Team Approach to Determining Cochlear Implant Candidacy in Early Infancy

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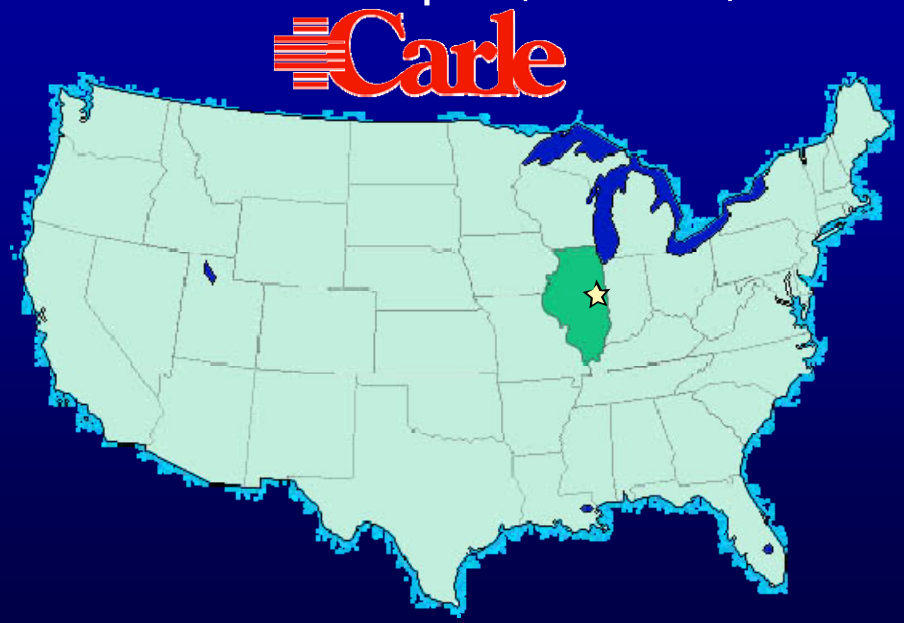

Early Intervention

- Critical periods for language development
- Spoken language and auditory skill development requires auditory input
- Delay in EI result in gap in language and listening skills

CDC Goals for EHDI

"1 – 3 – 6 Rule"

- Newborn hearing screening completed by 1 month of age
- Diagnostics completed by 3 months of age
- Follow up and intervention should be in place by 6 months of age

Infant Demographics

Age grouping	n=	NHS 1 mo	Avg. age of diagnosis 3 mo	Avg. age fit with HA 6 mo	Avg. age at CI surgery
≤12 mo	14	93% screened, majority failed (1 pass)	2 mo range .5-5 mo	3 mo range 1-7 mo	9 mo range 6-12 mo
13-18 mo	13	38% screened, all failed	7 mo range 1-14 mo	9 mo range 2-15 mo	15 mo range13-18 mo

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CI Candidacy

- **FDA guidelines**:
  - 12 months of age or older

CI in Infancy Leads To Positive Outcomes

- Hammes et al 2002
- Robbins et al 2004
- Schauwers et al 2004
- Sharma et al 2004
- Colletti et al 2005
- Kishon-Rabin et al 2005
- Tomblin et al 2005
- Waltzman & Roland 2005
- Dettman et al 2007

CI Candidacy

- **FDA guidelines**:
  - 12 months of age or older
  - Profound hearing loss in both ears (≥90dB)
  - Little or no benefit from appropriately fit hearing aids
  - Lack of auditory progress
  - Family motivation to improve hearing
  - Appropriate expectations
  - No medical contraindications

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Pediatric CI Evaluation	Infant CI Evaluation
Complete behavioral audiologic assessment	
Verification of hearing aid fitting	
Measure of aided speech recognition, with appropriate open/closed set materials	
Speech language evaluation using formal test measure	
Medical evaluation	

Pediatric CI Evaluation	Infant CI Evaluation
Complete behavioral audiologic assessment	Objective test measures, with behavioral audiometric evaluation when developmentally appropriate
Verification of hearing aid fitting	Verification of hearing aid fitting
Measure of aided speech recognition, with appropriate open/closed set materials	Evaluation of auditory skill development
Speech language evaluation using formal test measure	S/L eval incorporated in diagnostic therapy over several months
Medical evaluation	Medical evaluation

Pediatric Cochlear Implant Team

- Family
- Audiologist
- Otologist
- Speech language pathologist
- Child development specialist

