

# streamline

The Migrant Health News Source

## Access to Prenatal Care: The Case of Nebraska

Jillian Hopewell, MPA, MA

**O**n a recent day in late July, 2011, Courtney Allen, a certified nurse midwife with OneWorld Health Center in Omaha, Nebraska, conducted an initial exam on a 36-week pregnant woman for the very first time. Unfortunately, Allen says, this is now an almost daily event since the elimination of a highly effective government policy which provided funds to cover prenatal care for women in Nebraska.

Enrollment in care during the first trimester (first three months) of pregnancy is a reflection of timely initiation of prenatal care. Early prenatal care is associated with positive pregnancy outcomes, since early and regular prenatal care typically includes basic preventive care such as nutrition counseling and supplements, screening for risk factors, and educa-

tion related to a variety of self-care topics. The value of early prenatal care is not based on the isolated care provided in the first trimester, rather, it is based on the presumption that early care leads to regular prenatal visits throughout the pregnancy. It is also important to remember that the percentage of pregnant women who initiate prenatal care in the first trimester is a required clinical measure for federally-funded health centers. Enrollment of women into prenatal care in the first trimester is an acceptable way to measure access to care for pregnant women.

Since the 1980s, Nebraska has provided prenatal care under its Medicaid program to all pregnant, low-income women regardless of their citizenship status. However, late in 2009 the U.S. Department of Health and Human

Services, Centers for Medicare and Medicaid Services (CMS) notified the state of Nebraska that they could no longer provide Medicaid funds to cover prenatal care for certain individuals. CMS advised Nebraska instead to provide prenatal care through the state Child Health Insurance Program (CHIP). At that point, the Nebraska Department of Health and Human Services sent the issue to the state legislature for the authority to provide funding for prenatal care through CHIP. Although a bill was introduced in the state legislature and a hearing was held, the proposed bill was eventually pulled by the state senator who had introduced it because she felt there were not enough votes for it to pass.

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Without state approval for prenatal care coverage through CHIP, on March 1, 2010, Nebraska ended Medicaid benefits for 1,540 women, about 25 percent of the pregnant women eligible under the old rules. Seven hundred were U.S. citizens and legal immigrants and the other 840 were undocumented immigrants. (<http://www.womensradio.com/articles/Nebraska-Prenatal-Bill-Stirs-Fight-Over-Immigration/4635.html>) The women who lost coverage included undocumented immigrants, legal residents with less than 5 years in the U.S., other legal immigrants, and patients otherwise not eligible (i.e. not willing to seek child support from the child's father).

The impact of these policy changes has been profound for this vulnerable population as well as for migrant and community health centers in Nebraska. OneWorld Community Health Center in Omaha, Nebraska, is one of the health centers that have been dramatically affected by the changes in prenatal insurance coverage. Figures 1 and 2 demonstrate the immediate impact this policy had on insurance rates of prenatal patients at the health center.

OneWorld Health Center is a federally-funded health center located in south Omaha, Nebraska. This is an urban area with a sizable Hispanic/Latino population; approximately 85% of the health center's clients are Hispanic/Latino. The area employs a number of individuals in factory work including meat processing and tortilla plants. There is a significant migrant population that also uses the health center. Health center personnel say that every day they see new clients who have just moved to the area.

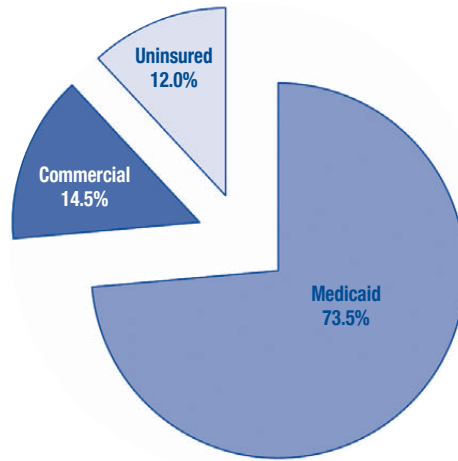
OneWorld has a strong maternal health program with four nurse-midwives on staff. The midwives have hospital privileges and average 25-30 births/month. The midwifery staff also provide primary care and gynecological services as do the other primary care clinicians employed by the health center.

Prior to the Medicaid policy change in early 2010, OneWorld had made steady progress in improving rates of entry into prenatal care. By 2009 OneWorld had an overall rate of 82.2% entry into prenatal care in the first trimester of pregnancy. This rate is significantly higher than the national rate in the U.S. and is also higher than other community-based health centers in Nebraska.

Immediately after the Medicaid coverage was eliminated OneWorld experienced a dramatic drop in the number of women coming in for prenatal care in the first trimester from 82.2% to 59.7%. By mid-2010 this rate had increased to 64%, but is still significantly below the 2009 rates.

