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Thresholds for resuscitation of extremely preterm infants in the UK, Sweden, and Netherlands

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Abstract

Background—It is widely acceptable to involve parents in decision-making about resuscitation for extremely preterm infants (EPI) in the ‘grey zone’. However, there are different views about where the boundaries of the grey zone should lie. The aim of this study was to compare resuscitation thresholds for EPI between neonatologists in UK, Sweden and the Netherlands.

Methods—We distributed an online survey to consultant neonatologists and neonatal registrars/fellows with clinical scenarios in which parents requested resuscitation/non-resuscitation. Respondents were asked about the lowest gestational age/worst prognosis at which they would provide resuscitation and about the highest gestational age/best prognosis at which they would withhold resuscitation. Further scenarios assessed influence of the condition at birth, or consideration of available healthcare resources.

Results—The survey was completed by 162 neonatologists (30% response rate). There was a significant difference between countries; the grey zone for most UK respondents was 23.0 – 23.6/24 weeks, compared with 22.0 - 22.6/23 weeks in Sweden and 24.0-25.6/26 weeks in Netherlands. Resuscitation thresholds were higher if an infant was born in poor condition. There was wide variation in the prognosis that warranted resuscitation/non-resuscitation. Consideration of resource scarcity did not alter responses.

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Contributors’ statement

Dr Wilkinson conceptualized and designed the study, carried out the initial analyses, drafted the initial manuscript, and reviewed and revised the manuscript.

Drs Verhagen and Johansson designed the survey, collected and analysed data, and reviewed and revised the manuscript.

All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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Conclusions—This survey found significant differences in approach to resuscitation of EPI with a spectrum from most (Sweden) to least proactive (Netherlands). Most survey respondents indicated shifts in decision-making attached to particular weeks of gestation. Despite the different approaches to decisions in the three countries, there was relatively little difference between countries in neonatologists' prognostic thresholds for resuscitation.

Introduction

Extremely preterm infants (EPI) have high rates of mortality and morbidity.¹ Those born at the lowest gestational ages require long periods of respiratory support and intensive care. ² It is widely thought to be ethically acceptable to involve parents in decisions about resuscitation for infants at the margin of viability, within the so-called 'grey zone'.³ However, there are different views about where the boundaries of the grey zone should lie ⁴: ie when infants are too immature for resuscitation not be attempted even if desired (the 'Lower Threshold' of the grey zone) and when infants are sufficiently mature that active resuscitation should be considered mandatory (the 'Upper Threshold').³

There are a large number of national guidelines around resuscitation of EPI in high income countries.^{4–6} Most of these guidelines provide recommendations for the Lower and Upper Thresholds based on estimated gestational age. It is not clear, though, how strictly neonatologists adhere to these recommendations or how they take into account infants' condition at birth. Gestational-age based guidelines have also been criticised.^{7–9} Such guidelines are argued to be overly-simplistic, to ignore uncertainty in estimation of gestational age, neglect other important prognostic factors, and even to represent discrimination against EPI.^{7–10} Some authors have argued that decisions should instead be individualised,^{8, 11, 12} or explicitly based upon infants' expected prognosis.¹³ Yet, there is little existing guidance on what prognosis would justify a decision to provide or withhold resuscitation.³ It is unclear when neonatologists would judge prognosis to be too poor to resuscitate or too good to provide comfort care at birth. Furthermore, thresholds and treatment strategies may also be context dependent.

The aim of this study was to explore and compare resuscitation thresholds for EPI between different European countries. We surveyed neonatologists in UK, Sweden and the Netherlands, countries that have previously been shown to have broadly similar approaches to ethical decision-making in neonatal intensive care.^{14, 15}

We sought the thresholds that they would apply – based on either gestational age or on prognosis. We also aimed to explore clinician's experience of resuscitating outside prevailing guidance, and whether concern for limited healthcare resources impacts on decisions.

Methods

Consultant neonatologists and neonatal registrars/fellows in the UK, Sweden, and the Netherlands were invited to participate in an anonymous online survey between May and September 2016. Recruitment differed between countries. In the UK, doctors attending a conference on neonatal ethics were invited to participate prior to the conference. Members

of the Swedish Neonatal Society and the Neonatology section of the Dutch Paediatric Association were invited to participate by email.

