




Fostering the Development of Infants & Toddlers Born Prematurely: Part I—Understanding Medical Complications Associated with Prematurity and the Potential Impact on Development


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Presentation Objectives

- ...become aware of premie statistics for the United States and South Carolina as well as the outcomes associated with prematurity.
- ...develop an understanding of neonatal diagnosis associated with prematurity.
- ...become familiar with the potential developmental impact of such diagnosis.




Definitions

- Preterm infant: Born < 37 weeks gestation
- Moderately preterm: 32-36 weeks gestation
- Very preterm: <32 weeks gestation
- LBW infant: Born <2,500 grams
- VLBW infant: Born <1,500 grams
- ELBW infant: Born <1,000 grams



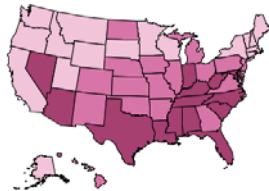
Preemie Statistics

...Rationale for Monitoring the Development of Infants Born Prematurely



Preterm, US 2004


www.marchofdimes.com/peristats/



- 1 in 8 babies born prematurely
- 12.5%
- N=508,358

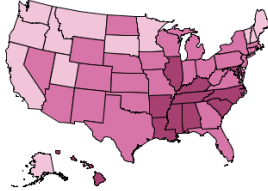
Percent of live births

- Over 13.1 (15)
- 11.8-13.1 (19)
- Under 11.8 (17)



Very Preterm, US 2004

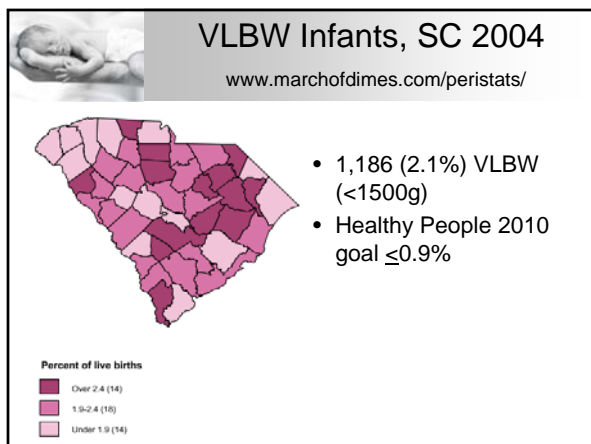
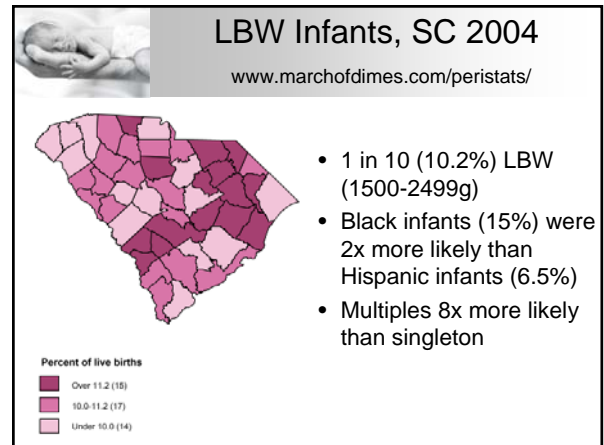
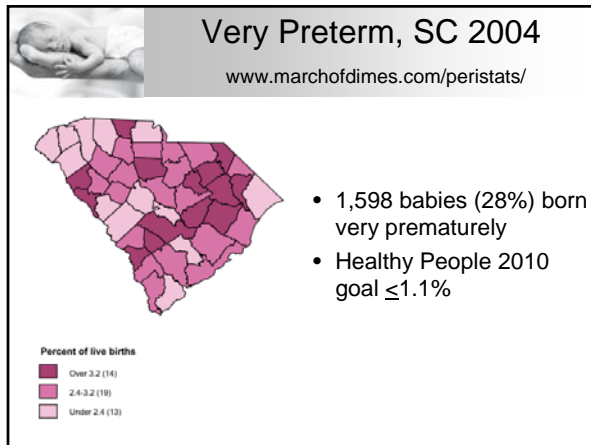
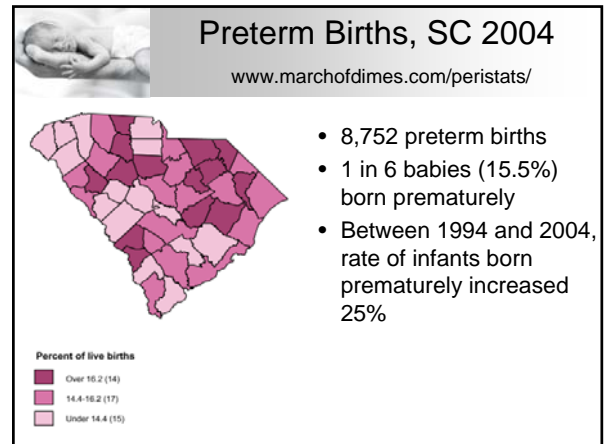
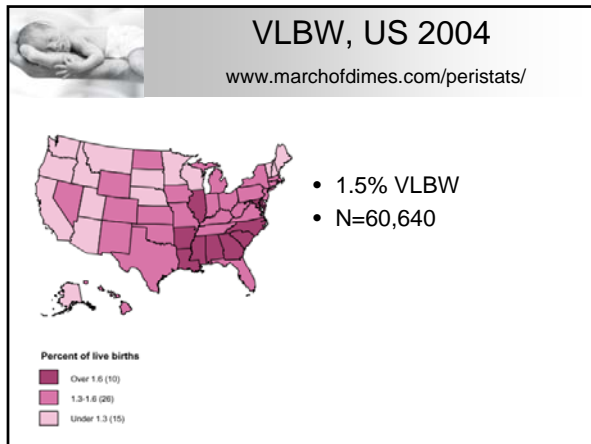
www.marchofdimes.com/peristats/



