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<p>Project Director(s) (PD):</p> <p>PD Jody Gangloff-Kaufmann _____ Institution Cornell University _____</p> <p>CO-PD _____ Institution _____</p> <p>CO-PD _____ Institution _____</p> <p>CO-PD _____ Institution _____</p>	<p align="center">PROPOSAL TYPE</p> <p align="center">For National Research Initiative Competitive Grants Program Proposals Only</p> <p><input type="checkbox"/> Standard Research Proposal</p> <p><input type="checkbox"/> Conference</p> <p><input type="checkbox"/> AREA Award</p> <p><input type="checkbox"/> Postdoctoral</p> <p><input type="checkbox"/> New Investigator</p> <p>Strengthening:</p> <p><input type="checkbox"/> Career Enhancement</p> <p><input type="checkbox"/> Equipment</p> <p><input type="checkbox"/> Seed Grant</p> <p><input type="checkbox"/> Standard Strengthening</p>
<p>Project Title: "A Partnership for Developing IPM Protocols for Bed Bug Management"</p> <p>Key Words: <u>Cimex lectularius, bed bugs, IPM, protocols, homeless shelters, urban, community</u></p>	<p align="center">For Higher Education Program Proposals Only:</p> <p>Need Area: _____</p> <p>Discipline: _____</p>

IPM Priorities Grant Proposal

The common bed bug, *Cimex lectularius*, is a blood-feeding parasite of humans that has reemerged as one of the most significant indoor pests of our time. Although it is well understood that integrated pest management is necessary for bed bug control, effective protocols and standardized IPM practices are lacking, particularly for multiple-unit dwellings, including homeless shelters. The integration of pesticides with physical controls is unsystematic and often ineffective. Sufferers of bed bug infestations are regularly taking matters into their own hands, by applying pesticides and discarding furniture and other possessions. The economic and health risks associated with bed bugs are presumably great. Bed bugs have reversed the benefits achieved in Urban IPM over the past fifteen years, by reintroducing frequent, unrestricted, household pesticide use. A standardized bed bug management strategy that relies on IPM is desperately needed.

This project will address the management of bed bugs in long-term homeless shelters in New York City, where bed bugs continue to be a major concern. Protocols for managing bed bugs and preventing their introduction and spread will be used and evaluated in shelters. Protocols will be made widely available and will be applicable to other multiple-unit dwellings. These protocols will be developed into training resources and a training session will be held in the New York City area and open to the public, but targeted at pest control professionals, shelter staff, and building managers. This project furthers the mission of the Northeast IPM Center by applying IPM to a critical emerging pest issue to directly reduce the impact of bed bugs and pesticides on human health and economic well-being.

According to the Paperwork Reduction Act of 1995, an agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a valid OMB control number. The valid OMB control number for this information collection is 0524-0039. The time required to complete this information collection is estimated to average .50 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

1) Project Description

a) Problem, Background, and Justification

Over the past decade the United States has witnessed an overwhelming resurgence of bed bugs that has affected every part of the country, as well as many countries throughout the world. Bed bugs, *Cimex lectularius*, are obligate blood-feeding parasites of humans and some domestic animals. They hide in cracks and crevices close to where their hosts sleep and typically bite at night. Bed bugs are difficult to eliminate even when using conventional pest management approaches. Bed bugs can remain undetected for long periods of time because they hide during the day, and eggs and nymphs are small and difficult to find. The bites cause itchy welts on some, but not all victims. Therefore in some cases problems can become unmanageable before they are even discovered. Bed bugs also spread rapidly through multiple-unit buildings, particularly when hosts are no longer available, for example, when people who have bed bugs move away.

The epidemic of bed bugs is particularly evident in New York City, where most city residents live in multiple-unit housing. In the 2005 fiscal year New York City received 1,839 complaints, however this number for the 2006 fiscal year has soared to 4,638 (NYC Department of Housing Preservation and Development). Bed bug resurgence has been documented to be fairly consistent throughout the United States (Gangloff-Kaufmann, et al. 2006) and may be especially problematic in urban areas.

