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Neonatal Training across Union of European Medical Specialists Member Countries: A Survey from the Next Generation of Neonatologists

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Abstract

Introduction: Taking care of critically ill newborn infants is challenging, even more so in the current era of greater use of non-invasive support, leaving limited exposure to learn critical skills. Supporting a growing workforce of neonatologists requires training of doctors with formal curriculums and assessment of skills ensuring delivery of high-quality care. Our aim was to gain an understanding of neonatal trainee experiences regarding current neonatal training across Union of European Medical Specialists (UEMS) member countries. The main focus of this survey was on pulmonology-related skills and decision-making. ***Methods:*** A structure online survey was sent via the European Society for Paediatric Research (ESPR) newsletter and targeted national neonatology societies from 35 full and associate member countries of the UEMS. Doctors currently in neonatal subspecialty training or having finished training within the last 3 years were eligible. The survey took place between December 2023 and June 2024. All answers were anonymous. ***Results:*** One hundred and eight individual responses from 24 countries were received.

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Trainees were confident in endotracheal intubation and postnatal surfactant administration. Current year of neonatal training was the most strongly associated factor with reported confidence in training requirements and procedures, as opposed to having a formal curriculum. Adequate face to face supervision also affected confidence in decision-making. ***Discussion:*** There currently is no "unified" pathway for training, curricula and formal assessments across member countries of the UEMS. Future developments include provision of simulation-based training approaches and collaborative mentorship opportunities in caring for complex respiratory diseases affecting newborns.

Introduction

Neonatology is an advancing medical specialty with increased survival of infants born extremely preterm [1] and those born at term requiring medical and surgical care [2]. There is therefore a growing need to build, maintain and support the neonatology workforce [3, 4]. Provision of 24/7 resident consultant care has led to improvements in mortality for infants born at night in one tertiary European neonatal intensive care unit (NICU) [5], with an in-house attending call model recommended as the correct care model for the increasingly complex neonatal population [6]. The European Society for Paediatric Research (ESPR), with the European Academy of Paediatrics (EAP) and Union of European Medical Specialists (UEMS), has developed an accredited European syllabus for neonatology, based on European Training Requirements (ETR) [7]. Standardisation of educational curriculums and accredited training requirements across UEMS aims to provide trainees with knowledge, skills and best practices.

The neonatal period marks a time where rapid physiological changes take place in the individual patient. Increased recognition of anatomical, biochemical, and congenital deviations, together with an increased understanding of the complex interplay between cardio- and pulmonary systems [8], pose challenges on adequate pulmonary management. Thus pulmonary disease, as well as iatrogenic injury, is frequently encountered by neonatologists, with half of moderately preterm infants admitted to the NICU receiving postnatal surfactant therapy [9], and approximately 40% of extremely preterm infants consequently being diagnosed with bronchopulmonary dysplasia [10]. Procedures such as less invasive surfactant administration and point-of-care lung ultrasound, have gained interest in recent years [11, 12]. Learning and maintaining competency of essential clinical skills relating to neonatal pulmonology, in particular the life-saving procedure of endotracheal intubation, becomes therefore especially valuable in the current era of minimally invasive care [13].

One European study of neonatal training reported that almost all NICUs surveyed would be interested in attending national courses on neonatal respiratory care, while only one-third have a policy for upgrading training and techniques in respiratory management [14]. Such responses came from directors and heads of neonatal divisions. Evidence suggests, however, that listening to trainee voices is an equally important step in implementing innovative ideas and providing effective medical education to achieve procedural competency [15]. The future generation of neonatologists will be working for many years within a new workforce model to deliver high-quality care. It is vital that we ensure they graduate from neonatal sub-specialty training with the knowledge and skills required. Our aim was to gain an understanding of neonatal sub-specialty trainees (NST) and junior consultant staff views and experiences regarding current neonatal training, with a focus on pulmonology, education and research, across UEMS member countries and identify areas for targeted training.

