

Durham Connects Impact Evaluation Final Report

Pew Center on the States

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Background and Significance

Child maltreatment is an urgent national public health problem. In 2009, 762,940 U.S. children (10 per 1,000) were identified as victims of abuse or neglect (U.S. Dept. of Health & Human Services [U.S. DHHS], 2011). The federal response to the needs of at risk children and families has accelerated in recent years through the Maternal, Infant, and Early Childhood Home Visiting Program (MIECHV; <http://mchb.hrsa.gov/programs/homevisiting>), which provides \$1.5 billion in grant funding over five years to states for expanded implementation of evidence-based home visiting programs improving health and development outcomes for at-risk children and families. Although the majority of the funding (75%) must be utilized to implement existing, evidenced-based programs identified through the Home Visiting Evidence of Effectiveness study (HomVEE; Paulsell et al., 2010), states may elect to allocate up to 25% of funds to promising new home visiting programs that are evidence-based, but that have not yet been reviewed through HomVEE (www.hrsa.gov/grants/manage/homevisiting/sir02082011.pdf). Thus, in addition to supporting implementation of well-established home visiting models, MIECHV offers an important, time-limited opportunity for expanded implementation of new, innovative home visiting programs with promising evidence supporting impact for children and families.

Currently, the most popular maltreatment-prevention programs, *including all evidence-based programs certified as effective by HomVEE*, are long-term, intensive home visiting for high-risk, pregnant, primiparous women selected by demographic characteristics, such as Healthy Families America (Holton & Harding, 2007) and Nurse Family Partnership (NFP; Olds et al., 2009). The rationale for these programs is that the highest victimization rates occur among infants under age 1 (23 per 1,000; Centers for Disease Control and Prevention, 2008) and certain

groups of women are at higher risk than others (Dodge et al., 1997). Although both Healthy Families America and NFP have implemented randomized controlled trial (RCT) studies demonstrating significant reductions in parent-reported (Healthy Families America; Harding et al., 2007) and objective reports of child maltreatment episodes (NFP; Olds et al., 1986), impact findings have been inconsistent across program sites (e.g., HFA reports significant reductions in official maltreatment reports for only one of six RCT sites; Harding et al., 2007) or limited to specific subpopulations of the treatment group (e.g., Healthy Families America; DuMont et al., 2008; Mitchell-Herzfeld et al., 2005; NFP; Olds, Henderson, & Kitzman, 1994; Olds et al., 1986). *Most importantly, no targeted home visiting program has been shown to lower the population rate of maltreatment for an entire community*, despite the Institute of Medicine mandate to move from basic science to an efficacy trial to an effectiveness trial to population dissemination (Mrazek & Haggerty, 1994).

Failures in moving from efficacy trials to community effectiveness and population impact have been noted for child psychotherapy (Weisz & Gray, 2008) and other psychosocial interventions (Kazdin, 2002). Welsh et al. (2010) found that the scaling up of early family interventions degrades impact by up to 50%, and identified four problems that must be overcome to achieve success for a population. First, most home-visiting programs, including Healthy Families American and NFP, rarely even try to reach the full population because of enormous opportunity costs and targeted enrollment criteria. As noted by Guterman (1999), the debate between universal and targeted home-visiting programs has important implications “not only for the screening process...but also for the ...subsequent configuring of services to address families’ specific needs” (p. 864). Enrolling families based on demographics, rather than a systematic assessment of actual risk, means that not all families at high risk for maltreatment will receive

services. Further, even if a disseminated program is successful in reducing child maltreatment among its participants by as much as one half, it would likely have only a negligible impact on population rates of maltreatment because it targets only a small portion of the population (Dodge, 2009). Further, Guterman's (1999) meta-analysis of home-based child abuse prevention programs indicated that "population-based" enrollment strategies had stronger effects on officially-reported cases of maltreatment and on "maltreatment-related" measures of parenting than "screening-based" enrollment strategies based on individual risk characteristics. Guterman suggests that focusing on high-risk individuals only may inadvertently undermine overall success and may exacerbate a mismatch between families' needs and the services they receive. Second, penetration and completion rates for home-visiting programs are typically low. For NFP, Olds et al. (1994) reported that over 40% of the targeted group never enrolled in their study (and were excluded from all analysis). Once enrolled, Harding et al. (2004) reported a 50% dropout rate within 12 months for Healthy Families America participants, and Daro et al. (2003) reported that only a third of families in all home-visiting programs remain for two years. Third, program developers acknowledge that programs typically suffer degradation in fidelity, quality, and impact when a small program is scaled up from a university context to a community population. Olds et al. (2003) reported that families have higher attrition rates when the NFP Program is disseminated to communities, and, even when retained, they attend fewer visits. Welsh et al. (2010) estimate this "scale-up penalty" at 40%. Finally, programs are predicated on the assumption that community capacity to respond to the needs of participants is sufficient. A key component of the effectiveness of home-visiting, according to Olds et al. (1986), is the ability of the nurse home-visitor to navigate the network of services in a community and advocate for individualized resources, such as high-quality child care and professional mental health services.

When a program is implemented in a randomized trial with only a small proportion of families in a community, the home visitor provides the family with a competitive advantage over non-treated families in receiving precious resources. If a program is taken to scale, however, the collective needs of all families may exceed community capacity to provide resources.

A Universal Approach to Home Visiting

The *Durham Connects (DC)* Program is an innovative, community based, universal newborn nurse home-visiting program designed to address these existing limitations to targeted home visiting programs. It has been developed in a community setting with complementary foci of increasing community capacity while delivering individual services to all families. The home visiting model is designed to be brief and inexpensive (\$700 per birth) so that communities can afford its costs. The program is delivered universally in order to achieve high penetration and population impact, as families do not perceive participation in a universal program as stigmatizing them as “poor or risky,” thereby maximizing community acceptance. Further, because the program was implemented universally from the start, the program avoids decreases in fidelity and impact reported by targeted home visiting programs after scaling-up from smaller RCT trials. Although it is implemented universally, it focuses on triaging families according to assessed risk and then connecting them with ongoing collaborating community resources that can continue to support the family after program completion. Further, its goals are consistent with those of more intensive, targeted maltreatment prevention home visiting programs, such as the NFP (Olds et al., 2009): 1) to connect with the mother in order to enhance maternal skills and self-efficacy; and 2) to connect the mother with matched community services such as health care, child care, mental health care, and financial and social support based on the families unique needs; in order to 3) promote healthy child development and family functioning.

Funding for *DC* piloting and implementation as a RCT study was provided by The Duke Endowment. The Pew Center on the States provided generous funding to support an initial wave of impact evaluation when infants were age 6-months through home interviews conducted with a random, representative subsample of 549 Durham County families with infants born during 18-month Durham Connects RCT period (i.e., the family of one child born on each day of the 18-month RCT period was randomly selected to participate in the home interview; $n = 269$ intervention eligible families; $n = 280$ control group families). The following hypotheses were examined:

1. Random assignment to *Durham Connects* will be associated with more connections to community resources.
2. Random assignment to *Durham Connects* will be associated with higher quality family functioning and better child health and well-being.
3. Associations between *Durham Connects* eligibility and improved child health and well-being will be accounted for by greater family connections to community resources and enhanced family functioning.

