The Challenge of the Urban Environment

Over the past century, there has been a rapid growth of urban centers around the country. Today, a majority of people in the United States live in cities and by 2050 more than 75% of the world's population will be urban dwellers. Unfortunately, few urban areas are equipped to meet the challenges brought on by rapid population growth. Despite steadily improving health status for the nation, residents of our cities experience a disproportionate burden of acute and chronic disease.

“The contribution of environmental exposures and underlying mechanisms of environmentally-occurring biological, chemical and physical pollutants to the disease burden is a critical factor that needs to be understood to improve public health,” says Center Director John D. Groopman, PhD. “The problems that we confront today in understanding the role of the urban environment in chronic human health outcomes are much more complex than in the past.” Addressing these problems requires a coalescence of multiple professional talents and scientific disciplines. Thus, the public health challenge facing Center members is how to improve the health of individuals who now and in the future live in urban environments. The Johns Hopkins Center in Urban Environmental Health is dedicated to addressing these health problems associated with an urban population, through research, education, and public outreach.

The Center in Urban Environmental Health

The NIEHS supported Center at Johns Hopkins University was established in 1985. The Center is administratively based in the
Tripping Down Memory Lane
The Baltimore Memory Study Seeks Clues to Cognitive Dysfunction in Urban Residents

Did you ever walk into a room, only to forget why you were there? Have you ever found yourself looking for misplaced sunglasses or car keys? Everyone experiences memory lapses from time to time. But for some, it is chronic, progressive, and may be preventable. Brian S. Schwartz, MD, MS may soon have some answers. Schwartz directs the Baltimore Memory Study, a cohort study of the multilevel determinants of cognitive decline in 50-70 year old randomly-selected residents of Baltimore city neighborhoods.

“The study’s name is a bit of a misnomer,” explains Schwartz. “More broadly, the study goes beyond memory decline and looks at cognitive functioning. As the U.S. population ages, cognitive dysfunction and decline will become increasingly prevalent with personal and societal implications.” Schwartz hopes that understanding the causes of cognitive dysfunction, and particularly how environmental exposures, genetic factors, and psychosocial hazards interact to explain differences in cognitive functioning across populations, will allow population-specific interventions to be developed to prevent this critical health challenge in the coming decades.

Prior studies have demonstrated that the risk of cognitive dysfunction differs by race/ethnicity, but the underlying basis for this disparity is not known. To better understand these differences, Schwartz recruited 1,140 individuals to participate in a five year study to evaluate such causes as environmental exposures like lead, mercury, and PCBs, medical conditions, genetic factors, habits, and neighborhood psychosocial hazards. During three clinic visits, study participants complete a detailed battery of neurobehavioral tests and a 90-minute interview to assess both cognitive function and confounding variables such as socioeconomic status (SES), health-related behaviors, and co-morbid illnesses. In addition, blood, urine, and saliva specimens are obtained and bone lead is measured by X-ray fluorescence, so that factors in the physical environment can be measured in terms of dose. Data is then analyzed to explain differences in cognitive function due to all these measured risk factors.

Initial evaluations found large differences in neurobehavioral test scores by race/ethnicity in all assessed cognitive domains. The next step for the study team was to consider factors other than race/ethnicity to explain those differences. After adjusting for individual SES (educational status, household income, household assets, and occupational status), health-related behaviors and medical conditions, age, sex, and testing technician, large differences in the cognitive test scores were still observed across three race/ethnicity groups. “These differences were present in all cognitive domains, including tests that would not be characterized as susceptible to differential item functioning by race/ethnicity,” adds Schwartz “suggesting that the results are not due to race/ethnicity-associated measurement error.”
Schwartz acknowledges that the determinants of cognitive dysfunction are complex and multifactorial, encompassing biologic, environmental, behavioral, and social pathways. While current funding for the study will continue through August 2005, Schwartz notes several important observations already. “Among the interesting findings to date,” concludes Schwartz, “mercury dose does not seem to be a strong cause of cognitive dysfunction, at least as estimated by a single blood mercury level; lead levels in the body are a strong predictor of elevated blood pressure; lead increases homocysteine, a known risk factor for poor cognitive function and high blood pressure; and neighborhood psychosocial factors are independent risk factors for obesity and cognitive dysfunction.” Further analysis will continue to disentangle the complex web of determinants, including blood lead, tibia lead, blood mercury, serum PCBs, serum cholesterol and triglycerides, bone mineral density, salivary cortisol levels as a measure of chronic ‘stress’, and a detailed set of multi-level neighborhood factors.

