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Neonatal Resuscitation Practices in Portuguese Delivery Rooms: A Cross-Sectional Study

Práticas Atuais de Reanimação Neonatal nas Salas de Parto em Portugal: Um Estudo Transversal

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ABSTRACT

Introduction: Data from previous studies have demonstrated inconsistency between current evidence and delivery room resuscitation practices in developed countries. The primary aim of this study was to assess the quality of newborn healthcare and resuscitation practices in Portuguese delivery rooms, comparing current practices with the 2021 European Resuscitation Council guidelines. The secondary aim was to compare the consistency of practices between tertiary and non-tertiary centers across Portugal.

Methods: An 87-question survey concerning neonatal care was sent to all physicians registered with the Portuguese Neonatal Society via email. In order to compare practices between centers, participants were divided into two groups: Group A (level III and level IIb centers) and Group B (level IIa and I centers). A descriptive analysis of variables was performed in order to compare the two groups.

Results: In total, 130 physicians responded to the survey. Group A included 91 (70%) and Group B 39 (30%) respondents. More than 80% of participants reported the presence of a healthcare professional with basic newborn resuscitation training in all deliveries, essential equipment in the delivery room, such as a resuscitator with a light and heat source, a pulse oximeter, and an O_2 blender, and performing delayed cord clamping for all neonates born without complications. Less than 60% reported performing team briefing before deliveries, the presence of electrocardiogram sensors, end-tidal CO_2 detector, and continuous positive airway pressure in the delivery room, and monitoring the neonate's temperature. Major differences between groups were found regarding staff attending deliveries, education, equipment, thermal control, umbilical cord management, vital signs monitoring, prophylactic surfactant administration, and the neonate's transportation out of the delivery room.

Conclusion: Overall, adherence to neonatal resuscitation international guidelines was high among Portuguese physicians. However, differences between guidelines and current practices, as well as between centers with different levels of care, were identified. Areas for improvement include team briefing, ethics, education, available equipment in delivery rooms, temperature control, and airway management. The authors emphasize the importance of continuous education to ensure compliance with the most recent guidelines and ultimately improve neonatal health outcomes.

Keywords: Delivery Rooms; Infant, Newborn; Portugal; Resuscitation; Surveys and Questionnaires

RESUMO

Introdução: Estudos previamente publicados demonstraram discordância entre as práticas de reanimação neonatal nas salas de partos e as recomendações internacionais em países desenvolvidos. O objetivo primário deste estudo foi avaliar a qualidade dos cuidados de saúde neonatais e de reanimação neonatal nas salas de partos portuguesas, comparando as práticas atuais com as diretrizes de 2021 do European Resuscitation Council. O objetivo secundário foi comparar a consistência das práticas entre centros terciários e centros não-terciários em Portugal.

Métodos: Um questionário com 87 perguntas foi enviado por correio eletrónico aos médicos inscritos na Sociedade Portuguesa de Neonatologia. Para comparar as práticas entre centros terciários e não-terciários, os participantes foram divididos em dois grupos: Grupo A (centros nível III e nível IIb) e Grupo B (centros nível IIa e nível I). Para comparar as práticas entre os grupos A e B foi efetuada uma análise descritiva das variáveis.

Resultados: No total, 130 médicos responderam ao questionário. O Grupo A incluiu 91 (70%) e o Grupo B 39 (30%) participantes. Mais de 80% relataram a presença de um profissional com treino básico em reanimação neonatal em todos os partos, realização de clampagem tardia do cordão a todos os recém-nascidos que nascem sem complicações, e a presença de alguns equipamentos essenciais nas salas de partos. Menos de 60% relataram a realização de *team briefing*, controlo da temperatura dos recém-nascidos, e a presença de sensores de eletrocardiograma, sensores de CO_2 expirado e máquinas geradoras de pressão positiva contínua da via aérea (CPAP). As áreas de maior divergência entre os grupos incluíram os recursos humanos presentes nas salas de partos, educação, equipamento, controlo térmico, manipulação do cordão umbilical, monitorização de sinais vitais, administração profilática de surfactante e transporte do recém-nascido.

Conclusão: De um modo geral, os médicos portugueses revelaram uma elevada adesão às diretrizes internacionais. Ainda assim, foram encontradas algumas diferenças entre as diretrizes internacionais e as práticas atuais, bem como entre as práticas em centros com diferentes níveis de diferenciação. Os aspetos a melhorar incluem o *team briefing*, questões éticas, educação, equipamentos disponíveis, monitorização da temperatura e abordagem à via aérea. Os autores salientam a importância da formação contínua, de modo a garantir adesão às diretrizes mais recentes e a melhorar os outcomes na saúde neonatal.

Palavras-chave: Inquéritos e Questionários; Portugal; Ressuscitação; Recém-Nascido; Salas de Partos

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INTRODUCTION

The transition from fetal to neonatal life involves major physiological changes.[1] Although most neonates do not need help and are able to start breathing spontaneously, approximately 10% will require simple stimulation in order to start breathing, 5% will need positive pressure ventilation, 0.4% to 2% will require endotracheal intubation, and < 0.3% will receive chest compressions to restore cardiorespiratory function.[2]

According to the World Health Organization (WHO), approximately 75% of all neonatal deaths occur during the first week of life, and a significant proportion of neonates die within the first 24 hours. Intrapartum-related events are still a leading cause of neonatal mortality.[3] Although most neonatal deaths take place in low and middle-income countries,[3] there is still room to improve newborn care in developed countries.