The current report provides an overview of 1) the *DC* program, including the home visiting model and a description of an 18-month randomized controlled trial (RCT) implementation of *DC* and subsequent impact evaluation study conducted with a random, representative subsample of 549 families at infant age 6-months; 2) results from the 18-month *DC* RCT implementation and initial impact evaluation study results; 3) conclusions and

recommendations to advance the home visiting field; and 4) limitations and future directions for continued *DC* dissemination and impact evaluation.

I. The Durham Connects Universal Newborn Nurse Home Visiting Program

Theoretical Rationale: An Ecological Model of Child Maltreatment

Risk for child maltreatment accrues from factors that range from *infant characteristics* that make infants harder to care for, to *parental and family (microsystem) characteristics* such as depression, substance abuse, poverty, lack of social support, and intimate partner violence, to *community (exosystem and macrosystem) characteristics*, such as lack of accessible resources (Belsky, 1993; Chaffin et al., 1996). The most compelling lessons for prevention offered by this approach are that risk for maltreatment varies across families and preventive interventions will be most successful if they identify family-specific risk factors and target the appropriate level of ecology. The *Durham Connects* program draws on this model by reaching all families, assessing family-specific risk and protective factors across multiple levels, and connecting families with collaborative health and human services to support their unique needs.

The ecological model further suggests that community resources must be available and aligned to support families during the first year of life. The most effective home visiting nurse cannot have an enduring impact if needed community resources such as health care, child care, financial supports, and parenting supports are not available or are not accessible to families from certain neighborhoods or income groups. The *Durham Connects* program has spent six years growing a Preventive System Of Care (PSOC; Tolan & Dodge, 2005) of community services by gaining the support of virtually all community agencies, providers, and volunteer groups in Durham County. The PSOC is modeled after the System Of Care concept in child mental health

treatment, which focuses on the needs of the child, includes all relevant members of the child's ecology, and "wraps" services around the child. *Durham Connects* follows this model but identifies risk rather than disorder and acts preventively. To support these efforts in implementation, all community agency directors signed a memorandum of agreement to follow the Preventive System of Care Model, directing increased resources toward prevention and delivering services in a family-centric way.

The Durham Connects (DC) Home Visiting Model

DC was implemented jointly by the Durham County (NC) Health Department and Duke University. *DC* consists of 4-7 intervention contacts, beginning with consenting during a birthing-hospital visit when a staff member communicates the importance of community support for parenting and schedules the family with an initial nurse home visit conducted when infants are approximately 3 weeks of age during which the nurse conducts an infant and mother health assessment and systematically assesses family unique strengths and needs, 1-2 nurse follow-up home visits, as needed, based on nurse assessment of family needs, 1-2 nurse contacts with community service providers to support provider connections with the family, and a staff-member telephone or in-home follow-up one month after the nurse completes all home visits.

DC is delivered universally to mothers (and fathers when possible) through "teachings" in important areas of health and well-being during the course of 1-3 home visits with the family (see Table 1 for a complete list of all possible nurse teachings). After engaging the mother, the nurse's first task is to nurses utilize motivational interviewing techniques (Miller & Rollnick, 2002) to deliver universal intervention through "teachings" and conversation about the importance of parenting. The intervention protocol is manualized (i.e., nurses adhere to a

standard protocol of topics to cover with each family), but delivered flexibly, so the nurse is free to cover topics as they naturally arise in conversation, and free to spend more or less time on specific topics based on each family's unique strengths and needs. The nurse also provides each family with a developmentally-informed gift bag with materials for the infant (diapers, thermometer, books, etc.).

During the course of the home visits, the nurse also assesses and scores health and psychosocial risk in each of 12 empirically-derived areas in 4 domains known to increase risk of child maltreatment (*Healthcare*: 1. Parent Health, 2. Infant & Safety Health, and 3. Health Care Plans; *Parenting / Childcare*: 4. Childcare Plans, 5. Parent-Child Relationship, 6. Management of Infant Crying; *Household Safety & Violence*: 7. Household / Material Supports, 8. Family & Community Violence, 9. History of Maltreatment; and *Parent Mental Health / Well-Being*: 10. Depression / Anxiety, 11. Substance Abuse, 12. Emotional Support). Nurses also complete a single global rating based on the overall impression of family well-being (*General Impressions*). The assessment emphasizes a high inference rating system drawing on nurses' experience and clinical judgment about the family. The interview also incorporates structured, validated screening instruments for psychosocial problems, including postpartum depression (Edinburgh Postnatal Depression Scale; Cox, Holden, & Sagovsky, 1987; Wisner, Parry, & Piontek, 2002), substance abuse (CAGE-AID; Brown, Leonard, Saunders, & Papasouliotis, 1998; Brown & Rounds, 1995), and interpersonal / family violence (Conflict Tactics Scale – Short Form; Straus & Douglas, 2004). At the conclusion of the interview, the nurse scores and responds to risk separately in *each* area on a 4-point scale (See Table 2 for a copy of the Family Strengths and Needs Matrix scoring system). A score of 1 (low risk) in a particular area receives no intervention. A score of 2 (moderate risk) receives short-term nurse-delivered intervention on

that particular topic over 1-3 home visiting sessions. A score of 3 (high risk) receives a connection (or referral) to one or more matched community resources tailored to address the particular risk. Services in Durham include both professional (e.g., mental health practitioner, housing authority, child care subsidies, emergency financial assistance) and para-professional (e.g., “grandparent” mentor, volunteer) persons and agencies from both public and private sectors. Durham Connects has created and maintains a database of several hundred appropriate community services that is available to the nurses on laptop computers during home visits. Once a family referral is made, the nurse and intervention support staff members also followed up to make sure that each connection “sticks”, requiring possible additional 1-2 contacts. A score of 4 (imminent risk) receives immediate emergency intervention (e.g., contacting the police for emergency safety concerns or an ambulance for emergency medical care). After completion of all home visits, and with consent from the family, the nurse sends an individualized letter to the infant's pediatrician/family practitioner and the mother's OBGYN and regular medical provider to inform the provider(s) about identified family needs and overall home visit outcomes.

A final telephone or in-home session is completed by a *DC* support staff member approximately four weeks after the nurse has completed the case to ascertain whether the family has received needed supports from local community resources, if additional problem-solving is needed to address previously-identified or new family needs, and if the family was satisfied with their *DC* home visit. Assessing outcomes for attempted connections with local community agencies serves an important dual purpose for the program by 1) ensuring that community agencies follow-through on commitments to provide services to *DC*-referred families; and 2) identifying gaps in existing community services, where community needs for services currently exceed capacity within the community. For instances where families referred to individual

agencies result in low “sticky connection” rates (i.e., the missed connection was not due to limited capacity on the part of the agency), a *DC* community outreach coordinator worked directly with that agency to troubleshoot ways to increase connection rates (e.g., developing an in-house application form nurses or support works could complete with the family providing the community agency with all information needed to provide services to the family). For instances where demand exceeded community capacity (e.g., affordable, high quality child care), *DC* worked with local community leaders to increase awareness of existing service gaps in the community.

