Original Article

Accuracy of clinical indicators of the nursing diagnosis proposal on *ocular dryness* in intensive care

Acurácia dos indicadores clínicos da proposta diagnóstica de enfermagem sobre o *ressecamento ocular* em terapia intensiva

Precisión de los indicadores clínicos de la propuesta diagnóstica de enfermería sobre la *sequedad ocular* en unidad de cuidados intensivos

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Abstract

Objective: To analyze the clinical indicator accuracy of *Ocular dryness* nursing diagnostic proposal in adult patients in the Intensive Care Unit.

Methods: This is a diagnostic accuracy study, with cross-sectional analytical design and quantitative approach. The sample consisted of 206 patients admitted to an adult Intensive Care Unit. An instrument designed according to variables related to sociodemographic and clinical data, clinical indicators, etiological factors, population at risk and associated conditions of *Ocular dryness* was applied. A latent class model was used to identify the prevalence of diagnosis and to identify clinical indicator specificity and sensitivity.

Results: Among the study participants, 52.4% were male and had a mean age of 58.69 years (±14.61). The prevalence of *Ocular dryness* was 76.22%. The *reduced tear volume* and *excessive mucous secretion* clinical indicators showed high specificity values (81.63% and 99.99%, respectively). Moreover, *extended blood vessels on the ocular surface*, *excessive mucous secretion*, *mucoid filaments* and *chemosis* presented higher values for sensitivity (74.52%, 99.99%, 100.0% and 71.97%, respectively).

Conclusion: After analyzing clinical indicator accuracy, it is concluded that five defining characteristics were able to present high values of specificity or sensitivity. This finding corroborates an accurate diagnostic inference, in order to enable the optimization of results in order to prevent the clinical decline related to the undesirable human response *Ocular dryness*.

Resumo

Objetivo: Analisar a acurácia dos indicadores clínicos da proposta diagnóstica de enfermagem *Ressecamento ocular* em pacientes adultos em Unidade de Terapia Intensiva.

Métodos: Estudo de acurácia diagnóstica, com delineamento analítico transversal e de abordagem quantitativa. A amostra foi composta por 206 pacientes internados em uma unidade de terapia intensiva adulto. Foi aplicado um instrumento elaborado de acordo com variáveis relacionadas aos dados sociodemográficos, clínicos, indicadores clínicos, fatores etiológicos, população em risco e condições associadas do *Ressecamento ocular*. Um modelo de classe latente foi utilizado para identificação da prevalência do diagnóstico e identificação da especificidade e sensibilidade dos indicadores clínicos.

Resultados: Dentre os participantes do estudo, 52,4% eram do sexo masculino e apresentaram média de idade de 58,69 anos (±14,61). A prevalência do *Ressecamento ocular* foi de 76,22%. Os indicadores clínicos *volume lacrimal diminuído* e *excesso de secreção mucoide* apresentaram valores elevados de especificidade (81,63% e 99,99%, respectivamente). Além disso, *vasos sanguíneos dilatados na superfície ocular*,

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excesso de secreção mucoide, *filamento mucoide* e *quemose* apresentaram valores mais altos para sensibilidade (74,52%, 99,99%, 100,0% e 71,97%, respectivamente).

Conclusão: Após a análise da acurácia dos indicadores clínicos, conclui-se que cinco características definidoras foram capazes de apresentar valores elevados de especificidade ou sensibilidade. Este achado corrobora para uma inferência diagnóstica acurada, de modo a possibilitar a otimização de resultados com o intuito de impedir o declínio clínico referente à resposta humana indesejável *Ressecamento ocular*.

Resumen

Objetivo: Analizar la precisión de los indicadores clínicos de la propuesta diagnóstica de enfermería *Sequedad ocular* en pacientes adultos en Unidad de Cuidados Intensivos.

Métodos: Estudio de precisión diagnóstica, con diseño analítico transversal y de enfoque cuantitativo. La muestra estuvo compuesta por 206 pacientes internados en una unidad de cuidados intensivos adulta. Se aplicó un instrumento elaborado de acuerdo con variables relacionadas con datos sociodemográficos, clínicos, indicadores clínicos, factores etiológicos, población en riesgo y condiciones asociadas a la *sequedad ocular*. Se utilizó un modelo de clase latente para identificar la prevalencia del diagnóstico y para identificar la especificidad y sensibilidad de los indicadores clínicos.