The economic impact of bed bug resurgence has not yet been evaluated, although it is clear that there are severe economic impacts on individuals and households battling the bugs. Often victims spend hundreds or thousands of dollars to hire a pest control professional, however, companies are reluctant to guarantee the work because follow up visits and reinfestation are very common. Victims often resort to discarding their belongings, including mattresses, beds and other furniture, as well as moving from infested homes, all at great personal expense. There is also concern about the overuse and potential for misuse of off-the-shelf pesticides, such as “bug bombs” by those who are reluctant to seek outside help. Bed bugs are also having a serious economic impact on the hospitality industry worldwide. Travelers report that hotels are commonly infested and many lawsuits against hotels have been publicized in the media. In Australia, the pest control industry has recently published a document titled “A Code of Practice for the Control of Bed Bug Infestations in Australia”, intended as a guideline to minimize the economic and health impacts of bed bug problems for hoteliers in Australia (http://medent.usyd.edu.au/bedbug/bedbug_cop.htm).

Bed bugs are not known vectors of human disease, although some research points to the potential for them to carry hepatitis (Jupp et al. 1991). Bed bugs bites can cause anemia in severe cases, however health impacts are more likely incurred from the large itchy welts and the emotional stress imparted on victims. The greatest potential health impact, however, may be associated with the misuse and overuse of over-the-counter and illegal pesticide products. Often people are reluctant to admit that they have bed bugs in their homes. Many do not have the resources to hire a pest control professional. These and other reasons deter victims from seeking outside help and instead many attempt to

manage bed bugs on their own. The level of skill within the pest control industry is also variable and probably leads to callbacks that require additional pesticide treatments.

Although pesticides have been deemed necessary by many for the effective management of bed bugs, physical controls, such as inspection and cleaning, must be integrated into a control program for that program to be successful. A whole building approach is also needed for bed bug management in multiple-unit dwellings. However, it is unclear what impacts the various recommended techniques have on overall control. Questions still exist such as: How can we optimize inspection time? What is the best way to monitor for bed bugs? How well does cleaning, vacuuming, and steam or heat work? What sound advice can we give to the person who has bed bugs? And how can we train pest control professionals to incorporate IPM into their services and encourage cooperation from their customers? Protocols are desperately needed to begin to standardize the quality and efficacy of bed bug management. Training pest control professionals and raising public awareness will help to reduce the risks associated with misuse of over-the-counter remedies.

The proposed project is designed to develop and evaluate bed bug inspection, management, and training protocols using long-term homeless (or family) shelters in New York City. Long-term shelters are a particularly challenging situation, where bed bugs may thrive and are easily spread within and among shelters and homes as residents come and go. Yet because guests stay for extended periods of time, bed bugs have reliable host access. The model IPM protocols developed for shelters from this work will contain the information needed to develop similar types of IPM protocols for hotels and multiple-unit housing. This information will be widely applicable throughout the Northeast and the United States. Training materials can be duplicated and used widely.

Stakeholders of an issue such as bed bugs could include any person. Specifically, untold numbers of homeowners and renters are fighting bed bugs in their homes. Pest control professionals are a very important part of the stakeholder group, because they are faced with the challenges of managing bed bugs in legal, safe, and effective ways. Municipal public housing agencies and shelter operators are also stakeholders in the battle against bed bugs. Many public housing units are infested with bed bugs and gaining cooperation from each household can be challenging. Landlords of multiple unit buildings and hotel operators are under considerable pressure to prevent and manage bed bugs.

The challenge of managing bed bugs using the principles of IPM falls into several stakeholder-driven priority lists. The Northeast IPM Center's Community IPM work group has identified residential IPM as the priority for 2006. Bed bugs are a pest of significant residential pest management issue that requires attention to directly reduce health and economic impacts. The Northeast Research, Extension, and Academic Program Committee (NEREAP) has listed "Urban pest issues including insects and rodents" as one of six priority areas for 2006. Furthermore, the tremendous attention that this pest is receiving through cooperative extension resources, the media, and the internet points to the need for the development of better management strategies and training. For example, a homeless shelter in Syracuse, NY, where residents stay for an average of 4-6

weeks, has recently been forced to relocate residents to another facility, treat repeatedly with chemical pesticides, and replace wood furniture with metal frames, to try to manage the infestation of bed bugs. All these tactics come at great cost to a non-for-profit service organization.

