THE Relationship BETWEEN Substandard Housing, MoisTure, and Health
IN SOUTHEASTERN North Carolina

by

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Abstract

Much literature exists on the theoretical association between substandard housing and poor health status. Less hard data is available as to the extent of the problem of substandard housing in the nation, in North Carolina, or in the five-county area in Southeastern North Carolina. There is no standard definition of substandard housing, other than the absence of indoor plumbing and the presence of overcrowding. The links between housing in ill repair or damaged by the elements and acute and chronic disease have not yet been fully demonstrated for adults, although some work has been done in children. The major problem affecting both housing and health in southeastern North Carolina is excessive moisture. High water tables, frequent storms and flooding, poor repair, and high ambient humidity all contribute to water and moisture damage. Excessive moisture leads primarily to mold and structural damage, which then leads to an increase in prevalence and severity of respiratory disease as well as other conditions. Little or no government assistance is available to homeowners without the physical and monetary resources to remediate problem housing, and no widespread inspection process is in place.

Nongovernmental agencies are beginning to address the problems of repair, new construction, and to train for maintenance. There is opportunity for clarification of a definition for substandard housing, for further study of the extent of substandard housing, and for cohort or matched set studies of the link between housing and health status. An integrated approach is needed to address all aspects of the problem, from health care to assessment and repair of the home. Partners from the Departments of Health, nongovernmental organizations, and the business community must work together for prevention and for remediation.
The Relationship Between Substandard Housing, Moisture, and Health in Southeastern North Carolina

Introduction:

There is much in the literature on the theoretical association between substandard housing and poor health status. Less hard data is available as to the extent of the problem of substandard housing in the nation, in North Carolina, or in the five-county area in Southeastern North Carolina. There is no standard definition of substandard housing, other than the absence of indoor plumbing and the presence of overcrowding. Although residents of rental and public housing units may appeal to landlords or housing authorities, little or no assistance is available to homeowners without the physical and monetary resources to remediate problem housing, and no widespread inspection process is in place. Nongovernmental agencies are beginning to address the problem of repair, new construction, and training for maintenance. There is opportunity for clarification of a definition for substandard housing, for further study of the extent of substandard housing, and for cohort or matched set study of the link between housing and health status in individuals. An even greater opportunity exists for upgrading substandard housing once it is identified.

Public health has been involved with the issue of substandard housing since at least the middle of the 19th century (Matte, 2000). In 1946, New York City Commissioner of the Department of Public Health Israel Weinstein stated, “Thus the recognition that proper housing and adequate recreational facilities are related intimately to public health is not as recent as many people think. From John Snow’s concern for the water supply in London to today’s indoor air quality inspectors, the safety, sanitation, and security of housing has been part of the sphere of public health policy and influence.”
Unfortunately, public health agencies have encountered difficulties in addressing this issue. New types of health concerns related to housing have surfaced due to advances in biomedical and environmental science. Lead poisoning, toxic indoor chemicals, and tightness of ventilation for energy conservation are problems not conceived by public health departments in the early part of the 20th century (Matte, 2000). Although public health departments are concerned with assessing and repairing gross problems and more subtle ones, regulatory power and the power to enforce remediation are limited in most areas. Funding of some programs that have addressed housing health issues in the past has been cut (Blackler, 2003). Those programs that do exist are often limited in scope, addressing a particular disease such as childhood asthma, or a particular type of housing deficiency such as the presence of lead.

Defining substandard housing

One major difficulty is that there is no quantified or comprehensive definition of substandard housing. Deficiencies in housing conditions are obvious to the lay person, but have not been applied to standards for research, assessment, or regulation.

The Bureau of the Census suggests the following definition of substandard housing:

"Substandard Housing: Occupied Housing Units Overcrowded/Incomplete Plumbing—
Occupied housing units that are overcrowded and/or lack complete plumbing facilities.
There is no universally accepted definition of substandard housing, but this definition is often used. An overcrowded unit is measured in terms of more than 1 person per room. Persons per room is a derived measure obtained by dividing the number of persons in each occupied housing unit by the number of rooms in the unit. "Lacking complete plumbing facilities for exclusive use of the occupants" may occur if there are complete plumbing
facilities, but they are also used by another household, or if some plumbing facilities are lacking. Complete plumbing facilities include hot and cold piped water, a flush toilet, and a bathtub or shower.”