Resultados: De los participantes del estudio, el 52,4 % era de sexo masculino y con edad promedio de 58,69 años (±14,61). La prevalencia de la *sequedad ocular* fue de 76,22 %. Los indicadores clínicos *volumen lagrimal reducido* y *exceso de secreción mucoide* presentaron valores elevados de especificidad (81,63 % y 99,99 %, respectivamente). Además, *vasos sanguíneos dilatados en la superficie ocular*, *exceso de secreción mucoide*, *filamento mucoide* y *quemosis* presentaron valores más altos de sensibilidad (74,52 %, 99,99 %, 100,0 % y 71,97 %, respectivamente).

Conclusión: Después del análisis de precisión de los indicadores clínicos, se concluye que cinco características definitorias fueron capaces de presentar valores elevados de especificidad o sensibilidad. Este descubrimiento corrobora una inferencia diagnóstica precisa, a fin de permitir la optimización de resultados con el objetivo de impedir el deterioro clínico referente a la respuesta humana indeseable *sequedad ocular*.

Introduction

In the Intensive Care Unit (ICU), hospitalized patients need complex assistance to maintain the clinical condition, often with the use of ventilatory support and various medications, such as neuromuscular blockers and sedatives. As a result, they are more likely to develop changes on the ocular surface with potential progression to visual loss.[1,2] A previous study found that 52.4% of patients admitted to the ICU were diagnosed with dry eye. Among the ocular alterations observed, hyperemia, mucous secretion, eyelid edema and lagophthalmos were present.[3]

Thus, special attention is essential in preventive ocular assessment, requiring nurses to identify potential diagnoses that are in line with the human responses presented by patients, making it possible to draw up more reliable care plans for each individual' needs.[4-6]

The NANDA International (NANDA-I) 2021-2023 edition comprises the nursing diagnosis *Risk for dry eye* (00219), approved in 2010 and revised in 2013, 2017 and 2020. It is defined as "Susceptible to inadequate tear film, which may cause eye discomfort and/or damage ocular surface, which may compromise health".[7] Still, there is the *Ineffective dry eye self-management* (00277) nursing diagnosis, approved in 2020, whose definition addresses the "Unsatisfactory management of symptoms, treatment regimen, physical, psychosocial, and spiritual consequences and lifestyle changes inherent in living with inadequate tear film".[7]

From the identification of *Ocular dryness* as an undesirable human response, there is a need to analyze the accuracy of *Ocular dryness* clinical indicators as a diagnostic proposition as a focus on the problem. Validity processes of nursing diagnoses are divided into three phases: concept analysis, content analysis by experts and analysis of accuracy of clinical indicators.[8]

In a previous study, through concept analysis, *Ocular dryness* nursing diagnosis was built and then had its diagnostic content validated by experts. It was defined as "Quantitative insufficiency of the tear film, which can compromise the ocular surface integrity maintenance".[9] The proposed diagnosis[9] has 14 defining characteristics subdivided into seven signs and seven symptoms. In patients admitted to the ICU, sometimes unable to verbalize or report the symptoms adequately, seven defining characteristics, objective clinical signs, were applied: *conjunctival hyperemia*, *reduced tear volume*, *excessive mucous secretion*, *chemosis*, *extended blood vessels on the ocular surface*, *mucoid filaments* and *mucous plaques*.

An accuracy study is essential so that it remains revised, provides subsidies for updating the NANDA-I taxonomy of nursing diagnoses as

well as promoting an impact on clinical practice. Considering the above, the following questions emerged: what is the prevalence of *Ocular dryness* nursing diagnosis in adult ICU patients? How accurate are *Ocular dryness* clinical indicators in adult ICU patients? This study can improve *Ocular dryness* diagnostic proposition for the NANDA-I nursing diagnosis taxonomy, in addition to providing nurses with evidence that can facilitate the inference of *Ocular dryness* in adult patients admitted to the ICU, in order to provide qualified assistance that meets the needs of these patients in relation to eye care.[10,11]

That said, this study aims to analyze clinical indicator accuracy of *Ocular dryness* nursing diagnosis in adult patients in the ICU.

Methods

This is a diagnostic accuracy study, with an analytical, cross-sectional design and a quantitative approach. A specific methodological framework was used to establish clinical indicator accuracy with the diagnostic test approach.[8] This report was based on the Standards for Reporting initiative Studies of Diagnostic Accuracy (STARD).