II. *Durham Connects* RCT Implementation and Evaluation Study Results

RCT Randomization Procedures and Evaluation Sample Selection

In order to determine whether a universal nurse home visiting program could be implemented with high penetration and fidelity for an entire population, *Durham Connects* was implemented as a randomized controlled trial (RCT) study for an 18-month period. From July 1, 2009, through December 31, 2010, all 4,782 residential births in Durham County, North Carolina, were randomly assigned according to birthdate, with even-birth-dates assigned to receive *DC*. Odd-birth-dates were assigned to receive services-as-usual (See Figure 1). Specifically, odd-birth-date families were not contacted by *DC* nurses or staff members, did not receive a *DC* nurse home visit, and received only those community services which they actively sought for themselves. Post-hoc analyses matching hospital discharge records with *DC* recruitment records and *DC* nurse home visit records confirmed that no odd-birth-date families participated in the *DC* program. Program implementation was evaluated for all 2,330 even-birth-date families. Electronic discharge records provided to *DC* by both hospitals in Durham County

ensured that the entire population of births for the 18-month period was identified and randomized.

We selected a random, representative subsample of the 4,782 families to evaluate *DC* program impact on multiple outcomes related to *DC* program implementation through intensive in-home interviews conducted when infants were 6-months of age. A random subsample of the broader population is a common procedure for intensive evaluation of population-level interventions (e.g., Moving to Opportunity neighborhood re-assignment intervention; Ludwig et al., 2011) and was utilized due to the high costs associated with blinded in-home interviewing. Using publically available birth records, we randomly selected one birth for each day of the *DC* RCT enrollment period (spanning both even and odd birth dates from July 1, 2009, through December 31, 2010) for participation in the evaluation study ($n = 549$ overall; $n = 269$ *DC*-eligible families; $n = 280$ control group families). Even-birth-date families were recruited without consideration for their *DC* recruitment and participation outcomes. Statistical power analyses were conducted to ensure that the evaluation sampling design was adequately powered to detect difference between *DC*-eligible (intervention) and control families. Following guidelines established by Cohen (1988) and using *Gpower* software (Faul et al., 2009), power analyses estimating at least .80 power and a significance level of .05 indicated that a sample of 549 is sufficiently powered to detect hypothesized effects: an effect size of 0.21 for continuous variables and a 9% difference for dichotomous variables.

Recruitment for the evaluation study was conducted by an independent research team of interviewers who had no knowledge of *DC* implementation. Short-form public birth records were used to identify all eligible families. Geographic codes (geocodes) were assigned based on birth record address to verify county of birth. Families that did not have a Durham County geocode

and families that did not give birth in Durham were removed from the selection pool. A unique ID number was assigned to all remaining births, and one family per birth date was then randomly selected to be solicited to participate in an IRB-approved research study examining the ways in which family characteristics and family services utilization predict child health and development, parent well-being, and parent-child relationship quality. Families were not informed that they would be participating in an evaluation of the *Durham Connects* program in order to reduce potential participation and response biases. When a selected child could not be located, the family declined to participate, or the family was discovered to be ineligible (e.g., infant was deceased or family moved out of county after birth), a replacement family with an identical infant birth date and race/ethnicity as the original family was selected. A total of 685 families were selected, with 549 (80.0%) participating.

We compared the 685 selected families with the population on 13 variables available from the hospital discharge records (See Table 3). The 685 families significantly ($p < .05$) differed from the population on only one variable, infant gender (selected families were more likely to have male infants). Next, we compared the 549 participating families to the population on the same 13 variables and found only one significant difference (interviewed families were more likely to be Medicaid-insured or uninsured). Interview participation rates did not differ between intervention (81%) and control (79%) families. We tested whether intervention ($n = 269$) and control ($n = 280$) groups differed on the 13 variables noted above plus 4 variables made available by the interview and found only one significant difference (control condition had more birth complications). We concluded that we had obtained an evaluation sample that was representative of the broader population, and that participation that was not biased between intervention and control groups.

Home interviews at age 6-months were approximately 1-2 hours in length; mothers provided information on demographic characteristics, family utilization of community resources, family functioning across all domains of risk assessed by the *Durham Connects* nurse home visitor (infant and parent health, parenting and child care, financial stability and home safety, and parent well-being and support), and information on child development and well-being. Additionally, research assistants completed observational ratings of the parent-child relationship home environment quality.

Age 6-Month Evaluation Study: Dependent Variables of Interest

Dependent variables were based on interviews with the participating representative subsample of 549 mothers when infants were age 6 months. Interviews took place in mothers' homes at pre-arranged times; all mothers provided written consent prior to participation and received \$50 as compensation for their time.

Community connections. Mothers reported the total number of professional, paraprofessional, and informal community resources they had utilized in the past three months (*number of community connections*). This is the primary measure of the program's proximal goal to improve community connections. Services most frequently utilized by families included Medicaid / SCHIP (state health insurance for children), WIC, food stamps, breastfeeding support, child care services, and the Department of Social Services (DSS; job search assistance, housing assistance, cash assistance, etc.).

Parenting/child care domain. Mothers completed standard reliable and valid questionnaires assessing their parenting behaviors and knowledge. Mothers reported on use of *positive parenting behaviors* (7 items, e.g., "comforted infant"; Durham Family Initiative, 2008)

and *negative parenting behaviors* (10 items, e.g., “shouted at infant”; Louds et al., 2004; Straus et al., 1995) in the past three months, *knowledge of infant development* (10 items, e.g., “6-month-olds know what ‘No’ means”; MacPhee, 1981), and *parenting sense of competence* (17 items, e.g., “being a parent makes me tense and anxious”; Ohan, Leung, & Johnston, 2000). If the biological father was involved with the infant, mothers reported on *father-infant relationship quality* (10 items, e.g., “hugs or shows physical affection toward child”; Center for Research on Child Wellbeing, 2008).

Trained in-home interviewers, blinded to intervention status, completed the 18-item Responsivity and Acceptance subscales of the Infant-Toddler Home Observation for Measurement of the Environment (IT-HOME; Caldwell & Bradley, 1984), providing an independent rating of *mother parenting quality*.

Mothers completed a brief questionnaire (Bates et al., 1994) on *non-parental child care use* (no vs. yes) and, if the infant had been placed in regulated childcare, the *child care center star rating* (based on North Carolina’s 5-Star rating).

Family/home safety domain. Blinded interviewers completed a 5-item rating of *overall home environment quality* (e.g., “the home is safe, clean, and free from hazards”; Daro & Dworsky, 2005). Mothers currently in a relationship completed the 20-item Conflict-Tactics Scale (Straus & Douglas, 2004), leading to a *marital relationship conflict score*.

Parent well-being domain. Mothers completed the 10-item Edinburgh Postnatal Depression Scale (EDPS; Cox et al., 1987; Wisner et al., 2002), indicating *possible clinical depression* (cut-point=10); the 7-item brief Generalized Anxiety Disorder-7 questionnaire (e.g., GAD-7; Spitzer et al., 2006) indicating *possible clinical anxiety* (cut-point=5); and the 8-item

CAGE and CAGE-AID questionnaires (Brown & Rounds, 1995; Brown et al., 1998) assessing *possible substance use problems* (cut-point =1) in the past three months.

Health care domain. Mothers reported the most recent *well-baby primary care visit*. Responses were coded as: 0) more than 1 month ago, or 1) within the last month. Mothers reported their infant's *number of emergency medical visits* in the past three months, which summed the numbers of emergency visits to a doctor or emergency room. Mothers also reported the infant's *number of overnights in the hospital* for non-birth-related medical care in the past three months. Finally, the *total number of emergency medical care episodes* was calculated by summing these two variables.