Characteristics of unsafe housing include exposed heating elements, unprotected upper story windows, and inadequate lighting. According to Matte and Jacobs (2000), provision of safe drinking water and water for personal hygiene, and an area for safe food preparation are elements of adequate housing conditions. As cited in that article, in 1995, 1.5% of occupied homes in the United States lacked complete or part of necessary plumbing facilities, 2.6% had an occupancy rate of more than one person per room, and 5% had heating inadequacies. Kreiger and Higgins add to the definition the absence of hot water for washing, ineffective waste disposal, intrusion by insects and rats, and inadequate food storage. Those who work in the field point out that integrity of roofing, walls and flooring should be assessed, as should presence of mold, dirty floor coverings, and water damage to structural elements (Wrenn and West, 2002, Blackler 2003).

Safety issues are closely related to substandard housing. Unsafe housing has led to unintentional injuries. Common causes of unintentional injuries are falls, fires, scalds, suffocation, poisoning, all of which are related to deficiencies or lack of common sense in regards to housing. A broken step, loose carpet, and rotten subflooring are hazards to mobility. Loose nails can lead to lacerations and tetanus or other infection. Faulty electricity or gas connections, or poorly ventilated heating sources can be lethal. Carbon monoxide poisoning is common in homes heated inappropriately. Heaters are also implicated in accidental burns. For a diabetic, a splinter or loose nail can lead to a nonhealing wound and amputation. To minimize danger, water heaters may be reset, smoke alarms may be installed or checked, and alternative
heating sources such as kerosene may be regulated closely. From 1996-1998, there were 288,427 deaths caused by unintentional injuries, for an average of 92,109 per year. In North Carolina, unintentional injuries accounted for 9,466 deaths during that same period (CDC information).

Table 1 illustrates the rate of housing characteristics in the five counties in southeastern North Carolina. The rate of substandard units is higher in the more rural counties of Bladen, Columbus, and Pender. Likewise, the rate of older housing units is greater in the more rural counties. Definitions for the terms used in the tables are found in Appendix II.

Table 1: Population and Housing Characteristics for Southeastern North Carolina

<table>
<thead>
<tr>
<th>Area Name</th>
<th>Population</th>
<th>Rural Pop.</th>
<th>Year-Round Housing Units</th>
<th>Owner Occupied</th>
<th>Mobile Homes</th>
<th>Substandard Units</th>
<th>% of Year-Round</th>
<th>Occ. Units &gt;20 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bladen County</td>
<td>32,278</td>
<td>28,696</td>
<td>13,603</td>
<td>10,036</td>
<td>4,688</td>
<td>526</td>
<td>3.9</td>
<td>7,740</td>
</tr>
<tr>
<td>Brunswick County</td>
<td>73,143</td>
<td>48,408</td>
<td>34,906</td>
<td>25,013</td>
<td>18,458</td>
<td>978</td>
<td>2.8</td>
<td>10,070</td>
</tr>
<tr>
<td>Columbus County</td>
<td>54,749</td>
<td>48,343</td>
<td>22,513</td>
<td>16,281</td>
<td>7,544</td>
<td>922</td>
<td>4.1</td>
<td>12,872</td>
</tr>
<tr>
<td>New Hanover County</td>
<td>160,327</td>
<td>7,377</td>
<td>74,213</td>
<td>44,109</td>
<td>4,891</td>
<td>1,476</td>
<td>2.0</td>
<td>31,865</td>
</tr>
<tr>
<td>Pender County</td>
<td>41,082</td>
<td>37,839</td>
<td>16,995</td>
<td>13,260</td>
<td>7,328</td>
<td>503</td>
<td>3.0</td>
<td>6,098</td>
</tr>
</tbody>
</table>

Data taken from the LINC Report for selected areas for the year 2000.

Effects of Moisture in Southeastern North Carolina

A major problem affecting housing and health in southeastern NC is moisture. The area has frequent floods, many homes are built on former wetlands, and many homes are in poor repair. Pests—termites and rodents—allow moisture from weather and groundwater into the home environment. Poor or absent plumbing causes leakage of contaminated water. Once a
structural substrate is affected, moisture will wick into adjoining areas, increasing the problem. Structural damage and hidden damage from water seepage follow southeastern NC’s frequent strong storms.

Excessive moisture in the indoor environment leads to triggers for several health problems. The most visible is mold. Mold is a fungus, a microorganism that needs warmth, moisture, still air and a food source to grow. Its spores are dormant until ambient humidity increases. Growth is positively related to the amount of moisture present. Several *Penicillium* species grow well and often in carpet, wallpaper, and in fiberglass insulation. Four molds have been labeled as “dangerous” by the American Industrial Hygiene Association, a category more severe than toxigenic. They are *Aspergillus versicolor*, *Stachybotrys atra*, *Aspergillus fumigatus*, and *Fusarium maniliforme* (Lawrence and Martin, 2001). The five most common indoor fungi are *Cladosporillium*, non-sporulating, *Penicillium*, yeasts, and *Aspergillus* (Suggs 2003). However, no mold is considered good mold in indoor environments (Suggs, 2003, EPA Publication, 2003). The Environmental Protection Agency does not regulate mold or mold spore content in the air. There is no EPA or federal limit set for mold or for mold spores.

