Original Article

Knowledge and practices regarding the handling of neonatal incubators among nursing professionals

Conhecimentos e práticas de manuseio de incubadoras neonatais por profissionais de enfermagem

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Keywords
Incubators, infant; Infant, newborn; Biomedical technology; Nursing, team; Neonatal nursing

Descritores
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Abstract

Objectives: To compare knowledge and practices regarding the handling of neonatal incubators among nurses and nursing technicians/aides.

Methods: This was a cross-sectional study conducted at the neonatal unit of a reference hospital, with data obtained via a questionnaire about the professionals' knowledge and direct, structured and nonparticipant observation of nursing team practices when handling incubators. The researchers developed a score to represent the adequateness of the practices observed.

Results: No difference was observed between the two studied groups in terms of knowledge in handling incubators, except for knowledge about the benefit of humidification, cited mostly by nurses (p=0.040). No differences were observed when comparing practice scores obtained individually and the overall score (p=0.723). The incubator practices of nursing technicians/aides and nurses were 70% adequate, which is a low percentage considering the hospital's high complexity.

Conclusion: In general, there was no difference between the nursing team members with regards to the studied knowledge and practices.

Resumo

Objetivos: Comparar conhecimentos e práticas de manuseio de incubadoras neonatais por enfermeiras e técnicas/auxiliares de enfermagem.

Métodos: Estudo transversal, realizado em unidade neonatal de hospital de referência, com dados obtidos por questionário sobre conhecimentos e observação direta, estruturada e não participante, das práticas da equipe de enfermagem no manuseio de incubadoras. Criou-se escore de adequação de práticas realizadas.

Resultados: Não houve diferença entre os dois grupos estudados, quanto aos conhecimentos sobre manuseio de incubadoras, exceto para o benefício de umidificação, mais citado entre enfermeiras (p=0,040). Comparando-se escores de práticas obtidos isoladamente e considerando o escore total, também não se constatou diferença (p=0,723). Técnicas/auxiliares de enfermagem e enfermeiras realizaram 70% de práticas adequadas ao manusearem a incubadora, proporção baixa, visto tratar-se de hospital de alta complexidade.

Conclusão: Em geral, não houve diferença entre os componentes da equipe de enfermagem com relação aos conhecimentos e práticas estudadas.

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Introduction

The introduction of increasingly more complex technologies in health services can facilitate the work process of nursing teams and increase the quality of care provision. However, in the absence of or inadequate planning of training, the incorporation of technological equipment can hinder professional practice in care routines and harm the quality of such care.[1]

For technological advances to be duly incorporated by nursing professionals, they must acquire appropriate knowledge and practices, which are obtained through specific training, information, and ongoing education.[2]

Among the several devices employed in neonatal units and used by the nursing teams, incubators represent one of the most important. This device provides a heated environment for premature newborns and infants with specific pathological conditions.[3]

Incubators prevent hypothermia, a condition that greatly concerns institutions and health professionals, as it is associated with increased neonatal mortality and morbidity.[3] Incubator use presents other benefits to newborns, such as humidification, isolation from infectious agents, and complete visualization of and access to the newborn.[4]

As with all technological devices, neonatal incubators are susceptible to malfunction and inadequate handling by professionals. Their use can cause hypothermia in neonates, both because of heating failures and due to variations in internal temperature due to professionals frequently opening portholes when carrying out care.[4,5] Other possible harmful occurrences for newborns associated with incubator use include: exposure to hyperthermia; falls; noise; and inadequate control of oxygen levels, any of which can result in irreversible adverse events.[4,6,7] To result in safe and effective care, such equipment requires not only appropriate material resources, but also handling by trained professionals.[2,8]

This study was developed based on the consideration that nurses are the main professionals responsible for providing direct care to hospitalized newborns and that they are responsible for the adequate use of equipment and the management of such care, which should be qualified and risk-free. Thus, the aim of the present study was to compare knowledge and practices regarding the handling of neonatal incubators among nurses and nursing technicians/aides.

The term "handling practices" was adopted to express the ways in which nursing professionals operate the equipment and their actions related to its handling, which can influence the adequacy of its functioning and the safety of newborns.