Age 6-Month Evaluation Study: Plan of Analysis

All analyses for the impact evaluation study were conducted using SAS v.9.2 software with a two-tailed “intent-to-treat” design that included all randomly-assigned interviewed families without regard to intervention adherence ($n = 269$ intervention eligible families; $n = 280$ control group families). Probability levels of $< .05$ were called significant, and levels of $< .10$ were called marginally significant. Ordinary Least Squares (OLS) regression models and multinomial logistic regression models estimated the impact of random assignment to *DC* on continuous and categorical outcomes, respectively. Poisson regression models were employed for count variables with skewed distributions (Coxe, West, & Aiken, 2009). Models included family Medicaid status (no vs. yes), mother race/ethnicity (non-minority vs. minority), and single parent household status (no vs. yes) as covariates.

Durham Connects RCT Implementation Results

Penetration. All eligible mothers that were successfully contacted and recruited by a DC staff member at birth received the initial intervention message indicating the importance of community support for parenting ($n = 2,997$; 99%). Further intervention services were provided to only those families that agreed to a nurse home visit. Of the 2,330 eligible even-date birth families, 1,863 (80.0%) consented to a nurse home visit, and 1,598 (85.8%) successfully completed a nurse home visit (net participation = 69%). Of 1,598 participating families 40% ($n = 638$) were European-American, 37% ($n = 591$) were African-American, and 23% ($n = 367$) were other/multiracial, with 26% ($n = 415$) reporting Hispanic ethnicity. Sixty-two percent ($n = 990$) received Medicaid or had no health insurance. Forty-four percent ($n = 709$) were married. Examination of differences between families that completed the program versus those that did not suggest that families characterized as being more “at risk” were more likely to complete the program. Specifically, mothers who completed the program were younger ($M_{\text{completed}} = 28.2$ years; $M_{\text{not completed}} = 29.1$ years, $p = .0001$), more likely to live in lower SES neighborhoods ($M_{\text{completed}} = 53.9$; $M_{\text{not completed}} = 58.2$, $p < .0001$), and more likely to have had an infant that was low birth weight (less than 2500 grams; $M_{\text{completed}} = 58\%$; $M_{\text{not completed}} = 42\%$, $p < .0001$) or born prematurely (prior to 37 weeks of age; $M_{\text{completed}} = 57\%$; $M_{\text{not completed}} = 43\%$, $p < .0001$).

Fidelity. Intervention program adherence as specified in the DC nurse home visiting manual was assessed by having an independent expert accompany the nurse or listen to an audiotape of a home visit for 116 of 1,548 families (8%). From a list of necessary program elements, the expert checked adherence (or not) to each model element. Additionally, the independent expert and the nurse independently rated the family on the 12 dimensions of child maltreatment risk assessed by the nurse during the home visit. Overall observer-rated nurse adherence to the manualized protocol was 84% (5,476/6,550), which is judged to be high. Inter-

rater agreement on scoring of risk yielded a mean Kappa coefficient across all nurses of .69, and across the 12 risk factors of .68 (Coefficients greater than .60 are considered substantial; Landis & Koch, 1977).

Risk assessment, intervention, and family consumer satisfaction. 50 of 1,598 families (3.1%) stopped assessment due to nurse-assessed emergency (scored as “4” on the 4-point scale) or family choice. Of 1,548 assessed families, 696 (45%) were scored with at least one “3”, indicating serious risk served best by referral to a community agency provider, 757 (49%) received at least one “2” (but not “3” or “4”), indicating mild-to-moderate risk that was addressed by brief nurse intervention in-home, and 93 (6%) of families received lowest-need scores (“1”) in all 12 domains.

Nurses implemented a mean of 13.8 “teachings” to each family. Of families receiving these interventions, most the most common were about: 1) maternal health (55.4%); 2) household supports (46.2%); 3) infant health (39.9%); and 4) maternal well-being (36.5%). Nurses recommended community connections for 28% of families in the health care domain, 20% in the family violence/safety domain, 11% in the parenting/child care domain, and 15% in the parent mental health/social support domain (summing to more than 46%, allowing for multiple referrals per family). During follow-up contacts one month after case completion, families reported that a successful connection had been established with the community service provider for 60% (1,009/1,671) of referrals, and community services had already been received for 39% (651/1,671) of the total. Families reported the following aspects to be helpful (versus not helpful): materials provided by the nurse (diapers, thermometer, books, etc.; 99%; 820/832); discussion with the nurse about mother’s needs (98%; 812/830); and nurse “teachings” (95%;

792/830). Almost every mother indicated that she would recommend the visit to another new mother (99%; 818/828).

Durham Connects Evaluation Study Impact Results

Descriptive statistics for all outcome variables of interest, as well as results for all evaluation study impact analyses can be found in Table 4. Prior to conducting impact analyses, we tested the representativeness of the *DC*-eligible evaluation subsample ($n = 269$) for *DC* participation rates. The overall net participation rate for this group (76%) did not differ significantly from the participation rate of the entire sample of interview-condition families (69%; $n = 2,330$).

Community connections. Families assigned to *DC* (herin called *DC* families) accessed 14% ($M_{\text{control}} = 4.35$; $M_{\text{intervention}} = 4.96$) more total community resources over the past three months than control families ($p < .0001$; effect size = 0.38, calculated as $(M_{\text{intervention}} - M_{\text{control}}) /$ average within-group standard deviation).

Parenting / childcare. *DC* mothers reported more total positive parenting behaviors than control mothers ($M_{\text{control}} = 4.01$; $M_{\text{intervention}} = 4.12$; $p = .0047$; effect size = .30); no differences, however, were found for mother reports of negative parenting behaviors ($M_{\text{control}} = 0.34$; $M_{\text{intervention}} = 0.32$; $p = .59$), knowledge of infant development ($M_{\text{control}} = 0.76$; $M_{\text{intervention}} = 0.75$; $p = .17$), or sense of parenting competence ($M_{\text{control}} = 4.36$; $M_{\text{intervention}} = 4.36$; $p = .96$). Blinded in-home observers rated the parenting quality of *DC* mothers as higher than that of control mothers ($M_{\text{control}} = 14.72$; $M_{\text{intervention}} = 15.15$; $p = .0317$; effect size = .23). *DC* mothers also reported marginally higher father-infant relationship quality ($M_{\text{control}} = 1.93$; $M_{\text{intervention}} = 2.08$; $p = .0741$).

No group difference was found for the likelihood of placing an infant in out-of-home childcare ($M_{\text{control}} = 0.53$; $M_{\text{intervention}} = 0.46$; $p = .14$) but, contingent on receipt of out-of-home childcare, the quality of that care as rated by the North Carolina 5-Star rating system was higher for *DC* families than control families ($M_{\text{control}} = 3.98$; $M_{\text{intervention}} = 4.59$; $p = .0004$; effect size = .40).

Family safety / violence. Blinded in-home observers rated the home-environment quality as significantly higher for *DC* families than control families ($M_{\text{control}} = 4.47$; $M_{\text{intervention}} = 4.81$; $p = .0146$; effect size = .27). No difference was reported for the partner relationship conflict score ($M_{\text{control}} = -4.65$; $M_{\text{intervention}} = -4.63$; $p = .86$).