Figures 1 through 10 illustrate high moisture content of indoor air and substrate of New Hanover County homes, and the resultant mold growth. Ambient and substrate moisture content is illustrated off the scale of the meters (Figures 1 and 2). Moisture in these figures collected from roof leakage, indoor water pipe leakage in an upstairs apartment unit, from condensation on pipes or ventilation system, and was exacerbated by the presence of rodent feces.
Figure 1. Ambient humidity meter

Figure 2. Substrate moisture probe

Figure 3. Mold rising from baseboard

Figure 4. Rat feces in attic ladder

Figure 5. Mold from leak at fixture

Figure 6. White mold in ceiling
Mold is evident on insulation, wood floors between apartments, and throughout drywall. Repair of the mold must include stopping the source of moisture at the source, and complete eradication of the mold.

Case Study

Figures 3-7 demonstrate the result of an unfortunate incident leading to water damage and resultant mold in a private home. New Hanover County residents purchased a home from a seller who claimed that he was a “real estate inspector” and that he had thoroughly checked the house. He told the buyers that everything was fine. However, when mold began to appear on the
ceilings and walls, they called for a Health Department inspection. The Environmental Health Specialist discovered that rats had chewed holes in the roof, letting water in through most of the attic. It mixed with numerous rat feces, and mold grew in the wood of the rafters, through the drywall, ran down to the flooring, and seeped up the walls. Within four months, one of the residents had to have home oxygen and nebulizer treatments. Health workers had to wear masks in order to breathe. The residents vacated the premises after four months. At the inspection in December of 2002, the rafters were found to have white mold, rusted galvanized pipes were present, and the furnace had been disconnected by the gas company because of damage.

Inadequate or improperly installed plumbing leads to excessive moisture in the soil or under the home. This water may be laced with bacteria and sewage products. Flooding or storm runoff adds to the burden of septic systems, and to the moisture in the soil or in the home.

The New Hanover County Health Department uses some guidelines for humidity and moisture during inspection. In checking relative humidity, 25%-50% is considered acceptable, with 35%-40% the desirable range. Relative humidity is measured with a sling psychrometer. The guideline for visible mold is zero tolerance. No type of mold is considered any more or less acceptable than another. A probe is used to test moisture content of substrates. 6% or less is considered acceptable. The health department is seeking funding to purchase smoke pencils to track ventilation.

The presence of allergens is a subtle element of unsafe housing. The public health aspects of asthma are increasing worldwide, as is the economic impact of asthma and allergic reactions. Allergens are trapped in moist air and substrates like carpet and upholstery.
Health effects resulting from excessive moisture

The effect of southeastern NC’s moisture problem is a high incidence of respiratory disease and conditions. Table 2 indicates the number of deaths in North Carolina from respiratory disease by age category and the ranking within that age group for that cause of death. Conditions which did not rank in the top ten for that age group did not have data on the number of individuals who died from that condition.


<table>
<thead>
<tr>
<th>Cause of Death</th>
<th>Age Groups</th>
<th>&lt;1</th>
<th>1-4</th>
<th>5-9</th>
<th>10-14</th>
<th>15-24</th>
<th>25-34</th>
<th>35-44</th>
<th>45-54</th>
<th>55-64</th>
<th>65+</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory distress syndrome</td>
<td></td>
<td>131</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>131 (unranked)</td>
</tr>
<tr>
<td>Pneumonia &amp; influenza</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7,680 (6)</td>
</tr>
<tr>
<td>Bronchitis, emphysema, asthma</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>9,408 (5)</td>
</tr>
</tbody>
</table>

* Denotes no data available. Not one of the ten leading causes of death for that age group. Number in parenthesis is ranking of cause of death within North Carolina.

The CDC reports that, in the United States, asthma is one of the most common chronic diseases, and that it affected more than 10.2 million adults during 1996. This disease has direct and indirect health care costs of approximately $12.7 billion per year. The 2000 Behavioral Risk Factor Surveillance System (BRFSS) survey indicated that about 7.2% of adults living in this country reported having asthma. The BRFSS represents the first state-specific data on asthma. It is a state-based survey of the United States adult population, consisting of a random-digit dialed questionnaire collecting information about modifiable risk factors. The first module on asthma was added to the survey in 1999, with all 50 states, Puerto Rico, and the District of Columbia self-reporting in the year 2000. Questions regarding the prevalence of asthma at any time during
the respondent's lifetime and currently were answered. The national prevalence of asthma at any point during a lifetime was 10.5%, based on answers from 182,293 persons. During the year 2000, the overall prevalence of current asthma was 7.2%, leading to an estimate of 14.6 million adults with the condition.