Methods

This was a cross-sectional and analytical study conducted with a neonatal nursing team at a teaching hospital in the state of São Paulo, Brazil, a reference center for high-risk newborn care.

In this institution, neonatal care consisted of the following sub-units: an intensive care unit (ICU); an intermediary care unit (IMCU) and special care unit (SCU), with a 17-, 8-, and 7-bed capacity, respectively; and two reception areas in the obstetric department (OD) structured to receive four patients simultaneously. The neonatal unit included 75 nursing team professionals, of which 74 agreed to participate in this study: two nursing aides; 57 nursing technicians; and 15 nurses. Participants worked in all the sub-unit shifts according to a rotating shift system.

The institution had a technical center that carried out preventive maintenance biannually, and corrective maintenance whenever necessary. The incubators present at the institution throughout the entire data gathering period were manufactured by FANEM®, and there were four different models of stationary incubators, considered appropriate for use in the neonatal unit.

A self-administered questionnaire was given to participants in order to gather data about their knowledge about incubators. The questionnaire contained open- and closed-ended questions and

was administered between November 2014 and January 2015. The following patient characteristics were assessed: years of nursing experience (median, minimum, and maximum); gender (female, male); participation in initial training (yes, no); regular ongoing education (yes, no); feeling capable of handling incubators (yes, no); reason for feeling capable or incapable; and history of error with incubators (yes, no). History of error with incubators was defined as the occurrence of nonintentional incidents that resulted in adverse effects involving professionals or newborns during care provided in the neonatal unit.

The questionnaire also measured the following variables to assess the knowledge of professionals: knowledge about the benefit(s) of incubator use (yes, no); benefit(s) of incubator use; knowledge of the risks of incubator use (yes, no); risk(s) of incubator use; and doubts/difficulty regarding incubator use (yes, no). The doubts/difficulty reported were related to mechanical areas (yes, no) and newborn care (yes, no).

To assess incubator use practices, one of the researchers, who worked at the studied institution, conducted direct, structured, and nonparticipant observation of the care performed by professionals in February and March 2015. The sample included one-third of the participants, which consisted of five nurses (20%) and 20 nursing technicians/aides (80%), working in different shifts and in the ICU, IMCU, and SCU units.

A checklist was created specifically for this study and was used during observation, based on the recommendations of the Brazilian Ministry of Health[4] and the incubator manufacturer.[9] The checklist was written in a "yes" (adequate practice) or "no" (inadequate practice) format, including 13 practices: uses skin mode; places blanket over canopy without obstructing air inlets; does not place objects on the canopy; does not make noise on canopy; does not place objects over air outlets; does not place objects on mattress; does not place blanket over newborn; keeps portholes closed; keeps iris port sleeves closed; keeps wheels in locked position; positions incubator out of direct sunlight; and places skin sensors on newborn. At the time of observation, all of the incubators had portholes, wheels locks, and skin sensors.

The final checklist was defined after being tested during three different observations, which began when professionals took over a bed to conduct routine care, such as checking vital signs, aspirating airways, changing positions, and rotating oximetry and hygiene sensors, and lasted for the time necessary for care to be completed. This was marked by professionals walking away from the observed bed and initiating another activity, such as cleaning furniture or other equipment, caring for another newborn, or talking with mothers. In the three observations, the professionals spent a little less than 30 minutes, which was the time established for observations during data collection.

The schedule for routine care in the studied unit did not depend on the level of complexity and severity of newborn health and was established every six hours, according to the three shifts: morning (8 AM); afternoon (2 PM); and night (8 PM to 2 AM), considering that in the night shift the observation was conducted at 8 PM. Six observations (24%) took place in the IMCU, five (20%) in the SCU, and 14 (56%) in the ICU. Nine observations (36%) took place in the morning, five (20%) in the afternoon, and 11 (44%) at night.

The final assessment of incubator handling was based on the individual score of participants. Adequate practices scored one point and total possible score ranged from 0 to 13. Higher scores indicated higher-quality professional practices. Data analysis included the median (with minimum and maximum values) score from the set of adequate handling practice scores, comparing nurses and nursing technicians/aides.

