National Center for Healthy Housing

DRAFT Case Studies on Integrated Pest Management in Low Income Housing

May 31, 2007

Pursuant to a contract with U.S. Environmental Protection Agency's Office of Pesticide Programs and Battelle, the National Center for Healthy Housing has developed a series of case studies on integrated pest management in low-income housing. NCHH is seeking comments on these draft case studies by June 15. Please contact NCHH's Tom Neltner at 443-539-4160 or tneltner@nchh.org with your comments

#1 *Rodents and Insects reported in more than 50% of public housing and housing choice voucher housing.* This case study focuses on pest conditions in public housing. It summarizes the information developed by U.S. Department of Housing and Urban Development's Real Estate Assessment Center and research from Purdue University on Gary Housing Authority.

#2 *Cincy cockroach reminds of dangers of poor pest control.* This case study focuses on the problem of bait aversion – where cockroaches do not feed on the baits that contain the pesticide. It is primarily based on research from Purdue University.

#3 *Can resident education make a difference in pest control for public housing.* This case study compares studies by researchers at Virginia Tech, Purdue and Orkin on the effectiveness and costs of various integrated pest management strategies.

#4 *CHAMACO: A Community-University Partnership.* This case study focuses on a community-wide effort between University of California at Berkeley and residents of Salinas Valley in California.

#5 *Boston Housing Authority.* This case study focuses on the comprehensive, resident-based integrated pest management program by Boston Housing Authority with support of Harvard University, Tufts University, Boston University and the Asthma Regional Council of New England.

#6 *Environmental Health Watch's Collaboration with Cuyahoga Housing Authority Demonstrates the Difference Integrated Pest Management Can Make.* This case study was developed by EPA in 2004. It is reprinted consistent with the draft format.

COSTS AND EFFECTIVENESS OF IPM-BASED INTERVENTIONS

Can Resident Education Make a Difference in Pest Control for Public Housing?

Two leading researchers on pest control in public housing studied the effectiveness and costs of implementing progressive pest control interventions based on integrated pest management (IPM). The studies show that vacuums and baits are much more effective at controlling cockroaches than traditional baseboard, and crack and crevice treatments. They also show that the more elements of IPM used the more effective it will be. The studies indicate that IPM costs more, especially initially. However, this analysis did not include the benefits to residents (e.g., reduced asthma or stress) from effective pest control and reduced burden on staff and management in responding to pest complaints.

Why Cockroaches?

Live cockroaches, as well as their remains and feces, cause asthma attacks in people sensitive to cockroach allergens according to a 2000 Institute of Medicine Report. The Inner City Asthma Study found that more than 60% of inner city children were sensitive to cockroach allergens. Asthma is a costly disease that disrupts a family and undermines a child's ability to learn. There is growing evidence that mice may have a similar effect.

This case study is part of a series addressing integrated pest management in low income housing. To access additional fact sheets in the series, please visit: www.healthyhomestraining.org/ipm/studies.htm.

In a 2004 study, Dini Miller of Virginia Tech and Frank Meek of Orkin compared IPM-based methods that relied on cockroach vacuums, baits and insect growth regulators (IGRs) with traditional approaches that include baseboard spraying and borate dusts for cracks and crevices.[1] They found that the Integrated Pest Management-based (IPM-based) approach was dramatically more effective than traditional methods. Pesticide use was cut by more than 50 times from 827 grams per unit to less than 15 grams per unit. Eighty percent of the units were cockroach-free after one year compared with 6 percent before IPM treatment. The number of cockroaches trapped per unit dropped almost as dramatically. While the total cost per unit for IPM-based treatment over a year was more - $25.70 v. $10.43 – primarily due to the initial vacuuming. By the end of the study, the monthly cost per unit at the end was approximately 60% less - $0.87 for IPM v. $1.52 for traditional control.

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In this study, pesticide use decreased by more than two-thirds and at one point all of the IPM-based units were cockroach free. Only one unit had a serious housekeeping relapse after showing initial promise. In this study, the IPM method cost nearly double the bait-only methods over the six months of the project - $65 to $35. It is likely that more aggressive management support for housekeeping and better maintenance would have reduced that difference, especially over time.

Neither study calculated the following cost savings from IPM:

- Benefits to the health and well-being of residents from a cockroach-free home;
- Reduced burden on management and staff in responding to tenant complaints about pest infestations;

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- Reduced burden on families responding to asthma attacks or taking time to file a complaint with management;
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- Broader benefits beyond pests – such as reduced mold – from better housekeeping and maintenance that would result from IPM.

Table 1 provides a summary comparison of each of the studies against the ten program elements established by the U.S. Department of Housing and Urban Development in 2005 for an effective IPM program.[3] The costs for each method are at the end. Results are in italics. However, a few items deserve note:

1. Both studies addressed buildings as a whole. All units were treated with one method or the other.
2. The Portsmouth, Virginia, study lasted one year – January to December. The Gary, Indiana, study started in May and ended in November. Cockroaches are especially hard to control during the hot, humid summer.
3. The Portsmouth, Virginia, researchers did not focus on changing resident behavior. In contrast, the Gary, Indiana, researchers educated residents and referred residents with housekeeping to a mandatory four-hour training program. One resident was evicted for lease violations related to housekeeping. The researchers applied 25% of the pesticides (215 of the 879 grams) used in the Partial IPM Program on this one unit.
4. The schedule of treatments varied between the studies. The Gary, Indiana, researchers added treatment after two weeks and did not treat for the fifth and sixth months. The Portsmouth, Virginia, researchers monitored the units and intervened as needed each month.
5. The Gary, Indiana, researchers assessed sanitation. They scored each unit on a scale of 1 to 5 with 5 being severely dirty. The scoring considered three factors: amount of clutter, amount of trash on floor, and amount of food on floor and kitchen counter. The Portsmouth, Virginia, researchers did not assess sanitation.
6. The score for units treated with the IPM Approach went from 3.8 to 2.4 – a statistically significant difference. The score dropped from 4.0 to 3.2 in the Bait-Only Approach units but was not statistically significant. The improvement indicates that initial cockroach cleanout and resident education makes a difference in unit sanitation.

For More Information

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[3] U.S. Department of Housing and Urban Development, 2006, *Guidance on Integrated Pest Management*, Notice PIH 2006 – 11(HA). See www.hud.gov/offices/pih/publications/notices/06/pih2006-11.pdf.

COMPARISON OF GARY, INDIANA, AND PORTSMOUTH, VIRGINIA, PEST CONTROL STUDIES TO HUD'S IPM PROGRAM ELEMENTS					
HUD IPM Program Elements *(Results of Study in Bold Italics)*		**Gary IN / Purdue Study**		**Portsmouth VA / Virginia Tech Study**	
		Partial IPM Program	Bait	Vacuum Trapping, Bait & Growth Regulators	Traditional Spray & Dust
1. Communicate Policies Communicate Housing Authority's IPM policies and procedures to: • All building occupants • Administrative staff • Maintenance personnel • Contractors.		Communicated to residents and staff in the impacted buildings. Seminars for resident managers and community program staff on IPM.		Communicated to residents and staff in the impacted buildings.	
2. **Identify Problems** Identify pests environmental conditions that limit the spread of pests.		Comprehensive initial assessment for 66 units in 12 buildings.		Comprehensive initial assessment for 100 units in 22 buildings.	
3. **Monitor and Track** Establish an ongoing monitoring and record keeping system for: • Regular sampling and assessment of pests; • Surveillance techniques • Remedial actions taken • Assessment of program effectiveness.	*Results at End of Study*	Assessed at weeks 2, 4, 8, 12, 16, and 29 with 6 glue traps. Scored sanitation on a 1 to 5 scale on three variables. 5 is worst		Assessed at monthly with 3 glue traps. No scoring of sanitation.	
	Sanitation	***Improved significantly from 3.8 to 2.4***	***Improved moderately from 4.0 to 3.2***	***Not Assessed.***	
	Severity of Infestation	***Units without heavy infestations improved from 65% to 97%***	***Units without heavy infestations improved from 66% to 84%***	***Adjusted # trapped per unit improved 60%***	***Adjusted # trapped per unit improved 15%***
	No trapped roaches	***Improved from 59% to 84%***	***Improved from 56% to 72%***	***Improved from 6% to 80%***	
4. **Set Thresholds for Action** Determine, with involvement of residents: • Pest population levels – by species – that will be tolerated • Thresholds at which pest populations warrant action.		Tolerance set at zero cockroaches.		Tolerance set at zero cockroaches.	
		Flushing and vacuuming dropped if < 12 trapped roaches/ unit. ***One unit vacuumed twice and another three times***.	No changes.	Treatment reduced to 3 months if < 3 trapped roaches per unit.	No changes.

