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Neonatal Resuscitation Training in Ireland

Integrating Teaching and Research

A Quality of Care Initiative in Health Services Research.

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FAAP, *Sub-Board Paed Crit Care Med*

A thesis submitted for the degree of Doctorate in Medicine to the National University of Ireland, Cork

(Department of Paediatrics and Child Health, University College Cork)

Submitted August 2001

Location of research: Department of Paediatrics and Child Health

University College Cork

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To my wife, Jo-Ann Ryan

and

to Professor Gerald Cussen

Acknowledgements

> If you want something said, ask a man; if you want something done, ask a woman.
>
> *Margaret Thatcher*

Advanced resuscitation of a newborn infant in clinical practice is a team effort. Similarly teaching resuscitation skills involves a constellation of individuals who collectively guide any given student through several stages of cognitive development. In addition, implementing a national training programme can only come about through the work of many. I would like to acknowledge the contribution of some of these individuals here.

Margaret Thatcher may have been referring to women like Ms. Lisa Clarke who was the prime mover in bringing the Neonatal Resuscitation Programme (NRP, UCC) to Cork and then throughout the country. Lisa, a neonatal nurse practitioner from New York, was the first co-ordinator of the UCC sponsored Programme and was responsible for collecting the in-hospital evaluation data. Dr Aileen Malone (Lecturer, Department of Paediatrics & Child Health) was an early convert to neonatal resuscitation training and subsequently has become a leader in Paediatric Advanced Life Support (PALS) training in Ireland. The Maternity Nurse Manager of the Erinville and St Finbarr's Hospital, Ms Mary O'Brien, was a firm supporter of the programme and motivated her midwives to participate from the onset. Jo-Anne Ryan, my wife, encouraged and supported me throughout and, using her background as a neonatal nurse in Canada, was one

of the first NRP instructors. Bernadette Fitzgerald provided the secretarial support for the programme over the last few years, while Christine Duggan provided me with invaluable personal secretarial assistance.

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In addition to the women mentioned above, a few good men should also be acknowledged. This work in this thesis was made possible by a grant from the President's Fund, University College, Cork and I would like to express my gratitude to Dr Michael Mortell for his support upon my arrival on staff at UCC. Professor Peter Kearney encouraged me and provided valuable advice. Dr Sami Ahmed and Dr Hamza Abdullah were both former NRP co-ordinators and collected the outreach evaluation data. They have made significant contributions to Irish neonatology by their teaching and training. Finally, I would like to thank the directors of the Neonatal Resuscitation Program (American Heart Association and the American Academy of Pediatrics) for their generous cooperation and help in allowing transfer of this programme into Ireland.

This thesis was written in UCC under the supervision of Professor Ivan Perry, Professor of Epidemiology and Public Health, to whom I am indebted. The text of this thesis was composed on Windows 98, Microsoft Word 2000. Copies are available on a disc on request.

Scientific presentations pertaining to this thesis.

1. Ryan CA, Clark, L, Malone A,J, Ahmed, S. The Introduction and Evaluation of a Neonatal Resuscitation Programme into Ireland. Podium Presentation, Irish American Paediatric Society, Vermont, U.S.A.. October 1995.

2. Clarke L. Ryan CA, Malone A. Neonatal resuscitation Program in Ireland. American Academy of Pediatrics Meeting: Poster presentation: Boston , U.S.A, Oct 1996

3. Ryan CA, Clark L, Malone, A, Ahmed, S. The Introduction and Evaluation of a Neonatal Resuscitation Programme into Ireland. Podium Presentation, Rotunda Hospital, Dublin, September 1995

4. Ahmed S, Ryan CA: The need for a neonatal resuscitation program in Ireland. Podium Presentation, Irish Perinatal Society Winter Meeting; Tralee General Hospital, Tralee, October, 1996. Winner; Best Presentation Award

5. Abdullah A, Ryan CA.: Dissemination and evaluation of a neonatal resuscitation program in Ireland. Podium Presentation, Irish Perinatal Society Winter Meeting; Tralee General Hospital, Tralee, October, 1996.

6. Mohammed I, Ryan CA. Mode of Deaths in a Neonatal Intensive Care Unit. Poster presentation. Irish American Paediatric Meeting. September 1998. Killarney

7. Ryan CA, Ryan F, Keane L, Hegarty H. Trend analysis and socio-economic differentials in infant mortality in the Southern Health Board, Ireland (1988-1998). Irish Paediatric Association, Wexford, March 1999

8. Ryan CA, Ryan F, Keane L, Hegarty H. Trend analysis and socio-economic differentials in infant mortality in the Southern Health Board, Ireland (1988-1998). Irish American Pediatric Association; San Francisco, U.S.A. September 1999

9. Clark L, Byrne H, Ryan CA. ABC Don't Ever Forget the Glucose: an evaluation of the introduction of the STABLE® programme into Ireland. Accepted for presentation at the Irish American Paediatric Association Meeting; Kentucky, September 2001

10. Ryan CA. The Breath of Life: a History of Newborn Resuscitation. Invited speaker: the Bill Kidney Lecture. Irish American Paediatric Association Meeting; Kentucky, September 2001

Peer reviewed publications related to this thesis

1. Ryan CA, Abdullah H, Ahmed S, Malone A, Clarke L. Dissemination and evaluation of the AAP/AHA neonatal resuscitation program in Ireland. Ir Med J 1998. 91:51-52. ***(A descriptive, quality assurance, evaluation of almost 500 providers trained in NRP, both locally in UCC and by out-reach educational initiatives: Chapter 8).***

2. Ryan, CA, Clark, L, Malone, AJ, Ahmed, S. Effects of a structured Neonatal Resuscitation Programme on delivery room practices. Neonatal Network 1999;18(1):25-30 ***(Interrupted time series comparing actual clinical evaluation of infant resuscitation before and after the introduction of the NRP: Chapter 4).***

3. Ryan CA, Ryan F, Keane L, Hegarty H. Trend analysis and socio-economic differentials in infant mortality in the Southern Health Board, Ireland (1988-1998). Ir Med J 2000; 93;7:204-6. ***(Local and national infant mortality data over the last 10 years were studied to determine if a structured NRP had an impact in terms of infant mortality: Chapter 5).***

4. Healy J, Ryan CA. Normal developmental outcome following prolonged exposure and hypothermia in a newborn infant. *Ir Med J* 1998;91:6:216-7.

(Resuscitation of an abandoned hypothermic baby; Preface: Historical Aspects of Newborn Resuscitation)

5. Ryan CA, Byrne P, Kuhn S, Tyebkhan J. No resuscitation and withdrawal of therapy in a Canadian neonatal and pediatric intensive care unit. *J Pediatr*, 1993,123;534-538. ***(An examination of end of life decision making in a Canadian NICU and PICU, that led to a similar examination of practices in Ireland; Chapter 6)***

6. Ryan CA. No resuscitation orders and withdrawal of therapy in paediatric intensive care units. *Acta Paediatr*. 1998 Jul; 87(7): 721-722.***(An invited commentary on international practices of end of life decision making in paediatrics; Chapter 6)***

7. Ryan CA, Finer NN. Changing attitudes and practices regarding local analgesia for newborn circumcision. *Pediatrics* 1994, 94:230-233.***(A study using educational techniques to change attitudes and thus clinical practice. This paper directed my interests in overcoming barriers and to discover ways to engender change in resuscitation training in Ireland; Chapters 8 & 9)***

Educational initiatives developed as a result of this thesis

1. A newsletter (***Resuscitation News***) has been circulated to all NRP instructors and senior administrators in Ireland on a quarterly basis since January 1996. Approximately 100 copies are distributed nationally per issue. To date there have been 9 issues published. The editorial committees for this newsletter include the author, Dr. Aileen Malone and Dr Hamza Abdullah. The newsletter is produced by Ms Bernadette Fitzgerald, the NRP secretary.

2. As a direct result of the NRP initiative, the author instigated the first neonatal stabilisation and transportation programme into Ireland in June 2000. **STABLE®** is an educational mnemonic that stands for *Sugar, Temperature, Airway, Breathing, Laboratory and Emotional Support.* This course was developed by Kris Karsten, in Salt Lake City, Utah. The European première of this course was held in UCC in June 2000, the first STABLE Course outside North America.

3. *North-South collaboration:* The DOH&C and the Northern Ireland Ministry of Health have funded an All-Ireland initiative (£70,000 from the DOH&C to the author; £30,000 from the Northern Ireland Ministry of Health to Dr John Jenkins, Neonatologist, Antrim

Hospital) to develop and propagate a joint neonatal resuscitation and transportation programme in both jurisdictions. This will consist of a basic resuscitation Programme such as NRP along with the STABLE® stabilisation and transportation programme.

4. Ryan CA, Barrington KJ. Structured resuscitation courses for reducing neonatal morbidity and mortality. Protocol accepted for *Canadian Neonatal Cochrane Review*. November 2000.

Courses attended in the preparation for this thesis

1. Workshop: Writing systematic reviews. Harris Manchester College, Oxford, 15 & 16 April 1999
2. American Academy of Pediatrics NRP Annual Meeting: Boston , U.S.A, Oct 1996
3. Launching the NRP Update: Chicago, U.S.A. Oct 2000. The new evidenced based guidelines and new teaching technologies for teaching NRP were presented and evaluated.
4. Developing a Teaching Portfolio: Nora Lyons; National University of Ireland, Cork, University College Cork, June 2001

List of abbreviations

AAP	American Academy of Pediatrics
AHA	American Heart Association
CPR	Cardiopulmonary resuscitation
CNS	Clinical Nurse Specialist
DOHC	Department of Health & Children
IMR	Infant mortality rate
ICU	Intensive Care Unit
MAS	Meconium aspiration syndrome
NICU	Neonatal Intensive Care Unit
NMR	Neonatal mortality rate
NRP	Neonatal Resuscitation Programme
PALS	Paediatric Advanced Life Support
RCT	Randomised controlled trial
SHO	Senior House Officer
STABLE®	Neonatal Stabilisation and Transportation Programme

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Summary

Resuscitation training is a vital area of education that could have a significant impact on patient outcome. This is especially true in the newborn period where inexperienced, inadequate or inappropriate resuscitation responses could affect the entire life span of a newborn infant. In addition, neonates are more often subject to asphyxia and are far more likely to be in need of resuscitation than any other age group. The World Health Organization (1995) estimates that every year there are one million neonatal deaths attributable to birth asphyxia.

Due to the unique aetiology and pathophysiology of neonatal arrests, successful resuscitation requires the application of knowledge and skills that require special training. The purpose of resuscitation training is to transfer the science of resuscitation into classroom performance, with the objective of transferring knowledge and skills into clinical practice. The ultimate goal of the process is to improve neonatal survival and decrease handicap.

While it is the responsibility of the Health Services to provide the necessary training for its employees, it is the function of Universities to design, develop, evaluate and promote effective educational programmes that improve patient care.

This thesis is therefore concerned with the status of newborn resuscitation training and education in Ireland. It describes the introduction and evaluation of a structured Neonatal Resuscitation training Programme into maternity hospitals in Ireland under the auspices of UCC, as an example of a quality of care initiative in Health Services Research, in the interface between the health services and the university. The integration of teaching and research into professional practice and an inquiry into such is also explored.

During the course of this thesis, a National Neonatal Resuscitation Programme has been established. Almost 2000 providers have been trained and certified throughout the country. In addition, a network of Instructors have has been trained and supported by the programme in most maternity sites in Ireland.

While this thesis demonstrates the benefits of educational interactions between the University and allied Health Institutions, the need for ongoing multi-disciplinary collaboration in health education and training is evident from the impediments to resuscitation training that are described in this thesis. The difficulties and restraints in designing and performing proper randomised controlled trials of resuscitation training and the ongoing tensions between research ideals and actual clinical practice are also explored.

In the preface, a historical outline of newborn resuscitation is presented. In chapter 1, the need for a structured Neonatal Resuscitation Programme is deliberated and the aims and objectives of this project are outlined. In chapter 2, the problem of inadequate training in neonatal resuscitation is more clearly illustrated by a national survey of neonatal resuscitation preparation, protocols, training and staff availability. In chapter 3, a systematic review of the literature on neonatal resuscitation training is presented, highlighting the limited number of randomised controlled studies in this area. In chapter 4, a controlled study evaluating the effects of a structured Neonatal Resuscitation programme on clinical performance and immediate neonatal outcomes is presented. In chapter 5, local and national infant mortality data over the last 10 years were studied to determine if a structured NRP had an impact in terms of infant mortality.

"I wish someone would bring a one-armed expert, so the s.o.b. couldn't say: "But on the other hand..." Thus spoke a wistful Harry Truman when faced with one crisis too many. Modern resuscitation and stabilization developments have been spectacularly successful, but have also given rise to their share of dilemmas. These ethical dilemmas are the focus of Chapter 6, by means of an examination of how babies die in an NICU.

In chapter 7, a descriptive, quality assurance, evaluation of almost 500 providers who passed the NRP (UCC) is presented. In chapter 8, the barriers to resuscitation training in Ireland are investigated by a phenomenological

investigation of a relevant focus group and some solutions to overcoming these barriers are discussed. In chapter 9, the process of introducing change and monitoring the changes in attitudes regarding neonatal resuscitation education are explored.

Teaching resuscitation training has had an impact on my own teaching philosophy. In chapter 10, I will be addressing the formative components of teaching the NRP Provider and Instructor courses and will demonstrate how teaching these courses have contributed to my personal development as a teacher.

Finally, in chapter 11, the results of the thesis studies are summarized and recommendations of the author for the future development of neonatal resuscitation training in Ireland are outlined. These recommendations have been adopted by the Board of the Faculty of Paediatrics, Royal College of Physicians of Ireland, as a blueprint for neonatal resuscitation standards and guidelines in Irish maternity hospitals.

The breath of life: historical aspects of newborn resuscitation



Figure 1: A newborn baby

> And he went up, and lay upon the child, and put his mouth upon his mouth, and his eyes upon his eyes, and his hands upon his hands: and stretched himself upon the child; and the flesh of the child waxed warm. Then he returned, and walked in the house to and fro; and went up, and stretched himself upon him: and the child sneezed seven times, and the child opened his eyes. *II Kings 4:34-35*

Most reviews of the history of resuscitation begin with this vivid description of mouth-to-mouth resuscitation described in the Old Testament approximately 3000 years ago. A child of a Shunemite couple complained of a headache, apparently died and was revived by the prophet Elisha, Hebrew for *God is deliverance*. (In retrospect, with the history of headache and the rapid response, one wonders whether the child simply had a seizure). The first Biblical reference to *newborn* resuscitation occurred in Exodus (1:15-17), when the Hebrew midwife Puah *"breathed into the baby's mouth to cause the baby to cry"*.

According to the Talmud, infants who do not cry at birth *"should be shaken to-and-fro and rubbed against placenta"* (Raju 1999).

Hippocrates was the apparently first to describe tracheal intubation cicra 400 BC. However, the first report of an experimental intubation of the trachea was by the Muslim physician Avicenna (Abu Ali Al-Hussain Ibn Abdallah Ibn Sinna, 980-1037) who wrote *"When necessary, a cannula of gold, silver or another suitable material is advanced down the throat to support inspiration."* In 1543, the Flemish anatomist Andreas Versalius described the performance of a tracheotomy in an animal. He describes the relief and pleasure occasionally felt by the present day neonatologist when he said: *"I have not learned anything more pleasing than... when the lung, long flaccid, has collapsed, the beat of the heart and arteries appear wavy, creepy, twisting. But when the lung is inflated, it becomes strong again and swift and displays wondrous variations."*



(Figure 2: Wood cutting of Andreas Versalius)

Childbirth has always been a dangerous time for both mother and child. Henry VIII, (who was said to have *never spared a man in his anger nor a woman in his lust*), had no doubt about his priorities when he said of one of his six wives, Jane Seymour, in labour: *"Save the child by any means, for another wife can be found."* The child in question became Edward VI, whose mother died 12 days after his birth, which many called a caesarean murder.

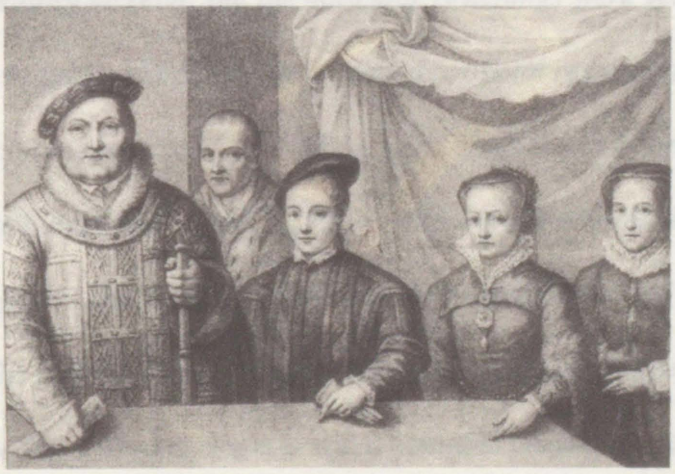


Figure 2: Henry VIII with his children Edward, Mary and Elizabeth (and the court jester, Will Sommers, in the background; IOS, June 2001)

Neonates are particularly prone to hypothermia. A successful case of "revivification" of a hypothermic newborn infant, was described by Waterman in 1883 as follows: *Mr. E___ called upon me during the winter of 18__, to obtain a death-certificate for a child of seven months' gestation. I expressed a desire to see the child, and promised to visit him during the day. A midwife had assisted during the delivery. It was a cold stormy day and 1 P.M. before I arrived at Mr. E___'s house. He lived in a low basement. Mr. E___ was a Hebrew, and*

according to Hebrew rites, the child had been laid with a little straw upon the ground, and covered with a light black shawl. It had thus been lying since 5 A.M. As I was examining the child, I could detect some slight twitching movement over the region of the heart. I watched attentively, and I observed the movement again. I had the child removed from the ground and placed upon a pillow on the table. The child was as cold as ice but not rigid. I could detect no heart's-sound, nor any respiratory murmur, but the muscular twitchings were very evident. I immersed the child in a hot bath, and initiated artificial respiration. Twenty minutes passed in this seemingly hopeless work. Then the child opened its eyes. A little more work and respiration began, laborious and interrupted at first, more normal by degrees. The heart's action came up in good style, and a human life was saved! The child thus saved is now one of the most accomplished violinists in this city (New York). Hypothermia is still a potential hazard encountered by the newborn. Over a hundred years later, a considerably more advanced resuscitation was required for a hypothermic newborn infant, found abandoned under leaves in a graveyard in West Cork, 19 hours after birth (Healy & Ryan 1998).

Norman Mailer (1998) describes the unorthodox revival at birth of another baby boy, delivered at 11:15 pm in the city of Malaga, October 25th; 1881. "He *came out stillborn. He did not breath, neither did he cry. The midwife gave up and turned her attention to his mother. If it had not been for the presence of his uncle, Dr. Salvador Ruiz, the infant might never have come to life. Don Salvador*

however, leaned over the child and exhaled cigar smoke into its nostrils. Picasso stirred. Picasso screamed. A genius came to life. His first breath must have entered on a rush of smoke, searing to the throat, scorching to the lungs and laced with the stimulants of nicotine. It is not unfair to say that the harsh spirit tobacco is seldom absent from his work." Mailer proposes that Don Salvador could have been offering the infant Picasso that whiff of smoke with the message: "Wake up, *nino*, life in these parts will seldom smell better than this!" At least the newborn artist did not suffer the indignity of fumigation by the introduction of tobacco smoke into the rectum, another questionable resuscitation manoeuvre first practiced by North American natives. It was not until 1811 that fumigation was abandoned after research by Benjamin Brodie demonstrated that four ounces of tobacco would kill a dog and one ounce would kill a cat (Keith 1909).

It took centuries of development in physiological concepts and technology for the evolution of a rational approach to resuscitation, of both adults and the newborn. Very early in history, people realized that the body became cold when lifeless and connected heat with life. In order to prevent death from taking the person, the body was warmed. Warm ashes, burning excrement, or hot water were placed directly on the body, in various attempts to restore life. Yelling, slapping, even whipping, tickling the throat with a feather and waving strong salts, were also used to attempt to resuscitate. Another resuscitation method comprised placing the victim across a trotting horse. It was thought that the rhythmic compressions

of the victim's chest as the body bounced would restore breathing. Sometimes this method was modified by replacing the horse with a barrel. The patient was placed over the barrel and rolled back and forth to compress and release pressure on the thorax. At times the victim was placed inside the barrel that was then rolled.

Most ancient physicians and midwives did know that stimulation and expansion of lungs was needed to revive the "apparently dead" newborn, but the means of providing these 'therapies' varied from brutal shaking, hitting, swinging, electrocuting, hanging upside-down, applying gentle pressures or squeezing of the chest and tongue stretching (Raju 1999). Even in recent times, techniques such as intragastric oxygen (Akerren & Furstenberg 1950, Cooper et al 1960, Coxon 1960), the dropping of respiratory stimulants on the tongue (Barrie et al 1962, Daniel et al 1966, Godfrey et al 1970), Eve's Tilting method (Eve 1932 & 1943, Handley & Handley 1951, Hemingway & Neil 1944), hyperbaric oxygen (Cross et al 1964, Hutchinson et al 1963) and rapid hypothermia (Westin et al 1959, Cordey et al 1973), were widely advocated.

Man has always been fascinated by technology and various devices to aid resuscitation were developed with varying degrees of success. Paracelsus (1493 – 1541) first reported the use of mechanical devices to support ventilation in drowned victims: he inserted bellows into their nostrils and blew into their lungs. French researchers developed a resuscitation device for newborn resuscitation,

called the Aerophore Pulmonaire, in the late 1800s. This device, which was similar to a modern bulb oropharyngeal aspirator, was inserted into the mouth and the bulb was alternately compressed and released, giving rise to a form of positive pressure ventilation (Hutchison 1975). Other instruments for augmented ventilation included Alexander Graham Bell's negative pressure cuirasse, which might have had a potential use in the respiratory management of the newborn. Bell's interest in ventilation arose following the premature death of one of his own children in infancy. (His concept occupied my own and others attention in the 1980's; Hayek et 1986; Samuels & Southall 1989). However, Bloxsom's positive pressure air lock, a modified pressure cooker according to Raju (1999), was a positively dangerous instrument.

Despite it's ancient roots, mouth-to-mouth breathing did not receive official recognition until the mid-eighteenth century as a method of resuscitation. Dr William Tossach described the simple manoeuvre of mouth-to-mouth resuscitation in 1732, which he used to save a miner's life after a fire. The practice was immediately discounted by Hunter, an enormously influential obstetrician, as a "vulgar practice", but was resurrected by Dr John Fothegill, the eminent London physician, following his presentation at the Royal Society in 1745. He recognised that mouth-to-mouth was better than using bellows for reasons that are still relevant for the by passer rescuer today and dissuaded his colleagues from the bellows with the following arguments: *" First, as the bellows may not be at hand. Secondly as the lungs of one man may bear, without*

injury, as great a force as those of another man may exert, which by the bellows cannot always be determined. Thirdly, the warmth and moisture of the breath would more likely to promote circulation, than the chilling air forced out of the bellows".

As a result of Fothegill's paper, a society for the recovery of Drowned Persons was formed in Amsterdam in 1767 and was followed by the Royal Humane Society in London in 1774. These societies formalized education on resuscitation, held teaching seminars and awarded medals for excellence. (One was inscribed: *Hoc pretium cive servato tulit; Awarded for having saved the life of a citizen*). Some of the recommendations endorsed by these societies include warmth, mouth-to-mouth inflation with compression of the chest and abdomen, introducing tobacco smoke into the rectum, electrical stimulation, and induction of vomiting.

The discovery of oxygen (Priestly, 1733-1804 and Lavoisier, 1743-1794) and later carbon dioxide, raised considerable controversy about the wisdom of using expired air in mouth-to-mouth resuscitation. As a result in 1782, the Royal Humane Society changed its recommendations from mouth-to-mouth inflations back to the use of bellows. In a texbook, published in Dublin in 1842, Evanson recommended mouth suction, and then mouth-to-face inflation in newborn resuscitation. However, this ancient technique still did not catch on, because of the concerns of the Humane Society.

Charles Kite, another London physician, was a vigorous proponent of resuscitation drowning victims by ventilating through an endotracheal tube, writing in 1788: *"the crooked tube, bent like a male catheter... should be introduced into the glottis, through the mouth or one nostril; the end should be connected to a blow pipe"*. He was also responsible for world's first "defibrillator", used on a three-year old child, who was taken for dead after falling out of a window (Kite1788). *"With the consent of the parents he very humanely tried the effects of electricity. Twenty minutes had at least elapsed before he could apply the shock, which he gave to various parts of the body without apparent success; but at length, upon transmitting a few shocks through the thorax, he perceived a small pulsation; soon after the child began to breath though with great difficulty. In about 10 minutes she vomited. A kind of stupour remained for some days but the child was restored to perfect health in about a week"*.

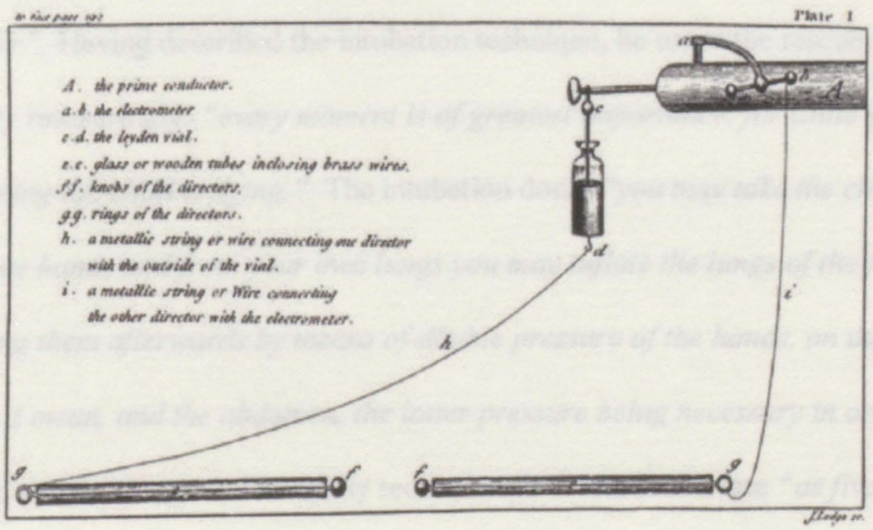


Figure 3: Charles Kite's electrical shock machine

Throughout the ages, right up to the eighteenth century, childbirth and attendance on young infants were the business of midwives, wet nurses, grandmothers, and wise old women in general. Theirs was an oral tradition. It was not until an increasing number of man-midwives, (interlopers to the midwives) invaded the lying-in room that the care of young infants was ursurped and a medical literature on the care of infants arose (Cone TE 1979).

Benjamin Pugh first developed an endotracheal tube for the resuscitation of asphyxiated neonates, in 1754. This tube consisted of an air pipe made from coiled wire, covered with soft leather. More than a half a century later in 1834, Dr James Blundell, Professor of Obstetrics, at Guy's Hospital, first described the intubation and positive pressure ventilation in neonates (Dunn 1989). *"The only mode of performing this operation effectually is by means of a small instrument, the tracheal pipe, which I think, every accoucheur should carry along with him to a labour"*. Having described the intubation technique, he urges the rescuer on, not very reassuringly: *"every moment is of greatest importance, for while you are blundering the child is dying."* The intubation done, *"you may take the child into your hands and from your own lungs you may inflate the lungs of the foetus, emptying them afterwards by means of double pressure of the hands, on the thorax, I mean, and the abdomen, the latter pressure being necessary in order to urge up the diaphragm"*. He rightly recommends a ventilation rate *"as five and twenty, or thirty respirations there ought to be in a minute, the newborn breathing faster than an adult"*. In 1829, Leroy d'Etiolles demonstrated that over

distention of the lungs by bellows could kill an animal. As a result, Blundel, discouraged the use of the bellows in neonates. Various methods of assisted ventilation such as moving the arms and pressing on the chest persisted well into the 20th century. These manoeuvres were subsequently shown to be of marginal benefit when evaluated scientifically in 1950.

In l928, Flagg rediscovered Blundel's method of digital intubation (Flagg 1928), reintroducing the concept of neonatal intubation once more. This skill was regularly practiced in New Orleans for more than 20 years in the early 1940's (Woody & Woody 1968). In some units it is said to be the preferred practice (Hancock & Peterson 1992). Digital intubation is well known in some developing countries where access to laryngoscopes is limited and a recent report showed that this technique was simple and effective leading to intubation within 7 seconds on average (Hancock & Peterson 1992). Today, it is included as a desirable skill in the UK Resuscitation Council Neonatal Life Support course manual (Resuscitation at Birth 2001). Certainly, considering the difficulties of direct vision laryngoscopy (below) prior to the invention of portable batteries and the modern laryngoscope, digital intubation would appear more convenient and less traumatic for baby and user.

Oxygen began to be used for sick newborns in the 1890's, but did not become routine for premature infants until the mid-1920's, subsequently resulting in a epidemic of blindness among premature survivors. In 1917, intragastric oxygen was introduced (Akerren & Furstenberg 1950) and used until Virginia Apgar proved that oxygen absorption from the gastrointestinal tract was negligible. Mobile oxygen tanks became routinely available by the end of the Second World War and allowed oxygen use in the delivery room.

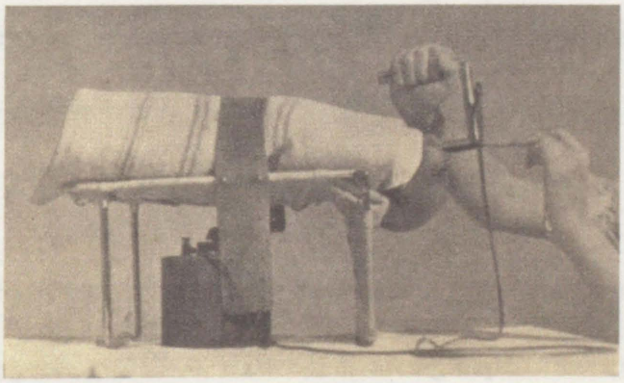


Figure 4: Endotracheal intubation of a newborn (circa 1940's), from Gibberds, A Short Textbook of Midwifery 1943;Churchill, London;504.

Up to the end of the 19th century, most of the focus was on the airway/breathing components of resuscitation. The discovery of Chloroform in 1847 and its widespread use led to many episodes of cardiac arrest in surgical theatres and the focus of resuscitation was directed at restarting the arrested heart. Not surprisingly, the response by surgeons was emergency thoracotomy and open chest cardiac compressions (Bains et al 1998). The procedure of closed chest cardiac compression had previously been described cats in 1878. Following this

report, Koenig, in Gottingen, initially recommended the use of closed chest cardiac compression in humans at a relatively low rate of 30/minute. However, his experience of using a more rapid rate of 120/minute following the cardiac arrest of a nine-year old boy, during a cleft palate repair, changed his approach. *"I went to direct compression of the heart region, and, in my excitement, I worked very fast and vigorously. The pupils suddenly constricted and when I continued at great speed, they were soon smaller, and during pauses, the slow gasping respirations started up again"*. Nevertheless, the practice of closed chest cardiac compression did not burgeon until its scientific evaluation by Kouwenhoven et al in 1960.

Two years prior to that, however, Dr Peter Safar, a pioneer in modern cardiopulmonary resuscitation, showed, in daring experiments using *curarized* volunteers, that adequate rescue ventilation with mouth-to-mouth technique was possible (Safer et al 1958, 1988, 1989; Elam et al 1958). The picture on the left shows Dr Peter Safar performing mouth-to-mouth ventilation (figure 5). Tidal volumes are monitored by a calibrated pneumograph on the chest of the volunteer. The picture on the right, taken in the 1960's, depicts Dr C. Clark (anaesthesia resident), Captain Martin McMahon, Chief Baltimore Fire Department Ambulance Service, and Dr Peter Safar, Chief, Department of Anaesthesia, Baltimore City Hospital.



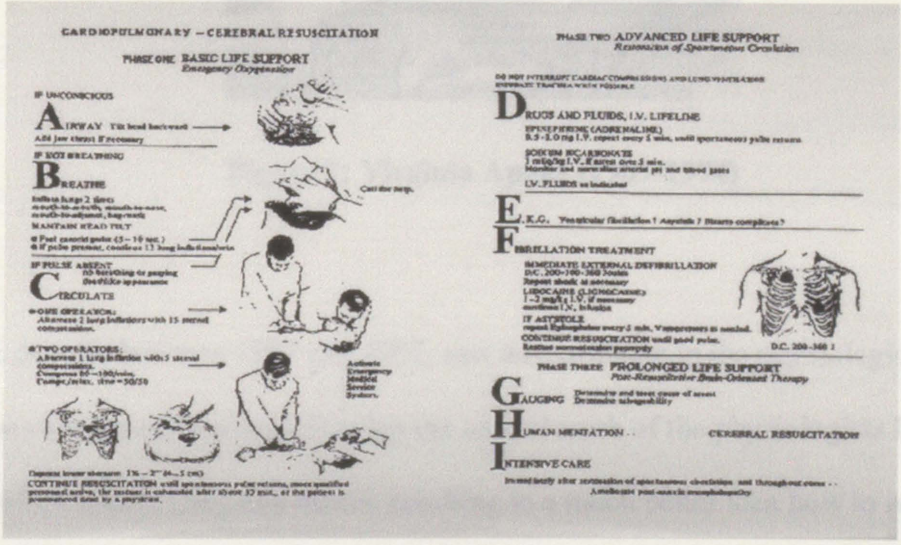


Figure 5: Dr Peter Safar's resuscitation experiments, Baltimore City Hospital, July 1957. (http://www.safar.pitt.edu/)

Electrical reversal of ventricular fibrillation by externally applied electrodes was described in 1956 (Zoll et al 1956). The ability to reverse a fatal arrhythmia without opening the chest challenged the medical community to develop a method of sustaining ventilation and circulation long enough to bring the defibrillator to the patient's aid, leading to the rediscovery of external chest compression by Kouwenhoven, Jude and Knickerbocker in 1960. The interaction of Kouwenhoven's closed chest compression with Safar's mouth-to-mouth ventilation had now arrived as modern day basic CPR and was endorsed by the American Heart Association in 1963. The simplicity of this technique has led to widespread dissemination since it was extended to the public in 1973. Belfast had the world's first pre-hospital cardiac care ambulance in the 1960's, following the work of J. Frank Pantridge, a cardiologist at the Royal Victoria Hospital (Pantridge & Geddes 1968; Haynes 1986). The first Advanced Cardiac Life

Support course was held in 1975, while the next thirty years concentrated on cerebral resuscitation (figure 6; http://www.safar.pitt.edu/).

Figure 6: Dr Peter Safar's pioneering Cerebral Resuscitation chart



Virginia Apgar (figure 7), an obstetrical anaesthetist, described her famous neonatal score in 1953 (Apgar 1953). Despite subsequent criticisms and calls for it's abandonment (Anonymous 1989), its' simplicity and utility as a predictor of neonatal outcome were recently endorsed by a study published in the New England Journal of Medicine (Casey 2000). Thus, the Apgar score continues to be the best-established index of immediate postnatal health. It should be appreciated, however, that the Apgar score was never designed to appraise *the need* for resuscitation in the newborn infant, which should be based on assessment of the infant's respiratory effort, heart rate and colour.



Figure 7: Virginia Apgar (1909-1974)

The decade, between 1957 and 1967, saw an expansion in the physiological basis of *newborn* resuscitation following the animal work of the physiologists Dawes (1966), Cross (1968), and others, resulting in a much better idea how to respond the asphyxiated newborn. Their work was based mainly on pregnant ewes, and involved opening the uterus in such a way as not to cause uterine contractions, preventing the foetus from being able to aerate the lungs by placing the head in a bag of normal saline and then obstructing the foeto-placental circulation, resulting in acute foetal hypoxia. The concepts of primary and secondary apnoea following neonatal asphyxia were defined by their experimental work. Later Milner and others (Boon et al 1979,Vyas et al 1986, Upton et al 1991, Field et al 1986) investigated the pattern of inflation pressures at birth, and showed that face mask systems largely depend on the Head paradoxical reflex to stimulate respiration and produce adequate tidal exchange.

The Neonatal Resuscitation Program (NRP), originally known as Neonatal Advanced Life Support (NALS), was developed at the Charles R. Drew Postgraduate School of Medicine in Los Angeles, California by Ronald S. Bloom, MD, and Catherine Cropley, RN, MN, and was finalized in 1985. In 1987, the first neonatal guidelines were adopted by the American Heart Association and the American Academy of Pediatrics in New Orleans. In July 1988, the program was introduced in Canada with the endorsement of the Canadian Paediatric Society and the Heart & Stroke Foundation of Canada.

The Provider course is a modular program based on self-learning, didactic teaching and, most importantly, skills training. It can be offered in a one-day or two-day workshop format, or in a series of sessions spread over 3-6 weeks. The course is given under the direction of a NRP instructor. Prior to learning the hands-on skills, it is essential that the most current edition of the Textbook of Neonatal Resuscitation be studied in detail. The course develops and clarifies this material and includes time for participants to practice the skills outlined in the manual, under the guidance of the instructor. Testing consists of a written test for each lesson and a practical demonstration of skills where indicated. At the end of the course, participants are asked to demonstrate all skills in the appropriate sequence, and to show how they would deal with problems in resuscitation, in a mock delivery situation or "Megacode".

A full outline of the programme is described in Appendix 1. However, the NRP course participants should achieve the following objectives:

- Know the equipment and drugs required for neonatal resuscitation.
- Know the sequence and priorities for neonatal resuscitation.
- Know how to manage the infant who has passed meconium *in utero*.
- Know that oxygenation and ventilation are the keys to a successful newborn resuscitation.
- Recognize the importance of heat conservation in resuscitating infants.

New evidenced based guidelines for neonatal resuscitation

In 2000, the International Guidelines 2000 Conference on Cardiopulmonary Resuscitation (CPR) and Emergency Cardiac Care (ECC) formulated new evidenced-based recommendations for neonatal resuscitation. This critical review has been sobering. Few resuscitation interventions are based on valid scientific data while proper RCT's on newborn resuscitation are difficult, if not impossible, to perform. Many existing resuscitation practices are driven by pathophysiological and nonquantitative reasoning rather than by evidence-based medicine. Nevertheless, as a result of the evidence evaluation process, significant changes occurred in the recommended management routines for the following:

Meconium-stained amniotic fluid: If the newly born infant has absent or depressed respirations, heart rate <100 bpm, or poor muscle tone, direct tracheal suctioning should be performed to remove meconium from the airway (Wiswell et al 1999).