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Team Approach in Determining CI Candidacy in Infants

- Coordinated effort
- Lengthy process making early referral important
- Begins when family and professionals enter the education and evaluation process **together**

Family on the CI Team

- Family supported in grieving process
- Family encouraged to be active participant in decision making process
  - Family education and training
  - Parent/Caregiver support groups

Supporting Parents in the Decision Making Process (Duncan 2009)

- Provide parents time to deal with their feelings. Do not rush the decision making process
- Discover parent aspirations for their child
- Professionals must provide families with impartial information that respects the family's needs

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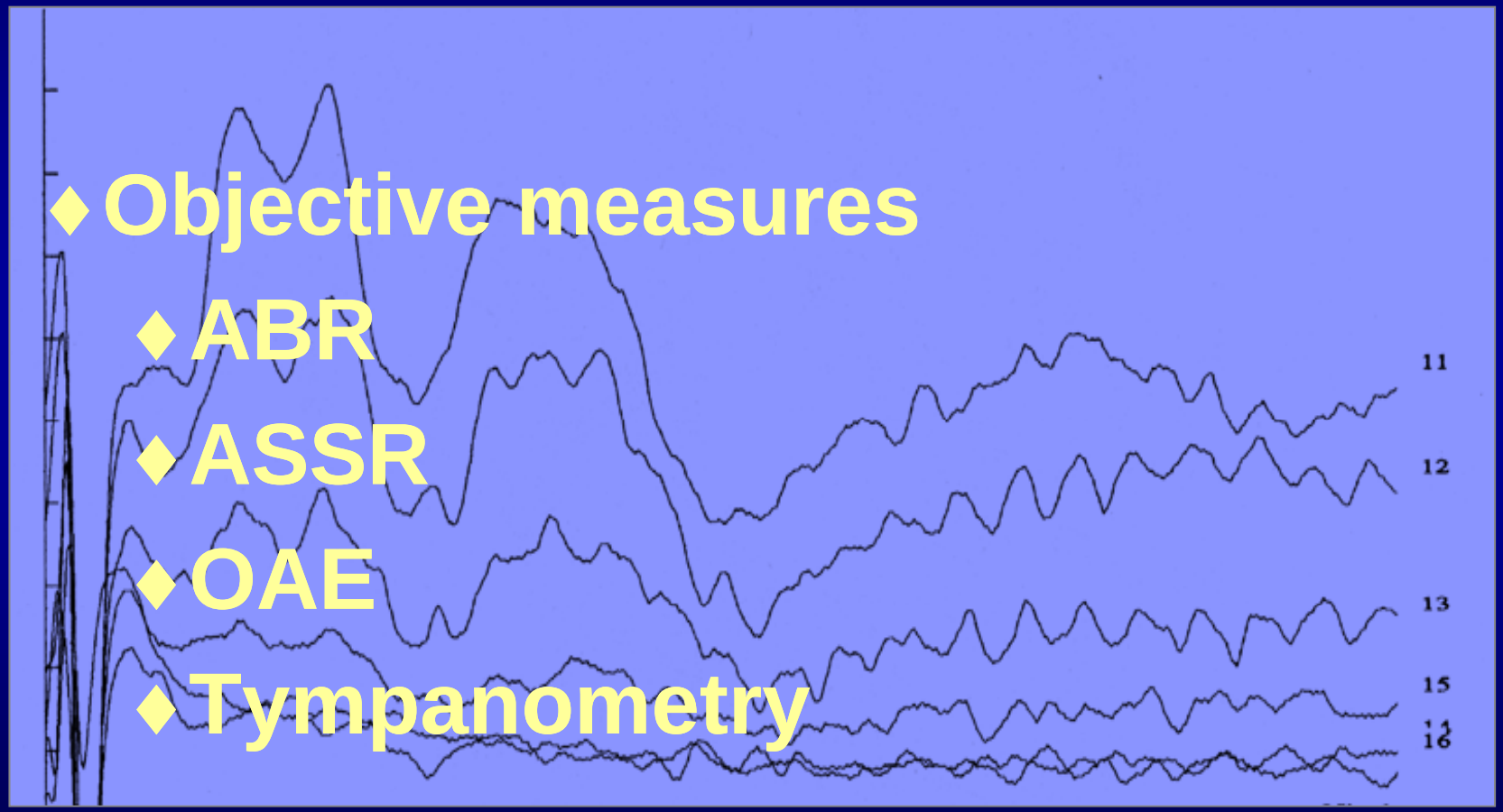
Audiologic Assessment