The setting sun casts its last glow upon a patient fisherman. In the waning light, the surface water suddenly ripples and the line becomes taut. No, this is not some Field and Stream adventure along a serene waterway. The location is Cox’s Point, a deceptively attractive part of Middle River along Baltimore’s Inner Harbor, almost within sight and sound of rush-hour traffic. Far from a rural setting, Baltimore’s watersheds, like Baltimore’s urban anglers, share space with the combined inputs of urban and suburban environments. Urban fishing is a traditional and growing activity in cities like Baltimore, particularly with the development that surrounds the Inner Harbor where residential homes now occupy old industrial warehouses. Many of these urban anglers fish more than ten times a month, and many of them consume their catch. “Urban fishing is an under-recognized environmental risk,” explains Ellen Silbergeld, PhD. “When EPA and state governments assess the possible health risks of fishing and consuming caught fish, the focus is on chemical contamination, such as methyl mercury, PCBs, or pesticides.” While Silbergeld acknowledges these can be real problems, she is concerned that there is little attention being paid to the special risks of urban fishing. These risks are primarily microbiological.

Due to the nature of urban environments, the health of urban waterways is often jeopardized by combined sewer overflows, garbage dumping, domestic animal waste, storm water runoff, lawn chemicals, deposition of air pollutants and leaks from an aging sanitary infrastructure. Water quality surveys conducted by Kellogg Schwab, PhD, and others in the School’s Center for Water and Health indicate that urban streams are threatened by highly dangerous pathogens, including viruses, microparasites, and pathogenic bacteria. These findings triggered Silbergeld to investigate the potential for pathogen exposure among Baltimore residents who fish on Gwynns Falls, Jones Falls, Herring Run, Middle Branch, Back River, and the Inner Harbor. With support from a Center pilot grant, Silbergeld began analyzing the risk of exposure to cryptosporidium, a highly pathogenic microorganism.

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Teachers from across Maryland recently worked on making environmental health sciences curriculum “zing” in their classroom. From July 19-22, 2004, the group gathered in Baltimore at the “EnviroHealth Connections Summer Institute.” This 4-day professional development opportunity is designed for Grade 6-12 teachers in all curriculum areas interested in integrating the latest information and research about environmental health issues and cutting edge education technology tools into their curricula. During the week, teachers met with scientists from the Johns Hopkins Bloomberg School of Public Health to learn and share lessons on air, water, population, and other environmental topics.

EnviroHealth Connections is a partnership between Maryland Public Television and the Center to infuse engaging, current human environmental health topics into all curriculum areas using inspired teachers, cutting-edge technology, and super-powered information exchange. Lesson plans and digital resources developed by teacher teams are accessible on www.thinkport.org—a free online resource for educators, families, and community members.

Tours, seminars, and computer labs were among the activities offered during the 2004 Summer Institute.
On April 21, Thomas Kensler, PhD presented his research findings on liver cancer to a crowded auditorium. Each quarter, the School’s Dean chooses a researcher to present his/her research at the Preventive Medicine/Public Health Grand Rounds. “Liver cancer is a huge but largely overlooked problem for global health, striking people in developing countries and emerging recently as a significant problem in the United States,” began Kensler. Liver cancer kills nearly 600,000 people each year and is the third leading cause of cancer death worldwide. An unfortunate mixture of poverty and climate has lead to a soaring incidence and mortality rate in China, particularly in the Qidong region of Jiangsu province where one in ten adults develops and dies of liver cancer. These alarming statistics led Kensler and colleagues to look into a means to prevent this health problem.

Researchers quickly discovered that both the hepatitis B virus (HBV) and exposure to aflatoxins in the diet affect development of liver cancer and together amplify risk. In the Qidong area of China, improper food storage leads to aflatoxin contamination while mother-to-child transmission of HBV leads to viral infection in infants despite a vaccination program. These findings were key scientific discoveries, but there was much more development work to be done before these etiological findings could be translated into the clinic. “Primary approaches for prevention include HBV vaccines and reduction of aflatoxin consumption through improved food storage and changes in dietary staples,” explained Kensler. “However, these long-term strategies are costly and not without their challenges. Vaccinations would require more than a generation to achieve overall protection from HBV and improved food storage would involve considerable investment in the infrastructure of food production, processing, and distribution.” Kensler and his team knew a short-term, inexpensive solution was needed and would involve chemoprevention, perhaps introducing a new, satisfactory food into the Chinese diet.