The survey was developed by the study authors after a review of the medical literature and following feedback from practising neonatologists in each country. The survey included basic demographic questions (gender, country, years of experience, religion), and questions about approach to resuscitation of extremely premature infants (Appendix).

Respondents were asked questions relating to two main scenarios. In the first scenario, parents expected delivery of an extremely premature infant and were requesting active resuscitation. Respondents were asked about the lowest gestational age at which they would be prepared to provide active resuscitation if the infant were born in good condition (spontaneously breathing with a heart rate of 100), or in poor condition (poor tone, no respiratory effort, heart rate of 40). Available options included a gestational age range from 21 to 25 weeks, 'always' or 'other' (free text)). They were also asked what probability of survival without severe disability would be too low to justify resuscitation for an extremely preterm infant.

In the second scenario, parents expected delivery of an extremely premature infant and were requesting non-resuscitation because they were concerned that the infant would die despite treatment, or survive with severe disability. Respondents were asked about the highest gestational age between 21 and 27 weeks at which they would be prepared to withhold active resuscitation if the infant were born in good or poor condition, as described above. They were also asked what probability of survival without severe disability would be too high to justify withholding resuscitation.

Further questions in the survey asked respondents whether they had local or national professional guidelines relating to resuscitation or non-resuscitation of preterm infants. They were asked whether in the preceding 5 years they had provided or withheld resuscitation outside those guidelines. Finally, respondents were asked about their willingness to provide resuscitation or non-resuscitation if there were no limit to available healthcare resources.

Statistical analysis was carried out using Wizard for Mac version 1.8.24. Differences between country and responses were explored using the Pearson Chi-square test. Participant responses to different questions were compared using the Stuart Maxwell test for marginal homogeneity in paired comparisons. To represent graphically the total number of neonatologists willing to resuscitate at a given gestation, we combined all those who indicated a resuscitation threshold at or below a given level (providing resuscitation on request) or at or above a given level (withholding resuscitation on request). We performed multivariate ordered probit logistic regression to determine the independent effect of baseline characteristics including country, gender (female vs. male), years of work in Neonatal Intensive Care Unit (NICU), and religion, on the thresholds for providing or withholding resuscitation. A p-value of 0.05 or less was considered to indicate statistical significance ($p < 0.01$ for multivariate analysis because of multiple comparisons).

The study was approved by the Medical Sciences Inter-divisional research ethics committee at the University of Oxford (R45847/RE001) May 2016.

Results

We contacted 553 neonatal consultants/fellows/registrars from the three countries (UK: 103, Sweden 250, Netherlands 200) and 162 completed the survey (response rates 41%, 24%, and 29% respectively). There was a higher proportion of consultants amongst Swedish and Dutch respondents, and they were more experienced (Table 1). There was a higher proportion of religious respondents from the UK, and a higher proportion of non-Christian religions.

Lower threshold

For an extremely preterm infant born in good condition, whose parents wished for active resuscitation, there was a significant difference between countries in the lowest gestation at which resuscitation would be provided ($p<0.001$ Figure 1A). Of UK respondents, 60% would only resuscitate beyond 23 completed weeks of gestation, while 56% of Swedish respondents would resuscitate beyond 22 weeks, and 58% of Dutch respondents would only resuscitate beyond 24 weeks. Ten Swedish respondents (6%) indicated that they would provide resuscitation at 21 weeks' gestation, or at any gestation if the infant were born alive.

If the infant were born in poor condition there was a significant increase in the lower gestational age threshold for resuscitation (Figure 1B, $p<0.001$). Compared with an infant born in good condition, a smaller proportion of UK respondents would only resuscitate if the infant's gestational age were 23.0 weeks (43% vs 60%), while a larger proportion (45% vs 5%) would only resuscitate if gestational age were 24 weeks or above. A smaller proportion of Swedish respondents would resuscitate at 22.0 weeks (36% vs 56%), while a larger proportion (33% vs 10%) would only resuscitate after 23 weeks. A larger proportion of Dutch respondents would only resuscitate after 25 weeks (19 vs 2%).