- Objective measures
  - ABR
  - ASSR
  - OAE
  - Tympanometry

Hearing Aid Fitting and Verification

- Fitting formula used to calculate targets for the gain and output of the hearing aid (DSL, NAL)
- Ensures that the hearing aid is amplifying speech to be comfortable and audible to maximize speech understanding

Hearing Aid Fitting and Verification

- Probe microphone measurements
- Individualize fitting with RECD

Assess Auditory Skill Development

Parent Questionnaires

- IT-MAIS assesses emergence of auditory skills in everyday situations
- LittlEARS assesses preverbal auditory behavior up to 2 years of age

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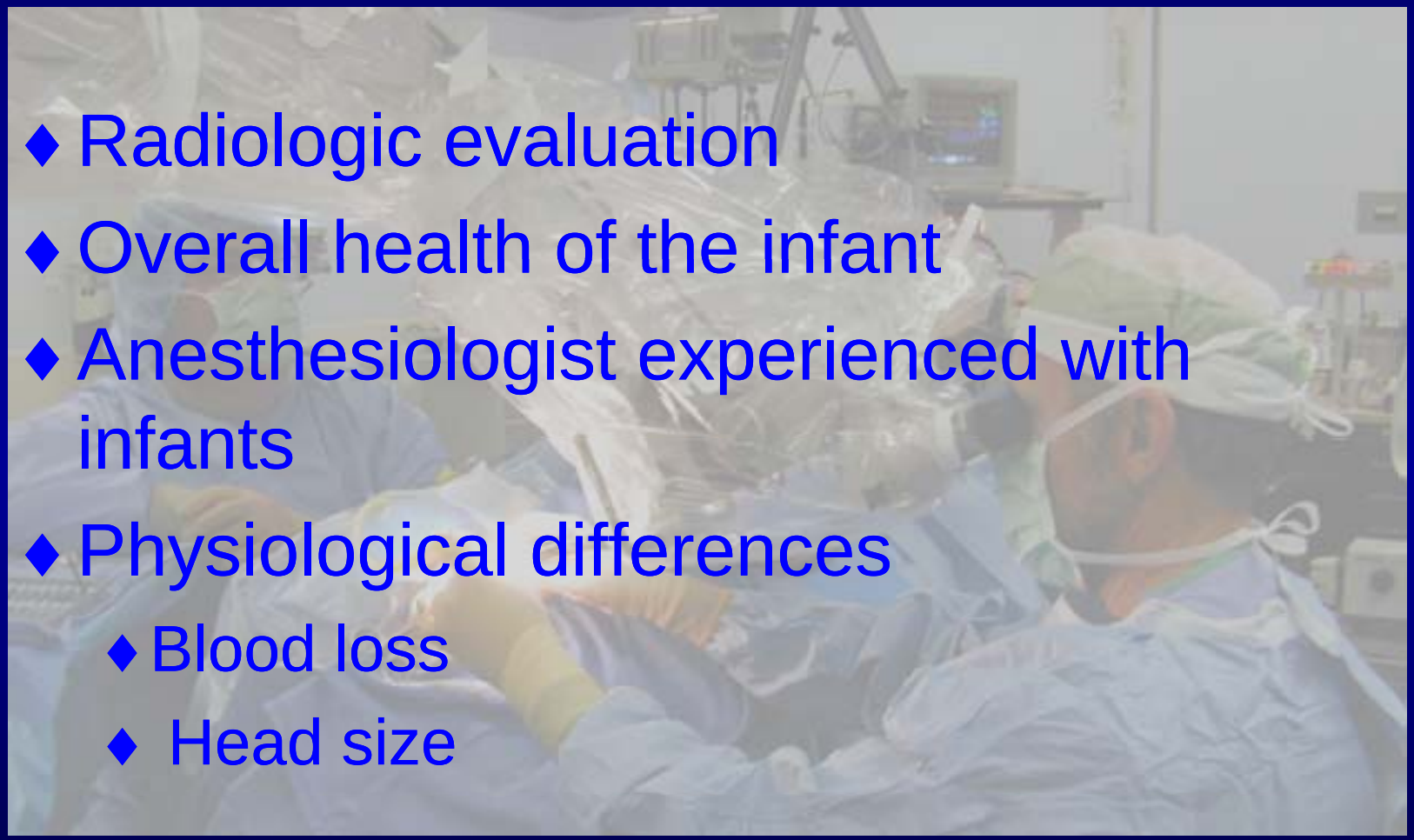
Medical Reports