Methods

A survey was sent via the European Society for Paediatric Research (ESPR) newsletter and targeted national neonatology societies from 35 full and associate member countries of the UEMS (countries listed in the online supplement; for all online suppl. material, see https://doi.org/10.1159/000547673). Current NST or those who completed specialist training within the last 3 years were invited to participate. The survey took place between December 2023 and June 2024 using a structured online questionnaire (attached as online supplement). Participation was voluntary, anonymous and the link to participate was distributed to individual trainees via the "early career investigator" and "pulmonology" sections of the ESPR (https://www.espr.eu/sections/section_overview.php). To maximise coverage, the link was publicised on the ESPR website. Trainees were sent multiple reminders throughout the survey period. The Health Research Authority Toolkit of the National

Health System, United Kingdom verified that regulatory approval by a Research Ethics Committee was not required. Formal approval by Research Ethics Committee was therefore not pursued as the authors decided no written informed consent of trainees answering the questionnaire was required.

The survey questions included demographic information, description of the NST, postgraduate research and abroad stays, and personal ranking of their own confidence level (1 = minimal, 5 = maximal) for different skills, and self-rated current level of supervision requirement for manual tasks as well as clinical decision-making (full list of questions in online supplement). Participants were also asked to rate their confidence level on a scale of 1–10 (1 = not ready, 10 = fully ready) for how ready they feel in becoming a consultant at the end of training. Potentially influencing factors assessed were: age, gender, current year of neonatal training, curriculum, adequate supervision, number of infants born < 32 weeks' gestation/year in the unit currently working in. Completion of the survey took about 15 min.

Statistics

Descriptive statistics and linear regression analysis were used to describe parameters and their association. Significance was defined as alpha < 0.05 for univariable regression analysis. In a second step, all significant predictors were combined in a multivariable model, and stepwise backward elimination starting from the highest non-significant *p* value was conducted until all predictors remained statistically significant (<0.05). Stata16, Statistical Software, TX: StataCorp LLC was used for analysis.

Results

One hundred and eight individual responses from 24 countries were received. We excluded three responses from trainees who completed more than 3 years prior, therefore analysing 105 responses. Eighty-five responses (82%) were from female trainees. Fifty (48%) respondents were aged between 35 and 40 years. Length of general paediatric training prior to neonatal subspecialty training was 4–6 years in 82% of responses (86 trainees) and 1–3 years in 11% (12 trainees). Thirty-two (31%) responses came from those who completed NST within the last 3 years.

Fifty-one percent of respondents undertook a 3-year NST in their country; 37% a 2-year programme, 4% a 1-year programme and in 6% of responses there was no formalised NST programme. Fifty-five (52%) trainees remained in one unit for the length of NST with 50 (48%) trainees reporting experience in multiple neonatal units. Ninety-nine (94%) trainees who completed the survey were currently working in a level 3 or level 4 neonatal unit. Fifty-five (55%) respondents reported working in a unit that manages more than 100 infants/year born at less than 32 weeks of gestation. Seventy-five (71%) trainees followed a pre-defined neonatal curriculum – this was a national curriculum in 80% and a European curriculum in 15%. Sixty-six (63%) were required to keep a logbook of procedures performed and experience in managing certain neonatal conditions. Sixty-three (60%) reported receiving adequate face-to-face supervision to meet their educational needs. Ninety-three (89%) trainees reported having exposure to neonatal surgical cases and 84 respondents (80%) did not have exposure to ECMO infants during sub-specialty training.

Twenty-four (23%) trainees had undertaken a postgraduate research degree during training, for which 78% this was a PhD. Sixty-nine (66%) trainees had submitted at least one abstract (national or international) and 36 (34%) had been invited as a speaker at a congress during sub-specialty training. Sixty-nine (66%) trainees were involved in research collaborations within their training hospital and fifty-seven (54%) had published at least one peer reviewed paper during NST. For 58% of respondents, they were required to undertake formal examinations at the end of NST, and a thesis project was required at the end of NST in 21%. Informative assessments were common for trainees (83%), in the form of case-based discussions, clinical examinations and directly observed procedures. When asked on a scale of 1 to 10 (where 1 = not ready and 10 = fully ready) how ready trainees felt to become a consultant at the end of NST 37% gave a score of 8, 10% a 9 and only 6% felt fully ready. Thirty-two (32%) trainees reported they had been or were in planning to undertake a fellowship abroad to further their training, with an additional 27% considering such a fellowship.