The research was carried out in an adult ICU of a public university hospital located in northeastern Brazil. The population consisted of patients hospitalized in the adult ICU of the referred hospital. To determine the sample, the use of a minimum value of 20 to 30 individuals was taken into account for each clinical indicator assessed. This strategy is used to determine the sample size in diagnostic accuracy studies based on latent class analysis.[12]

The proposed nursing diagnosis contains seven defining characteristics that are applicable for standardized assessment of patients admitted to the ICU and could require a minimum final sample of 140 and a maximum of 210 individuals. Data collection took place with all patients who met the eligibility criteria in the period of seven months (January to July), and the final sample was then composed of 206 patients, which accounts for approximately 29 individuals for each clinical indicator assessed.

Patients aged 18 years or older and admitted to the ICU of the hospital in question, with a hospital stay of more than 24 hours were included. Patients with ocular damage or topical treatments, facial surgeries and in agitation were excluded.

In the data collection stage, an instrument containing variables related to sociodemographic and clinical data, defining characteristics, etiological factors, population at risk and conditions associated with *Ocular dryness* was applied. The instrument was developed from the conceptual and operational definitions identified in a previous study.[9] Data collection for this proposal was carried out between November and December 2018 through a database of patients who underwent ocular assessment admitted to the ICU from January to July 2016.

Data were obtained from a primary source, through the researcher's direct assessment, and from a secondary source, by consulting medical records. To assess the instrument's applicability and possible necessary adjustments, a pilot collection of the instrument was carried out with 30 patients, who were included in the final sample due to lack of substantial changes in the ways of obtaining and measuring variables. In order to minimize biases, before data collection, a 60-hour training course was carried out by a group of study researchers composed of nurses and nursing students who were members of the Nucleus of Studies in the Nursing Process and Classifications (NEPEC) of the *Universidade Federal do Rio Grande do Norte* (UFRN). Training was carried out with the aim of qualifying the team for clinical assessment of adult patients admitted to the ICU. The data collection instrument and the assessment technique for each variable were discussed in detail during the training carried out by the researchers, which was composed of the following axes: 1. ocular anatomy and physiology; 2. semiotics to perform ocular physical examination; 3. presentation of data collection instrument; and 4. application of standardized equipment adopted for data collection.

The standardized equipment used for training and data collection were: Incoterm® thermo-hygrometer to check air humidity and the Ophtalmos® Schirmer Test, considered insufficient when the val-

ue was <10 millimeters. The Schirmer test is the quantitative method performed by inserting a strip of sterile filter paper under the eyelid, in the lower conjunctival fornix near the lateral canthus, away from the cornea. The length in millimeters that the strip moistens during the test period (5 minutes) defines tear volume. Values are considered normal when they are above 10 millimeters.[9]

At the end of the training, the collection team was submitted to assessments that involved the theoretical and practical scope. For the theoretical assessment, 10 questions with a two-hour duration for execution were included. It should be noted that, to ensure member anonymity, an individual number was drawn to identify the assessment, placed at the end in a sealed envelope. Thus, in order to ensure that corrections were blinded, the envelope with the identification number of each member was only opened when the results were announced. Regarding practical assessment, this took place during training and at the data collection site, under the guidance of the researcher in charge.

After carrying out the theoretical and practical assessments, team members would need to obtain at least 70% to be considered able to participate in the study's data collection. It should be noted that all participants were successful in participating in the collection and, due to the unavailability of schedules for three participants, the team consisted of six members.

The collected data were organized and stored in a database built in Microsoft Office Excel 2016, and data analysis was performed using the statistical package R version 2.12.1. For descriptive analysis, frequencies, measures of the center of distribution and its variability were considered. The Shapiro-Wilk test was used to verify data normality. To verify diagnosis prevalence, the sensitivity and specificity of each clinical indicator with their respective 95% confidence intervals, the latent class analysis (LCA) method was used based on the random effects model.[8] Furthermore, the likelihood ratio test (G^2) was used to verify the adequacy of the fit of the latent class models. From the model, clinical indicators that did not show statistical significance were excluded and a new model was adjusted. It is noteworthy that statistical non-significance was considered when the upper limit of confidence interval of sensitivity and specificity measures was less than 50% and/or when the confidence interval included this value. When any clinical indicator needed to be excluded, a new model was adjusted until the likelihood ratio test (G^2) indicated that it presented adequate adjustment ($p>0.05$). Posterior probabilities for the nursing diagnosis were calculated from the adjusted latent class model.

This study obtained a favorable opinion from the Research Ethics Committee of the *Universidade Federal do Rio Grande do Norte*, under Opinion 918.510 and CAAE (*Certificado de Apresentação para Apreciação Ética* - Certificate of Presentation for Ethical Consideration) 36079814.6.0000.5537. The recommendations of Resolution 466/12 of the Brazilian National Health Council were strictly respected. In addition to this, all participants and/or family members were informed about the research and agreed to participate by signing the Informed Consent Form.