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5. **Improve Non-Pesticide Methods** Improve: • Mechanical pest management methods • Sanitation • Waste management • Natural control agents that have been carefully selected as appropriate in light of allergies or cultural preferences of staff or residents.	Cleanout initially and when > 11 trapped roaches per unit using backpack vacuum and limited pyrethrin & piperonyl butoxide flush. Sticky traps capture remaining cockroaches.	No changes.	Cleanout initially and at 6 months using backpack vacuum in kitchen and bathroom.	No changes.
6. **Prevent Pest Entry and Movement** • Monitor and maintain structures and grounds including o Sealing cracks o Eliminating moisture intrusion and accumulation • Add physical barriers to pest entry and movement.	*None*		*None*	
7. **Educate Residents and Update Leases** • Develop an outreach/educational program • Ensure that leases reflect residents' responsibilities for: o Proper housekeeping o Reporting presence of pests, leaks, and mold.	Residents given educational packet and educated again during visit. One resident in each building asked to educate peers.	*None*	*None*	*None*
8. **Enforce Lease** Enforce lease provisions regarding resident responsibilities such as: • Housekeeping • Sanitation • Trash removal and storage.	Sanitation score given to property mgmt. Residents with poor sanitation (score of 4 or 5) required to attend 4-hour housekeeping class. One resident evicted.	*None*	*None*	*None*

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		Partial IPM Program	Bait	Vacuum Trapping, Bait & Growth Regulators	Traditional Spray & Dust
9. **Use Pesticides Only When Necessary** Use pesticides only when necessary, with preference for products that, while producing the desired level of effectiveness, pose the least harm to human health and the environment, and, as appropriate, notifying PHA management before application.		Baits and insect growth regulators used as needed. No sprays or fogs used.		Baits and insect growth regulators used as needed.	Sprays for baseboard. Dusts for cracks and crevices.
		879 grams used per unit over 29 weeks	***780 grams used per unit over 29 weeks***	***14.8 grams used per unit over 52 weeks***	***827 grams used per unit over 52 weeks.***
10. **Post Signs** Provide and post 'Pesticide Use Notification' signs or other warnings.		Notified at visits		Notified at visits	
Treatment Cost Per Unit at End of Study		***Last Visit***		***Last Visit***	
	Labor	***$ 0.74***	***$ 2.12***	***$ 0.69***	***$ 1.50***
	Pesticides & Traps	***$ 0.53***	***$ 0.53***	***$ 0.18***	***$ 0.02***
	Total	***$ 1.27***	***$ 2.65***	***$ 0.87***	***$ 1.52***
Total Cost Per Unit Over Length of Study		***Total Over 29 Weeks***		***Total Over 52 Weeks***	
	Labor	***$49***	***$22***	***$20.90***	***$10.03***
	Pesticides	***$16***	***$12***	***$ 4.80***	***$ 0.43***
	Total	***$65***	***$35***	***$25.70***	***$10.43***

COSTS AND EFFECTIVENESS OF IPM-BASED INTERVENTIONS

Environmental Health Watch's Collaboration with Cuyahoga Housing Authority Demonstrates the

Traditional methods of household pest management not only have limited success in actually eliminating pests, but in many cases, efforts at control can cause additional harm to residents, especially children. A new program to control household pests—adapted from agriculture—attempts to control pests more effectively while using less pesticides. A collaborative interagency effort is helping to make Integrated Pest Management (IPM) a viable option for the affordable housing community.

IPM is a new approach to pest control that offers a means to reduce the risk from—and in some cases, the amount of—chemical pesticides needed. IPM reduces risk by monitoring pest populations, conducting environmental controls, and placing small amounts of low-toxicity, low-volatility pesticides on surfaces inaccessible to children. By encouraging tenants, building management and staff, and even pest control contractors to work together and proactively eliminate conditions that allow infestations to thrive, dramatic pest reduction can be achieved without using large amounts of pesticides.

Cockroach infestation poses an especially compelling challenge. Evidence demonstrates that cockroach allergen is a potent, pervasive and persistent asthma trigger for low-income, inner-city populations. The common response to cockroach infestation is monthly pesticide spraying. But this method compounds the risk children face from cockroaches with a new risk: children are particularly vulnerable to the toxic effects of exposure to household pesticides.

Why Cockroaches?

Live cockroaches, as well as their remains and feces, cause asthma attacks in people sensitive to cockroach allergens according to a 2000 Institute of Medicine Report. The Inner City Asthma Study found that more than 60% of inner city children were sensitive to cockroach allergens. Asthma is a costly disease that disrupts a family and undermines a child's ability to learn. There is growing evidence that mice may have a similar effect.

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IPM in Action in Cleveland's Affordable Housing Units

With this in mind, Environmental Health Watch (EHW) teamed with the Department of Housing and Urban Development Office of Healthy House and Lead Hazard Control to conduct a study of the efficacy of IPM in an affordable housing development in Cleveland, Ohio. Asthma rates have increased dramatically over the past 20 years and asthma is now a major public health concern, especially for children. Removing the threat of roaches, and their debris (which contains the allergens) can benefit young people with asthma. EHW's study tested new methods for assessment of cockroach allergen contamination, the safer elimination of cockroach infestation, and finally, effective cleanup of roach allergens.

EHW worked with Cuyahoga Metropolitan Housing Authority, Greater Cleveland Asthma Coalition, the United States Department of Agriculture (USDA) Research Station in Gainesville, Florida, and the Johns Hopkins Allergy and Asthma Center to run the project.

Three multi-family complexes operated by Metropolitan Housing Authority in Cleveland, Ohio were the candidates for the project. The stated goal of the project was to explore methods to reduce cockroach allergen contamination in low-income public housing. The cockroach control intervention was "precision-targeted IPM," a modification of the standard cockroach IPM strategy, designed by the USDA Imported Fire Ants and Household Insects Research Unit, a partner in this project. Their approach increases the usual level of cockroach monitoring so that a detailed spatial analysis of harborages and feeding points can be used for more precise placement of pesticides.

Outreach Efforts

Outreach to participants began with a letter from the housing authority introducing the project, which was followed by a phone call to the residence. If the phone call was not successful, housing authority staff went door-to-door in the buildings to engage tenants. The housing authority staff visited participants' homes to provide them with a detailed description of the activities that would take place during the project and the incentives that would be provided to them for their participation.

Incentives given to engage participants included a $15 food certificate from a local supermarket for each visit to the unit and a new vacuum cleaner to encourage them to minimize food debris in their units. Furthermore, during the course of the intervention as resident health educators and the tenants identified specific needs unique to each unit, additional incentives were given, including new garbage bags, smaller garbage cans, or new food storage containers, which would help reduce the likelihood of renewed pest infestation.

Identifying the Level of Infestation

Initial roach infestation was measured in four ways: 1) roaches captured on sticky traps; 2) roaches flushed from harborages; 3) occupant reports of roaches; and 4) staff observations. However, due to the incidence of large food harborages that might have kept roaches from being lured by sticky traps, it was found that flushing was the most effective means of measuring the true level of infestation.

Stu Greenberg of Environmental Health Watch described the flushing approach as "reconnaissance by fire." Using a heat gun with a PVC collar to prevent burns (recommended by USDA staff), EHW conducted an "active inspection" of the units by passing the gun along baseboards, electrical outlets, light fixtures, tables, door frames and anywhere else roaches might be hiding. Aware of the risk that the heat might simply push the roaches in deeper, the results were nonetheless very good. A large number of roaches came out, and harborages not traditionally targeted by the pest control contractor were identified.