Respondents varied in their judgement of the probability of survival without severe disability that would be too low to provide resuscitation (Figure 2, Appendix Figure A1). Thirty-five (22%) would be prepared to provide resuscitation no matter how low the probability. Of those who provided a probability, the largest group (20%) indicated that they would resuscitate if the infant had a $>10\%$ chance of survival without severe disability. There was some difference between countries in the probability thresholds. For example, a larger proportion of Swedish than Dutch respondents would be prepared to resuscitate no matter how low the chance of survival (33% vs 6%, $p<0.01$).

When respondents were asked to imagine that there was no limit to available resources, there was no significant change in the probability at which resuscitation would be offered, nor was there a change in the proportion of respondents prepared to provide resuscitation in a hypothetical case of preterm delivery at 22.4 weeks gestation (38% vs 40%).

Upper threshold

There was a significant difference between countries in the highest gestational age at which resuscitation would be withheld at parental request ($p<0.001$, Figure 3). The majority of UK respondents (24/42, 57%) would withhold resuscitation at a maximum of either 23.6 or 24 weeks' gestation. In comparison, the majority of Dutch respondents (30/48, 60%) would be

prepared to withhold resuscitation at 25.6 or 26 weeks' gestation, while half of Swedish respondents (50%, 36/72) would withhold resuscitation at a maximum of 22.6 or 23 weeks' gestation. If the infant was born in poor condition, there was a small increase in the gestational age at which respondents in the three countries were prepared to withhold resuscitation (Appendix Figure A2).

Within countries there was a wide range in the prognosis judged to be too good to withhold resuscitation from an infant born in good condition, though there was not a significant difference between countries (Figure 2B/C). The most frequent response was to indicate that resuscitation would be provided despite parental wishes if there was a greater than 50% chance of survival without severe disability (44/162, 25%). Eleven respondents (2 of 42 UK, 5 of 72 Sweden, 4 of 48 Netherlands) (7%) responded that they would be prepared to withhold resuscitation at parental request at any level of prognosis.

Guidelines

Almost all respondents indicated that they had local or national guidelines relating to resuscitation of preterm infants (157/62, 96.9%). Most UK respondents (79.5%) indicated that according to this guideline, the lower threshold for resuscitation was 23 weeks, though 17.9% indicated that it was 24 weeks. Most Swedish respondents (78.9%) indicated that the guideline threshold was 22 weeks' gestation, though 7% indicated that the threshold was 23 weeks, and 7% indicated that according to the guideline resuscitation should always be provided. All Dutch respondents indicated that their guideline specified a lower gestational age threshold for resuscitation of 24 weeks gestation.

Forty-two respondents (26.6%) indicated that in the last 5 years they had resuscitated infants below their local or national lower threshold. This was somewhat more common among Dutch/UK respondents compared with Swedish respondents (33.3%, 35.9% and 16.9% respectively). In free text responses, many indicated that this was because infants were close to the gestational age threshold. For example, one Dutch respondent replied that the infant was "just a few hours before 24 weeks".

Compared to guidelines on resuscitation, a smaller proportion of respondents (71.6% vs 96.9%, $p<0.001$) indicated that they had local or national guidelines relating to *non*-resuscitation of preterm infants. A guideline was cited by a smaller proportion of Swedish respondents than UK/Netherlands respondents (58.3%, 81%, 83.3% $p<0.01$). Of those who indicated that there was such a guideline, there was a variation between countries and within countries in where respondents felt this threshold lay (Appendix Table 1, $p<0.001$). Sixteen respondents (12.9%) indicated that they had withheld resuscitation in the last 5 years in infants more mature than this limit. Seven of these sixteen respondents indicated in free text responses that the infants concerned were extremely growth restricted.

Associations

In a multivariate regression analysis, respondent country was significantly associated with the lower gestational age threshold for resuscitation ($p<0.01$), but not professional role, gender or experience. Importance of religion was associated with the lower gestational threshold, with those respondents indicated that religion was very important or fairly

important having a higher gestational age threshold than those for whom religion was not very important ($p < 0.01$). Addition of other demographic variables to the regression model did not change the strength of association between country and the lower threshold.

Respondent country was also associated with the upper threshold for resuscitation ($p < 0.01$). In general, demographic factors including respondent country were not associated with the probability thresholds for resuscitation. Greater respondent experience appeared to be associated with the probability threshold for providing resuscitation, with respondents with >20 years' experience indicating a higher threshold for resuscitating than those with 1-5 years' experience ($p < 0.01$).