Results

A total of 206 patients participated in this study, of which 52.4% were male and had a mean age of 58.69 years (±14.61); 63.9% of patients lived with a partner; 57.6% lived in the countryside from the state of Rio Grande do Norte; 41.8% had incomplete primary education and in terms of occupation; 43.3% were retired; and 88.8% were religious practitioners. Family income obtained a median of R$1,760.00 or US$ 320.00 and three was the median number of dependents. With regard to clinical data, 35.6% of patients have the surgical center as their sector of origin; 49.5% were hospitalized for reasons of clinical treatment and the number of days of hospitalization reached a median of one day (Shapiro-Wilk test $p<0.001$). The main type of ventilatory device was the endotracheal tube (47.0%), and according to ventilatory support 51.9% of patients used invasive mechanical ventilation. Among the drugs, it was observed that gastric secretion inhibitors/protectors (71.4%) were the most used. In

80.1% of patients, the Schirmer test was insufficient (< 10 millimeters). Table 1 shows the distribution of defining characteristics, related factors, populations at risk and associated conditions of *ocular dryness* nursing diagnosis in adult patients admitted to the ICU.

Table 1. Distribution of defining characteristics, related factors, populations at risk and associated conditions of *Ocular dryness* in adult patients admitted to the Intensive Care Unit (n=206)

Defining characteristics (signs)*	n(%)
Reduced tear volume	165(80.1)
Conjunctival hyperemia	129(62.6)
Chemosis	69(33.5)
Dilated blood vessels on the ocular surface	63(30.6)
Excessive mucous secretion	49(23.8)
Mucoid filaments	34(16.5)
Mucous plaques	20(9.7)
Related factors (individual factors) *	
Smoking	75 (36.4)
Eyelid edema	47 (22.8)
Lagophthalmos	43(20.9)
Poorly adapted non-invasive mechanical ventilation device or oxygen therapy	3 (1.5)
Related factors (environmental factors)*	
Air conditioning	206 (100.0)
Excessive wind	33 (16.0)
Low air humidity	0 (0.0)
Population at risk*	
Age greater than or equal to 60 years	105 (51.0)
Women	98 (47.6)
Associated conditions*	
Admission to the Intensive Care Unit	206 (100.0)
Systemic diseases that alter ocular surface homeostasis with reduced tear volume	146 (70.9)
Drugs that alter ocular surface homeostasis with reduced tear volume	140 (66.0)
Mechanical ventilation	107 (51.9)
Leukocytosis	104 (50.5)
Decreased blinking	100 (48.5)
Absence of reflex response to III cranial nerve pairs	86 (41.7)
Absence of reflex response to IV cranial nerve pairs	78 (37.9)
Surgical procedures	73 (35.4)
Absence of reflex response to VI cranial nerve pairs	72 (35.0)
Oxygen therapy	31 (15.0)
Allergy	21 (10.2)
Reduced level of consciousness	20 (9.7)
Autoimmune disorders that target the tear glands and result in reduced tear film	16 (7.8)
Absence of corneal-palpebral reflex	11 (5.3)
Proptosis	8 (3.9)
Eye surgical procedure	3 (1.5)

* Multi-choice answer.

The defining most predominant characteristics were *reduced tear volume* (80.1%), *conjunctival hyperemia* (62.6%) and *chemosis* (33.5%). With regard to factors related to individuals, *smoking* (36.4%), *eyelid edema* (22.8%) and *lagophthalmos* (20.9%) were the most frequent. Regarding environmental related factors, 100.0% used air *conditioning* and 16.0% were affected by *excessive wind.* According to the populations at risk, 51.0% were *aged 60 years or older* and 47.6% were *female*. Among the most frequent associated conditions, 100.0% were admitted *to the ICU*, 70.9% had *systemic diseases that alter ocular surface homeostasis with reduced tear volume*, and 66.0% used *medications that alter ocular surface homeostasis with reduced tear volume*. Table 2 represents the accuracy measures for defining characteristics of *Ocular dryness* from the adjusted latent class model. Seven defining characteristics were included in the analysis and five showed adequate adjustment, demonstrating that there is a sufficiently strong association between them to represent a latent variable (nursing diagnosis). Two characteristics were eliminated because they had sensitivity and specificity values below 0.5 or the 95% confidence interval included this value.