Independent variables consisted of professional categories (nursing technicians/aides and nurses). Dependent variables considered individual knowledge and practices relative to the

handling of incubators and the score of adequate practices.

Comparisons were performed using Fisher's exact test and the chi-squared test. All of the analyses were conducted using SPSS v21.0 software, with statistical significance set at $p<0.05$. The study protocol was ratified by the local research ethics committee, no. 837.424.

Results

All of the patients were female. Mean time of work at the unit for nursing technicians/aides was seven years (0.5-28.5 years) and, among nurses, 1.4 years (1-14 years). Thirty-four (57.6%) nursing technicians/aides and four (26.7%) nurses reported participating in initial training on entering the unit; 46 (78%) nursing technicians/aides and 11 (73.3%) nurses reported participating in periodic refresher courses on how to handle incubators, and three (5.1%) nursing technicians/aides and one (6.7%) nurse reported having committed some type of error while handling the equipment.

Fifty (84.7%) nursing technicians/aides and 11 (73.3%) nurses reported feeling capable of handling incubators. The main reasons listed by nursing technicians/aides were: training received (31 cases) and professional experience (11 cases) and, among nurses, the possibility of sharing doubts with other professionals (four cases) and training received (three cases). Regarding a sense of ineptitude, nursing technicians/aides mentioned not being familiar with the incubator's functions (six cases) and all of the nurses who felt inept (four cases) referred to inadequate training.

Comparisons between the knowledge of the two professional groups about the benefits of incubator use and risks and doubts/difficulties are illustrated in tables 1 and 2, respectively.

Table 3 refers to the practices observed in both professional groups.

The mean score of nursing technician/aide practices was 9 (7-11) and 9 (7-10), respectively, $p=0.723$. Considering that the maximum score was 13, the scores for both categories represent 69.2% of the maximum possible score.

Table 1. Comparison between nursing technicians/aides (n=59) and nurses (n=15) regarding knowledge about the benefits of incubator use for newborns

Incubator variables	Nursing technician/Aide n(%)	Nurse n(%)	p-value
Knows benefit(s) of use			
Yes	57(96.6)	15(100.0)	1.000(I)
No	2(3.4)	0(0.0)	
Benefits mentioned			
Thermoregulation			
Yes	54(91.5)	15(100.0)	0.576(I)
No	5(8.5)	0(0.0)	
Humidification			
Yes	22(37.3)	9(60.0)	0.040(II)
No	37(62.7)	6(40.0)	
Visualization/monitoring			
Yes	15(25.4)	5(33.3)	0.429(II)
No	44(74.6)	10(66.7)	
Comfort			
Yes	12(20.3)	0(0.0)	0.109(I)
No	47(79.7)	15(100.0)	
Environmental isolation			
Yes	11(18.6)	5(33.3)	0.102(II)
No	48(81.4)	10(66.7)	
Extrauterine development			
Yes	10(16.9)	4(26.7)	0.462(I)
No	49(83.1)	11(73.3)	
Safety			
Yes	8(13.6)	0(0.0)	0.194 (I)
No	51(86.4)	15(100.0)	
Noise protection			
Yes	7(11.9)	3(20.0)	0.413(I)
No	52(88.1)	12(80.0)	
Oxygen supply			
Yes	4(6.8)	1(6.7)	1.000(I)
No	55(93.2)	14(93.3)	
Weighing			
Yes	2(3.4)	1(6.7)	0.498(I)
No	57(96.6)	14(93.3)	
Transportation			
Yes	2(3.4)	0(0.0)	0.202(I)
No	57(96.6)	15(100.0)	
Access to manipulation			
Yes	1(1.7)	0(0.0)	1.000(I)
No	58(98.3)	15(100.0)	
Light barrier			
Yes	0(0.0)	1(6.7)	1.000(I)
No	59(100.0)	14(93.3)	

(I) Fisher's Exact Test; (II) Chi-Squared Test

Table 2. Comparison between nursing technicians/aides (n=59) and nurses (n=15) regarding knowledge and doubts about risks of incubator use