Discussion

Our survey found striking differences in the thresholds for resuscitation of EPI reported by neonatologists in three European countries, previously reported to have similar approaches to ethical decision-making in neonatal intensive care.^{14, 15} Those differences in resuscitation practices appeared to be heavily influenced by guidelines in the three countries, and closely tied to completed weeks of gestation. However, clinicians varied in their interpretation of the Upper Threshold (the gestational age beyond which resuscitation was mandatory). Further, clinicians were influenced by condition at birth: they indicated a higher threshold for resuscitating an infant born in poor condition. There was relatively little difference between countries in prognosis-based thresholds, while individual respondents varied in the prognosis that they believed would justify providing or withholding resuscitation.

Gestational-age based thresholds

The majority of neonatologists in our survey indicated that they would not resuscitate infants more premature than a gestational age of 22⁺⁰ weeks in Sweden, 23⁺⁰ weeks in the UK, and 24⁺⁰ weeks in the Netherlands. This appears to reflect current national guidance. The British Association of Perinatal Medicine published a framework document in 2009: it notes that it would be standard practice not to resuscitate <23⁺⁰ weeks.¹⁶ The Dutch Pediatric Society's 2010 guideline advises 'active care measures' for neonates from a gestational age of 24⁺⁰ weeks onwards and not below that.¹⁷ In Sweden, a national guideline issued in 2016 recommends antenatal transfer to a level-3 setting from 22⁺⁰ weeks' gestation, and consideration of antenatal steroids and resuscitation.¹⁸

These national guidelines endorse shifts in management based upon gestational weeks. This might lead to changes in the permissibility of resuscitation from one day to the next, a phenomenon that could be compared to a "Cinderella effect", (referencing the impact of the stroke of midnight in the Cinderella fairytale). In the three countries, there were clear increments in willingness to resuscitate at the boundary between one gestational age week and the next (Figures 1, 3). Seventy per cent (113/162) of the surveyed cohort elected to provide a 'whole week' cut-off for resuscitation. A minority of respondents indicated in free text responses that they would occasionally resuscitate below their guideline limit for infants very close to the week boundary. Of note, only one respondent in the cohort declined to provide a gestational age threshold because "I'd like to consider more elements than

gestational age only". In a large multi-centre study in the US, there were significant increments in the rates of active resuscitation in the last day and the first day of an estimated gestational age week19 – suggesting that completed gestational weeks do influence clinical management.

Our survey respondents indicated a grey zone for parental discretion around resuscitation of approximately one week. There were significant differences between countries in the highest gestational age at which non-resuscitation was regarded as permissible. However, within countries respondents were also divided on where they would draw the line. Among Dutch respondents, 29% would withhold resuscitation at a maximum of 25⁺⁶ weeks, while 33% would withhold resuscitation up to 26⁺⁰ weeks; similar division was evident in Swedish (21% up to 22⁺⁶, 29% up to 23⁺⁰) and UK respondents (29% up to 23⁺⁶, 29% up to 24⁺⁰).

Previous studies have compared national guidelines for care of EPIs and found variation in guidance at 23 and 24 weeks gestation, but more common ground at 22 and 25 weeks.^{4–6} There have been recent national surveys of approaches to neonatal resuscitation (Table 2). Of relevance, a study in Sweden undertaken in 2003,²⁰ found a Lower Threshold of 23⁺⁰ weeks' gestation, suggesting that practice in this country has shifted in the last decade.

An earlier international survey of neonatologists, performed in 1999/2000, compared 6 Pacific Rim countries.²¹ The Lower Threshold varied from 22 weeks in Japan to 25 weeks in Malaysia.²¹ A large European study (EURONIC) conducted in 1996-7, found significant differences in physicians' overall approaches to end of life decision-making between different countries.¹⁴ In that study, physicians from UK, Netherlands and Sweden appeared to apply similar values to decisions, 14 and have a similar overall experience of having made specific end of life decisions.¹⁵ However, EURONIC did not specifically gauge thresholds for resuscitation of EPI.