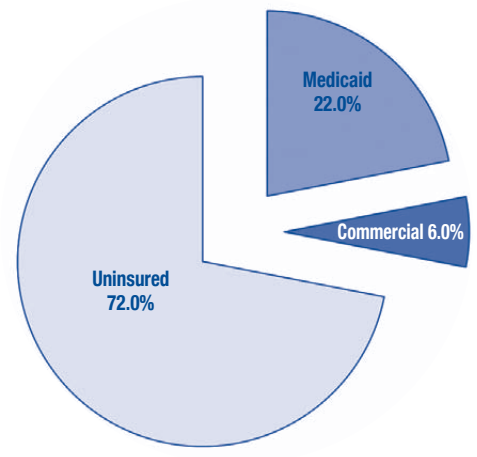
Table 1 shows the impact of this policy change on a neighboring state, health

**Figure 1**  
**Q4 2009 Prenatal Care Insurance Coverage at OneWorld Health Center**



(Source: Kris McVea, MD, Medical Director, OneWorld Health Center)

**Figure 2**  
**2010 Prenatal Care Insurance Coverage at OneWorld Health Center**



(Source: Kris McVea, MD, Medical Director, OneWorld Health Center)

centers in Nebraska and OneWorld in particular.

The aggregate numbers are disturbing, but the true impact of these changes is felt dramatically at the practice level. Prior to 2010 OneWorld saw most women in their first trimester of pregnancy while now they are seeing women late in the 2nd trimester and into the 3rd trimester. Clinic staff report that the principal reason women state for not coming in sooner is that they cannot afford to pay for prenatal care.

As a result of late prenatal care the health center is seeing an increase in pregnancy complications including undiagnosed gestational diabetes, high blood pressure, and fetal abnormalities that would have otherwise been diagnosed. Recently they had a case of a 16-year-old patient who was never seen for prenatal care. The patient was taken to an emergency department following a seizure episode in her home as a result of pregnancy induced high blood pressure. The patient had to have an emergency C-Section

and the baby spent weeks in the Neonatal Intensive Care Unit. This patient's case of preeclampsia would likely have been diagnosed and managed if she had been seen for prenatal care.

In another recent case, a woman presented in the clinic saying that she was "due tomorrow" and worried about her baby. An ultrasound revealed that the gestational age of the fetus was over 43 weeks. The placenta measured at a grade 3, meaning that circulation to the baby was seriously compromised. The woman had to have an emergency C-Section and the baby was sent to the Neonatal Intensive Care Unit.

To better understand the impact of insurance coverage for prenatal care, Dr. Kris McVea, Medical Director at OneWorld Health Center, examined rates of three major prenatal screening tests: the Quad Screen which tests for genetic problems; the Group B Strep which identifies a potential newborn infec-

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**Table 1**  
**Entry into Prenatal Care Comparison to Other CHC's**  
January to June 2010

	2009	2010 Midterm
CHC's Nationally	67.3%	—
Iowa CHCs (neighboring state that did not eliminate Medicaid coverage)	72.1%	77.5%
Nebraska CHCs	76.9%	52.9%
OneWorld Community Health Center	82.2%	64%

Photo courtesy of Alan Pogue

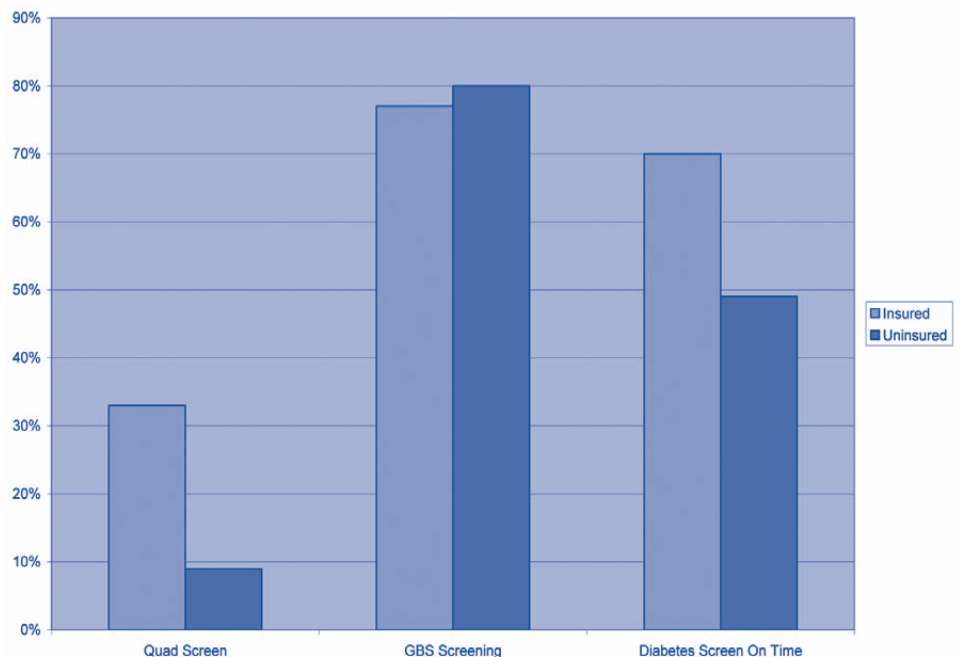


tion; and the Glucose Tolerance Test which tests for gestational diabetes. Figure 3 shows the rates of each test among the insured versus the uninsured at OneWorld Health Center. While the Group B Strep test was not affected by a lack of insurance, the rates of women who received the Glucose Tolerance Test and the Quad Screen was significantly lower among the uninsured. According to Dr. McVea, the reason for the decreased screening is that uninsured women self ration their health care expenses, electing to attend fewer visits and forgoing some laboratory tests in order to decrease their costs.

