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The Efficacy of a Developmental Follow-up Program for High-Risk Infants

Laurie M. De Jong

Lynn University

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The Efficacy of a Developmental Follow-up Program for High-Risk Infants

Laurie M. De Jong

Submitted in partial fulfillment of the requirements for the degree of Master of Science for:
HCA 665 Graduate Project in Health Care Administration

Professor/Advisor: Rita Nacken Gugel

Lynn University
1999
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Abstract

Objective: To assess the efficacy of a developmental follow-up program provided at a local community hospital. Efficacy was measured by the number of children referred to early intervention services and the cost effectiveness of the program. Design: This is a retrospective study of 174 children evaluated during 272 visits in the Follow-up Clinic from the inception of the program on November 22, 1994 through December 31, 1998. The data collected included referral rates and demographic information on all children. Financial information was also obtained on 74 children seen during a one year period to assess the financial implications of the clinic. The amount charged and the amount reimbursed for the clinic evaluation, and the charges generated for children receiving therapy at the facility were analyzed. Statistical analysis was performed on the gender, gestational age, multiple vs. singleton births, age at time of evaluation and referral trends. Results: The program made a total of $46.63 over a one year period. In addition there were charges totaling $10,185 for six children receiving direct therapy who had been identified and referred through the follow-up program. Overall there were 53 children referred to therapy, the Early Intervention Program or other specialists over the 4 year period. The percentage of referrals decreased over time from 30.5% to 24%. More boys than girls and more multiples than singletons were
referred for therapy services, however none of these indicators reached a level of statistical significance. Conclusion: The Developmental follow-up program identified children who required referrals to early intervention services. There were no statistically significant variables identified as to which children were more likely to be referred for additional services. The Hospital did not lose money by providing this service. The developmental follow-up program was an avenue to increase referrals into the hospital’s outpatient pediatric rehabilitative services program.
Chapter 1

Children with specific conditions are at a higher than average risk for developmental delays and other problems. These problems often lead to the need for expensive special education and other rehabilitative services. In many cases these problems may be reduced or alleviated with early detection and early referral into intervention services. A local community hospital has been providing a developmental follow-up program in a clinic format for the past few years. Anecdotal information reveals that some individuals feel the program is not necessary. Specifically some pediatricians report that there is no need for a clinic to identify children requiring developmental services; while some of the administrative staff feel the program is losing money. This study was undertaken to provide information as to the effectiveness of the program. Effectiveness is measured in terms of the number of children identified as requiring services, and the cost effectiveness of the program itself. The data that will be collected includes demographic information as well as financial information including the cost of running the clinic, the amount charged for the program and the amount of money collected as reimbursement from the insurance companies. An extensive literature review identifies (a) multiple risk factors which may contribute to later developmental problems, (b) the legal and financial aspects of children who require special services, (c) issues regarding referral to early intervention
was a 20 percent survival rate for infants born at less than 1500 grams and a 10 percent survival rate for infants born at 1000 grams. By 1990, the survival rate for infants born at 750 grams, 1000 grams, and 1500 grams was 39 percent, 77 percent, and 93 percent respectively (Bregman, 1998). The American College of Gynecologists Committee Opinion (as cited in Bregman, 1998) was that at 23 to 25 weeks gestation, the commitment to care of a survivor by families and society could be "extensive, costly, multidisciplinary and lifelong." The American Academy of Pediatrics (A.A.P.) (1995) reported that the birth of an infant at less than 25 weeks gestation or less than a birth weight of 750 grams presented a variety of complex medical, social, and ethical decisions. While the prevalence of these births was low the impact of these infants on their families, the health care system and society was profound. The survival of infants born at 23 to 25 weeks gestation continued to increase with each passing week. The survival rate was less than 40%, while approximately 40% of the survivors will have moderate to severe disabilities (A.A.P., 1995). Many require prolonged intensive care and long term care. The cost effectiveness of care for very low birth weight (less than 1500 grams) infants was studied by Rogowski (1998). The average cost of the first year for an infant born at less than 1500 grams was $93,800, while the cost increased to $273,900 for an infant born weighing less than 750 grams (see Table 1). On average, an additional $1300 was spent on each child
services, and (d) a discussion of the results of the study.

**Background**

In the United States, 12.6 million children, 18 percent of the children under 18 years old (Newacheck, et al., 1998), had a chronic physical, developmental, behavioral or emotional condition that required health and related services beyond those needed by healthy, normal children. It has been reported that 5.8 to 6.1 percent of the United States population under 18 years old, about four million children have disabilities (McNeil, 1996; Wenger, Kaye and LaPlante, 1998). Wenger, et al. (1998) defined a disability as any limitation in activity due to a chronic health condition. The presence of a disability in adults was associated with lower levels of income, an increased likelihood of living in poverty or receiving public assistance and a reduced chance for employment (McNeil, 1996).

Approximately 7 to 13 percent of the general school population required some form of special education services (Gold Report, 1998; Halsey, Collin, and Anderson, 1996; Ross, Lipper and Auld, 1991; Roth, et al., 1993) Overall 5.5%, 1.7 million children ages 5 to 17 years old had disabilities related to schooling which included the need for special education. Boys were more likely than girls to attend special education classes (Wenger, et al., 1998). Resnick, et al. (1998) investigated the academic
placement during the 1992-3 school year of neonatal intensive care unit (NICU) graduates born between 1980-1987 in the state of Florida. More than 95% of all children with disabilities were enrolled in public schools. Florida followed the United States Department of Education established regulations for defining and identifying students with disabilities. In turn, the state of Florida set up their own rules that guided the county school districts (Resnick et al., 1998). In Palm Beach County there were a total of 143,531 students enrolled in kindergarten through twelfth grade. There were 19,509 children, 13.5% of the total student population enrolled in special education programs (Florida Department of Education, 1998; Gold Report, 1998). This was higher than noted in the previous literature. According to the Annie E. Casey Foundation (1998) Florida ranked higher than the national average in the number of teen births, infants born at low or very low birth weights and children living in poverty, while the average income was lower than the national average. In Palm Beach and Broward counties there were 32,509 births; 2,586 at a low birth weight, 478 at a very low birth weight, 11,044 to unwed mothers, and 2,221 to teen mothers (Florida Department of Education, 1996). All of the above are related to an increased risk of developmental problems (Annie E. Casey Foundation, 1998).

The survival rates of infants born at a low birth weight has increased significantly over the past 30 years. Before 1960 there
was a 20 percent survival rate for infants born at less than 1500 grams and a 10 percent survival rate for infants born at 1000 grams. By 1990, the survival rate for infants born at 750 grams, 1000 grams, and 1500 grams was 39 percent, 77 percent, and 93 percent respectively (Bregman, 1998). The American College of Gynecologists Committee Opinion (as cited in Bregman, 1998) was that at 23 to 25 weeks gestation, the commitment to care of a survivor by families and society could be “extensive, costly, multidisciplinary and lifelong.” The American Academy of Pediatrics (A.A.P.) (1995) reported that the birth of an infant at less than 25 weeks gestation or less than a birth weight of 750 grams presented a variety of complex medical, social, and ethical decisions. While the prevalence of these births was low the impact of these infants on their families, the health care system and society was profound. The survival of infants born at 23 to 25 weeks gestation continued to increase with each passing week. The survival rate was less than 40%, while approximately 40% of the survivors will have moderate to severe disabilities (A.A.P., 1995). Many require prolonged intensive care and long term care. The cost effectiveness of care for very low birth weight (less than 1500 grams) infants was studied by Rogowski (1998). The average cost of the first year for an infant born at less than 1500 grams was $93,800, while the cost increased to $273,900 for an infant born weighing less than 750 grams (see Table 1). On average, an additional $1300 was spent on each child
for care provided outside the inpatient hospital setting during the first year (Rogowski, 1998).

**Table 1**
The cost of providing care for very low birth weight infants

<table>
<thead>
<tr>
<th>Birth Weight (grams)</th>
<th>Cost for 1st year</th>
</tr>
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<tbody>
<tr>
<td>&lt;1500</td>
<td>$93,800</td>
</tr>
<tr>
<td>1250 – 1499</td>
<td>$58,000</td>
</tr>
<tr>
<td>1000 – 1249</td>
<td>$75,100</td>
</tr>
<tr>
<td>750 – 999</td>
<td>$138,800</td>
</tr>
<tr>
<td>&lt;750</td>
<td>$273,900</td>
</tr>
</tbody>
</table>

The economic costs of denying neonatal intensive care to infants was studied by Stolz and McCormick (1998). In their study, hospital charges averaged $250,654 for infants weighing less than 500 grams, and $74,101 for infants weighing 1000 to 1500 grams at birth. They concluded that there was definitely a cost savings if children were denied neonatal intensive care (See Table 2). There was also a potential loss of human life. It was anticipated that had care been denied to infants weighing less than 700 grams, 3,400 infants who survived would have been denied care.
Table 2

The cost savings of denying care to low birth weight infants

<table>
<thead>
<tr>
<th>grams</th>
<th>savings</th>
<th># denied care</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;500</td>
<td>0.8%</td>
<td>136</td>
</tr>
<tr>
<td>&lt;600</td>
<td>3.2%</td>
<td>575</td>
</tr>
<tr>
<td>&lt;700</td>
<td>10.3%</td>
<td>2,689</td>
</tr>
</tbody>
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In the United States we do not routinely deny neonatal intensive care to infants based on economic factors. Due to the increasing number of low birth weight, low gestational age infants who are born and surviving we must find ways to lessen the physical, emotional, and financial impact on the individual, the family and society. The number of children receiving special education services in the public schools continues to grow (Gold Report, 1998). Research has documented the plasticity of the brain in early childhood and the importance of critical experiences in shaping brain development (Bregman, 1998). Children who received early intervention programming needed fewer special education services and other services later in life (Solomon, 1995). One way to address this issue is to identify the children who are at risk for developmental delays who were more likely to require special education services and provide appropriate intervention services with the goal of improving developmental outcomes.
Developmental disabilities do not depend on independent causes, but rather on interacting biological, social, and cultural factors (Rosetti, 1990). Wilson-Costello, et al. (1998) found that neurologic impairments among the very low birth weight (less than 1500 grams) children are probably not caused by individual risk factors, but are rather a final common endpoint of many factors operating at different stages of development.