Confidence levels for specific ventilatory modalities, initiating treatment plans and management of neonatal respiratory conditions were assessed, and selected neonatal respiratory Entrustable Professional Activities (EPAs) were also scored by trainees from level 1 to level 5 (see Table 1 for results). Trainees were more confident in endotracheal intubation than nasal intubation, as well as use of caffeine and postnatal surfactant administration. Trainees were less confident in performing referrals for

Table 1. Confidence levels in management of ventilatory strategies, treatment plans and neonatal respiratory conditions and scoring of neonatal Entrustable Professional Activities (EPAs)

	Confidence level (median (IQR))
Use of caffeine citrate	5 (5, 5)
Confidence in use of iNO	4 (3, 5)
Inhaled bronchodilator use	3 (2, 4)
Neonatal stridor	4 (3, 4)
Escalation of respiratory support	5 (4, 5)
Respiratory syncytial virus prophylaxis	5 (4, 5)
Home oxygen planning/weaning	3 (3, 4)
Tracheostomy referral	3 (2, 4)
Referral for neonatal ECMO	3 (2, 4)
High frequency oscillatory ventilation (HFOV)	
With VG	4 (4, 5)
Without VG	3 (2, 4)
Neurally adjusted ventilatory assist (NAVA)	
Invasive	1 (1, 3)
Non-invasive	1 (1, 3)
	EPA level (median (IQR))
Intubation of term infants	
NICU	5 (4, 5)
Delivery suite	5 (4, 5)
Intubation of preterm infants (<28 weeks)	
NICU	5 (3.5, 5)
Delivery suite	4 (3, 5)
Less invasive surfactant administration	5 (3, 5)
Laryngeal mask airway insertion	4 (2, 5)
Use of video laryngoscope	4 (2, 5)
Nasal intubation of term infants	3 (1, 5)
Nasal intubation of preterm infants	3 (1, 5)
Lung ultrasound (LUS)	3 (1, 4)

Levels were rated for confidence (1 = no confidence, 5 = full confidence) and EPA level. ECMO, extra corporeal membrane oxygenation; iNO, inhaled nitric oxide; IQR, interquartile range; NICU, neonatal intensive care unit; VG, volume guarantee. * = Level 1: observed. Level 2: works under direct proactive supervision (supervisor in the room). Level 3: works under indirect supervision (supervisor on call at all times). Level 4: works without supervision (supervisor available but not on site). Level 5: can supervise younger colleagues.

ECMO and tracheostomy. Regression analysis assessing EPA scores for manual skills and confidence levels in decision-making skills is shown in Table 2. Current year of neonatal training was the most strongly associated factor with reported confidence in training requirements and procedures, as opposed to having a formal curriculum or being exposed to a large number of infants born at less than 32 weeks gestational age. Adequate face-to-face supervision also affected confidence in decision-making. The depiction of EPA levels and clinical decision-making versus confidence levels in relation to current year of training is shown in Figures 1 and 2.

Examples of free text responses from the final question asking trainees at the end of the survey if they felt anything was missing from their training programme included the following responses:

Table 2. Trainee confidence levels in manual skills, decision-making and readiness to become a consultant after sub-specialty training as assessed in an ordinal regression model with potential confounding parameters printed in bold [*p* value (coefficient beta)]