Aside from the efficacy of the heat gun in simply drawing out roaches, it also proved a most effective recruiting tool. Skeptical tenants, convinced that roach infestation was an intractable problem, became much more enthusiastic about the IPM strategy after they saw that it was radically different from other methods. As Mr. Greenberg explained, once tenants realized that heat gunning and vacuuming of roaches had a real effect, they "saw hope" that the problem could really be managed, if not solved all together. This encouraged tenants to actively participate in meeting their responsibilities under the program.

Working Together to Implement the Program

Effective implementation of the IPM strategy was a team effort that required the housing authority, the tenants, and pest control contractors to each play an active role in combating the infestation. As is implied, an integrated strategy could not be effective without all participants doing their part. Tenants, of course, became much more enthusiastic when they saw progress being made. It encouraged them to cooperate with pest control contractors, enable the housing authority to make necessary repairs to their units, and most importantly, to create an unwelcoming environment for roaches. The housing authority, as noted, was responsible for repairs to the units, including caulking holes in walls and floors to prevent harborages—especially in areas where food debris could collect. In addition, they conducted basic unit repairs, such as the plumbing and other systems that provided a safe harbor for roaches.

The work required the participation of all of the housing authority staff, from the building's environmental supervisor, who served as entrée to tenants and liaison with operations and management staff, to those staff and contractors responsible for building maintenance and repair. Of course, these contractors, who often interacted with the pests in the course of their repair work, were enthusiastic about participating in a project that could reduce their exposure to roaches. Furthermore, the pest control contractors worked with EHW to better understand where to place roach traps and identify harborages (the old strategy of simply placing a couple of traps in kitchen cupboards obviously was not doing the trick).

In fact, the one unit that did not produce the desired results was the rare instance where the tenants refused to be cooperative. While for most residents, the real successes of the heat gunning method was enough for them to enlist in the rest of the IPM strategy, this one unit with a long-term history of heavy infestation, refused to change its behavior in order to stop roach infestations. The unit had serious repair problems, but the tenants were not cooperative with the Housing Authority. In spite of 12 site visits by EHW, the tenants did not remove food debris nor work with the other participants. The roach infestation was not mitigated.

No pesticides were spayed during the IPM process, nor were foggers or bombs used. No chemical flushing was done either. To counter infestations, low-toxicity and low-volatility gel baits and bait stations, as well as boric acid, were used. But because the heat gunning had identified specific harborages, these traps could be targeted, as opposed to haphazardly distributing the traps throughout the units. This meant that there was no broadcast application of pesticides—a huge benefit for the health of tenants and others in the buildings.

Objectives and Outcomes

The cockroach control objective was to achieve a 95% reduction in the roach population, as measured by the number of roaches trapped and flushed. That level of reduction was achieved in all but one case (the uncooperative tenants) and required one to four flush/vacuum/bait visits.

Of the 18 housing units that were part of the program, live roaches were seen in 11 of them (generally an indication of heavy infestation) and dead roaches were seen in 16 units. Building defects (holes in walls,

plumbing leaks, etc.) were identified in 13 of the 18 units and food debris and excess clutter in 10 of the 12 occupied units. This speaks to the value of the IPM approach to involve the housing authority and the tenants—without them fulfilling their roles, a true reduction in roach infestation would not be feasible.

The initial roach counts in the units varied widely. Six units had counts of 243 or greater, and two had counts of more than 1,000! In most cases, two or three visits were enough to achieve the 95% reduction. Three units achieved a 100% reduction; of the two units with major infestations, the unit where the IPM was unsuccessful (due to the tenant behavior) had a roughly 80% reduction, while the other a 97% reduction in four visits.

Overall, the combination of cockroach infestation reduction through precision-targeted IPM (including hot air flushing and HEPA vacuuming), a one-time professional cleaning based on the HUD lead dust cleaning protocol, occupant education, and occupant on-going cleaning effort, the project succeeded in substantially reducing cockroach allergen levels.

Lessons for Future Interventions

This small exploratory project demonstrated that previously intractable roach infestations could be virtually eliminated through a labor-intensive, aggressive and precision-targeted IPM strategy sustained over several months. It required cooperation from the public housing management, maintenance and environmental staff, and from the tenants.

Of course, this labor-intensive experiment, combined with the high degree of cooperation involved, cannot be achieved nor replicated overnight. What it shows, however, is that there is a viable alternative to traditional pest control methods. What is more, by incorporating already established techniques for responding to lead dust hazards, there is certainly a precedent for the type of intervention warranted here.

The Environmental Health Watch project demonstrated that effective roach control requires a division of responsibility among the housing authority, the pest control contractor, and the tenant. The housing authority has to provide and maintain the dwelling unit free from defects that support roach infestation. The pest control contractor has to thoroughly inspect the entire unit to determine roach harborages, reservoirs, entry points, food and water resources, use safe and effective treatments to get rid of the roaches, and provide ongoing monitoring. Finally, the tenants must maintain housekeeping practices that do not support roach infestation and they must cooperate with pest control efforts by the contractor.

EHW developed a guide to reducing infestation with IPM that is now available on their Web site (**www.ehw.org**). In addition, two slide shows on the organization's Web site summarize the pilot IPM project, and a valuable guide for contractors —A Model Contractor Program for IPM Management—was also created.

The new challenge is to find ways for this approach to be feasible and cost-effective to encourage more public housing authorities and their pest control contactors to adopt it. To achieve a large scale implementation of this type of pest control strategy would require reevaluating the pest control contracting process (e.g., fee structure, specifications, monitoring), training and supervision of contractor personnel, maintenance and repair practices; and tenant education and enforcement of responsibilities.

Given the risks to children inherent in traditional pest control methods, and the real benefits that can be realized from IPM, the EHW model just might be a valuable contribution to the quest for safer and cleaner affordable housing.

For More Information

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4. The schedule of treatments varied between the studies. The Gary, Indiana, researchers added treatment after two weeks and did not treat for the fifth and sixth months. The Portsmouth, Virginia, researchers monitored the units and intervened as needed each month.
5. The Gary, Indiana, researchers assessed sanitation. They scored each unit on a scale of 1 to 5 with 5 being severely dirty. The scoring considered three factors: amount of clutter, amount of trash on floor, and amount of food on floor and kitchen counter. The Portsmouth, Virginia, researchers did not assess sanitation.
6. The score for units treated with the IPM Approach went from 3.8 to 2.4 – a statistically significant difference. The score dropped from 4.0 to 3.2 in the Bait-Only Approach units but was not statistically significant. The improvement indicates that initial cockroach cleanout and resident education makes a difference in unit sanitation.

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This case study was prepared by the National Center for Healthy Housing through a contract with U.S. Environmental Protection Agency's Office of Pesticide Programs and Battelle.

[3] U.S. Department of Housing and Urban Development, 2006, *Guidance on Integrated Pest Management*, Notice PIH 2006 – 11(HA). See www.hud.gov/offices/pih/publications/notices/06/pih2006-11.pdf.

COMPARISON OF GARY, INDIANA, AND PORTSMOUTH, VIRGINIA, PEST CONTROL STUDIES TO HUD'S IPM PROGRAM ELEMENTS					
HUD IPM Program Elements *(Results of Study in Bold Italics)*		**Gary IN / Purdue Study**		**Portsmouth VA / Virginia Tech Study**	
		Partial IPM Program	Bait	Vacuum Trapping, Bait & Growth Regulators	Traditional Spray & Dust
1. Communicate Policies Communicate Housing Authority's IPM policies and procedures to: • All building occupants • Administrative staff • Maintenance personnel • Contractors.		Communicated to residents and staff in the impacted buildings. Seminars for resident managers and community program staff on IPM.		Communicated to residents and staff in the impacted buildings.	
2. **Identify Problems** Identify pests environmental conditions that limit the spread of pests.		Comprehensive initial assessment for 66 units in 12 buildings.		Comprehensive initial assessment for 100 units in 22 buildings.	
3. **Monitor and Track** Establish an ongoing monitoring and record keeping system for: • Regular sampling and assessment of pests; • Surveillance techniques • Remedial actions taken • Assessment of program effectiveness.	*Results at End of Study*	Assessed at weeks 2, 4, 8, 12, 16, and 29 with 6 glue traps. Scored sanitation on a 1 to 5 scale on three variables. 5 is worst		Assessed at monthly with 3 glue traps. No scoring of sanitation.	
	Sanitation	***Improved significantly from 3.8 to 2.4***	***Improved moderately from 4.0 to 3.2***	***Not Assessed.***	
	Severity of Infestation	***Units without heavy infestations improved from 65% to 97%***	***Units without heavy infestations improved from 66% to 84%***	***Adjusted # trapped per unit improved 60%***	***Adjusted # trapped per unit improved 15%***
	No trapped roaches	***Improved from 59% to 84%***	***Improved from 56% to 72%***	***Improved from 6% to 80%***	
4. **Set Thresholds for Action** Determine, with involvement of residents: • Pest population levels – by species – that will be tolerated • Thresholds at which pest populations warrant action.		Tolerance set at zero cockroaches.		Tolerance set at zero cockroaches.	
		Flushing and vacuuming dropped if < 12 trapped roaches/ unit. ***One unit vacuumed twice and another three times***.	No changes.	Treatment reduced to 3 months if < 3 trapped roaches per unit.	No changes.

