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Water balance in an intensive care unit

Balanço hídrico em unidade de terapia intensiva

Balance hídrico en una unidad de cuidados intensivos

ABSTRACT

Objective: To discuss and analyze the filling out of fluid balance forms for patients admitted to an Intensive Care Unit by the nursing team. **Method:** A cross-sectional study, conducted from February to December 2016. A simple random sample, composed of 220 water balance forms, approved by the Research Ethics Committee, Protocol No. 2.494.058. Analysis using SPSS Statistics 22.0 (IBM), using descriptive statistics, calculation of frequency distribution, measures of central tendency and dispersion. **Results:** A total of 92.7% of the hydric balances were completed. Of this total, 54.5% presented calculation errors; 37.30%, use of improper pen; 53.20%, illegible handwriting; 84.1%, erasures; 78.6% data registration errors; 50.50%, inadequate annotations in columns. There is a 40.7% chance of a correct water balance if there are no flaws in the records and it is completed. **Conclusion:** The results show the need for training of the nursing team and revision of the care protocol.

Descriptors: Water-Electrolyte Balance; Intensive Care Units; Nursing Records; Nursing Assessment; Continuing Education.

RESUMO

Objetivo: Discorrer e analisar o preenchimento dos impressos de balanço hídrico de pacientes internados em uma Unidade de Terapia Intensiva pela equipe de enfermagem. **Método:** Estudo transversal, realizado de fevereiro a dezembro de 2016. Amostra aleatória simples, composta de 220 impressos de balanço hídrico, aprovado no Comitê de Ética em Pesquisa, Protocolo nº. 2.494.058. Análise por meio do SPSS Statistics 22.0 (IBM), utilizando-se estatística descritiva, cálculo de distribuição de frequência, medidas de tendência central e de dispersão. **Resultados:** 92,7% dos balanços hídricos foram concluídos. Deste total, 54,5% apresentaram erros de cálculos; 37,30%, uso de caneta imprópria; 53,20%, letra ilegível; 84,1%, rasuras; 78,6% erros de registro de dados; 50,50%, anotações inadequadas em colunas. Há 40,7% de chances de um balanço hídrico correto se não houver falhas nos registros e o mesmo for concluído. **Conclusão:** Os resultados evidenciam a necessidade de capacitação da equipe de enfermagem e de revisão do protocolo assistencial.

Descritores: Equilíbrio Hidroeletrolítico; Unidades de Terapia Intensiva; Registros de Enfermagem; Avaliação em Enfermagem; Educação Continuada.

RESUMEN

Objetivo: Describir y analizar el balance hídrico realizado por el personal de enfermería en una Unidad de Cuidados Intensivos. **Método:** Estudio transversal, celebrada de febrero a diciembre de 2016. Muestra aleatoria simple, compuesta por 220 balances hídricos, aprobada por el Comité de Ética en Investigación, Protocolo nº. 2.494.058. Análisis a través del SPSS Statistics 22.0 (IBM), utilizando estadística descriptiva, cálculo de distribución de frecuencias, medidas de tendencia central y dispersión. **Resultados:** 92,7% de los balances hídricos. De este total, el 54,5% tuvo errores de cálculo; 37,30%, utilizando un bolígrafo inadecuado; 53,20%, caligrafía ilegible; 84,1%, tachaduras; 78,6% de errores de entrada de datos; 50,50%, anotaciones de columna inapropiadas. Hay un 40,7% de probabilidad de un correcto balance hídrico si no hay errores en los registros y se completa el mismo. **Conclusión:** Los resultados muestran la necesidad de capacitar al personal de enfermería y revisar el protocolo de atención.

Descriptores: Equilibrio hidroelectrolítico; Unidades de cuidados intensivos; Registros de enfermería; Evaluación de enfermería; Educación contínua.

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INTRODUCTION

Recording fluid balance is one of the most important items on the daily nursing assessment form for critically ill patients in Intensive Care Units[1]. The water balance calculation is represented by the difference between the body's volume gain and loss, generating a final balance. The input volume is represented by liquids, nutrition, and intravenous infusions, such as crystalloid solutions and medications; and if this accumulation is greater than the output volume, the patient's balance is considered positive. The output volume, on the other hand, is represented by diuresis, feces, vomit, drainage and exudates, and insensible losses that occur through the skin and breathing.

