incidence of hospital-acquired infections. Many cases of ventilator-associated pneumonia originate from inhaling oropharyngeal secretions laden with potentially harmful microorganisms. To a lesser extent, the inhalation of gastric secretions might also play a role in ventilator-associated pneumonia development. The natural protective mechanisms against aspiration are compromised by tracheal intubation, making mechanical ventilation a significant risk factor for ventilator-associated pneumonia. Consequently, patients with pulmonary infections face financial strain beyond the treatment of their initial condition. Ventilator-associated pneumonia, a secondary issue that can arise from intubation and mechanical ventilation, is largely preventable. A set of interventions, known as the ventilator-associated pneumonia prevention bundle has been effective in reducing its occurrence.* ***Objectives****: (1) To assess the influence of nursing-led interventions on preventing ventilator-associated pneumonia among critically ill patients within both experimental and control groups. (2) To find out the association of nurse-led intervention with selected demographic variables and clinical profiles of critically ill patients at the selected intensive care unit of Pt. B.D. Sharma PGIMS, Rohtak.* ***Materials and Methods:*** *The researcher conducted the study using a quasi-experimental research approach and pre-experimental research design on 40 patients admitted to the cardiothoracic and vascular surgery intensive care unit of Pt. B.D. Sharma PGIMS, Rohtak, by using a nonprobability consecutive sampling technique. The same patients were assigned equally to experimental groups 1(20) and control 2 (20). VAP prevention was determined with the help of the clinical pulmonary infection score tool on day 5. The data was evaluated with an unpaired t-test and Chi-squared test.* ***Result****: The study shows that in the experimental group, 25% (five patients) using mechanical ventilators were free from infection. Within the same group, 55% (11*

***Author for Correspondence**
Monika Kumari
E-mail: monikasansanwal082@gmail.com

[1]Student, Department of Nursing Critical Care, College of Nursing, Pt. B.D. Sharma PGIMS, Rohtak, Haryana, India
[2]Lecturer, Department of Nursing Critical Care, College of Nursing, Pt. B.D. Sharma PGIMS, Rohtak, Haryana, India

Received Date: January 08, 2024
Accepted Date: March 18, 2024
Published Date: March 21, 2024

Citation: Monika Kumari, Rajpati Amrawat. A Quasi-experimental Study to Evaluate the Impact of Nurse-led Intervention to Prevent Ventilator Associated Pneumonia in Critically-ill Patients at Selected ICU of Pt. B. D. Sharma PGIMS University of Health Science, Rohtak. International Journal of Nursing Critical Care. 2024; 10(1): 19–27p.

patients) experienced mild infections, while 20% (four patients) faced severe infections. Conversely, in the control group, 35% (seven patients) had mild infections, and a significantly higher percentage, 65% (13 patients), suffered from severe infections. This indicates that patients in the experimental group predominantly had milder infections compared to those in the control group, where severe infections were more common. ***Conclusion****: The study's goal was to evaluate how effective the ventilator bundle was at preventing ventilator-associated pneumonia in patients using mechanical ventilation in the specified cardiothoracic and vascular surgery intensive care unit at Pt. B.D. Sharma PGIMS, Rohtak. Results showed that the ventilator bundle successfully reduced the incidence of ventilator-associated pneumonia in the experimental group of patients. Furthermore, no notable link was found between the effectiveness of ventilator-associated pneumonia prevention and various demographic factors in either the experimental or control groups. As a result, research hypothesis H2 was rejected at a significance level of* $p \geq 0.05$.

Keywords: Knowledge, compliance, ventilator-associated pneumonia bundle, patient outcomes, nurses working in intensive care units

INTRODUCTION

Ventilator-associated pneumonia (VAP) represents a significant infection risk for critically ill patients on mechanical ventilation, contributing to heightened mortality rates, extended hospital stays, and substantial financial and emotional strain for patients and their families. Over the past 20 years, numerous protocols have been introduced aiming to lower the occurrence of VAP. Research has conclusively shown that a holistic approach involving a combination of measures is necessary for efficacy. A "bundle" refers to a compilation of individual elements brought together to establish a set of quality benchmarks for a particular system, process, or intervention. These interventions must all be implemented together to achieve significantly better results [1].