Maternal mental health / well-being. *DC* mothers were not less likely than control mothers to report possible depression ($M_{\text{control}} = 0.12$; $M_{\text{intervention}} = 0.08$; $p = .13$) or possible substance use problems ($M_{\text{control}} = 0.04$; $M_{\text{intervention}} = 0.06$; $p = .87$). They were, however, 27.5% less likely to report possible clinical anxiety ($M_{\text{control}} = 0.29$; $M_{\text{intervention}} = 0.22$; $p = .0469$).

Infant health care. Families did not differ in the time since the last well-baby pediatric visit ($M_{\text{control}} = 0.68$; $M_{\text{intervention}} = 0.70$; $p = .58$). Relative to control families, families randomly assigned to *DC* reported 34% ($M_{\text{control}} = 1.37$; $M_{\text{intervention}} = 0.90$) fewer overall emergency medical care episodes ($p < .0001$; effect size = .23); 17% ($M_{\text{control}} = 1.00$; $M_{\text{intervention}} = 0.83$) fewer emergency medical outpatient visits ($p < .0539$); and 82% ($M_{\text{control}} = 0.38$; $M_{\text{intervention}} = 0.07$) fewer overnights in the hospital ($p < .0001$; effect size = .17).

Benefit-cost analysis. The per-family cost of the intervention was estimated from budget allocations that included salaries and benefits of intervention staff members and supervisors, local travel reimbursements, and office and supply costs. It does not include in-kind and re-allocated time from community agencies. Intervention cost was estimated at \$700 per birth. We

estimate costs of emergency medical care using published rates that indicate a local average of \$423 per emergency outpatient visit and \$3,722 per hospital night (Paul et al., 2004). Using the group means reported in Table 4 and the dollar costs above, we can apply a standard formula for the ratio of costs of an intervention to the benefits that accrue (Drummond et al., 2001), as follows:

$$BCR_{DC} = \frac{OC_{OBD} - OC_{EBD}}{IC_{EBD} - IC_{OBD}}$$

Where BCR_{DC} is the Benefit-Cost Ratio that accrues from random assignment to the *DC* Program, OC_{OBD} is the Output Cost for each odd-birthdate infant measured as the average per-infant cost for emergency medical care at age 6 months, OC_{EBD} is the Output Cost for each even-birthdate infant measured as the average per-infant cost for emergency medical care at age 6 months, IC_{EBD} is the average per-infant cost of the *DC* Program (\$700), and IC_{OBD} is the average marginal cost of programs for control infants (\$0). We obtain average costs of emergency medical care of \$2,172 for control infants (\$423 in outpatient and \$1,749 in overnight costs) and \$1,058 for infants assigned to *DC* (\$351 in outpatient and \$707 in overnight costs), and a Benefit-Cost Ratio of 1.59, meaning that every \$1 spent on the *DC* program saved \$1.59 by age six months in costs for community emergency care. For a community the size of Durham, NC, USA, with an average of 3,187 resident births per year and *DC* intervention cost of \$700 per birth, a community annual investment of \$2,230,900 for the *DC* Program would yield a community-wide emergency health care cost savings of \$3,547,131.

III. Conclusions and Recommendations to Advance the Home Visiting Field

Conclusions

Based on results from an 18-month, universal RCT implementation trial and subsequent impact evaluation of a representative subsample of families at infant age 6-months, we conclude that the *Durham Connects (DC)* Program offers a feasible, affordable, and effective public health policy for families of newborn infants, combining a top-down commitment by community agencies to align services according to a Preventive System of Care Model with an individually administered, brief nurse home-visiting program that aims to reach every family. Findings reported here indicate that when this program is implemented in large numbers, it is successful in penetrating most of the community, can be implemented with high fidelity and reliable assessment of individual family risk, achieves high rates of family-consumer satisfaction, and is delivered at affordable cost. This approach offers a novel solution to the paradox faced by existing, targeted home visiting programs by offering services universally, but also tailoring intervention to individual-family needs by triaging families into matched community services based on individualized nurse assessments. Further, the utilization of individual assessments to match families to only those services that are needed offers a solution the broader paradox faced by communities in which some at-risk families receive too many community resources (including some that are not needed), while other at-risk families receive too few (Gutterman, 1999).

Beyond implementation results, we report the first known impact findings of a randomized controlled trial of universal infant home-visiting implemented with large numbers of families through intensive in-home interviews conducted with a random, representative subsample of families born during the 18-month *Durham Connects* RCT period. Impact findings indicate that random assignment to the *DC* Program at birth has a positive impact on reducing mother-reported infant emergency healthcare outcomes at age 6 months. It also improves a

family's connections to community resources, parent-child relationship quality, rates of high quality childcare utilization, home environment quality and safety, and maternal mental health. Effect sizes are modest for an individual family but are similar to those of longer, more intensive home-visiting programs (e.g., Armstrong, Fraser, Dadds, & Morris, 1999; Olds et al., 1986). Further, results from benefit-cost analyses on mother-reported infant emergency healthcare episodes at age 6 months suggest that the program could have a cost-beneficial impact on the population. Importantly, these cost benefit savings were observed approximately three months after program implementation, suggesting communities may obtain significant financial returns on initial program investments, through reduced infant emergency healthcare costs, within a relatively brief period of time.

We conclude at this early juncture that a brief, universal, postnatal, nurse home-visiting program can be delivered to most of the population with high fidelity and can have positive impact on infant health and well-being. We also conclude that a public policy of universal implementation could be cost-beneficial for a community.

Recommendations to Advance the Home Visiting Field

Based on available *Durham Connects* RCT implementation and impact evaluation results to date, we suggest the following recommendations to advance the field of home visiting:

1. We recommend that communities interested in utilizing home visiting services to promote healthy child development and family functioning incorporate a universal home visiting model into their design. Such an approach is the only means of achieving population-level impact. Based on community preferences and available funding, two approaches are possible: 1) implementation of a universal home visiting

program, such as *Durham Connects*, as a stand-alone program. Results from the current RCT implementation suggest such an approach could improve child well-being and family functioning in a cost-beneficial manner for communities, although further evaluation and replication is needed; 2) implementation of a universal home visiting program in collaboration with a home visiting program that provides long-term, intensive services to high risk families (e.g., NFP, Health Families America). Although more expensive for communities to implement, such an approach may represent an optimal approach to maltreatment prevention - utilizing a universal program to provide short-term intervention to all families, while systematically screening for risk and connecting high-risk families to long-term, intensive home visiting services in a manner that more accurately identifies actual family risk than inclusion based on demographic risk factors.

2. We recommend that the existing *Durham Connects* intervention model be replicated in order to examine whether similar implementation and impact results can be obtained in other communities. The forthcoming dissemination of the *Durham Connections* program to 3-6 rural counties as part of North Carolina's new early childhood Race-to-the-Top initiative will provide an important test of program effectiveness in communities with fewer relative communities resources than Durham County. Additional replication in communities with populations differing from those of Durham County (e.g., large urban communities) is also warranted.
3. We recommend that the *Durham Connects* program to be included as an evidence-based model eligible for funding through the Maternal, Infant, and Early Childhood Home Visiting Program (MIECHV). Although additional evaluation and replication

is needed before the *Durham Connects* program could be certified by the Home Visiting Evidence of Effectiveness study (HomVEE), the current implementation and impact results suggest that *DC* is warranted for consideration as a promising new home visiting programs that is evidence-based, but that has not yet been reviewed through HomVEE. This would allow states to use up to 25% of MIECHV funding to incorporate a universal intervention model into their home visiting services. We believe that such efforts would provide a critical opportunity to increase population-level impact for communities in a cost-effective manner.

