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LASTING EFFECTS OF A NICU STAY AND THE ROLE OF THE SLP

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LASTING EFFECTS OF A NICU STAY AND THE ROLE OF THE SLP

by

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A Research Paper

Submitted in Partial Fulfillment of the Requirements for the
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RESEARCH PAPER APPROVAL
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A Research Paper Submitted in Partial
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Master of Science
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Due to medical advancements in the Neonatal Intensive Care Units (NICU), infants are now surviving obstacles that they would not have survived in the past. Although the survival rates of NICU graduates have improved, the disabilities and delays experienced by these children have remained the same (Baar, Kleine, Kessel-Feddema, Sondaar, & Verhaak, 2007). Instead of being released to go home, children who are born and placed in a NICU may have major medical complications that can affect their development. These medical complications may extend beyond the initial health scare and result in developmental challenges. For example, these infants are at risk for communication delays as well as other disabilities. The developmental challenges of children who have a NICU stay is now a significant issue as advancing technology has increased infant survival rates.

There are many risk factors associated with infants who are placed in the NICU. Increased premature time of infant birth, typically affects the birth weight, with low birth weights associated with complications experienced in the NICU. Infant mortality rates are very closely related to low birth weight and shortened gestational age (Rossetti, 2001). A variety of medical complications are associated with infants who are pre-term and have low birth weight. Some medical complications that are common with infants at risk are: respiratory distress syndrome, bronchopulmonary dysplasia, patent ductus arteriosus, apnea and bradycardia. Intracranial hemorrhage, necrotizing enterocolitis, sepsis and respiratory syncytial virus are also common with these infants at risk (Rossetti, 2001). Various risk factors contribute to the potential of these medical conditions experienced by at infants at risk in NICU.

Before birth, the infant could be considered at risk for a NICU stay if the mother is an adolescent, had HIV, or if there was prenatal drug or alcohol exposure. These conditions frequently increase necessity of speech language pathology's therapeutic intervention for infants and family. Skills related to intervention therapies can also be taught to the staff of the NICU. Speech-language pathologists (SLPs) who are employed in hospitals and as early interventionists need to be knowledgeable of all the factors that contribute to a developmental delay, and more specifically, a communication delay (Rosetti, 2001).

Children born very pre-term (VPT), or very low birth weight (VLBW), are at a higher risk for neurological dysfunction such as cerebral palsy and intellectual disability than children born full-term or with a healthy birth weight. The children who are born VPT or VLBW are more likely to be placed in a NICU and are at an increased risk for communication delays. In addition to these complications, a child could be born and placed in the NICU who has a diagnosis that contributes to potential communication delays. Such diagnosis, to name a few, include fragile X syndrome, cerebral palsy, spina bifida, hydrocephalus, and cleft palate. (Rosetti, 2001).

Children born with these disorders are placed in an established risk category and are projected to have a developmental delay (Rosetti, 2001). NICU graduates who were VPT and VLBW are at risk for intellectual difficulties, lower speech and language skills, attention and behavioral problems (Baar et al., 2007). All of these difficulties can impact the child's eventual academic performance.

After infants graduate from a NICU it is critical that they receive follow up care. There is a team of professionals that can provide that follow up service, with the SLP

being one of those team members. Ideally these early interventionists stay involved with hospitals to maintain current information about what it is like for families and infants to be in a NICU. Specifically, the SLP in the early intervention team has a responsibility to be knowledgeable of various disorders and conditions that are common in the NICU and how they can affect the infant's speech and language development.

The SLP in an early childhood setting also needs to have knowledge in NICU disorders and how they can affect the child's learning. It is important for the SLP involved in early intervention to know why a child is determined to be at-risk, know potential specifics of developmental delays, know related conditions, and know how to treat the infant effectively. The school SLP frequently has a large caseload of pre-school children with various diagnoses that may affect their learning. The SLP's comprehensive knowledge regarding the impact of various conditions on learning is critical as it impacts efficacy of intervention. The school SLP will also need to advocate for the child as well as educate those working with the child regarding effective learning and communication strategies.