Table 2. Diagnostic accuracy measures obtained in the latent class model in adult patients admitted to the Intensive Care Unit

		95%CI		sp	95%CI	
Defining characteristics	if	Lower	upper		Lower	upper
Reduced tear volume	0.2038	0.1507	0.2762	0.8163	0.6466	0.9043
Dilated blood vessels on the ocular surface	0.7452	0.6638	0.8069	0.4694	0.2855	0.6263
Excessive mucous secretion	0.9999	0.9996	1,0000	0.9999	0.9999	1,0000
Mucoid filaments	1,0000	0.9999	1,0000	0.6940	0.0833	0.9501
Chemosis	0.7197	0.6479	0.7846	0.5102	0.3581	0.6493
Prevalence: 76.22%		G ^{2}: 28.8		DF:20	p= 0.092	

If – Sensitivity; Sp – Specificity; CI95% – 95% Confidence Interval; G2 – Likelihood ratio test; DF – degree of freedom; p – p-value

Using the latent class model, the prevalence of *Ocular dryness* was verified in 76.2% of the sample. The *reduced tear volume* and *excessive mucous secretion* clinical indicators showed high specificity values; thus, they can be used to confirm the presence of *Ocular dryness*. Furthermore, *dilated blood vessels on the ocular surface*, *excessive mucous secretion*, *mucoid filaments* and *chemosis* presented higher values for sensitivity, which shows that such characteristics demonstrate better measures of accuracy to infer initial stages of *Ocular dryness*. *Excessive mucous secretion* was the best clinical indicator to predict the presence of *Ocular dryness* in patients admitted to the ICU with high values of sensitivity (99.99%)

and specificity (99.99%), followed by *mucoid filaments*, with 100% sensitivity. Table 3 presents the probability of identifying *Ocular dryness* from the adjusted latent class model. In this table, 0 means absent/no and 1 means present/yes.

Table 3. Subsequent probabilities for *Ocular dryness* obtained in the latent class model in adult patients admitted to the Intensive Care Unit

Sets	Defining characteristics					n	Ocular dryness	
	DC1	DC2	DC3	DC4	DC5		Present	Absent
1	0	0	0	0	0	4	0.00	1.00
2	0	0	0	0	1	8	0.00	1.00
3	0	0	0	1	0	4	0.00	1.00
4	0	0	0	1	1	3	0.00	1.00
5	0	0	1	1	0	4	1.00	0.00
6	0	0	1	1	1	29	1.00	0.00
7	0	1	0	0	0	12	0.00	1.00
8	0	1	0	0	1	4	0.00	1.00
9	0	1	0	1	0	3	0.00	1.00
10	0	1	0	1	1	2	0.00	1.00
11	0	1	1	1	0	29	1.00	0.00
12	0	1	1	1	1	63	1.00	0.00
13	1	0	0	0	1	1	0.00	1.00
14	1	0	0	1	0	2	0.00	1.00
15	1	0	0	1	1	1	0.00	1.00
16	1	0	1	1	0	2	1.00	0.00
17	1	0	1	1	1	5	1.00	0.00
18	1	1	0	0	1	5	0.00	1.00
19	1	1	1	1	0	9	1.00	0.00
20	1	1	1	1	1	16	1.00	0.00

DC1 – Reduced tear volume; DC2 – Dilated blood vessels on the ocular surface; DC3 – Excessive mucous secretion; DC4 – Mucoid filaments; DC5 – Chemosis

Eight of the 20 sets with different combinations of defining characteristics were likely to have *Ocular dryness*, namely: 5, 6, 11,12, 16, 17,19 and 20. In all sets in which the diagnosis was present, the *excessive mucous secretion* and *mucoid filaments* characteristics were also present.

Discussion

When considering the objective of this study, the discussion was organized in order to address the relevant sociodemographic and clinical variables of the participants, and then diagnosis prevalence and clinical indicator accuracy.