Children may have disabilities for a variety of reasons. The etiology of which may or may not be known. Conditions known to contribute to the presence of later developmental delays included; genetic deviations, toxins and harmful drugs, lack of sufficient fetal nutrition, maternal infection, placental problems and environmental factors such as prenatal difficulties or trauma during labor and delivery, neonatal medical complications, prematurity, respiratory difficulties, and low birth weight (Rosetti, 1990). Sommerfelt, Ellertsen and Markestad (1995) indicated that low socioeconomic status was also associated with impaired cognitive development. Any child who was medically fragile during the first 2 years of life was also at risk for developmental delays, accidents, trauma and abuse (Rosetti, 1990). Escalona (1982) found the same results and reported that infants born prematurely were more vulnerable to these influences than infants born full term.
Rosetti (1990, p. 48) stated that "factors contributing greatly to infant mortality are the identical factors the practitioner is concerned with for the presence of developmental pathology for surviving infants." Pharoah, Cooke, Cooke and Rosenbloom (1990) found that there was no significant change in the prevalence of cerebral palsy between 1967 and 1984 among normal birth weight infants. Among infants born at a low birth weight, below 2500 grams, there had been a significant increase in the number of children with cerebral palsy, and hypothesized that this could be the result of improved survival rates in infants. Richardson, et al. (1998) found that between 1990 and 1995 the mortality rate of infants born at less than 1500 grams decreased almost 50% and was attributed to improved obstetric care and to more effect newborn intensive care. The risk of impairment and disability increased with decreasing gestational age. The authors also predicted that as the mortality rate continued to decrease there would be an increased number of survivors both disabled and nondisabled (Johnson, Townshend, Yudkin, Bull and Wilkinson, 1993). Pharoah et al. (1990) found an increased prevalence of cerebral palsy, although the overwhelming majority of literature disagrees. The increasing survival rates of premature and low or very low birth weight infants has not resulted in an increased prevalence of handicapping conditions among survivors (Hack, Friedman and Fanaroff, 1996; La Pine, Jackson and Bennett, 1995; Lee, et al., 1995; O'Shea, Preisser, Klinepeter and Dillard, 1998; The
Efficacy of follow-up

Victorian Infant Collaborative Study Group, 1995; Wariyar, Richmond and Hey, 1989). Lorenz, Wooliever, Jetton and Paneth (1998) completed a literature search and reviewed studies published since 1970 of infants born at or before 26 weeks gestation and a birth weight of 800 grams or less. They found that the prevalence of major neurodevelopmental disabilities, including cerebral palsy, among survivors had not changed over time. However the increasing survival of these infants had resulted in a steadily increasing prevalence of children with disabilities. Johnson, et al. (1993) reported that even if the rate of disability remained constant the number of disabled survivors would increase. There should also be an increase in the number of normal healthy children who, if born before recent medical advances, would have died. One estimate is that because of the improved survival rates of low birth weight infants between 1960 and 1986 in the United States 11 normal healthy children survived for every additional child with cerebral palsy (Bhusan, Paneth, and Kiely, 1991).

Studies have concluded that lower birth weight and decreased gestational age are associated with poorer developmental outcomes. (Allen, Donohue and Dusman 1993; Escobar, Littenberg, and Petitti, 1991; Johnson, et al., 1993; Sauve, Robertson, Etches, Byrne and Dayer-Zamora, 1991; Whyte, et al., 1993). Survival of infants at the limit of viability has increased since
the introduction of surfactant. (Allen, et al., 1993) Currently 1.2 to 1.4% of births are at a very low birth weight, defined as below 1500 grams (Guyer, MacDorman, Martin, Peters and Strobino, 1998; Rogowski, 1998). More of these infants are living with no overall increased incidence of morbidity (The Victorian Infant Collaborative Study Group, 1995). Birth weight and gestational age remained the best predictors of later cognitive and developmental outcomes (Bregman, 1998). Whyte, et al. (1993) and Allen, et al., (1993) each reported on studies of births at gestational ages of 23 to 26 weeks and found that only 1 to 2% of children born at 23 weeks and 20% of those at 24 weeks were without disabilities at 2-3 years of age. Johnson, et al., (1993) study looked at children born at less than 29 weeks gestation and found that 35% of them were normal at 4 years of age. The Victorian Infant Collaborative Study Group (1995) examined 230 babies born between 24 to 31 weeks gestation, at a very low birth weight, between 1979 and 1980 and compared them to infants born between 1985 and 1987. They found that less than 80 percent of the latter group were found to have serious handicaps. While reviewing outcomes from 11 different studies with children at 16 months to 14 years of age, Escobar, et al. (1991) found that the studies that followed children longer had an increased incidence of disability. It was also felt that 2 years old was too young to be sure of neurosensory outcome in very low birth weight infants (The Victorian Infant Collaborative Study Group, 1995).
Survival improved with increasing gestational age. The more immature the infant, the higher the incidence of neonatal complications (Allen, et al. 1993), however the risk of mortality and disability was found to be lower among twins than singletons born at the same gestational age (Wariyar, et al., 1989). McCarton, Wallace, Divon, and Vaughan (1996) compared neurologic and cognitive outcomes of 129 premature small for gestational age (S.G.A.) infants with 300 average for gestational age (A.G.A.) infants up until six years of age. They concluded that regardless of the degree of prematurity the S.G.A. infants were at greater risk for neurodevelopmental impairment than were equally premature A.G.A. infants. Developmental deficits appeared to occur only in the group of infants born with low birth weight, intrauterine growth retardation (I.U.G.R.) who also demonstrated poor head growth in utero (Strauss and Deitz, 1998). While studies consistently attribute decreased gestational age with poorer developmental outcomes, some studies found little evidence that low birth weight by itself limited intelligence or motor development (Strauss and Deitz, 1998), and did not associate low birth weight with developmental problems. (Piecuch, Leonard, Cooper and Sehring, 1997; Wariyar, et al., 1989).

When any infant is born the family experiences disruptions in everyday life. Krebs (1998) found that premature infants and
their families were at high risk for a complicated relationship that could lead to developmental delays. The intrauterine environment was ideally suited for the development of a fetus. The fetus heard muted sounds, saw a dim red glow; floated in amniotic fluid which eliminated gravity and provided for movement and temperature regulation. Once the premature infant was born and placed in the neonatal intensive care unit, the environment consisted of bright lights and constant offensive noise from medical equipment, voices, phones, alarms and the opening and closing of the incubator doors. The infant also received adverse tactile stimulation from medical procedures (Tecklin 1994). The premature infant demonstrated hypotonia (Carter and Campbell, 1975) the degree of which was related to the degree of prematurity. Gravity made movement into flexed (normal) positions difficult, making spontaneous movement minimal compared to the infant born at full term who had normal tone and strong physiological flexion to assist their movements. Premature infants lacked the counter balance of flexor tone to offset the overall extension which later interferes with developmental skills (Tecklin 1994). Pinkerton (1991) reported that caregivers needed to learn to take cues from their infants during interactions and respond appropriately in order to assist the infant’s development. There was evidence that high risk babies who were well organized with appropriate state modulation and control were less likely to encounter learning difficulties
during the school years (Bregman, 1998) than their peers. Early identification of problems and early intervention allowed the family members to feel that they were doing all they could to assist their child (First and Palfrey, 1994).

Physiologic homeostasis has been found to be a necessary condition for normal neurologic development. Educational, supportive, early intervention programs must be provided for high-risk infants and their parents after discharge (Bregman, 1998). Mattia and deRegnier (1998) found that prolonged physiologic instability following birth was associated with impaired neurodevelopmental consequences, independent of the effects of gestational age and intracranial abnormalities, for infants born at less than 30 weeks gestation. The child who had poor health or nutrition was delayed in the acquisition of motor skills (Connolly and Montgomery, 1993). Pinkerton (1991) estimated that 375,000 newborns face serious health hazards each year due to their mother's prenatal drug use. Illegal drug use may lead to prematurity, low birth weight and perinatal asphyxia (Avery and First, 1994; Tecklin, 1994), hemorrhagic infarctions, and congenital anomalies and malformations (Tecklin, 1994). Deficiencies in fine and gross motor development were still present at 2 years of age in children who were exposed to cocaine during pregnancy (Arendt, Angelopoulos, Salvator and Singer, 1999). While many drugs have been found to be detrimental to the
infant, Nulman, et al. (1997) found that there were no detrimental effects when antidepressant medication was taken by a mother during pregnancy, and there was an increased risk to the child if the mother required antidepressants, but did not take them.