Through a series of studies, Kensler learned the effects of aflatoxins can be averted with pharmaceutical treatments. A Phase IIa intervention trial with oltipraz, an effective chemopreventive agent, established a proof of principle that the development of liver cancer can be mitigated in humans using oltipraz. Expense and safety issues led Kensler to evaluate low cost intervention agents, such as broccoli and broccoli sprouts which contain cytoprotective molecules acting through the same molecular pathways as oltipraz. Another study demonstrates that chlorophyllin, a simple derivative of chlorophyll that forms molecular complexes with aflatoxins, greatly impedes its uptake into the body. They are currently being evaluated in a NIEHS supported clinical trial in Qidong. “Laboratory work will continue to develop adequate biomarkers to assess the efficacy of these plant-based interventions,” concluded Kensler. “Longer term clinical trials in high risk cohorts will be needed to demonstrate reduction in disease incidence.”
Pat Tracey needs no introduction in most Baltimore neighborhoods. Years before she ever started getting paid to attend community meetings, she was a fixture at such events all across Baltimore. Colleagues are stumped over whether to say she is an experienced advocate, a University representative or a community member. As Community Relations Coordinator for Johns Hopkins’ Center in Urban Environmental Health’s Community Outreach and Education Program (COEP), Pat would say she’s all that and more.

If anyone is going to bring together the energetic but often unfocused citizen groups of Baltimore, Pat Tracey is a prime candidate. She has been moving a similar organizational and networking template from field to field since 1989, when she came to the first of several health and quality-of-life focused departments within Johns Hopkins and its affiliates. Now it’s rare for her to walk into an outreach meeting and not know several participants, on all sides of the issues.

These years of connections allows her to navigate the potentially bewildering array of community resources in Baltimore more effectively than a newcomer would. A few confidential words to a friend in the hall outside a meeting often gets more done than a heated discussion inside. “Even just knowing who to direct a community group to for help, making the introductions and stepping back, can save time and aggravation for everyone,” explains Tracey.

Since its inception, she has closely followed the city-backed plans to raze and rebuild eighty acres north of Johns Hopkins’ East Baltimore Campus, her home neighborhood. The community-at-large was concerned too, but when no one came forward to attend city meetings and bring information back, Pat stepped up without hesitation. From that first meeting in 1999, she’s been attending regularly and energizing the community organization; challenging perceptions that low-income communities are apathetic and non-vocal. Since 2003 she has been attending in an official capacity as well.

“With 800 families likely to be affected in the 8 to 10 year scope of this plan,” she says, “someone has to remind the big guys how much of an impact relocation has on people. It’s not enough just to subsidize a move to a new area if the residents can’t afford higher property taxes or mortgage payments and lose their homes in the long run.” Tracey’s efforts have led directly to changes in the relocation proposal to strengthen home retention.

Helping to monitor community impact of development is only one aspect of her role at the Center. After Center students, faculty and staff examined air and noise pollution impact of the Maryland Transportation Authority’s (MTA) continued on page 12
Center Targets Smoke-Belching Buses

The Citizens Planning and Housing Association (CPHA) is one of the oldest community organizations that deal with various issues in the Baltimore Metropolitan Region. Under the auspices of the CPHA’s Transportation Committee, a Clean Fuel Buses group was formed to examine issues concerning diesel exhaust in buses. Center Deputy Director Michael Trush, PhD became a member of this educational and fact-finding group, which culminated in a report booklet, Clean Fuel Buses, Breathing Easier in Baltimore. The announcement of this report was made at a press conference held at the School of Public Health and highlighted in a Baltimore Sun OpEd piece authored by Center Director John Groopman, PhD and Trush. The intent of this project is to influence the Maryland Transit Administration (MTA) to examine its policies with regard to the type of fuel used and type of buses purchased in the future.