Preventing heat loss: Hyperthermia should be avoided.

Oxygenation and ventilation: 100% oxygen is recommended for assisted ventilation; however, if supplemental oxygen is unavailable, positive-pressure ventilation should be initiated with room air. The laryngeal mask airway may serve as an effective alternative for establishing an airway if bag-mask ventilation is ineffective or attempts at intubation have failed. Exhaled CO_2 detection can be useful in the secondary confirmation of endotracheal intubation.

Chest compressions: Compressions should be administered if the heart rate is absent or remains <60 bpm despite adequate assisted ventilation for 30 seconds. The 2-thumb, encircling-hands method of chest compression is preferred, with a depth of compression one-third the anterior-posterior diameter of the chest and sufficient to generate a palpable pulse.

Medications, volume expansion, and vascular access: Epinephrine in a dose of 0.01-0.03 mg/kg (0.1-0.3 ml/kg of 1:10,000 solution) should be administered if the heart rate remains <60 bpm after a minimum of 30 seconds of adequate ventilation and chest compressions. Emergency volume expansion may be accomplished with an isotonic crystalloid solution or O-negative red blood cells;

albumin-containing solutions are no longer the fluid of choice for initial volume expansion. Intraosseous access can serve as an alternative route for medications/volume expansion if umbilical or other direct venous access is not readily available.

Non-initiation and discontinuation of resuscitation: There are circumstances (relating to gestational age, birth weight, known underlying condition, lack of response to interventions) in which non-initiation or discontinuation of resuscitation in the delivery room may be appropriate (see chapter 6).

The NRP course is now taught in 25 countries worldwide (see figure 8) and over 500,000 providers have been trained (Carlo & Kattwinkle 1996; Boo & Pong 2000; Deorari et al 2001).



Figure 8: Countries where NRP has been taught

In the U.S and Canada, the program is recommended for all health professionals practicing within all centres that provide obstetrical care. NRP Provider courses are open to licensed or regulated professionals including physicians, nurses, midwives and ambulance personnel who are regularly involved in neonatal resuscitation. Successful completion of the NRP Provider course implies that the Provider has completed an educational activity and does not imply that he or she has been "certified" or licensed to perform any particular procedure.

Controversy and challenges have abounded in neonatal resuscitation since Biblical times and they continue to this day. However, the move towards evidence-based practice will ensure that current NRP guidelines be revisited and reviewed as controlled evidence on neonatal resuscitation becomes available from ongoing trials and meta-analyses (Wolkoff and Davis 1999).

Chapter 1 Background, research tool, aims, design and specific objectives

The first moments of an infant's life are critical. This is the time when the infant is making an abrupt transition from the mother's uterus to an extra-uterine environment. A major problem that could occur during this time is asphyxia or lack of oxygen. The way in which an asphyxiated infant is managed in the first few minutes of life can directly affect the quality of the individual's life and have consequences over the entire lifetime. Therefore, every newborn has the right to resuscitation performed at a high level of competence. Nevertheless, in a recent review of 33 rescuers (anaesthetists, paediatricians, midwives and neonatal nurses), Whyte et al (1999) showed that only a fifth were able to achieve European Resuscitation guidelines in a practice scenario.

Birth asphyxia, as defined by the need for ventilatory assistance for resuscitation, occurs in 4-5 per 1000 live births in term infants (McDonald et al 1980). An additional 12% of all term deliveries are complicated by meconium-stained amniotic fluid that may require intervention (Wiswell et al 1990). Some form of resuscitation is required for about 6% of all newborn deliveries. This rises to an intervention rate of approximately 80% in babies who are born with birth weights less than 1500 grams (Bloom & Cropley 1994). Approximately 20% of infants born by emergency caesarean section require some form of resuscitation

intervention. Milner and Vyas (1985) reported that 2.1% of al newborn babies required intubation and IPPV. More recently, Palme-Kilander (1992) found that only 1:100 babies needed active resuscitation and, unlike previous experience, only 20% of these (0.2% of the total) went on to need intubation and IPPV. About 4% of admissions to special care nurseries are related to asphyxia (Wegman 1994), many of which are unanticipated (Chance & Harvey 1987) and some of which could possibly be prevented by the immediate availability of expert resuscitation practices (Perlman & Risser 1995). Thus, most complex neonatal resuscitations can be initially managed by preventing hypothermia and relatively simple airway management techniques including bag and mask ventilation. Full cardiopulmonary resuscitation in the delivery room, resulting in administration of chest compressions and medications, is an extremely rare event. In one study in the United States, only 39 (0.12%) of 30,839 infants were administered chest compressions and/or epinephrine as part of cardiopulmonary resuscitation in the delivery room (Perlman & Risser 1995).

The Gap: Inadequate resuscitation training in a fragmented Neonatal Service.

Needs based research is often focused on the gap between the ideals standards for performance and the actual standards for clinical *performance* or *practice* or both. Such a gap in neonatal services existed at both levels in Cork 1994, when this research project was visualized.

a) Clinical resuscitation performance: Without proper training doctors cannot be expected to perform optimally in acute situations. In Australia, where postgraduate medical training is relatively well developed, Brady and Raftos (1997) found that the average trainee paediatrician was deficient in one quarter to one third of the theoretical precepts considered important for acute care. Furthermore, on average, the trainees required two minutes to establish effective bag-mask ventilation in an infant manikin. Similar concerns were expressed in an American study (White et al, 1998). In this context, it is not surprising that the performance of Irish doctors was no different from their Australian or American counterparts (Smith et al 1996; Walsh et al 2000).

b) Clinical Practice: Apart from the lack of structured training in neonatal resuscitation, the practice of neonatal medicine in Cork operated within a difficult fragmented structure. When the author took up the position as consultant neonatologist in the Southern Health Board in August 1994, there were serious concerns about the fragmented state of neonatal care in Cork City. At that time, there were over 6,000 deliveries each year in the city, scattered over 5 maternity sites, one of which has since closed (table). In addition, within the Southern Health Board another 1000 babies were born each year in Tralee General Hospital, Co. Kerry. Although a proposal for an amalgamated maternity site in Cork had been forwarded to the Department of Health in 1992, this programme development was still in an infancy stage.

Table 1.1: Hospital Deliveries in Cork City, 1994

Hospital	Deliveries per annum
Erinville Hospital	2800
St Finbarr's Hospital	1500
Bon Secours Hospital	1800
Victoria Hospital (closed 1996)	350
City General	180

The fragmentation of Newborn Services in Cork was due to historical reasons that prevented the significant regional development of Neonatal Intensive Care, and resulted in a lack of investment of resources in the Cork region over the previous 20 years. As pointed out in the Comhairle na nOspidēal report on Neonatal Care Services in 1988 "*even a cursory examination of the resources, medical and nursing staff, equipment, space and a range of other facilities in Cork would indicate that the level of investment compares very unfavourably with what has been developed in Dublin maternity hospitals.*"

In 1994, a single Consultant Neonatologist appointment existed. There was no separate Neonatal rotation at Registrar level. Instead, during the on-call period (5 pm to 9 am), a single Paediatric Registrar covered four separate acute care sites i.e. two neonatal intensive care units (Erinville and St Finbarr's) in addition to the busiest general paediatric hospital in the city (Cork University Hospital), and the Children's Unit (infectious diseases) at St. Finbarr's Hospital. This situation

was totally at variance with the guidelines of the British Association of Perinatal Medicine which recommended that: *"There must be 24-hour resident cover in any unit undertaking neonatal intensive care by a doctor who has completed at least one year general professional training in paediatrics which includes six months experience of neonatal intensive care"*. According to these guidelines, this doctor should be available in the intensive care unit at all times and not required to cover more than one hospital. In addition, the report recommends that where a busy paediatric service and a neonatal intensive care service co-exist at the same hospital there should be separate Registrar rosters for each. At the time this thesis was developed, none of these criteria were met by the Cork maternity and neonatal services*.

This fragmentation of maternity and neonatal services posed particular problems in terms of newborn resuscitation. It was traditional to depend on Paediatric SHO's to initiate and for paediatric Registrars to sustain the complex task of resuscitating an asphyxiated or premature neonate. Because of the fragmented service, the presence of an experienced paediatric Registrar at an unexpected complicated resuscitation could not be guaranteed.

For these reasons (lack of a structured training programme and a fragmented neonatal service) a quality of care study evaluating the effects of a structured neonatal resuscitation programme was not only deemed desirable but essential.

The Research Tool: The Neonatal Resuscitation Programme:

A review of the history of newborn resuscitation (see preface) reveals that, over the centuries, doctors and midwives understood the need for stimulation of the neonate for initiating breathing. However, the means of providing these stimuli (tickling, beating, shaking, yelling, fumigating, immersion, dilating and blowing smoke into the rectum) were crude and ineffective at best. "All was fair in the art of revival" (Raju TNK 1999).

In 1987, in an effort to provide greater uniformity and a higher quality of care in newborn resuscitation, the American Academy of Paediatrics (AAP) joined with the American Heart Association (AHA) to offer a course in delivery room resuscitation called the Neonatal Resuscitation Programme (NRP). The need for such a program was based on the premise that the quality of care provided in the first minute of life could have a great impact on the ultimate outcome for that life. The main objective of NRP (AHA/AAP) was to ensure that each delivery room or labour ward was fully equipped to handle the unanticipated asphyxiated infant and at least one skilled person capable of full neonatal resuscitation present at every delivery. This course consists of a number of didactic sessions followed by practical on-hands skill stations. A complete outline of the course is presented in Appendix 1.

Aims, study designs and objectives of this thesis:

Aims: This project was designed as an example of *needs based research.* The main project *aim* was to address a specific gap between standards and actual practice (inadequate neonatal resuscitation training) by introducing and evaluating a recognised standardised training programme. The intention was to *establish* this programme nationally and to *evaluate* this programme on a clinical (short term outcomes) and epidemiological (mortality) basis. The challenges of introducing change into clinical practice would also be explored. In the process, it was hoped that a change in clinical practice towards a more proactive form of training would occur and be sustained. In this manner, the clinical *needs* that prompted this research would be addressed. A secondary aim of this project was to prompt an inquiry into the scholarship of teaching this resuscitation programme, through critical reflections on my own teaching experiences with this course and the NRP Instructor course.

Studies design: Randomisation is the epidemiologist's solution to selection bias. Therefore, our medical training informs us that data from randomised controlled trials (RTC) or systematic reviews of RCT's are the best, sometimes even the only admissible evidence for all types of questions. The fact that 96% of primary treatments in neonatology are based on evidence from RCT's or convincing non-experimental evidence is encouraging for the evidence based medicine movement (Cairns 1998). However, detractors of systematic reviews of RCT's,

focus their criticism on known publication bias (for positive results), the lumping of trials of various quality and sizes into meta-analyses and the belief that RCT's often ask over-simplified questions that belie the complexity of human illness (Eden 2000).

There is evidence from RCT's in non-clinical (scenario) settings that indicated that resuscitation training is associated with improvement in knowledge and skills, at least in the short term. However, there are no published *clinical* RCT's on newborn resuscitation training. This reflects the ethical constraints limiting the use of RTC's, particularly in the newborn setting. Thus, while a RCT remains the gold standard for clinical research, the strengths, other methodologies, further down the so-called *pyramid of evidence*, are well recognised (Dawes et al 1999). Recognising the real difficulties of a properly executed RCT and the very real need within the local clinical setting for proper, structured neonatal resuscitation training processes, the author decided to investigate the *process* of introducing such a training programme using a number of quasi-experimental research methods including a systematic review of the available evidence (chapter 3), pre-post evaluation in a clinical setting (chapter 4), qualitative, phenomenological, investigation of a focus group (chapter 8), epidemiological approaches (chapter 6), surveys (chapters 2 and 7), and anecdotal reports (chapter 7), recognising the strengths, as well as the limitations, of these quasi-experimental methodologies.

The study *population* in the current project was multidisciplinary and included paediatric and obstetrical doctors at all levels of training. In addition, because a midwife is present at virtually every delivery in Ireland, particular efforts were directed at training and maintaining the skills of midwives and student midwives. In addition, I also directed our training at ambulance personnel who are often involved in unexpected deliveries in the field. The *intervention* was an internationally recognised neonatal resuscitation programme (NRP). There were a number of *outcomes* explored in these studies, including the effect of NRP on clinical performance, neonatal morbidity and mortality.

The **specific objectives** of this project were as follows:

- To assess the need for a neonatal resuscitation programme, throughout Ireland, in terms of neonatal resuscitation preparation, protocols, training and staff availability (chapter 2).

- To determine, by means of a systematic review, whether resuscitation training in hospital settings is associated with improvement and retention of knowledge and skills and whether neonatal morbidity and mortality are reduced (chapter 3).

- To introduce and evaluate a recognised neonatal resuscitation programme (NRP, AHA/AAP) into one maternity hospital in Cork (chapter 4).

- To extend and evaluate this programme nationwide by means of UCC sponsored and certified outreach training courses (chapter 7).

- To determine whether the NRP had any effect on patient care in terms of neonatal mortality (chapter 5).

- To explore some of the ethical difficulties around newborn resuscitation by reviewing the modes of death among neonates in the NICU (chapter 6).

- To develop a cross-disciplinary network of NRP instructors, which could provide opportunities for further programme developments in health services research into newborn care (chapter 7).

- To examine barriers to resuscitation training (chapter 8) with the goal of engendering changes in attitudes in the Health Services towards resuscitation training (chapter 9).

- Finally, to explore my own teaching philosophy, experiences and development as a teacher, while teaching the NRP and NRP instructor courses (chapter 10).

**Note: A new amalgamated maternity hospital, projected to be opened on the Cork University Hospital site by the year 2004, should improve the state of neonatal cover from that outlined above. This will only occur if is appreciated that such a development must incorporate a regionalized level III perinatal care centre. A regionalized centre implies that units are accredited according to criteria based on technology, equipment and specialized personnel, including full-time cover by trained neonatologists (Recommendations from the European Association of Perinatal Medicine; Agostino et al 1999). The aims of the regional centre are to ensure that all*

pregnant women and neonates receive adapted health care for their needs; to utilise specially trained personnel for high risk perinatal care; to improve health outcomes and to achieve reasonable cost-effectiveness. In-service and outreach education is an important mandate for the regional service in order to meet some of these goals. Thus, the need for a structured neonatal resuscitation programme will not be obviated by the development of a Regional Perinatal Centre in Cork.

Chapter 2 A needs assessment of newborn resuscitation preparation and training in maternity sites in Ireland

> It is our business to know our business and know it well.
>
> Neonatology for Clinicians

Maternity services in Ireland

Almost all of approximately 50,000 deliveries each year in the Republic of Ireland are hospital based, with less than 1% occurring at home. Hospital deliveries are scattered over 25 different units with annual delivery rates varying from less than 500 to greater than 7000 deliveries per annum. This broad geographic and demographic spread of deliveries means that midwives deliver and resuscitate most low risk neonates and often have to initiate complex resuscitation when an asphyxiated infant is born, unexpectedly.

In order to assess the needs for a formal Neonatal Resuscitation Programme (NRP) in the Republic of Ireland a survey of hospitals providing obstetrical care was undertaken to assess neonatal resuscitation in terms of *preparation, protocols, training and staff availability.*

Preparation: Ideally an assigned individual should be in charge of checking the resuscitation equipment on a daily basis. The person responsible for resuscitation of the about to be born baby should check the equipment before each delivery.

Protocols: Ideally written protocols be developed and displayed in all hospital delivery rooms for resuscitation of newborns, use of drugs in emergencies, and selection of equipment. In addition, there should be written protocols as to when the Paediatric team should be present at a delivery. An example of such a protocol is presented in appendix 3.

Staff training: Ideally, each hospital where babies are born should have a regular staff education and training programme, with annual recertification as an essential requirement for all personnel responsible for the care of the newborn.

Staff availability: Ideally, a person skilled in basic neonatal life support should be present at every delivery. In addition, selected hospital staff with advanced skills such as neonatal intubation procedures should be readily available within the hospital.

Methods

A 17-item questionnaire (appendix 3) was sent to paediatricians, neonatologists and obstetricians providing neonatal services in 25 Irish maternity hospitals in June 1996. The questionnaire consisted of 12 *factual* questions on current *workload* (number of births; NICU beds), written protocols, consultant and non-consultant paediatric *staffing levels*, *staff responsibilities* towards equipment

checks and actual neonatal resuscitation (low-risk and high-risk deliveries). There were 5 open-ended *attitudinal* questions related to current training practices in neonatal resuscitation, apart from the NRP, the latter having already been taught in some of these centres at the time of the survey. The questionnaire was derived from a previous study of Canadian neonatal resuscitation practices (Chance et al 1994).

Results

Resuscitation protocols and training practices. There was a 92% response rate to this survey (22/25 units). Fifteen units were attended by consultant paediatricians with an interest in neonatology, while five units were attended by at least one consultant neonatologist in addition to other consultant paediatricians. In the remaining units there was no resident paediatric staff, and initial medical care of the neonate was the responsibility of the obstetrical team.

The distribution of annual deliveries in these units were as follows: two units (9%) had <1000 annual deliveries; 18 units (78%) had between 1000 and 3500 annual deliveries, and 3 units (13%) had >3500 annual deliveries.

Table 2.1. Staffing and resuscitation practices in 22 maternity units

	No. Of Maternity Units (%)
Attended by *paediatricians only*	15 (68)
at least one neonatologist	5 (23)
obstetricians only	2 (9)
Registrar on-site 24 hours	5 (23)
Outside help called in emergency	17 (77)
Written guidelines when to call for help	12 (56)
Equipment checked *daily*	10 (45)
alternate days	9 (41)
Weekly	3 (14)

Midwives were responsible for resuscitation of all low risk deliveries. Only five units (22%) had a registrar available on-site 24 hours a day. Most units (78%) had to summon additional medical help from outside the institution in emergencies occurring outside of the normal working hours. More than half (56%) of units had written guidelines as to when to summon additional personnel (registrars or consultants) for help for high-risk deliveries or when a depressed neonate was delivered, unexpectedly. Resuscitation equipment was checked by nurses alone (52%), or by a nurse and physician (48%), on a daily (47%), alternate days (44%) or weekly basis (9%).

Although 82% of units provided neonatal resuscitation training available, in the form of lectures, videos or clinical instruction, only 35% of respondents were happy with their current training structures. The majority (78%) of respondents indicated the need for a structured, standardized neonatal resuscitation-training programme.

Discussion

This study confirmed that, in all maternity hospitals throughout Ireland, midwives were present at all low risk deliveries and were expected to initiate resuscitation when a baby is born with unexpected cardio-respiratory depression at birth. The midwives were also largely responsible for advanced and immediate equipment checks. This study also confirmed the broad geographical distribution of deliveries throughout the country has resulted in inequalities, and often inadequacies, in staffing levels particularly at registrar and consultant levels. Finally, it appeared that resuscitation training for midwives and doctors was limited to video demonstrations and variable levels of clinical instruction. A limited form of neonatal resuscitation training was also documented in an earlier study by the Faculty of Paediatrics, RCPI (Clarke 1996).

Despite their enormous differences in size, population and wealth, the distribution of services and training in Ireland were not dissimilar to the situation in Canada in 1987, prior to the introduction of NRP into that country (Chance &

Harvey 1987). In a survey of 200 Canadian maternity sites, 138 (69%) had to summon additional medical help from outside the institution, 60% at all times. This study was a major impetus for the propagation of the NRP throughout Canada in the early 1990's.

Since it is unlikely that all deliveries in Ireland will be centralized in tertiary facilities alone, every obstetrical facility must be prepared for the most difficult resuscitation. Therefore, all health care professionals, present at a delivery, should be trained to perform newborn resuscitation together in a coordinated, team-approach manner. Since a midwife is present at virtually every delivery in Ireland, particular efforts should be directed at training and maintaining the skills of midwives. Midwives are not licensed to perform endotracheal intubation. However, most complex resuscitation situations can be initially managed with a focus on preventing hypothermia and effective management of airway and ventilation breathing with a bag and mask, skills that are very much within the remit of the midwife. Bradycardia or asystole in newborn resuscitation are usually secondary to respiratory compromise and rarely as a consequence of primary myocardial injury. Effective bag mask ventilation, including, *if necessary*, a progressive increase in inflating pressures from the customary 20-30 cm H_2O up to 60-70 cm H_2O, remains the mainstay of resuscitation particularly for first line providers (Pearlman et al 1995). The fact that resuscitation in room air has been shown to be as effective as 100% oxygen (Rootwelt et al 1992; Ramjii et al 1993) emphasises the point that the establishment of an effective

functional residual capacity (FRC) with effective ventilation is the most important prerequisite of successful resuscitation in the newborn infant.

Endotracheal intubation remains a difficult skill to teach. Alternative airway interventions that need further study, include the use of the laryngeal mask airway (LMA). A comparison of the LMA and bag mask ventilation in one small study showed LMA to be as effective as BMV in newborn resuscitation (Paterson et al 1994). However, the main advantage of the LMA may lie in the management of the difficult neonatal airway, for instance the Pierre Robin syndrome.

This study established that neonatal resuscitation training in Ireland, in the mid-1990's, was deficient and unstructured, and that the majority of maternity units welcomed a structured approach to neonatal resuscitation training. The sparseness of experienced paediatric staffing on site, especially outside of the Dublin hospitals, confirm the conclusions reached in the Canadian study that special emphasis should be placed on training midwives.

Recommendations

Based on the findings of this survey, the author recommends

- That written protocols be developed and displayed in all hospital delivery rooms for resuscitation of newborns, use of drugs in emergencies, selection and maintenance of equipment and training of personnel

- That hospitals display lists of maternal and foetal indicators for summoning additional personnel to attend the birth of at-risk infant.

- That a person skilled in basic neonatal life support be present at every delivery.

- That a regular education and training programme with annual recertification be required for all personnel responsible for the care of the newborn. Midwives, student midwives, neonatal nurses and all paediatric and obstetric junior staff should be trained.

- That training should be given before they take up full responsibility for providing this service. They should continue to be supervised by experienced staff until their skills have been assessed as satisfactory.

- That training programs for professionals include the use of models to promote resuscitation expertise. The training programme should include both theory and practice with minimum competence levels for a written theory exam and supervised performance of skills.

- That advanced skills such as neonatal intubation procedures should be practiced regularly by selected hospital staff and that consideration be given to training nurse midwives in intubation of newborns.

- That every institution where infants are born should have on staff at least one or more health professionals trained as an **Instructor** in newborn resuscitation. For smaller units an identified regional maternity unit may be the most logical locale for the establishment of training facilities.

- That regular audit should be carried out on all aspects of resuscitation practice, including the availability of appropriately trained staff and the provision of equipment.

Chapter 3 A search for the evidence supporting neonatal resuscitation training in health care settings: a systematic review

It is a capital mistake to theorize before one has data

(Conan Doyle, Scandal in Bohemia)

Introduction

No health care system can satisfy all the possible demands made upon it. Therefore, decisions about allocating limited resources are very important. Ideally, resources should be allocated to those things that are effective, and withdrawn from those which are ineffective (Cochrane 1989). The only way of judging effectiveness of health care interventions is through evidence. In 1979, Professor Archie Cochrane, a British physician, criticised the medical profession for not having established a system for producing up-to-date summaries of the results of reliable research about the effects of health care. The Cochrane Collaboration was founded in 1993 to respond to Cochrane's challenge, and evolved rapidly to become the focus of the Evidence Based Medicine movement. This movement aims to help health care professionals make well informed decisions about healthcare by preparing, maintaining and promoting the accessibility of systematic reviews of the effects of healthcare interventions.

Evidence based health care takes place when decisions that affect the care of patients are taken with due weight accorded to all valid, relevant information. The purpose of systematic reviews is to establish whether scientific findings are consistent and can be generalized across populations, settings and treatment variations. Great emphasis is placed on the fact that "bias is everywhere": *selection* bias (no randomisation), *detection* bias (not blinded), *exclusion* bias (incomplete follow up), *performance* (evaluation) bias, *publication* bias (not publishing negative or unfavourable studies). The methods used in systematic reviews attempt to limit bias and therefore improve reliability and accuracy of conclusions (Egger & Smith 1995).

Background: The purpose of neonatal resuscitation education is to translate the science of resuscitation into *classroom performance* allowing the transfer of the knowledge and skills of resuscitation to *clinical practice*. The ultimate goal is to reduce neonatal *morbidity and mortality*. Every resuscitation education programme should be rigorously evaluated, using the principles of evidence based medicine to verify that the programme is valid and effective. Three types of study can be examined to determine the effectiveness of resuscitation training programmes. Studies on *mortality and morbidity* provide the most direct evidence. The next best answer would be found in examining *change in practice behaviour* among participants. The weakest source of information is that derived from studies of *knowledge and skill retention* (Jabbour 1996).

Objectives: The aim of this systematic review was to answer the following questions.

1. Is neonatal resuscitation training in hospital settings is associated with improvement in knowledge and skills?
2. Are the knowledge and skills obtained in neonatal resuscitation training was sustained over time?
3. Do changes in the practice (attitudes) of practitioners occurred following neonatal resuscitation training?
4. Does such training have any effects on patient care in terms reducing neonatal morbidity?
5. Has such training been shown to reduce neonatal mortality?

Scope of the guidelines: The topics addressed were: neonatal resuscitation training and knowledge retention; neonatal resuscitation training and skills retention; neonatal resuscitation training and changes in attitudes/practice; neonatal resuscitation training and neonatal morbidity (hypothermia, seizures, admission to the NICU); neonatal resuscitation training and neonatal mortality.

Search strategy and evaluation of the evidence: The search was performed using the MEDLINE (1966 – 2001), Embase (1986 – 2001) and the Cochrane Controlled Trials Register using OVID (*Copyright (c) 2001 Ovid Technologies, Inc).* Search headings were 'Resus#', 'Train#', 'Neonatal Resuscitation

Program', 'Newborn (limited to newborn infant: birth to 1 month)', 'outcome', 'hypothermia', 'admission', 'seizures'. Relevant articles were also identified from references cited in publications identified from these databases. In addition, Effective Care of the Newborn Infant, edited by JC Sinclair and MB Bracken, was examined for randomised and quasi-randomised controlled trials of neonatal resuscitation training. A search was also made of personal data files. The author discarded irrelevant publications based on the title of the publication and its abstract. In the event that the article could possibly be relevant, it was retrieved for further assessment. The author then reviewed the studies in which the intervention was training of health care professionals in neonatal resuscitation.

Data collection and analysis: The author extracted data on the type of health professionals trained, the nature of and duration of the training, the outcome measures, method of randomisation, and completeness of follow-up.

Appraisal of methodological quality: Relevant articles identified were critically appraised, using the questions suggested and evaluated by Jaddad et al 1996, to evaluate the likelihood of bias in research reports. This involved using a simple "yes/ can't tell / no" classification to assess studies for the following study characteristics: blinding of randomisation, blinding of intervention, completeness of follow-up and blinding of outcome measurement. The studies are tabulated in table 3.1.

Table 3.1: Tabulation of trials according to the 11 questions below.

Questions / *Author*	1	2	3	4	5	6	7	8	9	10	11
Singhal et al, 1992				x	x	x		x	x		
Dunn et al, 1992	x		x	x	x	x		x	x		x
Blond et al, 1994				x	x	x		x	x		x
Levitt et al, 1996			x	x	x	x		x	x		x
Zhu et al, 1997				x	x	x		x	x		x
Kaczorowski et al, 1998	x		x	x	x	x	x	x	x		x
Patel D et al, 2001				x	x	x		x	x		

Evaluation criteria:

1. Was the study randomised?
2. Was the study described as double blind?
3. Was there a description of withdrawals and dropouts?
4. Were the objectives of the study clearly defined?
5. Were the outcome measures clearly defined?
6. Was there a clear description of the inclusion and exclusion criteria?
7. Was the sample size justified (e.g. power calculation)?
8. Was there a clear description of the interventions?
9. Was there at least one control (comparison) group?
10. Was the method used to assess adverse effects described? (*Monitoring for side effects* is obviously of great importance in drug studies but is of less relevance in educational interventions).
11. Were the methods of statistical analysis described?

The first three questions, which look for adequacy of randomisation, double blinding and completeness of follow-up, are most likely to detect bias. Trials satisfying these criteria are therefore the most powerful and most likely to be generalisible. It has been shown that non-randomised trials or RCT's that do not use a double blind design are more likely to show advantage of an innovation over standard treatment (Colditz et al 1989). More recently, McNutt et al (1990) showed significantly larger treatment effects in trials in which treatment allocation was inadequately concealed or was unclear compared to trials in which concealment was adequate.

Only two studies were truly randomised and controlled (Dunn et al 1992 and Kazarowski et al 1998), both of which were in *educational* settings and not clinical trials. The remaining five studies were pre/post (interrupted time series) studies, two of which were set in actual clinical practice (Blond et al 1994, Zhu et al 1997). The paucity of RCT's probably reflects the difficulty of developing proper trials in clinical neonatal resuscitation scenarios, because of the ethical and logistical reasons discussed below. Although the latter trials were of lower validity and reliability compared to the two RCT's the fact that they were clinically based has some relevance and they were therefore included in this analysis.

Methodological quality of included studies:

1. **Was the study randomised?** Only two of the seven retrieved studies were randomised trails (Dunn et al 1992 and Kaczorowski et al 1998). However, the *methods* of randomisation were not specified. Furthermore, although hospitals were randomised in the study of Dunn et al (1992) the individual subjects were not. Such a difference in workplace may be important, since busier hospitals will more likely have nurses with greater current experience in newborn resuscitation.

2. **Was the study described as double blind?** In the study of Kaczorowski et al (1998), evaluation of the outcome measures was by the researchers themselves. Although it was stated that they were blinded to the training the groups received, it is difficult to imagine that performance bias was completely avoided since the researchers were also the NRP instructors who administered the training programmes. Blindness in evaluation of outcome measures was not described in the study of Dunn et al (1994). The subjects in both studies were obviously aware of the method of training they themselves received, so, by definition, neither of these trials was *double* blinded.

3. **Was there a description of withdrawals and dropouts?** In the study of Kazowowski et al (1998) 75 of 92 residents gave consent to participate in the study. Only 59 became NRP providers and were eligible to participate in the

study. Of these 59, 44 (75% of eligible participants) completed all aspects of the study. In the study of Dunn et al (1992) 13% of the participants (24/190) were lost to due to illness, moving, maternity leave and unavailability for the second scheduled day of the study. In the study of Levitt et al 1996, there was significant drop-out throughout each phase of the follow-up which limits the validity of their findings and also illustrates the difficulty of follow-up studies among doctors in training. Of the 81 residents who participated in the course, only 29 (32%) completed the pre-test and 67 (83%) took the post-test. Eight (10%) did not pass and did not receive NRP provider status. Only 10 residents (12%) completed, in addition to the pre-test and the post-test, the follow-up test 6-9 months after having completed the initial NRP workshop. The remaining pre-post studies examined practices in areas before and after training and the pre and post groups were not specifically identified and linked.

4. **Were the objectives of the study clearly defined?** The objectives of the studies were clearly outlined in all seven studies (table 3.2).

5. **Were the outcome measures clearly defined?** The NRP multiple choice question examination was the usual test for knowledge criteria. The NRP performance checklist was used to monitor skills progress. Changes in Apgar scores, a measure of newborn health, were the outcome measure in the study of Patel et al.

6. **Was there a clear description of the inclusion and exclusion criteria?** This was not specifically addressed in any of the trials.

7. **Was the sample size justified (e.g. power calculation)?** Power calculation was not described in any of the studies, apart from the study of Kaczarowski et al (1998). This was a rather small study (14 family medicine residents). Retrospective statistical power analysis revealed that the study had 80% power to detect differences at a two-sided 5% significance level of more than 16% on knowledge and more than 9% on lifesaving scores ($\geq$ 1 SD). Thus power was significant to detect large differences but not medium to small effects, which might be of clinical importance.

8. **Was there a clear description of the interventions?** NRP (AHA/AAP) was the intervention tool used in all studies.

9. **Was there at least one control (comparison) group?** There were controls in the two RCT's (Dunn 1994 & Kaczarowski 1998). The remaining studies were pre-post studies. A historical control group was used in the Chinese study (Zhu et al 1997).

10. **Was the method used to assess adverse effects described?** Monitoring for side effects is obviously of great importance in drug studies but is of less relevance in educational interventions. This was not mentioned in any of the trials.

11. **Were the methods of statistical analysis described?** The analyses were simple comparative statistics and were appropriate.

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Table 3.2: Baseline characteristics of included trials

Trial	Methods	Participants	Intervention	Outcomes	Length of follow-up
Singhal et al, 1992	Pre/post study; 57% response	137 doctors and nurses involved in neonates	NRP	*Attitudes* to neonatal resuscitation Resource changes in hospitals	3 months
Dunn et al, 1992	RTC; >80% F/U; not blinded. Randomised by hospitals	190 neonatal care nurses	NRP	NRP written test (*knowledge*) NRP performance checklist (*skills*)	Up to 6 months
Blond et al, 1994	Pre/post study	144/836 (17%) trained in 29 maternity hospitals; Centre, France	NRP	More trained locally Number of course established locally Meconium aspiration (*morbidity*)	12 months
Levitt et al, 1996	Pre/post study; NRP multiple-choice test	29 residents; only 10 did pre and follow-up tests	NRP	Multiple choice test scores (*knowledge*)	6-9 months
Zhu et al, 1997	Pre/post study Historical controls	4,571 (NRP) vs 1,722 neonates (trad Chinese resuscitation)	NRP (1993-95) vs traditional Chinese resuscitation (1992)	Early neonatal *mortality*	1 year
Kaczorowski et al, 1998	RCT; 75% F/U; blinded	14 Family Medicine residents	NRP video NPR 'hands on' Control	NRP written test (*knowledge*) NRP performance checklist (*skills*)	6 - 8 months
Patel et al, 2001	Pre/post,population based study. retrospective 3-time period cohort design (before the introduction of the NRP, transition when NRP training occurred,and after NRP training was completed)	636,429 high-risk birth records were selected for detailed analyses out of 2,077,533 births in Illinois between 1985 and 1995 for 193 hospitals	NRP: The number of active NRP Instructors in Illinois increased dramatically during the study period; 1 to 6 between 1987 and 1988 to 1096 to 1242 between 1991 and 1995.	Apgar scores of 636,429 high-risk neonates	None beyond recording Apgar scores a birth

Table 3.3: Summary of results of included trials

Trial	Results
Singhal et al, 1992	Improved *attitudes* towards resuscitation. Better preparation prior to delivery (equipment checks). Improved communication with tertiary centres. Better teamwork at resuscitation. 27/35 (77%) of hospitals had initiated their own NRP training following initial outreach training.
Dunn et al, 1992	*Knowledge* increased & retained. No difference in *skills* (NRP vs controls) after 6 months.
Blond et al, 1994	302 individuals trained locally following initial outreach courses giving a total of 446/836 personnel involved in neonates trained (53%). 21/29 hospitals in the region developed local courses. Reduction in severe meconium aspiration syndrome (3 cases in 1989 compared to none in 1990).
Levitt et al, 1996	Short term increase in knowledge (MCQ scores). following NRP but not sustained by 6 months. Skills not evaluated. High drop out rate.
Zhu et al, 1997	3.4% early neonatal mortality in NRP trained group vs 9.9% rate with in traditional Chinese resuscitation practices.
Kaczorowski et al, 1998	Knowledge & skills deteriorated over time. *Retention* of skills substantially lower than retention of NRP knowledge. No significant difference in knowledge & skills with *booster* groups compared to controls.
Patel et al, 2001	The percentage of neonates reported to have low (<7) 1-minute Apgar score decreased in 1991 to 1995 overall and for each of 4 hospital levels. There was a statistically significant lower proportion of high-risk newborns who showed a decrease or no change in their 5-minute Apgar scores after the NRP instruction. High-risk newborns with a low 1-minute Apgar were more likely to increase their 5-minute Apgar after the NRP instruction period of the study.

Results

One meta-analysis on the effectiveness of Life-Support courses for health care providers was retrieved (Jabbour et al 1996). This systematic review was mainly directed at adult resuscitation guidelines and training. However, it did include two of the six neonatal resuscitation studies retrieved for the current review (Singhal et al 1992 and Dunn et al 1992). The baseline characteristics of the seven included studies are presented in table 3.2 which describes the methods, participants, intervention, outcomes and length of follow up in each study.

Knowledge and skills: Two randomised controlled trials (Dunn et al 1992 and Kaczarowski et al 1998) and one pre-post evaluation study (Singhal et al 1992) on the effects of neonatal resuscitation teaching of knowledge and skills were retrieved (tables 3.2 and 3.3). One study evaluated both nurses and doctors involved in neonatal care, another was directed at nurses only and another involved family medicine residents only. The intervention was consistent in that all of the studies used the NRP (AHA/AAP) as the intervention. All three studies evaluated knowledge and skills. In three studies, skills and knowledge were assessed by *simulated* case scenarios and multiple-choice examinations. Kaczorowski et al (1998) was the only study to examine the effect of a booster strategy.

Morbidity and Mortality: Neonatal morbidity, in terms of the incidence of meconium aspiration syndrome, was the outcome assessed in the French study (Blond et al 1994). Neonatal mortality was evaluated in the Chinese study (Zhu et al 1997). Statewide (Illinois) Apgar scores in high risk deliveries were compared in the study of Patel et al (2001). High-risk neonates in this study were defined as meeting one of the following criteria: maternal age <20 years old or >35 years old, birth weight <2500 g or >4000 g, presence of a maternal medical risk factor, and no prenatal care or prenatal care started after the first trimester. Several exclusion criteria were applied including the following: birth records with missing data, multiple birth or congenital anomaly, and hospital information that indicate no birth deliveries in 1 of the 11 study years or delivery outside of a hospital.

The main results of the seven individual studies are summarized in table 3.3.

Effects on knowledge and skills: Healthcare professionals who had received training had improvements in knowledge and were significantly better at performing resuscitation skills than untrained controls in a case scenario situation (Dunn et al 1992). This study was the highest quality study among those retrieved, being a randomised controlled trial. However, the testing was limited to knowledge testing and skill performance in a test scenario situation and does not appear to have been blinded.