- 2% born very preterm
- N=81,645

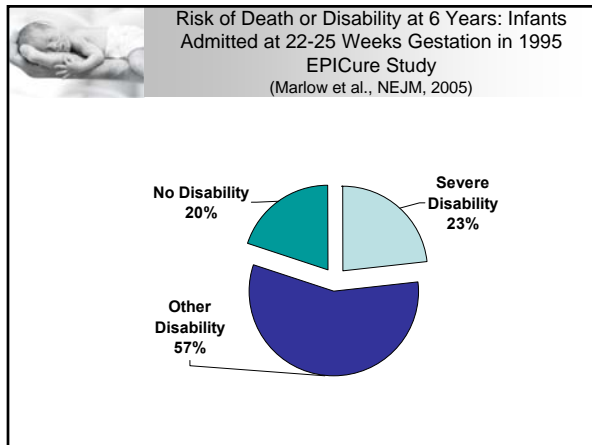
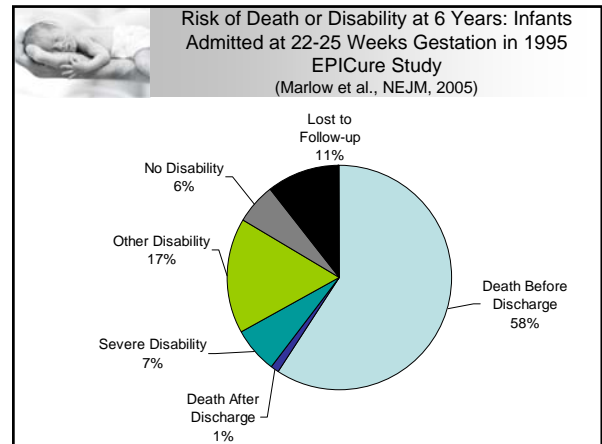
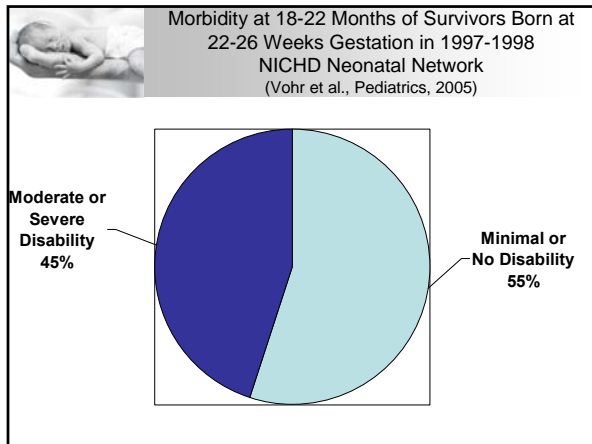
Percent of live births

- Over 2.1 (12)
- 1.8-2.1 (27)
- Under 1.8 (12)