COMPARISON OF GARY, INDIANA, AND PORTSMOUTH, VIRGINIA, PEST CONTROL STUDIES TO HUD'S IPM PROGRAM ELEMENTS				
HUD IPM Program Elements ***(Results of Study in Bold Italics)***	**Gary IN / Purdue Study**		**Portsmouth VA / Virginia Tech Study**	
	Partial IPM Program	Bait	Vacuum Trapping, Bait & Growth Regulators	Traditional Spray & Dust
5. **Improve Non-Pesticide Methods** Improve: • Mechanical pest management methods • Sanitation • Waste management • Natural control agents that have been carefully selected as appropriate in light of allergies or cultural preferences of staff or residents.	Cleanout initially and when > 11 trapped roaches per unit using backpack vacuum and limited pyrethrin & piperonyl butoxide flush. Sticky traps capture remaining cockroaches.	No changes.	Cleanout initially and at 6 months using backpack vacuum in kitchen and bathroom.	No changes.
6. **Prevent Pest Entry and Movement** • Monitor and maintain structures and grounds including o Sealing cracks o Eliminating moisture intrusion and accumulation • Add physical barriers to pest entry and movement.	*None*		*None*	
7. **Educate Residents and Update Leases** • Develop an outreach/educational program • Ensure that leases reflect residents' responsibilities for: o Proper housekeeping o Reporting presence of pests, leaks, and mold.	Residents given educational packet and educated again during visit. One resident in each building asked to educate peers.	*None*	*None*	*None*
8. **Enforce Lease** Enforce lease provisions regarding resident responsibilities such as: • Housekeeping • Sanitation • Trash removal and storage.	Sanitation score given to property mgmt. Residents with poor sanitation (score of 4 or 5) required to attend 4-hour housekeeping class. One resident evicted.	*None*	*None*	*None*

COMPARISON OF GARY, INDIANA, AND PORTSMOUTH, VIRGINIA, PEST CONTROL STUDIES TO HUD'S IPM PROGRAM ELEMENTS					
HUD IPM Program Elements ***(Results of Study in Bold Italics)***		**Gary IN / Purdue Study**		**Portsmouth VA / Virginia Tech Study**	
		Partial IPM Program	Bait	Vacuum Trapping, Bait & Growth Regulators	Traditional Spray & Dust
9. **Use Pesticides Only When Necessary** Use pesticides only when necessary, with preference for products that, while producing the desired level of effectiveness, pose the least harm to human health and the environment, and, as appropriate, notifying PHA management before application.		Baits and insect growth regulators used as needed. No sprays or fogs used.		Baits and insect growth regulators used as needed.	Sprays for baseboard. Dusts for cracks and crevices.
		879 grams used per unit over 29 weeks	***780 grams used per unit over 29 weeks***	***14.8 grams used per unit over 52 weeks***	***827 grams used per unit over 52 weeks.***
10. **Post Signs** Provide and post 'Pesticide Use Notification' signs or other warnings.		Notified at visits		Notified at visits	
Treatment Cost Per Unit at End of Study		***Last Visit***		***Last Visit***	
	Labor	***$ 0.74***	***$ 2.12***	***$ 0.69***	***$ 1.50***
	Pesticides & Traps	***$ 0.53***	***$ 0.53***	***$ 0.18***	***$ 0.02***
	Total	***$ 1.27***	***$ 2.65***	***$ 0.87***	***$ 1.52***
Total Cost Per Unit Over Length of Study		***Total Over 29 Weeks***		***Total Over 52 Weeks***	
	Labor	***$49***	***$22***	***$20.90***	***$10.03***
	Pesticides	***$16***	***$12***	***$ 4.80***	***$ 0.43***
	Total	***$65***	***$35***	***$25.70***	***$10.43***

COSTS AND EFFECTIVENESS OF IPM-BASED INTERVENTIONS

CHAMACOS: A Community-University Partnership

Pesticide exposures are a key concern in many agricultural communities. Residents who live in these communities may be exposed to pesticide spray drift from nearby applications or volatilization from chemicals that evaporate into the air. Additional exposures to farmworkers and their families may occur when pesticide residues from work are inadvertently transported into their homes on the worker's clothing and skin. As a result, children may also be exposed to pesticides brought into their homes. Many agricultural communities are composed of low income families who often live in substandard and overcrowded housing. These living conditions may promote pest infestations and potentially expose residents to additional pesticide use in their homes. Families in agricultural communities may also be exposed to a variety of respiratory irritants and safety hazards.

In the last 20 years, a growing awareness has emerged about the need to conduct environmental health research in partnership with communities. Community-based Participatory Research (CBPR) empowers community members to become active participants in the research process and enables university investigators to gain a more comprehensive understanding of environmental exposures and risks in local communities. Furthermore, CBPR permits research findings to be translated into actions and strategies to reduce exposures and improve public health.

Major Accomplishments

- Documented poor housing quality, pesticide exposures that exceed national reference levels, and potential adverse effects on child development.
- Conducted successful community-based intervention studies to reduce pesticide exposures to children from occupational take-home pathways and home pesticide use to control pest infestations.

This case study is part of a series addressing integrated pest management in low income housing. To access additional fact sheets in the series, please visit: www.healthyhomestraining.org/ipm/studies.htm.

The University of California, Berkeley Center for Children's Environmental Health Research (CCEHR) is one of a dozen centers funded by the U.S. Environmental Protection Agency (EPA) and the National Institute of Environmental Health Sciences (NIEHS) in 1998.

The CCEHR's central project, CHAMACOS (Center for the Health Assessment of Mothers and Children of Salinas), which means small child in Mexican Spanish, is a community-university partnership investigating pesticide and allergen exposures and growth, neurodevelopment, and respiratory disease in children residing in the Salinas Valley, an agricultural region in California. CHAMACOS intervention, outreach, and education programs also aim to reduce exposures to children. The ultimate goal of CHAMACOS is to identify and understand children's exposure pathways and their health effects so that effective and age-appropriate interventions can be designed and implemented to reduce the prevalence of environmentally induced disease.

Research Studies

The study enrolled 600 pregnant women between 1999 and 2000. Children continue to be followed and are currently 7 years old. Extensive contacts with participants pre- and post-natally included questionnaires, home inspections, environmental and biological sample collections, neurodevelopmental assessments, and lung function tests. Findings related to pesticide use, housing quality, environmental exposures to current and historic use pesticides, behavioral risks, and health outcomes have been published during the past five years. Participants were primarily low-income, Mexican immigrants working in agriculture. Poor housing quality was common. For example, cockroach and rodent infestations were present in 60% and 33% of homes, respectively, and as were peeling paint (58%), mold (43%), rotting wood (11%), water damage (25%) and high resident density (76%) .[1] Levels of disrepair and crowding in homes were associated with pest infestations and

home pesticide use.[1] Half of all households used pesticides. Of these households, over 60% used pyrethroids and less than 10% used organophosphates or carbamates.[1] Spray cans were the most common application method (30%).[1] Less than 10% of participants used products likely to reduce household pesticide exposure such as gels or bait stations.[1] House dust samples contained agricultural and home use pesticides.[2]

Pregnant women in the study had higher levels of organophosphorus pesticide metabolites in their urine compared to women of child bearing age in the U.S. population.[3] Although approximately 58% of pregnant women lived with three or more agricultural workers, their households had not received education about methods to reduce take-home pesticide exposure.[4] For example, 46% of these women lived in homes where people wore their work shoes or clothing into the home and 44% washed work and family clothing together.[4]

Pesticide exposures to pregnant women were associated with children's development. For example, mothers with higher levels of urinary OP metabolites were more likely to give birth earlier and their babies were more likely to have abnormal reflexes.[5-6] Pre-natal urinary OP metabolites levels were also associated with poorer mental development and pervasive development problems at 24 months of age.[7]

Intervention Studies

To address these environmental health concerns, reduce exposures, and prevent potential adverse health outcomes, the CHAMACOS partnership embarked on a variety of community-based research and outreach activities. With input from its community partners, CHAMACOS researchers developed two intervention studies aimed at reducing pesticide residues brought into the home from fields. One was a home-based education intervention that focused on changes in household behaviors to reduce take-home exposures from residues on farmworker clothing. This study was strongly supported by the CHAMACOS partnership, but concerns were raised about focusing solely on strategies that put the burden of exposure reduction on the family. Thus, a second intervention was developed that involved growers in an effort to reduce pesticide residues on worker's clothing and skin before the worker returned home.