IV. Limitations and Future Directions

Limitations

Several limitations to the current work should be noted. First, findings are limited by the implementation of *DC* in just one community. Further, only one-half of community births were eligible to receive the intervention during the RCT period. While randomization within county was necessary to ensure that the *DC* model was evaluated using the most rigorous experimental design possible (i.e., randomization within county across the entire population of births is the only way to experimentally determine that *DC* eligibility *causes* changes in outcomes of interest), such an implementation design does not allow for evaluating the extent to which existing community resources can support family needs across the entire population of births. Future replications in other communities, as well as continued, universal implementation of the *Durham Connects* program within Durham County (as a non-experimental community program serving all families), will inform broader generalizability of the intervention model.

Second, impact findings are limited to a representative subsample of families with infants born during the *DC* RCT period, and are based on reports by mothers and observations by blinded coders. Further, current findings are limited to the infant's first six months of life, and not all outcomes of interest yielded significant impact. Future studies of administrative records will inform the generalizability of these findings, both for the representative subsample of families, as well as for the full RCT population of births. Further, future studies will follow up these findings by extending cost analysis farther in the infants' lives and more broadly to other developmental domains, to see whether even larger savings accrue across development or costs are simply deferred by the *DC* Program. Additional population outcomes will be assessed, including reports to Child Protective Services (for a summary of all future research efforts, see Future Directions section below).

Third, the current results are limited to main effect findings for program impact on community connections, family functioning, and infant emergency medical care episodes for all families using an intent-to-treat analysis plan. Program impacts on infant health and development, however, are likely to be indirect, through program impact on more proximal processes. Future analyses will address the mediation of distal impact on healthcare services and child development outcomes through proximal impact on community connections and parent-child relationship quality, and parent well-being. Further, it is possible that program impacts on families and children may differ based on demographic characteristics or variations in program implementation (e.g., quality of protocol administration, number of intervention contacts with families). Future analyses will also examine the moderation of findings across subgroups within the population and across variations in program implementation.

Future Directions

Longitudinal Impact Evaluation of DC on Children and Families. Longitudinal assessment of family outcomes and child health and well-being is critical in order to fully understand the extent to which *Durham Connects* eligibility results in sustained improvements in family functioning and child well-being over time, as well as the mechanisms through which these changes occur. In order to assess the long-term impacts of the *DC* program, follow-up interviews are currently being conducted with each of the 549 families who participated in the *DC* impact evaluation study when infants were age six months. Currently, additional interviews are being conducted when infants are 18- and 24-months of age and are approximately 20- (18-months) to 45- (24-months) minutes in length. Mothers report on demographic and contact information, community service utilization, family functioning, and child health, development, and well-being. To date, the evaluation has been successful in tracking and completing additional interviews with a high percentage of families.

Of the 494 families contacted to date and invited to participate in the age 18-month interview, 436 have successfully completed interviews (88.2% completion rate), with an additional 11 families having scheduled appointments to complete the interview (90.4% completion / scheduling rate). Further, of the 306 families contacted to date regarding participation in the age 24-month interview, 271 have successfully completed interviews (88.5% completion rate), with 1 additional family having scheduled an appointment to complete the interview (88.8% completion / scheduling rate). Importantly, fewer than 2% of families contacted to date have declined further participation in the evaluation study. Remaining families could not be located or declined to complete one of the interviews, but expressed an interest in remaining in the study.

To further support long-term evaluation, a research grant from the National Institute for Child Health and Human Development (NICHD) has been funded to continue following this cohort of families over time. Specifically, this proposed follow-up study utilizes the existing, innovative randomized controlled trial design to evaluate the impact of *DC* on population rates of family functioning and child well-being through the transition to school (age 66 months). By building directly from the current evaluation funded by the Pew Center on the States, ongoing data collection efforts will allow for a more complete understanding of the magnitude of impact over time, the specific mechanisms through which the program impacts family functioning and child well-being, and the subgroups for whom the program is most effective. Details of the proposed data collection timeline are provided in Table 5 below.

Administrative Record Reviews. Program effectiveness will also be assessed using objective administrative records for emergency medical care utilization, investigations and substantiations of child maltreatment, and family adherence to infant well-baby care schedules. De-identified records will be collected for all children in Durham County born during the 18-month RCT period in order to examine the population impact of the *DC* Program. Individually identified records will also be collected for the 549 families participating in the age six-month evaluation, providing the ability to examine more nuanced associations between *DC* Program participation, family functioning, and child health and well-being. During the age 6-month interview, all families provided written consent to access detailed records from birth, hospitals, pediatric practices, and the Department of Social Services (DSS) for 5 years (through 66-months).

Our request for identified and de-identified hospital emergency room records has been processed by the Duke University Health Systems data center. These data were received by our

project in May 2012 and are currently being cleaned and processed for data analysis. We anticipate having preliminary analysis results for this data by the end of Summer 2012. Further, we have submitted a request for identified and de-identified records for investigated and substantiated cases of child maltreatment to the North Carolina Division of Social Services (NC DSS). We anticipate receiving NC DSS data in Summer 2012.

Durham Connects Program Dissemination and Replication. The NICHD research grant will not provide funds for dissemination of the *Durham Connects* Program, evaluation of dissemination, or policy engagement regarding community-based infant home visiting. At this time, the *DC* Program is being implemented at scale (i.e., all Durham County births are now eligible to receive *DC* nurse home visiting services) in the community of Durham, NC, through temporary funds from The Duke Endowment, government, and local sources. Further, we are preparing to implement the *DC* in 3-6 rural counties of North Carolina through funds from the Early Childhood supplement to the federal Race To The Top grant. We will seek funding for dissemination, evaluation, and policy engagement for these efforts.

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Table 1. *Manualized Nurse Teachings Administered During In-Home Visits*

Nurse Teaching	Risk Factor
Maternal Physical Health	Parental Health
Maternal Post-Delivery Recovery	Parental Health
Contraception and Pregnancy Spacing	Parental Health
Self-Care for Mom	Parental Health
Infant Physical Growth and Development	Infant Health and Safety
Infant Physical Health	Infant Health and Safety
First Aid/ Emergencies/ CPR Training Classes	Infant Health and Safety
Breastfeeding/ Lactation/ Pumping	Infant Health and Safety
Formula Preparation / Bottle Feeding	Infant Health and Safety
Sudden Infant Death Syndrome (SIDS)	Infant Health and Safety
Skin Care	Infant Health and Safety
Home Safety	Infant Health and Safety
Infant Behavioral Development	Infant Health and Safety
Hazards of Secondhand Smoke	Infant Health and Safety
Diapering and Diaper Rash Treatment and Prevention	Infant Health and Safety
Medicaid	Health Care Plans
Mother Medical Visits / Follow-Up	Health Care Plans
Childhood Immunizations and Seasonal Flu Vaccine	Health Care Plans
Choosing Quality Medical Home/ Pediatrician for Baby	Health Care Plans
Choosing Quality Medical Home for Mother	Health Care Plans
Appropriate Use of Healthcare Services	Health Care Plans
Health Insurance Coverage	Health Care Plans
Infant Medical Visits / Follow-Up	Health Care Plans
Quality Day Care Criteria	Child Care Plans
Parenting Strategies / Knowledge	Parent-Child Relationship
GED / Education	Household and Material Supports
Financial Assistance	Household and Material Supports
Transportation: Van Access / Bus	Household and Material Supports
WIC / Food Stamps / Food Services	Household and Material Supports
Domestic Violence (Partner or Child Maltreatment)	Family and Community Violence
Neighborhood and Environmental Safety	Family and Community Violence
Maternal Mental Health	Depression / Anxiety
Substance Abuse: Alcohol	Substance Abuse
Substance Abuse: Illicit drugs	Substance Abuse
Substance Abuse: Smoking	Substance Abuse
Marital / Partner Relations	Parent Emotional Support
Social Supports	Parent Emotional Support
Required In-Home Protocol Topics	General Impressions