Our body requires a continuous supply of oxygen to sustain metabolic processes, and respiration is a crucial mechanism for survival, providing the essential energy for vital life processes. This biological process involves the interchange of gases between an organism and its surroundings. The respiratory pathway, facilitating the flow of air from the nose to the lungs, is divided into two segments: the upper respiratory tract and the lower respiratory tract. The upper respiratory tract encompasses the nostrils, nasal cavities, pharynx, epiglottis, and larynx, while the lower respiratory tract includes the trachea, bronchi, bronchioles, and alveoli. Organs within the respiratory system ensure the absorption of oxygen and the elimination of carbon dioxide from our bodies.

The respiratory system is essential for the intake and release of respiratory gases in humans. Even with progress in diagnostic and management techniques, VAP continues to be a major contributor to hospital-related illness and death. However, a preventive approach is considered more effective than treatment for VAP, as it is a preventable condition, and proper measures can reduce hospital stays, costs, morbidity, and mortality. Critically ill patients in the intensive care unit (ICU) are at high risk for infections associated with increased morbidity, mortality, and health care costs. In critically ill patients, the rate of infection can reach up to 40%, escalating to 50 or 60% for those staying in the ICU for more than 5 days. The clinical goals are to correct hypoxemia and acute respiratory acidosis, alleviate respiratory distress, prevent or resolve atelectasis and muscle fatigue of the respiratory system, enable sedation, decrease intracranial pressure, and provide chest wall stability. Mechanical ventilation becomes essential for managing the patient's breathing during surgeries or in treating severe head injuries, as well as for oxygenating the blood when the patient's own breathing efforts fall short. This requires the use of a mechanical ventilator, a device designed to support breathing and oxygenation over extended periods [2].

In standard endotracheal tubes, secretions tend to accumulate above the cuff, an area not effectively cleared by regular oral suctioning. The pooling of secretions above the endotracheal tube's cuff can be

significantly reduced through either continuous or intermittent suctioning of these secretions, thereby preventing microaspiration. This is achieved using an advanced endotracheal tube equipped with an extradorsal lumen known as a subglottic suctioning port. The application of continuous subglottic secretion aspiration in intubated patients has been shown to lower the occurrence of VAP by 43.4%. This reduction is primarily observed in the early stages of mechanical ventilation. Subglottic suctioning is a cost-effective and efficient strategy for preventing hospital-acquired pneumonia, specifically targeting the risk posed by the patient's own oral flora present at the time of intubation. Additionally, this intervention can lead to a reduction in the required dosage of antibiotics, especially when integrated with other preventive measures [3–5].

OBJECTIVES

1. To assess the effectiveness of interventions led by nursing staff in reducing the incidence of VAP among critically ill patients within both experimental and control groups.
2. To find out the association of nurse lead intervention with selected demographic variables and clinical profiles of critically ill patients at selected ICU of Pt. B.D. Sharma PGIMS, Rohtak.

HYPOTHESIS

H1: A significant difference in posttest scores related to the prevention of VAP among mechanically ventilated patients is expected between the experimental and control groups at a significance level of $p \leq 0.05$.

H01: No significant difference in posttest scores regarding the prevention of VAP is anticipated among patients on mechanical ventilation in both the experimental and control groups, with a significance level of $p \leq 0.05$.

H2: A significant relationship is expected to be seen in the posttest results for preventing VAP in mechanically ventilated patients, correlating with certain demographic variables in both the experimental and control groups at a significance threshold of $p \leq 0.05$.

H02: There is expected to be no significant association between the posttest scores regarding the prevention of VAP in mechanically ventilated patients and the selected demographic variables in both the experimental and control groups, with a significance level set at $p \leq 0.05$.

MATERIALS AND METHODS

The researcher conducted the study using quasi quasi-experimental research approach and pre-experimental research design on 40 patients admitted to CTVS ICU of Pt. B.D. Sharma PGIMS, Rohtak, by using a nonprobability consecutive sampling technique. The same patients were assigned equally to experimental group 1 (20) and control group 2 (20). VAP prevention was determined with the help of the clinical pulmonary infection score (CPIS) tool on day 5. The data was evaluated with an unpaired t-test and Chi-squared test.

