

## **Information about the Critically Appraised Topic (CAT) Series**

The objective of the Doctor of Nursing Practice (DNP) program at George Mason University is to prepare graduates for the highest level of nursing practice. Emphasis is placed on evaluating and applying the evidence that supports practice, understanding and creating practice delivery systems based on patient outcomes, and assuming leadership roles in practice settings. Graduates of the program will be able to assume many roles in the health care system, including direct patient care, clinical nursing faculty, practice management, and policy development.

All DNP students take an evidence-based practice course titled Evidence Based Practice in Nursing and Healthcare (NURS 883). This hallmark course for the DNP program builds on knowledge of research methodologies to analyze the selection and evaluation of research underlying evidence based practice. Emphasis is placed on the translation of research in practice, the evaluation of practice and the improvement of the reliability of health care practice and outcomes.

The first assignment students complete is a Critically Appraised Topic (CAT). CATs are mini-systematic reviews and considered a snapshot of the literature on a topic of interest. Students critically appraise literature related to a focused clinical question and summarize the best available research evidence on the topic of interest. CATs conclude with clinical bottom lines for practitioners to quickly take away for consideration in practice.

The CATs published in MARS (Mason Archival Repository Service; [mars.gmu.edu](http://mars.gmu.edu)) are submitted by students after they have been reviewed, revised, and approved by their instructor. All CATs are current at the time of original publication but will not be updated over time.

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**Purpose:** To identify the existence for a causal relationship of both expressive and receptive language communications for a cochlear implant pediatric population.

**Appraised by:** Ms. Marjorie Jones, MSN, FNP, APRN

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**Question:** Is communication significantly enhanced by the use of cochlear implants versus conventional hearing aids for pediatric (6 months to -7 years of age) patients with a severe to profound unilateral hearing loss from 2010-2013 in the tri-state area (Washington D.C, Virginia, Maryland).

**Search Strategies and Results:** EBSCO HOST search engine was used to search: PUBMED, MEDLINE, and CINAHL databases. Terms used included: “expressive language and cochlear implant and pediatric”. The PUBMED search resulted in 20 articles; four articles were excluded since they involved non-English speaking studies, six studies were excluded due to the questionable selection of expressive and receptive language evaluation tools, and eight were excluded due to sample criteria being inconsistent with the identified issue of concern. The CINAHL search resulted in and seven articles; two were excluded since they involved non-English studies, and three studies were excluded due to the questionable selection of expressive and receptive language evaluation tools. The MEDLINE search resulted in 27 articles; four articles were excluded since they involved non-English speaking studies, nine studies were excluded due to the questionable selection of expressive and receptive language evaluation tools, and eight were excluded due to sample criteria being inconsistent with the current issue of concern. The previously selected articles were deleted following the development of a more refined search.

The cases selected represented cochlear dysfunction as audiologic diagnoses. Studies were limited to those in the United States in order to ensure results were obtained from the English language, (for inter-study reliability). Additionally, the articles were selected based on the inclusion of both expressive and receptive language evaluation. Finally, the articles were selected based on the quantitative assessment tools employed.

#### **Chosen Articles:**

1. Boons, T., Bokx, J.P., Ghooge, I., Frijns, J. H., Vemeulen, A., Wuters, J., & Van Wieringen, A. (2012). Predictors of spoken language development following pediatric cochlear implantation. *Ear and Hearing, 33*(5), 617-639.
2. Holt, R.F., & Svirsky, M.A. (2008). An exploratory look at cochlear implantation: Is earliest always best? *Ear and Hearing, 29*(4), 492-511.
3. Nittrouer, S., Caldwell, A., & Holloman, C. (2012). Measuring what matters: Effectively predicting language and literacy in children with cochlear implants. *International Journal of Pediatric Otorhinolaryngology, 76*, 1148-1158.
4. El-Hakim, H., Papsin, B., Mount, R.J., Lévassieur, J., Panesar, J., Stevens, D. & Harrison, R.V. (2001). Vocabulary acquisition rate after pediatric cochlear implantation and the impact of age at implantation. *International Journal of Pediatric*

*Otorhinolaryngology*, 59(3), 187-194.

5. Schramm, B., Bohnert, A., & Keilmann, A. (2010). Auditory speech and language development in young children with cochlear implants compared with children with normal hearing. *International Journal of Pediatric Otorhinolaryngology*, 74(7), 812-819.
6. Spencer, L.J., Barker, B.A. & Tomblin, J.B. (2003). Exploring the language and literacy outcomes of pediatric cochlear implant users. *Ear and Hearing*, 24(3), 236-247.
7. Wie, O.B. (2010). Language development in children after receiving bilateral cochlear implants between 5 and 18 months. *International Journal of Pediatric Otorhinolaryngology*, 74(11), 1258-1266.