Data from previous studies suggested inconsistency between current evidence and the delivery room (DR) resuscitation practices in developed countries,[4] as well as significant differences in practices among hospitals with different levels of care within the same country.[5,6] International guidelines on newborn resuscitation practices are updated regularly according to the most recent clinical evidence and should serve as a basis for the development of national guidelines to optimize clinical practice.[4] Consistency of clinical practice in early DR management should be assessed regularly to identify sources of variation and improve the quality of newborn health care in the DR.

The last study to assess the quality of neonatal resuscitation practices in the DR in Portugal was published in 2011 and showed that there was still room for improvement concerning medical equipment and human resources. It pointed out the need to update practices on oxygen therapy and prophylactic surfactant use.[7] This study also highlighted the need to improve team communication and reduce newborn transport after delivery.[7] Since then, the European Resuscitation Council (ERC) guidelines for newborn resuscitation and support of transition of infants at birth have been updated twice (in 2015 and 2021), and significant changes have been made.[2,8]

Therefore, the primary aim of this study was to assess the quality of newborn healthcare and resuscitation practices in the DR in Portugal, comparing current practices with the 2021 ERC guidelines. The secondary aim of this study was to compare the consistency of practices between tertiary centers and non-tertiary centers across the country.

METHODS

Study design

In this cross-sectional study, an 87-question web-based survey [Appendix 1 (Appendix 1: https://www.actamedicaportuguesa.com/revista/index.php/amp/article/view/20009/15399)] was developed to assess neonatal care practices in Portuguese DR. The survey included both multiple choice and short answer questions and was divided into five main sections: (I) demographic data of participants; (II) human resources, ethics and education; (III) available equipment and temperature control in the delivery room; (IV) medical practices regarding support with transition and newborn resuscitation; (V) characterization of the neonatal center. The questionnaire was developed by experts in the field of neonatology and was organized on the basis of the 2021 ERC Guidelines on newborn resuscitation and transition support for infants at birth.[2]

The levels of neonatal care considered in this study were as follows: level I – provides care for neonates with a gestational age (GA) greater that 34 weeks; level IIa – provides care for neonates over 32 weeks; level IIb – provides care for neonates over 23 weeks; level III – provides all levels of neonatal care (full range of medical and surgical specialties).

Participants

The survey was sent to all neonatologists and pediatricians registered with the Portuguese Neonatal Society (PNS). To be eligible, all participants had to be practicing clinicians. This approach was preferred over questioning the heads of department in order to avoid a potential bias in the responses. The physicians were invited to participate in the study via email, which included a link to answer the questionnaire via Google Forms, and a participant information document [Appendix 2 (Appendix 2: https://www.actamedicaportuguesa.com/revista/index.php/amp/article/view/20009/15400)]. The participant information document provided an overview of the study's objectives and informed participants of their anonymity throughout the study. Participation was strictly voluntary, and participants could withdraw at any time.

Data collection

The email was sent two times, with a one-month interval, in order to maximize response rates. Responses were collected between December 19, 2022, and February 20, 2023. All answers were stored in a Microsoft Excel datasheet.

Data analysis

Data analysis was performed using SPSS statistical software (SPSS for Windows, version 28, IBM SPSS statistics, Inc., Chicago, IL, USA). Categorical variables were described as absolute and relative frequencies and continuous variables with asymmetric distribution by median

(minimum – maximum). To investigate potential differences in clinical practice between tertiary and non-tertiary centers, the participants were categorized into two groups based on the gestational age limits of their respective centers. The first group (Group A) comprised participants working in level III and level IIb centers, and the second group (Group B) included those working in level IIa and level I centers. Descriptive analysis of variables was performed in order to

Table 1 – Demographic data of participants

	Total (n = 130)
(a) Age (years)	
< 40	41 (31.5)
40 - 49	38 (29.2)
50 - 59	22 (16.9)
≥ 60	29 (22.3)
Median age (minimum - maximum)	45 (29 - 69)
(b) Sex	
Female	98 (75.4)
Male	31 (23.8)
NA	1 (0.8)
(c) Specialty/subspecialty	
Pediatrician	46 (35.4)
Neonatologist	84 (64.6)
(d) Years of practice	
< 10	36 (27.7)
10 - 19	36 (27.7)
20 - 29	21 (16.1)
≥ 30	37 (28.5)
(e) Administrative sector	
Public	91 (70)
Private	2 (1.5)
Both public and private	37 (28.5)
(f) Region	
North	75 (57.7)
Center	23 (17.7)
South	30 (23.1)
Islands (Madeira or Azores)	2 (1.5)
(g) Level of care	
Level III (with neonatal intensive care unit, neonatal surgery, hemodynamic monitoring and induced hypothermia)	42 (32.3)
Level IIb (> 23 week-gestation)	49 (37.7)
Level IIa (> 32 week-gestation)	17 (13.1)
Level I (> 34 week-gestation)	22 (16.9)
(i) Deliveries per year	
> 2500	37 (28.5)
1500 - 2500	57 (43.8)
1000 - 1500	26 (20)
500 - 1000	6 (4.6)
< 500	4 (3.1)

Data are expressed as n(%).
NA : not applicable.

compare the two groups.

Ethical approval

This study was approved by the Ethics Committee of Centro Hospitalar Universitário de São João, Porto, with the license number CE 264-22.