	Healthcare			Parenting / Child Care		
	Parental health	Infant Health	Health care plans	Child Care Plans	Parent-Child Relationship	Management of Infant Crying
GOAL	<i>Mother is recovering from delivery, parents in good health, able to care for infant. Thought given to family planning.</i>	<i>Infant born at or near term and is in good health as are other children. Family has safety measures (e.g. CPR, smoke alarms.)</i>	<i>Primary health care for infant and mother is planned and scheduled as needed, and health insurance is in place.</i>	<i>Parent(s) has child care plan, including emergencies and respite with day care if needed.</i>	<i>Parent(s) and infant are growing into a sensitive and responsive relationship.</i>	<i>Parent(s) describes infant crying as normal and has planned response. Parent can identify crying that is out of normal range and has a plan to deal with this.</i>
No concerns, no immediate needs.	1- Mother is recovering as expected with few concerns.	1- Infant health good, as expected, other children have health needs addressed.	1- PCP identified for both infant and mother, infant's first visit completed, next visit scheduled.	1- Parent identifies care for each day, emergencies, and planned respite.	1-Parent understands infant's needs and is responsive to infant signals.	1- Parent sees infant crying as normal and responds. May find cry difficult but can cope.
Some needs for family well being in this factor, addressed during 1st home visit.	2- Mother has minor health issues, but not expected to affect parenting. Advice and/or resources given during visit	2- Minor infant health concerns (e.g., pre-term, postnatal condition). Advice and/or resources given during visit.	2- Uncertainty about medical home, regular care, or insurance. Advice and/or resources shared and medical home established during visit.	2- Care plan for 3 areas not in place, but adequate plan developed and/or resources suggested.	2- Parent not always understanding of infant cues and is perplexed or frustrated. Provided support and resources.	2- Parent is concerned about crying and needs reassurance; developed coping plan during visit.
Significant family concerns and needs in this factor. Resources and follow up needed.	3- Mother's health presents a concern for infant and family. Follow up with visit and referral, if needed.	3- Infant or other child has health concerns. Requires follow up visit with link to PCP and CSC, if applicable.	3- Uncertainty about medical home, need, or plan. Follow up to ensure link is made.	3- Care plan for all three areas needed but not in place, even following discussion.	3- Parent not aware of need or unable to be responsive to infant signals. Follow up with visit and/or referral.	3- Parent is unable to cope with crying without external intervention. Follow up with visit and/or referral.
This is an emergency situation for family risk and needs.	4- Mother's health presents immediate risk for infant.	4- Infant or other child has health or developmental problems requiring immediate intervention.	4- Failure to provide for primary care. Need immediate intervention.	4- Emergency child care problem. Call DSS.	4- Parent at risk of neglecting or harming the child. Call CPS.	4- Crying is out of control for parent and is at risk of neglecting or harming child. Call CPS and/or other emergency intervention.
	Household Violence & Safety			Parent Well-Being / Mental Health		
	Household/material supports	Family and community violence	History with parenting difficulties	Parent well being	Substance Abuse	Parent emotional support
GOAL	<i>Family has financial resources sufficient for basic needs.</i>	<i>Family experiences safety and security at home and in neighborhood.</i>	<i>No apparent risk factors for maltreatment with other children or in own childhood.</i>	<i>Parent(s) mental health adequate for meeting parenting demands.</i>	<i>Parent and family show no drug using seeking in household; no concerns about alcohol use that could interfere with parenting.</i>	<i>Parent has emotional, practical, and social support for parenting.</i>
No concerns, no immediate needs.	1. Financial resources adequate for food, shelter, and transport. Medicaid, MCC, or public supports being utilized if appropriate.	1. No concerns about potential violence. Parent and infant feel safe.	1. No known prior history of maltreatment as a child or parenting difficulties with own children.	1. Parent mental health is sound. No anxiety or depression in excess of normal adjustment.	1. Parent denies use now or in past and interviewer has no reason for concern.	1. Parent names other person(s) who provide emotional, practical, and social support for parenting.
Some needs for family well being in this factor, addressed during 1st home visit.	2. Financial resources limited or under-utilized. Advice and/or resources suggested during visit.	2. Mild concerns. Issues discussed and resource information about emergency services left during the visit.	2. Parent has history of maltreatment as a child and/or CPS involvement as adult, but reports good resolution and plans. Resources suggested.	2. Some concern is present and resolved during visit. Resources suggested as needed.	2. Possible past history but current use is denied. Discussion with suggested resources if need occurs.	2. Parent initially lacking in support, but develops plan for seeking support during visit.
Significant family concerns and needs in this factor. Resources and follow up needed.	3. Financial resources inadequate and/or not utilized. Follow up and/or refer for support.	3. Concerns about safety in the home or neighborhood. Follow up and/or refer.	3. Recent CPS involvement and/or ongoing concerns. Follow up and/or refer.	3. Parent screens positive for significant anxiety or depression. Follow up and/or refer.	3. Substance use is a concern. Follow up and/or facilitate referral to treatment.	3. Parent lacking in support, which presents risk for family well being. Follow up and/or refer.
This is an emergency situation for family risk and needs.	4. Family's financial status is urgent. Immediately contact DSS field worker.	4. Serious immediate concerns about safety. Call police or CPS.	4. Ongoing CPS investigation is active. Contact CPS about family needs.	4. Urgent need for mental health intervention for parent. Contact CPS.	4. Substance abuse a major issue. Contact CPS or immediate access to care.	4. Parent very isolated. Re-visit within 48 hours.