This project will provide demonstration and evaluation of bed bugs management protocols in order to directly engage with constituents, homeless and homeless service providers in New York City. In addition, other similar group housing situations will be considered for demonstration sites, such as group housing for mentally disabled people. The main criteria for participation are: multiple-unit facilities, chronic bed bug problems, and residents or guests who stay for longer than one week.

This project will directly address the need for better and more standardized protocols for managing bed bugs in multiple-unit housing. It will bring together many individuals and agencies that are looking for solutions or who may have experience and ideas to share.

Those suffering with bed bugs may be the most obvious beneficiaries of this work. The goal of this work is to examine and put into use more effective bed bug management steps for anyone who is fighting them. Directly, this project will benefit the residents and guests of homeless shelters. Tenants, landlords, and homeowners will benefit from the development of more effective protocols. Currently, debate rages over the placement of responsibility for undertaking management of bed bugs within privately rented multiple-unit housing facilities. It can be difficult to pinpoint the source of the outbreak in a building and impossible to prove. This protocol can provide a three-way agreement between a property manager, pest control professional, and a tenant for what is required to manage bed bugs. The timing, value, and cost of certain pest control actions will be clarified.

The major IPM impact to be gained through this project is the reduction of economic risks to people affected by bed bugs. This includes bed bug victims, landlords and building managers faced with extermination of entire buildings, and pest control companies facing liability when even well-planned tactics do not work. The economic benefits can be tremendous, if the bed bug control process can be streamlined and optimized by incorporating existing and new technologies. This can bring costs down and encourage more companies to take on bed bug work. Better efficacy can also lower the financial burden on people who otherwise might resort to throwing out their furniture and possessions or moving.

It is anticipated that human health benefits will be achieved with this project. Bed bugs are insidious and very difficult to eliminate, resulting in enormous costs of money and time. These costs, along with the fact that people are often forced to live with bed bugs, inflict incredible stress on the victims. In many cases, people report that they will use any legal or illegal pesticide product that they can get in order to try to kill the bed bugs in their homes. For example, a bed bug message board on the popular site www.Yahoo.com, which was formed in February 2006, today has 193 members, holds over 3,430 messages, and the numbers are growing rapidly. The board is a forum for support among victims of

bed bugs, and is an opportunity for people to discuss their experiences, tactics, setbacks and victories. An alarming number of individuals on this message board are buying professional use pesticides on the internet and using them at home with no prior experience or training. There have been claims of the use of banned organochlorine pesticides. Many have given up on professional pest control because of the enormous cost and inefficacy. However, there is great concern among experts that individuals undertaking their own pest control, as well as those using less qualified pest control services, are being more highly exposed to pesticides than ever before.

Bed bugs have essentially reversed the benefits achieved in Urban IPM over the past fifteen years, by reintroducing frequent, unrestricted, household pesticide use. A standardized bed bug management strategy that relies on IPM is desperately needed.

b) Literature Review

Due to the long period of time in the United States and Europe when bed bugs were uncommon or unheard of, there is a 40-year gap in research on pesticide efficacy, biology, ecology, pheromones, trapping, biocontrol, and all other aspects of this pest. Currently, investigators are looking at pesticide efficacy and beginning to take steps to identify aggregation pheromones. However published, peer-reviewed work is still scarce. One study from 1993 examined the efficacy of pesticide residues for bed bug management in poultry houses. The top three pesticide active ingredients included dichlorvos, pirimiphos methyl, and lambda-cyhalothrin (Fletcher and Axtell, 1993). Of those only lambda-cyhalothrin is labeled for use on bed bugs inside the home. Although it is commonly used in homes, efficacy is not 100% and further steps are always required.

The U.S. Centers for Disease Control website has no fact sheets about bed bugs, because the pests are not known to transmit diseases. However, local and state health departments are becoming aware of the epidemic through complaints and requests for more information. The Centre for Urban and Community Studies at the University of Toronto, Canada, published a research bulletin that describes the rapid increase in bed bug infestations in shelters and some methods to monitor and control bed bugs (Myles et al. 2003). Many cooperative extension websites have fact sheets describing bed bugs and their management. However, management recommendations are based on limited experience and research and there is still plenty of uncertainty about what combinations of management techniques work best.