RESULTS

In total, 130 neonatologists and pediatricians registered with the Portuguese Neonatal Society answered the survey and all met the eligibility criterion. It should be noted that the PNS membership list comprised 457 members, including retired physicians and some who have passed away. For confidentiality reasons, these individuals could not be quantified and excluded from the total count, and consequently, an accurate response rate could not be determined.

The median age [min - max] of respondents was 45 [29 - 69] years old, 98 (75.4%) participants were female and 84 (64.6%) were neonatologists. Group A included 91 (70%) respondents and Group B, 39 (30%). Table 1 presents the demographic data of all participants in the study.

Staff attending delivery, team briefing, ethics, and education (Table 2)

In total, 112 (86.2%) physicians reported that a healthcare professional with expertise in basic newborn resuscitation was present in all deliveries. Regarding team briefing, 73 (56.2%) respondents stated that it took place before each delivery or each high-risk delivery. During advanced resuscitation, 55 (42.3%) participants reported allowing the presence of the other parent in the DR. Concerning education, 96 (73.8%) respondents stated that their institution conducts periodic training sessions on neonatal resuscitation.

Equipment and temperature control in the delivery room (Table 3)

Devices reported as being present in the DR by more than 80% of participants were: pulse oximeter (98.5%), vital signs monitor (83.1%), plastic bag or polyethylene film (91.5%), resuscitator with light and heat source (99.2%), oxygen and compressed air in all DRs (90.8%), Guedel tubes (87.7%), face masks (96.2%), laryngoscope (100%), controlled pressure ventilatory support device with O_2 blender (81.5%), self-inflating device with pressure valve connected to O_2 source (81.5%), T-piece resuscitator with PIP and PEEP control (90.8%) and umbilical catheters (96.9%).

Devices that were reported to be present less often included electrocardiogram (ECG) sensors (54.6%), end-tidal CO_2 detector (30%), self-inflating bag with pressure valve connected to O_2 blender (59.2%), CPAP (46.2%), nasal CPAP (43.1%), and intraosseous needle (43.8%).

Concerning DR temperature control, 62 (47.7%) respondents reported its monitoring.

Newborn's thermal control, umbilical cord management and vital signs monitoring (Table 4)

Newborn temperature control was reported by 64 (49.2%) physicians. Among those who reported controlling the neonate's temperature, a target temperature of 36.5º - 37.5ºC was indicated by 39 (60.9%) participants. Drying and stimulation immediately after delivery for > 32 week-gestation neonates was performed by 125 (96.2%) participants of the study, and skin-to-skin contact with the mother for all > 32 week-gestation neonates born without complications was documented by 66 (50.8%) respondents.

Delayed cord clamping (> 60 s) for all neonates born without complications was performed by 113 (86.9%) of the respondents.

Intermittent monitoring combined with pulse oximetry was reported by 64 (49.2%) participants for vital signs monitoring in term infants and by 74 (56.9%) in preterm infants.

Transition support and neonatal resuscitation practices (Table 5)

Routine suctioning in all non-vigorous/apneic/inefficiently breathing infants was reported by 64 (49.2%) participants.

The use of an oxygen blender in assisted ventilation was reported by 113 (86.9%) participants. Air was the initial inflation gas mixture of choice for term infants in 101 (77.7%) participants. In Group A, 51 (56%) used a FiO_2 of 21% - 29% as the initial inflation gas mixture for the preterm newborns (< 32 weeks GA). An initial inflation pressure of 30 cmH_2O for term infants was reported by 75 (57.7%) participants. However, for preterm newborns, a 25 cmH_2O pressure was documented by 77 (84.6%) respondents in Group A. A total of 85 (65.4%) respondents chose auscultation only as the method to confirm correct endotracheal tube placement.

The compression/insufflation ratio of 3:1 was chosen by 99 (76.1%) participants. The umbilical access was the primary vascular access reported by 122 (93.8%) respondents. Fifteen (11.5%) physicians reported administering prophylactic surfactant routinely to neonates at risk of respiratory distress syndrome (RDS).

Transporting the newborn from the DR to the neonatal intensive care unit (NICU) was stated as being easy by 119 (91.5%) participants and access to a transport incubator with a fully controlled environment was noted by 106 (81.5%) physicians.

Comparison between Group A and Group B

Regarding staff attending deliveries and education

(Table 2), the presence of a professional with expertise in basic neonatal resuscitation in all deliveries was documented by 75 (82.4%) participants in Group A and by 37 (94.9%) in Group B. Fifty physicians (54.4%) in Group A confirmed the presence of a nurse specialized in neonatal care in the DR for all high-risk deliveries, compared with 14 (35.9%) in Group B. Seventy-two (79.1%) physicians in Group A reported attending periodic training sessions on neonatal resuscitation in their respective center, compared with 24 (61.5%) in Group B.