Effects on *retention* of knowledge and skills: Although the knowledge scores of most candidates improved between the pre-test and the post-test, scores declined significantly on remote testing as early as 2 months after completing the course. There were no differences in skills (NRP trained vs controls) at 6 months post training (Dunn et al 1992). Among practitioners who had been trained in NRP, the use of current booster strategies (video and mannequin practice, six months later, did not improve skills compared to controls who received no booster training (Kaczorowski, et al 1998).

Changes in attitudes and practice behaviour: Singhal et al (1992) showed that participants were more confident in their performance following NRP training. Mean scores on the question: "I am very comfortable leading an extensive resuscitation", were 2.6 and 3.25 (maximum score = 5) before and after NRP training, respectively ($p = .0004$). However, this pre-post evaluation study was not randomised and did not have control groups, thus weakening the validity and generalisibility of its findings.

Effects on neonatal morbidity: Blond et al (1994) showed a reduction in *meconium aspiration syndrome* a year following the introduction of a structured NRP. In one region in France, where 53% of personnel were trained in a structured NRP, severe MAS fell from 3 cases in 1989 to 0 cases in 1990 (Blond et al 1994). This was a small, uncontrolled study and the results may not have been sustained over time. The Illinois study (Patel et al 2001), used several strategies to control for bias and to adjust for secular trends in decreased infant morbidity during the study period. This

study demonstrated sufficient support for the hypothesis that a significant improvement in Apgar scores occurred among neonates born after the NRP instruction in Illinois. Improvements in scores were greater among high risk neonates.

Effects on neonatal mortality: Only one study (Zhu et al 1997) was designed to examine, prospectively, the effects of neonatal resuscitation training on neonatal mortality, albeit using historical controls. Neonatal deaths account for about 60% of infant mortality in China, with asphyxia being the leading cause of neonatal deaths in China (Ji 1993). This study from China has the benefits of large numbers and showed a significant reduction in early neonatal mortality following NRP training compared to traditional Chinese resuscitation practices.

The results of this study may not be *transferable* to developed western countries for a number of reasons. The resuscitation practices in vogue in this part of China prior to the introduction of NRP included 1) the administration of respiratory stimulants such as coramine, glucose 50% and vitamin C (so called 'triple injections'), 2) wiping and stimulating the baby with alcohol, 3) pressing the philtrum of the baby, 4) patting the baby's sole, 5) mouth to mouth breathing and 6) manipulating the arms and legs of the baby. Sodium bicarbonate and dexamethasone are also used empirically (Zhang 1992 and Cheng & Zhu, 1992).

Some of these traditional Chinese resuscitation techniques may be intrinsically harmful, quite apart from distracting the rescuer from basic airway management that is the cornerstone of proper resuscitation. Thus, the improvement in neonatal mortality may be partly related to the removal and discouragement of potentially harmful traditional resuscitation techniques. The validity of this study was also weakened by the use of historical controls. In addition, the high neonatal mortality in both the control group (99 per 1000 live births) and the treatment group (33 per 1000 live births) in China are more than 6 times the neonatal mortality in developed countries (less than 5 per 1000 live births), thus limiting the applicability of these findings to these countries.

Discussion

The simple philosophy of the evidence based medicine movement is one of never taking one's own practice for granted (Ellis et al 1995; Gill et al 1996; Kenny et al 1997; Cairns et al 1998). The underlying concept is to use a structured problem based approach to logically manoeuvre through the web of current information. This movement is part of philosophy, partly skill, partly the knowledge about and the application of a set of tools (Altman & Bland 1995; Antman et al 1992; Oxman & Guyat 1991).

There are a number of steps that need to be addressed in the process of evaluating clinical practice. The first is to *pose the appropriate questions*. The next step is to *seek the answers* to those questions from the mass of available information. The third step is to *appraise the quality of the evidence*. The fourth step is to *implement change* as

appropriate, this being the fundamental aim of the current thesis. Finally, the effects of this *change of practice must be monitored* to see if change has occurred and whether it can be sustained.

Posing the questions: In the current systematic review 5 discrete questions were posed to be systematically addressed (see objectives above). When evaluating practice in a systematic manner, Richardson et al suggest breaking down the question into several different parts (**PIO**): Population, Intervention and Outcome. In question 1 and 2 the study population are newborn infants. In questions 3, 4 and 5 the study population are health care providers. The Intervention in all of the questions is the Neonatal Resuscitation Programme (NRP), one of the few *structured* neonatal resuscitation programs and certainly the most successful worldwide with over half a million providers trained. There were a number of Outcomes addressed in this review. In questions 1 and 2, the study outcomes refer to skill performance, evaluated by using the NRP performance checklist. Changes in attitudes are tested in question 3. In question 4, the study outcome is morbidity e.g. asphyxia, neonatal seizures, neonatal hypothermia, admission to the NICU post delivery. Finally, death is the outcome investigated in question 5.

Finding the best resources of information: Once we have a clear and structured question or questions we can work through a logical process of finding and using the best information resources. *Information seeking* is a central and integral part of the process of evaluating evidence. The keys to effective searching of computer

bibliographic databases are good strategy skills transferable between databases and other resources. The OVID search machine provides this capability and allows transferable searching of MEDLINE, Cinahl, Embase. We need to be able to exploit information resources effectively not missing too much of importance, not getting overwhelmed by the mass of information. We must exploit the trade off between comprehensiveness and selectivity. We need at each stage to question resource appropriateness, coverage, currency, reliability and authority as well as our own skills at finding and exploiting the resources effectively.

Appraising the quality of the evidence: This review has highlighted the paucity of good quality studies in the realm of neonatal resuscitation training. Indeed, there are many health interventions that are not readily amenable to rigorous experimental research design (Popay and Williams 1998). The major limitations of the RCT are its impracticality for many types of activity or intervention, and the ethical problems of either exposing people in the experimental group to a potentially harmful intervention, or, alternatively, making people in the control group forgo the possible advantages of the experimental intervention (Illsey 1980). The RCT is particularly difficult to use in evaluation of teaching or learning effectiveness because of the ethical considerations, which prevent researchers from assigning humans to different artificial treatments (Anderson 1998). Similarly, RCT's examining the effects of resuscitation training on neonatal morbidity and mortality are difficult to envisage, given the ethical and logistical problems involved in random assignment of patients to providers who are or are not trained in neonatal resuscitation.

The author set out to answer the following questions by this systematic review.

- **Are the educational programmes effective? (i.e. do trainees learn and more importantly, retain?).** Learning is defined as *"a relatively permanent change in behaviour that comes about as a result of a planned experience"* (Advanced Trauma Life Support Instructor Manual). The NRP is a planned and structured experience. The results of this review suggest that participation in an NRP course significantly increased knowledge of neonatal resuscitation, but that knowledge may decrease over time. Positive attitudinal changes were also observed. However, it has not been established whether improvements in knowledge, skill and attitudes are sustained over time. Effective means of maintaining retention of knowledge and skills have yet to be developed. The results of a recent randomised controlled trial comparing two booster strategies, 3 –5 months following the NRP course were disappointing. Neither video nor hands-on mannequin practice session had any significant benefit on skills and knowledge retention, compared to a control group who received no booster session (Kaczorowski et al 1998).

- **Does resuscitation training affect performance in the actual clinical situation?** Improvements in knowledge and skills may have little relationship to actual performance in practice. Similarly, performance scores in various simulated stations cannot be accurately extrapolated to ascertain candidates' abilities to solve

problems in critical situations. Consequently, candidates test scores may not be a reliable reflection of a programme's effectiveness. Therefore, studies of change in attitudes and practice are needed to provide more evidence of the impact of NRP. Singhal et al (1991) in Alberta, Canada, and Blond et al (1994) in France were able to demonstrate positive changes in attitudes towards neonatal resuscitation, following the introduction of NRP. Patel et al showed a dramatic increase in the number of NRP Instructors in Illinois. However, the Malaysian experience suggests that less than a quarter of all instructors remain active in teaching.

More studies are needed to examine the effect of resuscitation training on actual clinical practice. If there is *no* change in practitioners' behaviour as a result of structured training, then it is unlikely that patients will benefit from that programme (Kane et al 1992). Intuitively, one might expect that frequent use of NRP skills in actual emergencies should improve skill retention. Existing evidence suggests that frequent use of CPR does not improve skill retention (Curry et al 1987 & Deliere 1980), presumably because the performance of resuscitation without the benefit of correction of errors does not improve skills retention

- **Is patient outcome improved?** There is some evidence in favour of a reduction in morbidity (less meconium aspiration syndrome, less neonatal hypothermia and improved Apgar scores in high risk neonates) following NRP training. The latter study (Patel et al 2001) study is the most convincing to date that NRP training indeed decreases neonatal morbidity.

However, randomised controlled trials showing a reduction in neonatal mortality from resuscitation training are not available possibly because of ethical difficulties in the design and execution of such studies. The Chinese study, although limited in validity as described above, reported a remarkable reduction in early neonatal mortality following training in NRP.

Conclusions

Training health professionals in newborn resuscitation had measurable effect on professional performance, with observed improvement in knowledge and skills. However, these improvements are not retained beyond a few months. Retention does not appear to be enhanced by current booster approaches such as video and mannequin refresher courses. Other educational techniques such as repetition, reinforcement and feedback of information may need to be enhanced in the current teaching programmes (Atkins 1986; Kaye et al 1985 & 1989; McKenna & Glendon 1985; Turner 1987). Quality improvement initiatives, where all deliveries are video-taped and analysed later to provide critical positive feedback to the resuscitation team, is an innovative measure recently described in California (Carbine et al 2000). Unfortunately, the current medico-legal climate and the lack of statutory protection for those engaged in quality assurance is a major limiting factor for such exercises in this country.

Can the NRP be improved educationally? Acquisition and maintenance of the skills necessary for successful resuscitation of the neonate can be accomplished by a standardized training course using textbooks, videotape, and mannequins. Research indicates that optimal acquisition and retention of skills by adults is best achieved by active participation rather than passive observation. (Slamecka 1978). The use of paradigms (clinical situations used as examples to bridge the gap between theory and practice) may also help to integrate learning (Benner 1994). Halamek et al (2000) have developed such a paradigm with a realistic simulation-based training programme based in a delivery room (NeoSim) that deserves further study. This programme may bridge the gap between textbook and real life and offer benefits not inherent in traditional paradigms of medical education. Other innovative and perhaps more cost effective booster methods such as CD-ROM demonstration and evaluation, virtual reality programmes (avatars) and perhaps telemedicine may prove to be effective but also need to be investigated.

Further research should be focused on developing effective ways to teach the knowledge and skills in order to improve *retention.* A simple example of this approach is the title of the STABLE® stabilisation and transportation programme that was recently inaugurated in Cork, in June 2000. STABLE® stands for the components of the programme (Sugar, Temperature, Airway, Blood pressure, Laboratory, and Emotional Support). This may act as an *aide-memoir* and reinforce retention of the core concepts of the programme.

By highlighting the lack of clinically based studies, this review of resuscitation training sets the scene for an evaluation of the introduction of the NRP in actual clinical practice described in the next chapter.

Chapter 4 The effects of a structured Neonatal Resuscitation Programme on clinical performance, delivery room practices and neonatal morbidity

Introduction

A needs assessment study (chapter 2) confirmed the desire for a structured training programme in neonatal resuscitation in Ireland. A review of the evidence indicated that training health professionals in newborn resuscitation had measurable effects on professional performance, at least in non-clinical case scenario settings (chapter 3).

Based on these needs and the available evidence, the author decided to introduce the NRP (AAP/ AHA) into the Southern Health Board region, one of nine health board regions in Ireland. Because of the previously described design and ethical difficulties in implementing RCT's in newborn resuscitation training, a pre-post evaluation study was proposed, which examined the effects of neonatal resuscitation training on delivery room practices, resuscitation skills and neonatal outcome in the largest maternity hospital in this region. One of the main advantages of this study over previous studies was that the study setting was in the actual clinical arena, not an artificial training scenario.

Methods

Setting: The Erinville Maternity Hospital, Cork, has a delivery rate of approximately 3,000 babies per annum. Obstetrical and neonatal SHO's are immediately available on site. Obstetrical and neonatal registrars provide cover for this hospital, in addition

to a second, geographically distinct, maternity hospital in the city. Four consultant obstetricians and one consultant neonatologist serve the hospital, with additional neonatal cover provided by three consultant general paediatricians.

All deliveries take place in the labour ward, with most deliveries being performed by registered nurse-midwives. The nurse-midwives perform neonatal resuscitation of all low risk deliveries. Paediatric SHO's are present to resuscitate new-borns following instrumental deliveries, caesarean sections, and deliveries where foetal distress is anticipated, based on foetal heart tracing abnormalities and/or meconium staining of the amniotic fluid.

Consent: Permission for this study was obtained from the hospital administrator, the matron, the neonatologist and the delivery suite charge-sister. The midwives, residents and parents were informed that a clinical nurse specialist CNS in neonatology (who was also a certified (AAP/AHA) NRP instructor), was conducting an observational study on delivery practices and would, following informed consent of the prospective parents, observe the active portion of labor, delivery and new-born resuscitation. The nurse-midwives and residents were not aware of what data was been collected. The CNS was present in the delivery room for each delivery and resuscitation but did not participate in the any way or comment on the actions or performance of the midwives or physicians.

Study design: In September 1994, prior to the introduction of the NRP, the CNS evaluated 51 deliveries, by direct observation in the delivery room, using the framework and guidelines outlined in the NRP textbook, described below. The NRP was introduced into the Erinville Hospital between October 1994 and February 1995. The NRP instructor trained all delivery room nurse-midwives and paediatric SHO's, usually in groups of 6 to 8 individuals. The recognized AAP/AHA NRP textbook was given to the participants 4 weeks in advance of the course. In April 1995, a further 51 deliveries were evaluated by the CNS. The subjects were evaluated as a team when more than one person was involved in the resuscitation. Therefore, although some individuals were observed on more than one occasion, the team composition was usually unique.

The deliveries in both arms of the study were not necessarily consecutive, since only births, where the CNS was present for the full second stage of labour or caesarean section delivery and the newborn resuscitation, were included in the study. Additional information collected during the study included demographic data on the infant's birth weight, gender, gestation and Apgar scores. The trained observer continued to observe the newborn infant until the infant was discharged to the post-natal wards or the neonatal intensive care unit.

Evaluation of deliveries: The following parameters were evaluated and participants were scored either as "pass" or "fail" for each section. The participants were

evaluated as a team if more than one person was actively participating in the resuscitation.

Preparation: The individual(s) responsible for the resuscitation of the new-born infant were given a pass mark only if they completed the following three actions: 1) turned on the radiant warmer or checked to see if it were turned on; 2) checked the resuscitation equipment; 3) ensured that warm linen was available prior to the delivery.

Initial Steps: During the initial steps of resuscitation, the resuscitator(s) were expected to position, suction and dry the infant appropriately and remove the wet linen in order to score a pass mark.

Clinical assessment of the neonate: The resuscitator(s) were expected to note whether the infant was breathing and to determine the infant's heart rate by auscultation or palpation of the umbilical cord. If the NRP observer considered the baby to have a good colour (i.e. not cyanosed), no action was expected of the resuscitating individual(s).

Actions related to neonatal assessment: The resuscitating individual(s) were expected to administer free-flow oxygen if the infant was cyanosed but breathing. Positive pressure ventilation with 100% oxygen was expected if the infant was

apnoeic and/or had a bradycardia (heart rate less than 100 beats per minute). A sole resuscitating individual was expected to call for additional help at this juncture. The resuscitation team was expected to initiate chest compressions if the infant's heart rate was less than 60 beats per minute or 60 to 80 beats per minute and not rising. Medications were expected to be administered according to NRP guidelines, i.e. asystole or persistent bradycardia despite adequate airway control, ventilation and chest compressions.

Statistical analysis was Students' t-test for continuous data and Fisher's Exact for proportional data. A two-tailed p value < 0.05 was accepted as significant. The data it is reported as the means ± the standard deviation for continuous data.

Results

Newborn resuscitations were performed by either midwives or by a midwife and a physician (table 4.1). The 102 neonatal resuscitations were performed by 44 different individuals (33 midwives and 11 physicians). In the pre-NRP study period, there were 9/51 occasions when a single nurse-midwife was present in the delivery room, at the time of birth. This situation only occurred on one occasion in the post-NRP period ($p = 0.0149$; table 4.1).

Table 4.1: *Personnel at resuscitation* before and after training in NRP

	Pre-NRP (n=51)	Post-NRP (n=51)	Fisher's Exact Test
Midwife present to resuscitate neonate	28	30	p = 0.48
Midwife and physician present to resuscitate neonate	23	21	p = 0.47
Only one midwife for mother and neonate	9	1*	p = 0.02

Patient demographics are presented in table 4.2 (next page). The pre- and post evaluation study groups were not strictly comparable in that there were more preterm infants (<37 weeks gestation) in the post-NRP part of the study. Thus, infants in the pre-NRP part of the study weighed more at birth and were more mature compared to infants in the post-NRP part of the study ($p < 0.05$). Meconium staining of the amniotic liquor was more common in the post-NRP arm of the study. The male: female ratio was similar in each group.

Following the introduction of NRP, there were significant improvements in the following parameters when comparing pre-NRP and post-NRP phases (table 4.3; next page): correct preparation (18/51 vs. 41/51; $p < 0.05$); correct initial steps (6/51 vs. 40/51; $p< 0.001$); correct evaluation of the neonate (24/51 vs. 46/51; $p < 0.05$) and correct actions related to those evaluations (22/51 vs. 44/51; $p < 0.05$).

Table 4.2: *Patient demographics* before and following training in NRP

	Pre-NRP (n=51)	Post-NRP (n=51)	Students' t-test or Fisher's Exact test
Birth weight	3895 ± 35g	3695 ± 35g*	$p < 0.05$
Gestation (weeks)	39.5 ± 2	38.5 ± 4*	$p < 0.05$
Infants < 37 weeks	1	6*	$p = 0.072$
Female	26	30	$p = 0.39$
Male	25	21	$p = 0.38$
Meconium staining of amniotic liquor	1	8*	$p = 0.008$

Table 4.3: *Clinical performance* before and following training in NRP:

	Pre-NRP (n =51)	Post-NRP (n=51)	Fisher's Exact Test
Correct preparation prior to delivery	18	41*	P = 0.01
Correct initial steps of resuscitation	6	40*	P = 0.0001
Correct evaluation of baby	24	46*	P = 0.03
Correct actions in resuscitation	22	44*	P = 0.02

* $p < 0.05$

There was an increase in the use of free-flow oxygen (20/51 vs. 36/51) following the introduction of NRP, approaching statistical significance (p = 0.589; table 4.4). There was, also, a significant increase in bag/mask ventilation (2/51 vs. 9/51; p = 0.0425). There were no significant differences in the number of intubations, chest compressions, medication administration and Apgar scores < 7 at 5 minutes after birth when comparing the two arms of the study (table 4.4). Meconium staining of the liquor at delivery was more common in the post-NRP part of the study (p = 0.253; table 4.5). Direct visualisation of the vocal cords and suctioning of the trachea was performed more commonly in the post-NRP study period (1/51 vs. 5/51; n.s.), possibly related to the higher incidence of meconium staining of the liquor at delivery in this group.

Table 4.4: *Resuscitation skills* before and following training in NRP

	Pre-NRP (n =51)	**Post-NRP** (n=51)	**Fisher's Exact Test**
Use of free flow oxygen	20	36	P = 0.06
Use of bag/mask ventilation	2	9*	P = 0.04
Use of endotracheal intubation	0	1	P = 0.51
Use of chest compressions	0	0	P = 1.00
Use of medications (Naloxone)	1	0	P = 0.51
Tracheal suctioning for meconium	1	5	P = 0.12

*p < 0.05

Fifteen of the 51 infants in the pre-NRP study developed hypothermia (core temperatures <36.5°C). In contrast no infant became hypothermic following the introduction of NRP (p = 0.0001). There was a long-standing practice in the delivery room of bathing certain newborn infants (meconium or blood covered) in the delivery room after birth. This practice declined (4/51 births pre-NRP vs. 1/51 births post-NRP) and subsequently was discontinued, without any formal policy decree. Slightly more infants required admission to the neonatal intensive care unit in the post-NRP period (table 4.5), mainly related to prematurity, and not due to complications of resuscitation.

Table 4.5: *Neonatal outcomes* before and following training in NRP

	Pre-NRP (n =51)	**Post-NRP** (n=51)	**Fisher's Exact Test**
Meconium staining of amniotic fluid	1	8*	P = 0.03
Apgar < 7 at 5 minutes	7	12	P = 0.21
Infant bathed post delivery	4	1	P = 0.2
Neonatal hypothermia (<36.5° C)	15	0*	P = 0.0001
NICU admission	5	8	P = 0.31

* p < 0.05

Discussion

The NRP concentrates on the need for effective preparation prior to each delivery, careful definition of the roles of each member of the resuscitation team, the importance of proper thermal management at birth and emphasis on proper bag and mask techniques as the major means of ventilation and oxygenation. Although the full range of resuscitation skills is taught during NRP, the author believes, along with others (Bloom & Cropley), that the effectiveness of most neonatal resuscitations is enhanced more by the prompt use of basic skills, rather than the use of advanced skills such as intubation and administration of medications. In the current study, the introduction of the NRP was associated with alterations in delivery room practices and significant improvements in the evaluation and management of the newborn infant and in thermal protection at birth.

Anticipation and preparation: The nurse-midwives became more conscious of the need for one individual to be available at each delivery whose responsibilities are solely directed at the newborn infant, one of the stated principles of NRP. Prior to the introduction of the NRP, there were nine occasions where only one nurse-midwife was present at a delivery and was responsible for both the mother and her new-born infant. This situation occurred only once in the post-NRP study period. This change in practice came about by the heightened awareness among midwives of the need for a specific individual to be present for the immediate care of each new-born infant at the moment of birth.

Change in practices: Following NRP, there was a trend towards more frequent use of free flow oxygen and bag/mask ventilation most likely related to better evaluation of the new-born infant. The higher (although not significant) incidence of low Apgar scores and more frequent admissions to the NICU post-NRP can be explained by a higher incidence of premature infants and also meconium staining of the amniotic fluid in the latter group. It may be that the expectation of a premature baby may have encouraged better preparation and resuscitation practices and may have accounted for the overall better performance in the post-NRP period. However, improved practices were observed in both term and preterm deliveries.

While the nurse-midwives were taught endotracheal intubation during the NRP training, the Irish codes of practice do not permit them to intubate a depressed or meconium compromised neonate. They were encouraged to be diligent about suctioning of the infant's oro-pharynx at the perineum, if there was meconium staining of the amniotic fluid, and to summon appropriate help in these circumstances. Although physician NRP providers were shown how to use an endotracheal tube and a meconium aspirator to suction the airway of depressed neonates with thick meconium, it is of interest to note that, in the clinical situation, the physicians were more likely to perform tracheal suctioning under direct vision with a suction catheter, a less effective, but perhaps technically easier, technique for suctioning thick meconium.

Thermal management: In teaching the NRP, there was no attempt to directly alter midwifery or medical practices in the delivery room. Nevertheless, it was obvious that some changes occurred as a result of NRP training. This was particularly noticeable in thermal management at birth. There are large evaporative and non-evaporative heat losses from the baby's wet skin, immediately following birth. Unless precautions are taken to limit these heat losses, the baby's core temperature, which is about 37.8°C at birth, may fall by 2 - 3°C, or more, during the first 30-60 minutes (Sinclair 1992). Simple measures to reduce heat loss at birth, such as drying and swaddling or skin-to-skin contact between mother and baby under warmed blankets, are sufficient for vigorous full term babies. Such measures do not interfere with early mother-infant contact or with the early opportunity for suckling.

The absence of hypothermia as a clinical problem following the introduction of the NRP is most likely related to the significant improvements in preparation and in the initial steps of resuscitation. The importance of pre-warmed blankets and drying of the neonate were emphasized throughout the course. In addition, the practice of bathing infants covered in blood or meconium while still in the delivery room may also have contributed to neonatal hypothermia. This change in practice came from the midwives themselves and not through a policy decree. The timing of a new-born infant's first bath varies among institutions. MacGillivay (1996) showed no significant differences in rectal temperature in healthy full term infants bathed at a mean of one hour after birth, compared to infants bathed at 4 hours of age. Earlier

bathing, as occurred occasionally in the Erinville hospital, may have predisposed to mild neonatal hypothermia.

Limitations of the study: The CNS was the only recognised AHA/AAP NRP instructor in our region. While this was an advantage (in that none of the local health care professionals had prior knowledge of NRP), it may also have led to observer bias during the study. The CNS, in being teacher as well as observer, may have wished to show that the NRP itself and her teaching of the program were effective. In addition, the midwives and physicians were aware that their instructor was observing them in the post-NRP part of the study. As a result, they may have been more conscious of their practices during that time. To partially counterbalance these potential biases, this study was designed to include a strict objective format of "pass" or "fail" in the observation of the deliveries. The subjects and the parents were informed that the objective of the study was to observe all aspects of the delivery in order to take the emphasis off the resuscitation component. Video-taping the delivery and evaluating the process independently was considered when designing the study design. However, this was considered too intrusive both for the parents and the health care providers and raised possible medico-legal consequence in terms of discovery. Finally, this study was limited in that the pre- and post evaluation study groups were not strictly comparable with more preterm infants (<37 weeks gestation) and a greater incidence of meconium staining of the amniotic fluid in the post-NRP part of the study. This difference could explain the increased use of free flow oxygen, vocal cord visualization for meconium and increased NICU admissions in

the post NRP evaluation group. Despite there being more preterm infants in the post NRP evaluation arm of the study, there was less hypothermia in this group of infants who would normally be of greater risk for this complication.

Conclusions

Despite the problems of observer bias, this study has added to the limited literature on standardized neonatal resuscitation programmes and neonatal outcome (Chapter 3), with findings that are consistent with positive effects on clinical practice. It is a clinically based study in contrast to the only 2 RCT's on this subject, both of which were scenario based and examined provider knowledge and skills but not clinical performance.

The current study demonstrated a number of changes in attitudes and behaviour among health care providers in addition to a reduction in neonatal morbidity as a result of teaching a structured approach to neonatal resuscitation.

- Anticipation of potential problems was improved in that midwives became more aware of the need for a single individual to have sole responsibility for managing the newborn infant at birth, even in uncomplicated deliveries.
- Better thermal management at birth resulted in less problems with neonatal hypothermia.
- Improved evaluation of the infant at birth and more appropriate clinical responses were also observed.

Chapter 5 Investigating the effects of the NRP on neonatal mortality

I gather, young man, you wish to be a Member of Parliament. The first lesson that you must learn is, when I call for statistics about the rate of infant mortality, what I want is proof that fewer babies died when I was Prime Minister than when anyone else was Prime Minister. That is a political statistic.

Winston Churchill

Introduction

Perinatal mortality has fallen over the last 30 years. Whilst this has mainly been due to improvements in social standards, rapid and effective neonatal resuscitation in response to acute neonatal asphyxia may also have affected survival (Lubchenco et al 1989). Studies to establish the benefits of training programmes such as NRP in terms of neonatal mortality or asphyxia outcomes are difficult to envision, because of the multifactorial causes affecting infant mortality and asphyxia and the ethical and logistical problems involved in random assignment of patients to providers who are or are not trained in neonatal resuscitation.

Nevertheless, the large Chinese study previously reviewed in Chapter 3, showed with a three-fold reduction in early neonatal mortality following the introduction of NRP guidelines (Zhu et al 1997). This prospective study compared neonatal outcome following the introduction of NRP guidelines to a historical group of infants resuscitated with traditional Chinese resuscitation practices. Sixteen of 4,751 (3.4%)

newborns, resuscitated according to NRP guidelines, died within 7 days, compared to 17 of 1,722 babies births (9.9%) in the traditionally resuscitated group.

In the present study, the author investigated whether the introduction of the NRP into Ireland in 1994 was associated with a reduction in the neonatal rate (NMR) nationally, and/or locally in the Southern Health Board and in the Erinville Hospital. In specific, the objective was to determine whether there was a reduction in deaths due to hypoxia/anoxia in the newborn period.

Methods

The IMR is the number of deaths in the first year of life per 1,000 live births. The IMR can be subdivided into the NMR (number of deaths in the first 4 weeks of life per 1000 live births) and the Post Neonatal Mortality Rate (number of deaths in infants between 4 weeks and 12 months of age per 1000 live births). In 1996, IMR were lowest in Japan (3.8 per 1000 births) and Scandinavia (4.0 per 1000 births); moderate in the United States (7.3 per 1000 births) and highest in developing countries (30-150/1000 births; Guyer et al, 1998). The IMR rate in Ireland compared favourably at 5.5 per 1000 births (National Center for Health Statistics 1997).

The NRP was introduced into Cork in 1994 and nationally over the next two years. Two distinct, five-year epochs (1988 – 1993 and 1994-1997) were examined for IMR and NMR trends nationally and in the SHB. The SHB is the second largest of

the regional Health Boards and provides health care for the people of Cork and Kerry. It encompasses a population of 546,640 (15% of the population of the Republic of Ireland, 1996 census). For local government administrative purposes, the SHB is divided into three areas; Cork City, County Cork and County Kerry. Over half (54%) of the population live in Cork County, 23% in Cork City and 23% in County Kerry. The population density varies from 3200/km^2 in Cork City to 8 per km^2 in Kenmare rural district in County Kerry.

Statistics on IMR and NMR are obtained in the course of the usual procedure for registration of deaths, which has been in operation in Ireland since the year 1863. Data pertaining to births and deaths are recorded by the county of residence of the mother. Along with a homogenous and stable population and mandatory registration of births and deaths in Ireland, omissions are negligible. The Central Statistics Office data on infant deaths and low birth-weight in Cork City, Cork County and Kerry were examined over the 10-year period, 1988 to 1997 and information on trends, geographical differences and cause of deaths extracted. The causes of neonatal deaths, particularly those causes by hypoxia/anoxia were examined. In addition, the causes of neonatal deaths in the Erinville Maternity Hospital were examined to see if there was a change in the incidence of deaths from hypoxia/anoxia, following the introduction of NRP into that hospital. The records of all babies who died in the Erinville Hospital between 1st January 1989 and 31st December 1998 were examined, dividing the study period into two five-year epochs (1989 to 1993 and 1994 to 1998) for purposes of comparison. This 10-year epoch is slightly different

from the one used above, but was chosen because of difficulties in accurately tracking deaths in 1988 in the Erinville hospital.

Results

Southern Health Board births and deaths: Over the ten-year study period, 74,222 babies were born to mothers resident in Cork and Kerry, giving an average birth rate of 7,422 per year (Table 5.1). There were 556 infant deaths in the SHB during the study period, resulting in a slightly higher IMR in the SHB compared to the national average (7.5 vs 6.9 per 1000 live births, respectively). There were no significant differences in IMR between male and female infants (7.7 Vs 7.3 per 1000 live births, respectively).

Table 5.1. Births, deaths, neonatal and infant mortality rates, 1988-1997

	1988	1989	1990	1991	1992	1993	1994	1995	1996*	1997*	Total
Births SHB	7838	7625	7637	7600	7391	7133	7107	7080	7396	7415	**74,222**
Deaths SHB	89	76	62	50	57	43	52	51	46	30	**556**
NMR SHB	7.9	5.9	5.4	4.1	3.4	5.3	6.2	5.1	4.7	2.3	**5.0**
IMR SHB	11.3	10	8.1	6.6	7.7	6	7.3	7.2	6.2	4	**7.5**
IMR Ireland	8.9	8.1	8.2	7.6	6.5	6.1	5.7	6.4	5.5	6.2	**6.9**

Two-thirds of deaths (380; 68%) occurred in the neonatal period (<4 weeks), with the remainder (176; 32%) occurring beyond the neonatal period (4 weeks to <1 year). Congenital anomalies accounting for a third of neonatal deaths (131; 34%) followed by anoxic causes and immaturity.

The reduction in the IMR, when comparing the two five year epochs (8.8 Vs 6.1 per 1000 live births), resulted in 62 fewer neonatal deaths in the latter five years compared to the previous five years (table 5.2). There was a significant decrease in the number and proportion of deaths from hypoxia in the latter epoch (52/221, 24% Vs 11/159, 7%, $p < 0.001$). However, a significant increase in the proportion of deaths from prematurity was observed (18/221, 8% Vs 43/159, 27%, $p < 0.001$).

Table 5.2. Causes of neonatal deaths, SHB (1988-1997): comparison of two 5-year epochs

	1988-92		1993-97	
	No.	**%**	**No.**	**%**
Anoxia/hypoxia	52	24	11	7
Prematurity	18	8	43	27
Other causes	151	68	105	66
All causes	221	100	159	100*

Preliminary figures for 1996/97; *Source: CSO*

National breakdown of causes of death: When the national causes of neonatal death over the same period was examined, an identical pattern emerged when comparing the two 5-year epochs. There was an increase in death related to prematurity (52 Vs 224) and a proportionate reduction in deaths from hypoxia/anoxia (215 Vs 76).

Table 5.3: Neonatal deaths by diagnosis (n=127), Erinville Hospital, 1988-97

Causes of death	*Number of babies (%)*
ELBW (440-999g)	55 (43%)
Sepsis	14 (12%)
Lethal trisomy	11 (8%)
Chronic lung disease	7 (6%)
Congenital heart defect	6 (5%)
Asphyxia	6 (5%)
Anencephaly	5 (4%)
Pulmonary Haemorrhage	3 (2%)
Non-immune hydrops	2 (1%)
Diaphragmatic Hernia	2 (1%)
Others	16 (12%)

Causes of neonatal deaths in the Erinville Hospital: During the study period 127 babies (65 male and 62 female) died. Gestational age ranged from 22 - 42 weeks. The mean birth-weight of the babies was 1610 grams (range 440 - 3770 grams). The mean age of death was 9.1 ± 26 days (range 2 hours -269 days). The primary diagnoses of the babies and their modes of death are presented in table 5.3 (above). Extremely low birth-weight (< 1000 grams) was the commonest cause of death, accounting for 43% of all deaths.

The number of deaths was significantly lower in the second epoch (1994-1998) (54/13,631 births; 3.3% of NICU admissions) compared to the 1989 - 1993 epoch (74/13,272 births; 4.8% of NICU admissions; $p < 0.001$). However there was no difference in the number of deaths from asphyxia, with three asphyxia related deaths occurring in each 5-year epoch.

Table 5. 4. Comparison of neonatal mortality in the two five-year epochs

	Neonatal deaths	Congenital abnormalities	Births	NICU admissions	Corrected NMR
1989 - 93	74	19	13,272	1536	4.37
1994 - 98	54	25	13,631	1616	2.64

Discussion

The main question that this study intended to address was whether improved training in neonatal resuscitation training could plausibly lead to a reduction in neonatal mortality. In order to address this hypothesis the causes of neonatal deaths were examined in order to measure the contribution of neonatal asphyxia to neonatal mortality. The incidence of severe neonatal asphyxia is approximately 1 –3 per thousand deliveries with a mortality rate of over 50%. With almost 75,000 births over the 10-year study period, between 75 and 225 babies could possibly have been asphyxiated at birth. It is not improbable that a detectable reduction in asphyxia related deaths could have been expected if some of these babies were more expertly resuscitated.

As it happened, a significant reduction in anoxia/hypoxia related deaths, both nationally and within the SHB, was observed in the years following the introduction of the NRP into Ireland. These data could be interpreted as important information in support of neonatal resuscitation training. However, caution should be exerted before reaching such conclusions for a number of reasons, not least that the non-experimental nature of the study can only show an association, but not causality.

It is important to note that there are some unexplained contradictions in these studies as to the causes of neonatal deaths. The rise in death certificate reported deaths from prematurity is just as puzzling as the dramatic decrease observed in anoxia/hypoxia

deaths. The consistently low LBW (low birth weight) rates in Ireland (<5% of live births) would suggest that the prematurity rate is not increasing. In addition, the clinical causes of deaths seen in the Erinville hospital, which accounts for almost half of all deliveries in the SHB, did not correlate with the causes of death reported to the CSO. In particular, no change in asphyxia related deaths was observed.

The CSO relies on death certificate records to develop national vital statistics. The accurate documentation of causes of death on death certificates remains a source of concern for statisticians (Howell & Blondel 1994). For instance, in the past there was a great reluctance for religious and cultural reasons to report suicide as a cause of death in Ireland. Changes in societal attitudes and the adoption of alternative verification processes of the causes of death by the CSO, have contributed to a more realistic description of the incidence of suicide in Ireland in recent years.

Thus, one possible explanation for the findings in the current study may be that the changing medico-legal climate in this country could have distorted reporting routines, with physicians becoming reluctant to attribute perinatal hypoxia as the cause of death, when other factors such as prematurity co-exist. Witnesses to the spiralling medical litigation in this country may recognise such actions, although unethical, as understandable acts of self-preservation in the circumstances. Others have observed differences in causes of death when deaths are assigned to a clinical

category (as in the Erinville hospital review) rather than to a catastrophic final event, as occurs in most death certificate reports (Hein & Lofgren 1999).

Other factors, apart from more consistent resuscitation training, could account for the apparent reduction in neonatal mortality rates. Firstly, improvements in obstetrical care may just as important as improvements in neonatal skills in preventing deaths from anoxia/hypoxia. In a recent North American study, one third of the decline in perinatal mortality was attributed to improved condition of the baby on admission ("better babies"), reflecting improving obstetric and labour ward care (Richardson et al 1998). Two thirds of the decline was attributed to advances in neonatal intensive care ("better care") associated with newer respiratory and cardiovascular treatments.

One of the major deficiencies with the current IMR collection systems, which hampered our efforts to explore these hypotheses further, is that there is no formal linkage between death and birth certificates. This study sets out the case for birth-weight standardisation of mortality data, linkage of birth and death certificates and the need for more in-depth explorations of neonatal and infant deaths. There is a need for an ongoing anonymised enquiry into perinatal and infant deaths in Ireland, similar to Confidential Enquiry into Infant deaths and Stillbirths (CEDSI) in the United Kingdom or the Canadian Perinatal Surveillance System (Kee et al 1989). This would have three main objectives: collection of data related to perinatal and infant health, analysis and interpretation of these data, and response. Such a system

would reduce the dependency on deaths certificates for analysing causes of death, a process that is inherently unreliable, as the current study seems to indicate.

Conclusions

Although NMR and the number of deaths from asphyxia/hypoxia appeared to have decreased following the introduction of NRP, one cannot draw the conclusion that these events are causally related.