Autism Spectrum Disorder

An increasing number of infants who are receiving specialized care in the NICU are later diagnosed with Autism Spectrum Disorder (ASD). A study was conducted to explore early behaviors of the NICU graduates who were later diagnosed with ASD (Barone, Bernard, Cohen, Gardner, Flory, & Harin, 2010). Typically, ASD is diagnosed around three years of age when clinical signs present, including language delays (Levy, Mandell & Schultz, 2009). Because early intervention is found to be especially effective for children with ASD, SLPs need to provide early intervention

services for these infants so they may have better academic outcomes (Barone et al., 2010).

Several indicators for ASD in the NICU graduates were identified in a study. At one month of age, the infants with ASD were found to have neurobehavioral abnormalities combined with muscle tone deficits in their arms and increased asymmetric visual tracking (Barone et al., 2010). When the infants diagnosed with ASD were four months old, they were still found to have a preference for higher amounts of visual stimulation and also behaved more similar to newborns than the control group of healthy infants. This pattern continued and at seven to ten months of age, the infants were found to have deteriorating motor and mental performance which is similar to infants with a severe central nervous system involvement (Barone et al., 2010).

A different study on autism and pre-term infants found that out of 91 pre-term infants, 26% were found to have a positive result on the autism-screening tool (Bassan, Limperopoulos, Moore, Plessis, Ringer & Robertson, 2008). The authors found multiple factors that were significantly related with a positive result on the screening tool: lower birth weight, gestational age, male gender, chorioamnionitis, acute aspiration hemorrhage, illness severity on admission and abnormal MRI studies (Bassan et al., 2008). These findings provide evidence that there is a high prevalence of positive initial screenings for ASD in premature infants.

Recent neurobiological findings support different theories on ASD. Levy et. al. (2009) indicates twenty percent of children in their study were found to have macrocephaly by two to three years of age. The brain rapidly grows around 12 months of age. This change is parallel with the onset of core symptoms within the first two years

of life (Levy et al., 2009). Results of neuroimaging studies show overgrowth in cortical white matter and abnormal growing patterns in the frontal and temporal lobes as well as limbic structures. The overgrowth in these regions could affect social development, communication, and motor abilities, which are all common impairments in children with ASD (Levy et al., 2009).

Abnormal findings in MRIs have indicated hypo activation of the fusiform face area, which is associated with deficits in perception of people compared with objects (Levy et al., 2009). The authors concluded that the combination of information from these different sources, clinical neuroimaging, neuropathological, and neurochemical studies show that ASDs are disorders of neuronal-cortical organization. This causes deficits in information processing in the nervous system, which affects the organization and connectivity in the brain, which in turn affects social communication (Levy et al., 2009).

NICU and Hearing Loss

Hearing loss is more prevalent in an at-risk infant population. In a typical newborn population the risk for hearing loss is .1 percent. In an at risk population, hearing loss ranges from 1-3 percent (Hille, Verker & Straate, 2007). A study was conducted to look at hearing loss in a high-risk population of infants born less than 30 weeks gestation and/or a birth weight of less than 1 thousand grams. The prevalence of hearing loss in the study was found to be 3.2% (Hille et al., 2007). From this perspective, NICU infants are at 30 times higher risk of hearing loss. Other independent factors were identified in these infants, including severe birth asphyxia and assisted ventilation (Hille et al., 2007).

An undetected hearing impairment in an infant can negatively impact that child's speech and language development and potentially contribute to poor academic performance. Hearing screenings are performed on newborns to detect a hearing impairment before it can negatively impact the child. A research study was designed to evaluate hearing screenings for children in the NICU regarding a satisfactory assessment of their hearing abilities (Fleisher, Gallagher, Messner, Price & Yoon, 2002). The research results revealed that the screening missed sensorineural hearing losses in 2 out of the 82 infants. This is significant due to the incidence of sensorineural hearing loss which is 0.1 to 0.2% in the general population. This study identified a higher rate of sensorineural hearing loss in the NICU population.