Field-Based Intervention

The field-based intervention focused on reducing malathion exposures to strawberry harvesters and the potential for take-home exposures to their families. Among the 130 farmworkers who participated in this intervention, almost half had never received training related to pesticides and over two-thirds reported that they never had talked to their bosses about pesticides. The components of this intervention included the provision of:

1) warm water to increase hand washing (investigators learned from the community that many farmworkers avoid washing their hands with cold water because they believed that cold water causes arthritis);
2) changeable outer clothing and routine laundering to prevent contamination of clothes;
3) disposable gloves;
4) closed laundry bags and shoe bins to promote "safe storage" of work clothing and work shoes, and
5) regular in-field health and pesticide education.

Malathion, a pesticide commonly used on strawberries, or the urinary metabolite MDA, was measured in urine, hand rinse, clothing patch, and skin patch samples collected to assess the efficacy of the intervention. Participants who wore gloves had much lower levels of malathion on their hands compared to those who did not wear them.[8] Additionally, harvesters who wore gloves had about half the urinary MDA levels compared to those who did not wear them.[8] Thus, glove use reduced exposures as well as skin loading that could be carried home. Clothing prevented virtually all accumulation of malathion on skin elsewhere on workers' bodies. We found that malathion collected on work clothing and that removing the coveralls would likely reduce take-home exposures.[8] The intervention group who wore coveralls most likely prevented the accumulation of malathion on their regular work clothing.

Farmworkers reported that they preferred to wash their hands with warm water. [8] This practice could increase hand washing among workers and result in a reduction of both personal exposure and potential take-home exposure to families members. The use of gloves and hand washing to minimize pesticide residues on the worker's hands, as well as coveralls to prevent pesticide accumulation on clothing, is likely to reduce the potential for para-occupational pesticide exposure to families and children among strawberry harvester entering fields after expiration of the post-harvest interval (72 hours). CHAMACOS is currently working with partners such as growers and agricultural officials to incorporate these intervention practices in the fields.

Home-Based Intervention
For the home-based intervention, we used an in-depth pesticide education program conducted within farmworker households to: 1) explain what pesticides are; 2) educate about farmworker rights related to pesticides; 3) describe exposure routes and health effects of pesticides on children; 4) demonstrate the concept of pesticide residue using fluorescent tracers; 5) educate about strategies to prevent pesticide residues on the worker's clothing from entering homes (e.g. removing work clothing and shoes before entering the home); 6) educate about integrated pest management (IPM) strategies to reduce pest infestations in the home; 7) develop a household-specific Home Action Plan to reduce pesticide levels in the home and protect children from exposures; 8) identify successes and barriers to implementing the Home Action Plan; and 9) provide household resources that assist participants in taking action on pesticide exposure

Our preliminary analyses indicate that significant improvements in exposure-related behaviors occurred, such as workers removing their shoes before entering the house and washing work and family clothing separately. Future analyses will focus on measurements of pesticide metabolites in children and pesticide concentration levels in house dust.

Community Education and Outreach
CHAMACOS partners have developed a number of initiatives to serve the community that include workshops, trainings, and multi-media materials.

Community Presentations
Presentations have been given to over 4000 people in the Salinas Valley. Participants at these forums include farm workers, community advocates, educators, and day care center providers. Some of the materials developed and distributed include:

- Things you can do to control pests (household maintenance practices);
- Alternatives to pesticide use in the home and garden;
- Least toxic approaches to pesticide use (limit use to gel and bait stations, types of least toxic pesticides, and ways to protect children when pesticides are used);
- Reducing take-home pesticide exposures from the fields (prevent work clothes from entering the home, separate storage and laundering of work clothes, and wash clothing immediately after work);
- How to protect yourself from pesticide exposure in the fields; and
- Rights of agricultural workers.

Prenatal Environmental Health Education
In partnership with Clinica de Salud del Valle Salinas, CHAMACOS developed an innovative, computer-based prenatal environmental health program to educate pregnant women about environmental health issues. The program is low-literacy and offered in Spanish on a touch-screen computer with voice-overs for all written materials. Through this mechanism, pregnant women can easily navigate over 60 screens that address a variety of issues including preventing pesticide exposure, IPM, lead, allergens, and other topics. CHAMACOS is working with state officials to make this module a reimbursable health education service under the California Comprehensive Peripartum Services Program, which provides prenatal care and education to low-income California women.

Environmental Health Education for Childcare/Preschool Settings

Anecdotal discussions indicated that pest infestations and other environmental health concerns are prevalent in local childcare centers and preschools. This situation may be related to the poor housing stock in many neighborhoods. To address this concern, CHAMACOS and its partners developed a workshop to train childcare providers about environmental health issues and how to improve the quality of their facilities. Specific topics addressed include pest infestations, pesticide use, IPM, lead, mercury, and air quality.

Healthy Homes Training Partnership

In a follow up to the documentation of severe housing quality problems among low-income Salinas Valley residents, CHAMACOS is working with local community groups to develop a research, training, and advocacy program to address the relationship between housing quality and health. In partnership with Alameda County's Lead Poisoning Prevention Program, CCEHR became one of the first training partners in California of the National Healthy Homes Training Center and Network (Training Center). The Training Center developed several courses designed to teach public health and housing professionals to take a holistic approach when identifying and resolving problems that affect the health of residents. The CHAMACOS partnership offered its first training in March 2007. Participants included the Environmental Health Division of the Monterey County Health Department and community advocacy groups. The CCEHR is also collaborating with the Training Center to develop a one-day Healthy Homes course that addresses agricultural, low-income, and Latino communities. The new course will be offered in Spanish and targeted to housing and health promoters, community advocates, educators, and housing managers who work directly with agricultural populations. After the course has been pilot tested and approved, it will be offered nationally by and for other training partners.

Lessons for the Future

The CHAMACOS partnership is a model of how researchers from universities can work with communities to increase knowledge about local public and environmental health concerns. The partnership established will build technical knowledge and create a permanent infrastructure in the Salinas Valley and throughout California. Interventions need to occur at several levels. Efforts to change individual behaviors as well as changes in policy and work practices are needed so the burden of protecting families and children is not placed solely on individuals. These efforts take time. However, the dissemination of knowledge and understanding gained through multiple efforts can lead to concrete changes that improve public and environmental health in the most affected communities.

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COSTS AND EFFECTIVENESS OF IPM-BASED INTERVENTIONS

Integrated Pest Management in Boston Public Housing: Partnerships, Programs, and Policy Advances

Public housing residents have some of the highest rates of allergic asthma in the country. Traditional pest control in low-income multifamily housing, with initial flush out and periodic spray, has failed to eliminate pests long-term. As a consequence, residents take pest control into their own hands, using over-the-counter, restricted and illegal pesticides. A series of IPM-based initiatives at Boston Housing Authority serve as a model for other public housing authorities. The model uses peer educators and increasingly standardized approaches to IPM training, IPM contracts, data collection, and IPM teams. It can be adapted and undertaken in multi-family housing developments throughout the United States. The campaign to educate residents about the toxicity of pesticides and the pesticide buyback program is easily replicable. The policy initiative to have health insurance cover residential IPM as part of asthma management is one of national import.

Why Cockroaches?

