Neonatal Resuscitation

Does Practice Make Perfect?

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Outline

- History of Neonatal Resuscitation
- A Public Health Perspective
- Resuscitation Science
- NRP 2010 Guidelines
- Future of Neonatal Resuscitation

Practice, Practice, Practice!
Objectives

- Evaluate the historic process of neonatal resuscitation and its evolution into our current framework of training
- Recognize the importance of practice or episodic learning in neonatal resuscitation
- Obtain practical application techniques to improve resuscitation efforts in birthing centers
Practice

“To perform or work at repeatedly so as to become proficient.”

Merriam-Webster
Practice
Perfect?
Practice
Perfect?
Practice
Practice
Perfect?
Do we need practice?

Clinical paper
Marked variation in newborn resuscitation practice: A national survey in the UK
Chantelle Mann, Carole Ward, Mark Grubb, Barrie Hayes-Gill, John Crowe, Neil Marlow, Don Sharkey

ORIGINAL ARTICLE
Delivery room resuscitation of preterm infants in Canada: current practice and views of neonatologists at level III centers

Resuscitation in the Delivery Room: Lung Protection From the First Breath
Thomas E Wiswell MD
Respiratory Care • September 2011 Vol. 56 No 9
History of Neonatal Resuscitation

Jacopo Robusti Tintoretto  www.oceansbridge.com
Historical Context

Chinese emperor and philosopher Hwang-Ti (2698–2599 BC) noted that newborn death from ventilatory failure occurred more commonly among infants born prematurely.

Increased mortality among premature infants was also reported in Eber's Papyrus in Egypt (1552 BC).

Hippocrates (460–380 BC) described intubation of the trachea of humans to support ventilation.

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2672845/
William Smellie's standard approach to apparently lifeless newborns included “... the head, temples and breast rubbed with spirits; garlic, onion or mustard applied to the mouth and nose”.

William Hunter (1781–1783) denounced mouth-to-mouth as “the method practiced by the vulgar to restore stillborn children”.

The Schultze method

[Image of medical illustrations]
1960’s Mechanical ventilation

1970’s Neonatal Intensive Care Units

1980 NIH Funded Research

1985 Neonatal Resuscitation Program

1992 International collaboration

http://www2.aap.org/nrp/about_history.html
The International Liaison Committee on Resuscitation (ILCOR) is a multinational group that provides coordinated forum for researching, reporting, and developing international resuscitation guidelines supported by scientific data. Every 5 years, ILCOR coordinates the research, debates the science, and determines new international resuscitation treatment recommendations.

ILCOR Consensus on Science With Treatment Recommendations (CoSTR)

Neonatal Resuscitation Program Textbook 6th Edition
Neonatal Resuscitation Program (NRP)

Vision
To have every newborn in need of resuscitation effectively cared for by health care professionals.

Mission
To develop an education program for health care professionals that promotes optimal care and resuscitation of newborns.
NRP International Dissemination

- 2 Million Trained
- 25 Languages
- 124 Countries

http://www2.aap.org/nrp/docs/NRP-20thAnniversaryBook.pdf
The Public Health Perspective
Why do we resuscitate newborns?

It’s our job.

‘Cause babies are cute!

It’s just the right thing to do.

It’s unethical not to.

God wants us to.

Our future depends on it
Survival rates by birth weight for infants ≤1000g

United States 2011

<table>
<thead>
<tr>
<th>Birthweight</th>
<th>22 weeks</th>
<th>23 weeks</th>
<th>24 weeks</th>
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<tbody>
<tr>
<td>Male</td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>&lt; 500 g</td>
<td>4% (n=6450)</td>
<td>3%</td>
<td>2%</td>
</tr>
<tr>
<td>500 – 750 g</td>
<td>52% (n=11,081)</td>
<td>6%</td>
<td>9%</td>
</tr>
<tr>
<td>750 – 1000 g</td>
<td>85% (n=11,847)</td>
<td>6%</td>
<td>9%</td>
</tr>
</tbody>
</table>

Survival rates by gestational age, gender, and birthweight for infants ≤25 weeks EGA and ≤600 g