Concerning the available equipment in the delivery room (Table 3), Group A participants more frequently reported the presence of equipment such as a plastic bag or a polyethylene film, quick access to videolaryngoscopy, end-tidal CO_2

Table 2 – Staff attending delivery, team briefing, ethics, and education

		Total (n = 130)	Group A (n = 91)	Group B (n = 39)
(a) Staff attending deliveries				
A neonatologist or a pediatrician with expertise in advanced newborn resuscitation is present at every delivery		58 (44.6)	36 (39.6)	22 (56.4)
If not at every delivery, there is a neonatologist or a pediatrician with expertise in advanced newborn resuscitation available in the institution for all high-risk deliveries		68 (94.4)	55 (100)	13 (76.5)
A health professional with expertise in basic newborn resuscitation is present at all deliveries		112 (86.2)	75 (82.4)	37 (94.9)
Two health professionals with expertise in advanced neonatal resuscitation are present in all high- risk deliveries		90 (69.2)	64 (70.3)	26 (66.7)
A nurse specialized in neonatal care is present at all high-risk deliveries		64 (49.2)	50 (54.9)	14 (35.9)
(b) Team briefing				
A pre-delivery checklist is verified before every delivery to clarify responsibilities and check equipment		113 (86.9)	79 (86.8)	34 (87.2)
Team briefing takes place before every delivery or every risk delivery		73 (56.2)	47 (51.6)	26 (66.7)
Debriefing takes place after every delivery where newborn resuscitation was performed	Always	24 (18.5)	17 (18.7)	7 (17.9)
	Sometimes	97 (74.6)	66 (72.5)	31 (79.5)
	Never	9 (6.9)	8 (8.8)	1 (2.6)
(c) Ethics				
The decision to attempt resuscitation of an extremely preterm or clinically complex infant is taken in consultation with the parents and other health professionals?	Yes	123 (94.6)	88 (96.7)	35 (89.7)
	No	6 (4.6)	2 (2.2)	4 (10.3)
	NR	1 (0.8)	1 (1.1)	0 (0)
During advanced resuscitation, the presence of the other parent is allowed in the DR.	Yes	55 (42.3)	35 (38.5)	20 (51.3)
	No	61 (46.9)	44 (48.3)	17 (43.6)
	Other	14 (10.8)	12 (13.2)	2 (5.1)
During advanced resuscitation with bad prognosis, the parent is involved in the decision to withdraw resuscitation.		29 (22.3)	19 (20.9)	10 (25.6)
(d) Education				
Your health institution conducts periodic training sessions on neonatal resuscitation?	Yes	96 (73.8)	72 (79.1)	24 (61.5)
Do those sessions take place in simulation centers?	Yes	40 (41.7)	30 (41.7)	10 (41.7)
	Sometimes	15 (15.6)	9 (12.5)	6 (25)
	No	41 (42.7)	33 (45.8)	8 (33.3)

Data are expressed as n(%).
NR: non respondents.

detector, controlled pressure ventilatory support device with O_2 blender, CPAP, nasal CPAP, and umbilical catheters in the delivery rooms of their respective centers, compared with Group B physicians.

In Group A, 51 physicians (56%) reported controlling the temperature of all newborns, compared with 13 physicians (33.3%) in Group B (Table 4). Performing skin to skin contact with the mother for all > 32 week-gestation neonates

Table 3 – Equipment and temperature control in the delivery room (section 1 of 2)

	Total (n = 130)	Group A (n = 91)	Group B (n = 39)
(a) Equipment and drugs			
Stopwatch	124 (95.4)	85 (93.4)	39 (100)
Scalpel/scissors	129 (99.2)	90 (98.9)	39 (100)
Pulse oximeter	128 (98.5)	89 (97.8)	39 (100)
ECG sensors	71 (54.6)	48 (52.7)	23 (59)
Stethoscope	129 (99.2)	91 (100)	38 (97.4)
Vital signs monitor	108 (83.1)	75 (82.4)	33 (84.6)
Plastic bag or polyethylene film	119 (91.5)	89 (97.8)	30 (76.9)
Resuscitator with light and heat source	129 (99.2)	91 (100)	38 (97.4)
Oxygen and compressed air in all DR	118 (90.8)	81 (89)	37 (94.9)
Guedel tubes	114 (87.7)	76 (83.5)	38 (97.4)
Face masks	125 (96.2)	87 (95.6)	38 (97.4)
Laryngoscope	130 (100)	91 (100)	39 (100)
Quick access to videolaryngoscope	42 (32.3)	38 (41.8)	4 (10.3)
Orotracheal tubes	128 (98.5)	90 (98.9)	38 (97.4)
Laryngeal masks	89 (68.5)	64 (70.3)	25 (64.1)
Aspiration endotracheal tubes	82 (63.1)	54 (59.3)	28 (71.8)
End-tidal CO_2 detector	39 (30)	33 (36.3)	6 (15.4)
Controlled pressure ventilatory support device	94 (72.3)	71 (78)	23 (59)
Controlled pressure ventilatory support device with O_2 blender	106 (81.5)	81 (89)	25 (64.1)
Self-inflating device with pressure valve	124 (95.4)	87 (95.6)	37 (94.9)
Self-inflating device with pressure valve connected to O_2 source	106 (81.5)	75 (82.4)	31 (79.5)
Self-inflating bag with pressure valve connected to O_2 blender	77 (59.2)	58 (63.7)	19 (48.7)
CPAP	60 (46.2)	51 (56)	9 (23.1)
Nasal CPAP	56 (43.1)	46 (50.5)	10 (25.6)
T-piece resuscitator with PIP and PEEP control	118 (90.8)	86 (94.5)	32 (82.1)
Umbilical catheters	126 (96.9)	91 (100)	35 (89.7)
Intraosseous needle	57 (43.8)	39 (42.9)	18 (46.2)
Material for thoracentesis	62 (47.7)	47 (51.6)	15 (38.5)
Chest drain	49 (37.7)	40 (44)	9 (23.1)
Adrenaline	129 (99.2)	90 (98.9)	39 (100)
10% glucose	124 (95.4)	88 (96.7)	36 (92.3)
Sodium bicarbonate	117 (90)	82 (90.1)	35 (89.7)
Naloxone	127 (97.7)	88 (96.7)	39 (100)
Physiological saline	129 (99.2)	90 (98.9)	39 (100)
Surfactant	71 (54.6)	46 (50.5)	25 (64.1)