### **Evidence Retrieved:**

**Holt et al:** This is a prospective comparative analysis of subjects of children with an audiologic diagnosis of bilateral congenital profound sensori-neural hearing loss that received cochlear implants (CI). The study included 96 subjects who were placed in one of four groups. Group I (n=4) implantation between 6-12 months; Group II (n=32) implantation between 13 and 24 months; Group III (n=37) implementation between 25-36 months and Group IV (n=21) implementation between 37 and 48 months. Subjects were followed for a minimum of two years post implantation. The rate of language development coupled with the spoken language scores were used as assessment tools. Covariates included estimated family income, communication mode, pure tone average, and gender was considered as a function of age. Subject scores were significantly improved with early intervention. The rate of word recognition was unaffected by age of implantation. However, evaluative expressive, receptive language and rates of language acquisition were significantly enhanced with early implantation.

### **Appraisal:**

**Strengths:** The article provides a risk assessment for CI, which includes the risks associated with implantation (adverse reactions to anesthesia). Furthermore, the article presents considerable insights into the use of various quantitative diagnostic assessment tools to determine audiologic cochlear functioning. The inclusion of the covariates provided most informative. The size of the sample was excellent. The decision to rely on quantitative diagnostic assessment tools provided added comfort to the test results.

**Weaknesses:** The use of pure tone averages is inappropriate. The author used Visual Response Audiometry. However, neither are considered reliable assessment tools for a hearing impaired infant. There was a great deal of variation in the size of the groups. Finally, the author did not provide any explanation regarding the rationale for determining the division of the age groups.

**Schramm et al:** This longitudinal study included ten subjects. Five had essentially normal hearing (NH), and five subjects were diagnosed with sensori-neural deafness. Test subjects of the impaired subject group were observed for 36 months post-cochlear implantation (CI). The CI subject group auditory processing documentation occurred every 3 months up until the age of two years in hearing age, chronological age and for only chronological age for the NH group. The expressive and receptive language development of each NH child was assessed at 12, 18, 24

and for 36 months of chronological age. Subjects with CIs were examined at the same age intervals at both hearing and chronological age.

The focus of the study was to demonstrate the outcomes of expressive and receptive language skills in children who received cochlear implants by 16 months of age compared with a NH population. Test subjects demonstrated individual patterns of language and auditory development for both groups. The variation differed for the CI group for receptive and expressive vocabulary compared with the NH control group. Overall, the receptive and expressive development in each CI subject increased with hearing age.

**Appraisal:**

**Strengths:** The design of the study (longitudinal) affords the opportunity to develop long-term analysis capabilities as opposed to a snapshot perspective. The selection of language assessment tools offered analytic validity of test scores. The decision to use normal hearing subjects as a control group allowed an analysis capability, which offers the greatest potential for intervention determination.

**Weakness:** The number of subjects per group (5) was disappointing. The potential application with a longitudinal study would be significantly enhanced with a greater sample size.

**Nittrouer et al:** This was a longitudinal study involving 50 subjects ranging in age from 12-48 months. Thirty-five children in the current study had permanent sensori-neural hearing loss (HL) with pure tone average of 50 dB HL in the least affected ear. A second group consisted of 27 subjects diagnosed with a severe-to-profound hearing loss. These subjects had either unilateral or bilateral cochlear implants (CIs). Eight subjects were diagnosed with a moderate hearing loss and wore bilateral hearing aids (HAs). Another 15 children had normal hearing, and served as a control group.

**Appraisal:**

**Strengths:** The longitudinal study design allows the greatest potential to observe long-term effects of study variables. This study compared CI groups of varying audiologic impairment to a hearing aid and normal hearing group. This provides significant insight into variable impacts. The sample size was large enough to provide predictive applications.

The study demonstrated that the more complex the skill being indexed by a language measure, the stronger the predictive power of that measure. Finally, measures that require the direct observation of child behavior were found to be more sensitive than those using parental report.

**Weakness:** The study suggests that measures that require the direct observation of the behavior of the CI subjects were identified to be a stronger indicator than those employing the parental report. This claim was not adequately substantiated through statistical analysis.

**Wie et al:** This is a prospective, longitudinal designed research study. The sample population was 42 subjects, which included 21 subjects with essentially normal hearing (NH) and 21 recipients of cochlear implantation (CI). CI subject implants were between five and 18 months of age. Post-implementation data was collected at months 3, 6, 9, 12, 18, 24, 36, and 48. Group subjects were matched by chronological age and gender. Results indicated comparable cochlear function between CI and NH subjects. CI mean scores of 31 and 33 were comparable to NH scores of 31 and 34. Expressive and receptive language scores (57% and 81%) for CI subjects

were within the normal range between year one and year four. Both language scores improved with increased experience

**Appraisal:**

**Strengths:** The paired matching of subjects between CI and NH groups by gender and chronological age. The selection of assessment tools for receptive and expressive language provided valid and reliable assessments of function. There was an extensive articulation of the impacts on both expressive and receptive language. The longitudinal design afforded the ability to assess functioning over time.