As an extension of this project, Trush and Tim Buckley, PhD participated in a project to assess bus emissions at a bus stop on Gay and Lexington Streets in downtown Baltimore. A film crew from WBAL television was there filming and interviewing bus riders, scientists and students. In addition to bus and fuel type, another major concern is the location of bus storage depots in Baltimore neighborhoods. In this regard, Center members have been working with the residents of Bartlett Avenue in Baltimore City, located across the street from one such depot. Trush and Buckley have meet with representatives of MTA concerning this issue and Buckley has been conducting exposure assessments. Under the direction of Pat Tracey, a community meeting was held on February 19, 2004 where research data on noise and particulate matter levels was presented to the community. A subsequent meeting was held with MTA representatives to discuss these findings and citizen concerns.

And the Emmy Goes to...
EnviroMysteries II: “Breaking the Mold” wins Emmy Award

EnviroMysteries II: “Breaking the Mold” won an Emmy award in the “Children’s Programs” category at the 46th annual National Capital/Chesapeake Bay chapter regional Emmy Awards dinner held Saturday, June 12th at the Omni Shoreham Hotel in Washington, DC. The ceremony was sponsored by the National Capital/Chesapeake Bay Chapter of the National Television Academy to recognize excellence in several categories of television production.

EnviroMysteries II is part of an ongoing video series for middle-school students, which explores the relationship between our health and the environment. Developed with the support of an NIEHS grant, the EnviroMysteries series is designed to show students how to become active participants in local, national, and global environmental health issues by becoming literate in science and health. The video features dramas and mini-documentaries, along with accompanying lesson plans and student activities. “Students today live in a world where they are exposed to many physical, biological, and chemical agents, explains Cynde Mutryn of Maryland Public Television. “EnviroMysteries helps teachers and students find answers to environmental health science questions.”

Educational experts from Maryland Public Television and the NIEHS Center at Johns Hopkins Bloomberg School of Public Health teamed up to create EnviroMysteries and the teacher’s guide materials that support the video dramas. “EnviroMysteries II was designed to help students understand the process of scientific inquiry, evaluate information they acquire, and make informed decisions based on fact,” explains Michael Trush, PhD, NIEHS Center Deputy Director. “In order to solve the mold mystery presented during the video, the main character follows the process of scientific inquiry, from observation to hypothesis development and testing to forming a conclusion.”
Center Provides High-Tech Tools of the Trade for Researchers

To address environmental health issues, more and more Center members are turning to molecular technologies. One of the resources Center members are utilizing is the DNA Microarray Core Facility, directed by Shyam Biswal, PhD since its creation in 2002. Biswal provides consultation to Center members about experimental design and data analysis, and oversees the functioning of the core. He is assisted by Hannah Lee, BS in carrying out everyday operations.

The Core Facility provides several cutting-edge technologies for molecular biology research to center members. The addition of this technology allows Center researchers to uncover the functions of genes and their interactions in genetic pathways by focusing research specifically on automated DNA microarraying and DNA sequencing hardware and software. Other capabilities include: analysis of nucleic acids using the Agilent Bioanalyzer; throughput gene expression analysis using the Affymetrix microarray platform; microarray data analysis; validation of gene expression analysis data from microarray experiments; SNP and haplotype analysis.

The DNA Microarray Core Facility has been especially useful for Center investigators to discover novel targets for intervention and mechanism of environmental diseases. One of the first microarray projects by Biswal and Dr. Thomas Kensler revealed the transcriptional program of environmental sensor Nrf2, which has had a major impact on our understanding of stress pathways in cancer research and in the field of environmental health sciences in general. Dr. Val Culotta has discovered that yeast cells lacking a copper chaperone showed a curious chromatin depression phenomenon consistent with loss of function in the Sir2 enzymes implicated in longevity. Center researchers Drs. Tankersely and Mitzner are currently pursuing studies focused on the development and diversity in lung structure and function among mouse strains. Other ongoing projects include a toxicogenomic study led by Dr. Rolf Halden using DNA microarray technology to explore gene expression alterations resulting from human fetal exposure to drinking water carcinogens; and whole genome association studies initiated by Biswal utilizing the 100k SNP array to pinpoint COPD genetic susceptibility factors.
Five Pilot Projects Receive 2004-05 NIEHS Funding

Each year, the NIEHS Center in Urban Environmental Health provides seed funding of new ideas that hold promise in the generation of preliminary data in support of subsequent grant applications. The program benefits include facilitating research into areas and methods important to environmental health and stimulating collaboration between investigators. Over the last five years, the Center has funded pilot project grants in such areas as the molecular toxicology of agents found in the urban environment such as pesticides, particulate matter, and PCBs; susceptibility determinants such as obesity and receptors; toxicogenomic research; and community-based research and education. The Center is pleased to announce the recipients of 2004-2005 grants.