Chapter 6 Ethical decision making in newborn resuscitation: When to start and when to stop.

> The task of medicine is to care even when it cannot cure.
>
> Ethical and Religious Directives for Catholic Health Care Services 1994

In an ideal world, there would be no such thing as an ethical dilemma: that is, a situation where one is forced to choose between two options that are individually convincing, mutually exclusive and jointly demanding. Unfortunately, in clinical practice, we are often faced with difficult, life and death, moral decisions. Thus, while modern perinatology has for the most part been spectacularly successful, it has also given rise to its share of problems. More and more babies survive, who would have previously died, resulting in new burdens as well as new ethical dilemmas. With the arrival of ever increasing diagnostic capabilities, many potential dilemmas present even before the baby is born, and extend to the delivery room (what resuscitation, if any, should be offered at birth), and to the NICU. Most disagreements around the decision-making process in the NICU have concentrated around two sets of issues. First, on what basis should medical treatment be initiated, withdrawn, or withheld (substantive issues). Secondly, who should make these decisions and how should they be carried out (procedural issues).

Critical care physicians, including neonatologists, have been perceived, rightly or wrongly, as providers of aggressive medical care without technologic limits and perhaps with little consideration for the ethics of such treatments. However, reports from the United States, Great Britain, Holland France and Japan concerning withdrawal and limitation of life support in adult ICU's (Vincent et al 1989; Smedira et al 1990), neonatal ICU's (Sauer et al 1992; Duff & Campbell 1973; Nishida & Sakamoto 1992; Young & Stevenson 1990)) and paediatric ICU's (Mink & Pollack 1992; Lantos et al 1993; Martinot et al 1998) confirm that intensivists frequently consider the ethical implications of the treatments they provide.

Rhoden (1986) has theorized on the international approaches to "end of life" strategies in neonatology as follows. She has suggested that Swedish physicians withheld treatment when there is statistical data to suggest a grim prognosis ("statistical approach"); British physicians were more likely to initiate treatment and withdraw in the face of a deteriorating clinical situation ("indiviualized approach") while the trend in the United States, following the Baby Doe controversy, was to initiate treatment and continue until it is virtually certain the infant would die ("waiting for near-cerainty"). In Japan, the senior staff member, following plenary discussions, arrived at a decision that was then communicated to the family. Here, limitation, but not withdrawal, of therapy is practiced in perceived futile situations. Medical uncertainty, fear of being accused of medical neglect, societal and cultural influences and family values may account for these various strategies (Ryan 1993).

In this chapter, I will address some of these ethical issues by examining the modes of death of babies born in the Erinville Hospital, Cork, over a 10-year period (1989-98). Such a review, which examines practices rather than ethical attitudes, can give a picture of the dilemmas currently facing neonatologists in Ireland in neonatal resuscitation and subsequent management and allow comparisons with approaches in other countries.

Methods

The Erinville Hospitals encompasses a 17 bed tertiary care NICU (approximately 400 admissions per annum). Approximately a third of admissions to the NICU are related to prematurity, one-third to congenital anomalies, and the remainder to other medical conditions.

The medical charts of all newborn infants who died in the NICU at the Erinville Hospital over a 10-year period (January 1st, 1989 to December 31st, 1998) were reviewed. The cause of death was defined as the principle condition responsible for the infant or child's death, which was not necessarily the admitting diagnosis. The mode of death was determined from documentation in the physician and nursing progress notes, and the order sheets. Cardiopulmonary resuscitation (CPR) was defined as the institution of chest compressions and/or the use of intravenous or intratracheal dose(s) of adrenaline to restore a cardiac rhythm and a measurable blood pressure. When no-CPR orders were written, the above measures were not

initiated in the event of a clinical deterioration. Withdrawal of treatment was defined as discontinuation of active support including positive pressure ventilation. Thus, deaths were classified into one of three groups according to the terminal event. In group 1, CPR failed to restore cardiac activity and a measurable blood pressure. In group 2 (no-CPR), CPR was not attempted. In group 3, the patient was removed from ventilator support. Brain death is rarely diagnosed in the newborn according to accepted criteria (Guidelines for the determination of brain death in children. American Academy of Pediatrics Task Force on Brain Death in Children. Pediatrics 1987;80:298-300), and was not included among the modes of death categories.

The process of decision making around death and dying in the NICU was as follows. Care was taken to establish the diagnosis and prognosis as accurately as possible. Consultation with specialist colleagues was routinely used. The parents were intimately involved in the decision making process by frequent communication of prognostic information and by the health care team's assessment of their values and beliefs. Communication with the families were usually led by the neonatologist or paediatrician, with the involvement of nurses, clergy and obstetricians, and paediatric NCHD's, as indicated. The communication of the final decision was always the responsibility of the neonatologist or paediatrician.

Results

During the study period 127 babies died. The majority of deaths occurred in the NICU (92%) with just 10 babies dying in the labour ward. Gestational age ranged

from 22 - 42 weeks. The mean birth-weight of the babies was 1526 grams (range 325 - 3770 grams). The mean age of death was 8.2 ± 27 days (range 2 hours -269 days). Just over half of the babies (52%) died following unsuccessful CPR, and just under half (48%) had treatment limitation, either by not being offered CPR (20%) or by withdrawal of ventilator support (28%).

Table 6.1 Modes of death by diagnosis

	Number of babies	Failed CPR	No CPR	Withdrawal from ventilator support
ELBW (440-999g)	55 (43%)	31	7	17
Sepsis	14 (12%)	13	0	1
Lethal trisomy	11 (8%)	3	6	2
Chronic lung disease	7 (6%)	6	0	1
Congenital heart defect	6 (5%)	4	1	1
Asphyxia	6 (5%)	1	1	4
Anencephaly	5 (4%)	0	5	0
Pulmonary haemorrhage	3 (2%)	3	0	0
Non-immune hydrops	2 (1%)	2	0	0
Diaphragmatic Hernia	2 (1%)	2	0	0
Others	16 (12%)	3	6	7
TOTAL	127	68 (52%)	26 (20%)	33 (28%)

The primary diagnoses of the babies and their modes of death are presented in table 6.1. Extremely low birth-weight (< 1000 grams) was the commonest cause of death, accounting for 43% of all deaths. Although the majority of these babies died following attempts at full cardiopulmonary resuscitation (31/55; 56%), this group of infants also accounted for more cases of treatment limitation (i.e. no CPR) and withdrawal of ventilator support compared to the other diagnostic categories (24/52).

Most babies with lethal trisomies (trisomy 13 or 18), had treatment limitation or withdrawal (8/11; no CPR, 6; withdrawal from ventilator, 2). All five babies with anencephaly died without receiving CPR or ventilator support. Four of 6 babies with severe perinatal asphyxia died following ventilator support withdrawal.

Discussion

We have observed a dramatic decrease in neonatal mortality in the latter 5 years of this study, reflecting similar reductions in other parts of the world (Richardson et al 1998). However, attempts to improve survival, particularly among the very immature infants, give rise to increasingly more difficult and challenging ethical situations. This study indicates that neonatologists in Ireland have to address very difficult decisions regarding when to begin and discontinue resuscitative measures in newborn infants and confirms that limitation of treatment and withdrawal of ventilator support are part of neonatal practice in Ireland, accounting for almost half of neonatal deaths. This proportion is significantly lower than Canadian NICU's

where up to 80% of deaths are due to limitation of treatment and withdrawal of support (Ryan et al 1993), but similar to a recent report from the National Maternity Hospital, Hollis Street, where 16 of 31 deaths in the NICU were due to limitation of treatment (3) or withdrawal of treatment (13; Bolger et al 2001). The latter study categorized decision-making according to the RCPCH Ethical Guidelines, which indicate five circumstances where treatment may be limited or withdrawn in children (Royal College of Paediatrics and Child Health 1997). These are described as: the brain dead child, the permanent vegetative state, the "no chance" situation, the "no purpose" situation, and the "unbearable" situation. Nine of the 16 deaths in the Hollis Street study were categorized as "no chance", while 7 were classified as being "no purpose".

Resuscitation of newborns is obligatory if it offers a reasonable chance of survival (Treatment decisions for infants and children. Bioethics Committee, Canadian Pediatric Society 1986.) Therefore, in general, the best interests of the baby will favour the provision of life saving treatment in difficult ethical dilemmas. Decisions regarding withdrawal of support should be postponed until the baby was admitted to the NICU, where there is the opportunity to solicit the input from appropriate subspecialists, to observe the baby's response to therapy, and to involve the parents in the decision-making process. The labour ward is not the place to have to make urgent decisions of whether or not to treat a newborn infant. There is no time to deliberate or consult. The information provided by the obstetrician, although increasingly more sophisticated and more accurate, can often be wrong. Thus, the

burden of proof lies with the proponent of non-treatment. It has been our practice to be present at the delivery of all infants > 22 weeks' completed gestation. Infants less than 500 g are not routinely resuscitated except in questionable cases, e.g. if the infant is vigorous or is thought to be growth restricted, in which case we resuscitate and stabilize the infant. We agree that it is up to each hospital involved in perinatal care to develop criteria for the initiation of treatment in neonates based on its own experience and outcomes (Yu 1987).

The most common reason for advanced resuscitation and post resuscitation stabilization in the NICU is prematurity. Not too long ago, babies born at 28 weeks or earlier were considered late term miscarriages. In 1961, a premature baby boy born at 34 weeks gestation to Jackie and John F. Kennedy, died in a Boston hospital of hyaline membrane disease. Almost all such babies now survive intact. In 1973, the survival rate for babies born at 28 weeks (weighing 1000 grams) was still only about 10%. Today, as many as half of babies born at 24 weeks, survive. However, there are concerns about the outcome of many of these immature babies. A study conducted at Johns Hopkins Hospital tracked 142 infants born at 22 to 25 weeks gestation for six months (Allen et al 1993). It was found that all babies born at 22 weeks died in the hospital. Only 15% of the babies born at 23 weeks survived, and those who did survive, suffered brain bleeds and retinopathy. At 24 weeks, 56% of the infants survived, but only 26% of them avoided intracranial bleeds, and more than 50% suffered retinopathy. At 25 weeks, 79% survived, 68% of them without intracranial bleeds. In the UK and Ireland, the recent Epicure study monitored 92% of infants <

25 weeks of gestational age, of whom 19% had severely delayed development and only 49% had no disability (Wood et al 2000). In the United States, when 79% of 1151 infants weighing 400 – 1000 grams at birth were evaluated at 18 months, 25% had abnormal neurological examination results, and 37% had a Bayley II Mental Developmental Index score under 79 (Vohr et al 2000).

Newer treatments which may have contributed to improved survival among very low birth weight infants include more aggressive use of antenatal steroids, better surfactant preparations, high frequency oscillation and perhaps nitric oxide. As a result, some very immature infants, who may have previously died of intractable respiratory failure, may now be maintained on ventilator support, often with multi-organ failure and significant intracranial haemorrhages. Many of these tiny infants died following withdrawal of ventilator support, with parental involvement and consent.

The severely asphyxiated or near stillborn baby poses another difficult dilemma for those working in the labour ward. The question asked here is: for how long should unsuccessful resuscitative techniques be continued? The US National Collaborative Study showed that the incidence of cerebral palsy increased steadily with an increase in the length of time that the Apgar score remained below 4; the chance of having cerebral palsy exceeded 50% only when there was no significant improvement after 20 minutes (Jain et al 1991). Using these and other data, many neonatologists recommend discontinuing resuscitation in a term baby if there is no significant

response after 20 minutes of maximum resuscitative efforts. When a severely asphyxiated baby is resuscitated in the labour ward and brought to the NICU, other dilemmas arise. Decisions to withdraw treatment in term-asphyxiated infants certainly involve quality of life deliberations. Studies of such infants have confirmed that those who are comatose with burst-suppressed electroencephalograms (Sarnat stage III) either die or are severely neurologically impaired (Sarnat & Sarnat 1976; Finer & Robertson 1981). In such cases, the parents should be made aware of the likelihood of a poor outcome and supported in their decisions to continue, limit or withdraw treatment in these circumstances. When a child is born with a tragic condition such as Trisomy 13, Trisomy 18 or Anecephaly it is clear that the infant's physical condition is not compatible with life, and quality of life is not an issue. Many if not all babies with a clearly defined lethal disorder, such as the anencephalic or lethal chromosomal disorder are admitted to the NICU where their management was caring and expectant and most of these babies died without aggressive resuscitation interventions. Two babies with lethal trisomies were ventilated until laboratory confirmation of the chromosomal abnormality was obtained, following which ventilator support was discontinued.

It is essential that parents are always closely involved in these treatment decisions (Lantos et al 1994). In the absence of medical certainty, decisions should be made on an "individualized approach" as opposed to "waiting for near certainty" or using a "statistical approach". The individualized approach entails constant reassessment of prognosis and, with the involvement and consent of the family, allows foregoing

treatment in situations in which there is a high likelihood (but not necessarily near-certainty) of severe disability or death (Rostain & Bhutani 1989). When it comes to issues concerning children, parents are usually the primary decision makers. Parents should and need to be actively involved in the decision making process, but first they must be adequately and honestly informed about what is going on with their child. It is also important to remember that a redirection of management from life-sustaining treatment to palliation represents a change in beneficial aims and objectives and does not constitute a withdrawal of care.

There are a number of often conflicting ethical principles and associated rules which apply to neonatal care as follows; ***beneficence*** (providing care that benefits the baby) versus ***non-maleficence*** (avoiding unnecessary suffering to the baby), ***proxy decision making*** (who decides: a baby cannot speak for his or herself, but parents, along with the Health Care Team should place the baby's best interests foremost), ***enhancing autonomy*** (usually by keeping the parents fully informed of all possible consequences), ***justice*** (being fair; resource allocation should not decide individual treatments), ***quality of life judgements*** (one of the most morally controversial issues in modern medicine), and the concept of ***medical uncertainty*** under which clinicians operate, where prognosis can never be guaranteed with 100% accuracy. While principles form a framework in which to identify the ethical dilemmas in a specific case, there are not helpful in prioritising which takes precedent.

This study was an examination of NICU practices rather than physician, nursing or parental moral attitudes. It is not always possible or wise to extrapolate attitudes from practice. A recent study of the ethical attitudes of neonatal end of life decision-making among 1391 neonatal physicians in10 European countries (which did not include Irish neonatologists), showed that country of origin remained the most important predictor of physician attitudes (Rebagliato et al 2000). This study concludes that cultural, legal and religious contexts influence both physician attitudes and end-of life practices with European countries.

Developments in neonatology have no doubt helped to keep many children alive, or at least have given them a chance at life which years ago, they would not have had. In the author's NICU experience and in the few reports that have been published on this subject, up to half (and in some reports as many as 80%) of the babies who die in the NICU, do so because of an elective collaborative decision made by their parents and caretakers. Such a decision is highly ethical, since it is done in the best interest of the baby and the family and only after as much prognostic information as possible has been sought. However, *"ethical dilemmas ... are rarely simple and stark but are, instead, multifaceted, complex, and gut-wrenching for parents and care givers alike"* (Stahlman MT 1990). Society must also realize that no approach will always be associated with a satisfactory outcome. It is the author's opinion, however, that the approach described here will result in the best outcome for the majority of cases, in that it permits sufficient time for adequate representation of all parties who have a

legitimate interest in the outcome, and minimizes the opportunity for serious errors in clinical judgment.

Conclusion

The latest edition of the NRP textbook (2000) contains a new section on ethics in the delivery room. It addresses some of the most pressing issues in the delivery room and reflects broadly the issues raised above. It recommends:

- That practitioners adhere to a principle of not making life-versus-death decisions in the labour ward for the vast majority of newborns.
- That vigorous resuscitation should be attempted in all babies until such time as it becomes clear that intact survival is highly unlikely.
- That legitimate exceptions to such a policy might include the baby with a clearly defined lethal disorder, such as the anencephalic; the baby with an antenatally-diagnosed lethal chromosomal disorder; or some babies born at extremely immature gestational ages (e.g., 23 weeks or less).
- That unsuccessful resuscitation efforts should be discontinued after about 20 minutes for the baby born at term, while in the extremely preterm baby many would discontinue after approximately 10 minutes.
- That decisions regarding withdrawal of support are postponed until the baby is in the regional newborn intensive care unit, where there is the opportunity

to solicit the input from appropriate subspecialists, to observe the baby's response to therapy, and to involve the parents in the decision-making process.

Chapter 7 Outreach NRP Training in Ireland

It's noble to teach oneself but still nobler to teach others – and less trouble.

Mark Twain

Establishing a neonatal resuscitation training program in usually a much bigger problem in a small hospital than in a large teaching institution, where in house-registrars, neonatologists and specialized nursing staff provide an available pool of skilled individuals. In addition, resources for equipment may also more limited in a smaller hospital. For this reason, we focused our resources on out-reach teaching programmes to the peripheral hospitals, a concept which has also been described in other countries (Bailey & Kattwinkel 1990; Kattwinkel 1984; Moore 1989). Beginning in September 1994, the author, with the help of a coordinator and a group of trained NRP instructors, introduced the NRP into Cork and subsequently throughout the country on an out-reach basis. Between September 1994 and May 1999, we trained 1578 individuals (72% nurses/midwives, 22% doctors and 6% ambulance personnel) in 89 separate courses. These courses were held in 17 maternity hospitals throughout the country attracting participants from all 25 maternity sites and individuals from the ambulance sector (see chapter 8; table 8.1).

The outreach provider courses were of one-day in length. All providers were given the course material 4-6 weeks in advance and were expected to have studied the manual. It is estimated that up to 18 hours pre-course study time is necessary in order to come to the provider course fully prepared. The first course in most of the venues

was directed by the UCC NRP co-ordinator or the author personally. All instructors had been originally taught the NRP provider course by the UCC group.

Selected candidates were then trained in five annual Instructor training courses, using the recognized AAP/AHA format. The programme was taught according to the guidelines of the American Academy of Paediatrics (AAP) and American Heart Association (AHA), with the assistance of a certified NRP instructor. The instructor course was taught over 2 days and consisted of lectures on issues in teaching adult learners and specific educational approaches to teaching by lecture, skills teaching, critique of students and motivation. An outline of the Instructor course is presented in Appendix 2. Since 1995, over 70 NRP instructors have been trained.

In this chapter, the author presents an evaluation of the programme by some of the NRP providers who passed the programme in courses throughout the country.

Methods

A 13-question evaluation form (appendix 3) was sent to all participants who took the course between April 1995 and March 1996. There were two factual questions (occupation and frequency of attendance at births). There were seven attitudinal questions relating to the educational objectives of the course with opinions scored on a Likert scale (Likert 1933) of 1 (poor) to 5 (excellent). There were 2 closed-ended, multiple choice, questions relating to the most difficult theory and practical lesson in

the course. In addition, one open-ended question inquired whether participants recalled a resuscitation situation where, in their opinion, the knowledge and the skills learned at the NRP were of fundamental importance in saving the neonate's life or having a significant impact on the infant's outcome.

Results

193 of the 429 participants surveyed (45%) responded to the evaluation questionnaire. Almost all of the respondents (97%) were satisfied (scale 4 -5) with the course. Most respondents (85%) felt that the course improved their skills, changed their approach to neonatal resuscitation, and gave them confidence in daily work. Almost three-quarters (74%) indicated that the course was highly beneficial (scale 4-5) to their clinical practice.

Two thirds of the participants expressed difficulty with the lesson on medications, with ambulance personnel (32/34; 94%) expressing more difficulty compared to doctors (17/29; 59%) and nurses/midwives (72/130; 55%). Almost half of the participants (45%) felt that the most difficult practical lesson was endotracheal intubation, with the nurses/midwifes (71/130; 55%) reporting more difficulty with this skill station compared to doctors (11/29; 38%) and ambulance personnel (8/34; 24%).

"Success" stories: Eighteen of the respondents (9 nurse/midwives, seven doctors and 2 ambulance personnel) described clinical situations where they felt that the knowledge and skills they learned at the NRP were important in saving a life of a neonate or had a significant impact on the infant's outcome. On two separate occasions, Emergency Medical Technicians (EMT) were the sole professionals at an unexpected home delivery and another delivery, which occurred in an ambulance en route to hospital. The latter was a preterm infant of 28 weeks gestation who survived and subsequently did very well. The EMT's reported that their NPR training provided them with the knowledge and skills to deal effectively with the resuscitation of these newborn infants. Nine nurses/midwives described situations where they were faced with the initial resuscitation of unexpectedly asphyxiated babies (7) or premature babies (2), without the presence of a doctor. These infants were successfully resuscitated with bag mask resuscitation. Seven doctors also described situations of successful resuscitation involving endotracheal intubation in 5 of the 7 cases, the success of which they attributed to their NRP training.

Discussion

This study confirmed that there was a need and a desire for formal training in newborn resuscitation in maternity units in Ireland. Second, although the structure of NRP was originally designed for the U.S. health care system, these observations show that the programme is adaptable to the Irish health care system. We demonstrated that the NRP could be taught, in entirety, to a broad range of Irish

health care providers, with apparent satisfaction among providers, with the level of knowledge and skills achieved in the course. Finally, the subjective accounts of possible life saving benefits of the NRP from a number of providers, reported in the current study were most encouraging.

Interdisciplinary responses: This programme was administered to a broad range of health care workers, including doctors, nurses and ambulance personnel. This evaluation showed that individuals from different disciplines had greater or lesser problems with certain lessons in the programme depending on their background and professional exposure. For instance, many ambulance personnel found the lesson on medications challenging. This is not surprising since their current professional training curriculum has little emphasis on resuscitation medications. This may change as their basic training is advanced to a higher level. On the other hand, ambulance personnel were most comfortable with the practical skills lessons in the NRP, which complimented their prior experience in the use of bag-mask ventilation and intubation. In contrast, nurses were more comfortable with the medication lesson, but less so with the skills stations. It would be difficult and perhaps impractical to adjust the curriculum and course design of the NRP to meet the specific needs of the various disciplines. However, this does not preclude using pre-course classes to address individual and interdisciplinary concerns. Indeed, this is encouraged and instructors are urged to vary the pace and emphasis of their presentations to meet such needs.

In introducing this outreach programme country-wide, we were anxious foster links between the university (UCC) academic groups to other professional organizations in the broader community, including nursing, public health and the ambulance services. This approach has been most successful and has allowed us to develop a cohort of trained instructors throughout the country with strong commitments to UCC and who could form the basis for future cooperation in terms of training and research.

Outreach training is more likely to result in successful and effective change in clinical practice, in that it encourages local ownership of the programme. Change from within an organization is invariably more successful than when it is imposed or initiated from outside. While the initial outreach teaching came from the University, we provided the local trainers with all the necessary resources including manuals, equipment sources and advice to develop and sustain their own programmes. We also trained at least 2 individuals in each hospital as NRP instructors, recognising that successful change requires the co-operation and involvement of key local people who are likely to be affected by change.

Conclusions

- Health care professionals in Ireland desire formal skills training programmes in resuscitation.

- The NRP has been shown to meet these needs in the field of neonatal resuscitation.
- Anecdotal "success stories" following NRP training are encouraging.
- A cohort of trained instructors has been developed throughout the country with strong commitments to UCC due the policy of outreach teaching. This group could form the basis for future cooperation in terms of training and research.

Chapter 8 Key issues for changing attitudes and overcoming barriers to NRP education in Ireland

Introduction

Health training and education is at the interface of academic institutions and the institutions delivering health care and are a responsibility of both institutions. In order to discharge this educative dimension, we must know how people learn, especially how adults learn, what barriers exist to the learning process and how these barriers can be overcome. The purpose of this chapter is to explore these barriers, and develop solutions to allow better access to effective training and ultimately improve health outcomes in neonatal care.

Methods

An NRP Instructor Course was held in UCC in March 1999. As part of the 2-day course, a workshop was held in order to explore the barriers to training within the various Health Boards in the country. The participants consisted of 18 instructor candidates and four instructors from all parts of the country. The candidates and instructors were divided into 4 sub-groups which each explored the barriers to training. Each sub-group appointed a leader who led the discussions and presented the conclusions of the group at a plenary session. When the problems and suggestions of each group were discussed a number of general themes were developed.

Table 8.1: Barriers to learning and lessons learned and insights

Barriers	Lessons learned and insights
1. Limited employer acceptance *For training* *For re-certification*	Get senior administrators on-board Quality assurance evaluation both at the local hospital and regional levels Lobby to make NRP mandatory for employment Lobby insurance industry re risk management Lobby hospital credentialing agencies Lobby the Medical Council & Board Altranais
2. Personal barriers *Fear of failure* *Lack of confidence* *Lack of time* *Difficulties with scheduling* *Limited CME availability* *Financing uncertainties; Who pays?*	Get course material well in advance Practice sessions with colleagues Non-stressful teaching environment Pre-view the NRP video Get CME recognition (Board Altranais, RCPI) Increase study leave for nurses & doctors Sponsorship for equipment Have local courses Arrange course to suit local needs Collaborate with regional instructors
3. Attitudinal barriers to training and re-certification *Motivating the sceptics*	Encourage/Advertise Train nursing and medical students Get midwife tutors trained in NRP Give public recognition (certification ceremony) Audit current resuscitation practices Regional NRP protocol used by all participants Use "mock code" resuscitation drills Get NRP on Paediatric Specialist Training and Bord Altranais training curricula
4. Professional barriers *Legal liability concerns: Who is responsible?* *Maintaining standards and re-certification*	Develop a National Multidisciplinary NRP Advisory Group Appoint a National NRP coordinator Clarify roles and responsibilities at national & local level

Barriers to successful implementation of the NPR were discussed and a number of themes, which described the barriers faced by the participants, were developed. In addition, the participants made suggestions for overcoming these barriers based on their own experience and insights. These issues are presented in table 8.1.

BARRIERS, LESSONS LEARNED AND INSIGHTS

Barrier 1: Limited employer acceptance – The concept of resuscitation training is relatively new in Ireland. Indeed, NRP was the first structured resuscitation-training programme in Paediatrics introduced into this country, to be followed by another UCC initiative, Paediatric Advanced Life Support (Malone 1997), which has also been disseminated nationally. Despite the emphasis in the Health strategy of 1994 on training, Health authorities, including the Department of Health, have not yet fully accepted their responsibilities to provide proper training, certification and re-certification for those working in critical areas. This is illustrated by the limited number of Resuscitation Training Officers who are mainly concentrated in the non-maternity Dublin Hospitals. The first Resuscitation Training Officer in the Southern Health Board, outside of the Ambulance Service, was appointed in the year 2000.

Lessons Learned and Insights – Some participants found their immediate line supervisors (usually the Matron) supportive of the NRP and the need for training. However, the general impression was that most were having significant difficulties

getting their superiors to respond to training needs on a consistent basis. The advice from the more successful groups was to focus efforts on sympathetic senior nurse administrators and/or medical consultants with vested interests in quality training such as consultant Obstetricians, Paediatricians and Neonatologists. Evaluation of current practices by quality assurance initiatives at the local hospital and regional levels could be influential in changing attitudes and opinions. Hospitals should be encouraged to develop protocols for maintaining resuscitation equipment and support neonatal resuscitation team activities by audit and regular practice. The participants in our workshop were unanimous in the belief that NRP should be a mandatory requirement for employment, for all professionals involved in delivering and caring for the newborn.

Barrier 2: Personal barriers: Most people can identify with the very personal, but universal, barriers to education, including lack of confidence and fear of failure. Most adults, with full time commitments to their jobs and families, are familiar with the constraints of time and the difficulties with scheduling time for learning and training. The limited availability of continuing education in the Irish Health Services also compounds the very real difficulties facing even committed adult learners. Finally, there are no consistent financial resources available to fund such essential training. Some health boards provide full funding while others provide no funding whatsoever. In addition, to direct funding there is the issue of resources for paid release of participants from their clinical duties during studying and training.

Lessons Learned and Insights – Many of the suggestions of the participants reflected the lessons they themselves had learned and assimilated in the Instructor Training Course. All participants in NRP training are adult learners and should be treated with consideration and respect. Their prior experience should be acknowledged. Providers should be given the course material well in advance to allow adequate time in their busy lives for course preparation. Practice sessions with colleagues who have already passed the course should be encouraged. The NRP video should be available to participants prior to the course. Personal fears and anxiety inhibit proper learning and retention. Therefore, teaching should occur in a non-stressful and comfortable environment with full release from clinical responsibilities. Resuscitation courses must be user-friendly, the training must be regular, and collaboration with regional instructors from other hospital and disciplines should be encouraged. Where possible courses should be held locally and arrangements made to suit local needs. For instance, the course format could occur over one day or two separate sessions. Finally, individual course should be designed to meet specific needs of different disciplines. In our original evaluation we found that nurses found the airway station more difficult compared to ambulance personnel (chapter 8). In contrast the latter were more likely to have difficulties with the lectures on medications in newborn resuscitation.

Nurses, in particular, have very limited Continuing Education allowances in Ireland, both in terms of time and re-imbursement and this needs to be addressed at a national level. Non-consultant hospital doctors receive an annual allowance from the Medical and Dental Postgraduate Research Board, which can be used towards resuscitation training costs. This has been enhanced in recent years. There have been improvements in the educational investment of ambulance personnel and in the SHB increasing numbers of ambulance personnel are being trained in NRP. This is not the case for all health boards, however.

Funding: Who should provide and pay for these courses is unclear. If access to more training is associated with improvements in the quality of care, the onus is on the individual Health Boards, (and ultimately the Department of Health and Children), to provide proper resources and funding for essential training of health professionals. The use of incentives (as well as disincentives) to bring about change in health care is well documented (Drummond 1994, Drummond & Maynard 1993, Maguire et al 1991). Medical defence organizations and hospital insurers may be willing to support if it can be shown that resuscitation training can reduce liability costs. Some participants in this study saw sponsorship, from the pharmaceutical, infant milk companies and the medical supplies industries, as one means to overcome initial start-up costs for equipment and other course materials. Others pointed to potential conflicts of interest and ethical constraints with such involvement.

Barrier 3: Attitudinal barriers to training: The participants in this workshop were highly motivated to learn and teach the principles of NRP. However, they did recognize that not all their colleagues were as motivated. Many believed the main reasons for failure to participate were personal as outlined above. In addition, it was felt that many veteran health care professionals were entrenched in the idea of "learning on the job" and did not necessarily see the value of structured skills training programmes. In addition, veteran employees may have no wish to take on a role with potential increased responsibility or liability.

Lessons Learned and Insights –Suggestions to overcome these barriers included recommending NRP training to students while still in training, i.e. nursing, medical students and ambulance trainees. Younger students and recent graduates were seen as more willing, and even anxious, to participate in resuscitation training. The recently published requirements and standards for midwife registration and education clearly emphasises cardiopulmonary resuscitation of the newborn infant in the revised training syllabus (An Bord Altranais 1999). This programme demands "flexible, innovative practice orientated programmes" from third level institutions and health care institutions involved in the education and training of midwives. Midwife tutors in Nurse Training Schools and Universities, were seen as a yet untapped resource in terms of NRP training and were a potential important group of instructors. Public recognition by means of a certification ceremony was also seen as necessary to reward successful participants and to motivate new candidates. Advertisement through success stories in the NRP Newsletter was also considered of

benefit. Regular audit of resuscitation practices was not common practice in most hospitals but was seen as a potential way of motivating a change in attitudes. Neonatal resuscitation drills ("mock codes") by those who had completed the NRP was seen as a way to encourage non-participants and an important way to maintain skills. Regional rivalries between maternity hospitals were also seen as stumbling blocks that needed to be overcome, not least because resources in smaller units, including available instructors, are limited. For smaller units an identified regional perinatal unit may be the most logical locale for the establishment of training facilities. Alternatively a geographical group of units may wish to combine and rotate resources, skills and venues, for mutual benefits. A shared regional NRP protocol, as outlined in the NRP, should lead to improved cooperation between the regions. Finally, it would be extremely helpful if the health services career development ladder recognised the added responsibility of training by connecting any new roles with a merit increase in salary.

Barrier 4: Professional barriers: – Uncertainties regarding licensure, personal jurisdiction and accountability are becoming particularly thorny issues in Irish Health Care in general, and not just in resuscitation training and practice. Participants, particularly from the nursing profession, expressed concern and uncertainty about the limits of their roles in the actual resuscitation situation. Are they allowed to perform endotracheal intubation? Can they administer emergency resuscitation medications? Current codes of practice do not permit nurses or ambulance personnel to perform endotracheal intubation or administer resuscitation

medications. During NRP training, all participants are taught the full range of resuscitation techniques. However, all participants are reminded that their NRP certification signifies successful completion of the course. It does not certify competence or the limits of their practice.

Lessons Learned and Insights: Licensure, competence and legal liability are all complex issues that need to be addressed nationally and were considered to be within the remit of a proposed national multidisciplinary Resuscitation Council. Other suggestions to advance resuscitation training included advocating NRP training as part of educational curricula in Paediatric Specialist Training and An Bord Altranais and the appointment of a National NRP coordinator to oversee the programme and maintain standards. Lobbying the hospital insurance agencies, the Medical Council, Bord Altranais, and the Department of Health was seen as the way forward. Such lobbying has proved successful in some jurisdictions. For instance, in New York, *legislation* requires all physicians attending patients in Emergency Rooms to be certified in Advanced Trauma Life Support, which has thus become a legal standard of care.

Discussion

This study has identified four general themes that act as barriers to NRP training in this country. These include:

- Limited employer acceptance

- Personal constraints including fear of failure, time constraints and
- The scepticism of colleagues
- Concerns of legal liability and codes of practice

The participants of this particular focus group, which included nurses, doctors and ambulance personnel, not only brought an understanding of the difficulties they faced in introducing resuscitation training, they were also prepared to develop solutions to these barriers.

The subjects in this study who highlighted the barriers to training were participating in the NRP Instructor Course. This course, which is based on the principles of constructivist learning, may have helped in overcoming some of the barriers to training that some adult learners experience. During the course, there is an emphasis on an andragogical (adult orientated) model of learning. The essential elements of this model, advocated by Knowles (1990) and others, are that adults learn best from solving problems to meet their needs and interests, by drawing on their existing knowledge and prior experience in a democratic, non-hierarchic, non-authoritarian environment. The effective teaching of adults, which is the focus of Chapter 9, requires the teacher to be a facilitator of learning, in a two-way contractual commitment, rather than simply a provider of information, knowledge and skills.

When introducing any new educational concept there may be resistance to change for reasons that cannot be addressed by teaching alone. There can be intrinsic problems within the social organization of health care, many of which have been identified above, that operate against the desire for change. These issues will be discussed further in the next chapter.

Methodology

A qualitative approach was used in this particular study. Qualitative research concentrates on people's experiences, attitudes and beliefs; their perception of a situation. Qualitative research recognises that individual experiences have commonalities with other people's experiences, although each is unique. This type of research aims to generate an understanding of what is going on in an every day setting. Various aspects of the study question are explored and the researcher examines descriptions and patterns, with a view to explaining the subject of the study.

Qualitative methods are useful when there is little known about the research question, in this particular case, the impediments to resuscitation training. These methods are also useful when describing phenomena from the perspective of a particular focus group. The advantages of using a focus group are that they are flexible, low-cost, and relatively easy to conduct (Reed and Payton 1997). In a relatively short time focus groups can identify a diverse range of information. Jackson (1998) also suggests that one participant can trigger a chain of responses

from others and that the group may "provide a stimulus for elaboration, analysis and justification of views".

There are also some disadvantages to this method in the current study. This group of instructor candidates was likely to be biased in favour of committed individuals and thus may not be representative of health care work-force relevant to neonatal resuscitation training. In addition, certain individuals in a focus group may prevent others from speaking about their experiences openly, thus dominating the forum and skewing the results. The division of the main group into small discussion groups who then reported back to the plenary group may have reduced this potential bias. This process also provided a form of group validation in that the common concepts and themes were then presented to the plenary group and discussed for applicability and accuracy.

In conclusion, this qualitative investigation of a relevant focus group has shown that significant barriers to education and barriers to realizing the potential and promise of deploying NRP, exist within the Health service. These include limited employer acceptance, resistance to change, financial constraints, professional and legal liability issues, and the complexity of integrating the programme into the curricula of various health care professionals. These barriers were real. However, participants were anxious to overcome them. The NRP Provider and Instructor courses are examples of how the strengthening of cooperation between institutions of Higher Education and Health can be developed for mutual benefit.

Chapter 9 Teaching and beyond: bringing about effective change.

Introduction

The objectives of this chapter are to examine current thinking and theories on bringing about effective change in attitudes and behaviour in health care. If there have been changes in attitudes and behaviours regarding neonatal resuscitation training, this should be reflected in expansion and acceptance of NRP into the Irish health care system. The current status of NRP teaching and other means that have been investigated in attempts to consolidate the role of NRP training in Ireland will be addressed.

Dissemination of NRP by teaching (the *Health Education Model*) has been the main focus of this thesis. This model recognises that health education attempts to influence the *knowledge*, *attitudes* and ultimately the *behaviour* of individuals and groups of individuals. In the current context, many individuals have been trained in NRP, and have been given certain skills and knowledge. That individuals learn and retain resuscitation *skills and knowledge*, at least in the short-term, has been confirmed by the systematic review in chapter 3.

However, there are limitations to what a teaching programme can achieve in teaching attitudes, a fundamentally necessary perquisite for bringing about change. Indeed,

the evidence suggests (Thorley 1985) that teaching programmes are really most successful at increasing knowledge. They are less successful about changing participants' attitudes and least successful at changing their behaviour.

Changing people's attitudes required a higher or deeper intellectual process of cognitive recognition and internalisation (Mackway-Jones & Walker 1999). The learning of attitudes has four stages, which include *perceiving, complying, accepting and internalising*. There is no guarantee that telling an individual an attitude is important (*perceiving*) will ensure that they will adopt that ethic, although learners, who go to the trouble of attending a course, are likely to *comply* with the concepts of a dynamic teaching programme. The subsequent testing of attitudes in real environments, such as an actual resuscitation scenario, may well bring the learner to *accept* the values taught. The final stage is reached when the learner recognises these attitudes as being of value in their own rights at which point the learner *internalises* the attitudes and makes them his or hers in all contexts.

Such internalisers are likely to want to become local or regional instructors and be actively committed to teaching in order to improve outcomes in their own workplace. In this way they become part of what is known as the *co-ordinated implementation model*, one of the most effective ways of bringing about change. This model involves *local* key players promoting effective change based on *locally* prepared analysis of what needs to be done and what measures need to be taken to achieve this. This

model requires effective leadership within a democratic environment that necessitates trust between all participants affected by the change. Lomas et al (1991) found that such local leaders were more effective than audit and feedback activities in bringing about effective change.