The correct calculation, therefore, aims at maintaining plasma homeostasis and preventing renal and cardiovascular complications that may generate serious consequences to the patient. As an example, one day of negative fluid balance seems to be enough to predict survival in septic shock patients. On the contrary, when positive it is considered a significant predictor of mortality in the Intensive Care Unit, predisposing to a greater probability of clinical repercussions such as pulmonary and hepatic congestion, malabsorption, increased intra-abdominal pressure/abdominal compartment syndrome, cerebral and renal edema, and inadequate wound healing[2].

Water balance (WB) is the record of accurate measurements of liquids administered intravenously and orally, and liquids excreted through gastrointestinal tract and urinary tract, and its difference must be calculated. When this ratio diverges, it indicates the presence of a fluid imbalance. The daily performance of this action is essential in the care and early diagnosis of water-electrolyte alterations. The nurse is the health professional who is by the patient's side 24 hours a day, and who has the best conditions to observe and identify changes in water-electrolyte imbalances that compromise the various organs and systems of the body. The results of the fluid balance guide the ways of care, identifying complications or disorders that can be prevented or minimized, through its adequate performance[3-4].

Nursing records are guided by a protocol called standard operating procedure (SOP). The standard operating procedure is one of the administrative resources used by the nursing team professionals in order to ensure the execution of the procedure in a technical and scientifically correct manner, ensuring the quality of care. Its effectiveness is linked to the process of collective construction, knowledge, research, ethics, and institutional context, availability of material resources and, especially, the prior awareness and mobilization of the multi-professional health team. The non-observance of these requirements in the preparation of the standard operating procedure can contribute to the team's non-adherence and generate weaknesses in this procedure[5]. Articles 36 and 38 of the Resolution of the Federal Council of Nursing (COFEN) No. 564/2017, determine that the record of nursing information, verbal and/or written, related to the care process, should be clear, objective, chronological, legible, without erasures, complete and reliable[6].

Despite the importance of an adequate fluid balance assessment, in practice some obstacles are encountered for it to occur in an appropriate manner, such as the presence of insensible losses and gains, undetected body temperature variations, the failure to measure the weight of diapers and clothes used by patients, the difficulty of measuring the patient's daily weight, and the occurrence of errors and poor quality records, which are detrimental to the patient's therapeutic approach[5].

There are other issues described by nurses that hinder fluid balance calculation, such as staff inability, lack of time management, work overload, and inaccuracy of fluid infusion equipment[6].

The observation of similar characteristics in our professional scenario motivated this research. Considering the importance of a complete and authentic fluid balance for decision making and assertive management in critically ill patients, this study is justified by considering that gaps in the process of calculating and recording fluid balance may compromise the reliability and safety of its results. The fluid balance result has been considered as a predictor of clinical outcomes mainly associated with mortality and survival of patients in sepsis and septic shock[7-8].

The object of this study is the water balance (WB) process of critically ill patients admitted to an Intensive Care Unit, with the objectives of discussing and analyzing the filling out of the WB forms by the nursing team.

METHODS

The study in question is a cross-sectional study, carried out from February to December 2016. The choice of study type was defined by the low cost, speed, objectivity in data collection, and ease of obtaining samples.

The study setting is an adult Intensive Care Unit of a teaching hospital. The unit has nine beds, which receive patients of both sexes, with clinical and/or surgical disorders. The fluid balance is performed, compulsorily, in all patients admitted to the unit, using a specific form, manually filled out and calculated. The fluid balance is partially done by means of the sum of the infused and eliminated liquids made at the end of each 12-hour shift by the nursing technicians. The calculations and the total closing of the fluid balance are performed by the on duty nurse every 24 hours.

Data collection was based on the probabilistic sampling method. In order to obtain representativeness for the fluid balance analysis, the inclusion criteria were patients aged 18 years or older, of both genders, who were admitted to the adult Intensive Care Unit from February to December 2016. By drawing lots, 35 patient charts were selected for analysis of the fluid balance forms, resulting in a sample of 220 forms. As exclusion criteria, it was defined that the fluid balance forms that were not completed at the time of discharge of the patients would be excluded from the study. In probabilistic sampling, all the elements that make up the study have a known non-zero probability of being part of the drawn sample. We considered a confidence interval of 90% and a margin of error of five (5) percentage points more or less.