Indoor Air Particulate Matter Concentrations and Respiratory Health in Older Women

Asthma and Chronic Obstructive Lung Disease are common in the United States and together affect nearly 28 million Americans. The prevalence and morbidity of both disorders appear to be increasing and disproportionately affect older Americans, particularly females. In this pilot study, George Diette, MD, MHS aims to assess the feasibility of measuring indoor air particulate matter and other pollutants in the home of community dwelling, older women. Data will serve as key preliminary data in anticipation for further NIH funding.

Development of a Controlled Welding Fumes Exposure System with Variable Manganese Content

Welding fumes contain potentially high concentrations of manganese, a known neurotoxin, and are a significant source of inhalation exposure for approximately 400,000 individuals employed as welders in the U.S. Through this study, Alison Geyh, PhD hopes to create a system for generating controlled atmospheres of welding fumes with varying Mn content that can then be used to deliver controlled inhalation Mn exposure to mice for the purpose of studying the impact on the central nervous system.

Role of Urban Air Toxic Exposures in Corticosteroid Responsiveness After Severe Asthma Exacerbations

Asthma is characterized by chronic airway inflammation and airflow obstruction. Limited data indicate a potential role for structural airway abnormalities and/or corticosteroid-refractory airway inflammation in the pathogenesis of persistent airflow obstruction. A study by Jerry Krishnan, MD will focus on evaluating the latter explanation, examining the extent to which environmental exposures after hospital discharge either alone or together perpetuate airway inflammation and persistent airflow obstruction in patients with severe asthma exacerbations.

Assessment of Oxidative Stress in Genetically-Modified Mice

The conceptual framework of the Center is that the risk for disease is the result of interactions between environmental exposures and susceptibility factors. In this pilot project, Michael Trush PhD will use single-photon-counting technology to evaluate in situ oxidative stress as an underlying susceptibility factor in genetically-modified mouse models.

Relations of Bone Mineral Density, Blood Lead Levels, Bone Lead Levels and the Apolipoprotein E and Vitamin D Receptor Genotypes

Bone is not only an internal source of blood lead, but it is also a target organ of lead toxicity. The overarching goal of this research by Brian Schwartz, PhD is to understand relations among bone lead concentrations, bone mineral density (BMD), and two genes known to modify bone lead concentrations or BMD.
Department of Environmental Health Sciences within the Johns Hopkins Bloomberg School of Public Health, although Center membership is drawn from many different departments and Schools of the University. Under the leadership of Groopman for the past seven years, the mission and goal of the Center is to identify environmental exposures and susceptibility factors that increase risk of illness for people living in urban environments, then to use these findings to develop prevention strategies to improve public health.

**Research is key**

The Center’s commitment to improving urban communities begins with research and ends with its translation to public health interventions. To this end the Center conducts research relating to the causes and consequences of urban environmental factors to resident’s health. Research Cores of this Center are: Environmental Epidemiology and Exposure Assessment, Gene-Environment Interaction and Disease Prevention, Molecular Toxicology, and Environmental Lung Diseases.

To accomplishing these research goals, the Center has brought together a multi-disciplinary team of researchers whose specialties include epidemiology, toxicology, physiology, pathology, biochemistry, medicine, virology, immunology, behavioral sciences, biostatistics and environmental engineering. In total, the Center promotes basic, population and clinical research in environmental health and proactively works to translate scientific findings to the design and implementation of prevention measures. Thus, the public health goal of the Johns Hopkins Center in Urban Environmental Health is to contribute to the reduction of morbidity and mortality induced by environmental agents in people residing in cities. The theme of our Center necessitates an organization that includes Research and Facility Cores and a Community Outreach and Education Program—each of which contribute to our overall goal.

**Meeting Tomorrow’s Challenges: Education**

The Community Outreach and Education Program (COEP) serves a critical role toward the Center’s primary goals to reduce morbidity and mortality from environmental agents. The COEP is the primary link to diverse communities throughout the Baltimore metropolitan area to control environmental disease through research, education and clinical programs related to environmental exposures.