Rationale...from the Literature

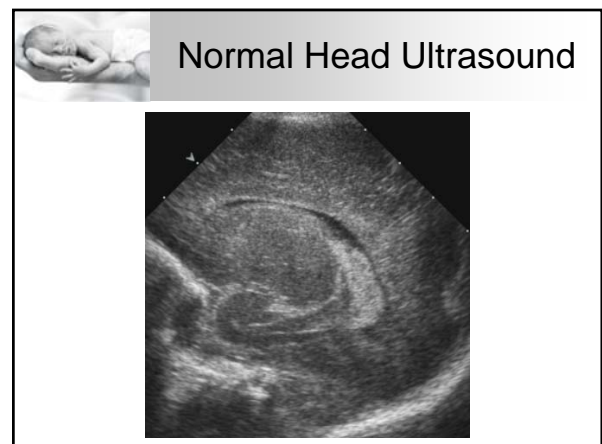
- The survival rate for premature infants has increased dramatically in the past decade (Hack, M, et al., 2000; Hack, M and Fanaroff, A, 1999).
- However, these premature infants are at risk for future developmental disabilities (Theunissen, NCM, et al., 2001; Burguet, A, et al., 2000; Hack, M, et al., 2000; Wood, NS, et al., 2000; Berger S, et al., 1998; Jackson, BW, et al., 1997).
- Although many factors go into predictions regarding morbidity, infants born earliest and at the smallest weights have the highest risk of developing disabilities.
- The rate of overall disability in infants born extremely premature is 49% and the rate of severe disability is 23% (Wood, NS, et al., 2000).




IVH
 Intraventricular Hemorrhage

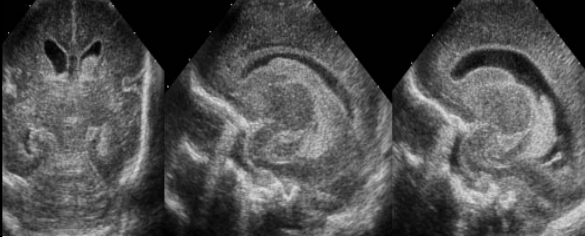
IVH


- Bleeding into the ventricular system of the premature brain.
- Four grades:
 - I Germinal Matrix Bleed
 - II Ventricular Bleed
 - III Ventricular Bleed + dilation of ventricle
 - IV Parenchymal bleed



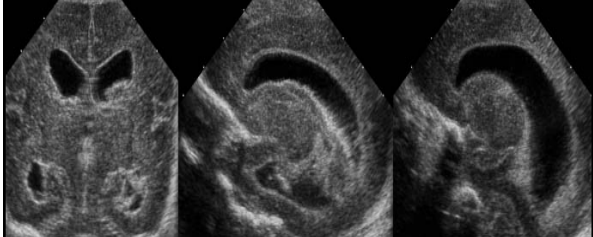
 **Grade II - IVH**


Bleed without significant ventricular dilation.



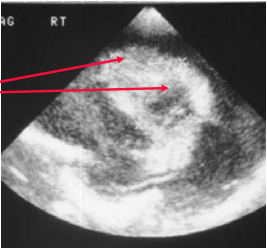
 **Grade III - IVH**


Bleed plus ventricular dilation.



 **Bleed into surrounding parenchymal tissue.**


- Bleed into surrounding parenchymal tissue.
 - White echodensities




 **Mortality**

- Grade I: 5%*
- Grade II: 10%*
- Grade III: 20%
- Grade IV: 50%


*Not increased, when controlled for prematurity.

 **Neurologic Sequelae**

- Grade I/II IVH
 - No increased risk for major disability.
- Grade III IVH
 - ~30% with major disability at school age most common are spastic diplegia and quadriplegia.
 - Cognitive and neuromotor disability common, ~50% require special education.
- Grade IV IVH
 - Little data b/c ↓ frequency ↑ mortality.
 - 80% manifest symptoms of major disability during infancy.
 - Most common: contralateral hemiparesis; cognitive and neuromotor ability affected.


 **PHH**

Post Hemorrhagic Hydrocephalus




Special Consideration: PHH

- Most common with Grade III/IV IVH:
 - Grade III ~20%
 - Grade IV >60%
- Inflammation, clot, protein and debris results in ventricular obstruction and then progressive and rapid accumulation of CSF.
- Severe ventricular dilation increases intracranial pressure and destroys surrounding parenchyma.
- TX with serial spinal taps or VP shunt.




PVL

Periventricular Leukomalacia

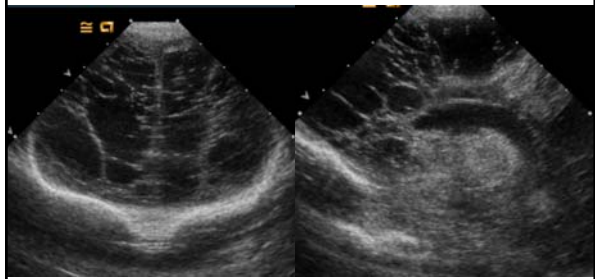



PVL

- Result of Hypoxic Ischemic Encephalopathy (HIE):
 - Clinical manifestation of neonatal asphyxia.
 - Criteria for Diagnosis:
 - Profound metabolic or mixed acidosis.
 - Apgar 0-3 for > 5 mins.
 - Neonatal neurologic manifestations include seizures, coma and hypotonia.
 - Multi system organ dysfunction (CV, GI, renal).
- Involves necrosis of periventricular white matter of the brain.
- Commonly results in CP; possibly MR & visual impairments.