A bed bug Code of Practice (CoP) has been developed by the Australian Environmental Pest Managers Association and Australian public health officials that addresses bed bugs in Australia's hospitality industry (see above for website address). The CoP is targeted toward hospitality industries and organizations that may have bed bugs, such as hotels, or have the potential to spread bed bugs, such as the linen industry. This protocol was developed from the accumulation of "successful anecdotal experiences of pest control industry professionals and researchers". This protocol provides valuable best practices for the use of steam cleaners for bed bug control. The CoP represents a significant accumulation of experience and information that can provide a foundation for our project.

However, the CoP is specific to the laws, regulations, and availability of pesticides in Australia.

In San Francisco, the Department of Public Health has outlined requirements for bed bug infestations. The guidelines include steps such as training, but control steps in the training are not specified. The guidelines also indicate that procedures must be put into place for reporting bed bugs infestations, taking action, managing furnishings, and preparing rooms for treatment. However the procedures are not outlined. There is also the requirement that hotel operators have procedures to assist tenants (public housing tenants, for example) unable or unwilling to cooperate, but these procedures are not included. See <http://www.dph.sf.ca.us/>.

Both of the previously mentioned guidelines address bed bug infestations in settings that are different from the subject of our proposed project. Client cooperation issues are significantly different between hotels and homeless shelters. Hotel guests cannot be monitored for bed bugs, and so bed bug management focuses on intensive control efforts in guest rooms rather than on prevention. In a homeless shelter, certain practices can be used to prevent the introduction of bed bugs by guests, and shelter operators may be able to enlist guest cooperation in monitoring and reporting problems. Hotel room access is generally easier to achieve than in long-term stay shelters or single room occupancy-type housing because hotel guests can choose to leave or change accommodations if they find bed bugs.

The potential accomplishments from this project have wide-reaching, unlimited applicability to other regions throughout the United States and beyond. Bed bug management protocols for homeless shelters could be used in any part of the country

c) Objectives and Anticipated Impacts:

The overall objective of this project is to develop, demonstrate, and test protocols for bed bug management in urban homeless shelters and extend this information to pest control professionals, municipal agencies, and the public. Demonstration of techniques for bed bug management and evaluation of the protocols will be the focus of the work funded. The development of sound protocols is anticipated to have tremendous impact on shelter managers and residents, tenants and landlords, and many others.

- i) Objective 1. The first objective is to create a stakeholder advisory group for bed bug management that will develop the management protocols out of their experience. The advisory group will include 2 pest control professionals, several university and extension staff (not limited to New York State), and New York City municipal agency officials. This regional group will gather for a one-day meeting to develop protocols that are feasible and tools for evaluating the success of the protocols.

Anticipated Impact: The project team (project leader, assistant, NYC Dept of Health and Mental Hygiene staff) will document the meeting of the stakeholder advisory group and compile a series of experience-based protocols that can be implemented in shelters where

bed bugs are a problem. The group will develop three protocols for use in shelters: prevention of bed bug infestation, identification and monitoring for infestations, and within-facility bed bug management and treatment. The advisory group will also discuss feasible evaluation strategies for control protocols, such as methods to quantify infestations before and after protocol implementation.

Deliverable: Three protocols for bed bug prevention, mitigation and management.

- ii) Objective 2. The team (project leader, assistant, Health Department staff, pest control professional, and shelter manager, or staff) will implement the protocols developed by the Advisory Group and set up resources for training shelter staff. The pest control technicians will be given specific instructions on how to manage bed bugs, shelter residents will be given instructions on how to cooperate, and shelter managers will be given resources to make the program work. For example, one non-chemical tool that has been shown to work is the use of mattress dust-mite covers that create a barrier between the main harborage and the host. Mattress covers will be provided to shelter managers for evaluation and use. Another helpful tool is direct training of residents in the identification and location of bed bug harborage sites. Resident self-inspection may be a more thorough approach than sole reliance on pest control technician inspections.