Changing people's behaviour may also require additional incentives and/or disincentives (Drummond 1984, Drummond & Maynard 1993, McGuire et al 1991). Thus, the rewards of changing behaviour must be greater than those of doing what has always been done and must be recognised and experienced as such by the people involved to bring about effective change. Financial rewards may be necessary to change certain behaviours. Lack of financial support to undertake training programmes can act as a disincentive as we have seen in chapter 8 when discussing the barriers to training.

Change can occur at different levels of the Health Care system. It can take place at the macro, meso or micro level, at the national and local level, at the strategic level and at the implementation level. One is encouraged to be aware of the relationships and interdependence between these levels. Otherwise innovations are likely to fail simply because the wrong thing is done at least appropriate level with the least chance of success.

When seeking to bring about health care change, one needs to be clear whether one is seeking to change *individuals, groups of individuals, health care systems* or all three. Teaching programmes are directed at individuals or groups of individuals. This approach to social change, giving more attention to the actions and interactions of the individuals and groups of individuals, is referred to as the *social interactionist approach* to social change and tends to be *inductive* or bottom up and for the main part. Teaching programmes help practitioners to see the innovation in operation (*observibility*) and allow them to try it out on a limited basis (*trialibility*).

In order to consolidate and advance inductive changes, it is also necessary to attempt to change at the *social systems* or macro level. Such 'top down', *deductive*, implementation can be the most effective way to introduce innovation. However, if used in isolation, these externally driven initiatives can work against successful change, particularly if the issue is seen as remote from practitioners day-to-day concerns, if the relative advantages of introducing change are not clear and if the innovation involves knock-on effects that increase the complexity of everyday practice.

While health care systems at the macro level may appear seemingly stagnant, they are, in fact, in a state of constant flux. Systems theorists use biological metaphors to describe the workings of such organizations. They suggest that there are self-adjusting boundary maintenance mechanisms between social systems, such as

hospitals, and the broader society and that change occurs only when they respond to the demands made upon them from the outside (Government Employers, Credentialing Agencies, Hospital Insurers, the Public) or from within (Professional Associations, Parents Groups or Carers Groups). Pressure from these organizations can bring about new social arrangements and establish a new equilibrium (*homeostasis*).

With these conceptual factors in mind and the author's previous experience in introducing change into neonatal pain control (Ryan et al 1995), the initial aim of this project was to initially introduce the NRP in an inductive "bottom-up" mode, focusing the resources and teaching on those individuals who are always present at deliveries, midwives, non-consultant paediatric and obstetric doctors and ambulance personnel. Past personal experience of finding oneself in critical resuscitation situations without proper training or supervision, convinced the author that structured resuscitation training was not only of vital importance to the patient but that the first line rescuer was likely to be receptive. Significant progress has been made at this level, as outlined in the following table, which outlines the current status of NRP training throughout the country.

Over 2000 providers have been trained since the inception of the programme in 1994. Courses have been held in 19 centres, with 176 documented official courses.

In addition, to date, over 100 Instructors in Neonatal Resuscitation have been trained. Approximately a quarter of trained instructors become active trainers.

Outreach courses directly from NRP (UCC) have been held in most maternity units in the country. The exceptions include Letterkenny General Hospital, Our Lady of Loudres, Droheda, and Portlaoise General Hospital. However, personnel from Letterkenny, including two Consultant Paediatricians, attending UCC provider and Instructor courses and now run regular provider courses for their own staff. Similarly the neonatologist in Droheda is a recognised NRP Instructor and runs local courses. In Dublin, outreach courses have been held in the Coombe and Instructors from the other major hospitals have been trained. Certain areas such as the SEHB have worked together to train staff in hospitals with their Health Board, following initial UCC outreach courses and Instructor training.

Almost all maternity hospitals in Ireland have NRP teaching resources at their disposal including the official NRP video and books. There has been widespread use of a set of teaching slides that were developed by NRP (UCC). See table 9.1 on next page.

Health Board	Health Board population 1996 census	Hospital	Deliveries per year 1999	UCC Outreach course	On-site NRP equipment	NRP manuals	UCC NRP slides	NRP video	Local instructors	Local NRP courses	Courses per year
SHB	546,640	Erinville, Cork	3000	Y	Y	Y	Y	Y	Y	Y	4
		St Finbarrs, Cork	1600	Y	Y	Y	Y	Y	Y	Y	4
		Bons, Cork	2000	Y	Y	Y	Y	Y	Y	Y	1
		Tralee General	1163	Y	Y	Y	Y	Y	Y	Y	3
MWHB	317,069	Limerick	4024	Y	Y	Y	Y	Y	Y	Y	3
WHB	352,353	University H Galway	2700	Y	Y	Y	Y	Y	Y	Y	3
NWHB	210,872	Mayo General	1188	Y	Y	Y	Y	Y	Y	Y	2
		Portiuncla	1700	Y	Y	Y	Y	Y	N		3
		Sligo General	1300	Y	Y	Y	Y	Y	Y	Y	6
		Letterkenny General	1500	N	Y	Y	Y	Y	Y	Y	2
NEHB	306,155	Droheda	2054	N	Y	Y	N	Y	Y	Y	3
		Dundalk	449	N	Y	Y	Y	Y	Y	Y	1
		Monaghan	350	Y	Y	Y	N	N	N	Y	4
		Cavan	950	Y	Y	Y	Y	Y	Y	Y	4
MHB	205,542	Mullingar	1200	Y	Y	Y	Y	Y	Y	Y	1
		Portlaoise	1100	N	Y	Y	N	Y	N		0
ERHA	1,295,939	Coombe	8000	Y	Y	Y	Y	Y	Y	Y	4
		Rotunda	6360	Y	Y	Y	Y	Y	Y	Y	2
		National Maternity	7537	N	Y	Y	N	Y	Y	Y	6
		Mount Carmel	1121	N	Y	N	N	N	N	N	0
SEHB	391,517	Wexford General	1500	Y	Y	Y	N	Y	Y	Y	0
		Waterford	1600	Y	Y	Y	Y	Y	Y	Y	2
		Kilkenny	1268	Y	Y	Y	N	Y	Y	Y	0
		Clonmel	1000	Y	Y	Y	N	Y	Y	Y	4

Table 9.1: Current status of NRP in Ireland by Health Board and hospital

For health care practitioners, the degree of conceptual abstraction outlined above may seem irrelevant to every day practice. However, it does clarify that, teaching at the social interactionist (micro) level is not sufficient to engender change and that it is also necessary to operate at the macro- level, i.e. *social systems*. Lomas refers to four key players who provide various sources of influence on actions and practice of heath care systems. These include health care administrators, public policy makers, clinical policy makers (professional associations and disciplinary bodies) and patients, parents and community interests groups. As a result of the suggestions that came about in the study of a focus group of Instructor candidates, outlined in the last chapter, the author has tried to influence development in the following areas, to varying degrees of success (Tables 9.2). If no progress was made in developing an issue to fruition, it is described as 'non-compliant', using the language of the Canadian Accreditation agency recently piloted by the DOH&C as the Major Academic Teaching Hospitals Accreditation Scheme. If some progress on a particular issue has been made, it is assessed as being 'partially compliant'; if complete, it is described as 'compliant'.

	Non-compliant	Partially compliant	Fully compliant	Comments
Get senior administrators on-board		x		DOH&C have funded a North-South pilot neonatal resuscitation & stabilization programme (£70,000)
Quality assurance evaluation local hospital level	x			Unaware of any audit of resuscitation practices apart from those outlined in this thesis
Quality assurance evaluation at regional levels	x			
Lobby to make NRP mandatory for employment		x		NRP is mandatory for National Neonatal Transport Team members. NRP is considered 'desirable' for Paediatric NCHD's including Specialist Registrars
Lobby insurance industry re risk management		x		See letters from medical defence and hospital Insurers (appendix 4)
Lobby hospital credentialing agencies	x			Credential agency (Major Academic Teaching Hospitals Accreditation Scheme) only in pilot phase
Lobby the Medical Council		x		Enquiry made: Medical Council do not it their role to promote or make mandatory individual courses but welcome any CME initiative
Lobby An Board Altranais		x		Education credits granted for NRP
Lobby the Faculty of Paediatrics RCPI		x		Neonatal resuscitation guidelines developed in thesis have been accepted by the Faculty of Paediatrics
Develop a National Multidisciplinary NRP Advisory Group	x			
Appoint a National NRP coordinator		x		A part-time coordinator post has been maintained in the Dept of Child Health and Paediatrics, UCC, since 1995.Faculty of Paediatrics blueprint guidelines (developed by the author) may be of help to providers in clarifying roles; but more needs to be done.
Clarify roles and responsibilities at national & local level		x		

Table 9.2: Non-teaching approaches to implementation of NRP nationally

Discussion

While significant progress has been both in dissemination of the NRP and in highlighting the need for structured training, much remains to be done in both teaching and lobbying.

- The appointment of *a national Co-ordinator* to oversee training, recertification and standards is an obvious priority.

- The development of a *multidisciplinary Steering Committee* to oversee the development of NRP and a neonatal stabilization and transportation education programme such as STABLE® is also a priority. Initials steps have been made in this direction, with preliminary discussions for such a group having taken place at the STABLE® course in June 2000. This will be progressed further at the Neonatal Subcommittee of the Faculty of Paediatrics.

- A *national network* of committed Regional Instructors has been developed. These individuals must be encouraged and supported.

- The ability to show demonstrable relative advantage is crucial to the change process and this requires careful and appropriate monitoring and evaluation. *Regional audit* is therefore necessary and could be the remit of Regional Instructors.

- Continued cooperation North/South co-operation may prove a very fruitful exercise for both Health Services. Significant cooperation already exists through the Faculty of Paediatrics RCPI. The major difficulty in the cooperative approach

to teaching across the border is that the Resuscitation Council in the United Kingdom does not recognise NRP. Instead it has developed a UK based programme, called Neonatal Life Support (Resuscitation at Birth 2001). While the basic principles of neonatal resuscitation are common to both programmes, the textbooks, lectures, skills stations and objective tests are different. A possible advantage for having different courses in neonatal resuscitation on either side of the border is the potential for future research to explore and compare the effectiveness and efficiency of the two programmes in terms of training and neonatal outcome.

Chapter 10 Professional reflection on the scholarship of teaching the NRP

Teaching, like sex, is something you do alone...although you're always with another person/other people when you do it .... and people rarely talk about the experience.

Jane Tomkins, 1993

This thesis, by the integration of teaching and research, has described a journey in teaching from the local introduction of a specific teaching course, through national propagation and evaluation of this course. A number of unique dimensions have intrigued and challenged me as a teacher, while teaching these courses. These include the fact that most of the students are adult learners of varying abilities and backgrounds. Skills teaching is a significant component, (more so than in many University teaching programmes), and poses unique challenges in practice. Other unique facets of teaching resuscitation courses, include the multidisciplinary nature of the students (doctors, nurses, Emergency Medical Technicians, medical and nursing students) and the outreach component, which led to local, national and global linkage in education.

My own approach to teaching has changed, prompted, in particular, by my experience of teaching the NRP Instructor Course. This course allowed me to reflect upon my own teaching style and my philosophy of teaching, engendering a greater

appreciation of the special needs of adult learners. The time has come to confound Jane Tomkin's statement and talk about my personal experience of teaching.

In this chapter, I intend to present a teaching portfolio that reflects on teaching and learning in the process of delivering the NRP Provider and the NRP Instructor courses. A teaching portfolio is best described as a goal-driven collection of materials that document one's teaching performance over time. Hutchings, (1993), argues that "*. . . teaching portfolios can prompt self-reflection and improvement, promote collaboration and attention to shared goals, provide richer, more authentic evidence of teaching effectiveness and encourage a view of teaching as scholarly activity*". Teaching portfolios offer a creative form of documenting teaching achievements (a summative portfolio), and through a formative process of self-reflection and self-improvement, can lead to better and stronger teaching. Thus, as well as providing a means of documenting teaching, the teaching portfolio serves as a method of scholarly inquiry.

I will be addressing the formative components of teaching the NRP Provider and Instructor courses and will demonstrate how teaching these courses have contributed to my personal development as a teacher. I will address a number of topics that are a recognised part of a teaching portfolio, including, a teaching biography, a statement of my teaching philosophy and a description of my teaching methodologies. Finally, a crucial component of a teaching portfolio is a demonstration of scholarly reflection and evaluation of that teaching experience.

A Teaching Biography

I have been teaching since my graduation from UCC Medical School in 1977 in Ireland, Scotland, England, Iraq, Canada and the United States. My teaching has included didactic lectures, tutorials, grand rounds, bedside teaching, outpatient clinical teaching, presentations and skills sessions. Students have come from a broad range of backgrounds including medicine (paediatric, obstetrical and anaesthetic junior house doctors), nursing (paediatric, midwifery and public health), respiratory technologists, ambulance and other paramedical specialties.

Theories of learning are important guides to teaching. In addition to learning how to teach from observing mentors, I have completed the University of Alberta Teaching course for University staff (TIPP). Other formal teaching seminars include instructor courses for Advanced Trauma Life Support, Paediatric Advanced Life Support and the Neonatal Resuscitation Programme. Small skills groups and skills teaching are emphasised in the latter courses. These teaching courses, I believe, have helped me develop a stronger knowledge of theories of learning and a fuller repertoire of skills and strategies to match these. As a result, my intuitions about good teaching practice have changed over time. I hope to be able to show how my teaching experience has influenced my teaching style and my philosophy of teaching.

A Statement of Teaching Philosophy

It is important to distinguish between the "whys" of teaching and the "hows" of teaching. The "whys" of teaching refer to teaching philosophy and are the focus here. The "hows", or methodologies, are another critical dimension of professional reflection that will be addressed later. This course portfolio, and therefore my teaching philosophy, refers to my teaching of the NRP and the NRP Instructor courses, although what I have learned here has influenced all aspects of my professional teaching responsibilities.

- *I teach resuscitation training in order to transmit the knowledge, and skills of evidenced based resuscitation of newborns.*
- *I teach because I want to bring about a change of behaviour in the student, initially in the classroom scenario but more importantly in actual clinical practice, when they transform from student into practitioners.*
- *I teach because I want a better clinical outcome for my patients, i.e. newborn babies, when their carers are proficient in resuscitation training and work together as a team.*
- *I teach because I want students to feel secure about their skills in the very challenging clinical situation of trying to save a newborn baby's life.*
- *I teach because I want students to make connections between the basic sciences and clinical sciences.*

- *I teach because I want students to feel good about themselves, to feel good about learning and for them to enjoy a sense of accomplishment.*

- *I teach because I believe that adult students should be treated with respect. The content of the course should be relevant and have meaning and purpose for everyday issues in their lives. As a teacher, I want to ensure the learner is actively involved, that objectives are defined and goals are set. Positive feedback must be provided and time for reflection should be encouraged.*

- *I teach* ***Instructor*** *training because I believe effective teaching skills can be taught, learned and developed.*

- *I teach* ***Instructor*** *training because I believe that an effective teacher must have a good understanding of the subject matter being taught as well as of the underlying pedagogical theory. Teachers should be able to vary teaching styles and should expect students to participate in a mixture of lecture, discussion, and group activities. Technology is important in the classroom since it is a vehicle for instruction and can be an invaluable tool for addressing different learning styles.*

- *I teach* ***Instructor*** *training because being an effective teacher can be a difficult task, requiring practice and dedication, but can provide rewards that are well worth the effort.*

- *I teach because I want to be part of a global community that believes in teaching as a field of inquiry, dedicated to the scholarship of that field. I believe that it is a teacher's responsibility to stay current in a field, engaging*

in research and participating in classes, conferences, workshops and mentoring.

Methodologies of teaching

Course content

The course content and objectives of these courses are outlined in appendices 1 and 2. The teaching goals of NRP are clearly well developed and well articulated, with an excellent textbook and accompanying CD-ROM, which are designed for self-study. There are flexible ways in which the course can be taught, using a variety of techniques and technologies. The latter including a course specific video and slides.

The Provider NRP Course teaches knowledge, attitudes and individual and group skills. Cooperation and teamwork are also emphasized, recognising the different expertise and different roles in clinical practice among the students. In the NRP Instructor Course, there is an emphasis on teaching an andragogical model of learning. Some of the slides I prepared for the lecture on theory, relationships, and group dynamics illustrate the essential elements of this adult orientated adult orientated model (appendix 4). The effective teaching of adults requires the teacher to be a facilitator of learning, in a two-way contractual commitment, rather than simply a provider of information, knowledge and skills. Thus, adults learn best from solving problems to meet their needs and interests, by drawing on their existing

knowledge and prior experience in a democratic, non-hierarchic, non-authoritarian environment.

Teaching strategies:

Teaching resuscitation to a multidisciplinary class demands a good repertoire of teaching skills including lecturing, leading workshops, skills teaching, and an awareness of group dynamics and assessment. Teachers of adults should adapt their teaching to accommodate these features. The *content* of the course should be relevant and have meaning and purpose for everyday issues. The teacher should ensure the learner is actively involved, that *objectives* are defined and *goals* are set. *Positive feedback* must be provided through positive critiquing of the candidates performance and through positive reception of the candidates' contribution. *Reflection* should be encouraged through summaries and during lecture and skill station activities.

Thus, during the NRP Instructor course, the Instructor candidate is taught to present the course to the new provider in a problem-solving manner, recognising that participants are more likely to learn if the course meets their clinical needs (*needs based*), and draws on their prior experiences (*experiential learning*). We teach the fundamentals of giving a good lecture, teaching a skill, evaluation through a process of positive feedback and group dynamics. These are described briefly below:

- *Giving a lecture:* Preparing the *environment* (lighting, heating, ventilation, equipment), the *set* (setting the mood and the objectives of the lecture), the *dialogue* (the body of the talk) and *closure* (questions, summarize and terminate) form the basis for good lecturing technique. In the NRP Instructor Course, we teach the student how to enhance their natural lecturing abilities (enthusiasm, approachability, humour), and correct poor techniques (voice projection, stance, etc), through role-playing and positive feedback.

- *Teaching a skill:* Skills are taught by *perception* (the student observes the instructor performing the skill) and *guided response* (the student performs the skill under supervision). We teach a 4-step system for skills teaching, originally developed to train children with disabilities to brush their teeth! First, the instructor performs the task, without commentary. She then repeats the task providing commentary on each step of the process. The instructor again demonstrates the skill and the student provides commentary. Finally, the student performs the task and provides commentary. With further practice, the student becomes *proficient* at performing the skill and with further experience performing *mastery* is achieved, at which point the skill becomes almost an automatic response. While the student may become proficient, mastery or autonomy is seldom achieved during short courses.

- *Positive feedback:* This refers to a process of critiquing the candidate's performance through a positive reception of the candidate's contribution,

often involving the other students in the group. This is particularly useful in improving and assessing skills, since learners cannot improve unless they know *where* improvements are necessary and *how* the improvements may be made. A six-step outline is as follows: What did you do well? (to the student). What did (s)he do well? (to the group). What would you change/improve? (to the student). What should (s)he change/improve? (to the group). The leader then summarizes and shows once more how the skill should be done, reinforcing the positive aspects of the student's performance.

- *Group dynamics:* There can be varying degrees of preparation, expertise and involvement among students in a small group session. Thus, much of the group's dynamics is dependent on the interpersonal skills of the members. This is similar to the clinical situation the students subsequently find themselves, when effective resuscitation of a newborn infant, depends on team rather than individual intervention. A team may be friendly/unfriendly, agreeing/disagreeing, or supportive/destructive. We teach instructors how to develop communication within a team, how to be creative, to recognise and use team strengths and how to evaluate the teams' performance. Practical ways of helping the "talkers" (enthusiastic but dominating participants), the "non-talkers" (the shy, nervous individual), and the "destroyer" (the aloof, obstinate or prejudiced candidate) are also discussed through role modelling and discussion.

Style of teaching

My teaching style has been influenced by my involvement in resuscitation training over the last 15 years and the teaching strategies outlined above. In one of the first teaching courses I attended, **learning** was defined for me as *a relatively permanent change in behaviour that comes about as a result of a planned experience*, with **teaching** being the planned experience. I try to practice what I preach, by preparing a planned teaching session, with the objective of engendering a change in attitudes and hopefully a change in behaviour, among at least some of my students. Ideally, in terms of neonatal resuscitation, I would like to see the students understand the physiological basis for neonatal resuscitation, to develop mastery in resuscitation skills, to enhance good clinical judgement (to know when to call for help), and maintain professionalism (to know how to work as a team with other disciplines). In the broader sense, I would like to see them engage in critical thinking ("When we all think alike, no-one is thinking": *W. Lippman (Public Opinion) 1922*). Finally, I would see some of the students becoming teachers themselves, in a cascade process, so I would also wish to impart some useful teaching strategies to them, by example and as a mentor.

I generally use technological aids when teaching, most recently, using a laptop computer to project my own slides (Microsoft Powerpoint®), with an increasing use of the Internet to download appropriate applications. On the premise that technology is a means, not an end, in teaching, I try not to let audio-visuals become a distraction and I keep my slides simple and relevant to the subject matter. My writing is not that

attractive and I find it difficult to write on a board of flip chart while talking, with the result that I reserve this teaching aid for brainstorming activities.

I am most comfortable teaching small groups, adopting an informal tone, and teaching in an interactive style. Even among larger groups, I try to create a small group atmosphere by encouraging the students to sit close together in the lecture hall. I am conscious of setting the mood appropriate to the talk and clarifying for the student the type of interaction I expect during the session. I do not believe in humiliating or embarrassing students in any way, conscious that anxiety and resentment are major barriers to effective learning. I am aware of the importance of presenting the objectives of my lecture at the outset (usually 5 or 6 important points I wish the student to remember) and constantly relating my ideas and student interaction to these fundamental points.

I try to teach with animation and enthusiasm, trying to create a dynamic mood. I use humour with care, drawing on a small repertoire of tried and tested jokes. I encourage the use of aphorisms and mnemonics, occasionally, to aid recall and retention. I try to enhance student motivation by demonstrating the usefulness of the content to them. I sometimes move about the classroom, making eye contact with students, asking questions. Asking questions is an integral part of teaching, allowing active participation and helping the student to articulate views and reflect. Most importantly, from my own perspective, they give me feedback to level of knowledge and understanding of the student and the relevancy of the teaching matter. I am

conscious that I need to repeat or rephrase the student's comment or question, so all the class can hear and stay involved. There are drawbacks with this style of teaching, which I will address by anecdote later.

I agree with the premise that *"teaching is not simply a matter of method and technique, but a matter of selecting, organising and transforming ones field in ways that connect with students' diverse mental worlds"*. (M. Hubar AAHE 1998). Therefore, the things that make me feel good about teaching include student interactions, responses, smiles, questions and general involvement. I get most satisfaction when I get feedback to suggest I have at least partially met my teaching objectives.

Reflecting on Teaching Experiences

> There are certain experiences – teaching is one, and people tell me that childbirth is another – in which automatic acts of repression immediately follow the experience, wiping out both the painful and sometimes the pleasurable aspects of the experience, but leaving one fresh to try it again.
>
> *Lee Shulman.*

The Course Portfolio is founded on the simple idea that the primary aim of teaching is to enhance students learning, thinking and development. Having outlined

the goals for student learning and the teaching practices to accomplish these above, the purpose of reflection is to see if these practices are helping to accomplish my goals, collecting evidence about effects and impact. Pedagogical amnesia described by Shulman above, discourages the recording and evaluation of teaching experiences. Fortunately, since this was a research project, an evaluation of the NRP programme was done at various levels and forms the basis of this thesis. The key question in evaluation is whether the students grasped the key ideas, methods, skills and values of the course. The evidence presented in this thesis would suggest that they have, at least in the short term and that the programme has been accepted in the broad stream of Irish paediatrics (chapter 4 and chapter 7). However, significant barriers remain (chapter 8).

The fundamental purpose of teaching is to attempt to engender change, an important measure of one's impact or influence. My own personal satisfactions as a teacher have occurred when I have brought about a major change in clinical practice. My first experience occurred when I was able to convince 95% of obstetricians and paediatricians in a major teaching hospital in Alberta to provide local anaesthesia (dorsal nerve penile block) while performing circumcisions in newborn babies (Ryan 1993). It may come as a shock to many that such a painful procedure is ever done without pain control; unfortunately, such practice is still widespread in the belief that babies do not feel pain, a totally erroneous assumption. Introducing the NRP has also been a focus of change, in the way it has been accepted nationally by professionals

throughout the country and also by professional bodies such as the Faculty of Paediatrics, RCPI (chapter 11).

Epiphanies in teaching:

Most of us hope we will teach our course better next time. However, in order to teach better, we must learn from past experience. Sometimes, the lessons forced upon us are humbling, sometimes uplifting. These moments in teaching, where we suddenly realise we have made a contribution or, alternatively, have missed the point completely, might be looked upon as e*piphanies*. An epiphany (from the Greek, *'a showing forth'*), was as James Joyce conceived it, a fragmentary moment invested with significance (Jackson & McGinley 1993). The Stephen of *Stephen Hero* defined it as *" a sudden spiritual manifestation, whether in the vulgarity of speech or of gesture or in a memorable phrase of the mind itself".*

During a lecture, a student appeared to be intensely and flatteringly interested in making eye contact with me as I moved through the class, teaching in what I believed was a constructivist fashion and asking questions of the class. At the termination of the class, she approached me and I realised the reason for the intensity of eye contact. She was profoundly deaf and was trying to lip-read as I wandered back and forth throughout the room oblivious to her plight. This experience has taught me to do less wandering and to give consideration to the possibilities of disabilities among the students.

At an awards-giving ceremony at my former secondary school, I gave the guest lecture, choosing to talk about the unique needs of adult learners, inferring that there was no difference between the teaching needs of adult learners and young adult learners. As guests, children and parents left the hall, a young boy looked up and said shyly: "Great speech". This was one of my most rewarding moments in teaching and convinced me that young adults and even children also want to be taught experientially and with respect. For me as a paediatrician, the circle is complete, in a deliciously ironic way. Teaching strategies that are developed to teach disabled children become the recognised way to teach skills to adult learners (p. 121). Young adults, who many teachers treat and teach as children, show that they want to be taught and learn, as adults have come to expect for themselves.

Even still, as I am evaluating a student's skill whether in a resuscitation scenario or medical examination in clinical practice, I have to stop myself from saying "What did you do *wrong* there?" When I do ask the right question ("What did you do *well* during that scenario?"), the student is usually reluctant to admit to any aspect of his performance being acceptable, let alone good. This is true of all disciplines from nursing, to medical student to paramedics. Thus, there are major cultural hurdles to be overcome in order to give good feedback. Having watched a performance in an area where I am relatively expert, my cultural inclination is to say what is wrong with it, thus demonstrating my own expertise. Learners share in this culture. They want to defend themselves, forestalling criticism by informing me that they are well

aware of the inadequacies of their performance. When I get the learner to admit to some good points in their performance and then request their accompanying colleagues, to give positive feedback, I find them smiling and positive about the encounter (epiphany?); relieved, I am convinced, that they themselves will be evaluated with fairness and respect. It is quite a remarkable experience.

Conclusion

Values about teaching may vary widely and there can be healthy disagreement about what constitutes what characterizes good teaching and what is meant by the scholarship of teaching. Some may value volume of content knowledge as an end, while others may value process or critical thinking skills. Some may value group skills and cooperation, others individual skills and independence. Resuscitation training is a limited area of education and some might argue that any form of "training" lacks scholarship. However, Lyons (1998 & 2001) has argued that *"the design, enactment and analysis of a course it is as much an act of inquiry as any other activity more traditionally called research or the scholarship of teaching".* Thus, although the subject matter of resuscitation training is limited, reflecting on the teaching of adult learners and engendering changes in behaviour are challenging tasks, worthy of the scholarship of inquiry.

"We close the classroom door and experience pedagogical solitude..." (Lee Shulman 1992). This analysis of my teaching experiences has shown that teaching need not occur in solitude and that there is an escape route from pedagogical

amnesia. The goal of developing a description of one's philosophy or pedagogical goals by means of a teaching portfolio, within the community of teaching, is a movement towards more meaningful teaching.

Chapter 11 Summary and recommendations

This thesis focused on the status of Newborn Resuscitation training in Ireland and the introduction of a structured Neonatal Resuscitation training Programme as an example of a quality of care initiative in Health Services Research. The focus is primarily on introducing change on a local and national level and changing attitudes towards resuscitation training.

The need for such a programme was identified by a national study of neonatal resuscitation preparation, protocols and training, and staff availability. A systematic review of the world literature to date assessed the efficiency and effectiveness of a structured training programme in newborn resuscitation and concluded that resuscitation training is associated with improvement in short term knowledge and skills. The way to maintain these skills and information over time needs further study. The programme was evaluated locally through a study evaluating the introduction of the NRP into a maternity unit in Cork. While a RCT would have been the ideal (gold standard) way to evaluate this resuscitation programme, ethical, clinical and service constraints, discussed in chapter 5, dictated a lower quality, but nevertheless, clinically relevant trial. A subsequent, quality assurance, evaluation of almost 500 providers who passed the NRP (UCC) confirmed the acceptance of this form of training by Irish health care workers.

The introduction of the NRP has been associated with a reduction in infant mortality, both nationally and in the SHB. These findings may be co-incidental and not causal as many different factors, not associated with acute hospital care, may be associated with changes in infant mortality. Barriers to resuscitation training in Ireland have been identified and solutions to these barriers explored. As a result of this project, a collaborative network of NRP instructors has evolved which may be an important resource for future research and the evaluation of other programmes such as a Newborn Stabilization and Transportation Programme, currently being evaluated through the Department of Paediatrics and Child Health (UCC). These key people have provided leadership and have helped overcome resistance to changes in resuscitation practices, by their commitment to resuscitation education and by acting as local opinion leaders. Their future role is to ensure that inertia does not set in and that such change is seen as an integral part of the health care provision and not as an optional extra.

Many factors contributed towards the successful implementation and dissemination of NRP. Seed funding was provided by University College, Cork and a recognized College Certificate was presented to successful participants (appendix 6). This certificate is important in affirming the individual's commitment to continuing education and also helps in allowing standards in the course to be maintained and monitored. We were also helped by the cooperation of the NRP (AHA/AAP) in the United States, which allowed, encouraged and facilitated transfer ownership of the programme.

NRP training requires a change in attitude at all levels of health care. In the meantime, it is the responsibility of all providers to clarify their roles and responsibilities at a local level. Nursing and physician organizations and the healthcare industry must work with the government to develop rules that permit expanded roles for nurses and paramedics. Likewise, hospitals must develop credentialing standards that include the requirement for proper resuscitation training for key personnel.

Based on the findings of the studies in this thesis and the experience in other countries in newborn resuscitation training, the author has drawn up the following recommendations, which have been adopted by the Faculty of Paediatrics, Royal College of Physicians of Ireland, as a blueprint for future developments in neonatal resuscitation education in Ireland.

Recommendations

A. Maternity Hospitals Service Responsibilities:

- That written protocols should be developed and displayed in all hospital delivery rooms for

    1. Resuscitation of newborns
    2. Use of drugs in emergencies

3. Selection and maintenance of equipment

4. Maternal and foetal indicators for summoning the paediatric team to attend the birth of an at-risk infant

- That resuscitation equipment should be checked at the beginning of every shift and immediately prior to every delivery

B. Maternity Hospitals Training Responsibilities

- That a person skilled in basic neonatal life support be present at every delivery.

- That a regular education and training programme with 2 yearly recertification be required for all personnel responsible for the care of the newborn. Midwives, student midwives, neonatal nurses and all paediatric and obstetric junior and consultant staff should be trained.

- That training should be given before these health professionals take up full responsibility for providing this service. They should continue to be supervised by experienced staff until their skills have been assessed as satisfactory.

- That training programs for professionals include the use of models to promote resuscitation expertise. The training programme should include both theory and practice with minimum competence levels for a written theory exam and supervised performance of skills.

- That advanced skills such as neonatal intubation procedures should be practiced regularly by selected hospital staff.

- That every institution where infants are born should have on staff at least one or more health professionals trained as an **Instructor** in newborn resuscitation. For smaller units an identified regional maternity unit may be the most logical locale for the establishment of training facilities.

C. A National Training Strategy

- That a national strategy is required to organize, provide and maintain training standards in every centre where births occur.

- That regular audit should be carried out on all aspects of resuscitation practice, including the availability of appropriately trained staff and the provision of equipment.

- That a national interdisciplinary perinatal group should be responsible for the implementation of protocols and guidelines for neonatal resuscitation

- That consideration be given to training nurse midwives in the intubation of newborns.

- That the Faculty of Paediatrics and An Bord Altranais recommend that hospitals adopt the neonatal resuscitation programme and standards.

- That the present network of NRP instructors be supported for continuing recertification in NRP and as a means of propagating others courses such as a neonatal stabilization and transportation course.

- That Department of Health and Children provide infrastructural support for neonatal stabilisation and resuscitation training.

- That cross border collaboration be developed for the evaluation and implementation of a neonatal resuscitation, stabilization and transportation programmes.

D. Educational and research goals

- That teaching strategies be simplified and reviewed based on advances in learning theory and evidence based practice.

- That innovative ways be developed to teach knowledge and skills in order to improve retention.

- That refresher training be based on diagnosed deficiencies and innovative ways to improve retention be evaluated.

- That current NRP guidelines be revisited and reviewed as controlled evidence on neonatal resuscitation becomes available from ongoing trials and meta-analyses.

- That NRP and post-resuscitation stabilization training be made more accessible to non-teaching centres, using videoconferencing and other media.

- That the network of trained instructors that has been created throughout the country forms the basis for future cooperation in terms of training and research.

Conclusion

To date, we have trained over 2000 health care workers, including midwives, physicians and ambulance personnel, throughout the Republic of Ireland. There is little doubt that widespread training in a formal program of neonatal resuscitation, such as NRP, is associated with certain economic costs related to training. However, in terms of risk-management in high-risk sub-specialities such as obstetrics and neonatology, increased training costs would possibly be balanced by reduced professional liability claims stemming from alleged birth injuries. (In 1999 alone, over £4 million was paid out to settle just four Irish obstetric claims, the average cost of settling such claims having increased more than four-fold since 1990; Irish Medical Times, 1999). In 2001, the Medical Defence Union has indicated that the average successful award for a child with cerebral palsy is over £3 million per claim, with up to 8 claims expected annually in Ireland.

While it is known that less than a fifth of cases of cerebral palsy derive from events in the perinatal period (Perlman et al 1997), avoidable factors, including inadequate resuscitation skills and practices, are still present in many cases of perinatal brain injuries. In the 1995 Confidential Enquiry into Stillbirths and Deaths in Infancy (CESDI), 43 cases of 388 deaths investigated had evidence of poor resuscitation

technique that contributed to the babies' deaths (See letter from MDU in Appendix 5). Neonatal outcome may improve and, at the very least, public confidence in the events surrounding birth will be enhanced by the knowledge that health care professionals are properly trained in the important area of newborn resuscitation. Indeed, the current developments in relationship to Clinical Governance will dictate that health professional undertake proper training and re-certification in resuscitation, so that unacceptable variations in the quality and outcome of clinical care are minimized.

Appendix 1

Description of the Neonatal Resuscitation Programme

The optimum environment for the delivery of a newborn infant is in a well-prepared delivery room. Immediate transport of a labouring mother to such a facility is a high priority. Advanced preparation is vitally important for a safe pre-hospital delivery and resuscitation of the newborn. The equipment necessary should be self-contained in a newborn resuscitation kit. This kit should be kept separately from adult resuscitation equipment, as there will be little overlap in its use.

Neonatal Resuscitation Equipment

A. Items for the Newborn Resuscitation Kit

- Bulb syringe, suction catheters (8 and 10 Fr), cord clamps, scissors, gloves, syringes (5, 10, and 20 ml), towels.

Items that should be readily accessible

- Suction with manometer, infant or child resuscitation bag (750 ml), facemasks (newborn and premature), orogastric tube (5 and 8 Fr), medications:(Oxygen, Adrenaline 1:10,000 and 1:1000, Sodium bicarbonate 4.2% (0.5 Meq/ml), Glucose, IV Fluids), blankets

C. Intubation Kit

- Laryngoscope, laryngoscope blades (straight 0 and 1), stylet, endotracheal tubes (2.5, 3.0 and 3.5 mm ID), suction catheters (5, 6 and 8 French to be used with the above ET tubes, respectively) and tape.

The Delivery of the Infant

History

- Is the baby full term? (A premature baby may need a vigorous resuscitation).
- Is this a multiple birth? (There may be two babies to resuscitate, and a back-up unit may need to be called).
- Is there meconium present? (Meticulous airway management will be needed).

Assessment and Management of the Newborn

Environment

All newborns have difficulty tolerating a cold environment. Hypothermia is a serious problem for infants born outside the hospital and special effort must be made to prevent heat loss. However, hyperthermia should also be avoided. The body and head should be thoroughly dried of amniotic fluid and the infant wrapped in warm towels or blankets. Chemical heat packs may burn the infant if applied directly to the skin and should be wrapped in a towel, if used. The

vigorous infant may be placed naked against the body of the mother, with covers over both.

Positioning

To assess or resuscitate, the newborn should be placed on his/her back in slight Trendelenburg position, with the neck slightly extended. The large occiput of a newborn will naturally cause hyperflexion of the neck. A small roll under the infant's shoulders is helpful in maintaining neutral head position.

Suctioning

To assure an open airway, suction the mouth, then the nose. Bulb syringe, or mechanical suction apparatus using an 8 or 10 Fr suction catheter may be used. No more than 100 mmHg of pressure should be employed if mechanical suction is used. Deep suctioning may produce a vagal response with bradycardia and/or apnoea. Heart rate must be monitored when suctioning a newborn. Time should be allowed for ventilation and oxygenation with 100% oxygen between suctioning attempts.

Tactile Stimulation

Drying and suctioning produce enough stimulation to induce effective respirations in most infants. Slapping/flicking soles of the feet or rubbing the infant's back will also stimulate the baby to breathe. If the infant fails to establish spontaneous and effective respirations following a brief period of stimulation, positive pressure ventilation is required.

Resuscitation of the Newborn

Birth results in radical changes in pulmonary and cardiovascular physiology. When a newborn fails to respond rapidly to positioning, suctioning, and stimulation with adequate respiratory effort and heart rate, further resuscitative measures are needed. The goal of resuscitation is to facilitate the initiation of normal cardiopulmonary function.