The more immature the infant the higher the incidence of neonatal complications (Allen, et al., 1993), including brain lesions. Intraventricular hemorrhage was the most common brain lesion seen in premature infants and occurred in approximately 40% of all premature births (Tecklin, 1994). Intraventricular hemorrhage, ventricular dilation and/or periventricular leukomalacia all have been associated with later neurological deficits (Allan, Vohr, Makuch, Katz, and Ment, 1997; Allen, et al., 1993; Bregman, 1998; Gray, Burns, Mohay, O’Callaghan and Tudehope, 1995; Grether and Nelson, 1997; Marlow, Hunt and Chiswick, 1988; Murphy, Hope and Johnson, 1997; Piecuch, et al., 1997; Roth, et al., 1994; Saliba, Bertrand, Gold, Marchand and Laugier, 1990; Sinha, D’Souza, Rivlin and Chiswick, 1990; Wilson-Costello, et al., 1998). Various neurologic sequelae including cerebral palsy have been associated with congenital infections (Bregman, 1998; Gray, et al., 1995; Grether and Nelson, 1997; Wilson-Costello, et al., 1998). Jaundice (hyperbilirubinemia) was commonly seen in premature infants and found to be a contributor to neurologic sequelae (Tecklin, 1994). Chronic lung disease has been
associated with poor cognitive outcomes (Allen, et al., 1993; Bregman, 1998; Gray, et al., 1995; Piecuch, et al., 1997). Gregoire, Lefebvre and Glorieux (1998) reported that infants who required oxygen after 36 weeks post conception were more likely to have developmental delays at 18 months. The important factor was not the length of time on oxygen as much as the age at which it was required.

**Special Education**

Approximately 7 to 10% of normal children and 45 to 56% of very low birth weight children required special education services by the age of eight to nine years old (Halsey, et al., 1996; Ross, et al., 1991; Roth, et al., 1993). Four school related outcomes were significantly attributed to perinatal factors. These included children classified as; physically impaired, sensory impaired, profoundly mentally handicapped, and trainable mentally handicapped. Children classified as educable mentally handicapped or specific learning disabled were affected by both perinatal and socioeconomic factors, while the children classified as speech-language impaired and emotionally handicapped were associated with primarily socioeconomic factors (Resnick, et al., 1998). Poor performance on neurodevelopmental examination at age one and at preschool predicted later problems in school (Olsen, et al., 1998; Roth, et al., 1993). Lindahl, Michelsson and Donnerm (1988) assessed children at age five and again at nine
years old. They found that poor performance at age five was significantly associated with failure at age nine on the examinations and with increased problems in school.

Halsey, et al. (1996) reported that 79 percent of the infants born at a very low birth weight had cognitive scores in the average range. However these children’s scores averaged 15 to 17 points lower than their peers. Learning disabilities and behavioral problems were noted in infants born at a low birth weight. Again the cognitive scores were in the low/normal range, but significantly lower than their peer group (Olsen, et al., 1998). All children born at a low or very low birth weight were found to have a significant risk for learning difficulties at school age (Bregman, 1998). Additionally the very low birth weight infants were at an increased risk for attention deficit disorder and hyperactivity which also affected learning (Bregman, 1998). Long term outcomes of children at 12 to 13 years of age born at a birth weight of less than 1250 grams, found that despite the lack of major neurodevelopmental impairments, these children were not keeping up with their peers in educational achievements, social integration and motor skills (Mercuri, et al., 1995). Poor motor skills have been associated with impaired educational achievement and may be the best predictor of subsequent school performance (Marlow, Roberts, and Cooke, 1993). Fifty-one percent of the group studied showed some impairment of
motor skills, with 34 percent showing significant impairments. Mercuri, et al. (1995) found that poor motor skills in very low birth weight children at school age is a common problem that persists into early adolescence, and can lead to failure in other areas of educational development and self esteem.

Filler (as cited in Rossetti, p. 2, 1990) stated that "historically, physically and behaviorally different offspring were either killed outright or simply left to die." Societal factors have enhanced the status of the handicapped over time. Print media and other mass communication have devoted increased attention to the plight of all variety of handicapping conditions. National organizations have educated the public, and lobbying efforts have promoted legal rights (Tecklin, 1994). Legislation has been developing for decades over the issue of the right of handicapped children to receive an education in public schools. Many credit the Civil Rights movement of the 1950's with directing attention towards the rights of the handicapped. An early court case, Brown v. Board of Education (1954) addressed the issue of a separate but equal education, and established the right of an equal opportunity education for minority children. Since the early 1970's a child's right to receive a publicly funded education has been increasing (The Education of All Handicapped Children Act of 1975 [Public Law 94-142]; The Education Amendments of 1986 [Public Law 99-457]; Individuals
Efficacy of follow-up

with Disabilities Education Act of 1990 [Public Law 102-119]; Individuals with Disabilities Education Act Amendments of 1997 [Public Law 105-171]), while the age of eligibility for receiving these services has been decreasing (Handicap or High Risk Condition Prevention and Early Childhood Assistance Act [Chapter 411, 1998]). The 1970’s brought new legislation designed to protect the rights of the handicapped. The Pennsylvania Association for Retarded Citizens v. Commonwealth of Pennsylvania (1972) gave every person age 6 to 21 years old access to a free and appropriate public education regardless of disability. Also in 1972, Mills v. District of Columbia Board of Education resulted in the right of each child to receive a free and suitable education. It also declared that the school district was not allowed to claim insufficient funds in order to deny a child an education. Together these and other laws were used to establish the most well known law, Public Law 94-142 (1975). It provided that all handicapped children have available to them a free, appropriate, public education which emphasized special education and related services. It provided for a free and appropriate education in the least restrictive environment with related services as necessary to function within the educational setting. The education included specifically designed instruction at no cost to the family, while educating handicapped children with non-handicapped as much as possible.
Public Law 99-457, (1986) required that every state provide services to all disabled children ages three to five years old, or risk losing federal funding. This law extended the same rights to preschool children that Public Law 94-142 (1975) afforded to school aged children. In addition it also provided federal grants to states that formed programs for developmentally delayed toddlers from birth to two years old. Each law promoted and expanded the federal role in identifying and providing appropriate educational services to handicapped children. The effect was to give all handicapped children the right to educational intervention at an early age.

"Handicapped Infants and Toddlers" were defined as individuals from birth through age two who required early intervention services because they are: experiencing developmental delays or have a diagnosed physical or mental condition that has a high probability of resulting in developmental delay (Public Law 99-457, 1986). The Federal government’s policy is to provide financial assistance to the states to facilitate coordination of payment for early intervention services from federal, state, local and private sources. Congress found that there was an urgent and substantial need to (a) enhance the development of infants and toddlers to minimize the potential of developmental delay; (b) decrease educational costs to society, including schools by minimizing the need for special education in school
aged children; (c) minimize the likelihood of institutionalization and maximize the child's potential for living in society and; (d) enhance the families' ability to care for a child with special needs. To qualify the child must present with a substantial developmental delay in one or more of the following areas; cognitive, physical, communication, social, emotional development or self help skills, or have a physical or mental condition which has a high probability of resulting in developmental delay (Public Law 99-457, 1986). Parental education is essential. Enactment of Public Law 99-457 (1986) has changed the focus of infant intervention from being infant centered to family centered (Tecklin, 1994). In 1990, Public Law 94-142 (1975) was amended and renamed the Individuals with Disabilities Education Act (Public Law 105-17). The intent was to give every disabled child the opportunity to participate in an appropriate educational process regardless of cost. Public Law 105-17 required; that local school districts participate in transitioning children from the infant-toddler program into the preschool program, calls for delivery of services in as natural a setting as possible, and clarifies that the early intervention program is the payer of last resort (Knoblauch, 1998).

Infants and toddlers in the state of Florida are regulated by The Handicap or High-Risk Condition Prevention and Early Childhood Assistance Act (Chapter 411, 1998). Early assistance included
developmental assistance programs, parent support and training programs, special education and related services and appropriate follow-up assistance services for handicapped and high risk infants and their families. The program must establish child-centered and family-focused goals and objectives for each element of the continuum.

"The Legislature finds and declares that 50 percent of handicapping conditions in young children can be prevented, and such conditions which are not prevented can be minimized by focusing prevention efforts on high-risk pregnant women and high-risk and handicapped preschool children and their families. The Legislature further finds that by preventing handicaps in preschool children, this state can reap substantial savings in both human potential and state funds." (Chapter 411.22, 1998) "The Legislature recognizes the need for and value of intensive comprehensive, integrated, and continuous services statewide for young children who are at risk of developmental dysfunction or delay. Children are part of families and lasting effects on children can occur most productively when there is investment in and with families." (Chapter 411.231, 1998).

According to the Education Finance Statistics Center (1998), it costs approximately 2.2 times as much to educate the child in
special education than was spent on a student in regular education. They estimated that a total of 30 to 34 billion dollars was spent annually on educating special needs students in the United States. The base expenditure per student for a standard education was $4,834 per year. The excess spent over the base expenditure for special education students was $6,187, and they estimated that 5,619,000 students were served. During the 1994-1995 school year Florida spent $14,701,861 on special education services for 290,630 children ages 3-21 (Education Finance Statistics Center, 1998). According to the Florida Department of Education (1997) the average cost per child in Palm Beach county receiving a regular education was $3,936. The cost of educating children in special education classes ranged from $9,084 for a child with a specific learning disability to $19,293 for a child classified as being physically handicapped (Florida Department of Education, 1997), with the average cost per elementary school child in Palm Beach County enrolled in special education of $10,675 (Florida Department of Education, 1998).