Cystic PVL (secondary to HIE)



BPD

Bronchopulmonary Dysplasia




BPD

- Need for oxygen on DOL #28.





Normal lung x-ray X-ray depicting BPD



NEC


Necrotizing Enterocolitis



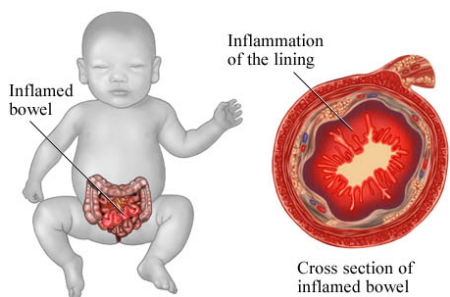
Definition

Necrotizing Entero colitis

↑ ↑ ↑ ↑
 Death Small Large Inflammation
 Of Intestine Intestine
 Tissue




Inflamed Bowel



Inflamed bowel

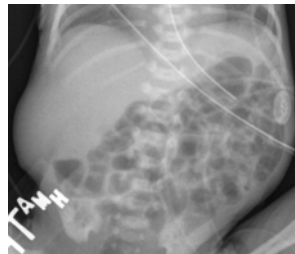
Inflammation of the lining

Cross section of inflamed bowel





Bowel Gas Pattern

Normal




Dilated loops of bowel





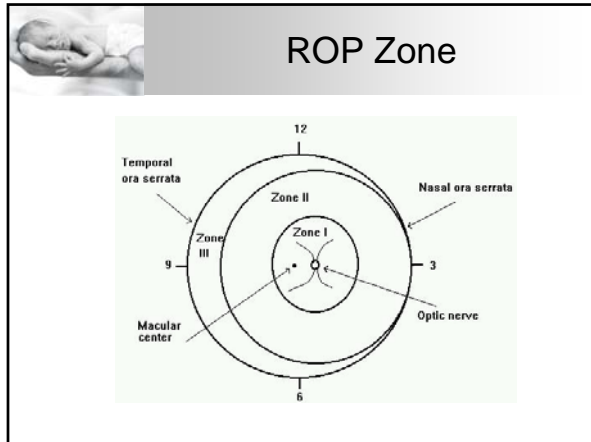
Prognosis

- Bowel Surgery:
 - Resection
 - Long-term parenteral nutrition
 - Enterostomy care, short gut syndrome, failure to thrive
 - NEC with perforation: 20-40% mortality
- Uncomplicated Course:
 - Growth, nutrition, GI function appear to catch up by the end of the first year



ROP: Retinopathy of Prematurity

- ROP is a progressive eye disease.
- It begins with some mild changes in the vessels, and may progress on to more severe changes.
- The zone of ROP describes the location.
- The stage of ROP describes how far along in this progression the vessels have reached. Concerns \geq Stage 4 ROP.



ROP

- Stage 4
 - Refers to a partial retinal detachment.
 - Further categorized depending upon the location of the retinal detachment.
 - Stage 4A, detachment does not include the macula—vision may be good.
 - Stage 4B, macula is detached—visual potential is markedly decreased.
- Stage 5
 - Implies a complete retinal detachment.
 - Eyes with stage 5 ROP usually have no useful vision, even if surgery is performed to repair the detachment.

ROP Screening

- 1st exam: 4-6 weeks of life for:
 - Premies born <1500g or <28wks
 - Any severely ill preemie
 - Any preemie with prolonged oxygen therapy
- Then, exams every 2 weeks or more often until discharge
- Follow-up post discharge:
 - Regressed ROP without scars: until full vascularization then annually
 - Regressed ROP with scars: annually
 - Progressed ROP (detachment): ongoing care

ROP: Treatment


- Based on results of the ETROP study, treatment is recommended for any eye with:
 - Zone I any stage with plus disease,
 - Zone I, stage 3 without plus disease, or
 - Zone II stage 2 or 3 with plus disease.
- Cryotherapy: Freezing of avascular retina anterior to the retina. Peak age is time of discharge.
- Laser therapy: Uses laser beam. Better tolerated, easier, faster, requires less sedation & better reaches most important area for vision (posterior retina).
- Scleral Buckle & Vitrectomy Procedures: Heroic. Some anatomic success but less functional improvement.

ROP: Common Sequelae

- Regressed without scars: strabismus, amblyopia, myopia.
- Regressed with scars: thinning of retina, retraction, retinal tears-retinal dragging-detachment-glaucoma, vision loss.
- Progressed ROP: reduced visual acuity, visual field loss, reduction in contrast sensitivity, nystagmus, glaucoma.