Airway and Breathing

Spontaneous breathing should begin after <15 seconds of stimulation.

- 100% free-flow oxygen should be provided.
- If the respiratory effort is shallow, slow, or absent, positive pressure ventilation should be initiated immediately. Continued tactile stimulation of an apnoeic infant delays the onset of needed oxygenation and ventilation.

Assisted ventilation

Indications for positive pressure ventilation:

- Apnœa, heart rate < 100 beats/min, persistent central cyanosis or pallor with 100% blow-by O_2.

The majority of infants requiring positive pressure ventilation will do well with bag and mask ventilation with initial lung inflations up to 30-40 mmHg pressure, and sometimes as much as 60 mmHg pressure. The pop-off valve on a self-inflating bag must be overridden to achieve these high inflating pressures.

Subsequent ventilation will require less pressure, and chest rise and breath sounds must be monitored to assess appropriate tidal volume. The normal newborn respiratory rate is between 30 and 60 breaths per minute. Bradycardia should respond to adequate oxygenation and ventilation. If chest expansion is not adequate: the infant's head should be repositioned, the seal checked and ventilation reattempted. If unsuccessful, the airway should be suctioned and ventilation reattempted. If chest expansion is still not adequate or bradycardia persists, intubation is indicated. If bag and mask ventilation continues for greater than 2 minutes gastric distension will occur, necessitating the placement of an orogastric tube.

Indications for endotracheal intubation

- When bag-mask ventilation is ineffective, i.e., inadequate chest expansion, continued bradycardia, or central cyanosis.
- When tracheal suctioning is required in the non-vigourous meconium stained infant.
- When prolonged positive-pressure ventilation is necessary.

Circulation

The normal newborn heart rate is 120-160 beats/minute. Newborns cannot increase their stroke volume and are dependent on rate for adequate cardiac output. The adequacy of the heart rate will determine the next steps in the resuscitation sequence.

The heart rate can be evaluated by listening to the apical beat with a stethoscope or feeling the pulse by lightly grasping the base of the umbilical cord - pulsations will be palpable for up to15 minutes after clamping and cutting the cord. If the heart rate is >100 bpm, infant assessment can continue. If the heart rate is <100 bpm, positive pressure ventilation should be started immediately.

a. If the heart rate rises, continue to hand ventilate until the infant breathes spontaneously.

b. If the heart rate does not increase, reassess the effectiveness of artificial ventilation, i.e., check the mask seal and observe for adequate chest rise.

c. If the heart rate still does not rise, intubate the infant - it is very likely that he is not being adequately ventilated.

d. If the heart rate is < 60 beats/min despite adequate ventilation with 100% O_2 for 30 seconds, chest compressions must be performed.

Colour

1. An infant may occasionally be cyanotic despite adequate ventilation and a heart rate >100. If central cyanosis is present in an infant with spontaneous respirations and an adequate heart rate, free flow oxygen should be given.

2. Oxygen is not required in infants with cyanosis of hands and feet only.

3. If the child is pale, assess for bradycardia. If the heart rate is acceptable (>100 bpm), give free flow oxygen and consider volume resuscitation.

Medications and Fluids

Cardiac dysfunction and shock in the neonate are usually the end result of profound hypoxia. Oxygenation, ventilation and heat maintenance are the only interventions needed to resuscitate the vast majority of newborns. Medications are rarely indicated and should be administered only if the heart rate remains <60 bpm despite adequate ventilation with 100% oxygen and chest compressions.

Adrenaline

1. May be indicated in the neonate with persistent bradycardia despite adequate ventilation with 100% oxygen and CPR.

2. Dose: 0.01-0.03 mg/kg (0.1-0.3 cc/kg of 1:10,000 solution).

3. Give IV if intravenous access has been established. If no IV, may give via endotracheal (ET) tube. If given per ET tube, administer 0.03 mg/kg diluted to total volume of 1cc with normal saline and ventilate into lungs.

Atropine and calcium are no longer recommended in acute newborn resuscitation.

Sodium bicarbonate: "May be useful in a prolonged resuscitation to help correct a documented metabolic acidosis, but its use is discouraged in brief arrests or episodes of bradycardia" (AHA Standards and Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiac Care). It corrects intracellular and CNS pH very slowly and will

not correct pH at all if adequate ventilation is not achieved. Produces acute changes in serum osmolarity and constitutes a sodium load. The dose is 2 Meq/kg/dose IV/IO, diluted to 0.5 Meq/ml with sterile water in order to decrease osmolar load.

Fluid Resuscitation

Fluid resuscitation is rarely needed in newborn resuscitation. Exception is overt haemorrhage from foetal-placental unit as in abruptio placentae. The umbilical vein is the preferred emergency intravascular route in newborns. If volume is needed, 10 ml/kg of Normal Saline should be administered IV/IO, and the clinical status re-evaluated.

Glucose

1. Hypoglycaemia is generally is not present immediately after delivery but may develop within the first hour.

Infants at high risk for hypoglycaemia include: premature infants, small for gestational age infants, chronically-stressed babies, infants of diabetic mothers, infants who have undergone prolonged or stressful labour and delivery or extensive resuscitation, infants with respiratory distress and hypothermic infants.

Symptoms of hypoglycaemia: Hypoglycaemia may mimic hypoxemia. Symptoms may include jitteriness, lethargy, floppiness, poor perfusion, respiratory distress and apnoea, seizures. Some hypoglycaemic infants will have no symptoms whatsoever. Severe or prolonged hypoglycaemia may result in serious neurological injury or death.

Treatment of hypoglycaemia (Blood glucose of <2 mmol/l): Oral fluids (D5W) may be given by bottle or orogastric tube to an otherwise healthy infant who is fully conscious and without respiratory distress. If the infant is symptomatic or if the blood glucose determination is <2 mmol/l the infant should be given D25W, 2ml/kg IV. The blood glucose should be measured 10 to 20 minutes after therapy and treated as necessary.

Apgar Score

The Apgar scoring system is widely used as an indicator of the need for resuscitation at birth. Five objective signs are evaluated, and the total score is noted at 1 minute and at 5 minutes after the complete birth of the infant. Evaluating the heart rate, respiratory activity, and color can more rapidly assess the need for resuscitation. Resuscitation should be started immediately as indicated by inadequate respirations and/or heart rate and should not be delayed in order to obtain the one minute APGAR score. APGAR values can be assigned in retrospect.

Meconium Aspiration

Meconium aspiration may lead to respiratory distress, chemical pneumonia pulmonary hypertension and pneumothorax. It is a major cause of neonatal morbidity and death. There is some controversy as to whether meconium aspiration occurs pre- or post-natally. Until that controversy is resolved, aggressive measures should be taken to avoid meconium aspiration at the time of delivery

When particulate meconium is present in the amniotic fluid, the hypopharynx should be thoroughly cleared of meconium as the head is delivered, before the infant takes his first breath. The delivery is then completed, keeping the child at the level of the perineum and double clamping and cutting the cord without delay. If the infant is crying and ventilating well and not hypotonic, normal resuscitation procedures are followed. If the infant has absent or depressed respirations, a heart rate <100 bpm, or poor muscle tone, direct tracheal suctioning should be performed to remove meconium from the airway. To remove meconium, direct suction is applied to the ET tube via a special adaptor (e.g., meconium aspirator) attached to a mechanical suction device as the tube is withdrawn. The procedure is repeated until no further meconium is retrieved. Suctioning must be completed rapidly to prevent prolonged hypoxemia. Suction catheters inserted through the endotracheal tube are inadequate to remove particulate meconium. Once the airway is cleared, the infant is stimulated to breathe. Free flow O_2 is administered if the infant is breathing spontaneously. If the infant does not quickly establish spontaneous respirations, positive pressure ventilation with 100% O_2 via bag-valve-mask is started. The infant is dried thoroughly, taking precautions to avoid heat loss.

Summary

The vast majority of deliveries are normal. Infants respond favourably to basic, simple interventions including positioning suctioning, stimulation, oxygen and keeping the baby warm and dry.

Appendix 2

NRP Instructor Course (UCC)

The NRP Instructor course is open to those who have a current NRP Provider card and have, or plan to have, active involvement in neonatal resuscitation and teaching in their own hospital. They should also have at least one year's experience in the labour & delivery or nursery area. The Instructor course curriculum consists of a one-day Instructors' course, followed by a Team-teaching experience under the supervision of a senior Instructor. The curriculum was developed by the NRP (AHA/AAP), which includes trained educators. The course allows the participants to hone their skills in resuscitation, and to learn how to teach these skills to others. The curriculum encompasses didactic teaching on adult learning theory and teaching technique, including the use of audiovisual material. The participants present a prepared topic of relevance to the Provider course, and are taught how to supervise a Megacode and to evaluate and provide feedback to candidates. Guidance is provided on the organization and execution of Provider courses. The Instructor's manual is published by the American Heart Association is provided.

Instructors' courses have been held every 12-18 months in Cork. The most recent course was held on March 2000 at University College Cork. Sixteen new Instructors were trained. Many of them have already completed their team-teaching. We continue to use and refine our locally-designed curriculum.

Objectives of the NRP Instructor Course

- To increase proficiency in all aspects of neonatal resuscitation.
- To provide training and practice in the teaching of the NRP Provider Course.
- To provide guidance in the practical details of setting up an NRP Provider Course.

Eligibility: Candidates must have a current NRP Provider Card and must be actively involved in neonatal resuscitation and teaching in their own institution, or must demonstrate their intention to be so involved.

- Candidates must provide the Regional Instructor responsible for the educational program with a letter from their hospital department director indicating a commitment to hospital educational activities.

Registration: Upon completion of the NRP Instructor Course, the candidate will be required to teach at least one course under supervision of a Regional Instructor (Team-Teaching) before full registration. Upon demonstration of the required standard of teaching, UCC will issue an Instructor registration card, valid for two years. There is no annual fee for registration.

Renewal: when guidelines change, the NRP, UCC, will update Instructors. Instructors will be required to teach at least two Provider course every two years to maintain registration. It is recommended that each Instructor teach a minimum of 8 (eight) Provider candidates in each two-year period.

Appendix 3

Questionnaire development

There were two questionnaires used in the course of this thesis (pages 154 –157). The first consisted of a 17-item questionnaire was sent to paediatricians, neonatologists and obstetricians providing neonatal services in 25 Irish maternity hospitals in June 1996. The purpose of this questionnaire was to explore the status of neonatal resuscitation in terms of *preparation for resuscitation; protocols for equipment checking; staff availability when extra help was needed and finally the status (in 1996) of staff training in neonatal resuscitation.* There was a 96% response to this survey.

The second questionnaire, a 13-question evaluation survey, was sent to 429 participants who took the course between April 1995 and March 1996. Questions related to whether the educational objectives of the program had been met, in addition to inquiries relating to attitudes and experiences because of participation in NRP. Opinions were gathered on Likert scale of 1 (poor) to 5 (excellent).

There were certain limitations to these surveys in that none of the questionnaires were piloted and latter survey was restricted by a relatively low response rate. As Oppenheim (1992) stated: "Questionnaires do not emerge fully fledged. They

have to be created or adapted, fashioned or developed to maturity after many abortive flights". The danger of unpiloted work, according to Oppenheim, is that a great deal of effort may be wasted on "unintelligible questions producing un-quantifiable responses and un-interpretable results".

This deficiency may have been of less significance in the first study, which was a descriptive survey, containing factual questions for the most part. With factual questions the respondent is being used as reporter of current status. While problems of *factual validity* i.e. did the question measure what it was supposed to measure?) and *reliability* (repeatability) can arise, these are usually of less significance than with attitude surveys. The fact, that many of the details requested in these surveys (number of deliveries, staffing levels, etc.) were known to the author from outreach visits, acted as *internal checks* to these surveys. Attitudinal questions are more sensitive than factual questions to changes in wording, context and emphasis. Despite exhaustive research the problem of attitudinal validity remains one of the most difficult in social research (Oppenheim 1992).

Questionnaire 1

Status of neonatal resuscitation in Ireland.

1. How many births per annum are there in your hospital?
2. How many SHO's in Paediatrics are in your hospital?
3. How many Registrars in Paediatrics serve your hospital?
4. Who is responsible for the initial resuscitation of the low-risk neonate i.e. the person present at all deliveries? a) Nurse/midwife b) Paediatric SHO c) Paediatric Registrar d) Consultant Paediatrician e) Other
5. Who is responsible for the neonatal resuscitation of high-risk deliveries? a) Nurse/midwife b) Paediatric SHO c) Paediatric Registrar d) Consultant Paediatrician e) Consultant Anaesthetist d) Other
6. Is the person responsible for high-risk deliveries, a) On site 24 hours a day b) On call from home - distance in kilometres c) Covers more than one hospital
7. Describe the training given to persons involved in Neonatal Resuscitation at the present time.
8. Are you satisfied with the present training of the midwives and junior medical staff? Yes- No
9. Are there any written protocols as to when the skilled resuscitation individual is summoned to the delivery room for high-risk patients? Yes- No
10. Who checks out the neonatal resuscitation equipment?

    a) Nurse b) SHO c) Others d) No checks
11. How often are these checks performed?

    a) Daily b) Every two days c) Weekly d) other

12. Do you have any suggestions as to how the training of individuals involved in neonatal care should be improved?

13. Do you think a National Neonatal Resuscitation Program is indicated?

Yes No

14. Do you have any suggestions as to how such a program could best meet your needs in terms of the training of your staff?

15. Do you have a Special Care Baby Unit or NICU in your hospital?

Yes No

16. When, if ever, would you consider *in-utero* transfer to a tertiary centre is indicated? Examples: Premature labour less than 32 weeks gestation, multiple pregnancy, growth restriction, suspected foetal anomaly

17. When do you consider transferring *babies* to tertiary centre? Examples: gestation less than 32 weeks, growth restriction, foetal complications, high frequency ventilation, nitric oxide

Questionnaire 2

NRP Evaluation

1. What is your current work status?

   Nurse, Midwife, Doctor, Ambulance personnel

2. What was your overall evaluation of the program?

   Poor 1 2 3 4 5 Excellent

3. The material presented at lectures was:

   Poor 1 2 3 4 5 Excellent

4. The material presented at practical sessions was:

   Poor 1 2 3 4 5 Excellent

5. To what degree will the information presented be put to use in your clinical practice? Limited 1 2 3 4 5 Highly beneficial

6. At what level do you grade your knowledge and skills before you completed the course? Average 1 2 3 4 5 Excellent

7. At what level do you grade your knowledge and skills after the course?

   Average I 2 3 4 5 Excellent

8. The Course day duration was: Reasonable I 2 3 4 5 Not acceptable

9. Has your attendance at the Course made any changes or improvements to your work? Yes No

10. The most difficult Theory lesson was: 1: Introduction 2- Initial steps 3 - Bag & Mask 4-Chest compression 5-Intubation 6-Medications

11. The most difficult Practical lesson was: 1- Initial steps 2-Bag & Mask 3- Chest compression 4-Intubation 5-Medications

12. How many deliveries per month do you normally attend?

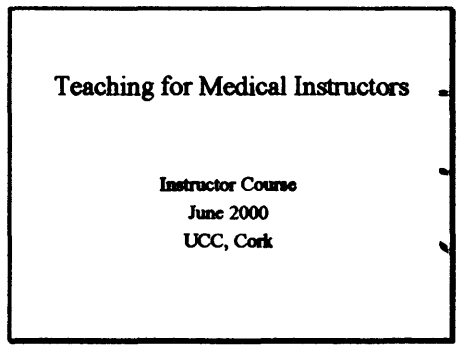
< 5. 5-10. 10-20. 20-30. 30-40, > 40

13. Can you recall a Resuscitation situation where the knowledge and skills you learned at the NRP were of fundamental importance in saying a neonate life or having a significant impact on the infant's outcome? Yes No

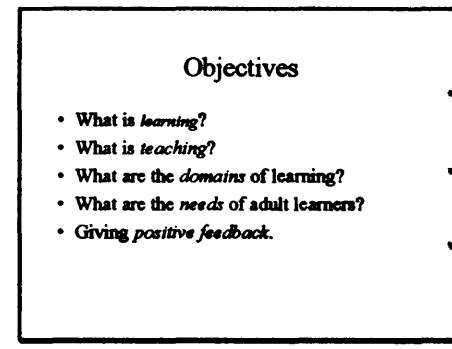
Describe the situation in detail if your answer is yes.

Appendix 4

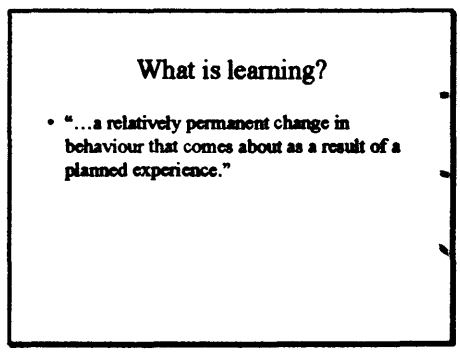
Slides for Teaching Medical Instructors



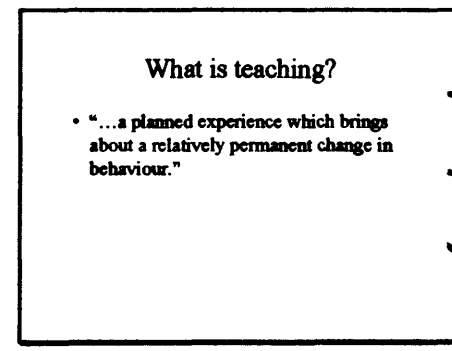
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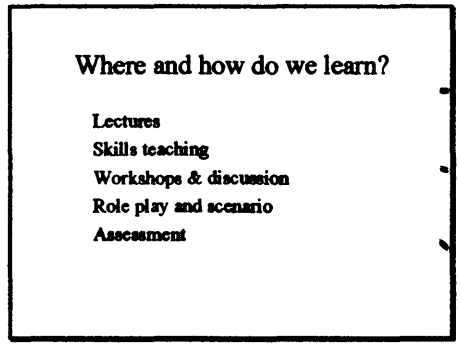
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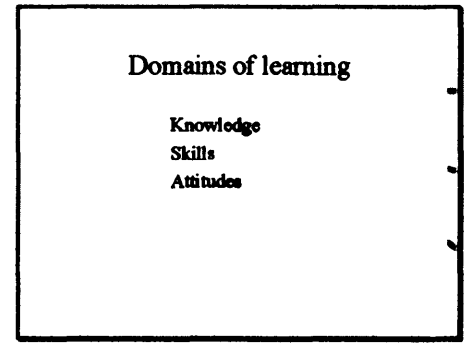
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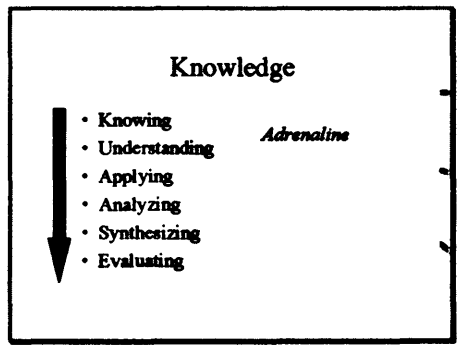
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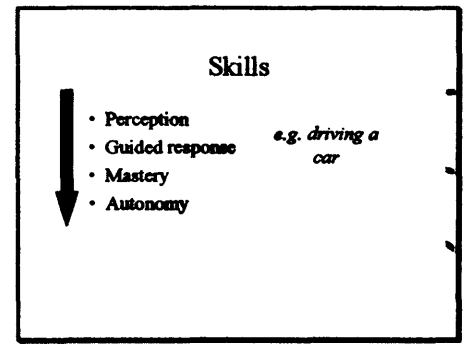
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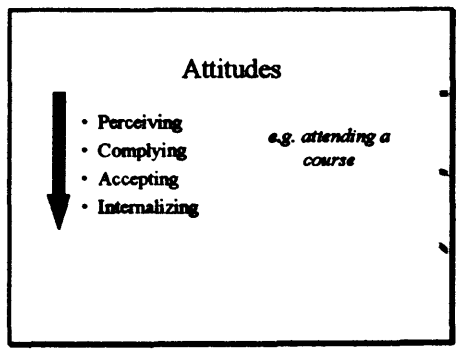
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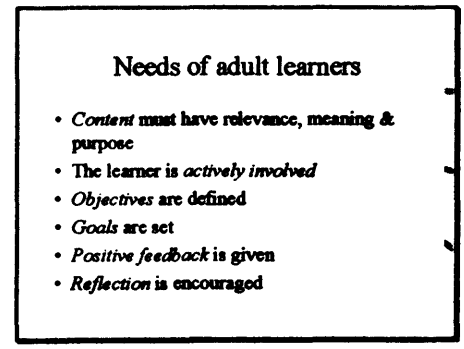
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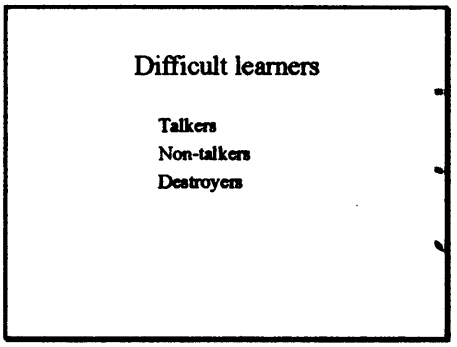
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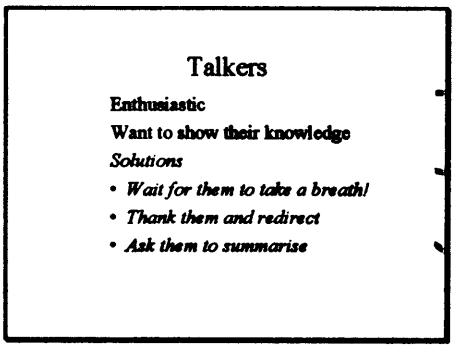
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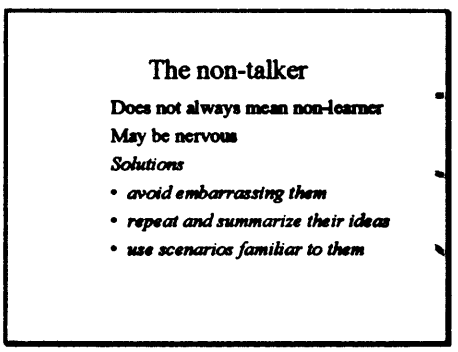
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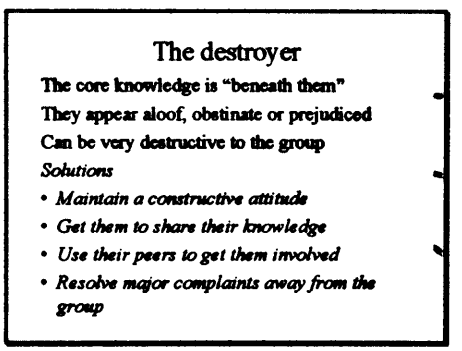
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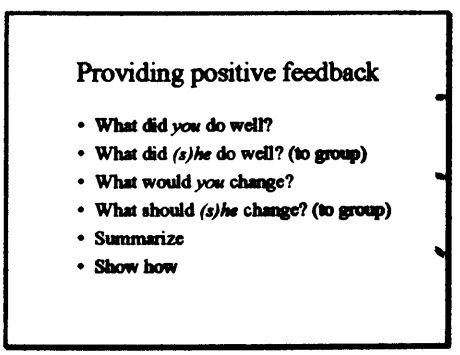
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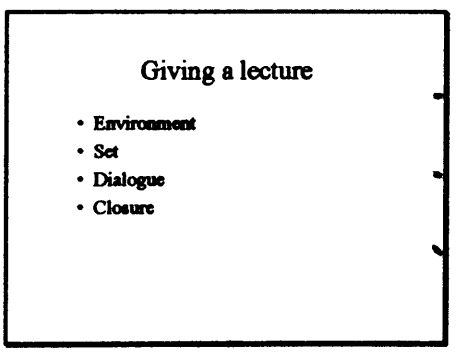
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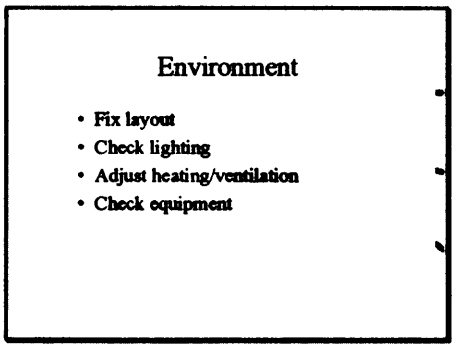
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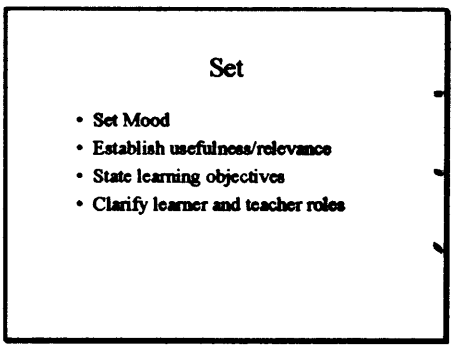
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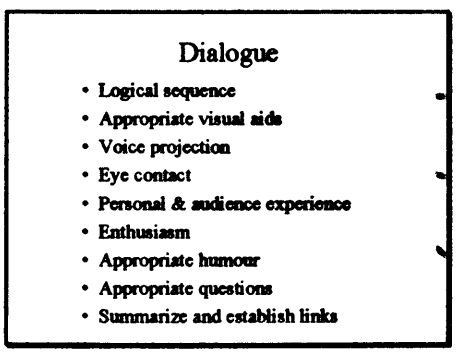
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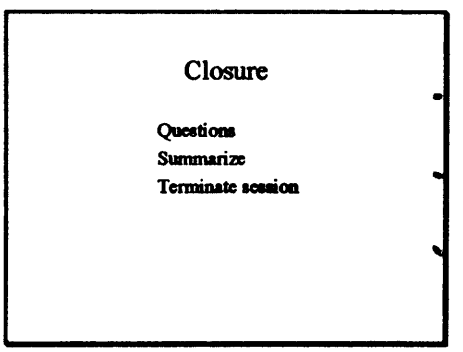
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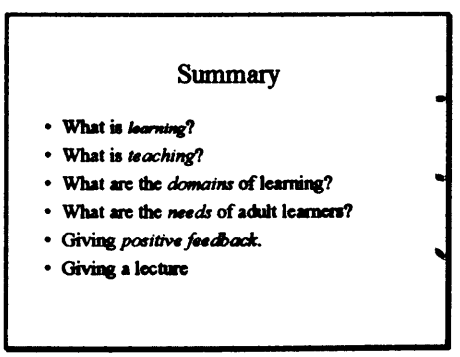
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Appendix 5

These letters, from medical defence organizations and hospital insurers, were in response to enquiries, seeking to determine their attitudes to resuscitation training (chapter 8).

The St Paul

St. Paul Ireland Insurance
Block 1
Harcourt Centre
Harcourt Street
Dublin 2
DX Number - 819 INSURANCE
Telephone (01) 609 5600
Motor (01) 609 5668
Facsimile (01) 662 4945
Web Site: www.stpaul.com/ireland

14/07/99

Dr C.Anthony Ryan
Consultant Neonatologist/Paediatrician,
Erinville Hospital,
Western Road,
Cork.

Our Client: The State Medical Indemnity Scheme

Dear Dr Ryan,

Thank you for your letter dated the 31st May 1999, which, unfortunately, did not reach us until the 9th July 1999. This was due to the fact that our offices are no longer located at Earlsfort Centre.

Firstly, I would like to congratulate you and your research team on your excellent publications in the area of neonatal resuscitation. It is an area of clinical care which, without doubt, has been badly neglected in this country. This is most surprising, indeed incredible, when one considers our unenviable claims experience to date, particularly in obstetrics.

Your research papers highlight the fact that resuscitation of the newborn is being conducted on an 'ad hoc' basis in hospitals, with no formal systems of training and evaluation in place. This is a state of affairs which is high risk, to put it mildly, particularly when one considers that many obstetrical units outside of Dublin, do not have a paediatrician on site. Indeed, at night, many such hospitals also do not have either a consultant obstetrician or a senior registrar available on site. In such circumstances, the responsibility for resuscitation of the neonate falls to the midwives and/or the junior doctors.

When one considers all of the above and more, there is a strong, compelling and indeed irrefutable case for making it mandatory for not just doctors, but all healthcare professionals involved in delivering babies to be certified in NRP.

I read, with interest, in your papers that there was a reluctance on the part of the NRP providers to use endotracheal intubation. It struck me that since this could not be described as an easy technique, (I suspect that even the most experienced anaesthetists who do not specialise in paediatric anaesthesia, might perhaps also find this a less-than-easy procedure to perform), that the issue is one of additional, practical on-site training (or indeed off-site training, perhaps in a teaching hospital where one is more likely to be presented with better opportunities to observe, and participate under supervision, in the intubation of a neonate).

St. Paul Ireland is a business name of St. Paul International Insurance Company Limited
Corporate and registered Office: The St. Paul House, 27 Camperdown Street, London E1 8DS. Registered in England 1034343
Registered as a branch in Dublin, Ireland: 903382
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Block 1
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Dublin 2
DX Number - 819 INSURANCE
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In putting your proposed motion before the Faculty, you are providing the Faculty with an opportunity to dictate best practice and encourage "uniformity and quality of care" in an area of medicine which to date has not conformed to any recognised code of practice or basic standards. The reality is that in numerous healthcare institutions in this country, neonatal resuscitation is currently the responsibility of healthcare professionals who lack the requisite knowledge and skills to carry it out effectively.

I would appreciate it if in time, you would let me know the outcome of the motion.

Yours sincerely,

Ann O'Driscoll

Ann O'Driscoll
Medico-legal Advisor
Clinical Risk Management

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Registered as a branch in Dublin, Ireland: 903382
Ultimate Holding Company: The St. Paul Companies Inc., Minnesota USA

Our ref: SAG/ER/9906358
Your ref: AR/CD

THE MDU

The Medical Defence Union Limited

Risk Management Department

Telephone: 0161 428 1234
Direct Fax: 0161 491 4064

PRIVATE AND CONFIDENTIAL

Dr C A Ryan
Consultant Neonatologist/Paediatrician
Erinville Hospital
Western Road
Cork
Republic of Ireland

19 July 1999

Dear Dr Ryan

Thank you for your letter of 31 May, received on 9 July, which has been passed to me. Thank you for sending the photocopies of the two articles describing the neonatal resuscitation program. I found this of great interest, and I can assure you we would support your efforts to introduce training and certification of healthcare workers involved in the resuscitation of babies.

I am sure your are aware of the 'Confidential Enquiry into Stillbirths and Deaths in Infancy', which is published in the UK. The report published in 1995 showed that 43 cases of the 388 deaths investigated had evidence of poor resuscitation technique and contributed to the babies' deaths. These cases involved problems with intubation in the main, but your paper clearly shows that attention to more basic skills in neonatal resuscitation is important and effective.

I note in the paper published in the Irish Medical Journal, you give a time limit of approximately two years before recertification is undertaken. As far as I am aware in the UK, the guidelines for delivery room staff require a re-evaluation of skills every six months.

I hope you find these comments of use, and I shall be pleased to hear the outcome of your proposal to the Faculty of Paediatrics.

Yours sincerely

Dr Stephen A Green
Head of Risk Management Services

MEDICAL PROTECTION SOCIETY

From: Dr B N MacKellar LLM MB ChB D(Obst) RCOG
Head of International Medical Services

Our Ref: BNM/JD/C.A.Ryan
(Please quote the above reference when corresponding with the Society)

Your Ref: AR/CD

22 July 1999

Dr C Anthony Ryan
Consultant Neonatologist/Paediatrician
Erinville Hospital
Western Road
Cork
Ireland

Dear Dr Ryan,

Thank you for your letter of 31 May.

The Medical Protection Society welcomes any initiative that will improve patient care and reduce the risk of patients suffering avoidable harm.

With kind regards, and many thanks for providing copies of the papers you have recently published.

Yours sincerely,

p.p. Dr B N MacKellar
Head of International Medical Services

Comhar Árachais Comhhairlí Éireann Teo
Irish Public Bodies Mutual Insurances Ltd

YOUR REF:

Mr. C. Anthony Ryan,
Consultant Neonatologist/Paediatrician,
Erinville Hospital,
Western Road,
Cork.

19 July 1999

RE: Neonatal Resuscitation Program

Dear Mr. Ryan,

I refer to your letter dated 31st May and apologise for the delay in getting back to you.

In view of the escalating number and cost of claims against Health Care providers in Ireland, we would welcome any training program which, in addition to improving the quality of service provided, would seek to eliminate or reduce the costs involved.

We would therefore support the proposed program of training/certification of health care workers involved in the resuscitation of babies in Ireland.

Yours sincerely,

Pat O'Loughlin,
Joint Liability Manager

/amd

c.c. Denis Fenton,
Personnel Officer,
Southern Health Board

Appendix 6

UCC College Certificate of Completion of NRP Provider Course



UNIVERSITY COLLEGE, CORK

Coláiste na hOllscoile, Corcaigh

CERTIFICATE

.....

has successfully completed the

NEONATAL RESUSCITATION PROGRAMME

during the academic year .....

.....

Dr. C. Anthony Ryan
Director, Neonatal Resuscitation Programme
Department of Paediatrics,
University College Cork.

(Recertification on a two yearly basis is recommended)

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Dissemination and evaluation of AAP/AHA Neonatal Resuscitation Programme in Ireland

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Abstract

We evaluated the need for a structured Neonatal Resuscitation Programme (NRP) by means of a questionnaire sent to 25 Irish maternity hospitals inquiring about staff availability and current teaching structures. Having taught NRP to almost 1000 health care providers, we present a descriptive evaluation of the programme by a sample of 429 NRP participants, exploring their opinions of NRP. Our results show that midwives were responsible for newborn resuscitation at all low risk deliveries. Only 5 units (23%) had a registrar available on-site 24 hours a day, while the remaining units (77%) had to summon additional medical help from outside, in emergency situations occurring outside of normal working hours. Resuscitation equipment was checked by nurses alone (52%), or by a nurse and physician (48%), on a daily (45%), alternate days (41%) or weekly basis (14%). Although 19 units had some form of neonatal resuscitation training available, only 35% of respondents were happy with the current training structures. Almost half of the 429 providers (45%) replied to the survey. Most (85%) indicated that NRP improved their skills and confidence. Two thirds of participants found the lesson on medications the most difficult theory lesson, while 45% found endotracheal intubation the most difficult skills station. Because of the wide geographical distribution of deliveries in this country, we conclude that all perinatal professionals should be trained to perform newborn resuscitation in a coordinated, team-approach manner. NRP provides such training with a high degree of approval from Irish health care providers.

Introduction

Almost all of approximately 50,000 deliveries each year in the Republic of Ireland are hospital based, with less than 1.0% occurring at home. Hospital deliveries are scattered over 25 different units with individual annual delivery rates varying from less than 500 to greater than 6000 deliveries per annum. This broad geographic and demographic spread of deliveries means that midwives deliver and resuscitate most low risk neonates and often have to initiate complex resuscitation when an asphyxiated infant is born unexpectedly. In order to assess the needs for a formal Neonatal Resuscitation Programme (NRP) in the Republic of Ireland we undertook a survey of hospitals providing obstetrical care, to assess neonatal resuscitation in terms of preparation, protocols, training and staff availability. Beginning in September 1994, we introduced the NRP into Cork and subsequently throughout the country on an out-reach basis. The programme was taught according to the guidelines of the American Academy of Paediatrics (AAP) and American Heart Association (AHA),[1] with the assistance of a certified NRP instructor. We also present our experience of this programme and an evaluation of the programme by some of the providers who passed the course.

Methods

(A) Resuscitation protocols and training practices: An 18-item questionnaire was mailed in June 1996 to paediatricians, neonatologists and obstetricians providing neonatal services in 25 Irish maternity hospitals. The questions related to staff availability for newborn resuscitation, the policies of preparation prior to delivery, and guidelines as to when to summon personnel for additional help. We also inquired about the current teaching and training structures in newborn resuscitation apart from the NRP, since the latter had already been taught in many of these centers at the time of the survey.

(B) The Neonatal Resuscitation Programme: In 1987, in an effort to provide greater uniformity and a higher quality of care, the AAP joined with the AHA to offer a course in delivery room resuscitation called the Neonatal Resuscitation Programme (NRP). The main objective was to ensure that each delivery room or labour ward was fully equipped to handle the unanticipated asphyxiated infant and at least one skilled person capable of full neonatal resuscitation present at every delivery. NRP was taught by an AAP/AHA certified NRP instructor. This course consists of a number of didactic sessions followed by practical on-hands skill stations. An overview of the programme which is now taught in 25 countries worldwide, is provided in Table 1.

NRP evaluation: A 13-question evaluation form was sent to all participants who took the course between April 1995 to March 1996. Questions related to whether the educational objectives of the program had been met, in addition to inquiries relating to attitudes and experiences as a result of participation in NRP. Opinions were gathered on scale of 1 (poor) to 5 (excellent). We also inquired whether participants recalled a resuscitation situation where, in their opinion, the knowledge and the skills learned at the NRP were of fundamental importance in saving the neonate's life or having a significant impact on the infant's outcome.

Table 1. Overview of Neonatal Resuscitation Programme (NRP).

Lesson 1 Introduction to the programme
Lesson 2 Initial steps in resuscitation
Lesson 3 Use of resuscitation bag and mask
Lesson 4 Chest compressions
Lesson 5 Endotracheal intubation
Lesson 6 Resuscitation medications

Results

(a) Resuscitation protocols and training practices:
There was a 92% response rate to this survey (22/25 units). Most units were attended by consultant paediatricians and had between 1000-3500 deliveries per annum (Table 2). Midwives were responsible for resuscitation of all low risk deliveries. Only 5 units (22%) had a registrar available on-site 24 hours a day. Most units (78%) had to summon additional medical help from outside the institution in emergency situations occurring outside of the normal working hours. More than half (56%) of units had written guidelines as to when to summon additional personnel (registrars or consultants) for help for high-risk deliveries or when a depressed neonate was delivered unexpectedly. Resuscitation equipment was checked by nurses alone (52%), or by a nurse and physician (48%), on a daily (47%), alternate days (44%) or weekly basis (9%). Although 19% of units provided neonatal resuscitation training, in the form of lectures, videos or clinical instruction, only 35% of respondents were happy with the current training structures. The majority (78%) of respondents supported the need for a structured, standardized neonatal resuscitation training programme.