The hearing screening does not seem to detect sensorineural loss in infants in NICU, but the study also showed that this population is 10 to 20 times more at risk for sensorineural hearing impairments (Fleisher et al., 2002). Hearing impairments are important to detect early so intervention can begin before the hearing loss negatively impacts a child's speech and language development.

Receptive and Expressive Language

Early identification of hearing loss in infants, and subsequent early intervention, is critical for infants in NICU. There is evidence that when an infant with sensorineural hearing loss is provided with early intervention they experience improved language abilities (Choo, Meinzen-Derr & Wiley, 2011). Results of the study showed that children enrolled in intervention before 6 months of age were more likely to have age appropriate language skills at baseline and maintain them compared to infants enrolled after 6 months of age (Choo et al., 2011). The authors of the study also found that children

whose hearing loss was identified early had positive effects on vocabulary development (Choo et al., 2011).

There are certain diseases that are now correlated to specific speech and language impairments. A research study found that infants who had bronchopulmonary dysplasia (BPD) had lower receptive and expressive language skills than the language of infants that were full term (Baley, Hawkins, Lewis, Siegel, Singer & Yamashita, 2001). While the study found all of the above risk factors, it was also identified that neurologic complications, low socioeconomic status, and minority race were significant predictors of language delay.

It is important to note that socio-demographic factors have a relationship with infants in NICU and educational disabilities. Birth weight alone should not be used to assess morbidity of NICU graduates (Ariet, Bucciarelli, Carter, Curran, Eitzman & Gomatam, 1998). The socio-demographic factors that were reviewed in the study by Ariet and colleagues (1998) were the child's sex, family income, mother's marital status, race and educational level. Being profoundly mentally handicapped, educable mentally handicapped, emotionally handicapped and having specific learning disabilities are associated with both perinatal and socio-demographic factors (Ariet et al., 1998).

A research study found the *Pediatric Language Acquisition Screening Tool for Early Referral (PLASTER)* and Early Language Milestone Scale-2 (*ELM-2*) to be reliable screening measures for receptive and expressive language and hearing (Hoff & Trimm, 1996). These two measures were applied to infants and toddlers between 3 and 36 months identified as high risk and a control group. The infants considered high-risk were either born prematurely or placed in a NICU following birth. The researchers found that

the group considered high risk had significantly lower scores than the control group and it was expected that a higher percentage of these infants and toddlers did fail the *PLASTER* and *ELM-2* (Hoff & Trimm, 1996).

All infants and toddlers at risk were found to have potential for developmental delay. Children with one of two specific variables had significantly lower scores on the screenings. The two specific variables were African American ethnicity and lower socioeconomic status. Multiple linear regression analyses revealed that the *PLASTER* was not biased against any of the ethnic, gender or socioeconomic groups observed in the study (Hoff & Trimm, 1996).

School-Age Effects

A study conducted by DePalma, Doyle, Marks, McGrath, Sullivan and Winchester (2009), demonstrated that the chances of receiving school services for special education, including speech language therapy, increases with greater and multiple indicators of perinatal morbidity (DePalma, Doyle, Marks, McGrath, Sullivan & Winchester, 2009). Infants who were pre-term, had neurological morbidity, and who were small for gestational age (SGA) were found to have the lowest academic competence scores in adolescence when compared to full-term infants (DePalma et al., 2009). Pre-term infants with neurological disease received the most services for speech and language therapy. Infants with SGA received the second highest rate of speech and language services (DePalma et al., 2009). Infants born preterm and healthy, required fewer services compared to other pre-term groups yet, 22% received speech and language services because of language delays. These results suggest that speech and

language difficulties are persistent in this group of at infants at risk. Therefore, they should be closely monitored for potential intervention needs.

DePalma et al. (2009) indicated that infants with multiple medical morbidities unexpectedly performed better on academic competence scores than hypothesized. Children with severe handicaps are more recognizable as being at risk for communication delay and receive special education services earlier. An explanation for better performance may be that children with multiple morbidities receive a higher rate of school services including speech and language therapy. This shows that all infants in NICU should be closely monitored because early detection of a disability and subsequent intervention could improve outcome (DePalma et al., 2009).