The fact that special education costs exceeded that of regular education has been well established. The cost of school-age children with special needs was found to be twice as high as for regular education. Private and public schools spent an average of $2,780 per child on the general student population and $6,355 on each special education student. The spending levels varied from
$647 for students receiving less than 15 hours of special services per week to $7,140 for students enrolled in over 15 hours of special education classes per week. Between 1977 and 1985 regular education costs rose four percent as compared with ten percent for special education. (American Speech and Hearing Association, 1989). Bricker, Bailey, and Bruder (as cited in Rosetti, 1990, p. 408) reported that the average annual cost per child for regular education ranged from $1,148 to $2,000. Thus the average cost per child for regular education to age 18 years was between $13,776 and $16,072. In contrast, the average cost for special education to age 18 was: $32,273, $37,600 and $48,816 when intervention started at birth, age two and age six respectively. These numbers also support the fact that the earlier the intervention begins the less money that will be spent in special education costs.

According to the United States Department of Education (1996) the number of children receiving special education services increased by 12.7 percent between 1990 and 1995. The rate of growth of children enrolled in special education exceeded the rate of growth of all children enrolled in school. Preschool children ages three to five were only 9.6 percent of all children served, but made up 20 percent of the growth in the number of children served. The federal funding per child, to cover costs exceeding the costs of educating a normal child, for preschool rose from
$71 in 1977 to $418 in 1994. As of December 12, 1994 there were 524,458 children between three and five years old receiving special education services, this represented 4.4 percent of the total population of children in this age range. Congress appropriated $315,600,000 to early intervention programs to cover services for children from birth to two years. Florida received $15 million to serve 7,696 children. This represented 1.3 percent of the total population of children from birth to two years in the state of Florida (United States Department of Education, 1996).

Children exited from special education programs in a number of ways. Some children only required services for a short period of time and then returned to regular classrooms, this often occurred with illnesses. Other children remained in special programming throughout their education and then graduated with their peers, while other children leave the program at age 21 when the federal law mandates it. The annual dropout rate for students with disabilities was 26 percent (See Table 3). Data suggested that dropouts with disabilities were less likely to eventually earn their high school diploma, thereby limiting their eventual earning potential (McNeil, 1996; United States Department of Education, 1996). When exiting special education 7.5 percent of the students ages 14 to 21 received a regular diploma. Ten percent of all students with a visual, hearing, orthopedic
impairment or a traumatic brain injury graduated with a regular diploma. The least likely group of student to graduate were those with multiple disabilities or autism, only 3 percent of children with these diagnoses graduated with a regular diploma. Of the rest of the children, 17 to 18 percent of children with other health impairments returned to a regular classroom setting, and overall 4 percent returned to a regular educational setting and no longer needed special services.

Table 3

Educational attainment of students with and without disabilities

<table>
<thead>
<tr>
<th>highest level of education</th>
<th>Students with disability</th>
<th>Students without disability</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; High School</td>
<td>25%</td>
<td>12%</td>
</tr>
<tr>
<td>High School Diploma</td>
<td>30%</td>
<td>41%</td>
</tr>
<tr>
<td>Some College</td>
<td>28%</td>
<td>26%</td>
</tr>
<tr>
<td>Bachelor’s Degree or more</td>
<td>16%</td>
<td>21%</td>
</tr>
</tbody>
</table>

Efficacy of Early Intervention Services

A review of 50 years of research produced evidence that early intervention can ameliorate and in some cases prevent developmental problems, result in fewer children being retained in later grades, reduce educational costs to school programs, and improve the quality of parent, child and family relationships
The best chance for effecting developmental change was when the child was young and still malleable and responsive (First and Palfrey, 1994). Children who received early intervention programming needed fewer special education services and other habilitative services later in life (Solomon, 1995). There was evidence that high risk babies who were able to regulate their own behaviors were less likely to encounter learning difficulties in school years (Bregman, 1998). Early detection and remediation was advocated for neuromotor deficits to minimize or prevent disabilities that emerged as compensations for initial movement disorders (Tecklin 1994). One study specifically examined the effect of early intervention for the child with biological involvement in relation to the age of onset of early intervention services. In the study children less than eight months old were compared to those who were between 9 to 25 months at the time the early intervention services were initiated. The results showed that the rate of gross motor development in the younger group was 35 percent higher than in the older group (Sharkey, 1996). The most effective early intervention programs reviewed began early (preferably at birth) and involved the parents (Solomon, 1995). The American Academy of Pediatrics (A.A.P.) (1994) issued a statement that the early identification of children with developmental disabilities could lead to elimination or improvement of the severity of a
Efficacy of follow-up
disability and its impact on the functioning of the child and family.

Children's access to early intervention services depended on early detection. The federal government supported the efficacy of early intervention by providing federal funding for the program through **Public Law 99-457** (1986). The state of Florida legislature, through **Chapter 411** (1998), recognized the value of intensive comprehensive services statewide for young children who are at risk of developmental dysfunction or delay, and found that handicapping conditions in young children can be prevented or minimized. Ramey et al. (1992) studied the efficacy of early intervention to enhance the cognitive, behavioral and health status of low birth weight, premature infants. They linked positive cognitive outcomes with the intensity of the intervention services each child received. In an attempt to determine the efficacy of early intervention services, McCormick, McCarton, Tonascia, Brooks-Gunn (1993) followed 280 infants, and found that all of the children who received intervention had less serious morbidity than those who did not receive services. Brooks-Gunn, Klebanov and Liaw (1993) found that children involved in early intervention services demonstrated cognitive gains at 24 to 36 months. The intervention was more beneficial to children with higher initial behavioral problems. Solomon (1995) found evidence that even children with established biological
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conditions such as Down’s syndrome, autism and cerebral palsy benefited from early intervention services. Early intervention did not change the basic biological condition, however children with these conditions were helped to reach their maximum potential through services (Infant Health and Development Program, 1990). Early intervention produced a better adult outcome, and the economic value of early detection and intervention was easily supported (Glascoe, Foster and Wolraich, 1997).

Colorado hospitals initiated a hospital based screening between 1992-1996, to test the hearing of all newborn infants and found the incidence of bilateral congenital hearing loss was 1:500 newborns. If a child was not screened at birth, the average age of diagnosis was 2.5 years, with an average delay of speech and language skills between 12 to 24 months at the time of diagnosis. Treatment required intensive therapy. With early amplification and therapy children who were hearing impaired were capable of achieving normal speech-language developmental milestones (Mehl and Thomson, 1998). The cost of an initial hearing screen was $25. If not diagnosed until 2.5 years, and the child has language delays, the cost for treatment often exceeded $25,000 per child (Mehl and Thomson, 1998).
The most successful early intervention programs promoted the whole child, whole family approach (Salisbury and Smith, 1993). The following components were present in the services that produced the greatest change in children; active parent participation, systematic early educational services, a developmentally based curriculum and intervention beginning at as early an age as possible (Rosetti, 1990, p.11). The best programs, according to Salisbury and Smith (1993), promoted activities into normally occurring routines at home or daycare centers, recognized that the child was part of a family unit, and allowed the family to participate as much as they desired. Early environmental enrichment with close attention to the family’s needs improved the developmental outcomes of the 985 normal birth weight and low birth weight infants in this study. The infants were evaluated at a corrected age of 36 months. The group who received intervention services had significantly higher IQ scores and fewer maternally reported behavior problems than the control group. The results of this study indicated the effectiveness of a comprehensive intervention program even for biologically vulnerable infants (Infant Health and Development Program, 1990).

In order for the early intervention services to be successful parental involvement was necessary for carryover in the home. Children are part of families and long term benefits to children
occur when there is involvement of the family (Chapter 411.231, 1998). Evidence supported the need for parent participation in addition to early intervention services in order to optimize development. Caregivers learned to take cues from the infant during interactions and responded appropriately in order to assist the infant’s development (Pinkerton, 1991). A home program enhanced the functioning of the child and the family by improving the ability of the family to care for the child while increasing the child’s independence. Parents served as natural reinforcing agents for children. Home programs were more likely to be carried out if they were part of daily routines and were not time consuming (Schreiber, Effegen and Palisano, 1995). Parents were often best able to provide an indication of whether activities would be successful in the home. Krebs (1998) found that education regarding an infant’s cues and parenting interventions improved parent-infant interactions and an infant’s overall health. Generally a more positive performance by the infant on developmental testing was associated with positive family functioning (Martin, Vandeveer, and DelRio, 1992). Children with disabilities or developmental delay often required intervention from physical therapists, occupational therapists, speech-language pathologists, social workers, and early childhood teachers. It was found to be important that the child and family remain at the center of the professionals’ focus. McWilliam and
Young (1996) found that families were key members of their child's intervention team through formal and informal activities.

Assessment
Easley (1996) reported that the ideal assessment incorporated the child's musculoskeletal limitations, the continued presence of primitive reflexes, which may influence behavioral outcomes, and the child's attainment of developmental milestones. Normally a child functions in a natural environment. In order to fully appreciate a child's abilities the assessment should capture interactions between the child's social context, ability to demonstrate functional activities, and anatomical, psychological and physiological structure and function. On any given day one or more influences may affect a child's ability to demonstrate functional skills or interact in a social context. Children's performance on the days of scheduled assessments may differ greatly from behavior on other days (Easley, 1996). When analyzing movement patterns in young children must consider the motivation, desirability of the goal of the movement, and environmental features. It is the combination of all of these elements that leads to individualized skill development.