For North Carolina, the BRFSS reported a prevalence of lifetime asthma (answering "yes" to "Have you ever been told by a doctor that you have asthma?") of 10.1%. The prevalence for current asthma (answering "yes" to the previous question and to "Do you still have asthma?") is 7.1%. Both rates put North Carolina near the national median. Separate data is not available for the coastal areas of southeastern North Carolina. (CDC data, 2001)

Asthma is costly, both in money spent for care and in lost productivity. Some hospitalizations for asthma and other respiratory diseases may be preventable. A November 1999 study by Jones-Vessey indicates that for rural populations, the poor and the elderly, hospitalization rates for pneumonia, asthma, and immunizable conditions are higher than expected. Hospitalizations for these conditions and diseases are considered avoidable with prevention and earlier intervention. In 1997, pneumonia accounted for 34 percent of avoidable hospitalizations in North Carolina, with over $290 million amassed as hospital charges. Asthma was the third most common, with over $52 million charged.

In southeastern North Carolina, Bladen, Brunswick, Columbus, New Hanover, and Pender Counties had rates of potentially avoidable hospitalizations as outlined in Table 3. The rates for Brunswick County and Columbus County may be artificially low because counties adjacent to other states have some residents seeking care in those states. All five counties were considered rural for the purposes of the Jones-Vessey report, although New Hanover County is the most densely populated in North Carolina. The three counties with the highest rates of
substandard housing are the counties with the highest rates of avoidable hospitalizations in southeastern North Carolina.

Table 3. 1997 Potentially Avoidable Inpatient Hospitalizations by County of Residence

<table>
<thead>
<tr>
<th>Area</th>
<th>Discharges with avoidable hospitalizations</th>
<th>1997 Avoidable Rate *</th>
<th>Total Hospital Charges</th>
</tr>
</thead>
<tbody>
<tr>
<td>N.C. Total</td>
<td>87,877</td>
<td>1182.5</td>
<td>$740,794,857</td>
</tr>
<tr>
<td>Rural Counties</td>
<td>60,188</td>
<td>1354.5</td>
<td>$509,168,510</td>
</tr>
<tr>
<td>Bladen</td>
<td>492</td>
<td>1623.0</td>
<td>$4,582,022</td>
</tr>
<tr>
<td>Brunswick</td>
<td>841</td>
<td>1289.9</td>
<td>$7,359,579</td>
</tr>
<tr>
<td>Columbus</td>
<td>1,024</td>
<td>1971.4</td>
<td>$9,690,360</td>
</tr>
<tr>
<td>New Hanover</td>
<td>1,369</td>
<td>933.8</td>
<td>$13,877,491</td>
</tr>
<tr>
<td>Pender</td>
<td>400</td>
<td>1075.0</td>
<td>$3,728,128</td>
</tr>
</tbody>
</table>

*Rates are per 100,000 population.

Sensitivity to allergens.

Moisture in the home can exacerbate sensitivity to allergens. Sensitivity to rat and mouse allergen, cat, cockroach, and dust mite exposure has been associated with asthma attacks (Crain et al., 2002). In that study, children in homes with overcrowded conditions were screened for allergies, their caregivers interviewed as to the number of asthma episodes occurring in the previous two weeks, and evaluation of the child’s environment. Following the gathering of this baseline information, interventions and education of the caregiver were individually tailored for the allergens and exposures of each child. This individualized approach was effective in encouraging the caretaker’s participation in altering the environment. Of barriers to implementation that the caretakers experienced, nearly 30% reported that structural problems in the home interfered with compliance.
The mold module for intervention was taken from the National Institute of Health (NIH) guidelines for the diagnosis and management of asthma. It called for provision of education for the caretaker on sources of mold and moisture in the home, methods for washing moldy surfaces with a 10% bleach solution, discussion of the importance and methods of providing ventilation and not using home humidifiers, and for giving the family a HEPA air purifier for the child’s room with instructions for its use.