Influence of condition at birth

A proportion of respondents in our survey indicated that they would adjust their threshold for resuscitation if an infant were born in poor condition (Figure 1). This was less evident amongst Dutch respondents, and was less apparent for the Upper Threshold. While previous surveys have also indicated that neonatologists consider condition at birth in decisions about providing intensive care,^{30, 32} this has been criticised.^{32, 33} Physician assessment of infant condition at the time of birth is variable,³⁴ and a poor predictor of outcome for EPIs.^{32, 34, 35}

Prognosis

Gestational-age-based thresholds have been criticised. One alternative would be to focus on the most ethically salient factor for decisions – an infants' prognosis.¹³ To the best of our knowledge, our study is the first to assess neonatal physician views about prognosis-based thresholds for resuscitation. Half of our respondents would not be prepared to resuscitate at parental request if an infant had at lower than 5-10% chance of survival without severe morbidity. Half of our respondents indicated that they would not be prepared to withhold resuscitation if an infant had a better than 20-30% chance of survival without severe morbidity. However, 10-15% of respondents declined to provide a prognostic threshold for

decisions. In free-text, several respondents mentioned that they did not consider decisions in this way.

Explanations for differing treatment

One potential reason for differences between countries in gestational-age thresholds is as a reflection of variation in the value placed on saving the life of a newborn, or on the burden of feeling responsible for a newborn's disabilities.³⁶ There is some indication of this from our survey, since among Swedish respondents (who as a group had the lowest thresholds for resuscitating EPIs), 33% indicated that they would consider providing resuscitation no matter how low the chance of an infant surviving (compared with 21% and 6% among UK and Dutch respondents). In contrast, in the earlier EURONIC study, only 2% of Swedish neonatologists indicated a belief that every neonate should receive maximal treatment irrespective of outcome.¹⁴ Differences in ethical values between the UK, Sweden and the Netherlands also do not appear to fully explain the differences in gestational age thresholds between countries, since the prognosis thresholds were similar overall (Figure 2). Physician religious beliefs were mostly not associated with prognosis or gestational age thresholds (though more religious respondents appeared to indicate a higher gestational age threshold for resuscitation.) Still, contextual differences in the three countries on how life and death is perceived could contribute to the difference found herein.

An alternative possible explanation for the difference in gestational age thresholds observed might be differences in mortality and morbidity for EPIs in the three countries. Table 3 summarises recent national cohort studies including survival and severe disability (assessed at 2 years of age). These studies demonstrate important differences in mortality rates, though necessarily not in rates of severe disability. For example, based on this data EPI in Sweden at 23 weeks appear to have a higher probability of survival without severe disability if resuscitated and admitted to NICU than in the UK (52% compared with 22%). However, some of the differences in outcome could reflect differences between countries in rates of provision of active perinatal management, active resuscitation, and in subsequent limitation of treatment.^{37, 38} This is evident in differences in survival as a proportion of live births, and in the absence of survivors at 22/23 weeks in the Netherlands. This makes it more challenging to evaluate the prognosis if full active management were provided.³⁹ Also, of note, survival rates for 24/25 week infants appear slightly better in the Dutch cohort than in the UK Epicure study. Therefore, this cannot explain the greater willingness of Dutch neonatologists to withhold treatment at these gestations. Another possibility is that neonatologists in the three countries differ in their perception of the risk of severe impairment among survivors at low gestations. For example, in the Swedish EXPRESS study, more active resuscitation was not associated with an increase in the rate of neurodevelopmental impairment.³⁷ This result may have encouraged a more proactive approach in Sweden. In contrast, the UK EPICure study has reported a clear association between earlier gestation and increased rates of severe impairment.⁴⁰ This may discourage UK neonatologists from offering resuscitation to some extremely premature infants.

A third possible explanation of differences in resuscitation decisions between countries might be on the basis of limited resources within a public health care system. However, the

UK, Sweden and the Netherlands all have universal public health systems with similar spending on health care as a proportion of GDP.⁴³ Lower rates of resuscitation at the lowest gestational ages could reflect lower priority for treatment for this group of infants (or higher costs),⁴⁴ although there was no evidence that this was influencing neonatal physicians' decision-making in our survey. When asked to imagine a scenario with unlimited NICU resources, there was no change in the proportion of respondents prepared to provide resuscitation at 22⁺³ weeks, nor in the prognosis considered sufficient to offer resuscitation.