- Young 2002
- James & Papsin 2004
- Miyamoto et al 2005
- Waltzman & Roland 2005
- Colletti et al 2005
- Birman 2009

Surgical Considerations



- Radiologic evaluation
- Overall health of the infant
- Anesthesiologist experienced with infants
- Physiological differences
  - Blood loss
  - Head size

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Developmental and Speech / Language Evaluation

Evaluation
Question #1

Given the infant's chronological age (adjusted if applicable),

How does he seem to be developing *apart from skills affected by hearing loss*?

For example, If the child is 3 mos old, is he doing the kinds of things that you would expect most 3-month old babies to do?

Evaluation

- Developmental Information *not* dependent upon hearing
  - Sleeping & Feeding Patterns
  - Reflexes
  - Gross & Fine Motor Skills
  - Visual Skills
  - Non-verbal cognition
  - Play & Socialization using facial cues, gestures, actions, props

Evaluation:
Question #2

In comparison to the infant's overall functioning level for skills *not* affected by hearing loss (Result #1) –

How does he seem to be developing skills that *are* affected by hearing loss?

Evaluation

- Developmental Information that *is* dependent upon hearing
  - Auditory Responses
  - Auditory Cognition
  - Types of Sound Production
  - Speech Sound Development
  - Comprehension of Language
    Spoken w/o Visual Cues
  - Social Initiations & Responses
    Using Spoken Language
    without visual cues

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Evaluation Results

Evaluation details provide developmental starting points for exploring an infant's candidacy for cochlear implantation through diagnostic therapy

Diagnostic Therapy:
Continuation of the Speech Language Evaluation Process

Diagnostic Therapy

- Begins as soon as possible following initial evaluation
- Infants generally seen weekly
- Necessarily involves family members
- Necessarily involves audiologists
- Helps ensure appropriateness of early cochlear implantation

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Diagnostic Therapy

- Observations of the child's communication behaviors in a play environment
- Parent education and training
- Develop auditory skills needed for behavioral assessment

Diagnostic Therapy

- Recording infant's vocalizations
- Pre-lexical vocalizations provide a window into what the child is hearing
- Ongoing formal assessment of speech language and listening skills

Team CI Evaluation Process

- Ongoing collaborative process
  - Bring parental priorities, expectations and goals to team meetings
  - Providers update team on evaluation findings and therapy status
  - Deliberate prognosis for achieving family's goals with HAs vs. CIs
  - Team recommendations made with knowledge of how timely intervention impacts outcomes

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OUTCOMES

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Recent Studies

- Geers et al 2009
  - Study of 153 children enrolled in oral communication programs. Testing completed at 5-6 yrs of age
  - Identified four predictors of spoken language skills
    - Nonverbal intelligence
    - Parent Education
    - Age at CI stimulation
    - Gender
  - Optimum age of CI varied depending on language domain being tested
  - Regression analysis indicated that age appropriate development of *complex* language skills requires early CI (12 mo of age)

Recent Studies

- Dettman et al 2007
  - Children who received CI younger than 12 mo achieved mean rates of language growth comparable to normal hearing peers
  - Rates were significantly greater than rates of children implanted between 12-24 mo
  - When data from children with cognitive delays were removed the difference in rates remained statistically significant

Speech and Spoken Language Outcomes: Effect of Implantation

Presented at CI2007

Dianne Hammes et al 2007

Children who were implanted by 18 months of age have smaller gaps in language abilities than do children implanted after 18 mo of age

Purpose

- To provide update on connected language progress of 4 groups of children (n=66) who ranged in age from 7 – 48 months at the time of implantation.
- To compare outcomes of those implanted by 12 months of age to that of children implanted between 13 - 18 months.