In order to test and adjust the data collection script, after approval by the Ethics Committee, a pilot study was conducted with 20 water balance forms, corresponding to the month of January 2016, which were not added to the sample.

Researchers linked to the study field carried out data collection in the Medical Archive and Statistics Service (SAME) of the referred health institution, using a structured script containing information about the epidemiological profile of the patients, records and calculations in the water balance forms.

In the Unit where the study took place, the standard operating procedure (SOP) for water balance was analyzed and updated in January 2016. The updated form consists of a header containing the patient's identification data: name, bed, medical record, weight, and date. In the body of the form, the administered and eliminated liquids, vital data, central venous pressure (CVP), blood glucose levels, and the date when invasive procedures were performed are recorded. On the back, nursing observations, pain scale, and gastric residue (GR) are recorded.

The institutional standard operating procedure (SOP) recommends a constant value of 600 ml and fractions in 24 hours for insensible losses. Insensible losses due to fever are estimated using the following formula: 2 x Tx. x PM, where 2 is a constant, Tx represents the difference of the highest axillary temperature measured in the day during the 24 hours by the temperature of 37.0°C, expressed in ordinal numerals and PM refers to the average weight of the day.

For losses that are difficult to measure, such as vomiting and feces, the plus sign (+) system was standardized, where each (+) is equivalent to 50ml. For vomiting the maximum value is two (++) which is equivalent to 100ml, where one (+) is a small amount, two (++) a large amount. For measuring feces the maximum value is four (++++), corresponding to 200ml. Being one (+) soiled the diaper; two (++) half of the diaper; three (+++) soiled the surface of the diaper and four (++++) overflowed the diaper.

The collected data was coded and entered into a database using Microsoft Excel and analyzed with SPSS Statistics 22.0 (IBM) using descriptive statistics by calculating frequency distributions, measures of central tendency and measures of dispersion.

The following variables were operationalized as proxy for analysis of the water balances of the sampled patients: (i) Filling out tears (ii) Legible/illegible handwriting type (iii) Use of proper pen for recording (iv) Error in recording in the appropriate column (v) Failure to record BH (vi) Correct calculation of BH (vii) Dripping administrations of more than 4 drugs (viii) Completed records. Such variables were operationalized to assess the compliance/incompliance factors of the water balances.

The research was developed according to Resolution 466/12 of the Ministry of Health and approved on February nine, 2018 by the Ethics and Research Committee of the Institution of the

aforementioned Intensive Care Unit, the setting of this study. Protocol no. 2.494.058.

RESULTS

From a total of 35 records drawn, 20 records (57.1%) were from male patients. Most of the patients, 20 (57.1%), were elderly patients aged 60 years or older. The percentage of surgical patients was 65.7% and 34.3% were medical patients. Most of the patients, 23 (65.715%), were hospitalized for 1 to 7 days. The predominance of surgical patients in this service can be justified by the low average stay in the Intensive Care Unit (4.8 days), providing higher turnover in surgical beds, unlike medical clinic patients who demanded a higher average stay in the Intensive Care Unit and, consequently, low turnover. The discharge conditions by death were 37.14% and by improved condition 62.86%. The specialty of general surgery (48.5%) and the medical specialties of gastroenterology (8.6%) and pulmonology (8.6%) were the most evidenced in the study. We observed a predominance of surgical patients, (65.7%) with a lower average length of stay (4.8%) and a higher number of patients discharged for improved condition compared to medical clinic patients (Table 01).

Table 01 - Epidemiological profile of patients admitted to an Intensive Care Unit, 2021. Juiz de Fora/MG.