Limitations

There are some limitations to the conclusions that can be drawn from our survey. The survey was piloted but not formally validated. We had modest response rates, albeit our overall results are consistent with average response rates for electronic surveys (34%).⁴⁵ The results are not necessarily generalizable to all neonatologists in the three countries. Although respondents indicated particular gestational ages at which resuscitation would or would not be provided in a hypothetical case, actual clinical decisions may incorporate a wider range of factors into decisions. While we provided clinicians with the option to enter free text responses, a future qualitative study might provide a richer insight into the reasons why neonatologists hold particular views about treatment of EPI. We only surveyed neonatal physicians; the views of neonatal nurses, obstetricians and parents are also of critical importance for decisions, and should be included in further research.

Conclusions

Our survey provides novel comparative data on the views of neonatologists in three European countries on resuscitation of extremely preterm infants. While limited by the response rate, the survey indicates significant differences in approach to resuscitation, with Sweden being most proactive and the Netherlands least proactive. Most survey respondents indicated significant shifts in decision-making attached to particular weeks of gestation, implying that the permissibility of resuscitation/non-resuscitation changes occur at the stroke of midnight, a phenomenon we have called the "Cinderella effect". One alternative to gestational-age thresholds would be to focus on an infants' prognosis. This survey provides the first data on neonatologists' prognostic thresholds for resuscitation. Of interest, despite the different approaches to decisions in the three countries, there was relatively little difference between countries in the prognosis judged sufficient to justify resuscitation/non-resuscitation. There was a wide range of different thresholds applied between neonatologists. Future work is needed to explore whether agreement is possible or desirable on prognostic thresholds for resuscitation of extremely preterm infants.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Abbreviations

EPI	Extremely Preterm Infant
NICU	Neonatal Intensive Care Unit

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Table of contents summary

This survey identifies differences in thresholds for resuscitation/non-resuscitation of extremely preterm infants applied by neonatologists in the UK, Sweden and the Netherlands.

What's known on this subject

There are variations between countries in guidelines relating to resuscitation of extremely preterm infants. Many published guidelines provide frameworks for resuscitation or non-resuscitation based on the gestational age of infants.

What this study adds

This study identified differences between three Northern European countries in the gestations at which resuscitation would be offered for extremely preterm infants. Neonatologists varied in the prognosis that they judged sufficient to offer or to withhold resuscitation.

Figure 1.

Lower threshold: Cumulative probability of resuscitation based on the lowest gestational age at which respondents would provide resuscitation.

The figure indicates the proportion of respondents prepared to resuscitate at a given gestation if parents request active treatment. (n=158. Four respondents who indicated an 'other' free text response excluded)

A. For an infant born in good condition (spontaneously breathing with a heart rate of 100)

B. For an infant born in poor condition (poor tone, no respiratory effort, heart rate of 40)

Figure 2.

Prognosis-based thresholds.

Cumulative proportion of respondents being prepared to either provide resuscitation at parental request (solid lines) or withhold resuscitation at parental request (broken lines), as prognosis improved. (n=144 (provide resuscitation), n=137 (withhold resuscitation)). For example, if there were a 10% predicted chance of survival without profound disability, 52% of Dutch neonatologists were prepared to provide resuscitation, while 100% were prepared to withhold resuscitation. Respondents (18 and 25, respectively) were excluded in the analyses if they gave only a free text response, i.e. did not indicate a numerical threshold.

Figure 3.

Upper threshold: Cumulative probability of non-resuscitation based on the highest gestational age at which neonatologists would withhold resuscitation at parental request in an infant born in good condition. The figure indicates the proportion of respondents prepared to withhold resuscitate at (or below) a given gestation if parents request palliative care be provided.