Statistical Analysis

The data was recorded into an Excel spreadsheet after collection and was then analyzed using the statistical software SPSS. Descriptive statistics, such as frequency, percentage, and mean, were computed, and inferential statistics were employed to explore the association between the frequency and percentage distribution of patients based on their demographic variables in both the experimental and control groups.

RESULTS

In the experimental group, the largest portion of participants, accounting for 30% (6 individuals), were aged between 41 and 51 years, while in the control group, the highest percentage, 35% (seven individuals), fell within the 52–62-year age range. The majority of the samples, 14 (70%), were male

in the experimental group, and 15 (75%) were males in the control group. The majority of the samples' average weight was six (30%) under 61–70 kg in the experimental group, and in the control group, seven (35%) under 51-60 kg. Most samples indicated mechanical ventilation in the experimental group. Nine (45%) had cardiac disease, and in the control group, seven (35%) had cardiac disease (Table 1).

The majority of sample time duration of the ventilator in the experimental group was 1 week, 15 (75%), and control group 12 (60%). In the experimental group, the frequency of suctioning was 2 hours with 12 (60%), and in the control group, for eight (40%), it was 3 hours. The majority of samples had a history of smoking in both experimental and control groups; 15 (75%)/11 (55%) samples were nonsmokers. The majority of the samples' lifestyle in the experimental group was 16 (80%), and in the control group, it was 10 (50%), not at all.

Table 1. Frequency and percentage distribution of patients according to their demographic variables in experimental and control groups.

S.N.	Demographic variables	Experimental group		Control group	
		F	*%*	*F*	*%*
1.	*Age (in years)*				
	18–28	4	20	4	10
	29–39	5	25	4	20
	41–51	6	30	7	35
	52–62	5	25	7	35
2.	*Gender*				
	Male	14	70	15	75
	Female	6	30	5	25
	Transgender	0	0	0	0
3.	*Weight (in kg)*				
	41–50	5	20	4	20
	51–60	4	25	7	35
	61–70	6	30	5	25
	71–80	5	25	4	20
4.	*Indication of mechanical ventilation*				
	CNS disease	1	5	3	15
	Respiratory disease	6	30	4	20
	Cardiac disease	9	45	7	35
	Renal disease	1	5	3	15
	Poisoning	0	0	0	0
	Others	3	15	3	15
5.	*Time and duration of ventilator (in weeks)*				
	1	15	75	12	60
	2	5	25	8	40
	4	0	0	0	0
	6	0	0	0	0
6.	*Frequency of suctioning (in hours)*				
	2	12	60	6	30
	3	7	35	8	40
	4	1	5	6	30
7.	*History of smoking*				
	Yes	5	25	9	45
	No	15	75	11	55
8.	*Lifestyle*				
	Tobacco	1	5	2	10
	Alcohol	1	5	2	10
	Tobacco and alcohol	3	15	6	30
	Not at all	16	80	10	50

Most of the samples were in the experimental group, 19 (95%), and in the control group, 13 (65%) patients, with a hospital stay duration of 1–2 weeks, respectively. The duration of the current illness of

samples in the experimental group was 18 (90%) patients, and in the control group, 15 (75%) patients' duration of current illness was 1-2 weeks. In most samples, the number of days patients had a ventilator in the experimental and control groups was 17 (85%) and 15 (75%) patients, respectively, with the number of days patients had a ventilator ranging from 2 to 6 days.

Most samples in both experimental 12 (60%) and control group 11 (55%) had no medical and surgical history. Most samples where any comorbid status is other in both experimental group 11 (55%) and control group 10 (50%). The majority of the samples had no family history in both groups, experimental nine (45%) and control nine (45%), respectively (Table 2).

Table 2. Frequency and percentage distribution as per clinical profile.