(b) NRP training and evaluation:
Between September 1994 and May 1997, we trained 983 individuals (712 nurses/midwives, 212 doctors and 59 ambulance personnel) in 89 separate courses. These courses were held in 17 maternity hospitals throughout the country attracting participants from all 25 maternity sites and individuals from the ambulance sector. In addition, 55 NRP instructors were trained in four instructor training courses, using the recognized AAP/AHA format. 193 of the 429 participants surveyed (45%) responded to the evaluation questionnaire. Almost all of the respondents (97%) were satisfied (scale 4 -5) with the course. Most respondents (85%) felt that the course improved their skills, changed their approach to neonatal resuscitation, and gave them confidence in daily work, while almost three quarters (74%) indicated that the course was highly beneficial (scale 4-5) to their clinical practice. Two thirds of the participants expressed difficulty with the lesson on medications, with ambulance personnel (32/34; 94%) expressing more difficulty compared to doctors (17/29; 59%) and nurses/midwives (72/130; 55%). Almost half of the participants (45%) felt that the most difficult practical lesson was endotracheal intubation, with the nurses/midwives (71/130; 55%) reporting more difficulty with this skill station compared to doctors (11/29; 38%) and ambulance personnel (8/34; 24%). Eighteen of the respondents (9 nurse/midwives, seven doctors and 2 ambulance personnel) described clinical situations where they felt that the knowledge and skills they learned at the NRP were important in saving the life of a neonate or had a significant impact on the infant's outcome. On two separate occasions, ambulance personnel providers were the sole professionals at an unexpected home delivery and another delivery, which occurred in an ambulance en route to hospital. They both reported

that their NPR training provided them with the knowledge and skills to deal effectively with the resuscitation of these newborn infants. Nine nurses/midwives described situations where they were faced with the initial resuscitation of unexpectedly asphyxiated babies (7) or premature babies (2), without the presence of a doctor. These infants were successfully resuscitated with bag mask resuscitation. Seven doctors also described situations of successful resuscitation (involving endotracheal intubation in 5 of the 7 cases), the success of which they attributed to their NRP training.

Table 2. Unit demographics, staffing and resuscitation practices in 22 maternity units.

	Maternity Units	(%)
Attended by paediatricians only	15	(68)
at least one neonatologist	5	(23)
obstetricians only	2	(9)
Deliveries (per annum) < 1000	2	(9)
1000-3500	17	(77)
>3500	3	(14)
Registrar on-site 24 hours	5	(23)
Outside help called in emergency	17	(77)
Written guidelines when to call for help	12	(56)

Table 3. Providers trained in 89 courses (September 1994 to May 1997).

Providers	**Number**	**(%)**
Nurse/midwives	712	(72)
Doctors	212	(22)
Ambulance personnel	56	(6)
Total	983	(100)

Discussion

These studies have two main findings. Firstly, they demonstrate a need and a desire for formal training in newborn resuscitation in maternity units in Ireland. Secondly, although the structure of NRP was originally designed for the US health care system, it seems to work in the Irish health care context. We demonstrated that the NRP can be taught, in entirety, to a broad range of Irish health care providers with apparent satisfaction among providers with the level of knowledge and skills achieved in the course. Establishing a neonatal resuscitation training program is usually a much bigger problem in a peripheral hospital than in a large teaching institution, where inhouse registrars, neonatologists and specialized nursing staff provide an available pool of skilled individuals. For this reason, we focused our resources on an out-reach teaching program to the peripheral hospitals, a concept which has been well developed in other countries.[2,3,4]Studies to establish the benefits of training programmes such as NRP in terms of mortality or asphyxia outcomes are difficult to develop. Other outcome measures, such as the incidence of severe meconium aspiration syndrome (MAS), have been studied. In one region in France, where 53% of personnel were trained in a structured NRP, severe MAS fell from 3 cases in 1989 to 0 cases in 1990.[5] This was a small uncontrolled study and the results may not have been sustained over time. We were not able to examine such outcome measures. However, we have shown improvements in delivery room practices and a reduction in neonatal hypothermia following the introduction of the NRP into an Irish maternity hospital.[6] In addition, the subjective accounts of possible life saving benefits from a number of providers, reported in the current study, are most encouraging. The broad geographical distribution of deliveries throughout the country has resulted in inequalities, and often inadequacies, in staffing levels particularly at middle grade (registrar) and consultant levels. Despite their enormous differences in size, population and wealth, the distribution of services and training in Ireland are not dissimilar to the situation in Canada in 1987.[7] In a survey of 200 Canadian maternity sites, 138 (69%) had to summon additional medical help from outside the institution, 60% at all times.

Since it is unlikely that all deliveries in this country will be centralized in tertiary facilities alone, every obstetrical facility must be prepared for the most difficult resuscitation. We believe that all health care professionals present at a delivery, should be trained to perform newborn resuscitation together in a coordinated, team-approach manner. Since a midwife is present at virtually every delivery in Ireland, particular efforts should be directed at training and maintaining the skills of midwives. Midwives are not licensed to perform endotracheal intubation. However, most complex resuscitation situations can be initially managed with a focus on preventing hypothermia and effective management of airway and ventilation breathing with a bag and mask, skills that are very much within the remit of the midwife. Many factors contributed towards the successful implementation and dissemination of NRP throughout the country. Seed funding was provided by University College, Cork and a recognized Certificate was presented to participants who passed the course. This certificate is important in affirming the individual's commitment to continuing education and also allows standards in the course to be maintained and monitored. We were also helped by the cooperation of the NRP (AHA/AAP) in the United States which allowed, encouraged and facilitated transfer ownership of the programme. We would envisage and encourage the development of NRP structures in Ireland similar to those in the United States and Canada. This would entail training more Hospital Based Instructors, who would teach the course in their own institutions, with the support of Regional Trainers. Providers would be given a time-limited certification of approximately 2 years, renewable upon completion of a re-certification course. National professional bodies such as the Faculty of Paediatrics, An Bord Altranais and the National Ambulance Advisory Council should develop guidelines as to whom should be trained and whether such training should be mandatory. In addition, hospitals should develop protocols for maintaining resuscitation equipment and support neonatal resuscitation team activities by audit and regular practice.

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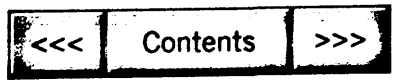
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The Effect of a Structured Neonatal Resuscitation Program on Delivery Room Practices

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ABSTRACT

Purpose: This study evaluated the introduction of the Neonatal Resuscitation Program (NRP) of the American Academy of Pediatrics and the American Heart Association into the delivery room of an Irish maternity hospital.

Design: Prospective, controlled observational study of 51 deliveries before and 51 deliveries following the training of delivery room personnel in the NRP.

Sample: Participants were 33 nurse-midwives and 11 pediatric resident physicians.

Main outcome variable: Evaluation of postdelivery, newborn resuscitation practices.

Results: The introduction of the NRP was associated with significant improvements in delivery room preparation, in the evaluation and management of the newborn infant, and in thermal protection at birth. Although there was a trend to use more free-flow oxygen following the introduction of the NRP, this was not statistically significant. Bag and mask ventilation was also used more frequently following NRP training. However, there were no significant differences in the use of endotracheal intubation, chest compressions, and medications. Fifteen of the 51 infants became hypothermic prior to the introduction of the NRP; none of the infants developed hypothermia in the post-NRP part of the study.

THE QUALITY OF CARE PROVIDED DURING THE FIRST minute of life can have a great impact on the ultimate outcome for that life. Approximately 6 percent of all newborns and up to 80 percent of infants weighing less than 1,500 gm require some resuscitation intervention at birth.[1] About 4 percent of admissions to special care nurseries are related to asphyxia: Many of these admissions are unanticipated, and some could possibly be prevented by the immediate application of expert resuscitation practices.[2-4]

To address these problems and to provide greater uniformity and quality of care, the American Academy of Pediatrics (AAP) joined with the American Heart Association (AHA) in 1987 to offer a course in delivery room resuscitation. The main objective was to ensure that each delivery room would be fully equipped to handle the unanticipated asphyxiated infant and that at least one skilled person capable of full neonatal resuscitation would be present at every delivery. Well established throughout the U.S. and Canada, the Neonatal Resuscitation Program (NRP) is now taught in 25 countries worldwide.[5]

The NRP organization in the U.S. allowed, encouraged, and facilitated transfer of ownership of the program into Ireland, and the NRP was introduced into the Southern Health Board region, one of nine health board regions in Ireland, in 1994. Prior to this there had been no consistent, structured neonatal resuscitation training available to nurse-midwives beyond their midwifery training. A pediatric fellow usually showed the pediatric residents the basics of neonatal resuscitation on the first day of their three-month neonatal rotation. There was no consistent teaching format and no formal evaluation of their skills. This article describes a study designed to evaluate the delivery room practices and resuscitation skills in the largest maternity hospital in this region prior to and following the introduction of the NRP.

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TABLE 1 ■ Personnel Present at Resuscitation Before and After Training in the Neonatal Resuscitation Program

Personnel	Pretraining (n = 51)	Posttraining (n = 51)	*p*
Midwife present to resuscitate neonate	28	30	.48
Midwife and physician present to resuscitate neonate	23	21	.47
Only one midwife for mother and neonate	9	1	.01

METHODS

Setting

The Erinville Maternity Hospital in Cork, Ireland, had a delivery rate of approximately 2,500 babies per annum. Obstetric and neonatal residents are immediately available on site. Obstetric and neonatal fellows provide coverage for this hospital, in addition to a second, geographically distinct, maternity hospital in the city. Four consultant obstetricians and one consultant neonatologist serve the Erinville Maternity Hospital, with additional neonatal coverage provided by three consultant general pediatricians.

All deliveries take place in the delivery room, and most deliveries are performed by registered nurse-midwives. The nurse-midwives perform neonatal resuscitation for all low-risk deliveries. Pediatric residents are present to resuscitate newborns following instrument deliveries, cesarean sections, and deliveries in which fetal distress is anticipated based on fetal heart tracing abnormalities and/or meconium staining of the amniotic fluid.

Training

The NRP course consists of a number of didactic sessions followed by practical hands-on skills stations, including initial steps in resuscitation, use of a resuscitation bag and mask, chest compressions, endotracheal intubation, and resuscitation mediations. Participants had to score at least 85 percent on the AAP/AHA multiple-choice examination in order to pass the course, in addition to demonstrating competence in each of the skills stations.

Consent

There was no formal institutional review board in the hospital at the time of the study. Therefore, permission for this study was obtained from the hospital administrator, the matron, the neonatologist, and the delivery suite charge-sister. Midwives, residents, and parents were informed that a clinical nurse specialist (CNS) in neonatology (who was also a certified NRP instructor) was conducting an observational study on delivery practices and would, following informed consent of the prospective parents, observe the active portion of labor, delivery, and newborn resuscitation.

The nurse-midwives and residents were not aware of what data were being collected. The CNS was present in the delivery room for each delivery and resuscitation but did not participate in any way or comment on the actions or performance of the midwives or physicians.

Study Design

In September 1994, prior to the introduction of the NRP, the CNS evaluated 51 deliveries by direct observation in the delivery room, using the framework and guidelines outlined in the NRP textbook.[1] The NRP was introduced into the Erinville Hospital between October 1994 and February 1995. The NRP instructor trained all 33 delivery room nurse-midwives and 11 pediatrics residents, usually in groups of six to eight individuals. The recognized NRP textbook was given to the participants four weeks in advance of the course. In April 1995, a further 51 deliveries were evaluated by the CNS.

The deliveries in both arms of the study (before and after NRP training) were not necessarily consecutive, because only births where the CNS was present for the full second stage of labor or cesarean section delivery and the newborn resuscitation were included in the study. Additional information collected during the study included demographic data on the infant's birth weight, gender, gestation, and Apgar scores. Continuous observation of the newborn infant was maintained by the trained observer until the infant was discharged to the postnatal wards or the neonatal intensive care unit.

Evaluation

The subjects were evaluated as a team when more than one person was involved in the resuscitation. Although some individuals were observed on more than one occasion, the team composition was almost always unique. The following parameters were evaluated, and participants were scored as either "pass" or "fail" for each section:

Preparation. Resuscitators passed if they completed the following three actions: (1) turned on the radiant warmer or checked to see

if it was turned on, (2) checked the resuscitation equipment, and (3) ensured that warm linen was available prior to the delivery.

Initial Steps. Resuscitators passed if they positioned, suctioned, and dried the infant appropriately and removed the wet linen.

Clinical Assessment of the Neonate. Resuscitators passed if they noted whether the infant was breathing and determined the infant's heart rate by auscultation or palpation of the umbilical cord. If the NRP observer considered the baby to have a good color (if cyanosis was absent), no action was expected of the resuscitating individual(s).

Actions Related to Neonatal Assessment. Resuscitators passed if they administered free-flow oxygen if the infant showed cyanosis but was breathing and administered positive-pressure ventilation with 100 percent oxygen if the infant was apneic and/or had bradycardia (heart rate <100 beats per minute). A sole resuscitating individual was expected to call for additional help at this juncture. The resuscitation team was expected to initiate chest compressions if the infant's heart rate was <60 beats per minute or 60–80 beats per minute and not rising. Medications were to be administered according to NRP guidelines—that is, in the presence of asystole or persistent bradycardia—despite adequate airway control, ventilation, and chest compressions.

Statistical analysis was performed using the student's *t*-test for continuous data and Fisher's Exact for proportional data. A two-tailed p value <.05 was accepted as significant. Continuous data are reported as the means ± the standard deviation.

RESULTS

Newborn resuscitations were performed by either midwives alone or by a midwife and a physician (Table 1). The 102 neonatal resuscitations were performed by 44 different individuals (33 midwives and 11 physicians). In the pretraining period, there were nine occasions when a single nurse-midwife was present in the delivery room at the time of birth. This situation occurred on only one occasion in the posttraining period ($p = .01$).

There were more preterm infants (<37 weeks gestation) in the posttraining part of the study, with the result that infants in the pretraining part of the study weighed more at birth and were more mature than infants in the posttraining part of the study ($p < .05$) (see Table 2).

TABLE 2 ■ Patient Demographics Before and After Training in the Neonatal Resuscitation Program

Characteristic	Pretraining (n = 51)	Posttraining (n = 51)	p
Birth weight	3895 ± 35 gm	3695 ± 35 gm	<.05
Gestation (weeks)	39.5 ± 2	38.5 ± 4	<.05
Infants <37 weeks gestation	1	6	.07
Female	26	30	.39
Male	25	21	.37

Following the introduction of the NRP, during the posttraining period of the study there were significant improvements in the following parameters as compared to the pretraining period (Table 3): correct preparation ($p = .01$), correct initial steps ($p < .01$), correct evaluation of neonate ($p = .02$), and correct actions related to those evaluations ($p = .02$).

Although there was an increase in the use of free-flow oxygen following the introduction of the NRP, this was not statistically significant ($p = 0.06$). There was, however, a significant increase in bag and mask ventilation ($p = .04$). There were no significant differences in the number of intubations, chest compressions, medication administration, and Apgar scores <7 at five minutes when comparing the two arms of the study (Table 3).

Meconium staining of amniotic fluid at delivery was more common in the posttraining part

TABLE 3 ■ Outcome Parameters Before and After Training in the Neonatal Resuscitation Program

Parameter	Pretraining (n = 51)	Posttraining (n = 51)	p
Correct preparation prior to delivery	18	41	0.01
Correct initial steps of resuscitation	6	40	<0.01
Correct evaluation of baby	24	46	0.02
Correct actions in resuscitation	22	44	0.02
Use of free-flow oxygen	20	36	0.06
Use of bag/mask ventilation	2	9	0.04
Use of endotracheal intubation	0	1	0.50
Use of chest compressions	0	0	1
Use of medications (naloxone)	1	0	0.5
Apgar <7 at five minutes	7	12	0.21
Meconium staining of amniotic fluid	1	8	0.02
Tracheal suctioning for meconium	1	5	0.12
Infant bathed postdelivery	4	1	0.19
Neonatal hypothermia (<36.5°C)	15	0	<0.01
NICU admission	5	8	0.31

of the study ($p = .02$). Direct visualization of the vocal cords and suctioning of the trachea were performed more frequently in the posttraining period (though not significantly so), which related to the higher incidence of meconium staining of amniotic fluid at delivery in this group.

Fifteen of the 51 infants in the pretraining arm developed hypothermia (core temperatures <36.5°C), but none of the infants became hypothermic following the introduction of the NRP ($p < .01$). There had been a long-standing practice of bathing certain newborn infants (those who were meconium or blood covered) in the delivery room after birth. This practice declined (from four during pretraining to one posttraining) and subsequently was discontinued without any formal policy decree. Slightly more infants required admission to the neonatal intensive care unit in the posttraining period, the result of a greater number of premature infants in this group rather than of complications of resuscitation.

DISCUSSION

The NRP concentrates on the need for effective preparation prior to each delivery, careful definition of the roles of each member of the resuscitation team, the importance of proper thermal management at birth, and emphasis on proper bag and mask techniques as the major means of ventilation and oxygenation. Although we teach the full range of resuscitation skills in the NRP, we believe, along with others, that the effectiveness of most neonatal resuscitations is enhanced more by the prompt use of basic skills than by the use of advanced skills such as intubation and administration of medications.[6] In our experience, the introduction of the NRP was associated with alterations in delivery room practices and significant improvements in the evaluation and management of the newborn infant and in thermal protection at birth.

We made no attempts to directly alter midwifery or medical practices in the delivery room. Nevertheless, it was obvious that some changes occurred as a result of NRP training. This was particularly noticeable in thermal management at birth. There are large evaporative and nonevaporative heat losses from the baby's wet skin immediately following birth. Unless precautions are taken to limit these heat losses, the baby's core temperature, which is about 37.8°C at birth, may fall by 2–3 degrees or more during the first 30–60 minutes.[7] Simple measures to reduce heat loss at birth, such as drying and swaddling or skin-to-skin contact between mother and baby under warmed blankets, are sufficient for vigorous term babies. Such measures do not interfere with early mother–infant contact or with the early opportunity for suckling.

The absence of hypothermia as a clinical problem following the introduction of the NRP is related, we believe, to the significant improvements in preparation and in the initial steps of resuscitation, during which the importance of prewarmed blankets and drying of the neonate were emphasized. Discontinuation of the practice of bathing infants covered in blood or meconium while still in the delivery room may also have contributed. This change in practice came from the midwives themselves and not through a policy decree. The timing of a newborn infant's first bath varies among institutions. Penny-MacGillivray found no significant difference in rectal temperature in healthy term infants bathed at a mean age of one hour after birth, compared to infants bathed at four hours of age.[8] However, it is possible that earlier bathing, as occurred occasionally in our institution, may have predisposed neonates to mild hypothermia.

Nurse-midwives became more conscious of the need at each delivery for one individual to be available whose responsibilities are solely directed at the newborn infant, one of the stated principles of the NRP. Prior to the introduction of the NRP, there had been nine occasions in which only one nurse-midwife, responsible for both the mother and her newborn infant, was present at a delivery. This situation occurred only once in the posttraining period. We believe this change in practice came about because of the heightened awareness among midwives of the need for a specific individual to be present for the immediate care of each newborn infant at the moment of birth.

Following the NRP training, there was a trend toward more frequent use of free-flow oxygen and bag and mask ventilation; this was most likely related to better evaluation of the newborn. The higher (although not significant) incidence of low Apgar scores and more frequent admissions to the NICU after the training can be explained by a higher incidence of premature infants and also meconium staining of the amniotic fluid in the latter group. It may be that

the expectation of a premature baby encouraged better preparation and resuscitation practices, accounting for the overall better performance in the posttraining period. However, we observed improved practices in both term and preterm deliveries.

Although the nurse-midwives were taught endotracheal intubation during the NRP training, the Irish codes of practice do not permit them to intubate a depressed or meconium-compromised neonate. If there was meconium staining of the amniotic fluid, they were encouraged to be diligent about suctioning of the infant's oropharynx at the perineum and to summon appropriate help in these circumstances. Although we encouraged all physician NRP providers to use an endotracheal tube and a meconium aspirator to suction the airway of depressed neonates with thick meconium, the physicians were more likely to perform tracheal suctioning under direct vision with a suction catheter—a less effective, but perhaps technically easier, technique for suctioning thick meconium.

Limitations

The CNS was the only recognized AHA/AAP NRP instructor in our region. Although this was an advantage (none of the local health care professionals had prior knowledge of the NRP), it may also have led to observer bias during the study. The CNS, being teacher as well as observer, may have wished to show that the NRP itself and her teaching of the program were effective. In addition, the midwives and physicians were aware that they were being observed by their instructor in the posttraining part of the study. As a result, they may have been more conscious of their practices during that time.

To partially counterbalance these potential biases, we designed a strict objective format of "pass" or "fail" in the observation of the deliveries. In order to take the emphasis off the resuscitation component, we informed the subjects and the parents that we were observing all aspects of the delivery. We did consider videotaping the delivery and evaluating the process independently. However, this was considered too intrusive both for the parents and the health care providers.

The current study evaluated only immediate outcomes in terms of preparation, evaluation, skills, and actions. In view of the low perinatal mortality in Ireland (9.1 per 1,000 live births in 1993), extremely large numbers would be required in a study designed to demonstrate a reduction in perinatal mortality associated with formal training such as the NRP. Neonatal morbidity as a result of inadequate or inexperienced resuscitation is more difficult, if not impossible, to quantify. However, it makes sense that individuals involved in acute resuscitation in any area of medicine need to be properly trained. Thus, the skills of neonatal resuscitation should be taught to all medical and nursing staff attending deliveries, and the appropriate resuscitation equipment should be available in every delivery room.

CONCLUSIONS

There is little doubt that widespread training in a formal program of neonatal resuscitation, such as the NRP, is associated with certain economic costs related to training. To date, we have trained more than 1,000 health care workers, including midwives, physicians, and ambulance personnel, throughout the Republic of Ireland.[9] However, in terms of risk management in high-risk subspecialties such as obstetrics and neonatology, increased training costs would possibly be balanced by reduced professional liability claims stemming from alleged birth injuries. Although we recognize that less than a quarter of all cases of cerebral palsy derive from events in the perinatal period,[10] many of which are unavoidable, public confidence in the events surrounding birth will only be enhanced by the knowledge that staff are properly trained in the important area of newborn resuscitation.

Learning is defined as "a relatively permanent change in behavior that comes about as a result of a planned experience."[11] The NRP is a planned and structured experience. Future studies need to address the retention of knowledge and skills learned in this program to ensure that the changes in behavior that we observed in this study are long lasting.

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Trend analysis and socio-economic differentials in infant mortality in the Southern Health Board, Ireland (1988-1997)

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Abstract

The objective of this paper is to examine trends in infant mortality (IMR) and low-birth weight (LBW) in the Southern Health Board (SHB) area and to investigate the relationship between and social and economic factors. IMR data were obtained from the Central Statistics Office (CSO) over a 10-year period (1988-1997). Social deprivation was measured using the Small Area Health Research Unit (SAHRU) Deprivation Index, which consists of five census-based indicators; unemployment, low social class, car ownership, rented accommodation and overcrowding.

During the 10 years, 556 infants died, 380 deaths (68%) occurring in the neonatal period and 176 (32%) in the post-neonatal period. There was a downward trend in IMR throughout the study period, from 11.3 in 1988 to 4.0 in 1997 ($p<0.001$). The IMR in Cork City was higher than the rate in the SHB area as a whole ($p = 0.0001$). Congenital anomalies accounted for 34% of neonatal deaths. Sudden infant death syndrome (SIDS) and congenital anomalies accounted for 45% (79/176) and 22% (39/176) of postnatal deaths, respectively. Only 7% of all district electoral division (DED's) in the SHB were classed in the most deprived SAHRU Deprivation Index category (level 5). Yet, almost half (43%) of the DED's in Cork City were level 5 compared to only 1% in Cork County and 2% in Kerry.

Despite significant overall improvements in infant mortality in the SHB, infants born into the lower socio-economic area (Cork City) continue to experience higher relative risks of mortality in comparison with those born in the higher socio-economic areas. Further investigation into the apparently divergent socio-economic patterns of infant mortality within the SHB is necessary.

Introduction

In 1996, international infant mortality rates (IMR) were lowest in Japan (3.8 per 1000 births) and Scandinavia (4.0 per 1000 births); moderate in the United States (7.3 per 1000 births) and highest in developing countries (30-150/1000 births).[1] The IMR rate in Ireland compared favourably at 5.5 per 1000 births. These differences in IMR must be interpreted with caution, as there are significant international variations in clinical practices and the methods used to register live births.[2] Nevertheless, socio-economic, cultural and perhaps geographic factors influence IMR, which is often regarded as an indicator of a community's overall quality of life.

The 1994 data on IMR published in September 1998 by the Central Statistics Office (CSO) caused significant public concern and outcry by pointing to an apparent wide disparity between the IMR within the Southern Health Board (SHB).[3,4] A particularly high IMR was observed in the Cork City (13.9 per 1000 births) compared to the national average IMR (5.7 per 1000 births). The objective of this study was to examine data on IMR and LBW in the SHB over a 10-year period (1988 -1997) and to investigate the relationship between IMR and social and economic factors in the area.

Methods

The SHB is the second largest of the regional Health Boards (population 546,640;1996

census).Over half (54%) of the population live in Cork County, 23% in Cork City and 23% in County Kerry. Statistics on IMR are obtained in the course of the usual procedure for of deaths, which has been in operation in Ireland since the year 1863. Data pertaining to births and deaths is recorded by the county of residence of the mother. Along with a homogenous and stable population and mandatory registration of births and deaths in Ireland, omissions are negligible. The CSO data on infant deaths and low birth-weight (LBW) rates in the SHB were examined over the 10 year period, 1988 to 1997 and information on trends, geographical differences and cause of deaths extracted.

The SAHRU Deprivation Index,[5] which uses five census-based indicators from the 1991 census (unemployment, low social class, car ownership, rented accommodation and overcrowding), was examined for each ward and district electoral division (DED's) in the SHB area. The distribution of DED's in each of five categories (ranked 1 to 5, where 5 is most deprived) were calculated for the areas of Cork City, Cork County and Kerry.

Chi square tests and the Extended Mantel-Haenszel chi square for trends over time were calculated using the Epi Info[6] programme. Because of the small numbers involved statistical analysis of differences between areas was carried out on aggregated figures either for the full 10-year study period or for two five year age bands, 1988-1992 and 1993-97.

Table 1

Live births <2,500g as percentage of total live births, 1988-1997

	1988	1989	1990	1991	1992	1993	1994	1995	1996*	1997*	Total
Total Births SHB (No.)	7838	7625	7637	7600	7391	7133	7107	7080	7396	7415	74,222
SHB (%)	4	4.4	4.4	3.7	4.3	3.9	4.3	4.3	4.2	4.3	4.2
Cork City (%)	6.1	5.4	6.2	4.9	5.4	4.5	4.8	5.7	4.8	5.1	5.3
Cork County (%)	3.4	4.3	3.9	3.4	4.1	3.6	3.9	3.5	4.3	3.7	3.8
Kerry (%)	3.3	3.8	3.9	3.5	3.5	4	4.6	5.1	3.4	5.2	4
Ireland (%)	4.2	4.1	3.9	4.2	4.1	4.1	4.3	4.7	4.7	4.8	4.3

* Preliminary figures
Source: CSO

Results

Over the ten-year study period, 74,222 babies were born to mothers resident in Cork and Kerry, giving an average birth rate of 7,422 per year (Table 1). The LBW rate was 4.2%, which was similar to the national average of 4.3%. Of the LBW babies, 3.5% of live babies weighed between 1500 - 2500 gms; 0.4% weighed between 1000 - 1500gms and 0.3% weighed less than 1000 gms at birth. There was no significant change in the incidence of LBW babies over the ten years. However, the distribution of LBW babies within the SHB area shows a consistently higher incidence in the Cork City area compared to the counties of Cork and Kerry (1988-92, 5.7% Vs 4.2%; 1993-97, 5.0% Vs 4.2%, $p < 0.01$).

There was a downward trend in IMR in the SHB throughout the study period, falling from 11.3 in 1988 to 4.0 in 1997 ($p<0.001$). This trend was evident in all the three divisions of the SHB. However, except for 1989, the IMR in Cork City was always higher than that in the SHB area as a whole ($p < 0.001$). When this comparison was made in two five year age bands, the difference was not statistically significant in the first five years ($p = 0.056$) but was significant in the second five years ($p < 0.001$).

There were 556 infant deaths in the SHB during the study period (Table 2).

Table 2

Infant Mortality Rates 1988-1997											
	1988	1989	1990	1991	1992	1993	1994	1995	1996*	1997*	Total
Infant Deaths SHB	89	76	62	50	57	43	52	51	46	30	556
Total Births SHB	7838	7625	7637	7600	7391	7133	7107	7080	7396	7415	74222
SHB IMR	11.3	10	8.1	6.6	7.7	6	7.3	7.2	6.2	4	7.5
Cork City IMR	17.6	8.4	10.2	7	11.2	12	13.9	7.6	11.9	4.6	10.5
Cork Co. IMR	10	11	7	7.5	6.7	3.6	5.7	8.1	4.9	3.9	6.9
Kerry IMR	8.2	9.1	8.5	3.7	7	6.3	4.6	4.2	3.2	3.8	5.9
Ireland IMR	8.9	8.1	8.2	7.6	6.5	6.1	5.7	6.4	5.5	6.2	6.9
* Preliminary figures Source: CSO											

There were no significant differences in IMR between male and female infants (7.7 Vs 7.3 per 1000 live births, respectively). Two-thirds of deaths (380; 68%) occurred in the neonatal period (<4 weeks), with the remainder (176; 32%) occurring beyond the neonatal period (4 weeks to <1 year). The leading cause of neonatal deaths are shown in Table 3,

Table 3

Causes of neonatal (<4 weeks) deaths, SHB, 1988-97						
	1988-92		1993-97		1988-97*	
	No.	%	No.	%	No.	%
Congenital anomalies	77	35	54	34	131	34
Anoxia/hypoxia	52	24	11	7	63	17
Prematurity	18	8	43	27	61	16
Other causes	74	35	51	32	125	33
All causes	221	100	159	100	380	100
* Preliminary figures for 1996/97 Source: CSO						

with congenital anomalies accounting for a third of neonatal deaths (131; 34%) followed by anoxic causes and immaturity. Sudden infant death syndrome (SIDS) was the single most common cause of post neonatal deaths (45%; Table 4).

Table 4

Causes of deaths 4 weeks to <1 year, SHB, 1988-97.						
	1988-92		1993-97		1988-97*	
	No.	%	No.	%	No.	%
SIDS	55	49	24	38	79	45
Congenital anomalies	21	18	18	29	39	22
Infectious diseases	9	8	4	6	13	7
Other causes	28	25	17	27	45	26
All causes	113	100	63	100	176	100
* Preliminary figures for 1996/97 Source: CSO						

The reduction in the IMR, when comparing the two five year epochs (8.8 Vs 6.1 per 1000 live births), resulted in 62 fewer neonatal deaths and 50 post-neonatal deaths in the latter five years

compared to the previous five years (Table 4). Although, there was a significant decrease in the number and proportion of deaths from hypoxia in the latter epoch (52/221, 24% Vs 11/159, 7%, $p < 0.001$), an increase in the proportion of deaths from prematurity was observed (18/221, 8% Vs 43/159, 27%, $p < 0.001$). Beyond the neonatal period, there was a significant drop in deaths from SIDS, when comparing the two epochs (55/113, 49% Vs 24/63, 38%, $p < 0.01$).

Only 7% of all DED's in the SHB were classed in the most deprived SAHRU Deprivation Index category (level 5). Yet, almost half (43%) of the DED's in Cork City were level 5 compared to only 1% in Cork County and 2% in Kerry.

Discussion

This study shows that the IMR in the SHB has paralleled similar declines seen in the national rates and in other developed countries. The incidence of LBW babies in the SHB area did not change significantly throughout the study period and was significantly lower than the UK average (4.5% Vs 9%, respectively)[7]. Nevertheless, within the SHB area, disparities exist, in that Cork City has consistently higher incidence of LBW babies and higher IMR both in the neonatal period and beyond, compared to the SHB and national average. In addition, while the SHB is close to the European average in terms of prosperity, pockets of deprivation persist as demonstrated by the high preponderance of "most deprived" DED's in Cork City.

One of the main purposes of this investigation was to analyse the incidence of IMR in each of the SHB areas to determine if a significant variation in incidence of infant death existed. While small area differences in infant mortality rates must be interpreted with caution (as rates are unstable in areas with few infant deaths), the high IMR in Cork City compared to remainder of the SHB has been very consistent throughout the years. Our data also confirms that pockets of deprivation exist within the SHB, as seen by the high proportion of deprived DED's in Cork City. Social disadvantage continues to be associated with above-average IMR within countries, with lack of equity between regions partly accounting for variations in health status between populations.8 Other possible explanations for differences in the IMR between populations could include some novel vector or hazard such as whooping cough or a congenital anomaly. However, no such factor apart, from a higher incidence of LBW in Cork City, was observed in this study.

The improvement in neonatal mortality in the SHB area over the last 10 years is probably due to a combination of social factors, better obstetrical care and more aggressive neonatal care. Ireland has certainly become more prosperous in recent years. The Gross Domestic Product (GDP) has more than doubled during the 10-year period of this study (1988-97)9, while unemployment has decreased from 14.7% in 1986 to 13% in 1996.10 A healthier population is reflected in life expectancy at birth, which has increased from 70.1 years for males and 75.6 years for females in the early 1980's to 72.3 years and 77.9 years respectively in 1990.11

Neonatal survival has been enhanced by the contribution of both high-risk obstetric care and to more effective newborn intensive care. In a recent study, one third of the decline in perinatal mortality was attributed to improved condition of the baby on admission ("better babies"), reflecting improving obstetric and labour ward care.12 Two thirds of the decline was attributed to advances in neonatal intensive care ("better care") associated with newer respiratory and cardiovascular treatments. As an example of improved obstetrical care, we have documented increase in antenatal steroid administration to mothers of babies born prior to 34 weeks gestation, from 50% in 1994 to 92% in 1997 (Quality Office, Cork University Hospital). In addition, a structured neonatal resuscitation programme was introduced into the region in 1994.13,14 Neonatal intensive care has become more aggressive, particularly in the use of more powerful lung extract surfactants, nitric oxide and other modes of mechanical ventilation, including high frequency oscillation, which were introduced into Cork in 1994.

Analysis of the cause of neonatal deaths showed significant reduction in anoxia/hypoxia related deaths and a significant rise in prematurity related deaths. When we looked at national data the same period an identical pattern emerged when comparing 1988-92 and 1993-1997 (prematurity deaths 52 Vs 224; hypoxia/anoxia 215 Vs 76, respectively). The consistently low LBW rates in Ireland would suggest that the prematurity rate is not increasing. Whether the observed increase in prematurity related deaths and the reduction in deaths related to hypoxia are real needs further examination. It is possible that the changing medico-legal climate in this country may have altered reporting routines, with physicians becoming reluctant to attribute perinatal hypoxia as the cause of death, when other factors such as prematurity co-exist. One of the major deficiencies with the current IMR collection systems, which hampered our efforts to explore these hypotheses further, is that there is no formal linkage between death and birth

certificates.

Since the early 1960's, reductions in IMR in Ireland (and in the SHB) have been dramatic and encouraging. However, there is still room for improvement, as other European countries have lower IMR. Disparities between regions and income groups within the SHB area continue to exist and provide further evidence of the need for improvement. Unfortunately, owing to the current lack of comprehensive perinatal health information in Ireland, sufficient data are not available to identify the causes of these disparities. Crude perinatal and infant mortality figures yield very little insight into the problem. Therefore meaningful management statistics are urgently required if service performance is to be reasonably assessed.

This study sets out the case for birth-weight standardisation of mortality data, linkage of birth and death certificates and the need for more in-depth explorations of neonatal and infant We suggest there is a need for an ongoing anonymised enquiry into perinatal and infant deaths in Ireland, similar to Confidential Enquiry into Infant deaths and Stillbirths (CEDSI) in the United Kingdom or the Canadian Perinatal Surveillance System. This would have three main objectives: collection of data related to perinatal and infant health, analysis and interpretation of these data, and response. Such data would add to the valuable insights already provided by National Sudden Infant Death Register. By collecting and analysing perinatal and infant mortality data, we may be able to identify more accurately causes of infant mortality and thereby help reduce the overall rates and disparities among regions.

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IMJ Correspondence

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Normal developmental outcome following exposure and hypothermia in a new-born infant

Sir - Post-natal chilling is the most common cause of mild (32^0C-35^0C) neonatal hypothermia.[1,2] Moderate (28^0C-32^0C) to severe (28^0C) hypothermia are usually due to abandonment. We present a neonate, who following prolonged exposure, developed severe hypothermia and subsequently had a full neurological recovery.

A term, male, infant was born, in the late evening, to a young teenage mother in a remote area, following a concealed pregnancy. The baby, who was initially responsive, was wrapped in a blanket and held by the parents. At an hour of age, he became unresponsive. The parents attempted mouth to mouth with no apparent response and the baby was left for dead under a pile of leaves. The ground temperature that night was recorded at 7^0C at the regional meteorological station. The baby was discovered, nineteen hours later, when locals heard a whimpering noise. Upon arrival at the local hospital, a rectal temperature of 28^0C was recorded. He was hypoglycaemic and acidotic (pH = 7.0). Intravenous dextrose was given and the infant was ventilated. Hypotension was treated with volume and a dopamine infusion. He was rewarmed externally and transferred to the regional NICU, where the core temperature had risen to 35^0C. A chest radiograph showed diffuse bilateral infiltrates. Surfactant (Curosurf[]) was administered intratracheally. The infant remained hypoxic with arterial oxygen saturations of 85%, on a FiQ_2 of 1.0 and mean airway pressures of 20 cm H_20. Trials of high frequency oscillation and tolazoline were initiated without demonstrable improvement He developed an unstable supraventricular tachycardia, requiring cardioversion, in addition to focal seizures treated with phenobarbitone. Nevertheless, oxygen requirements were gradually reduced and he was weaned from the ventilator by day 4 of life. At discharge, he had a normal neurological examination and a normal computerised tomography scan of brain. At 18 months of age, he had a normal developmental assessment with no evidence of a neurological deficit.