Dr. McVea explained that she also sees the impact of a decrease in prenatal visits in the delivery outcomes of patients at OneWorld. More women are choosing to stay home and labor because emergency Medicaid does not cover an evaluation in the hospital if the woman does not actually deliver. This has led to at least two deliveries in the clinic, four unintentional home deliv-

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**Figure 3**  
**Prenatal Test Rates in Insured versus Uninsured Patients at OneWorld Health Center**



eries and a number of women delivering very soon after hospital arrival. All of these situations mean that there is less of a chance for monitoring labor or conducting routine care such as administering antibiotics if needed for Group B Strep.

### **Clinic Response**

In response to the serious decline in early prenatal visits, OneWorld has instituted a new program called Every Baby Matters which allows women to come in for a prenatal visit at the much reduced rate of \$5.00 per visit. Currently the clinic is absorbing the costs associated with these visits. Additionally, OneWorld has an established relationship with Creighton University Medical Center which has agreed to offer reduced rates on ultrasound and perinatologist visits. To promote these programs, OneWorld participates in baby fairs in the community and distrib-

utes flyers about the services they offer.

The health center is challenged to find services and resources for the women who do come in for care. Health center staff does everything they can to maximize what they do in a given appointment. Additionally, they provide ongoing education to women to emphasize the importance of prenatal care. In general, their work has become more intensive on a day-to-day basis since the policy changes took effect.

### **Policy Response**

The health care advocacy community in Nebraska has rallied around this issue and made significant strides towards policy changes that could result in the restoration of prenatal care benefits. Becky Gould, JD, the Executive Director of Nebraska Appleseed, a non-profit, nonpartisan public interest law firm, says that there has been a strong recog-

nition of the shortsightedness of denying access to prenatal care. Appleseed and other advocates have been working with the state legislature and are hopeful that a new bill which would restore prenatal care coverage will advance out of committee this January when the state legislature returns to session. Gould says that "the health care community has fought hard on this issue and has done a fantastic job of providing data on the impact this policy has had on their practices. It is hugely important to have the medical community engaged in healthcare advocacy."

On a practice level, until the policy is reversed, clinicians such as Dr. McVea, Courtney Allen, and the other staff members at OneWorld continue to explore creative mechanisms for bringing women into care in the hope that progress that was made in Nebraska for pregnant women and their children will not be completely lost. ■

# Pregnancy on the Move

Ricardo Garay, Manager, Health Network and Candace Kugel, FNP, CNM, Clinical Specialist, Women's Health

MCN's Health Network is available to healthcare organizations to provide case management, referral and record transfer services for individuals who are likely to move during care—that is broader than treatment treatment. The following case illustrates how this program works for migrant women during pregnancy. Names and other details have been changed to protect patient privacy.

**X**iomara was referred to Health Network in May of 2010 by a health department in a southeastern state that sent enrollment forms for this 21-year-old woman for the prenatal arm of Health Network. This referral set into motion a series of interactions that ensured that this young migrant woman would not fall through the cracks in the network of healthcare services for the underserved.

Once the enrollment paperwork was processed in MCN's Austin, Texas office, the case was assigned to Gracie Castillo, one of four bilingual Health Network associates. Gracie proceeded to contact the client, and establish a better understanding of her situation. Xiomara stated that this was her first pregnancy, she was at about three months, and she was staying temporarily at a motel. She mentioned that she was planning on moving — perhaps to Pennsylvania sometime during the summer — though she did not have an exact address at that point. She expressed concern about the cost of care involved with her pregnancy at her current location and had made an appointment at a different clinic from the one that had enrolled her in Health Network. Gracie provided an overview of Health Network services and gave the woman a direct toll-free number to call in case immediate assistance was required.

The next step was to get medical records from the enrolling clinic. The health department had limited records, however, since they had only performed a pregnancy test and had then referred Xiomara elsewhere for prenatal care. Records were also requested from a secondary site where the client had been seen. Xiomara called Gracie a few days later complaining that she had had some abdominal pain a few days earlier. She had gone to the clinic but was instructed to go to the emergency room since the ob/gyn physician was not on site that day. She admitted that she had not gone because of concern about the cost of a hospital visit and was relieved that she was no longer

having pain. Gracie was able to locate a hospital clinic in her area that was willing to work with the patient's financial situation and arranged an appointment for Xiomara.

For two months the patient attended multiple appointments at the new location, touched base regularly with Health Network regarding her progress and her pregnancy proceeded normally. She received appropriate lab work, an ultrasound, and also completed financial paperwork. Health Network obtained medical records from this site and included these in the patient's file.

When Gracie made a routine follow up call to Xiomara about a month later, the patient did not answer her phone, despite numerous attempts and voicemails. It was not until three months later that the patient called Health Network, reporting she had moved to another state and had recently gone to the emergency room there because of unbearable pain. She did not know her address in the new location and said she would call back when she knew exactly where she was staying. She mentioned that she would only be there for a couple of weeks. She called back with her address. Health Network located a clinic, forwarded medical records to the clinic and made an appointment of Ximoara.

Another month passed when Xiomara did not answer her phone but she finally returned a call in October, stating that she had just delivered a healthy baby girl by cesarean section. She had returned to her original residence in the southeast and was concerned because of swelling, redness and general discomfort around her surgical incision. She had attempted to make an appointment at the clinic but the only time available was a week away. Gracie contacted the clinic to explain the situation and was able to get an appointment for the next day. Despite transportation difficulties and her husband's work demands, she was able to attend the visit and was given treatment. She recovered well and had a six-week post partum visit, as Gracie had encouraged.

