

Nurses' knowledge of intravenous nitroglycerine injection: a survey study

Encuesta a los profesionales de enfermería sobre seguridad clínica en el uso de la nitroglicerina intravenosa en urgencias

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Nitroglycerin, discovered more than a century ago, has historically been a fundamental therapeutic pillar in cardiology. The vasodilatory effect produced by the nitric oxide molecule is highly useful for the treatment of acute heart failure and acute coronary syndrome.¹ At cardiovascular level, coronary vasodilation increases blood flow to the myocardium, while the systemic venodilation—acting predominantly on arterioles—reduces preload.^{2,3} Nitric oxide also induces relaxation of smooth muscle in the bronchial and GI systems. However, repeated use of nitroglycerin can lead to pharmacological tolerance.¹

The minimum intravenous infusion dose of nitroglycerin (IV-NTG) is 0.3 mg/hour and the maximum is 4.0 mg/hour in subjects weighing approximately 70 kg.⁴ Among its adverse effects, hypotension is particularly notable; therefore, it should be avoided in conjunction with other hypotensive drugs such as calcium channel blockers, angiotensin-converting enzyme inhibitors, or angio-

tensin II receptor blockers.³ Furthermore, it is contraindicated in cases of uncorrected hypovolemia or severe hypotension.³

Due to its pharmacodynamics and pharmacokinetics, IV-NTG use must be precise and appropriate; otherwise, it may lose its chemical properties.³ Similarly, its side effects and contraindications must be considered to prevent inappropriate administration.³

All these considerations should be known by the health care professionals who prescribe, handle, and administer the drug. In our setting, nursing staff are usually the health care professionals with the most direct contact with this drug. We found no former studies evaluating differences in knowledge or use of IV-NTG among nursing staff according to their workplace. This was the objective of our study.

We conducted a prospective cross-sectional study in a tertiary referral center. A voluntary self-administered survey was conducted among volunteer nursing staff from this institution, randomly selecting 30 nurses from the emergency department and 30 nurses from the intensive care unit (ICU), excluding those from the coronary ICU (CICU). Nurses answered a single-choice questionnaire assessing their knowledge about the frequency and indications for IV-NTG use, administration methods, and adverse effects (Table 1). All participants understood the questions correctly, and no surveys were incorrectly

completed. The study was approved by the hospital Ethics Committee.

Demographic variables collected included age, sex, years of professional experience, and estimated monthly frequency of IV-NTG use. Variables related to knowledge, preparation, and administration of IV-NTG were also recorded. Results were compared between the 2 professional groups.

Qualitative variables were expressed as absolute and relative frequencies, while quantitative variables were expressed as mean and standard deviation for normally distributed data, and as median and interquartile range (Q1–Q3) for non-normal distributions. The chi-square or Fisher's exact test was used to determine associations across qualitative variables. For quantitative variables, Student's t-test or the Mann-Whitney U test was used depending on normality of distribution. Statistical analysis was performed using SPSS software version 20 (SPSS Inc., Armonk, New York, USA). A difference was considered statistically significant for an alpha error < 5% ($P < .05$).

Results

The emergency and ICU groups had median ages of 31 (26–34) and 35 (31–39) years, respectively. The proportion of women was similar between groups: 48% in the emergency group and 51% in the ICU group. The emergency group was significantly younger ($P < .001$), had fewer years of experience, and reported higher month-

Table 1. Self-administered questionnaire on the use of nitroglycerin, preparation, and administration methods

1. Year of birth:	-
2. Gender:	
a. Female	
b. Male	
3. Year of completion of the university degree in nursing:	-
4. Have you ever administered intravenous nitroglycerin (NTG) in your workplace?	
a. Yes	
b. No	
5. Approximately, what is the monthly frequency of nitroglycerin use if the previous answer is "yes"?	
a. No monthly use of NTG	
b. Between 1 and 5 times per month	
c. Between 6 and 15 times per month	
d. More than 15 times per month	
6. NTG is part of the treatment in the acute phase of the following conditions:	
a. Acute myocardial infarction	
b. Atrial fibrillation with rapid ventricular response	
c. Acute heart failure	
d. a and c are correct	
e. b and c are correct	
7. In which solution should NTG be diluted?	
a. 0.9% saline solution	
b. 5% dextrose solution	
c. Both dilutions are valid	
d. Neither of these dilutions is valid	
8. What type of container should NTG be prepared in?	
a. Plastic container	
b. Glass container	
c. Both	
9. Which vital signs should be monitored during continuous NTG infusion?	
a. Oxygen saturation	
b. Heart rate	
c. Blood pressure	
d. Respiratory rate	
10. What is the route of administration?	
a. Peripheral venous line	
b. Central venous line	
c. Both routes are appropriate for intravenous use	
11. Should administration be carried out using an opaque container?	
a. Yes	
b. No	

ly IV-NTG use vs the ICU group ($P = .001$). Emergency nurses showed greater knowledge on dilution and the type of container used for storing IV-NTG. No differences were found between groups regarding indications for use in acute cardiac conditions or the vital signs to monitor. There were

Table 2. Demographic characteristics of the population and comparison of IV nitroglycerin use and knowledge between emergency nurses and unit nurses