Thus, when analyzing the sociodemographic variables of the sample, it is observed that the results were similar to other studies, in which the majority of the target population was also male with a mean age of 59 years.[13,14]

In addition, there are similarities in relation to clinical data with other studies carried out in order to identify ocular changes in critically ill patients admitted to the ICU, in which they also identified the use of invasive mechanical ventilation in most of the sample, also justifying the endotracheal tube as a the main ventilator device.[13-15] Mechanical ventilation comprises invasive or non-invasive mechanical ventilatory support with positive end-expiratory pressure (PEEP). The use of high PEEP can compromise the eye by increasing intrathoracic pressure and producing effects that potentiate venous stasis, facial edema and decrease ocular perfusion.[16,17]

Still, studies also present results related to the routine use of drugs such as anticoagulants, antiulcer agents, analgesics, antibiotics and antihypertensives in patients admitted to the ICU.[2,18] These drugs are especially those that act on cholinergic receptors, causing a reduction or blocking of the action of acetylcholine with a decrease in the tonic contraction of the orbicularis muscle and resulting in incomplete eyelid closure, corneal exposure and dryness.[19,20]

In this study, *Ocular dryness* had a prevalence of 76.22%. Variable frequencies between 13.2% and 75.3% of other ocular surface disorders have been described in critically ill ICU patients. The lack of standardization among diagnostic criteria for ocular surface disorders may explain these variations in studies.[2,3,14,21] When assessing the accuracy of clinical indicators, reduced tear volume and excessive mucous secretion were the indicators that showed high specificity values. Reduced tear volume is characterized by a decrease in tear production due to changes in the responsible ocular mechanisms. Corroborating the result of this study, research carried out in the ICU showed low aqueous tear production according to Schirmer I Test results.[2,13,22]

In this sense, *reduced tear volume* was described in this study as important to confirm the presence of the proposed diagnosis. *Excessive mucous secretion* configures the increased activity of the conjunctival goblet glands as a result of an initial irritation. A study describes that mucous secretion and ocular

hyperemia were indicators that showed a significant relationship with the occurrence of *Ocular dryness*.[23] Thus, it is similar to the result of this study, since *excessive mucous secretion* was the best clinical indicator to confirm the presence of diagnosis in patients admitted to the ICU with high values of sensitivity and specificity. Moreover, *dilated blood vessels on the ocular surface*, *excessive mucous secretion*, *mucoid filaments* and *chemosis* indicated higher values for sensitivity. The *dilated blood vessels on the ocular surface* defining characteristic was identified as a clinical sign that indicates the detection of the early stages of *Ocular dryness* nursing diagnosis.[13] In this perspective, it is considered a clinical sign of lesser severity, which allows the early detection of the problem and was present in 30.6% of the sample of this study.

Mucoid filaments are characterized by the presence of small strands of whitish mucus on the ocular surface, associated with epithelial dysfunction caused by a decrease in tear volume.[13,23,24] This defining characteristic was identified in 16.5% of this study's sample and the indicator had a sensitivity of 100%. In this regard, *mucoid filaments* are also considered a clinical indicator of lesser severity, allowing the inference of the initial stages of *Ocular dryness* nursing diagnosis.

Chemosis can be caused by several factors and is characterized by conjunctival edema.[16] A study described in its results a high incidence of conjunctival edema in studies carried out in patients admitted to the ICU, especially in those with lagophthalmos.[25] Lagophthalmos represents inadequate eyelid closure due to suppression of the orbicularis muscle function by physiological mechanisms during sleep or secondary to drug treatment.[13,16,26]

It should be noted that the analysis of the information described that indicate the characteristics that can confirm the presence of diagnosis, and/or those that show better accuracy measures to infer the initial stages of diagnosis, considered indicators of less severity, and/or those that show the best clinical indicator to predict the presence of *Ocular dryness* were all interpreted and discussed taking into account the diagnostic accuracy measures of sensitivity and specificity presented.

Given the above, it is understood that there are obstacles in eye care assistance in the ICU, such as the demand for time, shortage of trained professionals and lack of adequate knowledge. However, it is believed that nurses can play an important role in identifying an early and accurate diagnosis of *Ocular dryness* during care provision. It is necessary to include a routine ocular assessment in order to prevent ocular surface complications, ensuring an increase in patients' quality of life.[16,27-29] The advancement of taxonomies of nursing phenomena, such as NANDA-I, through the development of research, provides a standardized language among nurses and promotes improvement in care practice.[7] In this sense, the study in question allowed the analysis of accuracy of clinical indicators of *Ocular dryness* in adult ICU patients.

Limitations of this study are the impossibility of knowing the cause and effect relationships due to the design used in the study and because it was carried out in the clinical setting of the ICU did not allow the assessment of some elements of the diagnosis and, therefore, it is not possible to generalize the findings to other populations. Thus, it is suggested to carry out research with other designs and in different populations to continue the formulation of evidence for continuous improvement of *Ocular dryness* nursing diagnosis.