Unresponsiveness is one of the clinical signs o[hypothermia in infants.[4,5] That this infant became unresponsive shortly after birth, suggests that he chilled rapidly and became hypothermic, leading his parents to believe that he was dead. Covering of his body with leaves may have provided insulation and protection against further heat loss. By the following morning, he had partially re-warmed and become responsive, resulting in an audible cry which led to his discovery.

Hypothermia leads to a decreased rate of cellular oxygen-requiring enzymatic reactions with the result that cerebral metabolic rate at 20^0C has been

estimated to be 23% of that at normothermia.[5] A higher surface to mass ratio compared to an adult, the paucity of subcutaneous fat and a spherically shaped head, can lead to rapid loss and core cooling in an exposed infant. If the rate of oxygen consumption decreases more rapidly than cellular supply, hypothermia can protect cells from the effects of anoxia.[5] Thus, remarkable recoveries from hypothermia have occasionally been reported, following prolonged cold water submersion and other more unusual circumstances.[3,4,6,7,8]

While full sympathy and understanding must be extended to those who find themselves in these difficult situations, it is possible to view this case as an attempted neonaticide. Seven neonaticides were reported during a 14-month period in the State of Iowa, (population 2.3 million), in similar circumstances.[9] The majority of cases involved the birth of a live infant to an adolescent following concealed pregnancies, with most deaths resulting from exposure or drowning Further studies into the background of neonaticides in Ireland are warranted and could provide useful information to prevent such tragedies occurring in the future.

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No resuscitation and withdrawal of therapy in a neonatal and a pediatric intensive care unit in Canada

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Study objective: **To compare and contrast the modes of death in a neonatal (NICU) and a pediatric (PICU) intensive care unit.**
Design: **Retrospective analysis of patient records.**
Subjects: **All newborn infants and children (<17 years of age) who died in the NICU and PICU at the University of Alberta Hospitals, Edmonton, between Jan. 1, 1990, to Dec. 31, 1991.**
Results: **The mortality rate in the PICU was 8.7% (73/839) compared with 5.6% (75/1333) in the NICU ($p = 0.007$). Withdrawal of therapy was the most common cause of death in both units and occurred more commonly in the NICU (NICU = 69% vs PICU = 34%; $p = 0.01$). There were significantly more deaths as a result of failed cardiopulmonary resuscitation (CPR) in the PICU than in the NICU (29% vs 13%; $p = 0.046$). Death after no-CPR orders occurred with equal frequency in both units (NICU 17%; PICU 15%). Brain death accounted for 22% (16/87) of PICU deaths; no infant in the NICU was declared brain dead ($p < 0.05$). When deaths resulting from brain death and failed CPR were excluded, there was no significant difference between the two units regarding withdrawal of therapy (NICU 80% vs PICU 69%) and no-CPR orders (NICU 20% vs PICU 30%).**
Conclusions: **This study confirms that both withdrawal of therapy and no-CPR orders are part of current clinical practice in both the NICU and PICU settings. The ethical foundations and implications of these practices need further elaboration. (J PEDIATR 1993;123:534-8)**

Critical care physicians have been perceived, rightly or wrongly, as providers of aggressive medical care without technologic limits and perhaps with little consideration for the ethics of such treatments. However, reports from the United States, Great Britain, Holland, and Japan concerning withdrawal and limitation of life support in adult,[1,2] neonatal,[3,4,5,6] and pediatric intensive care units[7,8] confirm that intensivists frequently consider the ethical implications of the treatments that they provide. Rhoden[9] has theorized on the international approaches to "end of life" strategies, and has suggested that Swedish physicians withhold treatment when the statistical data suggest a grim prognosis ("statistical approach"); British physicians are more likely to initiate treatment and withdraw in the face of a deteriorating clinical situation ("individualized approach"); and the trend in the United States is to initiate treatment and continue until it is virtually certain that the infant will die ("waiting for near certainty"). In Japan, the senior staff member, after plenary discussions, arrives at a decision that is then communicated to the family.[5] Limita-

CPR	Cardiopulmonary resuscitation
NICU	Neonatal intensive care unit
PICU	Pediatric intensive care unit

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tion, but not withdrawal, of therapy is practiced in perceived futile situations. Medical uncertainty, fear of being accused of medical neglect, societal and cultural influences, and family values may account for these various strategies.

The purpose of this study was to examine and compare the mode of death in an NICU and a PICU within the same institution in Canada. We also wished to determine the frequency by which decisions to discontinue or limit therapy were made and whether the patient populations in each unit influenced the decision-making process and mode of death in each unit.

METHODS

The University of Alberta Hospitals encompasses a 40-bed tertiary care NICU (approximately 700 admissions per year) and a multidisciplinary six- to eight-bed PICU (average of 450 admissions per year). Approximately half the admissions to the NICU are related to prematurity, one third to congenital anomalies, many of which require surgical intervention, and the remainder to other medical conditions. In the PICU, approximately one third of admissions are cardiovascular surgical, one third are other surgical, and one third are medical. The two intensive care units are located apart from each other within the same building and have separate nursing staffs. The NICU is staffed by five full-time neonatologists and the PICU by two full-time pediatric intensivists (with one of the neonatologists providing parttime coverage).

The medical charts of all newborn infants and children who died in the NICU and PICU at the University of Alberta Hospital during a 2-year period (Jan. 1, 1990, to Dec. 31, 1991) were reviewed. Data including time of admission, cause of death, age at declaration of death, and mode of death were collected. Birth weight and gestational age were also documented for neonates. The cause of death was defined as the principal condition responsible for the infant's or child's death, which was not necessarily the admitting diagnosis.

The mode of death was determined from documentation in the physician and nurse progress notes and in the order sheets, and from discussion with the attending neonatologists and pediatric intensivists. Cardiopulmonary resuscitation was defined as the institution of chest compressions and/or the use of intravenous or intratracheal dose(s) of epinephrine and/or the use of electrical defibrillation to restore a cardiac rhythm and a measurable blood pressure. When no-CPR orders were written, these measures were not initiated in the event of clinical deterioration. Withdrawal of treatment was defined as discontinuation of all active support, including positive-pressure ventilation. Thus deaths were classified into one of four groups according to the terminal event. Group 1 consisted of patients who were declared brain dead according to accepted criteria.[10] In group 2, CPR failed to restore cardiac activity and a measurable blood pressure. In group 3 (no-CPR orders), CPR was not attempted. In group 4, the patient was removed from all life-sustaining therapy.

Table I. Demographic data of those who died in the NICU and the PICU

	NICU (n = 75)	PICU (n = 73)
Gestational age range (wk)	23-43	NA
Birth weight (gm)		
Mean ± SD	1870 ± 1270	NA
Range	469-6000	
Age on admission		
Mean ± SD	Newborn	3.4 ± 5.8 yr
Range		1 mo to 16 yr
Time (days) from admission to death		
Mean ± SD	32 ± 73	3.6 ± 5.8
Range	1-477	1-37

NA, Not applicable.

The process of decision making around death and dying was similar in both the NICU and the PICU. Care was taken to establish the diagnosis and prognosis as accurately as possible. Consultation with specialist colleagues was routinely used. The parents were intimately involved in the decision-making process by frequent communication of prognostic information and by the health care team's assessment of their values and beliefs. Communication with the families was usually led by the attending neonatologist or pediatric intensivist, together with the involvement of nurses, social workers, clergy, and medical residents. The communication of the final decision was always the responsibility of the attending physician. Consultation with the hospital ethics committee was available when there was conflict or lack of consensus among the health care team and the parents.

Descriptive data are reported as means ± SD. Statistical analysis of categoric data was by Fisher Exact Test. A p value <0.05 was considered significant.

RESULTS

There were 839 admissions to the PICU and 1333 admissions to the NICU during the study period. The overall mortality rate in the PICU was 8.7% (73/839), which was higher than in the NICU (5.6%; 75/1333; $p = 0.007$). Demographic data of the infants and children who died in both intensive care units are presented in Table I. Significantly more deaths occurred in the PICU within the first 3 days (56/73; 77%) than in the NICU (35/75; 46.7%; $p = 0.04$). Late deaths (>28 days after admission) were

Table II. Causes and modes of deaths in the NICU and the PICU

	No.	(%)	BD	Failed CPR	No CPR	WT
NICU (n = 75)						
ELBW (430-999 gm)	16	(21)	0	4	2	10
Congenital heart defect	11	(15)	0	4	0	7
Lethal anomalies	10	(13)	0	0	5	5
Hypoxic-ischemic encephalopathy	9	(12)	0	1	2	6
Chronic lung disease	7	(9)	0	0	2	5
Pulmonary hypoplasia	6	(8)	0	0	1	5
Sepsis	6	(8)	0	0	0	6
Lethal trisomy	3	(4)	0	0	1	2
Others	7	(9)	0	1	0	6
TOTAL	75		0	10	13	52
PICU (n = 73)						
Cardiogenic shock (postoperative)	36	(49)	0	16	6	14
Septic shock	12	(16)	1	3	3	5
Cerebral herniation/hemorrhage	9	(12)	6	1	1	1
Meningitis	6	(8)	4	1	1	0
Multiplé trauma	5	(7)	4	0	0	1
Respiratory failure	3	(3)	0	0	0	3
Hypoxic-ischemic encephalopathy	2	(3)	1	0	0	1
TOTAL	73		16	21	11	25

BD, Brain death; *WT*, withdrawal of therapy; *ELBW*, extremely low birth weight.

more common in the NICU (12/75; range, 34 to 477 days) than in the PICU, where only one late death occurred at 37 days ($p = 0.003$).

The causes of death are listed in Table II. The most common cause of death in the NICU (21%) was related to the extreme prematurity of the extremely low birth weight infants (469 to 999 gm), two of whom had weighed <500 gm at birth. Congenital heart defects accounted for 15% of the NICU deaths. These lesions included those of hypoplastic left-heart syndrome (5 deaths), Ebstein anomaly with pulmonary atresia (2), interrupted aortic arch (2), and single cases of truncus arterfosus and tetralogy of Fallot. Major anomalies (13%) included Potter syndrome (4 cases) and single cases of holoprosencephaly, hydranencephaly, encephalocele, severe hydrocephalus, and diaphragmatic hernia. Nine infants (12%) had Sarnat stage III hypoxic-ischemic encephalopathy; 7 infants (9%) died of chronic lung disease. All six infants with sepsis had multisystem organ failure. The diagnosis of pulmonary hypoplasia was made in six infants who had a history of oligohydramnios, prolonged rupture of membranes, and postnatal respiratory failure. The three infants with lethal trisomies had either trisomy 13 or trisomy 18. The miscellaneous category included two infants with severe nonimmune hydrops and single cases of congenital tuberculosis, congenital viral infection, congenital neuromyopathy, total bowel infarction, and severe hyaline membrane disease.

Almost half of the total PICU deaths (49%) were due to intractable cardiac failure after surgery for congenital heart defects. There were 12 deaths from septic shock (16%). The remaining deaths, from raised intracranial pressure, were from head injuries, vascular malformations, meningitis, strangulation, and drowning. Multiple trauma (7%) and respiratory failure (3%) were uncommon causes of death in the PICU (Table II).

Withdrawal of therapy was the most common mode of death in both units and occurred more frequently in the NICU (52/75; 69%) than in the PICU (25/73; 34%; $p = 0.01$). A similar proportion of infants in both units died without receiving CPR at the time of death (NICU 13/75 [17%] vs PICU 11/73 [15%]). Death after failed resuscitation occurred twice as often in the PICU as in the NICU, occurring in 21 (29%) of 73 PICU deaths, in comparison with 10 (13%) of 75 NICU deaths ($p = 0.046$). Brain death accounted for significantly more deaths in the PICU (16/73; 21.9%) than in the NICU, where no cases of brain death were documented during the study period ($p = 0.001$). Brain death was associated with a primary neurologic insult in 15 of 16 cases (Table II). When infants and children with brain death and failed CPR were excluded, there was no statistical difference regarding withdrawal of therapy (NICU 52/65 [80%] vs PICU 25/36 [69%]) and no-CPR orders (NICU 13/65 [20%] vs PICU 11/36 [30%]).

DISCUSSION

The majority of deaths in both units occurred either as a result of withdrawal of treatment or after a no-CPR decision, with death from withdrawal of therapy being more common in the NICU. Although the patients from whom treatment was withdrawn or for whom it was limited are

high in proportion to the number of deaths, the overall mortality rates in both units were low and comparable to those in other major centers.

In the absence of medical certainty, decisions in both the NICU and the PICU were made by an "individualized approach" as opposed to "waiting for near certainty" or using a "statistical approach." The individualized approach entails constant reassessment of prognosis and, with the involvement and consent of the family, allows the forgoing of treatment in situations in which there is a high likelihood (but not necessarily a near certainty) of severe disability or death.[11] The parents were involved in all decisions; none of the decisions was made on the basis of allocation of resources or parental financial constraints. If a difference in opinion persisted between the family and the health care team after extensive discussion, we would have presented the case before the hospital bioethics committee. However, during the study period, the need for ethical committee consultation did not arise.

Before the "Baby Doe" debate, 14% of neonatal deaths at Yale–New Haven Hospital[4] were due to withdrawal of care. In the United Kingdom, 30% of neonatal deaths at the Hammersmith Hospital[12] and 21% of neonatal deaths at the Aberdeen Maternity Hospital[13] followed withdrawal of care. In the latter study, certain treatments were withheld before an additional 31% of deaths. The most recent neonatal data from the United States indicated that 21% (27/127) of infants weighing <1500 gm had no CPR before death.[14] Certain aspects of our practice differ from the practice in Aberdeen, where infants less than 26 weeks of gestational age were not routinely supported by mechanical ventilation, and from that reported by Lantos et al.,[14] in which babies weighing <590 gm were considered nonviable. It is our practice to be present at the delivery of all infants born at more than 22 completed weeks of gestation. Infants weighing <500 gm are not resuscitated except in questionable cases (e.g., if the infant is vigorous or thought to be growth retarded), in which case we resuscitate and stabilize the infant. In the NICU, a full evaluation of the infant's condition and prognosis, in addition to careful dialogue with the parents, may then result in either continuation or withdrawal of therapy.

The increasingly common practice of resuscitation of ever smaller and more immature infants necessitates the commitment to withdraw treatment in clearly adverse circumstances. Intractable respiratory or renal failure or intraparenchymal cerebral hemorrhage, or a combination of these events, was the usual indication for discontinuation of support in the NICU. Currently, our survival rate for infants weighing <750 gm is approximately 50%, with a continuing reduction in morbidity among survivors.[15] We believe that short periods (usually 1 to 2 days) of aggressive conventional therapy, including tracheal intubation, ventilation, insertion of arterial catheters, and surfactant administration, are acceptable when the temporary discomfort of the infant is balanced against the potential benefit of life with a significant chance of a normal outcome.

There are obvious differences in patient populations and therefore in the cause of death in comparisons of NICUs and PICUs. Thus it is likely that, in either type of unit, different processes lead to decision making that is based on the prognosis as determined by the current literature, the regional outcome, the personal experience of the health care team, and an assessment of the family's personal values.

In the NICU, the ultimately fatal outcome for certain conditions, such as trisomies 13 and 18, major anomalies of the central nervous system, and pulmonary hypoplasia with renal agenesis, is well established. Compassionate care was given in all such cases, but assisted ventilation was not initiated if the diagnosis had been made antenatally, and was withdrawn if made postnatally. All infants with congenital heart defects were treated aggressively and considered for either palliative or corrective surgery and heart transplantation if indicated. However, the scarcity of donors, the necessity to transfer the infant out of the province (in the absence of a neonatal heart transplantation program in Alberta), and the possibility of death before transplantation could be performed, despite full support, were factors in some parents' decisions to opt for palliative care.

Decisions to withdraw treatment in certain term asphyxiated infants certainly involved quality-of-life deliberations. Studies of such infants have confirmed that those who are comatose with burst-suppressed electroencephalograms (Sarnat stage III) either die or are severely impaired neurologically.[16, 17] In such cases the parents were made aware of the likelihood of a poor outcome and were supported in their decision to either continue, limit, or withdraw treatment.

The burdens and benefits were also assessed and weighed in the case of extremely low birth weight infants with chronic lung disease in whom hypoxia continued despite full ventilatory support with 100% oxygen, often for many months after birth. In addition to chronic respiratory failure, these infants had other problems, including posthemorrhagic hydrocephalus, cerebral atrophy, and seizures from repeated hypoxic episodes. Nevertheless, it was obvious that these cases were the most difficult ones for the health care team and parents alike, perhaps because of the infants' prolonged stays in the NICU and the strong bonds that developed with these infants and their families. As expressed by Stahlman[18]: "Ethical dilemmas . . . are rarely simple and stark but are, instead, multifaceted, complex, and gut-wrenching for parents and care givers alike."

The modes of death in our PICU were statistically no

different from the pattern seen in the PICU of the Children's National Medical Center, Washington, D.C.[7] In that study, approximately one third of deaths occurred from limitation or withdrawal of therapy, one third of deaths as a result of failed CPR, and another one third of the patients were declared brain dead. We appear to have had a higher rate of withdrawal of therapy from infants and children who had heart surgery. However, four children in our PICU population had CPR within hours of the withdrawal of life support but were categorized as having died as the result of withdrawal of therapy. According to our definition, CPR was deemed to have failed only when CPR was stopped because of asystole and pulselessness. In a retrospective study, it is difficult to ascertain the return of "adequate" circulation after CPR, which was the definition used by Mink and Pollack.[7]

Brain death accounted for one fifth of deaths in the PICU. The ethical conundrum in these cases could be whether the dying process was prolonged (before the confirmation of brain death) to avoid a decision to withdraw therapy, or to foster potential organ donation. The facts that the majority of brain deaths in our study were due to a primary neurologic insult and that 15 of the 16 deaths occurred within 48 hours of the insult are against such a premise. We agree with Fackler and Rogers[19] that rigidly requiring brain death as the sole criterion for discontinuation of support subjects families to unnecessary anguish.

Further studies are needed to evaluate and interpret the decision-making processes that lead to the initiation of treatment and subsequent limitation or withdrawal of support in pediatric patients.

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No resuscitation and withdrawal of therapy in neonatal and pediatric intensive care units

To the Editor:

We read with interest the article by Ryan et al.[1] on the modes of death in a neonatal and a pediatric intensive care unit. The authors note that there are different approaches to "end of life" strategies in different countries, such as the "statistical approach," the "individualized approach," and "waiting for near certainty." They distinguish four modes of death, under which withdrawal of treatment was the most common cause of death in both units. The discussion centers primarily on the limitation or withdrawal of therapy in neonatal patients. In *pediatric*patients the decision to withdraw intensive treatment or not to resuscitate is even more difficult. Withdrawal of treatment might be related to public opinion on quality of life, so different attitudes may exist in different countries.[2]

We are puzzled by a few questions. What was the time interval between the decision not to resuscitate or to withdraw treatment and the actual moment of death? If a short time interval exists, why do the authors call the process of decision making an "individualized approach" and not "waiting for near certainty"? In the case of a long time interval, what was done to reduce the child's suffering? Are there patients in whom therapy was withdrawn but who survived for a time? Although the parents were involved in the decision-making process, how often was there a lack of consensus between the health care team and the parents?

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Reply To the Editor:

We used the terms "individualized approach," "waiting for near certainty," and "statistical approach" to summarize Rhoden's broad characterizations of the typical decision-making strategies under conditions of uncertainty in Great Britain, the United States, and Sweden, respectively.[1] These terms do not refer to and should not determine the time interval between treatment withdrawal and the moment of death. However, they do imply that many physicians who wait until near certainty may continue what they perceive to be futile treatment because of fears of being accused of medical neglect.[2] In our article, we suggested that the typical decision-making process in Canada is probably closer to the individualized prognostic strategy.[3]

In this retrospective study, it was not possible to determine the time from treatment withdrawal to the moment of death, because this was not always documented in the charts. The moment of decision was even more difficult to pinpoint because these decisions evolve with time. Parents were always informed that withdrawal of support did not necessarily imply immediate demise; however, there were no long-term survivors (more than 10 days) among infants treated with compassionate care or in whom life support was withdrawn during this study period.

The decision to offer compassionate care does not end the ethical dilemmas that arise daily in intensive care units. The issues of feeding, pain assessment, pain control, and sedation were often intensely debated, and parents continued to play a significant role in these areas. Every effort was made in both the pediatric and the neonatal intensive care units to keep the infants and children as comfortable as possible. It is most unusual for a child receiving mechanical ventilation in our intensive care units not to be receiving a narcotic infusion, which is adjusted according to the child's perceived needs.

As we stated, if a difference of opinion had persisted between the family and health care team, we would have involved the hospital's bioethics committee. In general, we do not pursue the option of withdrawal or limitation of treatment if parental opposition is expressed. In such situations, the parents may subsequently change their minds or the child may later have died and been classified in another category (e.g., failed cardiopulmonary resuscitation) or may have survived and been discharged home. In the latter situation, the infant or child would not have been included in the study, which was based only on children who died before discharge. We are aware of several cases in each unit in which the parents requested continuation of therapy and the children survived, albeit with severe disabilities.

We do not altogether agree with Bos et al. that decision making under conditions of uncertainty is necessarily more difficult in pediatric patients compared with newborn infants. The decision-making process is similar for all pediatric age groups. In our opinion, the difficulties in establishing prognosis in terms of medical certainty vary according to the circumstances of the individual case and not according to the age of the child or a particular type of intensive care unit.

9/35/55239

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INVITED COMMENTARY

No resuscitation orders and withdrawal of therapy in paediatric intensive care units

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"After the first death, there is no other."
A Refusal to Mourn the Death, by Fire, of a Child in London. Dylan Thomas

The study by Martinot et al. (1), published in this issue of Acta Paediatrica, which was prospective and multicentred, is important in that it provides empirical evidence for what is current practice in end-of-life dilemmas in a selection of paediatric intensive care units (PICUs) in France. Combining previous studies with their own experience, Martinot et al. demonstrated that among the children who died in PICU, death was acknowledged according to brain death criteria in 24%. Over one-quarter (30%) fail to respond to cardiopulmonary resuscitation (CPR) and almost half (46%) have their treatment limited or withdrawn. The similarity in the distribution of modes of death in these studies which include PICUs in the United States, Canada, Britain and mainland Europe, is interesting. The fact that almost half of the children who die in PICUs die from limitation or withdrawal of support suggests that paediatric intensive care physicians, throughout the Western world, are willing to make judgements as to when additional or further therapy is considered futile and to act on those judgements. Premature infants were excluded from the French study. However, we are aware that limitation or withdrawal accounts for up to three-quarters of deaths in some neonatal intensive care units (2).

Of the three modes of death described above, decisions about withdrawal or limitation of support are the most agonizing, mainly because they are made in the absence of prognostic certainty. In order to help practitioners and families make informed choices, efforts have been made to develop predictive scoring systems. The Paediatric Risk of Mortality (PRISM) score, an objective validated severity of illness measure, was originally developed [and recently updated (3)] from PICU databases in the United States to identify patients with high mortality risks. In their study, Martinot et al. (1) prospectively applied this score to deaths in nine PICUs in France, postulating whether it might identify the mode of death. Secondly, these investigators questioned whether children with a pre-existing chronic illness or moderate to severe disability were more likely to die in a certain manner, presumably, more likely to have support limited or withdrawn.

Their results showed similar PRISM scores among critically ill children who died of brain death, failed CPR, and limitation or withdrawal of support. It is not surprising that the PRISM score, a predictor of mortality, was not associated with a particular mode of death. While some physicians use prognostication scores as an adjunct in determining futility (4), others are of the opinion that severity scores have no role in clinical decision making, owing to their low sensitivity (5). Most would agree that outcome of paediatric intensive care should incorporate not only survival but should also take into account quality of life, morbidity and disability. It is likely that these and other issues such as patient diagnosis, physician and family agreement on the prognosis (6), communication and family values that determine the mode of death.

The French study also indicated that a pre-existing handicap or chronic illness were not associated with a particular mode of death in the PICU. It is tempting to interpret this finding as an indication that quality of life issues are not important considerations in death and dying in PICU settings. Such an interpretation is likely to be incorrect and was rightly avoided by the investigators. One explanation for the observed lack of association between illness or disability and mode of death may be the PICU gatekeeper. Children dying of chronic conditions (e.g. cystic fibrosis, malignancies) and severely disabled children with life-threatening intercurrent illnesses are frequently not supported by intensive care facilities and technology. These ethical dilemmas frequently remain outside the domain of the PICU. Nevertheless, quality of life assessments are part of the decision making process in adult (4) and neonatal intensive care (2). Unquestionably, similar balancing of the complex tensions between life extension, quality of life and family values also occur in paediatric intensive care settings.

While we are aware that withdrawal and limitation of support are an integral part of paediatric intensive care, we need more information on the events surrounding limitation or withdrawal of care in PICUs, similar to those described in adult (7) and neonatal intensive care settings (8). Investigators should now address the process, timing and mechanics of dying in the PICU, the involvement of the team and the quality of communication with the family. With this information, consensus approaches might be developed that best protect the interests of the patient, and also help bereaved families to mourn the death of a child.

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Changing Attitudes and Practices Regarding Local Analgesia for Newborn Circumcision

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ABSTRACT. *Study objective.* To change physician attitudes and practices regarding the routine use of local and regional anesthesia for newborn circumcision.

Design. Interventional study, followed by an audit of physician practice over a 1-month period, 1 year following interventions.

Setting. The newborn nurseries of the Womens' Pavilion, Royal Alexandra Hospital, Edmonton.

Interventions. A broad range of awareness and educational programs were directed at physicians who perform newborn circumcisions, including posters, newsletters, presentations at grand rounds, video recordings, and practical "hands-on" demonstration of the techniques of local anesthesia to the prepuce and dorsal penile nerve block.

Results. Only one physician was using local analgesia for newborn circumcision prior to the introduction of the educational program. The audit, performed 12 months later, documented 46 circumcisions performed by 22 physicians, each performing between 1 and 6 circumcisions (median = 1). Sixteen of the 22 physicians (73%) used either local anesthesia to the prepuce (19 cases) or dorsal penile nerve block (13 cases) during circumcisions. Thus, local analgesia was used in 66% (32/48) of all circumcisions. Six physicians, performing 16 circumcisions, did not use any form of analgesia.

Conclusions. This simple educational program has been associated with a remarkable change in attitudes and practice regarding local analgesia for neonatal circumcision. Our ideal objective, which we hope to achieve through repeated education and practical demonstrations of the techniques to interested physicians, is that all newborn circumcisions are performed under local or regional anesthesia in our institution. *Pediatrics* 1994;94: 230–233; *circumcision, newborn, analgesia, local anesthetic.*

ABBREVIATIONS. DPNB, dorsal penile nerve block; EMLA, eutectic mixture of local anesthetics.

There is no doubt that the newborn infant experiences pain during circumcision as reflected by physiological and behavioral changes. Circumcision has been shown to increase the heart rate, decrease oxygenation, increase blood pressure, induce sweaty palms and has been associated with changed behavioral states lasting more than 22 hours following the procedure.[1–6] These physiological and behavioral effects have been attenuated by local anesthetic to the prepuce and by regional blockade. There are now a large number of randomized, controlled studies confirming these responses.[5–11]

Nevertheless, neonatal circumcisions continue to be performed without any form of analgesia in most institutions, including our own. Each year, over 1000 neonatal circumcisions are performed at the Royal Alexandra Hospital, Edmonton, representing almost 50% of inborn male neonates. In October 1992, only one physician, out of more than 20 physicians who perform neonatal circumcisions in this institution, used local anesthesia for the procedure.

The object of this study was to encourage voluntary implementation of the routine use of local or regional anesthesia for this common procedure among physicians from a variety of subspecialties.

METHODS

In October 1993, we introduced an educational program to the nursing staff and to obstetricians, family practice physicians, and pediatricians describing the published research on pain during neonatal circumcision. The educational program, which called attention to the controlled trials that had demonstrated the benefits of regional and local anesthesia during neonatal circumcision, was presented at grand rounds of each of the above specialties. In addition, a video showing two infants, one having a circumcision without local anesthesia and another being circumcised with local anesthesia, was widely circulated. Illustrative posters showing the method of prepucial local anesthesia and dorsal penile nerve block were displayed in all the newborn nurseries (Figure). Over the next few months, the authors made themselves available to perform and demonstrate these techniques, on newborns undergoing circumcision, to any interested physician in the hospital. A newsletter was published and distributed widely in the hospital and among the local medical community outlining the literature of pain control during circumcision and describing the techniques of local anesthesia. A pamphlet was prepared for parental information on the risks and possible benefits of neonatal circumcision. The pamphlet included an outline on the care of the uncircumcised penis, the American Academy of Pediatrics guidelines for circumcision,[12] and the procedure of circumcision, including the potential for using local anesthesia during circumcision. The program was fully supported by the heads of obstetrics, pediatrics, family practice, anesthesia and nursing within the institution.

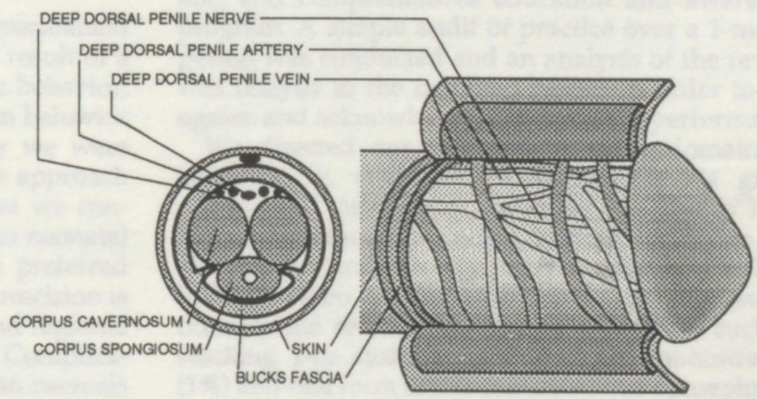
In September 1993, 12 months following the presentation of the educational program, an audit of practice was performed in order to determine the proportion of physicians who were using local anesthesia during circumcisions. In addition, a variable score of patient comfort was documented by the attending nurse during each of the procedures in the audit period. The local anesthetic during circumcision was scored as very effective, moderately effective, minimally effective, or ineffective. Any complications of the procedure were also recorded. Following the audit, the physicians involved were given feedback in terms of an analysis of the audit and were asked to complete a questionnaire which sought to

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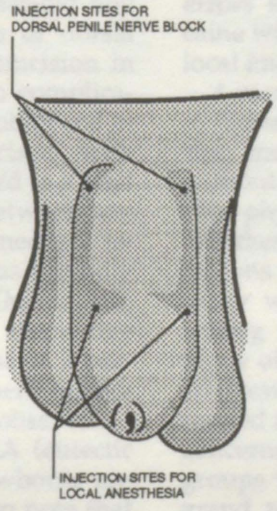


Figure. Poster illustrating the techniques of dorsal penile nerve block and local anesthesia to the prepuce.

METHODS

1. Draw up 0.8 mL lidocaine 1% (***without epinephine***) in 1cc syringe.
2. Attach 26 gauge needle.
3. Infiltrate 0.4 mL lidocaine on either side of 10 o'clock and 2 o'clock position to a depth of 5 to 10 mm.
4. Avoid the body of the penis.
5. Wait at least 3 minutes before circumcision.

determine which of the five methods of education, information and awareness described above, were most influential in convincing them to use local anesthesia during circumcisions. Their responses were scored as follows; no influence (0), mildly influential (1), moderately influential (2), or very influential (3).

RESULTS

There were 46 neonatal circumcisions performed in the two newborn nurseries during the audit period. These circumcisions were performed by a total of 22 physicians, each performing between 1 and 6 circumcisions (median = 1). Sixteen of the 22 physicians (73%) used either local anesthesia to the prepuce (19 cases) or dorsal penile nerve block (13 cases) during circumcision. Thus, some form of anesthesia was given in 66% (32/48) of all circumcisions. Six physicians, performing 16 circumcisions, did not use any form of anesthesia. During the study period, four circumcisions were performed by the sole physician whose practice was to use local anesthesia prior to the educational program.

Circumcisions with local anesthesia took longer to complete than those performed without anesthesia (10.0 ± 4.3 vs. 7.3 ± 2.9 minutes; $P = .07$). The nurses rated anesthesia as being very effective in 7/26 (26%), moderately effective in 13/26 (50%), and minimally effective in 2/26 (7%) instances. They considered the anesthesia to have been ineffective in only 2/26 (7%) of cases.

There was an 81% (13/16) response rate to the follow-up questionnaire from physicians who performed local anesthesia and 50% (3/6) response rate from physicians who continued to perform circumcision without any form of analgesia. Not all physicians were exposed to all five media in the educational program. In order to give weight to this factor when rating the influence of each media on physician practice, the sum of the scores of influence given by the physicians for each media was divided by the product of the number of physicians who saw the media and the maximum possible score (ie, "very influential" = 3). In this way, we were able to rate the influence of each media as a percentage of the potentially maximum score achievable for that media. The results were as follows: grand rounds (20/42, 48%); practical demonstration of techniques (10/27, 37%); newsletter (12/33; 36%), poster (10/39, 26%), and video (7/27, 26%). "Peer pressure" and parental request were considered mildly influential factors by only three and two physicians, respectively. Of the three physicians who did not change their practice but responded to the questionnaire, one

was interested in learning the techniques of local anesthesia and changing current practice.

DISCUSSION

Learning is defined as a "relatively permanent change in behavior that comes about as a result of a planned experience."[13] In order to change behavior, one must first of all identify the changes in behavior that need to occur. In the present study we were convinced of the need for a more humane approach to neonatal circumcision, a procedure that we consider among the most painful performed in neonatal medicine. We recognized that, while the preferred method of analgesia during newborn circumcision is still open to debate, the efficacy of local and regional anesthesia has been well documented.[5-11] Complications of local anesthesia are rare. Local skin necrosis resulting in minimal dorsal coronal skin scarring in a toddler and a normal outcome in a 3-year-old boy have been described related to the use of dorsal penile nerve block (DPNB) during circumcision in older children[14] but not in newborns. No complications related to regional anesthesia were observed in one series of 887 newborns circumcised with DPNB.[15] This experience has been extended to a total of 3802 infants circumcised with DPNB between January 1981 and November 1993. A spontaneously resolved hematoma at the injection site was the only complication observed related to DPNB (Mintz MR, personal communication). The use of alternative methods of analgesia, for example, sucrose on a pacifier,[16] and topical anesthetic creams[17-19] merit further investigation. While Benini et al have observed a reduction in pain responses using EMLA (eutectic mixture of local anesthetics) cream in newborns undergoing circumcision,[19] it is of interest to note that eight of nine adult males undergoing circumcision with EMLA required additional cutaneous infiltration of local anesthetic for the procedure.[20] In a comparison between EMLA cream and DPNB in boys aged 2 to 10 years undergoing circumcision under general anesthesia, Lee et al concluded that EMLA was not as effective as DPNB with regard to postoperative analgesia.[21] Systemic analgesia with acetaminophen or opiates for neonatal circumcision have not been systematically studied.

We did not plan this study as a controlled study of the risks/benefits or the efficacy of various forms of anesthesia for newborn circumcision. Rather, our objective was to convert practitioners to the use of either local anesthesia or regional blockade during newborn circumcision based on the best information available in the literature to date. The process we followed can be looked at as an example of continuous quality improvement. The primary objective in continuous quality improvement is shifting away from identifying and punishing "bad apples" to improving the level of the quality of care provided by the majority. Continuous quality improvement begins with a group of committed physicians familiarizing themselves with scientifically reliable current literature. This knowledge and awareness, combined with clinical experience and professional consensus, is used to informally assess practice patterns within the institution. The process in the current project was to introduce a new therapeutic modality in a high volume procedure by means of a planned, systematic, and comprehensive education and awareness program. A simple audit of practice over a 1-month period was conducted and an analysis of the review was relayed to the involved parties in order to recognize and acknowledge their superior performance.

We directed our approach at three domains of behavior, ie, cognitive ("knowledge") via grand rounds and newsletters, affective ("attitudes") via personal contact, newsletters, posters, and video presentations, and finally, psychomotor ("skills") through video, poster, and "hands-on" demonstrations of the techniques. Simple measures, such as stocking 1-cc syringes and a single concentration (1%) and one form of lidocaine (*without* epinephrine) in the nurseries, were instituted to prevent potential errors such as inadvertent administration of lidocaine with epinephrine or excessive lidocaine during local anesthesia.

A recent survey of newborn circumcision practices in Eastern Canada has reaffirmed our impression that most neonatal circumcisions are performed without effective analgesia.[22] In that study, only 3/74 (4%) physicians performing circumcisions used local anesthesia in the form of a DPNB. The most common reasons given for not employing analgesia in this study were lack of familiarity with analgesia use among neonates, lack of familiarity with the technique of DPNB, and concern over adverse effects of analgesic drugs and regional analgesia. Our multifaceted educational program addressed each of these concerns through a variety of media formats. Other groups may find it useful to note that subspecialty grand rounds, newsletters, and practical hands-on demonstrations of the techniques of local anesthesia appeared to be the most influential methods of altering behavior and practices among our physicians.

While the subjective assessment of the effectiveness of local anesthesia by the nursing staff in the present study was not scientifically valid in the absence of a control group, their observations on the benefits of local anesthesia during newborn circumcision are consistent with the results of published controlled trials.[5-11] Physicians did not spontaneously admit to being influenced by the nursing staff in changing their attitudes regarding local anesthesia. Nevertheless, we believe that the commitment and involvement of the nurses was and will continue to be of utmost importance in the continuing success of this project.

A conversion rate from just one physician to almost 75% of physicians in our institution using local anesthesia for newborn circumcisions in less than a year is remarkable. This success should be considered in light of the well known difficulties in altering attitudes and behavior in areas of public health such as compliance with wearing safety belts and bicycle helmets. While we have not achieved 100% success in converting physicians to the effective use of local analgesia, it is our intention to continue to address concerns of physicians who are reluctant to use local or regional anesthesia and to be available to demon-

strate the techniques to interested physicians. In addition, as part of ongoing quality improvement, we intend to perform intermittent audits and hope to convince all physicians that effective analgesia should be a requisite when performing neonatal circumcision. Our objective is that no infant will be circumcised without adequate analgesia in our institution and we hope that our success to date will convince other institutions to work toward the same ideal.

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