ARTICLE

Relationship Between Site of Training and Residents' Attitudes About Neonatal Resuscitation

Annie Janvier, MD; Keith Barrington, MB, ChB; Marianne Deschênes, MD; Elise Couture, MD; Sophie Nadeau, MD; John Lantos, MD

Objective: To determine whether the attitudes of pediatric and obstetric residents concerning the resuscitation of extremely preterm infants, and their knowledge of outcomes, varies according to their center of training and its resuscitation practices.

Design: Anonymous questionnaire.

Setting: Four province of Quebec, Canada, university centers.

Participants: A total of 165 pediatric and obstetric residents.

Interventions: Survey of attitudes about resuscitation of neonates born between 23 and 27 weeks of gestation, and knowledge of the prevalence of cerebral palsy in survivors.

Main Outcome Measures: Proportion of residents who would resuscitate a depressed, very preterm infant, and the proportion who overestimated the prevalence of cerebral palsy.

Results: The percentage of residents who would resuscitate a depressed infant born at 24 weeks varied from 11% to 39% between centers, at 25 weeks between 26% and 69%, and at 26 weeks between 51% and 86%. At the center most likely to intervene for very immature infants, the greatest proportion of residents favored resuscitation at each gestational age. At the least interventionist center, the smallest proportion would resuscitate. The center of training was the only factor related to willingness to resuscitate at 24, 25, 26, and 27 weeks of gestation; not age, years of training, religion, sex, or parental status (whether the person surveyed has children). A total of 53% of residents thought the prevalence of cerebral palsy was 25% or 40% in this population. Residents with a more accurate knowledge of outcome were more likely to want to resuscitate very immature infants.

Conclusion: Different treatment centers may develop their own ethos regarding resuscitation, which then shapes both the way the residents understand epidemiological data and how they make decisions.

Arch Pediatr Adolesc Med. 2008;162(6):532-537

Significant practice variation exists between neonatal centers in their resuscitation practices. For example, Vohr et al[1] reported that among the leading neonatal centers in the United States, the rate of active delivery room resuscitation for newborns weighing 401 g to 1000 g ranges from 5% to 28%. Lee et al[2] evaluated the differences in 12 Canadian centers and found that for infants born between 22 and 25 weeks of gestation, delivery room deaths (a condition for nonresuscitation) ranged from 8.5% to 57.4%. Such differences are neither illegal nor contrary to the guidelines of professional organizations. The American Academy of Pediatrics guidelines[3] state that resuscitation is futile prior to 22 weeks of gestational age and is generally obligatory at 25 weeks of gestational age or above, with 22 to 25 weeks as an acknowledged "gray zone." The Canadian Pediatric Society considers resuscitation optional before 25 weeks.[4] Other professional guidelines consider resuscitation optional between 22 and 25 weeks, and recommend a process of shared decision making between physicians and parents for these difficult cases.[5]

For editorial comment see page 584

A process of shared decision making requires physicians to counsel parents about the risks, benefits, and likely outcomes of treatment. Often, parents ask physicians for their opinions about what ought to be done — or even ask the physicians what they would do if faced with the decision

Author Affiliations: McGill University, Department of Pediatrics, Montreal, Quebec, Canada.

©2008 American Medical Association. All rights reserved.
Downloaded From: http://archpedi.jamanetwork.com/ on 10/08/2015

for their own infant.[6] Little is known, however, about the process by which physicians form their own opinions and attitudes about newborn resuscitation.

We wondered whether the practice variations between centers would be related to differences in knowledge and/or the attitudes of the trainees at those centers. We therefore studied pediatric and obstetric residents at 4 university-based residency programs in Canada (province of Quebec). Each program is affiliated with a level III neonatal center. We wished to describe the different approaches to resuscitation at the borderline of viability in these 4 university-based centers. We hypothesized that residents' knowledge and attitudes about resuscitation and prognosis would be related to the center in which they trained. We also wished to describe the effects of other factors that may be related to attitudes regarding resuscitation, such as religious beliefs, knowledge of outcomes, year of training, and whether the residents we surveyed had children themselves.