	Emergency nurse N = 30 n (%)	Unit nurse N = 30 n (%)	P-value
Age (years)	31.05 (26.27-34.84)	35.16 (31.16-39.09)	< .001
Sex			.77
Male	9 (52.94)	8 (47.6)	
Female	21 (48.84)	22 (51.16)	
Years of experience as a nurse	7 (4-12)	12 (8-16)	.01
Frequency of IV-NTG use			.001
None	3 (11.11)	8 (26.67)	
1-5 times per month	11 (40.74)	21 (70)	
6-15 times per month	10 (37.04)	1 (3.33)	
> 15 times per month	3 (11.11)	0 (0)	
Knowledge of IV-NTG indication			.13
AMI	3 (10)	7 (23.33)	
AF	0 (0)	0 (0)	
HF	2 (6.67)	5 (16.67)	
AMI + HF	25 (83.33)	17 (56.67)	
AF + HF	0 (0)	1 (3.33)	
IV-NTG dilution			.01
0.9% saline solution	1 (3.33)	0 (0)	
5% dextrose solution	21 (70)	13 (43.33)	
Both	7 (23.33)	17 (56.67)	
No solution	1 (3.33)	0 (0)	
Type of container for dilution			< .001
Plastic	2 (6.67)	3 (10)	
Glass	25 (83.33)	9 (30)	
Both	3 (10)	18 (60)	
Vital signs to monitor during IV-NTG use			1
Oxygen saturation	0 (0)	0 (0)	
Heart rate	5 (16.67)	4 (13.33)	
Blood pressure	25 (83.33)	26 (86.67)	
Respiratory rate	0 (0)	0 (0)	
IV-NTG administration route			1
Peripheral venous line	1 (3.33)	0 (0)	
Central venous line	2 (6.67)	3 (10)	
Both routes	27 (90)	27 (90)	
Container covering			.18
Opaque	15 (50)	21 (70)	
Transparent	15 (50)	9 (30)	

IV-NTG: intravenous nitroglycerin; AMI: acute myocardial infarction; HF: heart failure; AF: atrial fibrillation.

no differences either in the type of IV access used or in the choice of light-resistant containers for IV-NTG administration (Table 2).

This study aimed to investigate the role of nursing in the use of IV-NTG and patient safety through correct administration. The emergency nursing group, despite being younger, had greater experience using IV-NTG and better knowledge of its dilution and administration compared with ICU nurses. These differences may be related to the higher frequency of IV-NTG use in emergency departments, where patients with acute cardiovascular conditions commonly require it. It should be noted that CICU nurses

were excluded; in those units, IV-NTG use may be more frequent than in general ICU settings.

Chromatographic studies have evaluated IV-NTG storage and administration conditions, including pH, temperature, and chemical stability depending on container material and light exposure.⁴ IV-NTG remains stable in > 95% of cases after 24 hours of dilution in 5% dextrose solution, regardless of light exposure.⁵ Since the 1970s, it has been shown that the chemical properties of IV-NTG do not vary whether diluted in 5% dextrose or 0.9% saline solution.⁴ In our study, emergency nurses preferentially used 5% dextrose for dilution, while ICU

nurses used both solutions interchangeably. Several studies have assessed the type of container for IV-NTG. Glass is the container of choice, as the molecule can be absorbed by plastic walls.³ However, some studies report that IV-NTG can remain stable in certain plastics such as polypropylene and polyethylene.^{3,6} Nonetheless, the drug label recommends glass containers to prevent errors, since administration usually occurs in emergency situations.⁴ Notably, emergency nurses primarily used glass containers, whereas ICU nurses used plastic or glass interchangeably, which could result in solute loss during dilution—possibly related to less frequent exposure among ICU staff.

IV-NTG is a potent vasodilator with non-negligible side effects, often requiring administration in situations of cardiovascular instability. Therefore, the health care staff most directly involved—nurses—must have detailed knowledge of its pharmacological properties to prepare and administer it correctly. Furthermore, they must know the indications and vital signs to monitor to avoid adverse effects. Our findings show that ICU nurses prepared dilutions in inappropriate containers more often, possibly due to less frequent use of IV-NTG despite having more years of experience. Indeed, other studies have found few adverse events in prehospital IV-NTG adminis-

tration by paramedics who regularly use the drug.^{7,8}

The study presents several limitations, including its single-center design and the potential interindividual variability among nurses, which may have influenced survey responses. This variability could be affected by multiple factors such as institutional protocols, staff training, work environment, experience-based learning, and/or scientific evidence, among others. Additionally, there is a bias related to the subjective interpretation of the frequency of IV-NTG administration by each participant. Finally, the survey developed by our research group lacks external validation, as it is pioneering in the field of clinical safety.

In conclusion, we present the first study described in the literature that evaluates the use of IV-NTG according to the nursing workplace within the hospital. Our findings indicate that emergency department nurses, due to their more frequent use of the drug, demonstrate greater knowledge on the dilution and storage of IV-NTG, despite being younger and having fewer years of professional experience. Nursing staff who work with critically ill patients should improve and update their knowledge about the storage and administration of IV-NTG to prevent possible adverse events. This observation could be extended to other drugs, such as nitroprusside and fibrinolytic agents. It would be useful to have studies with external

validation to extrapolate the data to other health care centers and clinical units.

Note of the editors: This is a BOWMAN-generated English translation of the officially indexed Spanish-language article, which should be cited as *Rev Esp Urg Emerg.* 2023;2:52-54. In this translated version, the editors have supervised the process; however, it cannot be ruled out that some errors resulting from the artificial intelligence translation process may have gone unnoticed.

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