Subjects

Subjects

Age Group Comparisons

9 - 18 months (n=19)

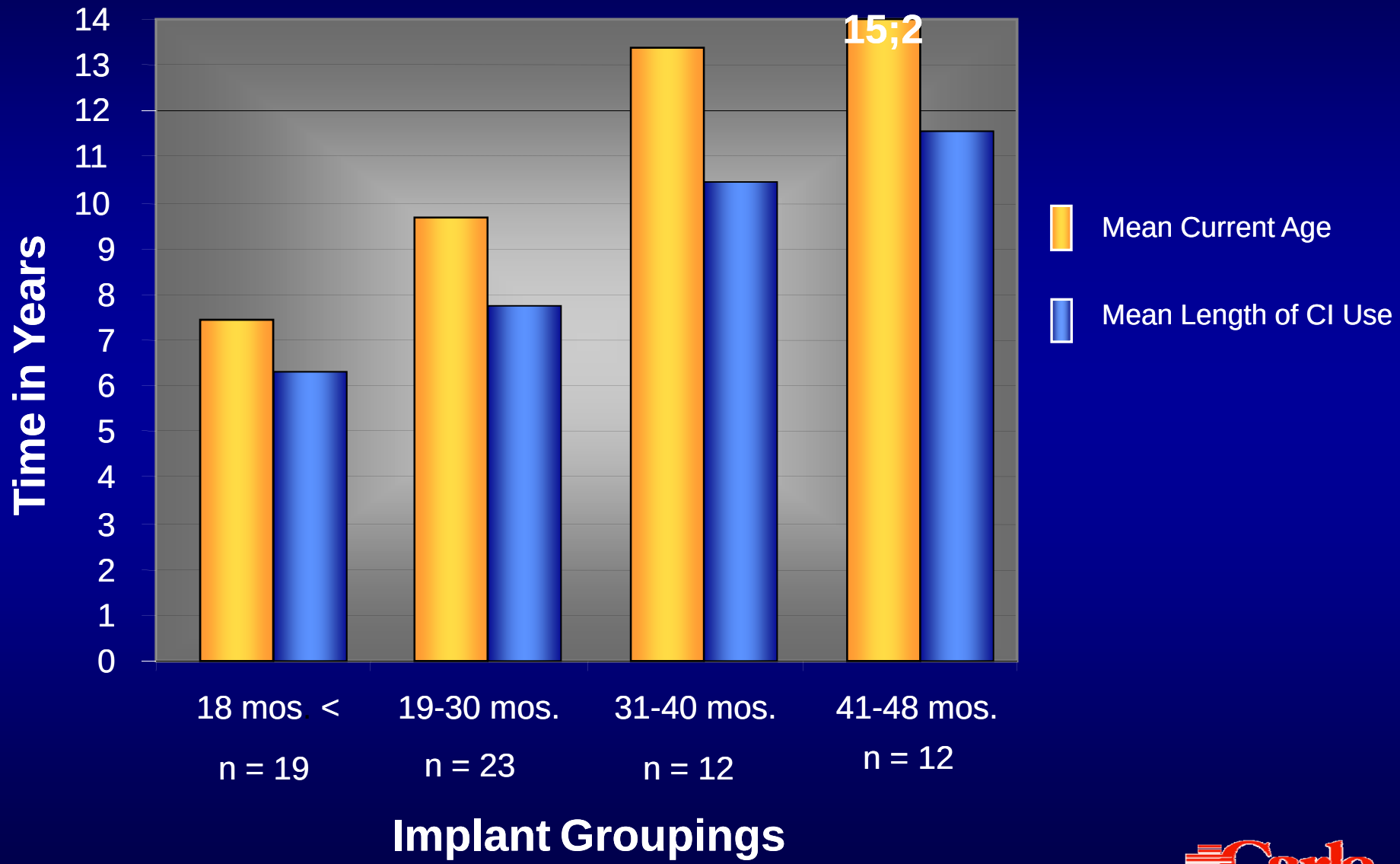
19 - 30 months (n=23)

31 - 40 months (n=12)

41 - 48 months (n=12)