METHODS

Between July and October 2002, we collected data from directors of neonatal centers and from the residents who train in these residency programs. We interviewed the directors of neonatology at all 4 university centers in Quebec about the prevailing resuscitation practices at their center.

We then administered an anonymous questionnaire to all residents at the 4 university centers regarding their attitudes about resuscitation. Individuals gave their consent to be included. We asked residents about their resuscitation preferences in 3 ways. First, we asked them to state whether they would want their own infant resuscitated at 5 different gestational ages, from 23 to 27 completed weeks of gestation. Second, we asked whether they would recommend resuscitation for a sister's or a good friend's infant at those same gestational ages. For each of these questions, residents could respond on a Likert scale, with options for their likelihood of resuscitating being "always," "generally," "exceptionally," or "never." We scored these answers for some of the nonparametric analyses by grading the responses and giving 4 points for "always" down to 1 for "never."

Each resident was asked if they thought it was reasonable to resuscitate a depressed infant in the delivery room at 22, 23, 24, 25, 26, 27, and 28 completed weeks of gestation. For this question, the 22 and 28 weeks of gestation options were added, as these were felt likely to elicit answers close to 0% and 100%, respectively, as a further test of the validity of the questionnaire.

To assess the residents' knowledge of 1 aspect of the outcomes for infants at these gestational ages, we asked them to estimate the prevalence of cerebral palsy (CP) in 5-year-old to 8-year-old survivors among infants born weighing less than 1000 g. The possible responses were 10%, 15%, 25%, and 40%. In this birth weight range, actual rates of cerebral palsy range from 8% to 11%;[7-10] we classified 10% or 15% as correct answers.

Questionnaires were administered during a group activity where a maximum number of residents could be reached, such as a residents' teaching session. The first question was a request for consent, and if consent was refused, the blank questionnaire was collected with the others at the end of the period. The first page of the questionnaire comprised demographic information, including age, sex, religion, parental status, and years in the residency program.

Our data analysis focused on factors that were related to differences in attitudes about resuscitation. We first conducted univariate analysis of demographic factors, center of training, knowledge of outcomes, and resuscitation attitudes. The residency centers were called A, B, C, and D to preserve anonymity. To determine whether the center at which residents were training was significantly related to resuscitation decisions, we built a regression model that included the center as well as demographic characteristics about individual residents, such as sex, age of respondent, religion, year of residency training, and parental status.

Table 1. Percentages of Respondent Demographics in the 4 Centers

Demographic Category	Percentage				
	Center A	Center B	Center C	Center D	Total
Sample size, No.	43	36	27	59	165
Age 25-30, y	67	77	70	59	65
Age 30-34, y	18	12	11	17	14
Junior residents	45	44	43	48	44
Pediatric residents	58	50	48	72	60
Female	71	77	82	74	75
Canadian	76	91	93	50	76
Christian	61	67	86	37	61
Muslim	10	2	3	24	10
Jewish	6	0	3	12	6
Atheist	15	23	6	12	15
Other	8	8	3	15	8
Parents	18	14	8	27	18

RESULTS

There were 173 residents training in pediatrics and obstetrics at the 4 centers in 2002. Of these, 165 were reached (95%) and 100% of those who received the questionnaire completed the survey. There were no significant differences in sex, age, or percentage of junior and senior residents between the centers (**Table 1**). Residents in the 4 centers were of similar ages (Table 1). A total of 18% of the residents had children. Center D was more culturally diverse; more than 5 religious groups, and atheists, were represented, none representing greater than 40% of the respondents. Residents in center D were more likely to have children (27% compared with 8%-18% in other groups) (Table 1) (odds of having children, 3.49; 95% confidence interval [CI], 1.57-7.74).

CENTER RESUSCITATION PRACTICES

The directors at each center described their resuscitation policies in 2002 as follows:

In center A, when infants were born at 23 and 24 weeks of gestation, parents and physicians engaged in a process of shared decision making. Infants were resuscitated if parents requested this. In 2002, 60% and 75% of infants were resuscitated in the delivery room at 23 and 24 weeks of gestation, respectively (data collected routinely by unit).