Table 3 – Equipment and temperature control in the delivery room (section 2 of 2)

		Total (n = 130)	Group A (n = 91)	Group B (n = 39)
(b) Temperature control				
Controls the temperature of the DR		62 (47.7)	41 (45.1)	21 (53.8)
If the answer to the previous question was yes, what DR target temperature do you use for newborns > 28 weeks?	21º - 23ºC	7 (11.3)	2 (4.9)	5 (23.8)
	23º - 25ºC	40 (64.5)	29 (70.7)	11 (52.4)
	25º - 27ºC	13 (21)	8 (19.5)	5 (23.8)
	NR	2 (3.2)	2 (4.9)	0 (0)
If the answer to the previous question was yes, what target temperature do you use for newborns ≤ 28 weeks?	21 - 23ºC	-	1 (2.4)	-
	23º - 25ºC	-	5 (12.2)	-
	> 25ºC	-	33 (80.5)	-
	NR	-	2 (4.9)	-
	NA	21 (33.9)	0 (0)	21 (100)

Data are expressed as n(%).
NR : non respondents; NA : not applicable.

was reported by 40 participants (44%) in Group A and 26 (66.7%) in Group B. Performing delayed cord clamping for all neonates born without complications was documented by 83 physicians (91.2%) in Group A and 30 (76.9%) in Group B (Table 4).

As for the neonate's airway approach (Table 5), 84 physicians (92.3%) in Group A reported using an O_2 blender in assisted ventilation compared with 29 (74.4%) in Group B. The administration of prophylactic surfactant to all neonates at risk for RDS was reported by four physicians (4.4%) in Group A, and 11 (28.2%) in Group B (Table 5).

Regarding the neonate's transportation (Table 5), 90 physicians (98.9%) in Group A described the transportation of the newborn out of the delivery room to a neonatal intensive care unit as being easy compared with 29 (74.4%) in Group B. Access to a transport incubator with a fully controlled environment was reported by 80 physicians (87.9%) in Group A and 26 (66.7%) in Group B.

DISCUSSION

Overall, the results of this study suggest there was good compliance of Portuguese neonatologists and pediatricians with the 2021 ERC guidelines for newborn resuscitation and support of transition, in both centers with the highest and the lowest level of differentiation of care. However, some differences between the current practices and international recommendations were identified.

Staff attending delivery and team briefing

According to a Canadian audit, the need for neonatal resuscitation is not anticipated in 76% of cases.[9] Ongoing in-house coverage by a neonatologist or pediatrician has been shown to reduce the need for chest compressions, admissions to the NICU, and hospital stay duration in term infants with poor transition at birth.[10] The 2021 ERC guidelines recommend that staff members competent in newborn life support should be available for every delivery.[2] In this study, 86.2% of respondents reported the presence of a professional with expertise in basic neonatal resuscitation in all deliveries. This finding highlights the need for improving the skills of staff members attending deliveries in Portugal, as a professional with basic neonatal resuscitation skills should be present in all delivery rooms, and 100% compliance should be the aim.

The results suggest that team briefing was not consistently adopted by participating physicians, both in Group A and in Group B, which could negatively affect team dynamics. Although there is no current evidence suggesting that team briefing improves clinical outcomes,[2] this is an aspect that could improve neonatal care in Portugal. There was, however, good compliance with the use of pre-delivery checklists.

Ethics and education

Family-witnessed resuscitation is a controversial issue that is still discussed widely, and this topic urgently needs high quality research to measure the actual impact of family presence on patient and family outcomes.[11,12] However, the 2021 ERC guidelines support the presence of family presence during cardiovascular resuscitation and advocate for facilitating the presence of parents during resuscitation whenever possible.[2] This study's findings suggest that Portuguese neonatologists and pediatricians have not widely adhered to the current recommendations, as 46.9% of respondents reported not allowing the other member of the couple to be present in the DR during advanced resuscitation. This is in line with the results of other studies,[13] highlighting the need for increased awareness of ethical issues

in Portuguese delivery rooms, as well as the need of further research to support current recommendations.

Overall, the adherence of the Portuguese medical centers to periodic training sessions on neonatal resuscitation appears to be adequate, as reported by 73.8% of respondents. However, there is room for improvement, particularly in Group B centers where physicians reported less frequent training than physicians in Group A. This highlights the need

Table 4 – Newborn's thermal control, umbilical cord management and vital signs monitoring