Incubator variables	Nursing technicians/Aides n(%)	Nurses n(%)	p-value
Knows about the risks of incubator use			
Yes	52(88.1)	12(80.0)	0.413(I)
No	7(11.9)	3(20.0)	
Risk mentioned			
Temperature deregulation			
Yes	44(74.6)	12(80.0)	1.000(I)
No	15(25.4)	3(20.0)	
Falls			
Yes	16(27.1)	2(13.3)	0.333(I)
No	43(72.9)	13(86.7)	
Excessive noise			
Yes	11(18.6)	5(33.3)	0.995(II)
No	48(81.4)	10(66.7)	
Imbalance in oxygen concentration			
Yes	9(15.3)	1(6.7)	0.675(I)
No	50(84.7)	14(93.3)	
Inadequate hygiene			
Yes	7(11.9)	0(0.0)	0.332(I)
No	52(88.8)	15(100.0)	
Has doubts/difficulties			
Yes	41(69.5)	11(73.3)	1.000(I)
No	18(30.5)	4(26.7)	
Doubts/difficulties relative to mechanics			
Yes	24(40.7)	10(66.7)	0.135(II)
No	35(59.3)	5(33.3)	
Doubts/difficulties relative to newborn care			
Yes	27(45.8)	7(46.7)	0.20(II)
No	32(54.2)	8(53.3)	

(I) Fisher's Exact Test; (II) Chi-Squared Test

Table 3. Comparison of practices observed among nursing technicians/aides (n=20) and nurses (n=5) when handling incubators

Adequate practices	Nursing technician/aide n(%)	Nurse n(%)	p-value(I)
Uses skin mode	0(0.0)	1(20.0)	0.200
Places blanket over canopy without obstructing air inlet	20(100.0)	5(100.0)	1.000
Does not place objects over canopy	4(20.0)	0(0.0)	0.549
Does not make noise on canopy	18(90.0)	5(100.0)	1.000
Does not keep objects over air outlet	13(65.0)	2(40.0)	0.358
Does not keep objects on mattress	18(90.0)	5(100.0)	1.000
Does not place blanket over newborn	19(95.0)	5(100.0)	1.000
Keeps portholes closed	20(100.0)	5(100.0)	1.000
Keeps iris port sleeve closed	17(85.0)	4(80.0)	1.000
Keeps iris port sleeves on incubator	20(100.0)	5(100.0)	1.000
Keeps wheels in locked position	1(5.0)	0(0.0)	1.000
Positions incubator out of direct sunlight	20(100.0)	5(100.0)	1.000
Keeps skin sensors on newborn	4(20.0)	2(40.0)	0.562

(I) Fisher's Exact Test

Discussion

Limitations of this study include the use of a convenience sample in the observation phase, a shortcoming that was minimized by observing professionals at different times, in different units, and on different shifts. The fact that the questionnaire was not validated also represents a limitation, which should be corrected before being used again.

In general, there were no differences between nursing technicians/aides and nurses in terms of knowledge and practice regarding incubator handling. However, the findings showed the occurrence of errors among the nursing team, demonstrating a reality at the institutional level that may occur at other services. Thus, this study can provide data for managers, professionals in the field of technology, and nurses so that they can conduct training actions with nursing staff to avoid the occurrence of adverse events and improve the quality of care provided to newborns. This can extend to the use of other technological equipment.

Observing professionals during their work routine presents advantages when compared to obtaining data from secondary sources or administering questionnaires, as researchers are able to systematically observe what occurs in the environment as it occurs. Another advantage was the fact that the observer was a professional at the studied unit, and thus the participants were accustomed to her presence, minimizing the possibility of participants altering their performance due to the awareness that they are being observed. Furthermore, if the practices were in fact influenced by reactivity, incubator handling practices would have been performed more carefully and with more endeavor; however, the results showed frequent adoption of inadequate practices.

Based on the score of observed practices, there was no difference between professional groups, as both scored approximately 70% of adequate practices. However, the results could have been more satisfactory, given the specialized nature of the unit in a high-complexity teaching hospital, in which incubator use is very common.