Demographics

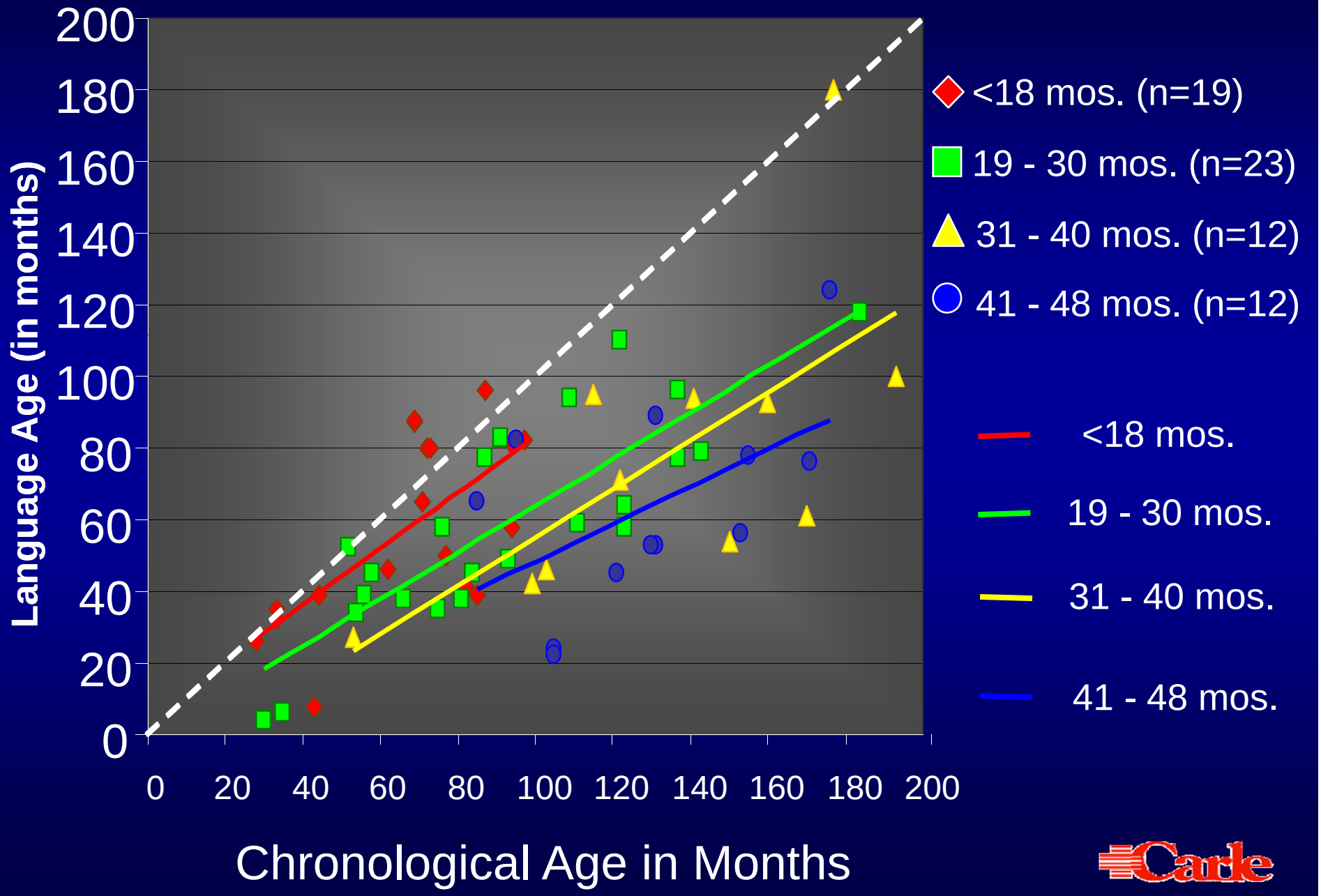
Mean Age and Length of CI Use



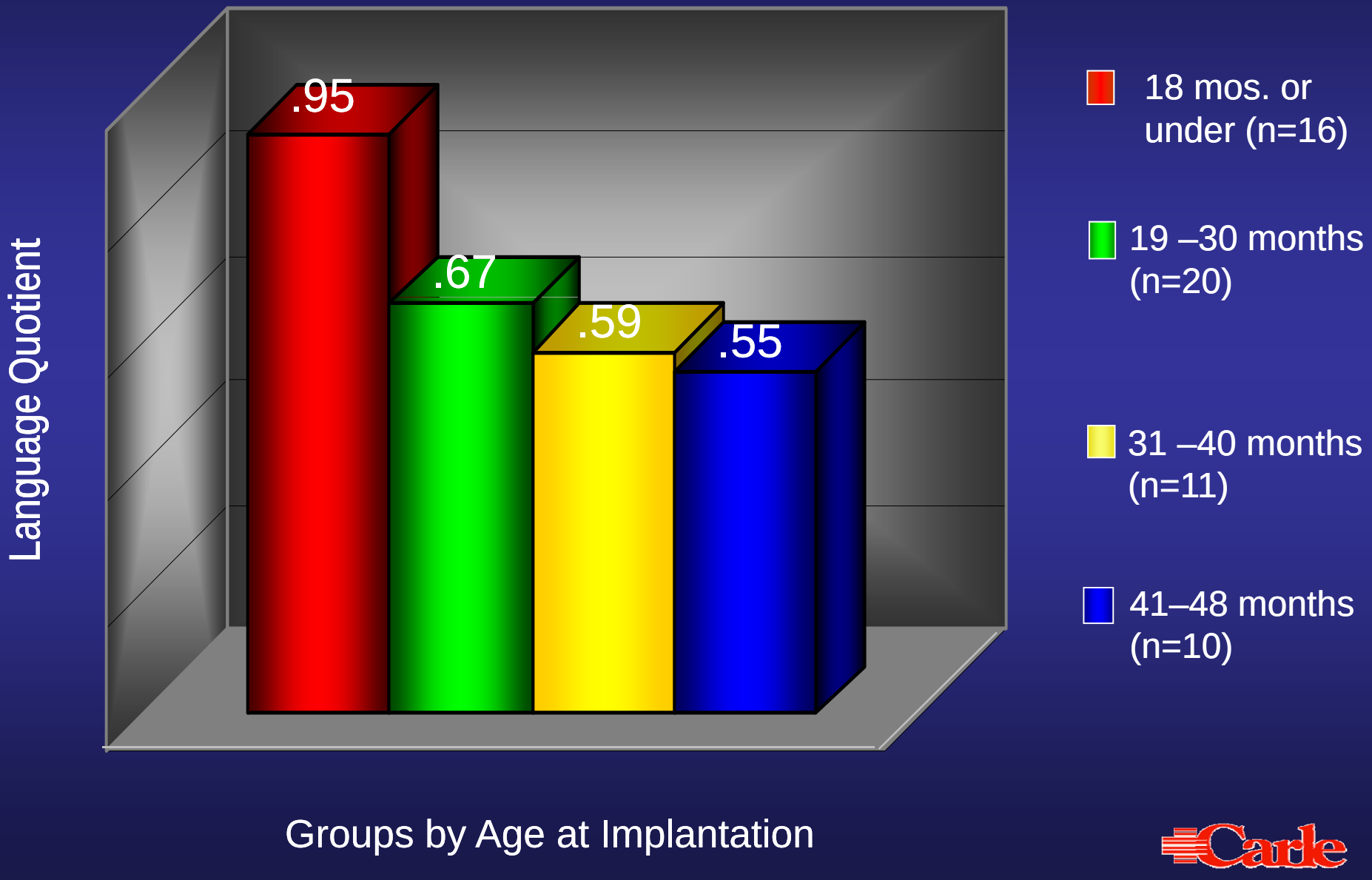
Results

Connected Language

Language Age vs. Chronological Age



Language Quotient by Age at Implantation



Young Group Break Down

7 - 12 months (mean=9.25)

vs.

13 - 18 months (mean=15)

Young Group Break Down

The Groups

12 months or under (n=8/10)

13 - 18 months (n=7/12)

Exclusions: <12 months of CI experience (n=2);
Substantial secondary disabilities (n=5)

Language Quotients with CI by 12 Months vs. CI at 13 - 18 Months

Age at Implant/ Test Interval	Lang. Quotient
Implanted by 12 mos.	
most recent (n=8)	1.020
1.5 year post	0.969
1 year post	0.944
Implanted at 13 - 18 mos.	
most recent (n=7)	0.923
1.5 year post	0.796
1 year post	0.916

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Summary of Study Findings

- Comparing the performance of 66 children implanted at Carle Foundation Hospital, the highest overall performance was seen in children implanted by 18 months of age.
- Implantation by 12 months resulted in an even smaller average gap than at 13-18 months.
- In all groups, the children who progressed most slowly were those with secondary disabilities, poor parental follow through, or inconsistent device use.

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Summary

- Early detection and diagnosis is critical to achieving implantation in early infancy
- In cases of severe to profound HL, referral for CI evaluation needs to be made soon after diagnosis - before 6 months of age
- A cooperative effort between families and an experienced pediatric CI team can lead to cochlear implantation by 12 months of age
- Cochlear implantation is desirable in infancy to maximize outcome

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