Variation in neonatal care may influence rates of retinopathy of prematurity in neonatal intensive care units in Rio de Janeiro, Brazil

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Retinopathy of Prematurity (ROP)

- ROP is the leading cause of blindness in children in the middle income countries of Latin America and Eastern Europe. It is also becoming important in the emerging economies of Asia
- ROP results from abnormal growth of blood vessels in the back of the eye
- The degree of prematurity is important: the more preterm the baby the greater the risk of blinding ROP
- Inadequate control of blood oxygen saturation is also an important risk factor
- To prevent ROP, it is essential that preterm babies have the *correct* oxygen level during the first few weeks after birth at all times i.e. saturation levels of 85 – 95%.

Why is ROP important in Brazil?

- High income countries have adequate resources (e.g. incubators, appropriate oxygen delivery and monitoring systems). Survival rates are high and rates of ROP low as ROP is largely prevented
- Low income countries do not have neonatal facilities and premature babies usually do not survive
- Middle income countries like Brazil have enough facilities to promote survival (which can vary between units) but sometimes resources are inadequate to prevent ROP.

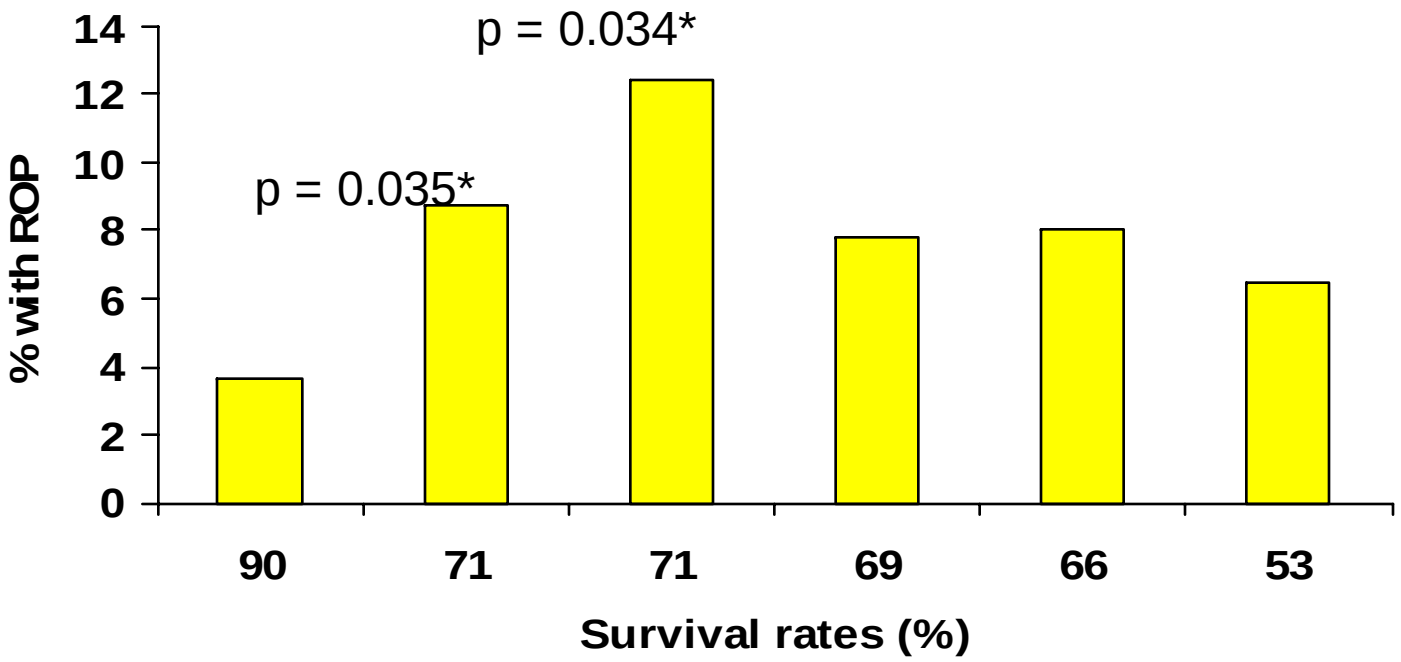
Case Study in Rio de Janeiro

- Five of six Neonatal Care Units (NICUs) in Rio de Janeiro involved in a study of ROP were visited in July, 2006
  - Hospital Municipal Oswaldo Nazareth (ON)
  - Hospital dos Servidores do Estado (HSE)
  - Hospital Municipal Alexander Fleming (AF)
  - Instituto Fenandes Figueira (IFF)
  - Clinica Perinatal de Laranjeiras

Rates of severe retinopathy of prematurity in Rio de Janeiro, Brazil

	Provider	Level of care	Admitted <1,500 g	Survival <1,500gs	Oxygen monitors	Nurses /incubator	ROP treated %
						Ranking	
1	Fed (IFF)	3	150	90%	100%	1/2	3.7%
2	Municipal (AF)	2	430	71%	20%	1/8	8.8%
3	Municipal (CD)	2	389	66%	50%	1/8	7.4%
4	Federal (HSE)	3	83	69%	50%	1/10	7.8%
5	Municipal (FM)	2	433	53%	40%	1/15	6.5%
6	Municipal (ON)	2	191	71%	50%	1/17	12.5%