Live cockroaches, as well as their remains and feces, cause asthma attacks in people sensitive to cockroach allergens according to a 2000 Institute of Medicine Report. The Inner City Asthma Study found that more than 60% of inner city children were sensitive to cockroach allergens. Asthma is a costly disease that disrupts a family and undermines a child's ability to learn. There is growing evidence that mice may have a similar effect.

This case study is part of a series addressing integrated pest management in low income housing. To access additional fact sheets in the series, please visit: www.healthyhomestraining.org/ipm/studies.htm.

The Healthy Public Housing Initiative: Research for Action and Community Empowerment (2000-2004)

The Healthy Public Housing Initiative (HPHI) is a community-university-city agency collaborative formed to improve resident respiratory health and building conditions in Boston public housing using an IPM intervention in 44 apartments of 57 asthmatic children enrolled in the project.[1]

The package of IPM interventions included:

- Educating and assisting residents with sanitation, clutter control, and preparation for IPM application;
- Deep cleaning with a HEPA vacuum;
- Monitoring for roaches with sticky traps;
- Flushing out cockroach harborages;
- Exclusion by sealing holes and cracks; and
- Application of gel baits and boric acid.

Pre- and post-interviews with residents over the course of a year and monthly standardized interviews with residents captured data on the change in asthma symptoms, caretaker quality of life, doctors' visits and hospitalizations for asthma. We also collected dust samples in apartments for cockroach allergens and pesticide residues as part of our study.

Key Findings

1. **Traditional approaches to pest control are ineffective, especially for cockroaches.** Nearly 50% of the homes tested in HPHI showed cockroach allergen levels in excess of asthma sensitivity exposures; nearly 60% of the tested children showed allergic sensitivity to the most prevalent cockroach antigen. The

factors found to correlate with pest-related allergen levels were lack of housing renovation, holes in walls, poor housekeeping practices, and season of the year.[2]

Every home tested showed evidence of between 3 and 8 pesticides used, at least one of which is either banned or restricted to non-residential use. Boston public housing residents in our study have a higher rate of pesticide use than the national average.[3]

2. **A package of IPM interventions designed to reduce allergen burden and re-infestation was effective and improved both environmental and health indicators**. Intense cleaning and reduction in cockroaches reduced allergen loads in all homes. The reduced allergen levels were sustained over 4 months and then began to rise, showing the need to implement the intervention on a regular basis to maintain results.[4] During the period of IPM intervention, asthmatic children involved in the study reported a significant reduction in asthma symptoms, including coughing and wheezing, activity limitations and poor sleep quality.[5]

3. **Residents are central to successful IPM in their housing developments**. HPHI trained more than 20 public housing residents to conduct housing surveys and inspections as both health advocates and IPM educators.

Second Generation IPM in Boston Public Housing

The research results spurred a set of pilot projects which refined the IPM model developed in the research project. The initial research and subsequent pilot projects also stimulated larger initiatives, including an IPM Demonstration Project and a Pesticide Buyback Program in Boston public housing.

Pilot Projects (2005)

1) The IPM Educator Pilot in Charlestown Housing Development

The IPM Educator Pilot study in the Charlestown Housing Development was designed to measure the effectiveness of training and employing an IPM peer educator on residents' preparation for IPM and on cockroach control.

Cyfluthrin, a nerve poison and the active ingredient in the roach powder Tempo, is used in its non-diluted, powder form by some residents, and is typically sold in Latino neighborhood bodegas with no health and safety information.

Thirty-four moderate- and high-infested units in the Charlestown family development received baseline assessment and three applications of gel baits, with 2-4 weeks between applications, by a pest management professional. Before the first pest control application, residents received written notice to prepare their units for treatment, a routine industry method of alerting residents to prepare for pest control treatment. Before the second and third gel bait treatments, an IPM peer educator:

- Instructed residents in how to prepare for IPM treatment;
- Educated them on pest biology and habits;
- Explained the role of sanitation and clutter in infestation; and
- Used a HEPA vacuum to remove dead insects and allergens in dust.

The IPM treatment with peer education resulted in a significant decrease in cockroach activity in the infested apartments, whereas IPM treatment with a written notice but without peer education did not. All of the units that were both clean and prepared for IPM treatment had "light" or "no" pest activity by the end of the study, while 100% of units that were both not prepared and not clean had no improvement in pest infestation at the end of the study.[6]

2) The IPM Pilot in Holgate Apartments Senior Housing

A second IPM pilot project, modeled on the Charlestown Development pilot program, was conducted by the Asthma Regional Council in an 85-unit housing development for elderly and disabled people, Holgate Apartments. Two residents were trained and employed as IPM Educators. An IPM team was formed including BHA management and maintenance personnel who were given a short training in IPM, the IPM Educators, and the pest control operator. Over a period of five to six months, every apartment was visited by the peer educators for the purposes of:

- Monitoring baseline infestation;
- Educating resident;
- Scheduling treatment visits for infested apartments;
- Assisting with HEPA vacuuming and preparation for IPM treatment;
- Calling in work orders for repairs; and
- Eliciting resident feedback on program satisfaction.

Results showed that by the end of the pilot program, units with "light" or "no" pest activity increased from 77% to 100% and the common areas with "light or no" pest activity improved from 0% pre- IPM to 100% post- IPM. In six of the units visited, IPM educators arranged for needed social services for the residents, another benefit of this model program.

IPM Demonstration Project: The Healthy Pest Free Housing Initiative (2006-2009)

With five years of promising results, the partners received funding to scale up IPM in the Boston Housing Authority, with an ambitious schedule to implement IPM in 15 family developments over the course of three years. The Healthy Pest Free Housing Initiative (HPFHI), as the demonstration is called, established a set of goals to:

- Improve asthma and overall health;
- Eliminate infestation;
- Reduce pesticide use and exposure;
- Maximize resident peer education; and
- Promote IPM in public policy on housing and health.

The HPFHI activities include:

- Hire and train 10 Boston Housing Authority (BHA) residents to be employed as health advocates and IPM educators within Boston public housing. Advocates will provide multi-lingual heath education on asthma and information about IPM; assist residents with reducing clutter and placing work orders; and will serve as a bridge for residents to other needed health and social services.

- Develop a multilingual, multimedia public health information campaign for public housing residents. The Safe Pest Control Campaign will reach all the BHA developments and will include posters, flyers and other materials including videos in several languages to educate about IPM and the toxicity of pesticides, with emphasis on illegal and restricted pesticides.

- Train BHA managers, staff and resident leaders in the model IPM program as they prepare to implement it in their developments. Work with BHA to set up a database to track baseline

housing conditions and IPM results, to develop a model IPM contract, and to prepare an IPM orientation for new residents.

- Distribute up to 800 Healthy Home Kits which include important information and supplies for safer pest management and for reducing asthma triggers in the home.

- Develop a pesticide "buy back" program, to eliminate potentially toxic substances from the home environment in all developments. Residents participating in the buyback will receive free pest control equipment and supplies.

"This demonstration project builds on an earlier initiative, which proved that including residents as full partners to educate their neighbors is the most successful method of addressing health related issues in public housing,"
Sandra B. Henriquez,
BHA Administrator.

Preliminary Results: Year 1
The IPM team in each development includes the housing manager and maintenance staff, the IPM contractor, the peer educator, and the residents. Data collected include the baseline data on infestation, sanitation, clutter, repairs needed, and any unique social needs. A list of "focus units" is developed by the IPM contractor and the development manager, these being units in need of continued IPM treatment, peer education, social services, and repair.

The peer educators are assigned to work with the residents of these focus units to educate them in IPM, to advocate for other needed services, and to assure that work order repairs are made. A comparative study of work orders for pest problems in the 12 months before and after the IPM program in developments is being conducted to help evaluate the effectiveness of the IPM program. Other components of evaluation include a comparison of pest control contract and services costs and a comparison of unit inspection findings pre-and post-IPM.

Other On-Going Initiatives

Health Policy
The Asthma Regional Council (ARC) has identified a need to create policies that would support sustainable financing mechanisms to address environmental controls in the home. ARC has spearheaded discussions with the health care payer and health purchaser communities about supporting policies for delivering and/or paying for home-centered environmental interventions. These interventions include IPM services and supplies.