		Total (n = 130)	Group A (n = 91)	Group B (n = 39)
(a) Newborn's thermal control				
Controls newborn's temperature	Yes	64 (49.2)	51 (56)	13 (33.3)
	No	60 (46.2)	36 (39.6)	24 (61.5)
	NR	6 (4.6)	4 (4.4)	2 (5.1)
Target temperature for the participants that responded "yes" to the previous question	< 36.5ºC	24 (37.5)	15 (29.4)	9 (69.2)
	36.5º - 37.5ºC	39 (60.9)	35 (68.6)	4 (30.8)
	> 37.5ºC	0 (0)	0 (0)	0 (0)
	NR	1 (1.6)	1 (2)	0 (0)
Performs drying and stimulation immediately after delivery for > 32-week-gestation newborns		125 (96.2)	89 (97.8)	36 (92.3)
Performs skin-to-skin contact with mother for all > 32 week-gestation newborns born without complications		66 (50.8)	40 (44)	26 (66.7)
Uses plastic bag or polyethylene wrapping in < 32 week-gestation preterms		90 (69.2)	90 (98.9)	-
(b) Umbilical cord management				
Performs delayed cord clamping (> 60s) for all newborns born without complications		113 (86.9)	83 (91.2)	30 (76.9)
Performs cord milking when delayed cord clamping is not possible in infants > 28 week-gestation		49 (37.7)	36 (39.6)	13 (33.3)
Routinely performs assessment of umbilical cord blood (arterial and venous) pH		23 (17.7)	18 (19.8)	5 (12.8)
(c) Vital signs monitoring				
Full-term newborns	Intermittent monitoring with stethoscope/ pulse palpation	40 (30.8)	25 (27.5)	15 (38.5)
	Intermittent + continuous monitoring with pulse oximeter	64 (49.2)	43 (47.2)	21 (53.8)
	Intermittent + continuous monitoring with pulse oximeter + ECG	24 (18.5)	22 (24.2)	2 (5.1)
	NR	2 (1.5)	1 (1.1)	1 (2.6)
Preterm newborns	Intermittent monitoring with stethoscope/ pulse palpation	1 (0.8)	0 (0)	1 (2.6)
	Intermittent + continuous monitoring with pulse oxymeter	74 (56.9)	49 (53.8)	25 (64.1)
	Intermittent + continuous monitoring with pulse oximeter + ECG	52 (40)	40 (44)	12 (30.8)
	NR	3 (2.3)	2 (2.2)	1 (2.6)

Data are expressed as n(%).
NR : non respondents.

for greater investment in training programs for neonatal resuscitation in these centers, as well as in the country, as research has shown that intermittent, infrequent training without periodic refreshment may lead to a decline in skills related to neonatal resuscitation.[2]

Table 5 – Transition support and neonatal resuscitation practices (section 1 of 2)

		Total (n = 130)	Group A (n = 91)	Group B (n = 39)
(a) Newborn's airway approach				
Ventilation support for < 30 weeks newborns born with spontaneous breathing	CPAP	-	84 (92.3)	-
	Endotracheal intubation	-	2 (2.2)	-
	NR	-	5 (5.5)	-
	NA	39 (30)	0	39 (100)
Performs routine airway aspiration in all non-vigorous/apneic/ineffective respiratory pattern newborns		64 (49.2)	45 (49.5)	19 (48.7)
Use of O_2 blender in assisted ventilation		113 (86.9)	84 (92.3)	29 (74.4)
Initial inflation gas mixture for the full-term newborn	Air	101 (77.7)	70 (76.9)	31 (79.5)
	21 - 29% O_2	24 (18.5)	19 (20.9)	5 (12.8)
	30% O_2	1 (0.8)	0 (0)	1 (2.6)
	> 30% O_2	4 (3.1)	2 (2.2)	2 (5.1)
	NR	0 (0)	0 (0)	0 (0)
	NA	0 (0)	0 (0)	0 (0)
Initial inflation gas mixture for the preterm newborn (<32 weeks)	Air	-	14 (15.4)	-
	21 - 29% O_2	-	51 (56)	-
	30% O_2	-	26 (28.6)	-
	> 30% O_2	-	0 (0)	-
	NR	-	0 (0)	-
	NA	39 (30)	0(0)	39 (100)
Initial inflation pressure for the full-term newborn	< 25 cmH_2O	4 (3.1)	3 (3.3)	1 (2.6)
	25 cmH_2O	44 (33.8)	27 (29.7)	17 (43.6)
	30 cmH_2O	75 (57.7)	59 (64.8)	16 (41)
	≥ 35 cmH_2O	1 (0.8)	0 (0)	1 (2.6)
	NR	3 (2.3)	2 (2.2)	1 (2.6)
	NA	3 (2.3)	0 (0)	3 (7.7)
Initial inflation pressure for the preterm newborn (< 32 week-gestation)	< 25 cmH_2O	-	10 (11)	-
	25 cmH_2O	-	77 (84.6)	-
	30 cmH_2O	-	3 (3.3)	-
	≥ 35 cmH_2O	-	0 (0)	-
	NR	-	1 (1.1)	-
	NA	39 (30)	0 (0)	39 (100)
Confirmation of correct endotracheal tube placement	Auscultation with stethoscope	85 (65.4)	57 (62.6)	28 (71.8)
	End tidal CO_2 device	3 (2.3)	2 (2.2)	1 (2.6)
	Auscultation + end tidal CO_2 device	37 (28.5)	32 (35.2)	5 (12.8)
	Thoracic X-ray	4 (3.1)	0 (0)	4 (10.3)
	NR	1 (0.8)	0 (0)	1 (2.6)

Table 5 – Transition support and neonatal resuscitation practices (section 2 of 2)