Persons demonstrating sensitivity to allergens or severe or frequent asthma exacerbations have the opportunity for consultation with a public health nurse in New Hanover County (Blackler, 2003). The nurse looks for the following in order to assess the appropriate intervention for the child with respiratory problems:

- In case of allergy, make sure the allergens are properly identified and that the child is under the care of a professional for wellcare.
- The presence of tobacco smoke.
- The presence of other smoke.
- Fragrances, such as perfumes, candles, air fresheners.
- Ventilation.
- Filters are monitored and changed frequently. HEPA filters used where possible.
- Housekeeping issues: the presence of roaches and rodents.
- Humidity below 50%.
- Particularly in the child’s bedroom, the mattresses and pillows are covered with impermeable material.
- If the child does chores, that he or she uses a mask, or does chores with low dust levels.
- Window coverings.
• Amount of clutter.

• That there is a plan for dealing with the environmental triggers in the home.

In helping the family with the plan, she suggests that the child’s linen be changed more frequently, that the use of comforters be decreased, that windows are covered with washable material, and that dust traps like bookshelves be enclosed. She recommends that treated cloths be used for dusting, that upholstered furniture be used sparingly and covered with washable cloth.

The health department has available a short video detailing the methods to decrease asthma triggers at low to no cost, and a section on how to deal effectively with landlords to effect needed changes. It is important that the family understand that a nurse should continue to check and monitor the child’s medications, and that the family comply with well care recommendations from the primary health care provider.

Higher humidity leads to microbial growth as well as worsening sensitivity to allergens. With ambient humidity greater than 50%, bacteria are able to find nutrition in substrates like wallboard, upholstery, and carpet. Spores are encouraged to activate in higher humidity.

Moisture in substrates leads to a small increase in lead exposure. Lead-containing paint bubbles with underlying moisture, peels and is available to be ingested. With scraping in order to repaint, lead exposure increases.

Moisture from overloaded septic systems and improperly installed plumbing is hazardous to health. High water tables common in southeastern North Carolina, flooding, and storm runoff increase the problem. Lack of indoor plumbing with latrines responsible for handling sewage and water supplies that may be easily contaminated are a problem in many homes in southeastern North Carolina. Food preparation in those homes can spread disease caused by protozoa, enterococcal bacteria such as salmonella and viruses including Hepatitis A. A bacterial infection,
*Clostridium difficile*, is highly contagious, difficult to treat, and becomes airborne. It is common after taking antibiotics, so that treatment for one problem like *Escherichia coli* can lead to further illness.

Moisture in structural elements of housing affects the physical safety of residents. As chronic moisture rots floorboards and subflooring, weight bearing is affected. Physical observation of the ground below flooring is not uncommon when assessing substandard housing. Moisture in ceilings can lead to collapse and injury. Data for the incidence of nonfatal injury is not available. Minor injuries are often unreported, and the cause for injuries requiring medical attention is not always reported as caused by a structural defect in a home. Unintentional injury was the fourth leading cause of death in North Carolina in 1997 (CDC State Profiles, 2003).

**Repair and remediation of moisture and its effects.**

Structural repair of moisture damage is ineffective if the source of the moisture is not removed. Leaks in the roof, walls, windows, and foundations need to be repaired. Chimneys and ventilation sources may be the cause of moisture entering the home. For example, in New Hanover County, a group of volunteers repairing a home after a hurricane closed off the fireplace of a home in an effort to improve drafty conditions. However, the group failed to cap off the fireplace chimney. Rain pooled in the sealed fireplace, finally seeping into the walls (Suggs, 2003). This is illustrated in Figure 8. Outdoor water runoff patterns must be assessed, and drainage rerouted if necessary. Soil surfaces should be graded away from buildings. The evaluator needs to assess the integrity of pipes and plumbing, as well as the septic or sewage system. If a home is in a frequent floodplain, the residents may need to consider relocation. Humidifiers in the home should be removed, and dehumidifiers may be appropriate.
Once the source of moisture has been eliminated, the effects must be repaired. Small surface areas should be cleaned with a 10% solution of bleach and water. The Environmental Protection Agency recommends that areas larger than about 10 square feet be treated as though the home were a commercial building. Large remediation efforts require use of protective equipment and isolation procedures. Rotten wood and drywall replacement, removal of damaged insulation and carpet, and removal of mold within the walls should be handled by persons experienced in handling mold (EPA Publications 2003). Four methods are recommended by the EPA. The first is use of a wet vacuum if sufficient moisture is still present. Wet vacuums may spread mold spores if the materials are not damp enough. The second method of removal of mold is damp wiping nonporous surfaces with water or water and detergent. Whether the mold is still alive or has been killed, the fungus is still allergenic. The third recommended method is the use of a HEPA (High-Efficiency Particulate Air) vacuum for final cleanup after all materials are dry and the materials unable to be cleaned have been removed. Discarding porous material that has been contaminated is the fourth method for dealing with mold. The damaged materials must be sealed in plastic bags, along with filters from the vacuums.