In center B, infants born at 23 weeks were not offered resuscitation. Infants born at 24 weeks were resuscitated if parents requested this. No infants born at 23

©2008 American Medical Association. All rights reserved.
Downloaded From: http://archpedi.jamanetwork.com/ on 10/08/2015

Table 2. Residents' Preference Concerning Resuscitation of Their Infant at Various Gestational Weeks by Center[a]

Week of Gestation	Mean (SD) Score				All Residents
	Center A	Center B	Center C	Center D	
23[b]	1.2 (0.4)	1.2 (0.4)	1.3 (0.5)	1.6 (0.8)	1.3 (0.6)
24[c]	1.7 (0.7)	1.8 (0.7)	1.7 (0.8)	2.4 (1.0)	2 (0.9)
25[c]	2.2 (0.8)	2.4 (0.8)	2.1 (1.0)	3 (0.9)	2.5 (0.9)
26[b]	2.7 (1.0)	2.8 (0.7)	2.6 (0.9)	3.4 (0.9)	3 (0.9)

[a] Answers were scored as: always, 4; generally, 3; exceptionally, 2; and never, 1. Scores were compared between the 4 training centers A, B, C, and D using the Kruskal-Wallis test.
[b] $P < .04$.
[c] $P < .004$.

Table 3. Percentage of Respondents Who Think It Is Reasonable to Resuscitate (in the Delivery Room) a Depressed Premature Infant by Week of Gestation and Center

Week of Gestation	Percentage			
	Center A	Center B	Center C	Center D
23	0	3	0	0
24	12	22	11	39[a]
25	33	42	26	69[b]
26	51	86	56	80
27	81	94	70[c]	90
28	98	97	93	98

Abbreviations: CI, confidence interval; OR, odds ratio.
[a] For 24 weeks of gestation, OR (95% CI) for center D responses was 3.40 (1.60-7.21).
[b] For 25 weeks of gestation, OR (95% CI) for center D responses was 4.63 (2.30-9.26).
[c] For 27 weeks of gestation, OR (95% CI) for center C responses was 0.27 (0.10-0.74).

weeks, and the majority of infants born at 24 weeks, were resuscitated in 2002, according to the unit director.

In center C, infants born at 23 and 24 weeks of gestation were not offered resuscitation.

In center D, when infants were born at 23 and 24 weeks of gestation, parents and physicians engaged in a process of shared decision making. Infants were resuscitated if parents requested this. In 2002, 75% of infants born at 23 weeks and 100% of infants born at 24 weeks were resuscitated (data collected by unit).

RESUSCITATION PREFERENCES OF RESIDENTS

When asked whether they would want their own infant resuscitated at various gestational ages, 3% of residents ("always" or "generally") said yes for an infant born at 23 weeks, 23% for an infant born at 24 weeks, 50% for an infant born at 25 weeks, and 65% for an infant born at 26 weeks. There was a wide range of responses between university residency programs A, B, C, and D, as shown by the mean scores in **Table 2**. At center D, a greater proportion of residents favored resuscitation at each gestational age than at the other centers (odds ratio [OR] compared with the remaining sites at 23 weeks, 12.0; 95% CI, 1.42-100.0; OR at 24 weeks, 4.58; 95% CI, 2.2-9.8; OR at 25 weeks, 2.8; 95% CI, 1.6-4.4; OR at 26 weeks, 1.75; 95% CI, 1.01-3.54); at center C, the fewest residents would resuscitate, with residents at centers A and B being slightly more willing to resuscitate. Then we asked about preferences if the infant was born to a best friend or sister rather than to themselves; there were no differences in the residents' recommendations.

THRESHOLD OF RESUSCITATION FOR A DEPRESSED PRETERM INFANT

A total of 75% and 44% of residents did not consider resuscitation reasonable for a depressed infant born at 24 and 25 weeks' gestation, respectively. Residents considering whether resuscitation was appropriate for a depressed infant at 24 weeks' gestation varied between 11% and 39% between centers, at 25 weeks between 26% and 69%, at 26 weeks between 51% and 86%, and at 27 weeks between 70% and 94% (**Table 3**); the threshold for resuscitation differed markedly from center to center.