Table 1
Baseline characteristics of participants by location

Characteristics	Overall n (%)	UK n (%)	Sweden	Netherlands n (%)	P-value*
Professional role (n=162)	125 (77)	22 (52)	61 (85)	42 (88)	<0.001
Consultant	37 (23)	20 (48)	11 (15)	6 (13)	
Registrar/Fellow					
Gender (n=161)					0.2
Male	80 (50)	16(38)	39 (55)	25 (52)	
Female	81 (50)	26 (62)	32 (45)	23 (48)	
Years working in NICU (n=162)					0.04
1-5 years	39 (24)	17 (41)	13 (18)	9 (19)	
6-10 years	25 (16)	9 (21)	9 (13)	7 (15)	
11-15 years	35 (22)	9 (21)	15 (21)	11 (23)	
16-20 years	22 (14)	1 (2)	12 (17)	9 (19)	
> 20 years	41 (26)	6 (14)	23 (32)	12 (25)	
Religion (n=161)					<0.001
Yes	63 (39)	30 (71)	20 (28)	13 (27)	
Atheist	69 (43)	9 (21)	35 (49)	25 (52)	
Agnostic	29 (18)	3 (7)	16 (23)	10 (21)	
Which religion (n=81) ⁺					<0.001
Christianity	58	14 (44)	29 (94)	15 (83)	
Islam	3	3 (9)	0	0	
Judaism	1	0	0	1 (6)	
Hinduism	11	11 (34)	0	0	
Other	8	4 (13)	2 (6)	2 (11)	

* Using Chi squared test for comparison

⁺ For respondents who indicated that they had a religion or were agnostic (not including 11 agnostic respondents leaving this question blank)

Table 2
National or regional surveys of neonatologists/paediatricians in high income countries performed after the year 2000.

Only surveys that including a range of gestational ages, and asked about thresholds for resuscitation/non-resuscitation were included

From surveys, the median Lower Threshold was defined as the lowest gestational age at which 50% of neonatologists would actively resuscitate. The median Upper Threshold was defined as the highest gestational age at which 50% of neonatologists would withhold resuscitation.

Location	Survey sample	Year	Lower Threshold (median) weeks	Upper Threshold (median) weeks
UK - South East England 22	111 consultants/trainees	2008	23 *	N/A
Ireland 23	170 health professionals (obstetricians, neonatologists, neonatal nurses)	N/A	24 *	N/A
Norway 24	62 medical directors (obstetric and paediatric units)	2005	23 *	N/A
Canada 25, 26	121 neonatologists	2004	N/A	24 *
Sweden 20	88 neonatologists	2003	23 ⁺⁰	23 ⁺¹⁻⁶
US				
US – national 27	637 members of AAP perinatal section	2012	23 *	25 *
New Jersey 28	20 NICU Directors/Associate directors	2006	23 *	24 *
Illinois 29	85 neonatologists	2002	22 *	25 *
New England 30	149 Neonatologists	2002	23 ⁺⁰	24 ⁺⁰
Connecticut, Rhode Island 31	48 neonatologists	2001	23 *	23 *

* only whole week options included in survey
 N/A – data not available

Table 3
Outcome for EPI in UK, Sweden and Netherlands from recent national cohort studies. All measures are expressed as %.

			22 weeks	23 weeks	24 weeks	25 weeks
UK	EPICure 2 England and Wales, 2006 40	Survival (livebirth) ⁱ	(2)	(19)	(40)	(65)
		Survival (NICU) ⁱⁱ	16	29	46	68
		Severe disability ⁱⁱⁱ	[26] ^{iv}	[26] ^{iv}	[15]	[15]
Sweden	EXPRESS Swedish Perinatal Quality Register 2004-2007 41	Survival (livebirth) ⁱ	(10)	(53)	(67)	(82)
		Survival (NICU) ⁱⁱ	26	65	73	84
		Severe disability ⁱⁱⁱ	[40]	[21]	[13]	[9]
Netherlands	Zegers Netherlands Perinatal Registry, 2007-2011 42	Survival (livebirth) ⁱ	n/a	n/a	(31)	(71)
		Survival (NICU) ⁱⁱ	-	-	56	73
		Severe disability ⁱⁱⁱ	-	-	[n/a]	[n/a]

ⁱ Survival as a proportion of livebirths

ⁱⁱ Survival - Proportion of NICU admissions

ⁱⁱⁱ Severe disability - Proportion of those seen at follow-up with non-ambulant cerebral palsy (GMFCS levels 3-5), blindness, profound sensorineural hearing loss not improved by aids, or a developmental quotient less than 3 standard deviations below the mean for age.

^{iv} Results combined for 22/23 weeks