**Weakness:** The decision to include a survey of parents in order to evaluate language skills. The construction of the survey included yes/no responses, which were elicited from patients. There was virtually no discussion regarding the impacts of gender. The breakdown of gender was not presented. This was an opportunity lost.

**Spencer et al:** This is a prospective analysis of 32 subjects. There were 16 subjects (7 girls and 9 boys) with essentially normal hearing (NH) which were age matched with 16 cochlear implant (CI) users for literacy and language functioning. The subjects were all educated within the same educational setting. Subtests of the Clinical Evaluation of Language Fundamentals test and the Woodcock Reading Mastery Test were employed to assess expressive and receptive capabilities. Significant differences were noted between the CI and NH groups for expressive language. Poorer performance was noted for reading performance, possibly indicating a receptive or processing lag with CI subjects. While scores decreased regarding language comprehension, the differences were within one standard deviation.

**Appraisal:**

**Strengths:** The age matching of subjects coupled with all subjects being from the same educational system effectively controls variables and strengthens the findings of the study. The author used well-established language assessment tools, which have been well documented for their validity and reliability. The subjects were selected from a larger cohort in order to ensure that no subjects had been previously identified to have a language deficit.

**Weakness:** The article suggests a predictive relationship between receptive/expressive performance and classroom performance. However, statistical analysis was insufficient to support this claim without supporting research.

**Boons et al:** This was a retrospective comparative analysis of pediatric patients with a sensorineural hearing loss being fit with cochlear implants. Expressive and receptive language was assessed for 288 pediatric cochlear implant (CI) recipients. CIs were completed by age five for all subjects. Linear regression demonstrated that implantations were most successful for expressive and receptive language development when completed by age two. The mean language quotient was .78 with a standard deviation of .18. Bilateral implantation was demonstrated to occur with improved outcomes. A multiple regression model accounted for 58% of the variance in expressive language scores and 52% of the variance in receptive language functioning.

**Appraisal:**

**Strengths:** The study employed well-validated intelligence assessment tools to ensure the absence of any cognitive dysfunction factors. Eleven predictive factors were included in this study. These were separated into three groups: a. four environmental factors, b. four auditory factors, and c. three child related factors. These could be instrumental in development of interventions.

**Weakness:** The CI group included both unilateral and bilateral implants. Research has demonstrated significant variation to exist when comparing unilateral versus bilateral implants. Additionally, there were identified inconsistencies in the number of electrodes in the different implanted devices. The follow-up efforts were not consistent between subjects within the CI group.

**El Hakim et al:** This was a retrospective study of vocabulary for 72 cochlear implant (CI) recipients. The CI subjects language assessments using the Peabody Picture Vocabulary Test (37 subjects) and the One Word Picture Vocabulary Test (35 subjects) for expressive language assessment. The mean rates of age equivalent scores were determined for the whole follow-up period. The mean rate of the earlier period was higher than that of the later period (1.33 vs. 0.67,  $P < 0.01$ ) and the mean Peabody Picture Vocabulary Test (PPVT) rate of the earlier period was higher than that of the later period (0.72 vs. 0.5). The latter difference was not statistically significant ( $P > 0.05$ ). Within subgroups by age at implantation, the PPVT mean rates were stable for younger implanted patients (0.56 for both periods) and dropped for the older implanted subgroup (0.87–0.43,  $P > 0.05$ ). The mean rates declined significantly for the older patients group (1.72–0.55,  $P < 0.01$ ) but insignificantly for the younger patients (0.99–0.77,  $P > 0.05$ ).

**Appraisal:**

**Strengths:** The identical implant device was employed for each CI recipient. The choice of language assessment tools provided equally reliable and valid scores of both overall language as well as expressive language functioning.

**Weakness:** Every CI subject should have been given both language assessment tools and equal amount of times. Due to missed appointments, relocations etc. this was not the case.

**Conclusion/Clinical Bottom Line:** The use of bilateral cochlear implants is associated with an improved capability for language functioning. The interval between the first and second implantation correlates negatively with language scores. On expressive language development, an advantage for simultaneous implantation compared with sequential implantation was demonstrated. Improved speech recognition skills and localization enhance speech perception capabilities were demonstrated in environments with multiple sound sources. This improved capability for speech perception impacts both expressive and receptive language functions. The results suggest that sequential bilateral cochlear implantation contributes to improved auditory processing beyond the benefits of the single implant even in users with an extended period of deafness in the later-implanted ear for both expressive and receptive language among a pediatric population.