The present study promotes contributions to the advancement of nursing, as it provides subsidies for the improvement of nursing science and the NANDA-I taxonomy, providing evidence for practice with attention focused on unwanted human responses. Thus, it may contribute to a better understanding of the most relevant signs for the inference of *Ocular dryness*, and may direct the development of preventive actions and adequate therapy for *Ocular dryness* in adults hospitalized in the ICU.

Among these actions, the daily ocular assessment, eye hygiene to remove dirt, lubrication with artificial tears or with ointment/gel, eyelid closure with the aid of adhesive tape or wet camera with polyethylene film by a trained professional and, above all, the continuing education program stand out, including health education on the subject and training to train professionals

in eye assessment as well as specific protocols for eye care in the ICU.[30,31]

Thus, it corroborates an accurate diagnostic inference, in order to enable the optimization of results in order to prevent the clinical decline related to the unwanted human response of *Ocular dryness*.

Conclusion

It is concluded that five defining characteristics were able to present high values of specificity or sensitivity. *Reduced tear volume* and *excessive mucous secretion* understood satisfactory characteristics to confirm the presence of *Ocular dryness*. Still, the *dilated blood vessels on the ocular surface*, *excessive mucous secretion*, *mucoid filaments* and *chemosis* characteristics were considered relevant to understanding the early stages of the diagnosis. *Excessive mucous secretion* and *mucoid filaments* were the best indicators to predict the presence of *Ocular dryness* in patients admitted to the ICU. It is noteworthy that accuracy studies allow the correct identification of clinical indicators that influence the presence of the outcome.

Collaborations

Araújo JNM, Botarelli FR, Fernandes APNL, Dantas AC, Lopes MVO and Vitor AF contributed to the study design, data analysis and interpretation, article writing, relevant critical review of the intellectual content and approval of the final version to be published.

References

1. Machado AS, Cruz IC. Risk of eye dryness in intensive care unit: systematic review of literature. J Specialized Nurs Care. 2019;11(1):1-8.
2. Dana R, Bradley JL, Guerin A, Pivneva I, Evans AM, Stillman IÖ. Comorbidities and prescribed medications in patients with or without dry eye disease: a population-based study. Am J Ophthalmol. 2019;198:181-92.
3. Araújo JN, Botarelli FR, Fernandes AP, Oliveira-Kumakura AR, Ferreira Júnior MA, Vitor AF. Predictive clinical factors for ocular dryness in patients admitted to the Intensive Care Unit. Rev Esc Enferm USP. 2019;53:e03493.
4. Płaszewska-Żywko L, Sega A, Bukowa A, Wojnar-Gruszka K, Podstawa M, Kózka M. Risk Factors of Eye Complications in Patients Treated in the Intensive Care Unit. Int J Environ Res Public Health. 2021;18(21):11178.
5. Golden MI, Meyer JJ, Patel BC. Dry Eye Syndrome. 2022 Nov 2. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2022.
6. Pourghaffari Lahiji A, Gohari M, Mirzaei S, Nasiriani K. The effect of implementation of evidence-based eye care protocol for patients in the intensive care units on superficial eye disorders. BMC Ophthalmol. 2021;21(1):275.
7. Herdman TH, Kamitsuru S, Lopez CT. NANDA-I Nursing Diagnoses: Definitions and Classification 2021-2023. 12a ed. Porto Alegre: Artmed; 2021. 592 p.
8. Lopes MV, Silva VM, Araujo TL. Methods for establishing the accuracy of clinical indicators in predicting nursing diagnoses. Int J Nurs Knowl. 2012;23(3):134-9.
9. Araújo JN. Construction and validation of the ocular dryness nursing diagnosis in adult patients hospitalized in an intensive care unit. Natal [tese]. Rio Grande do Norte: Universidade Federal do Rio Grande do Norte; 2019.
10. O'Neil EC, Henderson M, Massaro-Giordano M, Bunya VY. Advances in dry eye disease treatment. Curr Opin Ophthalmol. 2019;30(3):166-78. Review.
11. Adeyemo T, AbdulRahman A, Kyari F. The many roles of an ophthalmic nurse in a tertiary eye institution. Community Eye Health. 2020;33(110):46-47.
12. Swanson SA, Lindenberg K, Bauer S, Crosby RD. A Monte Carlo investigation of factors influencing latent class analysis: an application to eating disorder research. Int J Eating Disords. 2012;45(5):677–84.
13. de Araújo DD, Almeida NG, Silva PM, Ribeiro NS, Werli-Alvarenga A, Chianca TC. Prediction of risk and incidence of dry eye in critical patients. Rev Lat Am Enfermagem. 2016;24:e2689.
14. Swiston CJ, Hu KS, Simpson A, Burton E, Brintz BJ, Lin A. Prevention of Exposure Keratopathy in the Intensive Care Unit: Evaluation of an EMR-Based Lubrication Order Protocol for Ventilated Patients. J Acad Ophthalmol. 2022;14:e141–6.
15. Parekh PH, Boente CS, Boente RD, Meeker JW, Carlos WG. Ophthalmology in critical care. Ann Am Thorac Soc. 2019;16(8):957-66. Review.
16. Ebadi A, Moayed M, Mirsadeghi A, Saeid Y. Evaluating Intensive Care Nurses' Clinical Competence in Eye Care; a Cross-Sectional Descriptive Study. Health Educ Health Promot. 2021;9(3):171-5.
17. Hasan O. Intraocular pressure changes in the intensive care unit: the effect of spontaneous respiration, mechanical ventilation, non-invasive CPAP and medical treatments. Ann Med Res. 2019;26(12):2758-62.
18. Bakker T, Abu-Hanna A, Dongelmans DA, Vermeijden WJ, Bosman RJ, Lange DW, et al. Clinically relevant potential drug-drug interactions in intensive care patients: a large retrospective observational multicenter study. J Crit Care. 2021;62:124-30.
19. Alkabbani S, Jeyaseelan L, Rao AP, Thakur SP, Warhekar PT. The prevalence, severity, and risk factors for dry eye disease in Dubai – a cross sectional study. BMC Ophthalmol. 2021;21:219.
20. Korosh R, Nazanin A, Reza R, Fatemeh R, Mehdi H. The effects of passive blinking on exposure keratopathy among patients in intensive care units. Iranian J Nurs Midwifery Res 2022;27:144-8.
21. Akpek EK, Amescua G, Farid M, Garcia-Ferrer FJ, Lin A, Rhee MK, et al. Dry Eye Syndrome Preferred Practice Pattern®. Ophthalmol. 2019;126(1):286–334. Review.