Deliverable: Training materials for pest control, inspection, custodial, residents and management staff for identification and scouting, and management of bed bugs.

- iii) Objective 3. Evaluate the protocols for bed bug management, and the training materials, and conduct a basic economic analysis of the cost of bed bug management. Evaluation measures for control techniques might include the numbers of bed bugs that can be found at a certain time after treatment. Counts might be made using vacuuming, sticky traps, and/or visual inspection. If circumstances allow, it may also be possible to evaluate new techniques like heat traps or steam cleaning. Shelters may be paired allowing the comparison of shelters where the protocol was tested to shelters with no intervention, where only conventional pest management is being used. Follow-up evaluations to each shelter involved will also be useful to determine the relative long-term efficacy of bed bug management protocols.

Deliverable: Publication and use of protocols for bedbug control in urban homeless shelters for publication. These protocols can be broadened for use in any multiple-unit dwelling.

d) Approach and Procedures

i) Leadership and cooperation:

The project will be led by Jody Gangloff-Kaufmann, of the NYS IPM Program, Cornell University. Daniel Kass, Caroline Bragdon, and Waheed Bajwa from the NYC

Department of Health and Mental Hygiene (DOHMH) will be major cooperators in this work. The DOHMH leads the Local Law 37 Pest Management Inter-Agency Committee, which is a standing committee that meets regularly to discuss pest and pesticide issues in NYC. Through DOHMH, cooperation is guaranteed from city agencies, including but not limited to the Department of Homeless Services, NYC Housing Authority, and NYC Housing Preservation and Development. Cooperation will be enlisted from the pest control professionals of the shelters chosen as demonstration sites. Pest control professionals may be city-employed or contracted depending on which facilities participate. New York City contracts with a limited number of pest control vendors that understand and use IPM. In addition, at least two independent pest control professionals will be enlisted as advisors to this project.

A temporary employee will be hired to assist in the protocol development and evaluation. This person will oversee IPM practices in shelters, conduct and evaluate bed bug inspection and monitoring, aid in on-site problem solving, and will interface directly with the project leader and cooperators on progress. The employee will be in charge of organizing training materials and assist in workshop development. Training materials will include original photographs of bed bug infestations and control methods, taken during the demonstration. Video may also be used to document bed bugs and management techniques and included in training materials. The NYC DOHMH will provide facilities and support for training workshops.

At least two shelters will be chosen to participate in this project, depending on their need. If more shelters express need, they may also be included in the demonstration. It is anticipated that once protocols are developed and beginning to be implemented, the demand for this information will result in other shelters testing the protocols independently. Several women's and homeless shelters have contacted Cornell IPM, seeking such protocols. In this case, the protocols will be made available, as well as phone support

ii) Criteria for selecting cooperating shelters:

It is impossible to choose cooperating shelters for these demonstrations many months in advance of the project start date, because bed bug problems are continuously being addressed. However, bed bug problems are rampant in the NYC public congregate living environments. Therefore the following criteria will be used to decide which shelter(s) are suitable for cooperation at the start of this project. The shelter must:

- * Be a long-term stay shelter or family shelter, where guests remain for more than one week in the same bed or room.
- * Have ongoing bed bug problems in more than one room.
- * Have laundry facilities
- * Have staff willing to participate in the demonstration.

The IPM process will begin with a complete and thorough inspection of the shelter with bed bugs by the project director, assistant and NYC staff. The extent of the infestation will be defined and carefully documented using photographs and notes. A record book will be kept at each facility. Using the developed protocols, a plan will be drawn up for

the facility and the IPM process will be explained to residents, shelter staff and the pest control professional. The pest control professional will be the only person to apply any pesticide materials for bed bugs. Records of all treatments will be kept along with inspection and procedure records. Mattress covers will be installed, steam cleaners and vacuums will be put to use for crack and crevice cleaning. All three protocols will be implemented and evaluated on a regular basis (weekly or bi weekly). Demonstrations will be managed for two to three months, and protocols will be fully implemented at the end of this period.

iii) Timeline:

Objective	Tasks	Complete by
1	Solicit advisory group members. Locate and commit shelters for demonstration project.	End of month 1
1	Hold bed bug advisory group meeting, 1 day, NYC Hire field assistant.	End of month 3
1	Protocols developed and ready for demonstration	End of Month 4
2	Demonstrations begin.	End of Month 5
2	Protocols evaluated.	Duration of the demonstration
2	Demonstrations end, protocols evaluated.	End of month 7 to 8
3	Training materials developed.	End of month 9
3	Training workshops held.	End of month 11
3	Project evaluated and reports written. Protocols and training materials distributed and published online.	End of month 12

iv) Evaluation Plans:

The protocols developed from this project will be evaluated as they are being developed. During the year that follows the completion of the work, participating shelters will be contacted by DOHMH and DHS for updates on whether the protocols are being used and if they are working. This will be the main tool in evaluating the long-term efficacy of the protocols.

Trainings will be held to educate and raise awareness for those involved in bed bug management. Training will be provided through the DOHMH to shelter and other NYC congregate living agency managers, staff, and pest control professionals. The anticipated number of participants is about 50, but could be much higher. The protocols and training materials will be made available through the NYS IPM and the NYC DOHMH websites for public use. Further extension and use of these materials through workshops and trainings is anticipated as a result of the completed project. The project leader will continue to provide support and training opportunities in the future with these materials.

e) References

Fletcher, M.G. and R.C. Axtell. 1993. Susceptibility of the bedbug, *Cimex lectularius*, to selected insecticides and various treated surfaces. *Medical and Veterinary Entomology*. 7, pg. 69-72.

Gangloff-Kaufmann, J.L., C. Hollingsworth, J. Hahn, L. Hansen, B. Kard, M. Waldvogel. 2006. Bed bugs in America: A pest management industry survey. *American Entomologist* 52(2), pg. 105-106.

Jupp, P.G., R.H. Purcell, J.M. Phillips, M. Shapiro, J.L. Gerin. 1991. Attempts to transmit hepatitis B virus to chimpanzees by arthropods. *South African Med. J.*, 79 (6), pg. 320-322.

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2) Cooperation and Institutional Units Involved

New York State IPM Program, Cornell Cooperative Extension, Cornell University

The New York State IPM Program will be the project leader, serving as organizer and liaison among stakeholder advisory committee members. NYSIPM will hire and serve as supervisor of the temporary assistant and will coordinate the development of bed bug IPM protocols with all cooperators. Additionally, NYSIPM will coordinate with the NYC DOHMH staff to choose facilities as demonstration sites, supervise the implementation and evaluation of IPM at these sites, and will be fully responsible for administration, evaluation, and reporting for the grant.

New York City Department of Health and Mental Hygiene and the Local Law 37 Pest Management Inter-Agency Committee.

DOHMH will provide assistance in engaging other NYC municipal agencies, and coordinating access to city owned facilities. DOHMH will evaluate drafts of protocols for applicability, feasibility, scientific soundness and will help to identify sites for evaluation, and ensure access to appropriate venues for developing, testing and sharing protocols for bed bug management. Key personnel at DOHMH offering support for this project include members of the Bureau of Environmental Surveillance and Policy, and the Office of Vector Control and Surveillance. The municipal agencies involved in Local Law 37 Pest Management Inter-Agency Committee include the NYC Department of Homeless Services, NYC Housing Authority, and NYC Department of Housing Preservation and Development. Each of these agencies works closely with DOHMH, both on urban pest management issues and on pesticide reduction. Through the already established cooperative arrangements, each of these three agencies will be engaged in this project by DOHMH staff.

Key Personnel and Scope of Work

Jody Gangloff-Kaufmann, Ph.D., Project Director

Jody Gangloff-Kaufmann will serve as the project director. She will serve as organizer and liaison among stakeholder advisory committee members. She will hire and serve as supervisor of the temporary assistant. Dr. Gangloff-Kaufmann will coordinate the development of bed bug IPM protocols with all cooperators. Additionally, she will coordinate with the NYC DOHMH staff to choose facilities as demonstration sites, supervise the implementation and evaluation of IPM at these sites, and she will be fully responsible for administration, evaluation, and reporting for the grant.