Variables	Categories	Absolute Frequency (n)	Relative Frequency (%)
Sex	Female	15	57.1
	Male	20	42.9
Total		35	100.0
Age group	18-38 years	3	8.6
	39-59 years	11	31.4
	60 or more	20	57.1
	Unavailable data	1	2.9
Total		35	100.0
Type of clinic	Medical Clinic Patients	12	34.3
	Surgical clinic patients	23	65.7
Total		35	100.0
Medical practice specialties evidenced	Gastroenterology	3	8.6
	Pneumology	3	8.6
	Nephrology	2	5.7
	Infectology	2	5.7
	Hematology	1	2.9
	Coloproctology	1	2.9
Surgical Clinic Specialties	Gemeral surgery	17	48.5
	Urology	2	5.7
	Thoracic surgery	2	5.7
	Head and neck surgery	1	2.9
	Orthopedics and traumatology	1	2.9
Total		35	100
Hospitalization Days	01-07 days	23	65.7
	08-15 days	8	22.9
	16 or more	4	11.4
Total		35	100
Discharge Conditions	Improved	22	62.9
	Death	13	37.1
Total		35	100

Source: Prepared by the authors.

Of the 220 hydric balance forms analyzed, 92.70% were concluded, and the non-conformities detected were: erasures in 84.1%; illegible letters in 53.20%; use of improper pens in 37.30%; records in in inappropriate columns of the form in 50.50%; failure to record 78.60%; calculation/summation errors 54.50%. In this study, dripping from the use of more than four drugs was not configured as nonconformity because it did not interfere in the fluid balance result.

The 78.60% percentage of errors in nursing records in patient data and/or in the notes referring to infused/administered and/or drained liquids identified in the research draws attention. It is noteworthy that the research result points out that there is a 40.7% chance of obtaining a correct fluid balance if there are no flaws in the records and that the BH are completed.

In the parametric test of variance to check whether there are differences between the means of a given variable (response or dependent variable) in relation to a treatment with two or more categorical levels (predictor or independent variable). In our case, the independent variables (record failures, erasures, column, letter, pen and completed record) were gathered under the heading "Correct Procedure" and the response or dependent variable, under the heading "Correct WB", as shown in Table 02.

Table 02 - Parametric test of variance, 2021. Juiz de Fora/MG.

ANOVA						
Models		Sum x	df	Mean	F	Sig.
1	Regression	3.213	6	0.535	2.224	.042a
	Residue	51.034	212	0.241		
	Total	54.247	218			
2	Regression	5.311	7	0.759		
	Residue	48.936	211	0.232	3.271	0.003b
	Total	54.247	218			

a. Predictors: (Constant), FAILURE, SNARE, COLUMN, DRIPPING, LETTER, PEN.

b. Predictors: (Constant), FAILURE, SNARE, COLUMN, DRIPPING, LETTER, PEN, REGISTER.

c. Dependent variable: WB

Source: Prepared by the authors based on statistical calculations (SPSS 22.0).

Multiple regression was used to verify if the independent variables are able to predict the dependent variable, that is, the correct water balance results. The analysis of variance tested two models: model 1 did not take into account the variable "completed records" and showed no statistical significance (p<0.042). On the other hand, model 2 included this variable, showing acceptable statistical significance (p<0.003), i.e., better than chance.

Table 03 shows the standardized and non-standardized coefficients, as well as the statistical collinearity tests for each of the variables in the two proposed models. The fundamental criterion for ascertaining which independent variables correlate significantly with the dependent variable (correct BH) is the degree of significance, which should be p<0.005. As can be seen in Model 2, two variables had acceptable degrees of significance: Failure to register p<0.001 and Registration completed p<0.003.

Table 03 - Statistical collinearity test, in the period from February to December 2016. Juiz de Fora/MG.

Coefficients						
Non-standard Coef.		Standard Coef.			Statistical Collinearity	
B	Standar error	Beta	t	Sig.	Tolerance	VIF
0.616	0.13		4.728	0		
0.07	0.074	0.034	0.501	0.617	0.97	1.031
0.065	0.093	0.048	0.705	0.482	0.951	1.051
0.007	0.069	-0.007	-0.095	0.924	0.935	1.07
0.037	0.073	-0.036	-0.505	0.614	0.874	1.144
0.041	0.067	0.041	0.609	0.543	0.976	1.024
0.295	0.084	-0.242	-3.517	0.001	0.94	1.063
0.259	0.175		1.482	0.14		
0.02	0.073	0.018	0.27	0.787	0.964	1.037
0.027	0.092	0.02	0.291	0.772	0.933	1.072
0.004	0.068	0.004	0.058	0.954	0.933	1.072
-0.011	0.073	-0.01	-0.149	0.882	0.862	1.161
0.042	0.066	0.042	0.637	0.525	0.976	1.024
-0.27	0.083	-0.221	-3.259	0.001	0.931	1.075
0.387	0.129	0.203	3.008	0.003	0.942	1.061

Source: Prepared by the authors based on statistical calculations (SPSS 22.0).