In replacing the damaged materials, the homeowner should keep in mind that new floor coverings and furniture, as well as new insulation and paint will release Volatile Organic Compounds (VOCs), which may irritate sensitive or compromised respiratory systems and which require good ventilation.

Once the mold has been removed, further damage from moisture and its effects must be prevented. The residents should continue to keep walls and internal surfaces clean. Ventilation and heating and air systems need to be maintained, to help prevent and remove dampness. Dehumidifiers to control humidity and HEPA filters are important in preventing the recurrence
of internal moisture. Inspection of structural elements and early repair of leaks are extremely important to control moisture. In controlling the presence of contaminating molds, and preventing a foothold in the home, these techniques require diligence, and perhaps assistance for the resident (Lawrence and Martin, 2001).

Resources for repair and remediation.

Southeastern North Carolina has depended on its strong sense of community to remediate housing for those in need. Independent Living will assess and recommend modifications for homes of the newly disabled, and will make the modifications for persons with long-term disabilities until its budget is exhausted. Religious agencies and local religious groups have traditionally assisted when the need is known. In southeastern North Carolina, Catholic Social Services, WARM and M.E.R.C.I. (part of the North Carolina Conference of the United Methodist Church), Faith in Action, and the Southern Baptist Association are the agencies most active in repair and rebuilding. The Mennonite Church and Salvation Army are particularly active following natural disasters such as hurricanes.

In southeastern North Carolina as in other areas of the world, Habitat for Humanity works on the problem of substandard housing by building new homes for families able to pay an interest free mortgage and supply some "sweat equity" during the construction process.

Coalitions and partnerships are essential for effective intervention to prevent and repair substandard housing. A national initiative called Turning Point brings together facets of the community. Funded by the Robert Wood Johnson and W. K. Kellogg Foundations, Turning Point seeks to strengthen the nation's public health system. New York City established a citywide partnership in the late 1990's to stress the importance of the community's role in its own health. Housing was among the issues identified as priority through community forums,
Health and Substandard Housing

along with access to care, environmental health, mental health, asthma, education, and dietary issues. The participants in the forums also identified community assets to be used to improve the health of the entire community, such as tenant, business, and block associations, libraries, adult education programs, faith communities, college community service programs, and sports groups and health clubs. The partnership model can be translated particularly to the housing issue. Community groups can monitor status of housing within the influence of their group, access resources to improve the housing, and participate in the actual repair or building (Cagan, et al, 2001).

In Washington State, another government-sponsored coalition formed to address housing issues is the Seattle-King County Healthy Homes Project. The target population for this program is low-income children with asthma, and was a randomized controlled trial of an intervention designed to improve the home environment to decrease asthma triggers. The coalition brought together community home environmental specialists, Seattle Partners for Healthy Communities, the Hoover Vacuum Company, the Group Health Cooperative of Puget Sound for smoking cessation, the local hazardous waste management program, and Aerotech Laboratories for fungal analysis.

The Smart Start program for preschool children has had funding in the past for supplying cleaning products and antiallergenic products for those families where a child has been identified as at risk for severe asthma. This funding has ended for southeastern North Carolina.

Opportunities for study

Many studies have been done (Lawrence and Martin 2001) linking the health status of populations to the level of the housing in that community or socioeconomic stratum. Few or no studies have been done measuring the change of health status upon improvement of housing in
individuals. A prospective cohort study might follow the health, number of emergency calls, care provider visits, nursing home admissions, etc. of occupants who did or did not receive intervention to improve housing situations.

Another study may individually correlate health care status with substandard housing. Attempts have been made to do this with asthma (Matte and Jacobs 2000) but the condition is prevalent even in homes not classified as substandard. Other conditions may be more directly related to the effects of moisture, such as mold toxicity (Martin and Lawrence 2001) and injury from damaged flooring, but have not been thoroughly studied.

Likewise, a retrospective cohort or matched-pair study could be done to track the health status of individuals in households which either received intervention or remained in substandard housing.

Conclusion and Recommendations:

It is impossible for one agency or department to address the complete problem of substandard housing, excessive moisture, and health in southeastern North Carolina. A coalition of governmental and nongovernmental organizations needs to come together to define standards for housing, for policy and regulatory development to enforce those standards, and to provide resources—monetary and personnel—to remediate, repair, and educate. The general public must be made aware of avenues to bring substandard housing into good repair, to make it safe, sanitary, and secure. Landlords must take responsibility for maintenance and repair. Homeowners need to be aware of the danger of excessive moisture, the insufficiency of making cosmetic repairs, and the need to address the source of the problem and to prevent its recurrence.