A greater number of residents also believed resuscitation to be appropriate at 24 weeks' gestation in center D (OR for center D compared with the remaining centers, 3.40; 95% CI, 1.6-7.2). Fewer pediatric residents in center C believed it appropriate to resuscitate a depressed premature infant between 25 and 27 weeks' gestation (OR at 25 weeks, 0.33; 95% CI, 0.13-0.83; OR at 26 weeks, 0.45; 95% CI, 0.19-0.98). Even at 27 weeks' gestation, fewer residents in residency program C would resuscitate (OR, 0.27; 95% CI, 0.10-0.74). At 28 weeks' gestation, there was no difference between the centers, as more than 93% of residents would resuscitate in every center (Table 3).

We entered all the variables into a multiple regression analysis to see whether the centers remain statistically significant after correcting for the other variables. The residents' threshold for resuscitation of a depressed infant was not related to age of respondents, years of training, religion, sex, or whether they had children. The center of training was the only factor related to willingness to resuscitate at 24, 25, 26, and 27 weeks. For example, the adjusted OR for wishing to resuscitate at 25 weeks' gestation in center D was 4.6 (95% CI, 2.3-9.3), and at 24 weeks it was 3.4 (95% CI, 1.6-7.2).

CP PREVALENCE IN EXTREMELY LOW-BIRTH-WEIGHT INFANTS

A total of 53% of residents thought the prevalence of CP was 25% or 40% in this population. Knowledge of CP prevalence did not increase substantially with year of training. Of first year residents, 49% estimated the prevalence correctly, compared with 55% of residents in years 4 and 5. Estimates of the prevalence of CP were not related to age, sex, religious beliefs, or parental status. They were only significantly related to the center. A higher percentage of residents who trained at centers B and C overestimated the prevalence of CP than at centers A and D (Table 3). For example, 63%

©2008 American Medical Association. All rights reserved.
Downloaded From: http://archpedi.jamanetwork.com/ on 10/08/2015

Table 4. Residents' Knowledge of Cerebral Palsy Rates Among Preterm Neonates by Center[a]

Estimate of Cerebral Palsy Prevalence	Percentage				OR of Lowest Center vs Remainder (95% C I)	OR of Highest Center vs Remainder (95% C I)
	Center A	Center B	Center C	Center D		
40%	5	25	22	8	0.25 (0.06-1.1)	2.79 (1.09-7.2)
25%	44	47	44	29	0.51 (0.26-1.0)	1.4 (0.7-2.9)
15%	21	8	26	37	0.73 (0.33-1.6)	1.4 (0.7-2.8)
10%	9	0	11	20	0.74 (0.68-0.82)	3.8 (1.4-10.2)
Incorrect estimate	49	72	67	37	0.39 (0.20-0.77)	2.5 (1.2-5.5)

Abbreviations: CI, confidence interval; OR, odds ratio.
[a] Percentages of respondents according to center of training with responses to the question: "What is the prevalence of cerebral palsy in infants born weighing less than 1000 g when examined at 5 to 8 years of age?"

of residents had a correct answer in center D compared with 28% and 33% in centers B and C, respectively (**Table 4**).

Residents who answered that the prevalence of CP was 10% were much more likely to want their own infant resuscitated at 24 and 25 weeks' gestation, and to want to resuscitate a depressed infant born at 24 or 25 weeks, compared with residents who answered that CP prevalence was 40% (**Figure**). A priori we had decided to divide the answers into 2 groups: 10% or 15%, and 25% or 40%. The OR for wanting to resuscitate their own infant born at 24 weeks was 0.37 (95% CI, 0.18-0.78) among those who incorrectly placed the percentage too high, compared with the others; at 25 weeks the OR was 0.57 (95% CI, 0.30-0.97).