As & Bs

- Apnea: pause in breathing ≥ 20 seconds.
- Bradycardia: fall in heart rate, often accompanies breathing lapse.
- Incidence: 10% preemies, >40% VLBW.
- Treatment: theophylline or caffeine used to stimulate breathing, rocker beds.
- Persistent apnea correlated with bad prognosis:
 - May indicate brain damage.
 - May be precursor to SIDS:
 - 20% of all SIDS are preemies.
 - Occurs during first 5 months of life.
 - Babies w/ As at discharge go home on monitor.




PDA: Patent Ductus Arteriosus

- Incidence: 21% 500-1700 grams, 50% 500-1000 grams, > if received surfactant.
- Cause: In preemies w/ RDS the O2 level in the blood isn't high enough to stimulate contraction of the ductus.
- Treatment
 - Medication (indomethacin) to stimulate contraction of the muscular walls of the ductus arteriosus, closing it in most cases.
 - Surgical ligation to close the ductus.




SGA

- Newborn with weight < 10th %ile for GA.
- Problems:
 - Remain short and underweight throughout life.
 - Incidence of developmental disabilities higher compared to babies AGA.
 - PT SGA: MR, CP.
- Medical Care: deliver in NICU, outcome better than transports.




RSV Respiratory Syncytial (sin-sish-shul) Virus

www.synagis.com




RSV: Signs & Symptoms

- Mild: moderate tachypnea, rhinorrhea, low-grade fever, and, frequently, otitis media. Recovery occurs after an illness of 7 to 12 days.
- Severe: coughing and wheezing followed by dyspnea; severe tachypnea is common; in cases of extreme hypoxemia, respiratory failure occurs.
- In high-risk infants, respiratory failure severe enough to require airway intubation can occur early in the course of illness.





RSV...More Facts

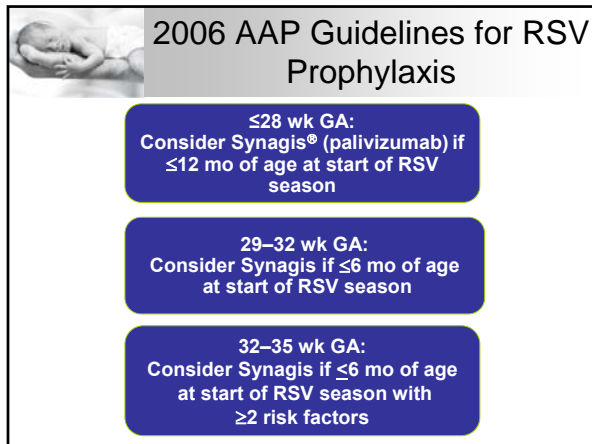
- RSV disease is universal and occurs in nearly all children by 2 years of age.
- RSV is the leading cause of hospitalization in infants <1 year old.
- RSV epidemics are local and local virology is the best way to determine timing of RSV prophylaxis.
- Effective therapeutic options are not available.
- Synagis® (palivizumab) is the only immunoprophylaxis option approved by the FDA.
- Synagis is generally well tolerated and effective in preventing hospitalizations due to severe RSV infections.



RSV Transmission

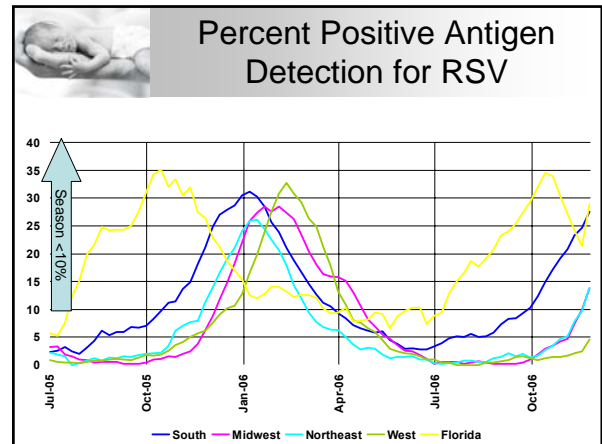
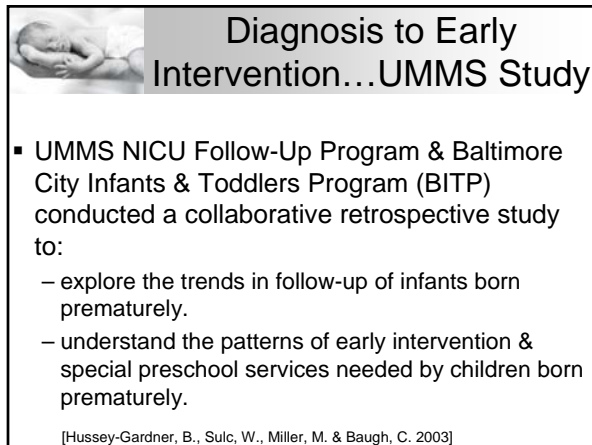



- Transmitted by droplets, large particles, and fomites.
- RSV survives up to 6 hours on stethoscopes and up to 12 hours on hard, nonporous surfaces.
- Over 50% of medical personnel infected when RSV is prevalent in community.
- Hospital acquired infection remains a serious problem.