Early identification of problems was essential in seeking early intervention services. Assessments were performed for a variety of reasons; screening, placement of the child into an appropriate
therapy program, program planning, program evaluation or assessment of individual progress. Assessment was defined as any activity either formal or informal that was designed to elicit accurate and reliable infant behaviors and information from which developmental skill status was inferred (Rosetti, 1990). A basic premise of assessment was that an individual child’s performance was compared with the expected performance of children of a similar age (Rosetti, 1986), and significant deviations from normal growth and development were identified (Case-Smith, 1993). Norm referenced tests, those standardized on groups of individuals, must be used in the screening process to determine if a child’s performance was typical of a child of a similar age (Case-Smith, 1993; Connolly and Montgomery, 1993). The younger the child, the less reliable predictions were across the developmental dimensions tested (Escobar, et al., 1991; The Victorian Infant Collaborative Study Group, 1995). Murphy, Nichter and Liden (as cited in Rosetti, 1990) reported that serial assessments provided the only means for measuring developmental patterns and rates of change over time, and were the only means of detecting and monitoring new problems as a child matured. Wildin, et al. (1997) concluded that neurologic examinations during the first year of life may be used with other factors in decisions to refer to early intervention programs. They recommended neurological exams at 6, 12 and 40 months of
age. Allen and Alexander (1997) found that using motor milestones was effective as a serial screening test for cerebral palsy.

There are no set standards to identify a specific age at which early assessment activity should begin, or how frequently the assessments should occur. First and Palfrey (1994) recommended attempting to identify developmental delay as early as possible so appropriate services can be provided along with ongoing surveillance rather than a one-time assessment. There were no set time intervals between assessments. Variables for frequency of assessments related to the child’s age at initial referral, medical history, performance on previous assessments, whether the child was receiving early intervention services, and the number of other professionals involved in follow-up and intervention. All of these should all be taken into consideration when planning intervals for follow-up assessments. The younger the child the more potential for change. If the practitioner detected behavior that suggests a developmental pathology an assessment schedule of every three months should be followed (Rosetti, 1986), but the intervals should be altered as needed.

Owens (1984) described five principles of development: (a) development is predictable, (b) developmental milestones are attained at about the same rate in most children, (c) developmental opportunity is needed, (d) children go through
developmental changes or periods, and (e) individuals differ greatly. We know that processes of motor control are not random. Motor development, age related change in motor behavior, results from internal and external influences and often have been attributed to processes such as maturation, growth or learning. The medical community tends to heavily weight biological maturation. On the other hand we know that developmental change can be affected by environmental or external influences such as learning or culture. Instead of motor behavior being prescribed by the central nervous system, current theory indicates that motor development is the result of the dynamic interaction of the infant or child with the environment and the task (Heriza and Sweeney, 1994). Assessment of a child involved more than a test and was qualitative as well as quantitative (Connolly and Montgomery, 1993). Developmental assessments were usually performed for one of 2 reasons: 1) to identify infants or children developing atypically, or 2) to obtain a baseline from which to plan a remediation program if an infant or child has been diagnosed with a developmental disability (Bartlett and Piper, 1994).

Traditionally studies of normal motor development have utilized the acquisition of motor milestones, and have helped develop age norms for motor development. Delay or deviation in motor development may be the first indication of a neuromotor disorder
such as cerebral palsy or a generalized developmental delay (Washington and Dietz, 1995). Motor milestones were useful in organizing a developmental review, because children moved through these stages in an orderly fashion (First and Palfrey 1994). Motor development was one of the best indicators of developmental well being in the first year of life (Piper and Darrah, 1994). Motor skills changed rapidly during the first two years of life and were usually recognized early, while speech and language development occurred later and was frequently not identified until after two years of age (Allen and Alexander, 1997). In infants and toddlers, motor and language milestones were often the best proxy for true cognitive assessment. An early hint of cognitive difficulties was noted at eight to ten months of age if a child did not appreciate object permanence (First and Palfrey, 1994). The presence of a definite hand preference before 24 months suggested a central or peripheral nervous system impairment of the opposite hand and arm (First and Palfrey, 1994; Swainman, 1994, p. 46). Idiopathic toe walking was viewed as a marker for later developmental problems. Sixty seven percent of children who toe walked had other deficits including gross, fine or visuomotor problems or speech-language delays (Shulman, Sala, Chu, McCaul and Sandler, 1997).

The A.A.P. recommended that physicians screen for developmental, emotional, and behavioral problems at each of the 12 well-child
visits routinely scheduled between birth and five years of age (Glascoe, et al., 1997). A developmental history was recommended as a requirement of each routine well child visit, whether or not formal screening was used. Avery and First (1994) recommended that children be screened for developmental milestones and pediatricians not over interpret the results, but be prepared to perform further developmental tests or send the child out to specialists as needed. Shonkoff, Dworkin and Leviton and Levine (1979) reported that only 25 percent of pediatricians used any type of screening tool, most relied on subjective clinical judgment and general observations for assessing developmental problems (Glascoe, 1991; Shonkoff, et al., 1979). Although the benefits of early detection and intervention were substantial, physicians were not well compensated for providing this critical service to society (Glascoe, et al., 1997). Studies have shown that physicians tended to under identify children with developmental (Dearlove and Kearney, 1990) and hearing (Stewart and Downs, 1993) problems. They often took the “wait and see” approach (Glascoe, 1991). Palfrey, Singer, Walker, and Butler (1987) found that overall 4.5 percent of children’s problems were identified at birth and only 28.7 percent before age five. Physicians identified only 15 to 25 percent of learning disabilities and other developmental pathology before five years of age. The type, severity and complexity of the condition were predictors of physician identification. The dilemma for the
Efficacy of follow-up

pediatrician was that identifying a child who needed further evaluation caused anxiety for the parents, this concern lead to only identifying very impaired children and missing others with less severe problems (Allen and Alexander, 1997). The A.A.P. (1996) recommended that pediatricians identify problems created by high risk birth and post natal disease by using systematic developmental and behavioral follow up and share the responsibility with follow-up programs doing developmental and psychological evaluations.

Follow-up clinics should be an integral part of every neonatal intensive care unit (NICU) according to Hack (1993). Specialized care of problems of growth, chronic disease, and adaptation was best provided within the setting of a neonatal follow-up program. Initially care was best provided by neonatologists and then transferred to developmental specialists. After the first year problems that become evident were usually subtle motor, visuomotor, and behavioral difficulties, which were best diagnosed and treated in an educational rather than a medical setting (Hack, 1993). The outcomes of the evaluations (such as in follow-up clinic) were to; develop an interdisciplinary comprehensive plan of remediation, decide there was no problem, or decide that further observation was needed. Delays or deviations in development came to attention because a child was at high risk and had a physical or medical condition known to be
associated with developmental delay or manifested delays at the time of observation (Allen and Alexander, 1997). The major objective of a follow-up clinic was to identify developmental delays and other problems as early as possible in order to seek intervention services. A thorough history helped determine which children were at risk for developmental problems and would benefit from assessment. Typical criteria for a NICU follow-up clinic included:

1. Low birth weight
2. Perinatal asphyxia as measured by low Apgar scores
3. Mechanical ventilation
4. Intrauterine Growth Retardation
5. Neurological abnormality (seizure, abnormal muscle tone, intracranial hemorrhage, congenital or acquired hydrocephalus)
6. Sepsis or meningitis
7. Congenital anomalies, birth defects, and chromosomal abnormalities
8. Vision and hearing deficits
9. Substance abuse
10. Abnormal or prolonged feeding difficulties
11. Potential HIV infection

(Connolly and Montgomery, 1993; Hack, 1993)

Martin et al. (1992) supported the clinical decision that all children with a history of early insult needed sequential developmental follow up and appropriate referral for services. Analysis of the data indicated that graduates of high risk nurseries had an increased risk of developmental delay. They found delays in both fine motor and gross motor skills. The percentage of children with gross motor delays indicated that
even in the absence of obvious pathology, this group was still at risk for subtle concerns. The study by Schendel, et al. (1997) supported the developmental follow up of non-disabled, very low birth weight children because of the increased risk of developmental delay.

There has been increased research efforts towards the birth to three year old population in recent years. A vast amount of information is available regarding specific patterns of infant development in all areas. An infant was found to be an active observer and, as time progressed, an active participant in the world (Piper and Darrah, 1994). Skill acquisition was independent and developed across all modalities simultaneously and was influenced to some degree by delays in any single area of maturation (Rosetti, 1990). Allen and Alexander (1997) found that using motor milestones as a serial screening test for cerebral palsy was more effective in terms of positive predictive values than any individual milestone. They recommended that children with delays in more than four motor milestones be referred for further evaluation and early intervention services. Evaluation of infant gross motor development was believed to provide the earliest opportunity to diagnose neuromotor abnormality such as cerebral palsy (Scherzer and Tscharnuter, 1990). The assessment of motor milestones has been reported to be useful in identifying infants with neuromotor abnormality (Allen, and Alexander, 1992).
Others have noted that infants may score well on the acquisition of motor milestones while exhibiting atypical motor behavior (Bartlett and Piper, 1994; Valvano and DeGangi, 1986). Because of the dramatic changes in motor development over the first 18 months it is often used to give early clues to the overall developmental integrity of the infant (Piper and Darrah, 1994).

Premature infants whose neonatal neurodevelopmental exam results were abnormal had significantly higher incidences of cerebral palsy and other neuromotor dysfunction than did premature infants with normal exams. Abnormal neurodevelopmental exams helped select the group of high-risk infants who should be carefully followed (Allen and Capute, 1989). A neurological examination includes an evaluation of muscle tone, strength, developmental (primitive) reflexes, and developmental milestones. The sequence of the exam is flexible and is determined by the child’s comfort and cooperation. The child’s state of alertness, awareness of surroundings and affect all are noted, and may affect the exam results (Swainman, 1994, p. 46). Muscle tone, the resistance of muscle to passive stretch, may show; normal resistance, greater than normal resistance (hypertonia) or less than normal resistance (hypotonia). Both hypertonia and hypotonia can be detrimental to motor development (Carter and Campbell, 1975).