This means that the variables Failure to Register and Registration Completed are predictors of correct WB, the greater the failure to correctly fill out the registers, the lower the correct WB.

The logistic regression result suggests that the independent variables Failure and Record Completed have a predictive power on correct WB=0.407 or 40.7%. In other words, there is a 40.7% chance of getting a correct WB if there are no record failures and the records are filled out.

DISCUSSION

In this study the specialty of general surgery and the medical specialties of gastroenterology and pulmonology were the most evidenced in the study[9].

Regarding the presentation of the fluid balance form, it was observed that there is no space for a check/signature of the professionals who administered liquids, drugs and diets, as well as for the professional who closed the partial and total balance. It was also not detected in the analyzed forms the register of exudates that are measurable losses, which raised doubts if it is implicit in the constant 600ml attributed to insensible losses by mistake, or if really none of the patients in the study had these losses.

The water balance was considered wrong when it presented flaws in the summation and/or in the processing of the result. Non-compliance was considered due to improper pens, those with inks that erased and invalidated the notes on the back of the water balance form, and incomplete water balance, those that were not completed due to loss of records of drained liquids (e.g., diuresis on the bed).

On the other hand, the nonconformities due to recording errors refer to the failures and/or lack of annotations in the header of the forms and/or in the records of administered and/or drained liquids. The annotation in inadequate columns refers to the note of a particular drainage in a non-compliant column, as well as the records of the characteristics of the drained liquids in the columns where the drained volumes should be recorded, causing error in the summation by impairing the visibility of the volume of liquid recorded.

The lack of clarity in the water balance standard operating procedure for recording the absence or presence of daily bowel movements and of exudates and sweating hindered the water balance notes[10-11].

However, the non-conformities should not be seen only as the responsibility of the nursing team professional, but as consequences of the failures in the complex process of work and management in health that propitiate the occurrence of errors involved in the assistance, due to the quality of the hospital materials, the service scales, the staff dimensioning, the remuneration, the respect to the professional exercise[12-13], as well as for lack of staff training. Thus, in health work, the working conditions are determinant for patient and worker safety and for the possible occurrence of errors. In this sense, the National Health Surveillance Agency (ANVISA) through Manuals, Technical Notes and Protocols, sought to reduce the occurrence of adverse events in health services, through strategies, products and actions on patient safety aimed at managers, workers and health users[14].

Critically ill patients and patients undergoing major surgeries are susceptible to complications that can lead to water-electrolyte imbalance, which makes the continuous monitoring and assessment of these patients by a qualified multidisciplinary team able to identify and act early in the intercurrences resulting from the water-electrolyte imbalance relevant[15]. It is emphasized that the diagnosis of water-electrolyte imbalance is made through clinical evaluation, continuous nursing evaluation, biochemical analysis, and fluid balance findings. In Intensive Care Units, in addition to these, invasive and non-invasive hemodynamic monitoring[2].

A study carried out in a teaching hospital identified that, although a significant number of nursing professionals identified the importance of records, most of them were unaware of the legislation and the legal ethical penalties resulting from non-compliance in notes made in patient records[16]. It is pointed out that the incorrect recording of patient data can compromise the safety and quality of the care provided and the therapy based on the results of the fluid balance, which when incorrect can have a negative impact on the recovery of patients in the Intensive Care Unit[17].

The non-conformities due to erasures in the data records, illegible handwriting, the use of pens with ink that blot and invalidate the document, and the lack of a professional's check/signature in the procedures performed compromise the legality of the records and hurt the ethical and legal precepts of the exercise of the profession[12]. These nonconformities in the fluid balance may be

associated with the lack of recognition of the importance of the fluid balance by the nursing team, as well as the low valuation of the profession in relation to the regulatory standards of the professional practice, identified in other researches[18].