Children born VPT or VLBW are at risk for neurological dysfunction such as cerebral palsy and intellectual disorders (Baar et al., 2007). Children with VPT and VLBW are at a higher risk for difficulties intellectually, speech and language challenges, clumsiness, as well as attention and behavioral problems (Baar et al., 2007). All of these difficulties can affect academic performance and success in school. Children with major handicaps are usually identified earlier as having developmental delays and subsequently receive special education services in a timely manner. In contrast, less noticeable impairments are not detected early, and the challenges may not be observed and addressed until the child is already in school. Therefore, the child receives services much later in life (Baar et al., 2007).

Children from the NICU, who eventually present with problems in school and receive specialized help, were more likely to be boys who were small for gestational age. These boys were found to have lower movement scores and lower score on

language screening tests (Baar et al., 2007). Children from NICU, who were not receiving the help they needed at school, were less pre-term with higher Apgar scores, had BPD less often and were treated with steroids less frequently (Baar et al., 2007). The Apgar score evaluates a newborn on appearance, pulse, grimace, activity and respiration on a scale of zero to two and then summed for a result from zero to 10 (Baar et al., 2007). It appears that children with a lower gestational age along with more serious perinatal problems become more of a concern for parents and teachers and so they receive special assistance. In contrast, other children from NICU may fall between the cracks and miss out on the special attention and assistance that they also need.

Many studies of infants in the NICU are focused on children who have eventual educational problems. A different research study was able to show that school problems can be predicted prior to school entry. The benefits of this study are that if we can reliably predict problems before a child enters school then they can receive early intervention. The study showed that 43.2% of the NICU population that was followed either repeated a grade or required special help in school (Gaines, Gluckman, Sell, & Williams 1985). The *McCarthy Scales of Children's Abilities* was shown to be an accurate predictor of school performance of graduates from NICU. They also found that the length of stay in a hospital was a significant perinatal variable (Gaines et al., 1985). These authors point out that it is possible to identify children that need language and learning assistance before entering school, which is valuable information for SLPs in regard to early therapeutic intervention.

The SLPs Role with an Infant in NICU and Beyond

Role of the NICU SLP

The SLP has an important role with infants at risk in a NICU stay. There are four main areas in which the SLP is involved but not limited to: communication evaluation and intervention, feeding and swallowing evaluation and intervention, parent and caregiver education and counseling, staff (team) education and collaboration, as well as other roles (ASHA, 2004).

The SLPs role in the NICU is developmentally supportive. This means that the SLP will perform developmentally appropriate assessments of prelinguistic and socio-communication interactions to enhance the infants developmental outcomes. The care provided in the hospital is family focused not client focused. Since the family is involved with the infant's care the family needs to be involved with the intervention, this is why it is considered family focused care. In regards to communication, the SLP needs to use developmentally appropriate assessment that examines pre-linguistic and communication interactions, and identify disorders that impact communication. The SLP needs to implement intervention that will promote social skills, interactive communication, and infant's development, as well as assist the family in communicating with their child (ASHA, 2004).

Additionally, the SLP needs to plan to apply assessments of the infants feeding and swallowing behavior. It is important to be knowledgeable of the suck and swallow structures, and be able to diagnose disorders. Furthermore, SLPs can assess the coexistence of additional disorders that may impact feeding and swallowing. The SLP will also provide education and counseling to the family and other caregivers in the

NICU about the specific feeding and swallowing ability for the infant (ASHA, 2004).

Therefore, the SLP can share information about developmental expectations, adequate communication interaction patterns, as well as feeding and swallowing behaviors.

In addition to the three areas addressed previously, there are other roles in which the SLP may assist. Speech language pathologists are a part of a quality control and risk management program for the NICU. They take part in discharge and transition planning for follow up care and assist in a smooth transition for the infants released from the NICU. The SLP is also in charge of training clinical fellows and students-in-training. Lastly, the SLP in a NICU is an advocate serving infants and families to assist them in getting services that will help their child reach their potential (ASHA, 2004). They need to be a part of the NICU's developmental care plan and environment while focusing on their four main areas: communication evaluation and intervention, feeding and swallowing evaluation and intervention, parent and caregiver education and counseling, staff (team) education and collaboration, among other roles (ASHA, 2004).