<table>
<thead>
<tr>
<th>Birthweight</th>
<th>22 weeks</th>
<th>23 weeks</th>
<th>24 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>401g-500g</td>
<td>3%</td>
<td>2%</td>
<td>8%</td>
</tr>
<tr>
<td>501g-600g</td>
<td>6%</td>
<td>9%</td>
<td>21%</td>
</tr>
</tbody>
</table>
Gestational Age

Figure 4. Percentage of live births by weeks of gestation: United States, 2000 and 2005

- 37 and over: 88.4% (2000), 87.3% (2005)
- Less than 32: 1.9% (2000), 2.0% (2005)
- 32–33: 1.5% (2000), 1.6% (2005)

Figure 16-3. Low Birth Weight (LBW) Births, 2006–08

Healthy People 2010 objective 16-10a • Target = 5.0 percent

NOTES: Data are for low birth weight births (< 2,500 grams) as a percent of all live births. Rates are displayed by modified Jenks classification for U.S. health service areas.

SOURCE: National Vital Statistics System—Natality (NVSS-N), CDC, NCHS.
Birth and Fertility


NOTE: The 2012 number of births and fertility rate are based on 12 months of provisional counts ending with December 2012.


Infant Mortality

*Infant mortality* is defined as the death of a child less than one year of age.

Infant mortality takes away society’s potential physical, social, and human capital.

The *infant mortality rate* is an estimate of the number of infant deaths for every 1,000 live births.

often used as an indicator to measure the health and well-being of a nation.
Infant Mortality

Rate per 1,000 live births

Canada* - Australia - United Kingdom† - United States‡
Sweden - Finland - Japan

Year


The World
By Subnational Administrative Level

Measures of Poverty
Infant Mortality Rates [IMR]

Subnational mortality rates are adjusted to 2000 using national trend data.
Original data for 96% of countries are from 1995 or later. All data are from 1990 or later.

Copyright 2010. The Trustees of Columbia University in the City of New York.
Source: Center for International Earth Science Information Network (CIESIN),
Columbia University. Global subnational infant mortality rates; maps and
further documentation available at: http://www.ciesin.columbia.edu/povmap

Infant mortality rate, 2000
(deaths per 1000 live births)

< 8.1
9.1 - 25.0
25.1 - 50.0
50.1 - 75.0
75.1 - 100.0
100.1 - 125.0
125 - 150.0
150.0 <

no data

National Boundary

Subnational boundaries have been removed from countries for clarity.
Objective - To ensure that all babies are born with a skilled birth attendant present.

- Developed by AAP and many partners worldwide
- Resource-limited circumstances
- Input from WHO
- Supported by Laerdal Foundation

“Developed on the premise that assessment at birth and simple newborn care are things that every baby deserves”
The Golden Minute® Helping Babies Breathe emphasizes skilled attendance at birth, assessment of every baby, temperature support, stimulation to breathe, and assisted ventilation as needed, all within "The Golden Minute" after birth.
U.S. Global Health Funding: Maternal, Newborn & Child Health (MNCH) and Nutrition, FY 2001-FY 2014

In Millions

<table>
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<tr>
<th>Year</th>
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<tr>
<td>FY 2002</td>
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<td>$95</td>
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<tr>
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<td>FY 2014</td>
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</table>

NOTES: While FY 2013 funding was finalized through a Continuing Resolution (CR) on March 26, 2013, final funding levels for global health are not yet available and are represented by the FY 2013 budget request. FY 2014 is President’s Budget Request to Congress. Represents funding through the Global Health Initiative (GHI) only. The GHI was created as an initiative in FY 2009. All prior years represent the same programs and accounts which were not yet referred to as the GHI. Includes funding for GAVI and GPEI.

Resuscitation Science
Among clinicians observing the same videos there was disagreement about whether newborn infants looked pink with wide variation in the Spo(2) when they were considered to become pink.

Pulse oximetry may be useful during neonatal resuscitation. A randomized crossover study was performed to determine the most efficient method of applying the sensor. Applying it to the infant before connecting to the oximeter resulted in quickest acquisition of accurate heart rate. This technique should be preferred during resuscitation.