We entered all the variables into a multiple regression analysis to see whether the center remains statistically significant after correcting for the other variables. The residents' estimation of CP rates in extremely low birth weight infants was not related to age of respondents, years of training, religion, sex, or whether they had children. The center of training was the only factor related to inaccurate estimation of CP, with centers A and D having a greater number of correct answers, and being less likely to estimate CP as 40% (OR for an answer of 40% at centers A and D compared with B and C, 0.11; 95% CI, 0.03-0.71).

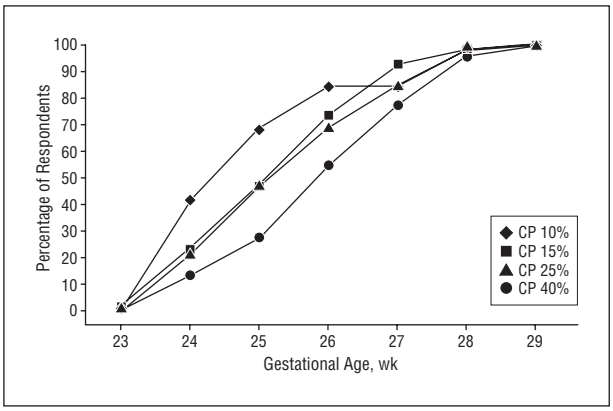

Figure. Percentage of residents who would resuscitate at each gestational age depending on answers to the question of prevalence of cerebral palsy (CP) in extremely low-birth-weight infants. $P < .05$ at 24, 25, and 26 weeks between CP estimates of 10% vs 40%.

COMMENT

The purpose of this study was to analyze the relationship between prevailing resuscitation practices at different centers and the knowledge and attitudes of the residents who were being trained. Our first significant finding was that, between the 4 centers we studied, there were differences in prevailing resuscitation practices. In 2002, in 2 out of 4 university centers, resuscitation was routinely offered at 23 and 24 weeks' gestation. In the other 2 centers, resuscitation was either never offered or discouraged at 23 and 24 weeks' gestation.

Our second finding is that residents' attitudes at the different centers were related to the prevailing practices at those centers. Where resuscitation of infants born at 23 and 24 weeks was routine, residents were more likely to favor resuscitation; conversely, where resuscitation was not offered, residents were far less likely to favor resuscitation. Because this was a cross-sectional survey, we could not say whether the attitudes of residents shifted over time, so we do not know whether residents selected programs whose practices were most consistent with their own values, or whether those values were shaped by the practices they observed.

Although we only studied residents in the province of Quebec, this restriction in the geographic extent of the study was felt to reduce some of the other variations between centers that might be present if a larger number of universities had been included. Three of the 4 universities have residents that are primarily French-speaking and mostly originally from Quebec; the other is mainly English-speaking, with a larger proportion of residents who are from outside of Quebec. The 3 French-speaking universities had very similar respondent demographics, but had different approaches to the resuscitation of extremely preterm infants, and significantly different responses to our questions. Thus, even within a geographically restricted area, major differences between training centers exist. Furthermore, our methodology having a response rate of nearly 100% allows for the elimination of response bias, which is always a major limitation of postal surveys.

A third interesting finding is that there were also differences in the residents' knowledge of prognosis for extremely premature infants. Clearly, CP is not the only long-term disability among formerly preterm infants.

©2008 American Medical Association. All rights reserved.
Downloaded From: http://archpedi.jamanetwork.com/ on 10/08/2015

Developmental delay, learning disabilities, hearing loss, etc, occur with an elevated frequency among these children. The question focused on CP because it is consistently and clearly reported and is relatively stable between studies.[2-4] Residents in the 4 training centers were not well informed about this outcome, although those in centers where resuscitation was more prevalent at 23 and 24 weeks' gestation were better informed. Furthermore, these differences in knowledge were related to differences in resuscitation practices, with center D having the most correct answers, centers B and C the least, and center A having an intermediate number. Knowledge of outcomes and center of training were more influential than age, sex, or religious beliefs.