Role of SLP in Early Intervention and the need for a seamless transition in care

ASHA has a position statement on the roles and responsibilities of SLPs in an early intervention setting. It states that SLPs should be on an early intervention team to provide services and support for families with infants and toddlers who have disabilities (ASHA, 2004).

Parents are most often overwhelmed when their child is placed in a NICU. First they have to worry about life-threatening complications, and then they have to worry about medical diagnoses, hospital procedures and referrals (Akers, Boyce, Boyce & Mabey, 2007). Premature infants may experience developmental delays and

impairments throughout their life such as visual impairment, motor delay, speech delay, hearing loss and learning disability (Akers et al., 2007). Extremely low birth-weight infants face the greatest obstacles (Akers et al., 2007). The leading cause of infant death within the first month of life is prematurity. Those infants that survive may have life-long consequences such as cerebral palsy or mental retardation (Akers et al., 2007). It is difficult for parents to begin to understand available early intervention services provided through the Individuals with Disabilities Education Act (IDEA) Part C.

If there is a smooth transition between the NICU and early intervention services, parents would understand the services that are available for their family. Most state services are not effective when transitioning parents from the NICU to early intervention services (Akers et al., 2007). When there is not a clear understanding of the role of the IDEA Part C services, parents and infants' needs could go unnoticed. In many state jurisdictions it is entirely dependent upon the NICU staff to understand eligibility and to recommend families to services in their area (Akers, 2007). Thus, collaboration between NICU staff, early interventionists, and families is vital.

Continued services needed may be a delicate subject for parents of infants in the NICU. They may still want to believe or hope that their infant will be just fine once their baby is allowed to be brought home. Although premature infants can appear to be typically developing, it is still a risk factor that should not be forgotten (Akers et al., 2007). The survival rates for VLBW infants have increased in the past decade. While the incidence for significant disabilities has remained stable, the incidence for milder problems appears to be increasing. (Akers et al., 2007)

Parents need to be informed that their child is still at risk for mild to moderate problems. For example, about 50-70% of infants with VLBW develop mild to moderate symptoms including learning disabilities, attention deficit and hyperactivity disorders, and behavioral problems (Akers et al., 2007). These mild to moderate problems may not be noticeable until after preschool when these children are in early elementary school. Even though a discussion about this topic may be awkward with parents, they need to be notified of the services available, to be aware and to help monitor their child's developmental needs.

The InReach model was created for when an infant has made progress and was being discharged. Instead of sending families home to find resources themselves, staff in NICU informed local early interventionists aware of the infants move (Akers et al., 2007). The InReach model, created by Akers, is designed to create a smooth transition for services when families moved from a hospital to home (Akers et al., 2007). Then hospital staff introduced an Individuals with Disabilities Education Act (IDEA) Part C service provider to the family and a hospital meeting would be scheduled to create an Individualized Family Service Plan (IFSP) (Akers et al., 2007). IDEA Part C offers families health, education and therapeutic services once their infant is released from the hospital. Often families are unaware that these services are available. When a hospital staff member informs a local early intervention provider about a family's transition, then an infant is more likely to receive services.

Akers created the InReach model in hopes of reducing parental stress and to provide the professional support needed. Staff from Part C and NICU was in agreement that creating the IFSP before the infants were discharged had many advantages,

including parent preparedness and engagement in future IFSP meetings. Parents also reported feeling more confident in their knowledge about their baby and feeling more supported from staff of NICU and Part C (Akers et al., 2007). The research on the InReach model found that creating a relationship between staff and families provided a seamless transition from the NICU to available services (Akers et al., 2007).