Typically Health Network considers a prenatal case to be completed after the post partum visit takes place and all records are received. Xiomara provided an unusual opportunity for follow up when she called Gracie four months after her baby's birth to express her appreciation for Health Network's involvement in her



Photo courtesy of Candace Kugel

case. She confided that her relationship with her husband had dramatically changed after having her baby — she was thrilled that she was no longer a victim of abuse.

According to protocol, this case was closed after being reviewed by MCN clinical staff. All notes for interactions with the client and the various healthcare organizations involved in Xiomara's care are documented according to HIPAA standards. Through three moves, five healthcare organizations and 43 contacts with Health Network, this patient's enrollment in Health Network reveals the impact of "bridge case management", not only through the mechanical services of scheduling appointments and transferring medical records, but also through the more personal avenue of direct communication with patients and their clinicians.

For additional information about Health Network see [www.migrantclinician.org/services/health-network.html](http://www.migrantclinician.org/services/health-network.html).

# Considering Midwifery Models of Care for FQHCs

Robyn Northup

**C**ertified Nurse Midwives (CNMs) are advanced practice nurses trained to provide primary care for women across the lifespan with a special emphasis on pregnancy, childbirth, and gynecologic and reproductive health. The presentation *Giving Birth to Quality Perinatal Care Services: Midwifery Models for FQHCs*, developed and delivered by Barbara Boehler, CNM; Candace Kugel, FNP, CNM; Denise Henning, CNM; and Martha Carter, MBA, CNM, at the 2011 National Association of Community Health Center's Policy and Issues Forum identified the benefits and considerations associated with implementing midwifery models of care in Community and Migrant Health Centers (CMHCs). An audience of health center clinicians, executive directors, state and regional primary care partners, CMHC board members and advocates were in attendance to receive the presentation.

Considering midwifery models of care are of critical interest in 2011 as state and federal government policies affecting health centers and health care for millions of Americans are being decided, and both U.S. birth and maternal mortality rates are up from the 1990's. In 2007, the nation's maternal mortality rate was 17 maternal deaths for every 100,000 live births, a more than 200% increase from 8 of 100,000 live births in 1990. Similarly, both preterm birth and low birth weight rates show increases, and racial and ethnic minorities are significantly overrepresented in these worsening outcomes. When we consider that the U.S. currently has one of the highest maternal mortality rates among developed nations, the urgency of addressing disparities in maternal and infant health is self-evident. Expanding employment of CNMs in community health centers is an option for relief.

The practice of midwifery, which means "with woman," recognizes the woman as a unique individual in the context of her family and community, supports and protects the normal physiologic process of labor and birth and establishes the woman as an active partner in her own care.

In multiple studies of low-risk, low-income women in collaborative CNM/obstetrician care, participants had more spontaneous vaginal births, lower utilization of resources and no differences in adverse outcomes compared to those in traditional (obstetrician-only) care. Additionally, participants obtained appointments more quickly, spent more time with providers and were provided

## Women's Health Resources Recommended by MCN

1. The first report to comprehensively explore current midwifery practices across the globe, the *State of the World's Midwifery 2011: Delivering Health, Saving Lives*, was released in June by the International Confederation of Midwives in Durban, South Africa.
2. MCN is an outreach partner for Text4baby a service for pregnant women that provides free educational text messages in English or Spanish. Enroll your pregnant women! See [www.text4baby.org](http://www.text4baby.org).
3. The Southern Poverty Law Center produced a report called "Injustice on our Plates: Immigrant Women in the US Food Industry" (<http://www.splcenter.org/get-informed/publications/injustice-on-our-plates>), an examination of workplace exploitation sexual violence in the lives of immigrant women.
4. Childbirth Connection has launched a new site focused on maternity care system improvement, designed to engage diverse stakeholders in quality improvement efforts. The site offers full access to the landmark 2020 Vision and Blueprint for Action, an Action Center, a database of quality improvement projects, an interactive data center, and many more tools and resources. Go to *Transforming Maternity Care*

more health information than those in traditional care.(1-2) We can assume the practical application of the collaborative care model indicates that CNM utilization is ideal for diverse patient populations: allowing women to be matched to the appropriate level of care, increasing access to care, leading to better health outcomes and lower preterm birth rates, as well as providing greater patient satisfaction with treatment and services and promoting better communication among providers.

Midwifery models of care are realistic options for CMHCs and other medical settings. CNM practice is legal in all 50 states and CNMs have prescriptive authority. Required credentials are a Master's degree and board certification. Ninety-eight percent of CNM deliveries are hospital-based.

CNMs' scope of practice extends beyond the realm of attending births. Nurse-midwives provide prenatal care, annual gynecological exams, family planning counseling and services, preconception care, depression screening and school physicals. Practice may encompass colposcopy, limited ultrasounds, IUD and Implanon insertions, circumcisions and first assistance at cesarean sections.

Considerations in creating infrastructure for and implementing a midwifery care

model include the clinical, financial and practical. Volume is key to sustainability of perinatal care services. Creating a medical home for pregnant patients from the onset is a systematic way of increasing the likelihood that those utilizing obstetric and gynecological services will also access CMHCs' pediatric and family medicine services.

Practical considerations include accommodating scheduling demands, which may differ from that of other providers (i.e., ideally, on call hours and office hours are not scheduled at the same time), and that providing support staff for CNMs is necessary.