Manual skills task	Score (median (IQR))	**Current year of neonatal training**	**Curriculum (y/n)**	**Adequate supervision (y/n)**	**No infants <32 weeks/ year**	**Age**	**Gender (m/f)**	Adjusted R^2 final best model (%)
Entrustable Professional Activities (EPA) level								
Intubation delivery room	5 (4, 5)	<0.001*, (0.829)	ns	ns	0.046, (0.450)	<0.001*, (1,165)	ns	17
Intubation NICU	5 (4, 5)	<0.001*, (0.819)	ns	ns	0.020*, (0.550)	<0.001*, (1,161)	ns	20
Term nasal intubation	3 (1, 5)	<0.001*, (0.703)	ns	ns	ns	0.001*, (0.804)	ns	9
Preterm nasal intubation	3 (1, 5)	<0.001*, (0.653)	ns	ns	ns	<0.001*, (0.947)	ns	9
Video-laryngoscopy	4 (2, 5)	<0.001*, (0.721)	0.044, (0.801)	ns	ns	0.004*, (0.705)	ns	9
LISA	5 (3, 5)	<0.001*, (0.707)	ns	ns	ns	0.023, (0.537)	ns	10
Needle thoracentesis	4 (3, 5)	<0.001*, (0.629)	ns	ns	0.025*, (0.473)	0.010, (0.613)	ns	7
Chest drain	4 (2, 5)	<0.001*, (0.636)	ns	ns	ns	0.004*, (0.692)	ns	8
Decision-making confidence level								
Who, when and how to give surfactant	5 (4, 5)	ns	ns	0.048*, (0.914)	0.030*, (0.522)	ns	ns	5
Escalating respiratory support modes and settings	5 (4, 5)	0.001*, (0.510)	ns	ns	ns	0.009*, (0.665)	ns	7
Ventilatory strategies and modes for infants with CDH	3 (2, 4)	ns	0.033*, (0.813)	ns	0.039, (0.423)	ns	ns	2
Management of pneumothorax and pneumomediastinum	4 (3, 5)	ns	ns	ns	0.004*, (0.618)	ns	ns	3
When and who needs postnatal steroids	4 (3, 4)	0.004*, (0.407)	ns	0.033*, (0.452)	ns	0.035, (0.528)	ns	5
Readiness for extubation	4 (4, 5)	0.021, (0.340)	ns	ns	ns	0.012*, (0.615)	ns	3
Overall, I believe I will feel ready to become a consultant after my training/did feel ready to become a consultant after my training (1–10)								
Confidence becoming consultant	8 (7, 8)	<0.001*, (0.484)	0.037, (0.803)	0.001*, (1.539)	0.022*, (0.462)	ns	ns	10

Coefficient beta: change of dependent variable in relation to deviation in predictor variable. * = significant in final best multivariable model after inclusion of all significant variables from univariable regression analysis and stepwise backward elimination until all remaining variables had a *p* value <0.05. CDH, congenital diaphragmatic hernia; f, female; IQR, interquartile range; LISA, less invasive surfactant administration; m, male; NICU, neonatal intensive care unit; n, no; y, yes.