Parents and professionals need to have a partnership in the NICU and early intervention settings. Based on two empirical studies, six guidelines were created to support the partnership needed. These guidelines emphasize the need to individualize practices to meet parent needs: involve parent support, trust and respect parents; adopt a strengths based perspective; understand parents' and professionals' unique perceptions; and coordinate the professional team (Bruns & Steeples, 2001)

Medical professionals understand the importance of family centered care in the NICU. They know that for the infant to survive and thrive the family must be involved in their care and development. Medical professionals are to assume all parents have strengths that they can use to support their infant's development. NICU staff support and nurture the bond between infants and parents (Bruns & Steeples, 2001). Early intervention has a similar philosophy of family-centered care, where intervention is influenced by family's opinion. Parent participation and decision-making are emphasized. Parents are invited to be active in all parts of their child's services (Bruns et al., 2001). Even though both NICU and early intervention are family centered both professions admit that much more needs to be done to make services more family centered.

It is important that there is an individualized approach for each family. Although each family is different and comes from different cultures, beliefs and values, the intent is to emphasize the need to adjust practices to individuals. Parent's participation should be welcomed and supported in planning, implementing and evaluating services. When parents are involved they are more likely to invest their efforts in assisting their children to accomplish the agreed upon goals. In addition, the study conducted by Bruns and Steeples (2001) found that the interaction between staff and parents needed to be respectful and focused on the parent's strengths. Staff needs to recognize that each parent and child has inherent strengths and to avoid negative perceptions of the parent or child (Bruns et al., 2001).

Role of School SLP and Early Intervention

The article, "Collaborative Experiences for NICU and Early Childhood Education Personnel", described a collaborative training program involving a university where education students spent 15-20 hours in a NICU at a medical center (Miller, Mutton & Williams, 1993). The reason for the collaboration is that it is known that cooperation between hospitals and early childhood programs are essential to successful treatment for the infant at risk (Miller et al., 1993). Students were able to see a NICU and gained insight on some of the most common medical conditions and treatments encountered by infants who are pre-term and high-risk, as well as the impact of these problems on the infant's long-term development (Miller et al., 1993). Nurses and other hospital personnel became more knowledgeable about community based early intervention services and providers. They also reported making referrals for these

services with more confidence. The hospital staff was able to develop relationships with the agencies that provide the next step of care for these infants (Miller et al., 1993).

Miller et al. (1993) explained the need for collaboration between hospitals and early childhood programs by contrasting the institutions and the models of care they use. The medical model that hospitals follow, work on their acute care population and allows them to treat a large number of patients for a short term (Miller et al., 1993). The educational model that early education programs follow allows them to serve fewer clients for a longer period of time, which allows for a greater intensity of treatment. Early education programs also work with the family and the caretaking community when providing intervention (Miller et al., 1993).

Education students have varying experiences in the NICU; however hospital staff made sure that each student observed routine NICU caregiving and how developmental care is incorporated into each infant's routine. Students also get to see the parent-child interaction and then understand how everyone's interaction and experience in a NICU is unique. This is important for students to see so they can understand parent concerns when enrolling their children in early childhood programming (Miller et al., 1993). Students also observe parents that have a difficult time bonding with their child and understand that this can lead to later problems when the infant leaves the NICU for home (Miller et al., 1993).

In addition, students learn about the most commonly occurring medical problems infants in a NICU face and how it affects their development. The students involved in the study learned about sensory difficulties including vision and hearing problems (Miller et al., 1993). They also learned about bronchopulmonary dysplasia and

how fragile infant lungs are (Miller et al., 1993). Moreover, students learned how stressful a NICU environment is for infants and their families (Miller et al., 1993). Most importantly, the students learned how the long-term effects of these conditions and their treatments have on a child's later ability to learn and how it impacts educational approaches (Miller et al., 1993). The program was designed to help early childhood and special education students better understand the medical histories of their clients, help them to work cooperatively in teams, and to help them carry out therapy treatment.