Infants and toddlers rarely follow specific commands, therefore spontaneous movements, particularly against gravity, provided the most information concerning muscle strength (Swainman, 1994, p.
Developmental (primitive) reflexes are patterned responses that are achieved by certain ages. Abnormalities include an absence of expected responses, persistence of a reflex that should have dissipated or asymmetrical responses (Swainman, 1994, p. 48). Zafeiriou, Tsikoulas and Kremenopoulos (1995) reported that primitive reflexes can be used to help predict and lead to an early diagnosis of cerebral palsy.

In the evaluation of young children it is common practice to correct for prematurity until age two. The literature does not necessarily support this time frame. Siegel (1983) found that it was a more accurate predictor and better reflected later developmental performance to subtract the degree of prematurity only for infants less than one year of age. Palisano, Short, and Nelson (1985) found that correcting for prematurity only until 12 to 15 months of age was found to be of value to the infant-toddler assessment. Locally pediatricians sometimes do correct for prematurity while others do not. The Early Intervention Program of Palm Beach County officially corrects until age two. Unofficially, parents of very premature infants, especially those born at 22 to 26 weeks gestation, are encouraged to make allowances for the degree of prematurity until age five (personal communication, Lori Wasserman, Ph.D., psychologist, December 17, 1998).
Parental Involvement

In order to obtain a completely accurate picture of a child’s developmental status, the child’s performance would be observed in a variety of environments and situations. This is logistically impossible, therefore “typical” performance is difficult to assess in the testing environment. Long (1992) recommended taking parental information into account in order to get a more accurate picture of the child’s development. Public Law 99-457 (1986) mandated that professionals establish partnerships with parents. The collaborative nature of the partnership required that professionals respect and accept parental perceptions of the child. Parental report may provide a mechanism to consider the typical performance seen during a formal professionally administered assessment (Long, 1992). Parent collaboration was believed to increase the validity of developmental evaluations, (Squires, Nickel and Bracer, 1990) enhance parents’ feelings of competence in their ability to help their children (Deal, Dunst, and Trivette, 1989) and save health care dollars (Bricker, Squires, Kaminski and Mounts, 1988). Evidence suggested that parents were able to assist with developmental assessments by identifying infants at risk who were atypical in their overall development (Bartlett and Piper, 1994).

Easley, et al. (1996) studied the use of parent completed developmental questionnaires (P.C.D.Q.). This study concluded
that the use of P.C.D.Q.’s to screen infants who have or are at risk for developmental delays may increase the involvement of the families, be a more effective use of resources, and increase the accuracy of diagnostic evaluations of the children. The use of parents’ concerns was by far the least costly method for physicians to administer and interpret (Glascoe, et al., 1997). Little was known about parent’s abilities to accurately rate the early motor development of infants at risk, the developmental domain commonly assessed by physical therapists and other early intervention professionals (Bartlett and Piper, 1994). Parents of children who raised a significant concern had children who performed substantially lower on almost all developmental measures than did the normally developing children (Glascoe, 1997). Mothers of preterm infants had difficulty recognizing subtle deviations from the typical patterns of motor development. In particular those subtle differences present between preterm and full term infants. These results suggested that mothers’ assessments should not replace those of the physical therapist, but rather complement them (Bartlett and Piper, 1994). Parents tended to commit to the positive perception more than the negative perception (Martin, et al., 1992), but the use of parental report as a method of obtaining information, both qualitative and quantitative, is recommended. Glascoe (1997) found that parents’ concerns about language, motor, global, and cognitive development, medical problems (particularly hearing
status) and social skills in children were highly sensitive predictors of developmental problems. These parents were not anxious or ill-informed but rather appeared to be noticing subtle developmental and behavioral problems.

During the evaluation it is important to take into account the parent's perception of the child to obtain an accurate picture of the infant. It is equally important to take into account the family belief's. Pachter and Dworkin (1997) found that developmental expectations differed among mothers from different ethnocultural groups. Many differences were due to underlying cultural beliefs and values and specific child rearing practices. Young, Davis, Schoen and Parker (1998) studied child rearing needs and pediatric health care experiences for the parents of children from birth to three. Most parents viewed the pediatric health care system as meeting the child's physical needs, but wanted more information and support on child rearing issues. Martin, et al., (1992) identified that the families of the children were essentially healthy and well functioning regardless of the child's developmental outcome. The families in this study were in a low risk group based on socioeconomic status, years of education, and had a high degree of cohesion and adaptability. This group of families is very similar in nature to the population in my study.
One recent example of the influence of cultural and child rearing practices that affected development is the change in infant sleep position. In 1992 the A.A.P. recommended that all infants sleep on their backs (supine). Kane, Mitchell, Craven and Marsh (1996) reported that the physicians at St. Louis Children’s Hospital noticed a significant increase in plagiocephaly (cranial asymmetry) between 1992 and 1994 compared with the previous 13 years. Cranial asymmetry and deformation are commonly seen in infants and usually self corrects within a few months. Some abnormalities persist and require further investigation. If the asymmetry is caused by premature fusion of the cranial sutures or other conditions causing microcephaly, it may require surgery (Kane, et al., 1996). Plagiocephaly does not require treatment, although a helmet may be used for cosmetic reasons to reshape the head. The marked increase occurred at the same time as the A.A.P. recommendations to place infants in supine for sleep.

The common interpretation of a developmental milestone is that it will occur within a fixed range in infants with normal development. With the change in sleep position it may be appropriate to adjust the “normal” range for rolling. Bartlett (1998) investigated the relationship between body mass index, head proportion, and body length to determine if they had any influence on the acquisition of motor skills. The implication was that if there was a positive correlation then evaluations must
include techniques to measure height, weight, and head circumference. Bartlett (1998) found a positive correlation between a large head and delayed head lifting in prone at 6 weeks of age. There was no correlation between head size and later skills including sitting abilities or stair climbing at 18 months. It is important in our follow-up clinic to take into account the possibility of delayed head lifting at six weeks of age and the size of the child’s head.

Mildred, Beard, Dallwitz and Unwin (1995) found that since being educated about placing infants in supine to sleep 26 percent of the parents surveyed NEVER placed their children on their stomachs (prone) to play. Jantz, Blosser and Fruechting (1997) studied 343 full-term, healthy infants. They found that sleeping in the supine position delayed the achievement of the gross motor milestone of rolling over, which is usually expected at four months of age. Children who slept on their side or back rolled over later than those who slept on their stomach. Dewey, Fleming, Golding and the ALSPAC study team (1998) studied over 10,000 infants born between 1991 and 1992 and found that infants who slept in prone or in variable positions had an increased gross motor and social skill scores at six months of age. These findings were transient, by 18 months of age there was no difference in developmental scores. Davis, Moon, Sachs and Ottolini (1998) studied 351 infants and tracked milestones from
birth until the child walked. When comparing infants who slept in the prone vs. supine positions there was a significant difference with prone sleepers attaining rolling, sitting, creeping, crawling and pulling to stand earlier than their counterparts infants who slept in supine. All of these studies indicate that there has been a change in the “normal” age for developmental milestones to be achieved. It is important for the evaluation team to take into account cultural and child rearing practices when determining if a child is performing at a “typical” level.

**Purpose**

The purpose of this study is to determine the efficacy of a developmental follow-up program. The effectiveness of the program will be measured in both human and financial terms. The number of children referred for early intervention services and analysis of specific characteristics including multiple birth, gender, age at time of evaluation and gestational age will allow clinical assumptions to be made about the program. My assumptions are that the referral rates will show more boys than girls, the children were older at the time of evaluation, there is no difference in gestational age or multiple births and that the referral rates over time have decreased. Business related decisions could be based on the financial indicators including; charges and reimbursement for clinic visits, and referrals into the hospital’s pediatric rehabilitative services department. This
study will be performed retrospectively and include the data available for all of the children seen in this clinic. The possible results of the information discovered in this study are the elimination of the program, the continuation of the program with changes or the continuation of the program as it is currently being run. From a clinical perspective the program could be discontinued if it was found to not be a needed service in the community, referral criteria into the program could be changed or the timeframes for visits could be altered. Aside from the human perspective, some financial reasons to continue the program would be that it makes a profit, it acts as a referral source for other revenue generating programs in the hospital, or as a community service for tax write off purposes to assist with maintaining the Hospital’s not-for-profit status. The information from this study will be made available to the hospital’s administration to determine if any changes to the Developmental Follow-up program are appropriate or necessary.
Chapter 2

Method

Subjects:
Children between the ages of birth to three years old were evaluated in the developmental follow-up program at a local community hospital. All children actually evaluated through the clinic from the inception of the program on November 22, 1994 through December 31, 1998 were included. The vast majority of the children in the program were referred from the special needs nursery at the hospital and only a few children were referred from other sources. The criteria for referral from the nursery into the program included infants with the following:

- birth weight below 1500 grams
- gestational age less than 35 weeks
- five minute APGAR score at or below seven
- poor nippling for over 3 days
- abnormal muscle tone
- prenatal exposure to drugs
- extreme irritability
- family history of developmental delays or disabilities
- bronchopulmonary dysplasia
- intrauterine growth retardation
- confirmed or suspected neurological insult
- congenital anomalies
- birth trauma (i.e. - Erb’s Palsy)
- confirmed or suspected genetic syndromes
- other nonspecific physician or parent concerns