The process of transitioning to a normal postnatal oxygen saturation requires more than 5 minutes in healthy newborns breathing room air.

In healthy newly born infants, oxygen saturation rises slowly and does not usually reach 90% in the first 5 minutes of life. A gradient between pre- and post-ductal SpO2 levels remains significant for the first 15 minutes of life.

Pulse Oximetry

Prospective observational study comparing newborn infants resuscitated with a pulse oximeter in place with the concurrent control group consisting of newborn infants resuscitated without a pulse oximeter in place. There were 25 infants in both groups. There were no complications of pulse oximetry. Apgar scores were similar in the 2 groups. Infants in the experimental group were significantly less likely to be admitted to the Special Care Nursery (32% vs 52%, p=0.04).

Airway obstruction occurs in the majority of the very low birth weight infants who receive ventilation with a face mask during resuscitation and the use of a colorimetric detector can facilitate its recognition and management.

End-tidal CO₂

Colorimetric carbon dioxide detectors are useful indicators of proper endotracheal tube placement. They also are helpful during bag and mask ventilation as an indicator of a patent airway. Data were collected from videotaped performances from a prospective, randomized trial of intubation premedication.

There is insufficient evidence to support or refute the use of one type of mask over another for achieving clinical outcome, except that the Rendell-Baker style mask is suboptimal in achieving an adequate seal when used for newborns.

Nasal prongs may be a more effective device than face masks for providing respiratory support after birth.

Evidence from randomized studies in swine models, manikin studies, small case series, and cadavers support the current practice of favoring the 2 thumb-encircling hands technique of chest compressions when compared with the 2-finger technique.


Haque IU, Udassi JP, Udassi S, Theriaque DW, Shuster JJ, Zaritsky AL. Chest compression quality and rescuer fatigue with increased compression to ventilation ratio during single rescuer pediatric CPR. Resuscitation. 2008;79:82–89

A large body of evidence demonstrated that induced hypothermia (33.5° to 34.5°C) implemented within 6 hours of birth in term infants at highest risk for brain injury is associated with significantly fewer deaths and less neurodevelopmental disability at 18-month follow-up.


Access

Fluids and medications can be successfully delivered by the intraosseous route during resuscitation of neonates when equipment or personnel skilled in establishing venous access are not available or if other vascular access sites (especially intravenous) cannot be successfully established within several minutes.


Although it has been widely assumed that epinephrine can be administered faster by the endotracheal route than by the intravenous route, no clinical trials have evaluated this hypothesis. Despite the widespread use of epinephrine during resuscitation, no controlled clinical trials have directly compared endotracheal and intravenous administration of epinephrine among neonates.

Although it has been widely assumed that epinephrine can be administered faster by the endotracheal route than by the intravenous route, no clinical trials have evaluated this hypothesis.
Treatment and outcome of infants at the margins of viability may be influenced by factors in addition to gestational age and birthweight. Noninitiation of resuscitation and withdrawal of cardiorespiratory support are ethically equivalent.


Use of simulation as an adjunct to traditional education methodologies may enhance performance of healthcare professionals in actual clinical settings.


Evidence from studies of briefings and debriefings document improvement in the acquisition of content knowledge, technical skills, or behavioral skills required for effective and safe resuscitation.

NRP 2010 Guidelines

http://pediatrics.aappublications.org/content/126/5/e1400.full.pdf+html
Approximately 10% of newborns require some assistance to begin breathing at birth, and 1% require extensive resuscitation.
Newborn Resuscitation

Birth

Term gestation? Breathing or crying? Good tone?

Yes, stay with mother

Routine care
- Provide warmth
- Clear airway if necessary
- Dry
- Ongoing evaluation

No

Warm, clear airway if necessary, dry, stimulate

30 sec

HR below 100, gasping, or apnea?

Yes

Labored breathing or persistent cyanosis?

No

HR below 100?

Yes

Targeted Preductal $\text{SpO}_2$
After Birth

1 min 60%-65%
2 min 65%-70%
3 min 70%-75%
4 min 75%-80%
5 min 80%-85%
10 min 85%-95%

Clear airway $\text{SpO}_2$ monitoring Consider CPAP

No

PPV $\text{SpO}_2$ monitoring

No

HR below 60?