We had a priori decided to pool the results of the CP knowledge question into 2 groups. Examining the data after collection showed that there was little difference in the resuscitation threshold between those who estimated CP prevalence as 15% and those who estimated it at 25%, the main differences being at estimates of 10% and 40% (Figure). However, changing the data analysis plan after viewing the results was not felt to be appropriate. We have also performed numerous comparisons, which increases the risk of a type 1 error, and warrants caution in interpretation. However, the results were consistent with our hypotheses, and always in the same direction, which increases our confidence in their reliability.

The resuscitation decision that residents would recommend to a family or close friend were almost identical to the decisions made when they thought about a patient or about their own infant. This may be in part because of an attempt to "not do to others what you would not want done to yourself," or because close family and friends often share the same values.

These data suggest that each center develops its own ethos regarding resuscitation. That ethos then shapes the way the physicians understand epidemiological data, the way that they would make decisions for themselves or their family, and the recommendations that they would make for patients. This consistency between personal decisions and recommendations to parents could be considered compassionate and empathetic, but is not necessarily value-neutral.

One question raised by this study, and other studies of practice variation in neonatal resuscitation, is whether such variation is somehow more tolerable with regard to extremely premature infants than it might be for other children with life-threatening disease. We suspect that there is less practice variation, for example, in the institution of treatment of children with cancer or severe trauma. If that is the case, it would suggest that decisions about premature infants reflect more complex motivations than solely an assessment of the child's best interests.[11]

This is a questionnaire study that has multiple limitations. We do not know if opinions would translate into actions if the resident were in the specific situation. Answering a questionnaire is clearly very different than having to make a decision for a living infant, but there was no other way to know caregivers' opinions without placing them in the actual situation. This study was done in a single Canadian province and although we explain our reasoning for doing this above, the results might not reflect the attitudes of other groups of residents.

Previous investigators have shown that misapprehension by both obstetricians and pediatricians regarding outcomes of extremely preterm infants affects their willingness to actively treat mothers and their infants.[12-16] Haywood et al[14] have shown that pediatricians who are the most pessimistic about the outcomes of extremely preterm infants are the least likely to say they would actively resuscitate. This underestimation of a good outcome appears to lead to variations in patterns of real-world practice and of outcomes.[17] None of the previous studies have questioned residents; one might have hoped that residents would be better informed and more consistent in their attitudes, but this was clearly not the case.

This study does not explain why residents have these attitudes to intervention for extremely preterm infants. We did not ask them specifically, but perhaps they are following the lead of official statements[3-5] that usually claim that low survival rates and a high frequency of disability are justifications for having a limit to intervention, although we have questioned this reasoning.[11] Further research is needed to continue exploring these avenues. Our research confirms that our experiences and the environment in which we work form our opinions, values, and possibly our ethical framework. It is important to acknowledge the complexity of caring for infants in high-risk situations, to regularly question our values, to be critical of our rules of conduct, and to work with the uncertainty of ethical issues instead of blindly accepting policies. Only in doing so can we show residents to do likewise.

Accepted for Publication: October 18, 2007.
Correspondence: Keith J. Barrington, MB, ChB, Royal Victoria Hospital, 687 Pine Ave W, Montreal, Quebec, H3A 1A1, Canada (keith.barrington@mcgill.ca).
Author Contributions: *Study concept and design:* Janvier, Barrington. *Acquisition of data:* Janvier, Barrington, Deschênes, Couture, Nadeau. *Analysis and interpretation of data:* Janvier, Barrington, Lantos. *Drafting of the manuscript:* Janvier. *Critical revision of the manuscript for important intellectual content:* Janvier, Barrington, Deschênes, Couture, Nadeau, Lantos. *Statistical analysis:* Barrington. *Administrative, technical, and material support:* Janvier, Nadeau, Lantos. *Study supervision:* Janvier, Barrington, Lantos.
Financial Disclosure: None reported.