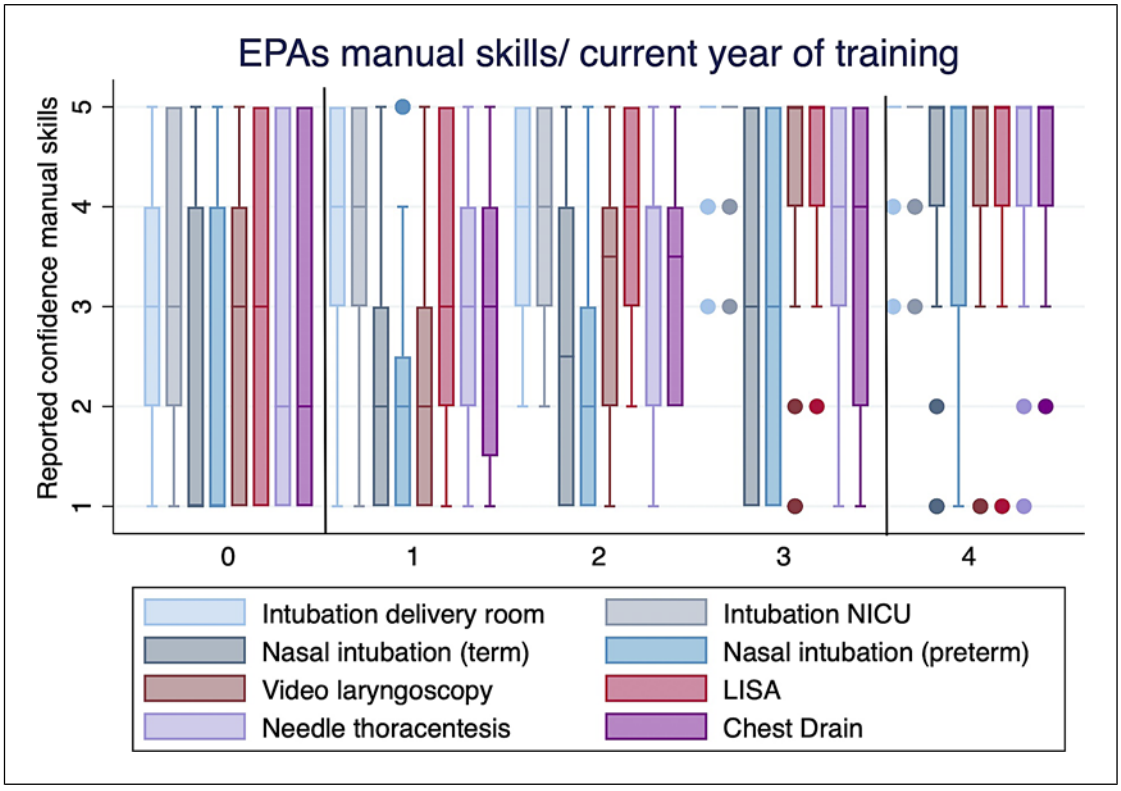

Fig. 1. EPAs manual skills/current year of training. Reported Entrustable Professional Activities (EPA) levels (1 = low, 5 = high) for different manual skills separated by current year of training. x-axis: 0 = no formal training; 1 = 1st year; 2 = 2nd year; 3 = 3rd year; 4 = training completed within last 3 years. LISA, less invasive surfactant administration; NICU, neonatal intensive care unit.

"More supervision and guidance, more theoretical and practical sessions, would like final exams, a structured curriculum is needed, more mentorship and more time in training"

"Guidance on how to be a leader, how to manage cot status and staffing numbers"

"Ethical dilemmas and conflict"

"POCUS, ECMO, neonatal cardiology and transport of critically unstable neonates"

"Opportunities to share knowledge of practice between countries, more research case-based discussions"

Discussion

There is variation in neonatal pulmonology training across the UEMS member countries, with differences observed in both clinical and academic exposure of trainees. Year of training and access to adequate supervision affected trainee confidence and readiness to become a consultant, with manual clinical skills often being learnt during training, and higher level clinical decision-making and management skills developing later.

Our results highlight potential areas of teaching and procedural skills that could aid focus of future curriculums, especially shifting towards less invasive diagnostics and interventions. Many trainees reporting being unaware of future training plans regarding training programmes to maintain technical skills in the current era of minimally invasive care. A 2024 study demonstrated the positive impact that online learning platforms can have in allowing trainees to maintain confidence and standardisation of skills [16]. Furthermore, results from a 2024 modified European Delphi consensus approach highlighted technical skills to be included in simulation-based training curriculums, with the idea to improve infant outcomes and maintain safety [17]. Simulation training also has a role in NICUs with less cases per year of rare pathologies such as CDH and pulmonary malformations. If centralisation of care develops further this