At the time of discharge from the hospital the parent of any child who met the above criteria was given information regarding the program. The nurse responsible for the discharge forwarded information on each patient to the rehabilitative services department. The patient’s family was contacted to set up an
appointment for a clinic visit. Insurance information was requested and the parent’s permission was obtained to bill the insurance company. Each family was informed that they would not be responsible for the bill unless they had not met their insurance company’s annual deductible. This was done to prevent a conflict of interest with the Palm Beach County’s Early Intervention Program, and to assure that every child had the opportunity to participate in the follow up process regardless of their family’s ability to pay. There were a large number of children referred to the program who did not attend for an evaluation. If the hospital was aware of the name of the child’s pediatrician, a letter was sent to the physician informing them that the child had met the criteria for a follow-up evaluation and the parents chose not to take advantage of the program. The program remained open for referrals from parents or physicians at any time. At the initial clinic visit, a physical therapist and a neonatologist were present and examined the infant. The neonatologist performed a physical exam and the physical therapist performed a developmental examination. At subsequent visits at least two developmental team members were present including a physical therapist, occupational therapist and/or a speech-language pathologist. The child’s developmental milestones were measured according to The Mullen Scales of Early Learning (1995) to determine the child’s developmental age. The child’s movement patterns were assessed using the guidelines of normal
motor development described by Lois Bly (1994). If the child’s evaluation aroused any suspicions by the neonatologist a referral was made to the appropriate specialist. These specialties included genetics, orthopedics, and neurology. If the child demonstrated developmental delays in one or more areas or abnormal movement patterns a recommendation for therapy was made. The options and potential goals were discussed with the parent. If the child scored more than 1.5 standard deviations below the mean on the Mullen Scales of Early Learning (1995), or met other criteria, the parent was also given information regarding the appropriate county’s Early Intervention Program. If there were concerns that did not warrant a direct therapy referral, the parent was given education and/or a home activity program to assist with correcting any areas of concern. Children were then given a recommended return date to the clinic based on the results of the assessment. This return date ranged from one month to one year. Parents were encouraged to contact the therapist(s) if questions or concerns arose prior to their next visit. The information from the evaluation was written into a report that was sent to the child’s pediatrician with the parent’s permission.

**Procedure**

I performed a retrospective study of the Developmental Follow-up program at a local hospital provided through an outpatient
pediatric clinic. The clinic schedules were reviewed for all children seen between November 22, 1994 through December 31, 1998. The information gathered included: the child’s date of birth, sex, singleton or multiple birth, and referrals to therapy or other pediatric specialists. Additional data was collected on children evaluated during a one year period from November 1, 1997 through October 31, 1998. In addition to the previously mentioned information, the child’s gestational age, age at the time of evaluation, the charge for the visit, and the amount of reimbursement. This specific time frame was chosen because the (a) financial data was available on the hospital’s computer system, (b) the clinical chart was likely to be available, and (c) the insurance companies had already made a determination of payment on the claim. A number of families chose not to participate in the program for a variety of reasons. No effort was made to determine the number of children referred into the program, but did not attend. In addition to the official follow-up program some children were seen during free 15 minute screenings or during Early Intervention Program clinics. The data available for these visits was incomplete and therefore not considered in my research.
Chapter 3

Analysis

During the period from November 22, 1994 through December 31, 1998, 174 children were evaluated during 272 separate visits. Of the 174 children, all were under three years of age, there were 27 sets of multiples, 25 sets of twins and 2 sets of triplets. Over 30 percent, 53 of the total 174 children, were referred for additional services this included 18 of the 56 multiples (See Table 4).

<table>
<thead>
<tr>
<th>Children</th>
<th>Number children</th>
<th>Number referred</th>
<th>% referred</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>174</td>
<td>53</td>
<td>30.5%</td>
</tr>
<tr>
<td>Multiples</td>
<td>56</td>
<td>18</td>
<td>32.1%</td>
</tr>
</tbody>
</table>

Financial data was collected along with the demographic data for children seen between November, 22, 1994 and December 31, 1998. A total of 74 children were seen during 96 separate visits. There were 71 children seen for their first visit. Out of the 71 visits there was some reimbursement made on 46 of the visits. There were 25 children evaluated during subsequent follow-up visits. There was some money collected on 8 of these visits. Insurance companies paid on 54 of the total 96 visits. The total charges for all of the visits was $8,785. The average charge per visit
Efficacy of follow-up

was $87.72. Reimbursement ranged from $0 to $120 per visit, with an average of $27.63 per visit. Reimbursement totaled $2,969 for all of the visits. This means the hospital collected payment on 56.3% of the accounts, and was reimbursed for 33.8% of the charges for the follow-up clinic during a one year period of time (Table 5).

<table>
<thead>
<tr>
<th>Charge</th>
<th>Average</th>
<th>Standard Deviation</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial visit</td>
<td>$64</td>
<td>$0</td>
<td></td>
</tr>
<tr>
<td>Follow up visit</td>
<td>$160</td>
<td>$0</td>
<td></td>
</tr>
<tr>
<td>Both</td>
<td>$87.72</td>
<td>$45.23</td>
<td>$8,785</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reimbursement</th>
<th>Average</th>
<th>Standard Deviation</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial visit</td>
<td>$30.27</td>
<td>$25.96</td>
<td></td>
</tr>
<tr>
<td>Follow up visit</td>
<td>$23.28</td>
<td>$39.74</td>
<td></td>
</tr>
<tr>
<td>Both</td>
<td>$27.63</td>
<td>$28.43</td>
<td>$2,969</td>
</tr>
</tbody>
</table>

Percent reimbursed 33.8%

The direct cost of supplying personnel to provide services in the follow-up clinic was $2,926.47 (See Appendix A). The profit over the course of a one year period was $42.63 (See table 6).

Another factor I took into consideration was the amount of charges generated by children identified during the clinic evaluations who eventually received therapy services at the hospital. The timing of the referrals only allowed the charges
Table 6

Profit/(Loss)

Cost x Number of visits = program cost

Initial visit \[ \$26.82 \times 71 = \$1,904.22 \]
Follow-up visit \[ \$40.89 \times 25 = \$1,022.25 \]

\[ \text{Reimbursement less cost of service:} \]

\[ \begin{align*}
\text{reimbursement} & \quad \$2,969.10 \\
\text{cost} & \quad \$2,926.47 \\
\text{profit/(loss)} & \quad \$42.63
\end{align*} \]

Revenue generated from therapy provided \( \$10,185 \)

generated to be collected. Eighteen children were referred to therapy, the early intervention program or pediatric specialists, during this time period. This represented a 24% referral rate. Data indicated that six of these children received one or more therapy services at the same hospital. Revenue as of December 31, 1998 equaled \( \$10,185 \). Six additional children began services after 1/1/99, however no financial data was available at the time of this study.

In addition to the financial data I reviewed clinical data to determine if there was a difference in the referral rates over time, age at time of evaluation, gender, gestational age or multiple vs. singleton birth of the children referred to early
intervention services when compared with all children seen in the clinic. Fifty-eight charts were available for a more detailed review: Eighteen of the children were referred to special services. Of those 18, 9 were referred directly to therapy, 7 were referred to the appropriate county's early intervention program and 4 to physician specialists. Of the 18 children referred for services there were 13 males and 5 females. Only 4 children had low APGAR scores of below 4 at 1 minute and only 2 remained at or below 7 at five minutes. One of these children was referred to a neurologist and none of them for therapy. Prematurity was considered to be below 37 weeks gestation. Forty-two of the 58 infants met this criteria and 13 (31%) of them were referred to early intervention services. There were 29 children of multiples, 13 sets of twins and 1 set of triplets. Eight of the children, 27.5% were referred to services. Four children were known to have genetic or congenital conditions, two were referred for therapy and all four were referred to specialists.

Statistical analysis was performed using the difference of the means at a 95% level of significance (See Appendix C). The drop in referral rates from 30% to 24% before and after November 1997, was not considered to be statistically significant. Analysis was also performed on the gestational age, gender, age at the time of evaluation and multiple vs. singleton birth. When comparing the
children referred to the population of children seen in the clinic there were no statistically significant difference noted.
Chapter 4

Discussion

The results of this study support the benefit of continuing the follow-up program for this population of children. The program supported itself financially by breaking even in terms of insurance reimbursement, and by acting as a referral source for infants and toddlers needing therapy from the outpatient rehabilitative services department. The literature review indicated that this group of children was not considered to be at high risk for developmental problems, however over 30% of the children were recommended for additional follow-up services with therapists or physicians. Previously mentioned studies indicated that early identification of developmental problems and early referral to services can help decrease the physical, emotional and financial impact of developmental delays and disabilities. The literature also reinforces that fact that the child’s family and their child care practices must be taken into consideration in order to obtain an accurate picture of the infant’s developmental status. The program acts as a source of information for parents and physicians and as a safety net to catch any children with subtle difficulties not readily identified by their parents (Bartlett and Piper, 1994) or pediatrician (Dearlove and Kearney, 1990; Palfrey, et al, 1987), and as a place for the physician to send patients about whom they have minor concerns for further evaluation (A.A.P., 1996). It is a safety net for
children discharged from the Early Intervention Program or therapy services who have achieved age appropriate milestones. Often these children are at continued risk for developmental difficulties (Shulman, et al., 1997) as the demands on motor and communication skills change over time (Allen and Alexander, 1997).