REFERENCES

1. Vohr BR, Wright LL, Dusick AM, et al. Center differences and outcomes of extremely low birth weight infants. *Pediatrics*. 2004;113(4):781-789.
2. Lee SK, McMillan DD, Ohlsson A, et al. Variations in practice and outcomes in the Canadian NICU network: 1996-1997. *Pediatrics*. 2000;106(5):1070-1079.
3. MacDonald H; Committee on Fetus and Newborn of the American Academy of Pediatrics. Perinatal Care at the Threshold of Viability. *Pediatrics*. 2002;110 (5):1024-1027.
4. The Canadian Pediatric Society and the Society of Obstetricians and Gynaecologists of Canada. Management of the woman with threatened birth of an infant of extremely low gestational age. *CMAJ*. 1994;151(5):547-551, 553.

©2008 American Medical Association. All rights reserved.
Downloaded From: http://archpedi.jamanetwork.com/ on 10/08/2015

5. The Nuffield Council on Bioethics. Critical care decisions in fetal and neonatal medicine: ethical issues. http://www.nuffieldbioethics.org/go/ourwork/prolonginglife/publication_406.html.
6. Truog R. Revisiting "Doctor, if this were your child, what would you do?". *J Clin Ethics*. 2003;14(1-2):63-67.
7. Saigal S, Rosenbaum P, Hattersley B, Milner R. Decreased disability rate among 3-year-old survivors weighing 501 to 1000 grams at birth and born to residents of a geographically defined region from 1981 to 1984 compared with 1977 to 1980. *J Pediatr*. 1989;114(5):839-846.
8. Lefebvre F, Gregoire MC, Dubois J, Glorieux J. Nursery Neurobiologic Risk Score and outcome at 18 months. *Acta Paediatr*. 1998;87(7):751-757.
9. Hack M, Breslau N, Fanaroff AA. Differential effects of intrauterine and postnatal brain growth failure in infants of very low birth weight. *Am J Dis Child*. 1989;143(1):63-68.
10. Teplin SW, Burchinal M. Neurodevelopmental, health, and growth status at age 6 years of children with birth weights less than 1001 grams. *J Pediatr*. 1991;118(5):768-777.
11. Janvier A, Barrington KJ. Advocating for the very preterm infant. *Pediatrics*. 2006;118(1):429-430.
12. Goldenberg RL, Nelson KG, Dyer RL, Wayne J. The variability of viability: the effect of physicians' perceptions of viability on the survival of very low–birth weight infants. *Am J Obstet Gynecol*. 1982;143(6):678-684.
13. Trudinger BJ, Boshell L. A survey of the management of premature labour by Australian obstetricians. *Aust N Z J Obstet Gynaecol*. 1987;27(3):188-195.
14. Haywood JL, Goldenberg RL, Bronstein J, Nelson KG, Carlo WA. Comparison of perceived and actual rates of survival and freedom from handicap in premature infants. *Am J Obstet Gynecol*. 1994;171(2):432-439.
15. Haywood JL, Morse SB, Goldenberg RL, Bronstein J, Nelson KG, Carlo WA. Estimation of outcome and restriction of interventions in neonates. *Pediatrics*. 1998;102(2):e20.
16. Morse SB, Haywood JL, Goldenberg RL, Bronstein J, Nelson KG, Carlo WA. Estimation of neonatal outcome and perinatal therapy use. *Pediatrics*. 2000;105(5):1046-1050.
17. Bottoms SF, Paul RH, Iams JD, et al. Obstetric determinants of neonatal survival: influence of willingness to perform cesarean delivery on survival of extremely low-birth-weight infants. *Am J Obstet Gynecol*. 1997;176(5):960-966.

Specialization in the nineteenth century was at first vehemently opposed by many in the profession who felt that it would be detrimental to the patient. Examples from the past of itinerant charlatans who specialized in pulling teeth, cutting for the stone, or treating only one kind of illness (for instance, venereal disease) caused ethical practitioners, and many lay people also, to regard with suspicion any physician who established himself to treat one group of diseases or one organ system. . . . Nevertheless, as the pressures of scientific, social, and economic factors became irresistible, specialization became an accepted fact.

—From *Medicine: An Illustrated History* by Albert S. Lyons, MD, and R. Joseph Petrucelli, MD, 1987.

©2008 American Medical Association. All rights reserved.
Downloaded From: http://archpedi.jamanetwork.com/ on 10/08/2015