2006 AAP Guidelines for RSV Prophylaxis

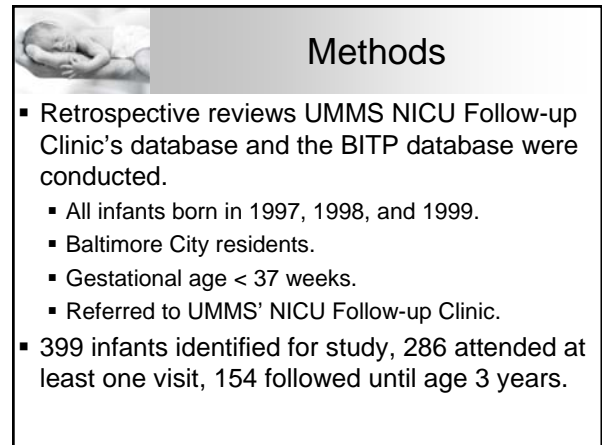
- ≤28 wk GA:
Consider Synagis® (palivizumab) if ≤12 mo of age at start of RSV season
- 29–32 wk GA:
Consider Synagis if ≤6 mo of age at start of RSV season
- 32–35 wk GA:
Consider Synagis if ≤6 mo of age at start of RSV season with ≥2 risk factors

Diagnosis to Early Intervention...UMMS Study

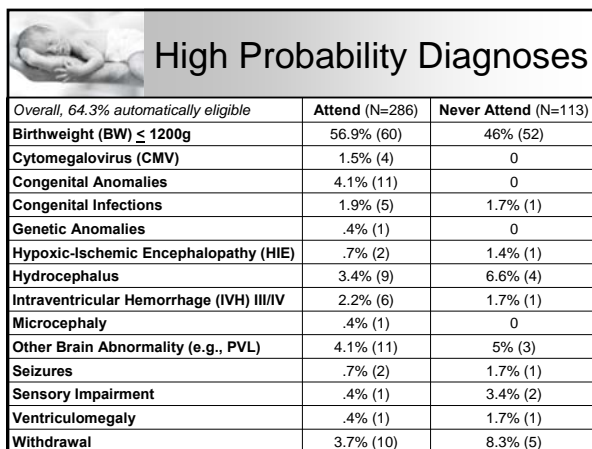
- UMMS NICU Follow-Up Program & Baltimore City Infants & Toddlers Program (BITP) conducted a collaborative retrospective study to:
 - explore the trends in follow-up of infants born prematurely.
 - understand the patterns of early intervention & special preschool services needed by children born prematurely.

[Hussey-Gardner, B., Sulc, W., Miller, M. & Baugh, C. 2003]



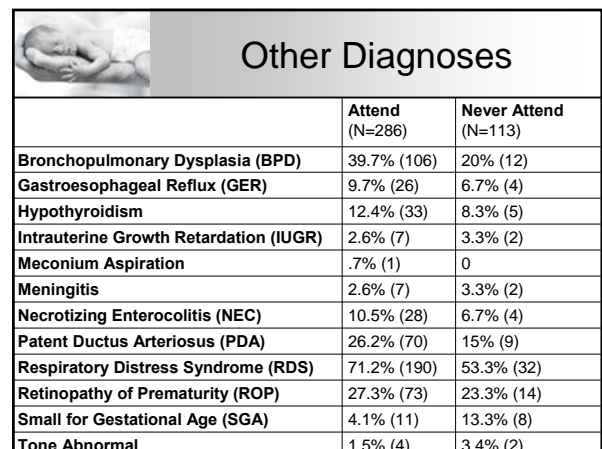
Methods

- Retrospective reviews UMMS NICU Follow-up Clinic's database and the BITP database were conducted.
 - All infants born in 1997, 1998, and 1999.
 - Baltimore City residents.
 - Gestational age < 37 weeks.
 - Referred to UMMS' NICU Follow-up Clinic.
- 399 infants identified for study, 286 attended at least one visit, 154 followed until age 3 years.