S.N.	Clinical profile	Experimental group		Control group	
		F	*%*	*F*	*%*
1.	*Duration of hospital stay (in weeks)*				
	1–2	19	95%	13	65%
	2–4	2	10%	6	30%
	4–6	0	0%	0	0%
	>6	0	0%	0	0%
	Emergency condition	0	0%	1	5%
2.	*Duration of current illness (in weeks)*				
	1–2	18	90%	15	75%
	2–4	0	0%	4	20%
	4–6	0	0%	0	0%
	>6	0	0%	0	0%
	Emergency condition	2	10%	1	25%
3.	No. of days the patient had a ventilator				
	2–6	17	85%	15	75%
	8–12	2	10%	4	20%
	12–14	1	5%	1	5%
4.	*Medical and surgical history*				
	Previous surgery	2	10	3	15
	Previous disease	4	20	2	10
	Diabetes mellitus (DM)	0	0	0	0
	Hypertension	2	10	4	20
	None	12	60	11	55
5.	*Any comorbid filtration patient*				
	Hypertension	9	45	8	40
	DM	0	0	1	5
	Thyroid	0	0	1	5
	Others	11	55	10	50
6.	*Family history*				
	Cardiac illness	6	30	8	40
	DM	0	0	0	0
	Hypertension	5	25	3	15
	Any other	0	0	0	0
	None	9	45	9	45

Table 3 depicts the findings regarding the interpretation score. Out of 20 study subjects in experimental group 1, a maximum of 55% had a mild infection, followed by 25% with no infection, and 20% had a severe infection. However, out of 20 subjects in control group 2 maximum of 65% had severe infection, followed by 35% had mild infection, and 0% had no infection.

a) Effects of implementing a ventilator care bundle on decreasing the incidence of VAP among patients on mechanical ventilation in the experimental group. Table of mean, standard deviation, and t-test values for posttest scores on VAP prevention in patients using mechanical ventilation across experimental and control groups.

The data indicates that the average score for the experimental group is 1.40 ± 1.188, while the mean score for the control group is 2.90 ± 1.25. The "t" value is 2.024, and it is significant at the $p \leq 0.05$

level. Therefore, the research hypothesis H1 is upheld. This implies that the ventilator bundle is successful in preventing (Table 4).

Table 3. CPIS score tool: Frequency and percentage distribution as per modified CPIS for assessing VAP.

S.N.	Variables and range	Experimental group		Control group	
		F	*%*	*F*	*%*
1.	*Temperature*				
	98.6	12	60%	7	35%
	>99	8	40%	13	65%
2.	*Leukocytes*				
	>4000 and <11000	6	30%	7	35%
	<4000 and >11000	14	70%	13	65%
3.	PaO_2/FiO_2				
	(mmHg)				
	>240	17	85%	9	45%
	<240	3	15%	11	55%
4.	*Chest radiograph*				
	No filtration	10	50%	5	25%
	Localized/patchy filtration	10	50%	15	75%
5.	*Tracheal aspirate culture*				
	No growth	18	90%	14	70%
	>1 pathogenic bacteria	2	10%	6	30%

Table 4. Mean, standard deviation, and 't' test values for posttest scores on VAP prevention in patients using mechanical ventilation across experimental and control groups.

Group	*Mean*	*Standard deviation*	*df*	*t*	*p-value*
Experimental group	1.40	1.188	38	2.024	0.0023
Control group	2.90	1.25			

b) Examining the relationship between posttest scores regarding the prevention of VAP among patients on mechanical ventilation and their selected demographic variables in both the experimental and control groups. Utilizing the Chi-squared test to assess posttest scores on the prevention of VAP in patients on mechanical ventilation in relation to their demographic variables in both the experimental and control groups. Comparisons of baseline sociodemographic and clinical variables were conducted using Pearson's Chi-squared test (or Fisher's exact test when the expected frequencies in a cell were less than 5) for categorical variables and independent sample t-test for continuous variables.

The data presented in Table 5 indicates that there is no correlation between the prevention of VAP and selected demographic variables in both the experimental and control groups. These variables include age, gender, weight, indication of mechanical ventilation, time and duration of ventilation, frequency of suctioning, history of smoking, and lifestyle. Thus, the null hypothesis H02 is dismissed for patients using mechanical ventilation and their chosen demographic variables at a significance threshold of $p \geq 0.05$.