In essence, midwifery and collaborative care models benefit both the health center and the patient. CNM utilization is a gateway to high quality, low-cost perinatal care services that are potentially more patient-centered than traditional models to populations in need: those suffering the greatest barriers to accessing health care. ■

## References:

1. Jackson, DJ, et al. Outcomes, safety and resource utilization in a collaborative care birth center program compared with traditional physician-based perinatal care. *American Journal of Public Health* 2003. 93; 6:999-1006.
2. Hankins, GD, et al. Patient satisfaction with collaborative practice. *Obstet and Gynecol*, 1996; 88:6:1011-15.

# Text4baby Outreach to the Hispanic Community

Luisa F. Soaterna-Castañeda

## BACKGROUND

In the U.S., 85% of English speaking Hispanics (31 million Hispanics) own a cell phone and out of these 83% send and or receive text messages. There is a lot to be learned about the usage of cell phones for Hispanic migrant workers; however, anecdotal evidence suggests that the majority of migrant workers own and use cell phones as their primary method of communication. Text messaging represents an enormous yet untapped channel for delivering vital health information to those who need it most. This is the opportunity that an innovative new program called text4baby has seized.

Hispanics are the largest and the fastest growing minority group in the United States, much of this growth is attributed to new births. Unfortunately, among Hispanic women 12.2% of live births are premature and this population experiences major barriers to accessing prenatal care services. These barriers are exacerbated for migrant workers who face very complex challenges.

National Healthy Mothers, Healthy Babies Coalition (HMHB) is committed to helping women have healthy pregnancies and healthy babies. To help address factors that contribute to the problem of prematurity, HMHB launched text4baby, a free mobile information service that provides pregnant women and new moms with information to help them care for their health and give their babies the best possible start in life.

Text4baby is a free service where women can sign up to receive this service in Spanish by texting BEBE to 511411 (or BABY for English). Once enrolled, they receive weekly text messages, timed to their due date or their baby's date of birth. The texts continue through the baby's first year. These messages focus on a variety of topics critical to maternal and child health, including birth defects prevention, immunization, nutrition, seasonal flu, mental health, oral health and safe sleep. Text4baby messages also connect women to bilingual prenatal and infant care services and other resources. Thanks to the partnership of CTIA-The Wireless Foundation, the text messages are completely free of charge.

As one young Latina participant said, "If you use text4baby, you're going to have a resource that's going to help you understand what to expect, and not only that... it's also going to give you phone numbers where you can find help for whatever deci-



Photo courtesy of Shannon Aichele

sion making you need to make for your baby. I've been using it and it's helped me, so I hope you use it too."

## OUTREACH PARTNERS

Text4baby is made possible through a broad public-private partnership. Johnson & Johnson is the founding sponsor, and founding partners include the National Healthy Mothers, Healthy Babies Coalition, Voxiva, CTIA-The Wireless Foundation and Grey Healthcare Group. U.S. government partners include the White House Office of Science and Technology Policy, the Department of Health and Human Services, the Department of Defense Military Health System, and the U.S. Department of Agriculture. Free messaging is generously donated by participating wireless service providers.

The HMHB Coalition is working with a broad range of partners to encourage the Latinas they reach to take advantage of this free service. Over 600 outreach partners implement text4baby, including major medical associations, state and local health departments, community health centers, WIC programs, non-profits and community organizations. Outreach partners include: National

Alliance for Hispanic Health, National Council of La Raza, Migrant Clinicians Network, National Hispanic Medical Association and the Latino Caucus of the American Public Health Association.

Text4baby promotional materials are made available in Spanish and English to better support partners serving monolingual and bilingual Spanish-speaking women. These include informative posters and fliers, in addition to tearpads and referral cards with clear instructions on how to enroll in the service. Many activities have been executed by text4baby partners some of these include: showcasing the Spanish-language poster in a mall kiosk, inclusion of text4baby information in bilingual e-newsletters or print newsletters, using posters in health clinics and exam waiting rooms, the creation and distribution of bilingual fliers and other promotional materials, training of bilingual health center staff to inform and assist Hispanic women who wish to enroll.

Visit [www.text4baby.org](http://www.text4baby.org) to find out how you can become a partner, who is promoting the text4baby in your community, as well as to join statewide collaborations to get the word out. ■

# Prenatal Exposure to Organophosphate Pesticides and IQ in 7-Year-Old Children

Maryse F. Bouchard, Jonathan Chevrier, Kim G. Harley, Katherine Kogut, Michelle Vedar, Norma Calderon, Celina Trujillo, Caroline Johnson, Asa Bradman, Dana Boyd Barr, and Brenda Eskenazi

The following article is *excerpted* with permission from *Environmental Health Perspectives*, Volume 119, Number 8, August 2011. To read the full article go to: <http://ehp03.niehs.nih.gov>

**O**rganophosphate (OP) pesticides are widely used in agriculture, and several are registered for home garden use [U.S. Environmental Protection Agency (EPA) 2006]<sup>1</sup>. In 2010, 32 OP pesticides were registered in the United States (U.S. EPA 2010).<sup>2</sup> In 2007, 15 million kilograms of OP pesticides were used in the United States, representing 36% of all insecticides used (Grube et al. 2011).<sup>3</sup> In California, 1.6 million kilograms of OP pesticides were used in agriculture in 2008; the top five active ingredients were chlorpyrifos, malathion, phosmet, ethephon, and dimethoate [California Department of Pesticide Regulation (CDPR) 2010].<sup>4</sup>

OP pesticides have well-known neurotoxic properties, with the primary mechanism of action involving inhibition of acetylcholinesterase at high doses (Sultatos 1994).<sup>5</sup> At doses lower than those needed to inhibit acetylcholinesterase, certain OP pesticides affect different neurochemical targets, including growth factors, several neurotransmitter systems, and second-messenger systems (Slotkin and Seidler 2007;<sup>6</sup> Verma et al. 2009)<sup>7</sup>.