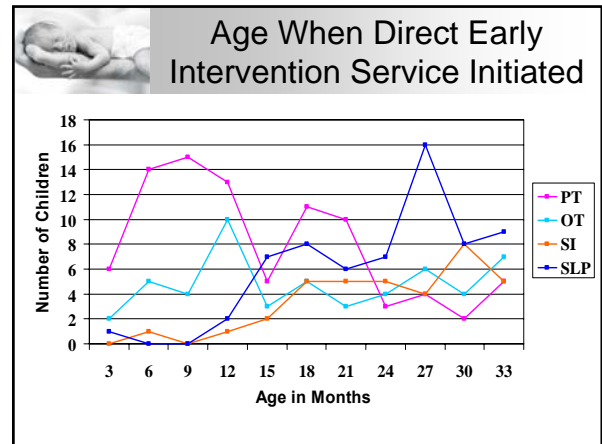
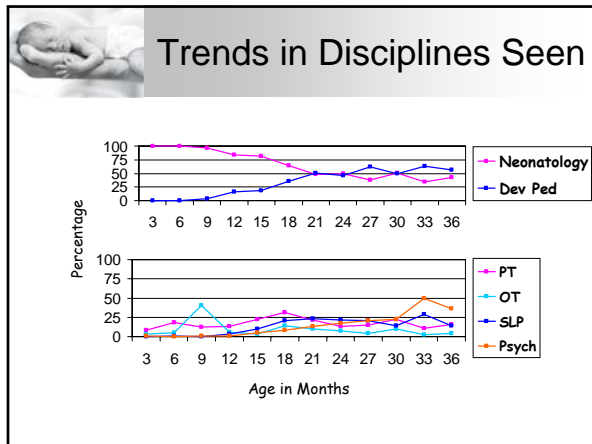
High Probability Diagnoses

Overall, 64.3% automatically eligible	Attend (N=286)	Never Attend (N=113)
Birthweight (BW) ≤ 1200g	56.9% (60)	46% (52)
Cytomegalovirus (CMV)	1.5% (4)	0
Congenital Anomalies	4.1% (11)	0
Congenital Infections	1.9% (5)	1.7% (1)
Genetic Anomalies	.4% (1)	0
Hypoxic-Ischemic Encephalopathy (HIE)	.7% (2)	1.4% (1)
Hydrocephalus	3.4% (9)	6.6% (4)
Intraventricular Hemorrhage (IVH) III/IV	2.2% (6)	1.7% (1)
Microcephaly	.4% (1)	0
Other Brain Abnormality (e.g., PVL)	4.1% (11)	5% (3)
Seizures	.7% (2)	1.7% (1)
Sensory Impairment	.4% (1)	3.4% (2)
Ventriculomegaly	.4% (1)	1.7% (1)
Withdrawal	3.7% (10)	8.3% (5)



Other Diagnoses

	Attend (N=286)	Never Attend (N=113)
Bronchopulmonary Dysplasia (BPD)	39.7% (106)	20% (12)
Gastroesophageal Reflux (GER)	9.7% (26)	6.7% (4)
Hypothyroidism	12.4% (33)	8.3% (5)
Intrauterine Growth Retardation (IUGR)	2.6% (7)	3.3% (2)
Meconium Aspiration	.7% (1)	0
Meningitis	2.6% (7)	3.3% (2)
Necrotizing Enterocolitis (NEC)	10.5% (28)	6.7% (4)
Patent Ductus Arteriosus (PDA)	26.2% (70)	15% (9)
Respiratory Distress Syndrome (RDS)	71.2% (190)	53.3% (32)
Retinopathy of Prematurity (ROP)	27.3% (73)	23.3% (14)
Small for Gestational Age (SGA)	4.1% (11)	13.3% (8)
Tone Abnormal	1.5% (4)	3.4% (2)



Diagnoses Correlated with Obtaining Specific Services

	Any	PT	OT	SI	SLP
BPD	.254**	.182**	.194**	.186**	.162**
Hydrocephalus	.002	.061	.124*	.129*	-.079
Hypothyroidism	.152*	.045	.054	.083	.156*
IVH	.245**	.239**	.230**	.101	.144*
NEC	.151*	.144*	.180**	.116	.178**
Other Brain Abnormality	.085	.089	.183**	.192**	.105
ROP	.259**	.238**	.234**	.166**	.157**
Seizures	.088	.122*	.061	-.038	-.053
Tone Abnormal	.087*	.132*	.105	.041	.081

*Significant at the .05 level. ** Significant at the .01 level.

Diagnoses Predicting Services, Above & Beyond Birthweight

	Any	PT	OT	SI	SLP
BPD	X		X		
Hydrocephalus				X	
IVH	X	X	X		
NEC			X		X
Other Brain Abnormality			X	X	
ROP		X	X		
Seizures		X			
Tone Abnormal	X	X			


X denotes multiple regression significant at $p < .05$.