Education of the general public could be accomplished through use of Public Service Announcements and brochures. These could be distributed in places where individuals with
respiratory health problems or their caregivers will be interested in improving the environment. Emergency department waiting areas, physician offices, and urgent care centers would be appropriate to place information for households with the resources to address moisture damage and its effects with private resources. This would require some self-assessment of the environment as well as a desire to expend the effort needed for repair. Another avenue of raising awareness is speaking to groups in the five county area. The New Hanover Health Department’s Action Plan for 2003 (Appendix I) is a good model for this. Planned talks with homeowner associations, school assemblies, service and church groups will help educate the general public to the consequences of moisture damage.

In low income households, home assessment would best be accomplished by a professional with access to resources and referrals (Matte and Jacobs 2000). Home health workers such as nurses, personal care aides, or respiratory care therapists can be easily trained to recognize presence of mold, mildew, or water damage. An environmentalist may be called on to document structural damage and fungus, then to deal with a landlord or building superintendent with recommendations for repair. With a well-trained assessor, multiple problems can be identified and addressed along with the moisture-related problem. A simple addition of looking for fire hazards or potential for injury may make a difference in overall health of the resident.

Southeastern North Carolina, although struggling with funding, has begun to establish parish nurse programs. The parish nurses are often on the frontlines for education and for identification of allergies and sensitivities. The parish nurse clients have established trust with the nurse, and would be more likely to report structural needs if asked. Continuing education for the parish nurses regarding water and moisture damage can be presented on a regional, state, or county basis.
The model from British Columbia integrated two routes of assessment (Lawrence and Martin 2001). All included the building’s history, characteristics of any illness of the occupants, especially illness related to mold, visual inspection, environmental evaluation, and sampling. The National Institute of Environmental Health in this country does not recommend sampling of mold, considering all molds detrimental to health. Humidity and moisture sampling is recommended (Suggs 2003). The assessment was initiated through a health investigation by community health nurses or physicians, or through a housing inspection by environmental health officers, building inspectors, and housing maintenance officers.

Once a problem has been identified, a referral to the proper county health department or remediation agency is appropriate. Health issues, including evaluation of allergies or sensitivities, need to be addressed in concert with the interior environment. EPA guidelines are available for the residents and for those assisting them (EPA Publications, 2001). The partnership would benefit from annual training specifically designed toward repair of water damage and its source, and for protection of the workers performing the repairs. A referral base of agencies needs to be developed, along with a base of groups willing to work on particular projects.

One agency already addressing the problem and its solutions in southeastern North Carolina is Wilmington Area Rebuilding Ministries (WARM). WARM brings together interfaith volunteers, civic and community groups to assist low-income homeowners and heirs living in substandard housing, helping to rehabilitate and improve homes at no cost to the occupants. The home is assessed by two persons experienced in evaluating visible and hidden damage, including the source of the damage. The volunteers are drawn from the community where the home is located, reconnecting the resident with neighbors and services. The volunteers are partnered with
professionals and businesses, and are given the opportunity to improve construction skills and to learn new techniques. For the five counties of Bladen, Brunswick, Columbus, New Hanover and Pender, the quality of housing improves along with quality of life.

Since southeastern North Carolina is prone to excessive moisture through storms and flooding, assessment and repair instructions should be prepared for disaster relief workers. Again, the EPA publications can be made available, but these materials could be coordinated with a coalition of the county health departments, along with further instructions and local health referral agencies.

As with the Seattle-King County coalition, a partnership with businesses and financial resources is useful to be able to supply residents and landowners with the necessary tools for repair (Kriger, et al, 2002). HEPA filters, vacuum cleaners, fans, cleaning products, and products to decrease exposure to allergens are often beyond the means of the target population. Within the coalition, grant funding would be available for education, administrative costs, and some costs of the remediation.

A demonstration project is needed to test whether this integrative strategy is effective in improving outcomes in the health of residents of southeastern North Carolina. The project could track hospitalizations and emergency visits related to diseases and injuries associated with moisture. It could be used as a screening tool to begin the structural assessment process, and the health status of these persons would then be tracked, as outlined in the opportunities for research section.

In looking at larger issues, local laws should be passed to give regulatory power to health departments. At this point, no governmental body has the power to do more than recommend repairs or prevention. There is no recourse to force landlords to make the proper remediation.
Another larger issue is that of preservation of wetlands and planning to avoid major flooding. Consistent enforcement of existing regulations and restoration of drained wetlands are the purview of the state and county Departments of Environmental Health and Natural Resources. If these departments would add their influence to the partnership of health workers and agencies dealing with the repair of homes, the problem would be prevented to some degree.