Table 2. Durham Connects Family Strengths and Needs Matrix

GENERAL IMPRESSIONS.	1- Family doing well.	2- Family doing well. Mild concerns addressed in home.	3- There are some concerns in some areas (scored or not). Follow up.	4. Major concerns. Follow up.
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Table 3. *Pre-Intervention Sample Characteristics for Population and Selected Evaluation Subsample Groups.*

Variable	RCT Population vs. Selected & Interviewed Evaluation Subsamples			Interviewed Intervention vs. Control Evaluation Subsamples	
	RCT Population (n=4,780)	Selected Evaluation Subsample (n=685)	Participating Evaluation Subsample (n=549)	Participating Intervention Subsample (n=269)	Participating Control Subsample (n=280)
% Participation of selected			80.0	81.5	78.9 (p = 0.39)
% Low birth weight	10.0	09.1 (p = 0.47)	08.9 (p = 0.42)	07.8	09.6 (p = 0.39)
% Gestation < 37 weeks	08.2	06.7 (p = 0.16)	06.2 (p = 0.10)	04.6	07.7 (p = 0.15)
% Any birth complications	07.4	05.7 (p = 0.12)	06.0 (p = 0.24)	03.9	08.0 (p = 0.04)
% Caesarian section	30.6	31.7 (p = 0.55)	31.9 (p = 0.51)	32.4	31.4 (p = 0.80)
% Multiple births	02.1	02.1 (p = 0.97)	02.6 (p = 0.45)	03.4	01.8 (p = 0.24)
% Teenage mother	05.7	05.8 (p = 0.91)	06.4 (p = 0.55)	06.5	06.2 (p = 0.89)
% Medicaid / no insurance	60.7	63.1 (p = 0.22)	65.5 (p = 0.03)	63.2	67.9 (p = 0.25)
Mother age (mean, years)	28.5	28.4 (p = 0.74)	28.3 (p = 0.43)	28.3	28.5 (p = 0.69)
Mother race / ethnicity					
% White, non-Hispanic	29.8	29.0 (p = 0.69)	26.3 (p = 0.10)	27.5	23.9 (p = 0.34)
% Black	36.7	38.2 (p = 0.46)	39.6 (p = 0.18)	35.7	41.4 (p = 0.17)
% Hispanic	22.5	23.2 (p = 0.68)	24.7 (p = 0.25)	24.5	23.6 (p = 0.79)
% Other	11.0	09.6 (p = 0.26)	09.4 (p = 0.24)	12.3	11.1 (p = 0.66)
Mother education (mean)	—	—	—	05.5	05.3 (p = 0.29)
% Mother employed / in school	—	—	—	57.6	58.2 (p = 0.88)
% Mother single, no partner	—	—	—	36.4	42.5 (p = 0.15)
% Non-English language	—	—	—	26.8	28.2 (p = 0.70)
% Infant female	49.6	54.3 (p = 0.02)	53.0 (p = 0.13)	49.8	55.4 (p = 0.11)

Note. For mother education level, figure is the mean on a scale of 1 to 9, with 6 or higher indicating some college attendance.

Note. Column 2 is contrasted with column 1, with significance level in parentheses. Column 3 is contrasted with column 1, with significance level in parentheses. Column 5 is contrasted with column 4, with significance level in parentheses.

Note. Dash denotes data not available.

Table 4. *Descriptive Statistics and Regression Models Testing Impact of Random Assignment to Durham Connects on Infant Health, Community Connections, and Family Behavior and Well-Being.*

Variable	Intervention (<i>n</i> = 269)		Control (<i>n</i> = 280)		Model			
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>B</i>	<i>OR</i>	95% CI	<i>p</i> -value
Distal Outcome: Infant Health								
Number of emergency medical care	0.90	1.27	1.37	3.40	-0.40	—	-0.56, -0.23	0.0001
Number of emergency medical visits ^{a,d}	0.83	1.15	1.00	1.60	-0.17	—	-0.35, 0.003	0.05
Number of overnights in hospital ^a	0.07	0.47	0.38	2.72	-1.55	—	-2.04, -1.06	0.0001
Proximal Goal: Total # of community	4.96	2.68	4.35	2.35	0.75	—	0.41, 1.10	0.0001
Proximal Impact: Parenting and Child Care								
Mother positive parenting behaviors ^b	4.12	0.43	4.01	0.44	0.10	—	0.03, 0.17	0.0047
Mother negative parenting behaviors ^b	0.32	0.13	0.34	0.14	-0.01	—	-0.09, 0.05	0.59
Mother knowledge of infant development ^b	0.75	0.19	0.76	0.18	-0.02	—	-0.05, 0.01	0.17
Mother sense of parenting competence ^b	4.63	0.51	4.63	0.53	0.002	—	-0.09, 0.09	0.96
Observer-rated mother parenting quality ^b (<i>n</i> =	15.15	1.50	14.72	1.80	0.31	—	0.03, 0.58	0.0317
Father – infant relationship quality ^b (<i>n</i> = 434)	2.08	0.74	1.93	0.86	0.11	—	-0.01, 0.23	0.07
Proportion using non-parental child care ^c	0.46	0.50	0.53	0.50	—	0.76	0.55, 1.09	0.14
Out-of-home child care quality rating ^b (<i>n</i> =	4.59	0.55	3.98	0.92	0.64	—	0.29, 0.98	0.0004
Proximal Impact: Family Safety								
Observer-rated home environment ^b (<i>n</i> = 516)	4.81	1.49	4.47	1.53	0.24	—	0.05, 0.44	0.0146
Marital relationship conflict ^{b,f} (<i>n</i> = 441)	-4.65	1.63	-4.63	1.68	0.03	—	-0.27, 0.32	0.86
Proximal Impact: Parent Mental Health								
Mother possible clinical depression disorder ^c	0.08	0.27	0.12	0.33	—	0.63	0.36, 1.14	0.13
Mother possible anxiety disorder ^c	0.22	0.41	0.29	0.46	—	0.67	0.46, 1.00	0.0469
Mother possible substance use problems ^c (<i>n</i> =	0.04	0.30	0.06	0.34	—	0.94	0.41, 2.13	0.87
Proximal Impact: Infant Health Care								
Timing of most recent well-baby health visit	0.70	0.46	0.68	0.47	—	1.11	0.77, 1.59	0.58

Note: *N* = 549 unless otherwise noted. All models include Medicaid status, minority race/ethnicity status, and single parent status as covariates.

^a Model estimated using Poisson regression. ^b Model estimated using ordinary least squares regression. ^c Model estimated using logistic regression. ^d Number of emergency medical visits = (number of emergency pediatric visits + number of emergency ER visits). ^e Overall use of emergency medical care = (number of emergency medical visits + number of days in hospital).

^f Marital relationship = (total relationship conflict – total relationship negotiation).

Table 5. *NICHD Grant Timeline with Proposed Data Collection Schedule*

Timeline	Infant Age	Project Activity	Status	Funding Source
7/1/09 – 12/31/10	Birth	Enroll; Intervene	Completed	Existing
1/1/10 – 6/30/11	6 months	In-home interview	Completed	Funding
1/1/11 – 6/30/12	18 months	Telephone interview	In progress; Complete in grant year 1	NICHD
7/1/11 – 12/31/12	24 months	Telephone interview	In progress; Complete in grant year 1	
1/1/12 – 6/30/13	30 months	In-home interview	Complete in grant years 1-2	
7/1/12 – 12/31/13	36 months	Mailing contact	Complete in grant years 1-2	
1/1/13 – 6/30/14	42 months	Telephone interview	Complete in grant years 1-3	
7/1/13 – 12/31/14	48 months	In-home interview	Complete in grant years 2-3	
1/1/14 – 6/30/15	54 months	Telephone interview	Complete in grant years 2-4	
7/1/14 – 12/31/15	60 months	Mailing contact	Complete in grant years 3-4	
1/1/15 – 6/30/16	66 months	School records; interview	Complete in grant years 3-5	

Figure 1. CONSORT 2010 Flow Diagram for Durham Connects RCT Implementation