Health payers have indicated receptiveness to addressing environmental triggers, but want guidance on what are considered to be best practices and how implementing the practices will affect their bottom line. To that end, ARC has produced a *Business Case*, which documents the health and cost benefits associated with offering asthma education programs and home-based interventions to reduce environmental triggers. The document, entitled "Investing in Best Practices for Asthma: A Business Case for Education and Environmental Interventions" concludes that health payer organizations and policy makers would be well-served to invest in these effective asthma management strategies.

ARC is also developing an *Issues Brief* with the Alliance for Healthy Homes on recommended federal, state and local policies to pursue for promoting IPM in residential settings. The policy brief will focus on the residential environment where virtually no regulations exist to govern the use of IPM. To complement the *Issues Brief*, ARC is also developing a manual on "How to Implement IPM in Residential Housing." The manual is geared toward housing development Facilities Managers, incorporating

effective strategies implemented at the Boston Housing Authority. For contact information on ARC, see below.

Training Center for Healthy Housing and IPM
The Center for Healthy Homes and Neighborhoods in Boston University School of Public Health offers trainings in New England as a member of the National Healthy Homes Training Center & Network and specifically has tailored and offered the IPM curriculum developed in the Healthy Public Housing Initiative for low-income, multifamily housing managers, including public housing authorities, community development corporations, and Section 8 programs. To date the center has provided one- and two-day trainings in IPM to:

- Large and medium public housing authorities in six New England cities, with the goal of launching IPM programs in those housing developments;
- Two community-based organizations; and
- Local health officers in Massachusetts.

For contact information on the IPM curriculum, see below.

HUD IPM Program Elements *(Results of Study in Bold Italics)*	**HPHI** **IPM and Asthma Research Project** **2000-2004**	**HPFHI** **IPM Demonstration Project** **2006-2009**
1. Communicate Policies Communicate Housing Authority's IPM policies and procedures to: • All building occupants • Administrative staff • Maintenance personnel • Contractors.	Communication by researchers to managers and residents about IPM intervention program	Communication by BHA administration to managers and maintenance. Community meeting for residents with manager and IPM contractor
2. **Identify Problems** Identify: • Pests • Environmental conditions that limit the spread of pests.	Comprehensive initial visual assessment of 44 units in three developments and use of sticky traps to monitor cockroach activity	Comprehensive visual assessment of every unit, common areas, basements, perimeter of bldg., in five developments per year for three year demonstration program and use of sticky traps
3. Monitor and Track	Monitor traps every 2 weeks and intervene as necessary Research Results: Allergen results reduced in all homes and sustained for 4 months, after which they began to rise Statistically significant reduction in asthma symptoms	Develop short list of units with persistent pest problems and monitor. Inspect every 2 to 3 weeks and treat with gel baits until no infestation. Provide data on sanitation, infestation, repairs, and social services needed to building manager after every visit.
4. **Set Thresholds for Action**		

HUD IPM Program Elements *(Results of Study in Bold Italics)*	**HPHI** **IPM and Asthma Research Project** **2000-2004**	**HPFHI** **IPM Demonstration Project** **2006-2009**
Determine, with involvement of residents: • Pest population levels – by species – that will be tolerated • Thresholds at which pest populations warrant action.	Zero pests is the goal Evidence/presence of pest warrants action	Zero pests is the goal Evidence/presence of pest warrants action
5. **Improve Non-Pesticide Methods** Improve: • Mechanical pest management methods • Sanitation • Waste management • Natural control agents that have been carefully selected as appropriate in light of allergies or cultural preferences of staff or residents.	HEPA vac all units Educate residents to improve sanitation and to prepare for IPM treatment Provide residents with plastic containers for food and garbage.	HEPA vac all units Educate residents to improve sanitation and to prepare for IPM treatment. Resident peer educators continue to work with residents needing more education, repairs, social services.
6. **Prevent Pest Entry and Movement** • Monitor and maintain structures and grounds including • Sealing cracks • Eliminating moisture intrusion and accumulation • Add physical barriers to pest entry and movement.	Seal cracks and small holes with copper mesh, expanding foam. Report water leaks to BHA for repair	Seal cracks and small holes with expanding foam. Report water leaks to BHA for repair
7. **Educate Residents and Update Leases** • Develop an outreach/educational program • Ensure that leases reflect residents' responsibilities for: • Proper housekeeping • Reporting presence of pests, leaks, and mold.	Residents are educated by peer educators and research staff regarding sanitation preparation, and hazards of pesticides and assisted with work orders. Lease spells out responsibilities	Residents are educated by peer educators and research staff regarding sanitation preparation, and hazards of pesticides And assisted with work orders where needed. Lease spells out responsibilities
8. **Enforce Lease** Enforce lease provisions regarding resident responsibilities such as: • Housekeeping • Sanitation • Trash removal and storage.	BHA enforces lease where necessary.	Emphasis is on peer educators' assisting residents with housekeeping problems. BHA enforces lease where necessary.

HUD IPM Program Elements *(Results of Study in Bold Italics)*	**HPHI** **IPM and Asthma Research Project** **2000-2004**	**HPFHI** **IPM Demonstration Project** **2006-2009**
9. **Use Pesticides Only When Necessary** Use pesticides only when necessary, with preference for products that, while producing the desired level of effectiveness, pose the least harm to human health and the environment, and, as appropriate, notifying PHA management before application.	Flushing and vacuuming where high infestation Work with resident to improve sanitation. Do exclusion. Where evidence of infestation, apply get baits and boric acid.	Flushing and vacuuming where high infestation Work with resident to improve sanitation. Do exclusion. Where evidence of infestation, apply gel baits. Rodent treatment: exclusion, traps and tamper-resistant bait boxes
10. **Post Signs** Provide and post 'Pesticide Use Notification' signs or other warnings.	Notice given	Notice given
Treatment Cost Per Unit at End of Study	NA Asthma Research Study	Not yet available
Total Cost Per Unit Over Length of Study	NA Asthma Research Study	Not yet available

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COSTS AND EFFECTIVENESS OF IPM-BASED INTERVENTIONS

Environmental Health Watch's Collaboration with Cuyahoga Housing Authority Demonstrates the

Traditional methods of household pest management not only have limited success in actually eliminating pests, but in many cases, efforts at control can cause additional harm to residents, especially children. A new program to control household pests—adapted from agriculture—attempts to control pests more effectively while using less pesticides. A collaborative interagency effort is helping to make Integrated Pest Management (IPM) a viable option for the affordable housing community.

IPM is a new approach to pest control that offers a means to reduce the risk from—and in some cases, the amount of—chemical pesticides needed. IPM reduces risk by monitoring pest populations, conducting environmental controls, and placing small amounts of low-toxicity, low-volatility pesticides on surfaces inaccessible to children. By encouraging tenants, building management and staff, and even pest control contractors to work together and proactively eliminate conditions that allow infestations to thrive, dramatic pest reduction can be achieved without using large amounts of pesticides.

Cockroach infestation poses an especially compelling challenge. Evidence demonstrates that cockroach allergen is a potent, pervasive and persistent asthma trigger for low-income, inner-city populations. The common response to cockroach infestation is monthly pesticide spraying. But this method compounds the risk children face from cockroaches with a new risk: children are particularly vulnerable to the toxic effects of exposure to household pesticides.

Why Cockroaches?

Live cockroaches, as well as their remains and feces, cause asthma attacks in people sensitive to cockroach allergens according to a 2000 Institute of Medicine Report. The Inner City Asthma Study found that more than 60% of inner city children were sensitive to cockroach allergens. Asthma is a costly disease that disrupts a family and undermines a child's ability to learn. There is growing evidence that mice may have a similar effect.

This case study is part of a series addressing integrated pest management in low income housing. To access additional fact sheets in the series, please visit: www.healthyhomestraining.org/ipm/studies.htm.

IPM in Action in Cleveland's Affordable Housing Units

With this in mind, Environmental Health Watch (EHW) teamed with the Department of Housing and Urban Development Office of Healthy House and Lead Hazard Control to conduct a study of the efficacy of IPM in an affordable housing development in Cleveland, Ohio. Asthma rates have increased dramatically over the past 20 years and asthma is now a major public health concern, especially for children. Removing the threat of roaches, and their debris (which contains the allergens) can benefit young people with asthma. EHW's study tested new methods for assessment of cockroach allergen contamination, the safer elimination of cockroach infestation, and finally, effective cleanup of roach allergens.