The data presented in Table 6 indicates a lack of correlation in both the experimental and control groups regarding the prevention of VAP with selected clinical variables. These variables include the duration of hospital stay, duration of the current illness, number of days the patient is on the ventilator, medical and surgical history, any comorbid status of the patient, and family history. Consequently, the null hypothesis H02 is rejected for patients on mechanical ventilators with their selected clinical variables at a significance level of $p \geq 0.05$.

Table 5. Correlation between the prevention of VAP and selected demographic variables in both the experimental and control groups.

S.N.	Variables	Exp.		Cont.				
		F	*%*	*F*	*%*	*df* (×2)	*p-value*	*Result*
1.	*Age (in years)*							
	18–28	4	20%	2	10%	1.188 (3)	0.756	NS
	29–39	5	25%	4	20%			
	41–51	6	30%	7	35%			
	52–62	5	25%	7	35%			
2.	*Gender*							
	Male	14	70%	15	75%	0.125 (1)	0.723	NS
	Female	6	30%	5	25%			
	Transgender	0	0%	0	0%			
3.	*Weight (in kg)*							
	41–50	4	20%	4	20%	0.535 (3)	0.911	NS
	51–60	5	25%	7	35%			
	61–70	6	30%	5	25%			
	71–80	5	25%	4	20%			
4.	*Indication of mechanical ventilation*							
	Central nervous system (CNS) disease	1	5%	3	15%	8.650a (5)	0.124	NS
	Respiratory	6	30%	4	20%			
	Cardiac disease	9	45%	7	35%			
	Renal disease	1	5%	3	15%			
	Poisoning	0	0%	0	0%			
	Others	3	15%	3	15%			
5.	*Time and duration of ventilator (in week)*							
	1	15	75%	12	60%	1.026a (1)	0.311	NS
	2	5	25%	8	40%			
	4	0	0%	0	0%			
	6	0	0%	0	0%			
6.	*Frequency of suctioning (in hour)*							
	2	12	60%	6	30%	5.638a (2)	0.060	NS
	3	7	35%	8	40%			
	4	1	5%	6	30%			
7.	*History of smoking*							
	Yes	5	25%	9	45%	1.758a (1)	0.185	NS
	No	15	75%	11	55%			
8.	*Lifestyle*							
	Tobacco	1	5%	2	10%	4.000a (3)	0.261	NS
	Alcohol	1	5%	2	10%			
	Tobacco and alcohol	3	15%	6	30%			
	Not at all	16	80%	10	50%			

Table 6. Correlation in both the experimental and control groups regarding the prevention of VAP with selected clinical variables.

S.N.	Variables	Exp.		Cont.				
		F	**%**	**F**	**%**	**df (×2)**	**p-value**	**Result**
1.	*Duration of hospital stays (in weeks)*							
	1–2	19	95%	13	65	3.806a (2)	0.0149	NS
	2–4	2	10%	6	30			
	4–6	0	0%	0	0			
	>6	0	0%	0	0			
	Emergency condition	0	0%	1	5			
2.	*Duration of current illness (in weeks)*							
	1–2	18	90	15	75	4.606a (2)	0.100	NS
	2–4	0	0	4	20			
	4–6	0	0	0	0			
	>6	0	0	0	0			
	Emergency condition	2	10	1	25			

3.	*No. of days the patient has a ventilator*							
	2–6	17	85	15	75	1.939a (2)	0.379	NS
	8–12	2	10	4	20			
	12–14	1	5	1	5			
4.	*Medical and surgical history*							
	Previous surgery	2	10	3	15	1.577a (3)	0.665	NS
	Previous disease	4	20	2	10			
	DM	0	0	0	0			
	Hypertension	2	10	4	20			
	None	12	60	11	55			
5.	*Any comorbid status of the patient*							
	Hypertension	9	45	8	40	2.106a (3)	0.55	NS
	DM	0	0	1	5			
	Thyroid	0	0	1	5			
	Others	11	55	10	50			
6.	*Family history*							
	Cardiac illness	6	30	8	40	0.786a (2)	0.675	NS
	DM	0	0	0	0			
	Hypertension	5	25	3	15			
	Any other	0	0	0	0			
	None	9	45	9	45			