There was no statistically significant criteria to indicate the need exclude categories of children currently referred to the program, or to target additional populations for referrals. My original hypotheses were that there has been a decrease in referrals, that boys are referred more often than girls, and that the children are generally older when referred to early intervention services all proved to not be statistically significant. Additionally it was proven that there is no difference in gestational age, or multiple births when comparing referral trends. Although not statistically significant, the trend over time of a decrease in referrals from 30% to 24% was present. I suspect that the rehabilitative services staff, special needs nursery staff, and pediatricians are better educated. Infants are now referred to the appropriate locations (i.e.: early intervention program, pediatric specialists, or therapy services) immediately at the time of discharge, rather than to the developmental follow-up program first, as was the custom in the past.
There were inherent weaknesses in this study. Most of the literature supports follow up services for very premature, very low birth weight infants. There is little research available for this population of infants, yet 53 children were referred for services. The population in this study was not random. The children were preselected by the hospital staff based on specific criteria to be referred to the program. Therefore these results are not representative of all children in this age range. The children were again selected by their parents to attend the clinic. Parents were required to bring the child to the clinic for evaluation. There could be a variety of reasons as to why the evaluation was refused. It may be due to lack of transportation, lack of understanding of the program, a feeling that the child is normal, a fear that the child is not normal, or the child could already be receiving services elsewhere. Due to these factor it is impossible to tell if the referral rates are actually higher or lower in the special needs nursery population in general. Possibilities for future studies include; following all children discharged from the hospital’s special needs nursery to determine their developmental outcomes, doing a detailed medical review to examine more specific indicators for the children referred for services, and researching why parents chose to attend or not to attend the follow-up program.
References


Efficacy of follow-up


Efficacy of follow-up


Appendix A

Cost Accounting

I estimated the cost of each clinic visit. I took into account salaries multiplied by the time spent on the clinic. I included the time of the therapist(s), administrative support staff, and the transcriptionist. The cost of the initial visit, return visit, and free screening were $26.82, $39.00 and $9.18 respectively.

Initial Visit:

<table>
<thead>
<tr>
<th>Personnel</th>
<th>time</th>
<th>salary</th>
<th>cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>therapist</td>
<td>40 min</td>
<td>$21.00</td>
<td>$14.07</td>
</tr>
<tr>
<td>transcriptionist</td>
<td>30 min</td>
<td>$12.00</td>
<td>6.00</td>
</tr>
<tr>
<td>administrative</td>
<td>45 min</td>
<td>$9.00</td>
<td>6.75</td>
</tr>
<tr>
<td>Total</td>
<td>115 min</td>
<td></td>
<td>$26.82</td>
</tr>
</tbody>
</table>

Return Visit:

<table>
<thead>
<tr>
<th>Personnel</th>
<th>time</th>
<th>salary</th>
<th>cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>therapist</td>
<td>75 min</td>
<td>$21.00</td>
<td>$26.25</td>
</tr>
<tr>
<td>transcriptionist</td>
<td>30 min</td>
<td>$12.00</td>
<td>6.00</td>
</tr>
<tr>
<td>administrative</td>
<td>45 min</td>
<td>$9.00</td>
<td>6.75</td>
</tr>
<tr>
<td>Total</td>
<td>150 min</td>
<td></td>
<td>$39.00</td>
</tr>
</tbody>
</table>

Free 15 minute screening:

<table>
<thead>
<tr>
<th>Personnel</th>
<th>time</th>
<th>salary</th>
<th>cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>therapist</td>
<td>20 min</td>
<td>$21.00</td>
<td>$6.93</td>
</tr>
<tr>
<td>administrative</td>
<td>15 min</td>
<td>$9.00</td>
<td>2.25</td>
</tr>
<tr>
<td></td>
<td>35 min</td>
<td></td>
<td>$9.18</td>
</tr>
</tbody>
</table>
# Appendix B

## Raw Data

<table>
<thead>
<tr>
<th></th>
<th>Population</th>
<th>Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>All children seen</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td># of subjects</td>
<td>74</td>
<td>13</td>
</tr>
<tr>
<td># of boys</td>
<td>47/74 = 64%</td>
<td>13/18 = 72%</td>
</tr>
<tr>
<td>mean</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Age at eval (m/d)</strong></td>
<td>4/16</td>
<td>6/26</td>
</tr>
<tr>
<td><strong>GA (wks)</strong></td>
<td>35.76</td>
<td>35.08</td>
</tr>
<tr>
<td><strong>charge ($)</strong></td>
<td>87.72</td>
<td>108.31</td>
</tr>
<tr>
<td><strong>reimbursed ($)</strong></td>
<td>27.63</td>
<td>26.15</td>
</tr>
</tbody>
</table>

STD

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age at eval (m/d)</strong></td>
<td>4/29</td>
<td>5/14</td>
</tr>
<tr>
<td><strong>GA (wks)</strong></td>
<td>3.01</td>
<td>3.23</td>
</tr>
<tr>
<td><strong>charge ($)</strong></td>
<td>45.23</td>
<td>49.81</td>
</tr>
<tr>
<td><strong>reimbursed ($)</strong></td>
<td>28.43</td>
<td>31.52</td>
</tr>
</tbody>
</table>
Appendix C

Statistical Analysis

Percentage of children referred for early intervention services before and after November 1, 1997.

My hypothesis is that there has been a decrease in the number of children referred for early intervention services over time.

\[ H_0: \mu P_1 = \mu P_2 \quad \text{No difference in referral rates} \]

\[ H_1: \mu P_1 \neq \mu P_2 \quad \text{There has been a change in referral rates} \]

I tested the hypothesis using the difference of the proportions.

\[ Z = \frac{(P_1 - P_2)}{\sqrt{\frac{pq(1/n_1 + 1/n_2)}}} \]

\[ p = \frac{P_1 n_1 + P_2 n_2}{n_1 + n_2} \]

\[ q = 1 - p \]

\[ = \frac{(0.3535 - 0.2400)}{0.0704} \]

\[ = 1.612 \]

Confidence interval at 95% = 1.96

Therefore: accept \( H_0 \).

The conclusion is that there has been no significant change in referral rates over time.
Appendix D

Statistical Analysis

Gestational age of children

My hypothesis is that there is no difference in the gestational ages of children referred or not referred for early intervention services.

\[ \text{Ho: } \mu = \bar{x} \quad \text{No difference in gestational age} \]

\[ \text{H}_1: \mu \neq \bar{x} \quad \text{There is a difference in gestational age} \]

I used a t-test for the difference of the means.

\[
t = \frac{\bar{x}_1 - \mu}{\sigma}
\]

\[= \frac{(35.76 - 35.08)}{3.01}
\]

\[= 0.2389\]

d.f. = 85

confidence interval at 95% = 0.8225

Therefore: accept \( H_0 \)

The conclusion is that gestational age is not a significant indicator of which children will be referred to early intervention services.
Appendix E

Statistical Analysis

The percentage of multiples referred for services.

My hypothesis is that there is no difference between the number of children who are a product of multiple births referred for early intervention services compared with the number of all children referred for additional services.

\[ H_0: \mu_{P_1} = \mu_{P_2} \text{ No difference in number of multiples referred} \]

\[ H_1: \mu_{P_1} \neq \mu_{P_2} \text{ There is a difference in number of multiples referred} \]

Using a Z test

\[
Z = \frac{(P_1 - P_2)}{\sigma_{P_1 - P_2}} \\
\sigma_{P_1 - P_2} = \sqrt{pq \left(\frac{1}{n_1} + \frac{1}{n_2}\right)} \\
p = \frac{P_1n_1 + P_2n_2}{n_1 + n_2} \\
q = 1 - p
\]

\[
= \frac{0.3046 - 0.3214}{0.071}
\]

\[ = 0.2366 \]

confidence interval at 95% = 1.96

Therefore: reject \( H_0 \).

The conclusion is that there is not a significant difference in the number of children born from multiple births referred for services, when compared to all children referred for services.
Appendix F

Statistical Analysis

The percentage of boys referred for services.

My hypothesis is that boys are more likely to be referred for early intervention services.

$H_0: \mu_1 = \mu_2$  No difference in the number of boys referred

$H_1: \mu_1 \neq \mu_2$  There is a difference in the number of boys referred

Using a Z test $Z = \frac{(P_1-P_2)}{\sigma[P_1-P_2]}$

$\sigma[P_1-P_2] = \sqrt{pq(1/n_1+1/n_2)}$

$P = \frac{P_1 n_1 + P_2 n_2}{n_1 + n_2}$

$q = 1 - p$

$= (0.7222 - 0.6379) \over 0.1280$

$= .6586$

Confidence interval at 95% = 1.96

Therefore: accept $H_0$.

The Conclusion is that there is not a significant difference in the number of boys referred for services compared with the population of boys in the program.
Appendix G

Statistical Analysis

Age at time of referral

My hypothesis is that children referred for services were older at the time of evaluation than the average child.

Ho: \( \mu = \bar{x} \) No difference in age at time of evaluation

H1: \( \mu \neq \bar{x} \) There is a difference in age at time of evaluation

I used a t-test for the difference of the means.

\[
t = \frac{\bar{x}_i - \mu}{\sigma}
\]

\[
= \frac{(136-182)}{149}
\]

\[
= 0.3082
\]

d.f. = 85

confidence interval at 95\% = 0.8225

Therefore: accept \( H_0 \)

The conclusion is that age at the time of evaluation is not a significant indicator of which children will be referred to early intervention services.