To further the Center’s environmental health education initiatives, a collaborative partnership was established between the Center, its COEP, and Maryland Public Television (MPT) to develop educational materials for middle and secondary school students and teachers. The Center’s efforts toward environmental health education for children have resulted in several NIEHS-funded collaborative projects with MPT, including an educational video series on environmental health issues for middle school children and a professional enrichment program designed to help teachers incorporate environmental health science topics and materials into their classroom curricula.

**Professional Development**

For the past several years, the Center has offered a graduate course on environmental health community outreach. The course attracts a wide-range of professionals, including current...
students from The Johns Hopkins Schools of Medicine, Nursing, and Public Health. The seminar course introduces concepts of environmental justice and community outreach in environmental health emphasizing ongoing projects in the Baltimore region. Through this course, students then have the opportunity to participate in ongoing community-based projects. “This course provides an important forum for students to interact and work with community organizations,” explains Michael Trush, PhD, COEP Director and Center Deputy Director. “Taking research to the community is a vital part of our Center’s mission.”

Meeting today’s challenges: Community Outreach

Given the capability of Center members to conduct community-based research in diverse communities, the COEP translates research findings into clinical services, educational programs and public health policy. At the core of the Center’s philosophy on community–based research is that education is a critical and essential component of this process. COEP is an extension of this philosophy. Established partnerships with community agencies create the unique opportunity to respond to specific concerns identified by community leaders and residents throughout diverse urban areas. These types of effective partnerships generate mutually beneficial relationships and assure positive outcomes through the translation of information and outcomes from the Research Cores into knowledge applied to public health.

Our urban future

As urban areas become ever more crowded, governments, citizens, and scientists will face a growing challenge: how to make urban areas work. Given that urban populations are growing much faster than the general population, how we meet the challenges of this rapid urbanization could fundamentally determine our world’s future. “The most important public health challenges of the coming decades will be related to the urban environment and quality of life,” concludes Trush. “Through research, outreach, and education, our Center will help urban dwellers to confront these challenges head on, using innovative technology, creative problem solving, and contemporary science.”

Taking research to the community is a vital part of the Center’s mission. Center members recently studied air and noise levels in a residential area located adjacent to a bus storage depot.

Administrative Core of the Center

Dr. Michael A. Trush
Deputy Director
Professor of Environmental Health Sciences
Department of Environmental Health Sciences
tel: (410) 955-2973

Dr. John D. Groopman
Center Director
Anna M. Baetjer Professor and Chair
Department of Environmental Health Sciences
tel: (410) 955-3720
fax: (410) 955-0617

Mr. Ramesh Mannan
Business Manager
Department of Environmental Health Sciences
tel: (410) 955-3537/2425
Kirk Avenue bus depot on surrounding neighborhoods, they found measurements validated some of the residents’ concerns, especially that noise ordinances were routinely exceeded. Tracey developed and distributed an informational pamphlet for area residents and spearheaded a movement to help residents address this potential public health problem. With an attorney now on board advocating for the residents, lines of communication have finally opened up between the MTA, the City Health Department and the East Baltimore Community Association. As Tracey says, “For two meetings and a letter, it’s been very effective.”

Success stories like these are what make Tracey shine over her work. “If a community is organized and speaking with one voice,” she says, “they can’t be ignored. They don’t always need money, they just need to learn how to speak out.”

One of the truly special and singular aspects of working within the Center, she notes, are the students at the School of Public Health. “They have so much energy and creativity,” Pat gushes. Coupling that with the expert technical knowledge they are training toward makes a powerful force. In a group of School of Public Health students and their advisor professors there is always someone to come up with another avenue to overcome a challenge. They provide links to other experts as well as imaginative solutions and angles of inquiry.

The Center’s mission is to improve public health by designing prevention strategies based on their research into exposures, susceptibility and gene-environment interactions that increase health risk. By raising community awareness of and advocating for public health issues, Tracey is a key part of the prevention strategy. Her personal goal is to teach communities to work for themselves, rather than just doing it for them. In Baltimore City alone there are so many pressing areas of public health needs that not all of them can be addressed by the limited number of outreach and government organizations. Even when it is offered, Pat stresses, outreach can’t last forever. After the outside organizations go away, a community ought to have been trained to look after itself more effectively. One by one, Pat is doing just that.