To be efficient, technology cannot rely solely on the availability of material resources, but is com-

plemented by the body of knowledge and skills of the team members who use it.[2,8,10] In this context, better performance was expected from the nursing staff's practices, as they are responsible for team training and for the technologies used in nursing services. This includes equipment surveillance, mastery over machinery, and observation of technological language.[11,12]

Thus, nurses must be capable, confident, and qualified to multiply their knowledge, as they must ensure the nursing team's role in the scientific, technological, and humanized dimensions of care.[10]

Regarding individual analysis of incubator handling practices, the lack of significant differences between nursing technicians/aides and nurses indicates that inadequate practices occurred equally in both groups, especially in terms of placing objects over the canopy, placing objects over air outlets, keeping incubator wheels unlocked, using skin sensors on newborns, and using the air mode to regulate temperature.

Placing objects on top of the canopy while performing care can damage the incubator and prevent its opening in case of emergency, in addition to generating noise in the newborn's environment. Placing objects over air outlets can cause circulation failures, with possible negative repercussions to newborns.[4] Maintaining incubator wheels in the unlocked position while handling can also increase noise production and incubator instability.[9]

Using skin sensors on newborns is inadequate, as this can result in imprecise temperature measurements, impacting correct monitoring and overheating the incubator when controlled using the skin mode. However, practically all of the professionals opted for air mode over skin mode, even though the first allows for incubator temperature to be regulated according to the newborn's needs, contributing to the constant maintenance of its temperature. In general, only initial heating should be conducted through air mode, and skin mode should be adopted after placing the newborn in the incubator.[9]

Corroborating this statement, a study in the United States assessed temperature variation using skin and air modes and found that in skin mode, newborn temperature remained constant despite air temperature variations. In air mode, newborn temperature increased and air temperature fluctuated.[13] In another study conducted with 186 health units in France, temperature control through skin mode was more commonly used for premature babies born before 28 weeks of gestation.[14]

A low number of nursing technicians/aides and nurses reported having committed errors when handling neonatal incubators. No literature was found with data on this type of occurrence, whether with professionals or with patients. However, a study developed in a neonatal ICU in the Northeast region of Brazil found a 29% occurrence rate of adverse events involving thermoregulation disorders, of which 65.9% involved neonatal hypothermia and 5.4% hyperthermia, often secondary to attempts to correct hypothermia. As the study involved high-risk newborns, it is assumed that neonatal incubators were frequently used. This study emphasized the importance of improving practices to reduce such incidents.[15]

In the present study, the low frequency of reported errors must be considered with caution, as it may have been underestimated. Nursing professionals may have been afraid to admit having caused harm to patients or be unaware that an error had occurred, as the use of technological equipment during work routines is subject to operating anomalies.[16] In fact, the frequency of errors found here is considered low, especially considering the high proportion of professionals who reported not having received training, who did not feel apt to operate the incubators, and who conducted inadequate handling practices during observation. Professionals in both categories reported being familiar with at least one of the benefits of neonatal incubator use, at similar rates. Among the benefits that were mentioned equally were: temperature regulation; newborn safety; and oxygen supply.

Nurses mentioned the benefit of humidification more frequently when compared with nursing technicians/aides, demonstrating that technicians/aides use the humidification function without awareness of its benefit.

Some professionals from both groups wrongfully cited "protection against noise" as one of the ben-

efits of incubators. In fact, this equipment produces several forms of noise, depending on the quality of periodic maintenance and the practices of those who handle them.[4]

In both categories, more benefits were mentioned than risks. Among the mentioned risks of incubator use were consequences of temperature deregulation, inadequate equipment hygiene, noise, imbalance in oxygen concentration, and falls, data corroborated by the scientific literature.[4,6,7,17]

A high and similar proportion of nursing technicians/aides and nurses reported doubts/difficulties involving the mechanic functioning of incubators and/or newborn care while using the equipment. These aspects should be considered in future ongoing education activities with the team.

Conclusion

Knowledge about how to handle incubators did not differ between nurses and nursing technicians/aides, except for the benefit of humidification for newborns, cited more often by nurses. Regarding the observed practices, no differences in incubator handling were observed between groups, either individually or in terms of overall score.

Collaborations

Costa CC, Tonete VLP, and Parada CMGL contributed to the project's conception, data analysis, and interpretation, drafting of the article, critical review of relevant intellectual content, and approval of the final version to be published.

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