Most human studies showing adverse health effects of OP pesticides have been carried out in occupational settings with high exposure levels (Kamel et al. 2007).<sup>8</sup> Children may experience chronic, low-level exposure due to historical home use, living near an agricultural field, and residues in food (Bradman et al. 2007;<sup>9</sup> Lu et al. 2004).<sup>10</sup> Children are at higher risk for pesticide toxicity than are adults because the developing brain is more susceptible to neurotoxicants and the dose of pesticides per body weight is likely to be higher in children (Weiss 2000).<sup>11</sup> Children also have lower activity and levels of enzymes that detoxify activated forms of certain OP pesticides (Holland et al. 2006).<sup>12</sup>

Epidemiologic studies suggest that prenatal exposure to OP pesticides is associated with poorer neurobehavioral development in infants (Engel et al. 2007;<sup>13</sup> Young et al. 2005)<sup>14</sup> and toddlers and preschoolers (Eskenazi et al. 2007;<sup>15</sup> Handal et al. 2008;<sup>16</sup> Rauh et al. 2006).<sup>17</sup> Postnatal OP exposure has also been associated with behavioral

problems; poorer short-term memory, executive function, and motor skills; and longer reaction time in children (Bouchard et al. 2010;<sup>18</sup> Grandjean et al. 2006;<sup>19</sup> Rohlman et al. 2005;<sup>20</sup> Ruckart et al. 2004)<sup>21</sup>. Few studies have assessed exposure to OP pesticides both prenatally and during childhood.

The Center for the Health Assessment of Mothers and Children of Salinas (CHAMACOS) study is a birth cohort study investigating pesticide and other environmental exposures and the health of pregnant women and their children living in an agricultural community. Our findings suggest that most maternal pesticide exposure probably occurs through the diet, as is the case for the general U.S. population, but with additional residential nondietary exposure most likely from ingress of pesticides from agricultural use into homes (Harnly et al. 2009);<sup>22</sup> McKone et al. 2007).<sup>23</sup> Previous reports on the CHAMACOS cohort suggested that prenatal, but not postnatal, exposure to OP pesticides was associated with increased odds of pervasive developmental disorder and lower scores of mental development at 2 years of age (Eskenazi et al. 2007),<sup>15</sup> and with poorer attention skills as well as hyperactive behaviors at 5 years of age (Marks et al. 2010).<sup>24</sup> It remains unclear whether cognitive deficits associated with prenatal exposure to OP pesticides are persistent, because cohort studies have not followed children to school age, when deficits may have greater implications for school performance. Here, we report the association between prenatal and postnatal exposure to OP pesticides, indicated by urinary dialkyl phosphate (DAP) metabolite concentrations, and cognitive abilities of 7-year-olds.

## Discussion

Our findings suggest that prenatal exposure to OP pesticides, as measured by urinary DAP metabolites in women during pregnancy, is associated with poorer cognitive abilities in children at 7 years of age. Children in the highest quintile of maternal DAP concentrations had an average deficit of 7.0 IQ points compared with those in the lowest quintile. Associations were linear, and we observed no threshold. However, DAP concentrations during childhood were not associated with cognitive scores in this cohort of children.

Developing fetal nervous systems may be

more vulnerable to *in utero* exposure to OP pesticides because of the many unique processes occurring during this stage of development, such as cell division, migration, differentiation, formation of synapses, pruning of synapses, apoptosis, and myelination (Tau and Peterson 2010)(25). Fetal exposure to OP pesticides occurs via passage of the OPs through the placenta (Rauh et al. 2006(17); Whyatt et al. 2009(26)). In addition, DAP metabolites have been detected in amniotic fluid (Bradman et al. 2003) (27).

Previous reports from this cohort have also shown associations of prenatal but not postnatal OP exposure with adverse neurobehavioral functioning (Eskenazi et al. 2007 (15); Marks et al. 2010 (24)). Our findings are consistent with those of other investigations of adverse associations between prenatal exposure to OP pesticides and cognition (Harari et al. 2010 (28); Rauh et al. 2006(17)). In contrast to the present findings, a few other studies reported that OP metabolites measured in children were associated with poorer cognitive abilities (Lizardi et al. 2008(29); Ruckart et al. 2004(21)). However, these studies differed in exposure and/or the outcomes found to be associated with OP pesticides. For instance, Ruckart et al. (2004)(21) examined the relationship between methyl parathion—an OP pesticide rarely used in the Salinas Valley—and found no association with general intelligence in 6-year-olds but did find adverse associations between concurrent exposure and other specific neuropsychological domains (i.e., poorer memory, attention, and motor skills). In a study of 48 children 7 years of age, Lizardi et al. (2008)(29) reported that those with detectable levels of DAPs had a worse performance on a test of executive function, but not on the Full-Scale IQ, compared with those with nondetectable levels. Studies of women who worked in floriculture in Ecuador found associations with certain specific neurobehavioral domains in their children but did not assess general intelligence (Grandjean et al. 2006(19); Handal et al. 2007(30), 2008; Harari et al. 2010(16)).