		Total (n = 130)	Group A (n = 91)	Group B (n = 39)
(b) Chest compressions				
Chest compressions/insuflations ratio	15 compressions to 2 insuflations	29 (22.3)	17 (18.7)	12 (30.8)
	30 compressions to 2 insuflation	1 (0.8)	1 (1.1)	0 (0)
	3 compressions to 1 insuflation	99 (76.1)	72 (79.1)	27 (69.2)
	NR	1 (0.8)	1 (1.1)	0 (0)
(c) Vascular access				
First line vascular access if needed	Umbilical access	122 (93.8)	87 (95.6)	35 (89.7)
	Periferal venous access	8 (6.2)	4 (4.4)	4 (10.3)
	Intraosseous access	0 (0)	0 (0)	0 (0)
(d) Prophylactic surfactant in the DR				
Routinely performs administration of prophylactic surfactant to all newborns at risk of respiratory distress syndrome		15 (11.5)	4 (4.4)	11 (28.2)
(e) Glycemic control of the newborn				
Routinely performs glycemic monitoring to all newborns who underwent resuscitation		87 (66.9)	56 (61.5)	31 (79.5)
(f) Transportation of the newborn after resuscitation				
Easy access/transportation of the newborn to a neonatal intensive care unit (NICU)		119 (91.5)	90 (98.9)	29 (74.4)
Access to short-duration invasive ventilation in the DR before transportation to differentiated care		116 (89.2)	84 (92.3)	32 (82.1)
Access to a transport incubator with fully controlled environment		106 (81.5)	80 (87.9)	26 (66.7)
Access to a transport incubator with humidified air		65 (50)	44 (48.4)	21 (53.8)

Data are expressed as n(%).
NR : non respondents; NA : not applicable.

Equipment

The availability and suitability of appropriate equipment is critical for successful neonatal resuscitation, and the use of checklists can help to ensure that.[14] Based on the findings of this study, the Portuguese delivery rooms appear to be well-equipped for adequate neonatal resuscitation, as the presence of most of the essential equipment was reported among participants. However, end-tidal CO_2 detector, CPAP and nasal CPAP were underreported in both groups, despite being significantly more reported by the Group A physicians, which is to be expected given the gestational age limit of these centers. The ERC guidelines advocate for exhaled CO_2 detector as the preferred method for confirmation of the correct endotracheal tube placement, and for CPAP as the preferred method of ventilatory support after delivery of preterm infants who are breathing spontaneously.[2] Therefore, improving the availability of these devices in the Portuguese DRs should be considered.

Temperature

Both hypothermia and hyperthermia increase the risk of neonatal morbidity and mortality in both term and preterm infants.[15] A high incidence of postnatal hypothermia has been reported in both high and low resource countries and preterm infants are especially vulnerable.[15] According to the ERC guidelines, the temperature of newly born infants should be maintained between 36.5ºC and 37.5ºC. In order to achieve this, European guidelines advise keeping the delivery room temperature between 23º – 25ºC for neonates ≥ 28 week-gestation and > 25°C for preterm infants < 28 week-gestation.[2] Skin-to-skin contact with the mother may be effective in maintaining thermal stability (low

quality evidence) in infants > 32 week-gestation where resuscitation was not required.[16] Portuguese physicians seem to have not yet adopted these recommendations widely, which is in line with results of other studies.[13] Only 47.7% reported monitoring the DR temperature, and only 49.2% indicated monitoring the temperature for all neonates, with participants in Group B reporting it less often. Given these findings, it would be appropriate to increase awareness in Portugal regarding the need to control the temperature of neonates and the DR's temperature, as well as re-establishing target temperatures according to the current international guidelines, especially in level I and in level IIa centers.

Umbilical cord management

The act of clamping the umbilical cord immediately after birth is associated with a reduction in preload, which subsequently causes a decrease in the neonate's cardiac output.[17] This effect can be reduced by ventilating the lungs and increasing pulmonary blood flow before clamping the cord.[17] A recent systematic review and meta-analysis has shown that delayed cord clamping in term infants was associated with significantly reduced hospital mortality (high-quality evidence).[18] For these reasons, the ERC guidelines clearly advise delaying cord clamping for at least 60 seconds when immediate resuscitation is not required.[2] Overall, Portuguese neonatologists and pediatricians appeared to follow the international guidelines for umbilical cord management. However, Group B physicians seem to have a lower adherence to this practice, despite the majority still being compliant. This finding suggests there is room for improvement in these centers.

Heart rate monitoring

The neonate's heart rate is an important indicator of the effectiveness of spontaneous breathing, and it guides the need of further interventions and serves as a marker of response to resuscitative interventions.[1] For these reasons, a reliable method of measuring it is crucial in neonatal care.[1] The ERC guidelines advocate the determination of the heart rate with auscultation and pulse oximetry monitoring ± ECG for later continuous assessment. For preterm infants it is suggested that continuous rather than intermittent monitoring be considered.[2] Portuguese physicians appear to be aligned with these recommendations, as the combination of auscultation and continuous monitoring using a pulse oximeter appears to be the most commonly used strategy for vital signs monitoring both in term and preterm infants. However, the use of ECG in term infants in Portugal, particularly among Group B participants, seems limited.

Airway, ventilation and circulation

Routine suctioning of the oro- or nasopharynx of newborns is currently not recommended in those born with meconium-stained fluid,[2] since it does not decrease the incidence of meconium aspiration syndrome or newborn deaths[19] and is likely to delay initiation of ventilation. However, some studies show that following this recommendation is associated with an increase in admissions to the NICU.[19] In this study, a significant percentage of participants (49.2%) reported to perform routine airway aspiration in all non-vigorous/apneic/ineffective breathing neonates. This emphasizes the need of raising awareness about this recommendation among Portuguese neonatologists and pediatricians, as well as the need to conduct additional research to reinforce existing guidelines.