Rates of ROP needing treatment in Rio, by survival rate



High survival + low rates of ROP as ROP largely prevented

Moderate survival + high rates of ROP as some most at risk survive

Low survival + low rates of ROP as babies most at risk die

* compared with lowest rate

Resource Issues

- There is a wide variation among Rio de Janeiro neonatal care units regarding nurse staff and organization
  - 4 year university trained registered nurses (RNs)
  - 1 year technically trained nurses
  - 6 months OTJ training for auxiliary nurses
  - One consistent problem with the organization is designating the responsibility for setting the alarm for the babies' oxygen levels
  - There are usually 2 oxygen pumps per bed and 1 oxymeter per two beds

Resource Needs

- Issues of resource needs varied among the neonatal care units examined.
  - At **ON** there was not enough physical space. For example, the ceiling was too low amplifying loud voices and a difficulty in controlling lighting.
  - There were not enough monitors and staff and continuity of care was jeopardized by the rotation schedule of RNs and auxiliary nurses

Resource Needs Cont.

- At **HSE** there were not enough oxygen monitors for all the babies, except for high risk.
- Lack of coordination between physicians and RNs
- Less qualified RNs

Resource Needs Cont.

- At **AF**, there are only 7 monitors properly operating for a 40 bed unit (15 ICU beds and 25 intermediate care beds)
- One-half of the babies treated at AF receive oxygen in the ICU
- The auxiliary nurses also do more at AF than at other Rio de Janeiro units such as manually ventilate, aspirate, dips, and IV drug administration denoting a sharp tradeoff between labor and capital.

Resource Needs cont.

- **IFF** is the federal hospital and the public health research branch of the Ministry of Health.
- The biggest problem facing IFF is the number of qualified nurses.
- Space is also warranted for more babies.
- *However,* IFF is the best staffed and all the babies requiring oxygen in either the ICU or intermediate care beds have a monitor.

Resource Needs cont.

- Unlike the other hospitals studied in Rio de Janeiro, *Perinatal* is a private clinic and is considered the best unit in Rio de Janeiro.
- There are 18 qualified nurses and 50 auxiliary nurses. All babies have adequate access to medications, IV nutrition, monitored at 85-95% oxygen saturation level and all shifts are covered even during vacation times.

Nursing Costs

- Even though specialized training exists, it is difficult to find trained nurses for all the neonatal care units. This structure of nurses' training leads to a bi-modal distribution of knowledge among nurses, but the wages paid to RN and Technical nurses are the same: 1,600 Br Rials for 32 hours per week for RNs and technical nurses and 600 Br Rials for 32 hours per week for auxiliary nurses.
- Nurses also work in 12 hour shifts – 1 day on and 2 days off. Therefore, to treat babies in a 20 bed unit requires 30 nurses. The recommended standard for nurse per baby is 1 qualified RN to 2 babies on ventilation in the intensive care unit, and 1 qualified nurse per 15 babies in the intermediate care units. For auxiliary nurses, 1 nurse per 4 babies in the intensive care unit and 1 auxiliary nurse per 6 babies. To increase the number of nurses is a political decision and deputies of the city must approve the proposal.

Capital Costs

- Oxygen 1 m3 = Br R$ 2.5
- For a severely ill baby 24 m3 per day or 60 Br reais per day
- Surfactant 1 bottle at 600 Br reais
- Severely ill baby 2 bottles or 1,200 Br reais
- IV nutrition per day 200 Br reais
- A severely ill baby will require IV nutrition for 1 week at 1,400 Br reais.
- D. Monitor with Cardiac Frequency 15,000 Br reais
- E. Oxymeter 6000 Br reais
- F. Sensor for the Oxymeter 500 Br reais per month (only lasts one month)
- G. Blender 3,500 Br reais and 2 blenders per ventilator
- H. Ventilator at 30,000 Br reais (30% of incubators/beds require a ventilator)
- I. Pumps at 1 per bed at 3,000 Br reais per bed.

Marginal Gains for Additional Nurse /Incubator

Unit Name	Survival Rate	Change in Survival Rate	**Nurses/ Incubator**	Change in Nurse/Incubator	Marginal change in outcome/1 RN increase
IFF	90%		1/2	0.20	40%
AF	71%	19%	1/8	0.375	38%
HSE	NA	NA	1/10	0	0
IMM	53%	13%	1/15	0.06	2.16%
ON	71%	18%	1/17	0.008	-22.5%

Interpretation

- Combining information from this table and information gathered at the site visit interviews, we find that
  - ON does not have enough nurses, but a higher quality level of nurses
  - AF appears to have enough nurses but not have enough equipment

Summary

- There are distinct disparities in the units with survival rates ranging from 53% to 90% among babies born weighing 1,500 grams or less.
- From the empirical data and results from the focus group interviews, units treating premature babies, especially those at risk of ROP and perhaps eventual blindness, require advanced equipment and qualified nurses. This is true in relation to monitoring oxygen levels which requires both equipment and trained nurses.
- We found a large benefit to cost ratio for screening programs for ROP in Rio de Janeiro that could be expanded to other areas of Brazil.
- Focusing on the Rio de Janeiro scenarios, we find that adding nurses to specific units could improve overall outcomes rather than just increasing the number of qualified nurses overall.

Summary

- We also found disparities in the number of nurses per incubator ranging from 1/17 to 1/2. Interestingly, there isn't a 1 to 1 correlation between labor intensity and survival outcomes. The correlation is .837 and is significant at the 0.06 level. Indicating a high correlation but barely statistically significant.
- This study indicates that more resources should be allocated carefully to units according to their specific needs in order to increase survival and prevent ROP and blindness.