This study has limitations, mostly related to the assessment of exposure to OP pesticides. Assessing OP exposure is challenging because of their fast clearance from the

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body, with complete excretion in the urine within 3–6 days (Bradway et al. 1977)(31). We observed that prenatal exposure indicated by the average of two DAP metabolite measures taken during pregnancy was associated with markedly poorer cognitive performances. However, the association of DAP metabolites measured at one point in time during pregnancy—either earlier or later during gestation—was not as strongly associated with cognitive scores. Considering the rapid metabolism of these compounds, it seems likely that exposure assessment based on a single urinary DAP measure is less representative of longer-term exposure than are serial measurements. In addition, DAP metabolites in urine may in part reflect exposure to preformed DAPs present in the environment or food (Lu et al. 2005);<sup>32</sup> therefore, the proportion of urinary DAP metabolites that reflect exposure to parent pesticide compounds is unknown. However, these sources of exposure misclassification are nondifferential and would bias results toward the null. Despite the limitations pertaining to the use of urinary DAPs as exposure indicators to OP pesticides, they may provide the best integrated measure available at this time. Indeed, for many OP pesticides, no methods currently available measure pesticide-specific metabolites in urine or OP parent compounds in blood.

Prenatal exposure to OP pesticides, primarily with DM rather than DE metabolites, was associated with poorer cognition at 2 years of age in this cohort (Eskenzi et al. 2007),<sup>15</sup> as well as in the 7-year follow-up we report here. The exception was that DE metabolites were more strongly associated than DM metabolites with deficits on Processing Speed. The stronger associations with DM metabolites for most cognitive measures could be explained by the greater toxicity of some of these OP pesticides. For example, oxydemeton-methyl, which devolves to DM metabolites, is the most toxic of OP pesticides used in the study region and represents the greatest cumulative risk (Castorina et al. 2003).<sup>33</sup> On the other hand, DE metabolites may be less stable and, consequently, poorer exposure biomarkers (Bradman et al. 2007);<sup>9</sup> this would likely bias the effect estimates toward the null.

The present study also has considerable strengths, perhaps most notable among them being its longitudinal design. We

**Table 1.**  
Study cohort characteristics and maternal urinary DAP concentrations (mean of two measures taken during pregnancy), CHAMACOS (n = 329).

Cohort Characteristic	n (%)	Geometric mean DAP (95% CI) (nmol/L)	p-Value <sup>a</sup>
<b>Child's sex</b>			0.50
Boys	154 (47)	136 (115-161)	
Girls	175 (53)	126 (108-146)	0.71
<b>Maternal Education</b>			
<6th grade	148 (45)	127 (106-152)	
7th-12th grade	111 (34)	127 (105-154)	
Completed high school	70 (21)	143 (113-181)	
<b>Maternal intelligence (PPVT score)</b>			0.17
≤ 74	106 (32)	150 (128-177)	
75-100	120 (36)	129 (109-154)	
> 100	103 (31)	103 (95-136)	
<b>HOME score at 6 months</b>	0.10		
≤ 31.0	139 (42)	150 (128-177)	
31.1-33.3	85 (26)	118 (95-147)	
> 33.4	105 (32)	117 (97-141)	
<b>Family income at 7 years</b>			0.31
< Poverty level	232 (71)	125 (109-142)	
Within 200% of poverty level	95 (29)	143 (116-179)	
> 200% of poverty level	2 (1)	283 (207-389)	
<b>Language of WISC-IV verbal subtests</b>			0.77
English	108 (33)	133 (108-160)	
Spanish	221 (67)	129 (113-149)	
<b>Maternal country of birth</b>			0.55
Mexico	282 (86)	133 (118-152)	
United States	43 (13)	115 (83-160)	
Other	4 (1)	94 (62-186)	
<b>Mother performed farm work during pregnancy</b>			0.64
Yes	145 (44)	123 (105-146)	
No	180 (55)	136 (117-159)	
Missing	4 (1)	160 (31-2539)	
<b>Farmworker in household during pregnancy</b>			0.76
Yes	273 (83)	128 (113-145)	
No	54 (16)	142 (110-189)	
Missing	2 (1)	108 (89-131)	

<sup>a</sup> One-way analysis of variance on log10-transformed DAP concentrations.

**Table 2.**  
Change in cognitive scores in children tested at 7 years of age, for a 10-fold increase in maternal DAP concentrations (nmol/L) measured in the first and second half of pregnancy (≤ 20 weeks, > 20 weeks), CHAMACOS.