22. Khatiban M, Moradi Amin H, Falahinia G, Moghimbeigi A, Yadollahi M. Polyethylene eye-cover versus artificial teardrops in the prevention of ocular surface diseases in comatose patients: a prospective multicenter randomized triple-blinded three-arm clinical trial. PLoS One. 2021;16(4):e0248830.

23. Hayakawa LY, Matsuda LM, Inoue KC, Oyamaguchi EK, Ribeiro E. Ocular surface injuries at an intensive care unit: a selfpaired clinical trial. Acta Paul Enferm. 2020;eAPE20180279.

24. Bird B, Dingley S, Stawicki SP, Wojda TR. Exposure Keratopathy in the Intensive Care Unit: Do Not Neglect the Unseen. Chapter 9. In: Firstenberg MS, Stawicki SP, editors. Vignettes in Patient Safety. vol. 2. 2018. pp.131-49.

25. Bukke SN, Gurapa R, Chari GK, Mandalaneni RS. A clinical study on ocular surface disorders in intensive care unit patients at S.V.R.R.G.G.H., Tirupati - a hospital based descriptive cross-sectional study. J Evid Based Med Healthc 2021;8(11):633-7.

26. Shaeri M, Mahdian M, Akbari H, Azizzadeh Asl S. Incidence and related factors of surface eye disorders in traumatic intensive care unit patients in Iran. Int J Burns Trauma. 2021;11(4):344-9.

27. Momeni Mehrjardi Z, Mirzaei S, Gohari M, Hafezieh A, Nasiriani K. Effect of Training Eye Care Clinical Guideline for ICU Patients on Clinical Competence of Eye Care in Nurses. Crit Care Res Pract. 2021;2021:6669538.

28. Kim M, Lee Y, Mehra D, Sabater AL, Galor A. Dry eye: why artificial tears are not always the answer. BMJ Open Ophthalmol. 2021;6(1):e000697. Review.

29. Brissette AR, Drinkwater OJ, Bohm KJ, Starr CE. The utility of a normal tear osmolarity test in patients presenting with dry eye disease like symptoms: a prospective analysis. Cont Lens Anterior Eye. 2019;42(2):185-9.

30. Butcher HK, Bulechek GM, Dochterman JM, Wagner CM. NIC Nursing Interventions Classification. 7th ed. Rio de Janeiro: Grupo Editorial Nacional S.A; 2020.

31. Aragão RE, Araruna LP, Sousa MP, Santos EA, Gomes LM. Eye care protocol in patients admitted to intensive care units. Rev Med UFC. 2022;62(1):1-3.