Clinical Implications

There is a lot of new research on the developmental outcomes of graduates of NICU and it is important that SLPs provide early intervention services for this population. With early intervention, these infants from NICU will be given a chance to thrive. With increasing numbers of infants surviving and increasing numbers of disabilities, perhaps with early intervention there could be decreasing numbers of communication and developmental delays. It is also important for early interventionists to maintain connections with area hospitals. Without these connections, an infant's needs could go undiagnosed. If SLPs involved in early intervention maintains ties with the hospitals they can provide families support promptly. It is also important for the school SLP to maintain relationships with early interventionists in the area, so that once the child is too old for early intervention and is ready for school; they can still receive services by an SLP that is knowledgeable of the child's NICU history and care. It is also important for the school SLP to stay current of new information involving NICU care and early intervention for efficacy of intervention based on evidence based practices.

Evidence Based Practice

Evidence based practice is a combination of current research, clinical judgment/experience and client/family needs. With the evidence of the long-term developmental effects of being placed in a NICU it is in the client's best interest to receive early intervention services (ASHA, 2004). Early intervention is important to evidence based practice because of the needs of this population. The literature shows that the infants placed in the NICU are at risk for developmental delays and signs and symptoms of these developmental delays may be detected quite early.

There are many clinical applications from the literature based on studies of NICU graduates. Infants that are placed in a NICU are significantly more likely to have a communication delay. If screenings were done on this population and they tested positive then they could receive intervention before they are school age and struggling. This screening could provide an early detection of a communication delay and thus early intervention. Also, there needs to be continued monitoring of infants born in the NICU through adolescence to diagnose any disorders and to ensure that they are receiving appropriate resources to increase their academic success, as well as improve their quality of life.

With NICU infants having a greater chance of survival, unfortunately the rate of diseases and disorders remains constant (Baar et al., 2007). With the increase of infants now surviving, there are also an increased number of infants with disorders that need to be identified, closely monitored and possibly provided early intervention services. There are many disorders that are now being recognized earlier than before; these include autism, hearing impairments and receptive and expressive language delays. Early intervention could be very helpful in improving outcomes for these infants.

Future Investigations

NICU graduates are surviving greater obstacles but will still face greater challenges in life than their non-NICU counterparts. Future research on these infants will provide more information on how to improve the NICU experience, and assure early intervention.

While the NICU is only a temporary home for infant and parents, improvements can always be made. Future research could include a parent questionnaire for parents that spent time with their infants in a NICU. Important questions to be asked would include how to make the NICU experience better for a more positive outcome.

Another related research topic could be about follow up of NICU graduates in the schools. It would be interesting to find out if there is a common point in the child's life that their NICU experience and related circumstances are no longer impacting their learning or if on average they will always need additional help in the academic setting.

Further studies on infants found to be positive with ASD would be necessary. It would be interesting to continue to follow these same infants found positive on the screenings to see if they were still on the spectrum when they are entering school. A more comprehensive diagnostics could be performed around the age of three, with hopefully more reliable results.

Another associated research topic could be performed on these children on the ASD spectrum to see how effective early intervention is when provided right after birth instead of waiting until the child is typically diagnosed with ASD around the age of three or later. Once again, the desire is quality research to support evidence based practice.

Conclusion

All of the findings thus far on NICU graduates and the SLPs involvement in their care show that constant learning about this population is a necessity. With recent medical advances allowing NIUC infants to survive obstacles that they previously could not have, we have a whole new population of at-risk children. These children need to be studied more extensively to determine the longitudinal impact of NICU experience and treatment.

Further research can provide more concrete information as to how effective medical treatments and early intervention of speech and language treatment are. If the stated findings continue to be replicated, then incidence and severity of later morbidity and speech and language problems may decrease with increased efficacy of intervention supported by research evidence. This not only affects infants and their caregivers but also may provide cost savings for families and society. Research regarding early intervention has shown that when therapy is provided for infants at a very young age they can reach age-level standards sooner and not need additional assistance for as long as children that did not receive services at a young age. This can cut costs down for schools and families.

Collaboration and continuing education for all the SLPs involved in a NICU graduate's life are vital in the success of the infant and family. Families of infants from NICU are relying on the medical professionals, early intervention teams, SLPs and teachers for education and quality care for their child. While there may be many SLPs and related professionals familiar with the process of addressing needs of infants with high risk, there is always potential for improvement with the collaborative process.

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