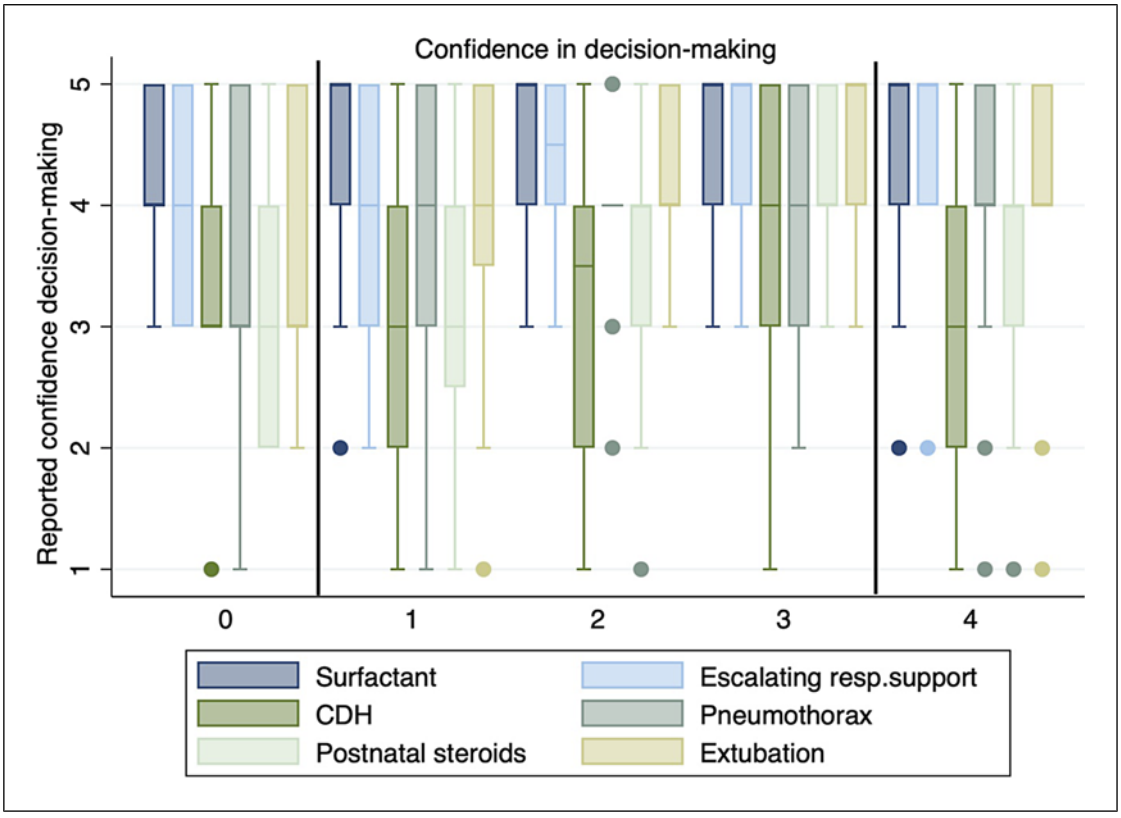

Fig. 2. Confidence in decision-making. Reported confidence levels (1 = low, 5 = high) for decision-making tasks separated by current year of training. x-axis: 0 = no formal training; 1 = 1st year; 2 = 2nd year; 3 = 3rd year; 4 = training completed within last 3 years. CDH, congenital diaphragmatic hernia.

too may affect neonatal consultants, with even less level 3 NICUs caring for such complex pathologies. In the future, the development and inclusion of such scenarios for training and clinical management could be a focus of simulation curriculums, with the aim to incorporate current European consensus guidance [18]. It is also worth noting that there will be variation in skills required by training country and indeed many countries included within UEMS have differing resuscitation practices and guidelines (following either Neonatal Life Support (NLS), Neonatal Resuscitation Program (NRP) or bespoke national algorithms [19]) for newborn resuscitation and stabilisation of extremely preterm infants [20]. Thus, trainees will have variation in exposure of learning and development of manual and decision-making skills in this complex evolving neonatal population.

The results from the current survey suggest research is an area which could be better incorporated into training, e.g., through provision of protected research time for those interested in academia. Two-thirds of respondents reported being involved in research collaborations, with 56% publishing at least one peer reviewed paper during NST. As the survey was distributed through the ESPR, there was the unavoidable bias of trainees who participated in the survey being from more academically inclined institutions and scientifically oriented clinics. We were surprised that despite such bias, the number of trainees participating in research was not the great majority, although we acknowledge not all trainees completed the survey. Exchange programmes can enable trainees to network and form connections outside their home institution, providing an opportunity for collaboration and learning of new skills. Currently, the ESPR offers a mentoring programme to allow early career investigators to develop skills and receive career support from international experts through conducting research together. The future development of clinical exchange programmes may enable neonatal trainees to undertake approved fellowships and gain exposure to more specialised services such as neonatal ECMO which might not be offered at their current institution. Additionally, the

ESN (https://www.espr.eu/activities-projects/esn.php) provides an educational programme covering knowledge, skills, and competency requirements for clinicians to effectively practise safe neonatal care, encompassing the ESPR derived curriculum [7].

Themes that came from trainees relating to what was missing in their current training programmes were: management/leadership opportunities and more career mentoring/clinical supervision. These should be considered when designing future training programmes so that "consultant skills" are learnt during training, after clinical manual skills have been acquired, rather than after training. How we assess confidence and competence of trainees is challenging – e.g., a 1st-year trainee may feel confident in skills of intubation, knowing there is a consultant available, however a 3rd-year trainee may feel less confident (although more competent) knowing soon there will be no back-up available to call. This is where the development and concept of EPAs can provide standardisation of assessing trainee level of independence in such skills [7].