Yes

Postresuscitation care

No

Take ventilation corrective steps

Consider intubation
Chest compressions
Coordinate with PPV

Take ventilation corrective steps

Intubate if no chest rise!

60 sec

Consider:
- Hypovolemia
- Pneumothorax

No

HR below 60?

Yes

IV epinephrine

© 2010 American Heart Association
Progression to the next step following the initial evaluation is now defined by the simultaneous assessment of 2 vital characteristics: heart rate and respirations. Oximetry should be used for evaluation of oxygenation because assessment of color is unreliable.

http://blog.babyheartscreening.com/tag/amazon-pulse-oximeter/

NRP 6th Edition Update
For babies born at term it is best to begin resuscitation with air rather than 100% oxygen.

NRP 6th Edition Update
Administration of supplementary oxygen should be regulated by blending oxygen and air, and the concentration delivered should be guided by oximetry.
The available evidence does not support or refute the routine endotracheal suctioning of infants born through meconium-stained amniotic fluid, even when the newborn is depressed.

http://robertandchristina.com/110601baby/birthstory.html

NRP 6th Edition Update
The chest compression-ventilation ratio should remain at 3:1 for neonates unless the arrest is known to be of cardiac etiology, in which case a higher ratio should be considered.
Therapeutic hypothermia should be considered for infants born at term or near-term with evolving moderate to severe hypoxic-ischemic encephalopathy, with protocol and follow-up coordinated through a regional perinatal system.
It is appropriate to consider discontinuing resuscitation if there has been no detectable heart rate for 10 minutes. Many factors contribute to the decision to continue beyond 10 minutes.

NRP 6th Edition Update
Cord clamping should be delayed for at least 1 minute in babies who do not require resuscitation. Evidence is insufficient to recommend a time for clamping in those who require resuscitation.

The Future of Neonatal Resuscitation
Rainbow Babies & Children’s Hospital
Practice!

Thursday’s at 2:00pm & 9:00pm
CHECKLIST AND ROLES

Circulation:
- Assist with dry/stimulate/thermal wrap
- Heart rate
- Listen for breath sounds during PPV
- Pulse ox placement
- Chest compressions
- Administer medication

Airway:
- Apgar Timer
- Suction mouth (bulb)
- Dry & stimulate/wrap & stimulate
- Help with PPV seal
- Adjust PP
- Adjust oxygen
- Assist with MRI/OPA

Team Leader:
- Draw up medications
- Prepare UVC tray
- Delegate person to bring blood
- Draw up fluids and boluses

Recorder:
- Suction mouth
- Dry and stimulate
- Thermal wrap
- Position head
- PPV
- Intubate

Extra:
- T-Piece
- CO2 Detector
- ETT
- Mec Aspirator
- Laryngoscope
- Blender

Warmers:
- Thermal wrap
- Suction
- Pulse ox
Extending evidence-based practice to education and training practices and adopting strategies that follow from adult learning theory.

Transitioning the role of teacher to that of a facilitator of learning and empowering the learner to take control of his or her own education.

Moving from a model of sporadic or intermittent “bolus” training to one that is episodic and facilitates learning on a continuous basis throughout a career.
Embracing high-fidelity, high-stakes simulation-based training as the standard in preparation for and assessment of performance in the real environment.

Encouraging development of challenging training experiences and expecting and accepting failure during these experiences so trainees may learn from their mistakes.

Focusing on staff competency rather than regulatory compliance.

http://www2.aap.org/nrp/docs/NeoReviews-Halamek-94e142.pdf
What’s next?

“Resuscitation of infants at birth has been the subject of many articles. Seldom have there been such imaginative ideas, such enthusiasms, and dislikes, and such unscientific observations and study about one clinical picture. There are outstanding exceptions to these statements, but the poor quality and lack of precise data of the majority of papers concerned with infant resuscitation are interesting.”

Virginia Apgar, 1953
What’s next?


http://westminsterprego.wordpress.com/2013/02/03/intact-amniotic-sac-upon-birth/
Way to Go!

http://slodive.com/inspiration/thumbs-up-symbol/
Questions?