An integrated approach to improving the health of southeastern North Carolinians is the only effective one. The incidence and prevalence of respiratory disease, sensitivity to allergies, intestinal infections, and unintentional injuries resulting from moisture-damaged substandard housing is far too high. The cost of hospitalizations, doctor visits, and continuing care for those with these conditions can be decreased by addressing the environmental causes. An integrated, multidisciplinary approach is necessary for effective education, research, and intervention.
REFERENCE LIST

http://census.state.nc.us/. North Carolina population data.

http://linc.state.nc.us. Statistical data by county.


http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5032a3.htm 2001. BRFSS data on prevalence of asthma.


Wrenn, E, and West, LE (2002). Interview, Wilmington Area Rebuilding Ministries.
APPENDIX I

Action Plan for New Hanover County Health Department

Environmental Health Division

Mission

To create and maintain an Indoor Air Quality program in New Hanover County

Goal

Heighten residential awareness of indoor environmental hazards associated with indoor air quality issues during the 2003 calendar year.

Objective

Inform our community of the resources and abilities of our department regarding IAQ and asthma issues.

Tasks/Activities

- To perform individual inspections of homes and businesses, based on citizen complaints, for mold, dust and asthma triggers.
- Archive documentation for addresses and construct an GIS database for IAQ complaints in New Hanover County.
- To implement the “Tools for Schools” program in at least one public school building.
- To disseminate information to the public through PSAs and radio broadcasts.
- To solicit various homeowner associations for presentation opportunities on allergen and mold maintenance.
Measurable Outcomes

- Cataloguing citizen requests and outcomes of investigations.
- Creation of and ABCview GIS database for mold related issues.
- Number of schools participating in “Tools for Schools.”
- Number of stations broadcasting PSAs, time of day, and demographics targeted.
- Number of presentations made, to whom and numbers reached.
- Number of follow-up inquiries from presentations.

(2003)
APPENDIX II

Data Definitions

Rural population: Resident populations other than that classified as urban. The 2000 data are from table-cell P005005, SF3, Sample data. Source: Federal Agency Data: Bureau of the Census-Census of Population and Housing

Year-Round Housing Units: For 2000, year-round housing units are approximated as the sum of occupied housing units and those vacant units that are classified as for rent, for sale, or rented or sold but not occupied. It excludes vacant housing units that are for seasonal, recreational, or occasional use; for migrant workers, and other vacant. The 2000 data are the sums of table-cells H007001, H008002, H008003, and H007004, SF3. Source: Federal Agency Data: Bureau of the Census-Census of Population and Housing

Owner-Occupied Housing Units: Owner-occupied housing units are those in which the owner of co-owner lives in the unit even if the unit is mortgaged or not fully paid for. The owner or co-owner need not be the householder. The 2000 data are from table-cell H004002, SF1. (100% count data). Source: Federal Agency Data: Bureau of the Census-Census of Population and Housing

Mobile Homes or Trailers: Both occupied and vacant mobile homes are included if intended for occupancy where located in 2000. Excluded are mobile homes to which permanent rooms have been added, mobile homes used only for business purposes or for extra sleeping space, and mobile homes for sale on a dealer's lot. The 2000 data are the sums of table-cells H032011, H032022, and H031010, SF3. Sample data. Source: Federal Agency Data: Bureau of the Census-Census of Population and Housing

Substandard Housing: Occupied Housing Units Overcrowded/Incomplete Plumbing—Occupied housing units that are overcrowded and/or lack complete plumbing facilities. There is no universally accepted definition of substandard housing, but this definition is often used. An overcrowded unit is measured in terms of more than 1 person per room. Persons per room is a derived measure obtained by dividing the number of persons in each occupied housing unit by the number of rooms in the unit. "Lacking complete plumbing facilities for exclusive use of the occupants" may occur if there are complete plumbing facilities, but they are also used by another household, or if some plumbing facilities are lacking. Complete plumbing facilities include hot and cold piped water, a flush toilet, and a bathtub or shower. The 2000 data are calculated as table-cells H022001-H022004-H022013 from SF3. Source: Federal Agency Data: Bureau of the Census-Census of Population and Housing

Occupied Housing Units over 20 Years Old: the year the original construction of the building was completed (not the date of any later remodeling, addition, or conversion). For occupied housing units. The 2000 data are the sum of table-cells H036007, H036008, H036009, H036010, H036011, H036017, H036018, H036019, H036020, and H036021 from SF3. Sample data. Source: Federal Agency Data: Bureau of the Census-Census of Population and Housing.