Trainees reported feeling less confident with ventilatory modes such as neurally adjusted ventilatory assist (NAVA). These areas of neonatal pulmonology are not yet standard practice across many institutions with lack of robust evidence showing improved long-term outcomes in large multi-centre randomised clinical trials [21]. Lung ultrasound is another novel bedside skill being integrated into more NICUs across Europe, with standardised European guidelines recently published [22]. A focus on specific additional training, workshops and completion of log books to achieve accreditation in lung ultrasound could be one example of how competence in such practical procedures and skills could be incorporated into training programmes in the future. One aspect not covered in this survey but would be interesting to ascertain is whether confidence levels of established NICU consultants is related to confidence levels of NST working within the same institutions. As newer technologies are introduced and practices continually developing, current consultants may not have been exposed to such advances until later in their careers. Indeed, for new evidence-based developments to be safely and robustly introduced into routine clinical practice requires a model of change and empowerment [23, 24].

There are strengths and limitations to this survey. The survey has been widely distributed across UEMS member countries. Countries included in the UEMS, but without replying to the survey (Armenia, Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Iceland, Latvia, Slovenia, and Ukraine) may not have the possibility to train their own neonatologists, which might explain the lack of response. People originating from these countries may also have answered as trainees from a different country – one where they are currently undertaking NST. The results are nonetheless reflective of a large sample of countries with different practices and populations, yet despite this similar themes and concerns from trainees arose. As the survey was not mandatory, however, one limitation is risk of selection bias. Trainees choosing to participate may be more likely to also actively engage in research and training opportunities. There may additionally be differences in cultural background, gender, and years of experience relating to training needs/confidence that we have not been able to comment on due to the small number included. We noticed the high proportion of female participants (>80%) yet cannot determine if this is reflective of an actual majority of trainees being female, or if female trainees were more willing to participate. Finally, the survey relied on trainees self-reporting their confidence in managing certain clinical aspects; however, we cannot fully determine the positives of each training programme given that confidence does not necessarily equate to competence.

Conclusion

We have described views of trainees with regards to neonatal pulmonology training. Despite ongoing efforts to standardise subspecialty training in Europe, there currently is no "unified" training pathway alignment of national and international recommendations for training, curricula, and formal assessments across member countries of the UEMS. Future developments include provision of simulation-based training approaches and collaborative mentorship opportunities for exposure to specialist management approaches in caring for complex respiratory diseases affecting newborns.

Statement of Ethics

The Health Research Authority Toolkit of the National Health System, United Kingdom verified that regulatory approval by a Research Ethics Committee was not required. Formal approval by Research Ethics Committee was, therefore, not pursued as the authors decided no written informed consent of trainees answering the questionnaire was required. Written informed consent to participate was not directly obtained but inferred by completion of the questionnaire. Participation was voluntary and

no compensation was given to trainees answering the survey. No information allowing identification of the people answering the survey was collected.

Conflict of Interest Statement

E.E.W. is a junior board member of pulmonology group of the European Society for Paediatric Research. T.D. is currently the Principal Investigator for two research studies at King's College London, funded by Chiesi UK and the King's Medical Research Trust and a co-investigator in a National Institute for Health and Care Research (NIHR) research grant. T.D. has received honoraria from Chiesi UK and Draeger Greece for delivering lectures. C.C.R. is a co-author on the ETR3 and has received an unconditional grant by Chiesi for a clinical study, as well as lecture fees from Chiesi. C.C.R. was a member of the journal's Editorial Board at the time of submission. J.B. chairs the Epidemiology, Public Health, and Health Services Research section of the European Society for Pediatric Research. He is PI of research projects funded by RDO Balije van Utrecht, Fondsencollectief Veilig & Gezond Opgroeien, Convergence Healthy Start, the Dutch Ministry of the Interior and Kingdom Relations, the Dutch Research Council (NWO), Bilihome BV, Topsector Lifesciences and Health, Erasmus Trustfonds, and Strong Babies. W.Jd.B. is president of the European Society for Paediatric Research. K.J. is the chair of the early career investigator section of the European Society for Paediatric Research. The other authors (A.A.O.) have no conflicts of interest to declare.

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Author Contributions

E.E.W., T.D., and K.J. had substantial contributions to conception and study design. E.E.W. and K.J. acquired the data and drafted the article. E.E.W., T.D., A.A.O., C.C.R., J.V.B., W.J.d.B., and K.J. analysed and interpretated the data. All authors had final approval of this version to be published.

Data Availability Statement

The data that support the findings of this study are not publicly available due to not all data being published yet but are available from the corresponding author upon reasonable request.

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