Demographics & Diagnosis: Followed Until 3 Years

	Yes, N=135	No, N=151
Race	AA=93.2%	AA=87.7%
BW	Mean=1079.8g Median=956g	Mean=1348g Median=1294
GA	Mean & Median=28wks	Mean & Median=30wks
Sex	Males=48.1%	Males=54%
BPD	45.7%	34.1%
Brain Lesion	5.5%	2.9%
Hydrocephalus	5.4%	1.4%
IUGR	2.3%	2.9%
IVH	35%	21%
ROP	36.7%	19.6%
Tone Abnormal	3.1%	0%

Transition at Age 3 (N=135)

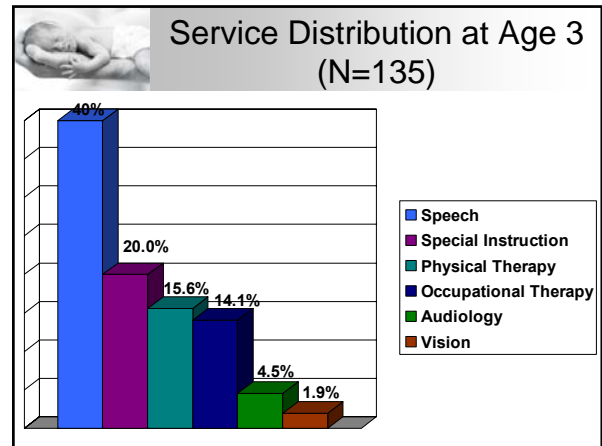

Characteristic	Part B N=58, 43.9%	Don't Need Services N=73, 55.3%
Sex		
Male	63.8%	37%
Female	36.2%	63%
Race		
African-American	92.9%	93.1%
BW		
Median	930 grams	989 grams
Mean	1086.5 grams	1082.1 grams
Minimum	530 grams	535 grams
Maximum	2505 grams	2116 grams
GA		
Median	27 weeks	27 weeks
Mean	28.2 weeks	28 weeks
Minimum	22 weeks	23 weeks
Maximum	36 weeks	35 weeks



Diagnosis Correlated with Part B, Above & Beyond BW \leq 1200g


Diagnosis	PT	OT	SI
Brain Lesion	.380*		
HIE	.380*	.422**	
Hydrocephalus	.408*		
Seizures	.380*	.422**	
Tone Abnormal	.544**	.606**	.423**

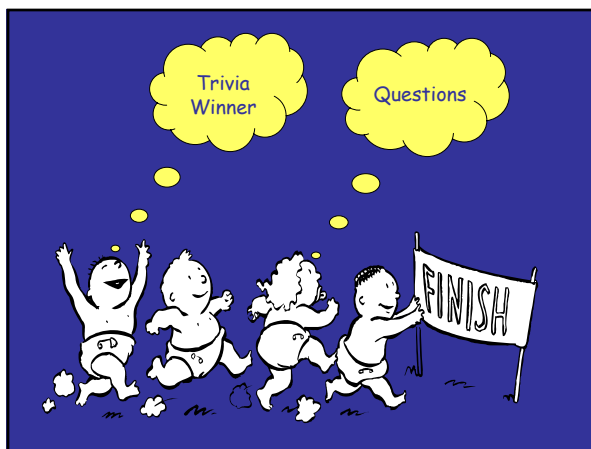
Significance Level *=.05, **=.01.
No significant correlations with diagnosis & SLP.





Comparison of Services

	All (N=135)		BW \leq 1200g (N=94)		BW 1201-1500g (N=21)	
	Part C	Part B	Part C	Part B	Part C	Part B
Any	77%	45.9%	84%	47.8%	66.7%	42.9%
PT	51.9%	15.6%	55.3%	16.3%	42.9%	9.5%
OT	34.1%	14.1%	37.2%	14.1%	23.8%	9.5%
SI	28.9%	20%	31.9%	18.5%	9.5%	19%
SLP	48.9%	40%	54.3%	42.4%	47.6%	38.1%

- 
- ### Conclusions
- Reinforces clinic policy of routinely following all infants born at \leq 32 weeks gestation, under 1500g, and all infants with high-risk medical conditions (e.g., BPD, NEC) regardless of BW.
 - Emphasizes need to routinely screen all developmental domains until at least 3 years.
 - The inclusion of high probability conditions as an eligibility criteria is supported by the results of this study. Consideration should be given to adding BPD & NEC (surgical) to the existing list, & increasing birthweight to <1500g.
 - BPD & Surgical NEC are now accepted as High Probability conditions in Maryland.



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