DISCUSSION

In the experimental group, 30% of patients were in the 41–51 age bracket, while in the control group, 35% fell within the 52–62 years range. Most participants in both the experimental (70%) and control (75%) groups were male. Regarding the need for ventilation, 45% of patients in the experimental group and 35% in the control group required it due to cardiac diseases. Suctioning frequency varied, with 60% of the experimental group undergoing suctioning every 2 hours, while 40% of the control group had suctioning every 3 hours. A notable proportion, 75% in the experimental group and 55% in the control group had a history of smoking. The weight distribution saw 30% of the experimental group within the 61-70 kg range and 35% of the control group in the 51–60 kg range. The duration and time of ventilator use were 1 week for 75% of the experimental group and 60% of the control group. Lifestyle factors were noted for 80% of the experimental group and 50% of the control group participants. Regarding infection rates, 25% of the experimental group had no infection, 55% had a mild infection, and 20% had severe infections. In the control group, 35% experienced mild infections, and 65% had severe infections. The mean score in the experimental group was 1.4 ± 1.188 compared to 2.9 ± 1.25 in the control group, with mean percentages being 28 and 58%, respectively, indicating a mean difference of 30% [6–10].

CONCLUSION

This study was conducted to evaluate the effectiveness of a ventilator care package in reducing the occurrence of VAP in patients using mechanical ventilation in specified Erode hospitals. The results demonstrated that the ventilator care package successfully reduced VAP incidents in the experimental group. Nonetheless, there was no significant link found between VAP prevention and the demographic variables chosen for both the experimental and control groups. Consequently, the research hypothesis H2 was not supported, with a significance threshold set at $p \geq 0.05$.

REFERENCES

1. Arlene, L, Polaski. Core Principle and Practice of Medical Surgical Nursing, 2nd edition. Haryana: Elsevier Publication; 2010.
2. Barbara K, Timby N, Smith E. (2007). Introduction to Medical Surgical Nursing, 9th edition. Philadelphia: Lippincott Williams and Wilkin.
3. Black JM, Hawks HJ. Medical Surgical Nursing, 7th edition. Philadelphia: W.B. Saunders Company; 2005.
4. Brunner and Suddarth. Medical surgical Nursing, 12th edition. Philadelphia: Lippincott Williams and Wilkins; 2004.

5. Dolan JT. Critical Care Nursing: Clinical Management through the Nursing Process, 2nd edition. Singapore: FA. Davis Company Publication; 1991.
6. Lewis Heitkemper. Medical Surgical Nursing, 7th edition. Haryana: Elsevier; 2007.
7. Yazdani M, Sabetian G, Ra'ofi S, Roudgari A, Feizi M. A comparative study of teaching clinical guideline for prevention of ventilator-associated pneumonia in two ways: face-to-face and workshop training on the knowledge and practice of nurses in the intensive care unit. J Adv Med Educ Prof. 2015; 3(2): 68–71.
8. Bagheri-Nesami M, Amiri-Abchuyeh M, Gholipour-Baradari A, Yazdani-Cherati J, Nikkhah A. Assessment of critical care provider's application of preventive measures for ventilator-associated pneumonia in intensive care units. J Clin Diagnos Res. 2015;9(8): IC05–IC08p. DOI: 10.7860/JCDR/2015/11996.6308.
9. Pérez-Granda MJ, Muñoz P, Heras C, Sánchez G, Rello J, Bouza E. Prevention of ventilator-associated pneumonia: Can knowledge and clinical practice be simply assessed in a large institution? Respir Care. 2013;58(7):1213–1219p. DOI: 10.4187/respcare.01854.
10. Collard HR, Saint S, Matthay MA. Prevention of ventilator-associated pneumonia: an evidence-based systematic review. Ann Int Med. 2003;138(6):494–501p. DOI: 10.7326/0003-4819-138-6-200303180-00015.