Errors in nursing notes impair the quality of care provided because they do not reliably portray the patient's clinical picture and the dynamics of the service. Besides not conferring safety to patients and professionals[18]. A study identified a change in culture and consequently more authentic nursing notes from organizational restructuring, implementation of protocols, internal audits and continuing education programs[19].

In relation to professional training, continuing education is a fundamental strategy in the collective construction of knowledge through the articulation of theoretical and practical knowledge of the various professionals. It is a dynamic process of interaction, of reflection on daily practice that proposes another look at know-how, generating new knowledge through experience/experience. To achieve these assumptions, it is necessary a dynamic continuing education with active methodologies and indicators based on scientific evidence[20].

The nonconformities identified in the research may reflect failures in management and in the work process. The causes and effects of nursing errors are often complex and may go unnoticed by professionals. Understanding these causalities in light of the work process allows the detection of gaps and enables health service managers, political managers, and the nursing team itself to review them with the goal of not incurring in future errors and to reflect and reassess the working conditions in which nursing professionals are continuously exposed[1].

Systematization of Nursing Care is one of the tools of nursing management that enables integral and individualized care in an efficient and effective manner. Its use in Intensive Care Units is essential due to the high complexity and specificity of care required by critically ill patients. Furthermore, the use of the Nursing Care Systematization provides the nurse with autonomy and safety in decision making, certifying technical and scientific knowledge and, consequently, conferring legitimacy to the development of technical procedures, such as the measurement of water balance[21].

The calculation and/or summation errors identified in the fluid balance related to professionals' lapses, lack of time management and non-observance of standard operating procedures (SOP) compromised the results of most of the fluid balances analyzed in the study. It is noteworthy that the acquisition and implementation of technology, the assessment of the organizational work process and nursing care planning, and the development and implementation of protocols for hydric control would certainly minimize these nonconformities[6].

It is understood that the results found are relevant to provide reflection on the nursing work process in the Intensive Care Unit, the study scenario. It also seeks to expand the technical-scientific knowledge in order to develop strategies for monitoring the fluid balance of critically ill patients in a safer and more reliable way.

CONCLUSION

The nursing team plays a fundamental role in the accomplishment of the water balance, once it participates in the whole process of registration, calculation and analysis of the water balance.

The nonconformities in the performance of the fluid balance in this study impaired the authenticity of the procedure and, consequently, the quality of the care provided.

Incorrect registration of patient data can compromise the safety and quality of the care provided and the therapy based on the results of fluid balance, which when incorrect can have a negative impact on the recovery of patients in the Intensive Care Unit. It compromises the legality of the records and harms the ethical and legal precepts of the exercise of the profession.

The causes and effects of nursing errors are often complex and may go unnoticed by professionals. Understanding these causalities in light of the work process allows the detection of gaps and enables health service managers, political managers, and the nursing team itself to take measures to resolve this issue.

It is noteworthy that the acquisition and implementation of technology, the evaluation of the organizational work process and nursing care planning, and the elaboration and implementation of protocols for hydric control would certainly minimize these nonconformities.

The results expressed here are consistent with previous investigations and suggest other

studies that allow correlating the identified data to factors of the work process and the patient's clinical picture in order to elucidate and contribute to the accomplishment of the fluid balance in a more reliable way.

The limitations of the study include the scarcity of research related to the process and methodology for performing water balance; it was observed among the researched articles the predominance of biomedical themes. It is important to highlight the portrayal of a single investigated reality, which may represent approximations or distancings to others already studied, making it indispensable to investigate other services, poor record-keeping, the need for more precise methods of measurement that can lead to greater reliability of the data.

It can be inferred that the relevance of this research is in the contribution to the technical and scientific improvement of the professional, regarding the quality and reliability of the records made by the nursing team, which will certainly have repercussions on the safety of critically ill patients regarding their diagnosis, treatment and care. It is pertinent to emphasize that strategies for this change be taken by the institution where the study was developed as well as in other similar realities. The research also aims to contribute to teaching and research on the subject.

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