According to the ERC guidelines, pulse oximeters and oxygen blenders should be used when resuscitating newborns in the DR.[2] Portuguese physicians showed good compliance with this recommendation. However, Group B physicians reported less often the use of oxygen blenders in assisted ventilation, suggesting that this could be an area of improvement in these centers.

The findings of this study suggest that in terms of ventilation of term infants, Portuguese physicians mostly initiate ventilation with air and with an inflation pressure of 30 cmH_2O. This shows good compliance with international guidelines.[2] However, there was some variation between the groups regarding the initial inflation pressures used for these neonates, with Group A predominantly reporting pressures of 30 cmH_2O and Group B predominantly reporting pressures of 25 cmH_2O. In fact, the evidence supporting the optimal initial inflation pressure for lung ventilation in term infants remains limited,[2] and these results highlight the importance of further research.

Regarding the ventilation of newborns < 32 week-gestation, Portuguese physicians also appear to be in line with the current recommendations, as most participants who deal with these infants reported initiating ventilation with 21% - 29% O_2 and an inflating pressure of 25 cmH_2O. Nevertheless, there was some variation in responses regarding the gas mixture used during the initial inflation of these neonates, which may be explained by the fact that the O_2 concentration used for preterm infants depends on the gestational age, according to ERC guidelines.[2]

Prophylactic administration of surfactant consists of its administration to infants at risk of RDS, while selective surfactant treatment occurs in infants with established RDS.[20] With the increasing use of CPAP in the stabilization of preterm infants, the evidence showed that prophylactic use of surfactant was no longer beneficial.[20] The 2022 European Consensus Guidelines on the management of RDS advocate for surfactant administration in the DR when intubation is needed for stabilization.[21] The Portuguese neonatologists and pediatricians are in line with this recommendation, as

only 11.5% of respondents reported performing routine prophylactic administration of surfactant. However, Group B physicians appear to be less compliant with current recommendations, so further investment should be made in education towards this matter in these centers.

Chest compressions are a crucial part of the neonatal resuscitation algorithm, but circulatory support with chest compressions is only effective if the lungs have been successfully ventilated.[2] The ERC guidelines advocate for a 3:1 compression ratio to be used,[2] and most Portuguese physicians seem to be compliant with these recommendations. The intraosseous needle is considered a reasonable alternative to the umbilical vein catheterization when this access is not feasible[1] and the presence of this device in Portuguese DRs is still limited, suggesting there is a need to increase its availability.

Strengths and limitations

The present study has several strengths. Firstly, the questionnaire was carefully designed, covering most aspects of neonatal resuscitation in accordance with the ERC guidelines. Moreover, the questionnaire was approved by experts in the field of neonatology, ensuring its validity and reliability. Thirdly, the use of an online survey facilitated participation, and the dissemination through the Portuguese Neonatal Society increased the response rate compared with the 30 responses obtained in the 2011 survey.[7]

However, this study also has some limitations. Firstly, the use of a survey comes with the risk of inducing response bias, as well as a limited response rate. The fact that the response rate could not be determined limited the generalizability of the findings, although 130 responses represent a substantial absolute count. Moreover, physicians working in level IIb and level III centers may be overrepresented in this study, as the Portuguese Neonatal Society has a larger number of physicians working in these centers, which limited making statistical inferences when comparing the groups. Nonetheless, the results are consistent with what would be expected both in higher and in lower-level units. This study did not include all neonatologists in Portugal as not all are registered with the Portuguese Neonatal Society. Lastly, the questionnaire did not cover the use of positive end-expiratory pressure (PEEP) during positive pressure ventilation (PPV) administration to neonates, which is an important measure to evaluate as it has been demonstrated to be beneficial, particularly in preterm infants, and it is advocated by the 2021 ERC guidelines. Moreover, the questionnaire did not cover the methods for administering surfactant in the delivery room.

Future studies should consider these limitations and address them to provide a more comprehensive understanding of the current practices in neonatal resuscitation in Portugal as well as in other countries.

CONCLUSION

Overall, adherence to neonatal resuscitation international guidelines was high among Portuguese physicians. However, there was some variation between guidelines and current practice, as well as between centers with different levels of care. Areas for improvement include team briefing, ethics, education, available equipment in delivery rooms, temperature control and airway management. The findings of this study are relevant, as this is one of the few studies assessing the quality of neonatal resuscitation practices in Portugal. The authors of this study emphasize the importance of continuous training and educational updates, particularly in level I and level IIa centers, in order to ensure compliance with the most recent guidelines and ultimately improve neonatal health outcomes in Portugal.

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AUTHOR CONTRIBUTIONS

NA: Literature search, data collection, analysis, and interpretation, drafting of the manuscript.

GR, FFL: Study design, literature search, data collection, analysis, and interpretation, critical review of the manuscript.

MR: Study design, literature search, critical review, approval of the final version of the manuscript.

SP: Literature search, data collection, analysis, and interpretation, critical review, approval of the final version of the manuscript.

MM: Study design, literature search, critical review, approval of the final version of the manuscript.

IA: Literature search, data interpretation, critical review, approval of the final version of the manuscript.

HS: Study design, literature search, data interpretation, critical review, approval of the final version of the manuscript.

PROTECTION OF HUMANS AND ANIMALS

The authors declare that the procedures were followed according to the regulations established by the Clinical Research and Ethics Committee and to the Helsinki Declaration of the World Medical Association updated in 2013.

DATA CONFIDENTIALITY

The authors declare having followed the protocols in use at their working center regarding patients' data publication.

COMPETING INTERESTS

The authors have declared that no competing interests exist.

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