Cognitive test	FIRST HALF OF PREGNANCY			SECOND HALF OF PREGNANCY		
	n	β-Coefficient (95% CI)	p-Value	n	β-Coefficient (95% CI)	p-Value
<b>WISC-IV scale</b>						
Working Memory	267	-1.6 (-4.2 to 1.0)	0.22	279	-3.0 (-6.4 to 0.4)	0.08
Processing Speed	268	-1.5 (-3.9 to 0.9)	0.21	280	-2.6 (-5.9 to 0.7)	0.12
Verbal Comprehension	291	-2.6 (-5.1 to -0.1)	0.04	309	-3.1 (-6.4 to 0.2)	0.06
Perceptual Reasoning	292	-1.2 (-4.1 to 1.7)	0.42	309	-2.4 (-6.3 to 1.4)	0.22
<b>Full-scale IQ</b>	266	-2.3 (-4.9 to 0.2)	0.07	279	-3.5 (-6.9 to -0.1)	0.04

Estimates were adjusted for HOME score at 6 months and maternal education and intelligence. Verbal Comprehension and Full-Scale IQ were also adjusted for language of assessment.

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## ■ Prenatal Exposure to Organophosphate Pesticides and IQ in 7-Year-Olds *continued from page 9*

measured urinary DAP concentrations during prenatal development and throughout childhood. We followed children until 7 years of age, when the tests of cognitive function are more reliable than at younger ages (Honzik 1976).<sup>34</sup> As in any epidemiologic study, the reported associations could be attributable to uncontrolled confounders, but we were able to examine or adjust for numerous important factors over the lifetime of the child, including exposure to other environmental agents, several socioeconomic indicators, maternal cognitive abilities, and child stimulation. Urinary DAP concentrations during pregnancy were weakly associated with measures of socioeconomic status, such as maternal intelligence and education. Furthermore, the study popula-

tion had a homogeneous socioeconomic profile, reducing the potential for uncontrolled confounding.

The level of urinary DAP metabolites in the pregnant women in the present study was higher than in a representative U.S. sample of women of reproductive age [National Health and Nutrition Examination Survey (NHANES) 1999–2000] (Bradman et al. 2005).<sup>35</sup> In the present group, the median of total maternal DAP concentrations was 128 nmol/L. As a comparison, NHANES levels were 72 nmol/L among pregnant women and 90 nmol/L among nonpregnant women. However, > 25% of pregnant women from the general U.S. population had DAP levels exceeding the median levels measured in the present study. Thus, the

prenatal DAP concentrations associated with cognitive deficits in offspring in the present investigation were within the range of concentrations found in the general population.

### Conclusion

Prenatal but not postnatal exposure to OP pesticides was associated with poorer intellectual development in 7-year-old children from an agricultural community. Maternal urinary DAP levels in this sample, although higher than general U.S. levels, were nonetheless within the range of the distribution levels. These findings suggest that some U.S. women in the general population may experience OP pesticide exposure at levels that are associated with poorer cognitive development in offspring in the present study. ■

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# Clinical Diagnostic Tools and Biomonitoring of Pesticide Exposures: EPA to hold October 11, 2011 meeting

Clinicians often face significant hurdles in identifying and diagnosing pesticide poisoning. Though farmworkers may present symptoms associated with pesticide exposure, there are few accessible diagnostic tests that can identify the particular type and quantity of pesticides present in the body. On October 11, 2011, the Environmental Protection Agency (EPA) will convene a meeting of clinicians, researchers, industry leaders, farmworker advocates, and other stakeholders to discuss the development of biomarkers and other tools for use in diagnosing exposure to pesticides.

Accurate diagnosis of pesticide poisoning is necessary to ensure that patients are appropriately treated and receive workers'

compensation if they are entitled to it. Additionally, accurate diagnosis is essential to informing public health surveillance efforts. Several toxic pesticides have lost registration in the United States largely because of the information available to EPA through surveillance of pesticide poisonings.

The American Public Health Association (APHA), clinical organizations and other advocates have asked the EPA to require that pesticide registrants (chemical companies) develop and provide an effective biomarker as part of the registration process. For more information on this topic, see APHA Policy Resolution – *Requiring Clinical Diagnostic Tools and Biomonitoring of Exposures to Pesticides*

<http://www.apha.org/advocacy/policy/policysearch/default.htm?id=1400>.

The October meeting will allow stakeholders to examine the issue of biomarkers and discuss the scientific and policy issues involved in their development. Migrant Clinicians Network, the National Farm Medicine Center and Farmworker Justice are active participants in this important conversation with the goal of advancing clinical practice to improve farmworker health and workplace safety. The October meeting will be held at the Office of Pesticide Programs in Arlington, VA. Information about the October meeting is posted on the EPA website at <http://www.epa.gov/pesticides/ppdc/testing/index.html> ■



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**calendar**

**Exploring Social Justice for Vulnerable Populations: The Face of the Immigrant The Second Annual Rita M. McGinley Symposium**

September 29-30, 2011  
Pittsburg, PA  
Duquesne University School of Nursing  
<http://www.duq.edu/social-justice/agenda.cfm>

**Clinical Diagnostic Tools and Biomonitoring of Pesticide Exposures**

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<http://www.epa.gov/pesticides/ppdc/testing/index.html>

**24th Annual East Coast Migrant Stream Forum**

October 20-22, 2011  
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North Carolina Community Health Care Association  
[www.ncchca.org](http://www.ncchca.org)

**American Public Health Association 139th Annual Meeting and Exposition**

October 29-November 2, 2011  
Washington, DC  
American Public Health Association  
[www.apha.org](http://www.apha.org)

**National Advisory Council on Migrant Health Meeting**

Hotel Albuquerque at Old Town  
November 8-9, 2011  
Albuquerque, NM

**21st Annual Midwest Migrant Stream Forum**

November 10-12, 2011  
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National Center for Farmworker Health  
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