EHW worked with Cuyahoga Metropolitan Housing Authority, Greater Cleveland Asthma Coalition, the United States Department of Agriculture (USDA) Research Station in Gainesville, Florida, and the Johns Hopkins Allergy and Asthma Center to run the project.

Three multi-family complexes operated by Metropolitan Housing Authority in Cleveland, Ohio were the candidates for the project. The stated goal of the project was to explore methods to reduce cockroach allergen contamination in low-income public housing. The cockroach control intervention was "precision-targeted IPM," a modification of the standard cockroach IPM strategy, designed by the USDA Imported Fire Ants and Household Insects Research Unit, a partner in this project. Their approach increases the usual level of cockroach monitoring so that a detailed spatial analysis of harborages and feeding points can be used for more precise placement of pesticides.

Outreach Efforts

Outreach to participants began with a letter from the housing authority introducing the project, which was followed by a phone call to the residence. If the phone call was not successful, housing authority staff went door-to-door in the buildings to engage tenants. The housing authority staff visited participants' homes to provide them with a detailed description of the activities that would take place during the project and the incentives that would be provided to them for their participation.

Incentives given to engage participants included a $15 food certificate from a local supermarket for each visit to the unit and a new vacuum cleaner to encourage them to minimize food debris in their units. Furthermore, during the course of the intervention as resident health educators and the tenants identified specific needs unique to each unit, additional incentives were given, including new garbage bags, smaller garbage cans, or new food storage containers, which would help reduce the likelihood of renewed pest infestation.

Identifying the Level of Infestation

Initial roach infestation was measured in four ways: 1) roaches captured on sticky traps; 2) roaches flushed from harborages; 3) occupant reports of roaches; and 4) staff observations. However, due to the incidence of large food harborages that might have kept roaches from being lured by sticky traps, it was found that flushing was the most effective means of measuring the true level of infestation.

Stu Greenberg of Environmental Health Watch described the flushing approach as "reconnaissance by fire." Using a heat gun with a PVC collar to prevent burns (recommended by USDA staff), EHW conducted an "active inspection" of the units by passing the gun along baseboards, electrical outlets, light fixtures, tables, door frames and anywhere else roaches might be hiding. Aware of the risk that the heat might simply push the roaches in deeper, the results were nonetheless very good. A large number of roaches came out, and harborages not traditionally targeted by the pest control contractor were identified.

Aside from the efficacy of the heat gun in simply drawing out roaches, it also proved a most effective recruiting tool. Skeptical tenants, convinced that roach infestation was an intractable problem, became much more enthusiastic about the IPM strategy after they saw that it was radically different from other methods. As Mr. Greenberg explained, once tenants realized that heat gunning and vacuuming of roaches had a real effect, they "saw hope" that the problem could really be managed, if not solved all together. This encouraged tenants to actively participate in meeting their responsibilities under the program.

Working Together to Implement the Program

Effective implementation of the IPM strategy was a team effort that required the housing authority, the tenants, and pest control contractors to each play an active role in combating the infestation. As is implied, an integrated strategy could not be effective without all participants doing their part. Tenants, of course, became much more enthusiastic when they saw progress being made. It encouraged them to cooperate with pest control contractors, enable the housing authority to make necessary repairs to their units, and most importantly, to create an unwelcoming environment for roaches. The housing authority, as noted, was responsible for repairs to the units, including caulking holes in walls and floors to prevent harborages—especially in areas where food debris could collect. In addition, they conducted basic unit repairs, such as the plumbing and other systems that provided a safe harbor for roaches.

The work required the participation of all of the housing authority staff, from the building's environmental supervisor, who served as entrée to tenants and liaison with operations and management staff, to those staff and contractors responsible for building maintenance and repair. Of course, these contractors, who often interacted with the pests in the course of their repair work, were enthusiastic about participating in a project that could reduce their exposure to roaches. Furthermore, the pest control contractors worked with EHW to better understand where to place roach traps and identify harborages (the old strategy of simply placing a couple of traps in kitchen cupboards obviously was not doing the trick).

In fact, the one unit that did not produce the desired results was the rare instance where the tenants refused to be cooperative. While for most residents, the real successes of the heat gunning method was enough for them to enlist in the rest of the IPM strategy, this one unit with a long-term history of heavy infestation, refused to change its behavior in order to stop roach infestations. The unit had serious repair problems, but the tenants were not cooperative with the Housing Authority. In spite of 12 site visits by EHW, the tenants did not remove food debris nor work with the other participants. The roach infestation was not mitigated.

No pesticides were spayed during the IPM process, nor were foggers or bombs used. No chemical flushing was done either. To counter infestations, low-toxicity and low-volatility gel baits and bait stations, as well as boric acid, were used. But because the heat gunning had identified specific harborages, these traps could be targeted, as opposed to haphazardly distributing the traps throughout the units. This meant that there was no broadcast application of pesticides—a huge benefit for the health of tenants and others in the buildings.

Objectives and Outcomes

The cockroach control objective was to achieve a 95% reduction in the roach population, as measured by the number of roaches trapped and flushed. That level of reduction was achieved in all but one case (the uncooperative tenants) and required one to four flush/vacuum/bait visits.

Of the 18 housing units that were part of the program, live roaches were seen in 11 of them (generally an indication of heavy infestation) and dead roaches were seen in 16 units. Building defects (holes in walls,

plumbing leaks, etc.) were identified in 13 of the 18 units and food debris and excess clutter in 10 of the 12 occupied units. This speaks to the value of the IPM approach to involve the housing authority and the tenants—without them fulfilling their roles, a true reduction in roach infestation would not be feasible.

The initial roach counts in the units varied widely. Six units had counts of 243 or greater, and two had counts of more than 1,000! In most cases, two or three visits were enough to achieve the 95% reduction. Three units achieved a 100% reduction; of the two units with major infestations, the unit where the IPM was unsuccessful (due to the tenant behavior) had a roughly 80% reduction, while the other a 97% reduction in four visits.

Overall, the combination of cockroach infestation reduction through precision-targeted IPM (including hot air flushing and HEPA vacuuming), a one-time professional cleaning based on the HUD lead dust cleaning protocol, occupant education, and occupant on-going cleaning effort, the project succeeded in substantially reducing cockroach allergen levels.

Lessons for Future Interventions

This small exploratory project demonstrated that previously intractable roach infestations could be virtually eliminated through a labor-intensive, aggressive and precision-targeted IPM strategy sustained over several months. It required cooperation from the public housing management, maintenance and environmental staff, and from the tenants.

Of course, this labor-intensive experiment, combined with the high degree of cooperation involved, cannot be achieved nor replicated overnight. What it shows, however, is that there is a viable alternative to traditional pest control methods. What is more, by incorporating already established techniques for responding to lead dust hazards, there is certainly a precedent for the type of intervention warranted here.

The Environmental Health Watch project demonstrated that effective roach control requires a division of responsibility among the housing authority, the pest control contractor, and the tenant. The housing authority has to provide and maintain the dwelling unit free from defects that support roach infestation. The pest control contractor has to thoroughly inspect the entire unit to determine roach harborages, reservoirs, entry points, food and water resources, use safe and effective treatments to get rid of the roaches, and provide ongoing monitoring. Finally, the tenants must maintain housekeeping practices that do not support roach infestation and they must cooperate with pest control efforts by the contractor.

EHW developed a guide to reducing infestation with IPM that is now available on their Web site (**www.ehw.org**). In addition, two slide shows on the organization's Web site summarize the pilot IPM project, and a valuable guide for contractors —A Model Contractor Program for IPM Management—was also created.

The new challenge is to find ways for this approach to be feasible and cost-effective to encourage more public housing authorities and their pest control contactors to adopt it. To achieve a large scale implementation of this type of pest control strategy would require reevaluating the pest control contracting process (e.g., fee structure, specifications, monitoring), training and supervision of contractor personnel, maintenance and repair practices; and tenant education and enforcement of responsibilities.

Given the risks to children inherent in traditional pest control methods, and the real benefits that can be realized from IPM, the EHW model just might be a valuable contribution to the quest for safer and cleaner affordable housing.

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