

Collaborative Strategy on Bed Bugs



Prepared by
The Federal Bed Bug Workgroup¹
February 2015

¹ The Collaborative Strategy on Bed Bugs reflects a broad-based consensus of federal agencies. It is an outcome of the interagency Federal Bed Bug Workgroup. The Strategy was authored by key agencies (EPA, HHS [CDC], HUD, and USDA) and includes technical information and input from the Department of Defense and the National Institutes of Health. The cover photo was downloaded from the CDC Public Health Image Library (<http://phil.cdc.gov/phil/home.asp>).

Table of Contents

Introduction	3
Federal Involvement and Community Efforts	3
IPM and Community Efforts.....	4
Nature of the Problem	5
Priority Area I: Prevention.....	5
Actions to Improve Prevention	6
Measuring Progress	7
Priority Area II: Surveillance and IPM for Bed Bugs.....	7
Actions to Improve Surveillance and IPM.....	8
Measuring Progress	10
Priority Area III: Education and Communication.....	11
Actions to Improve Education and Communications	11
Measuring Progress	12
Priority Area IV: Research.....	13
Actions to Improve Research	14
Measuring Progress	15
Conclusions	15
Appendix A: Key Elements of Successful Bed Bug Management.....	17
Appendix B: The Federal Bed Bug Workgroup	18

Introduction

The Collaborative Strategy on Bed Bugs (the strategy) was developed by the Federal Bed Bug Workgroup¹ to clarify the federal role in bed bug control and highlight ways that all levels of government, community, academia and private industry can work together to reduce bed bugs across the United States.

Controlling bed bugs can be very costly and nearly all communities and states are currently facing resource limitations. Collaborating and sharing training programs, communication materials or treatment plans will conserve resources and may also lead to higher quality outputs by providing new opportunities for improvement.

The strategy outlines four priority areas for bed bug control (Prevention, Surveillance and Integrated Pest Management [IPM], Education and Communication, and Research). Each of these areas is critical to national efforts, but the workgroup recognizes that interest in an individual area will vary across localities and stakeholders. The strategy does not outline specific commitments for the federal government because any action will depend on an individual agency's mission as well as regulatory and budgetary circumstances. The workgroup recognizes that collaboration among partners is the best path to success and has designed the strategy to facilitate and encourage these interactions.

Within each priority area, the goals of the strategy are to help stakeholders by

- Coordinating and guiding federal activities;
- Facilitating collaboration among stakeholders and various levels of government;
- Raising awareness of the issues surrounding the bed bug problem;
- Maximizing efficient and effective use of resources to address high priority needs; and
- Encouraging realistic appraisal and management of bed bug problems through education and integrated mitigation measures.

The strategy also focuses on the importance of evaluating the success of any intervention effort. With resource pressures at all levels of government, it is critical to evaluate which interventions are the most effective and the best candidates for sharing with other communities. The evaluations can be conducted by the lead local/state/federal agency or others, to provide an objective means of allocating future resources.

Federal Involvement and Community Efforts

Resourceful and innovative communities can take information disseminated at the national or state level and apply it to their unique local context for a more robust program. Private and nonprofit organizations, or commercial businesses, can work with local governments, adding their expertise or resources to the community response. Examples of strong partners include: private funders looking to provide resources

¹ The current workgroup comprises representatives from the Department of Defense (DoD), the Environmental Protection Agency (EPA), the Department of Health and Human Services (represented by the Centers for Disease Control and Prevention [CDC]), the Department of Housing and Urban Development (HUD), and the U.S. Department of Agriculture (USDA).

for research or control or affected commercial sectors such as health, pest control, hospitality, housing, real estate, or chemical manufacturing industries.

Stakeholders in the community who have an interest in bed bug control include schools, housing providers, social service providers, pest management firms, local businesses, law enforcement, and local public health departments. Communities can lower costs and improve bed bug control by working with all of their stakeholders to develop and share the following kinds of information:

- Infestation rates in specific areas of the community, including potential reservoirs of bed bug infestations that may serve as sources for new infestations;
- Levels of resistance to specific pesticides in local bed bug populations;
- Needs and existing resources to support underserved groups of people; and
- Cultural considerations (for example, values, ethnicity, national origin, language, gender, age, education, mobility, beliefs, standards, behavioral norms, communication styles, literacy, etc.) that potentially affect management efforts and recommendations.

The federal government can help communities by

- Providing information and educational materials based on the best scientific information and expert knowledge available;
- Facilitating interactions among communities to leverage knowledge and experience;
- Encouraging objective evaluations of interventions; and
- Promoting research activities to improve prevention and control techniques.

When complete elimination is not feasible, people living or working in an infested area can take steps to prevent the spread of this pest to new areas within the community and strive to reduce the bed bug population(s) as much as possible given the characteristics of the infested site. In this way, local efforts in even the most difficult cases can contribute to the management of bed bugs throughout the community.

IPM and Community Efforts

Communities cannot expect to effectively manage bed bugs without coordinated community involvement using the principles of Integrated Pest Management (IPM). IPM is an effective and safe approach to pest management that relies on a combination of common-sense practices that present the least possible hazard to people, property and the environment. An IPM approach is especially critical to control in multifamily housing, lodging and institutional facilities. To manage bed bugs at the local level, communities need the capacity to coordinate prevention, surveillance, IPM, education, and communication activities. Appendix A contains additional key elements to include when setting up a bed bug program.

Bed bug action committees (such as task forces) made up of recognized and respected leaders can be an effective way to organize collaborative local efforts. In addition, the state's IPM Coordinator may be a source of information about groups doing bed bug work in the state (www.ipmcenters.org/contacts/IPMDirectory.cfm). Guidance and examples from programs that shared

successful approaches at the Second National Bed Bug Summit can be found at <http://www.epa.gov/oppfead1/cb/ppdc/bedbug-summit/2011/2nd-bedbug-summit.html>.

Nature of the Problem

Bed bug infestations can happen anywhere – at home, at work, at school or anyplace people bring their belongings. Because bed bugs are small, people may unknowingly transport them from place to place on clothes, luggage or other goods. Infestations may spread when bed bugs crawl to adjacent rooms or housing units. Bed bug infestations can be small and isolated or more extensive and complex. Small, isolated infestations are more easily controlled; however, extensive and complex infestations can persist for an extended period of time.

The United States, like many countries, has recently seen increases in bed bug populations. In 2010, CDC and EPA issued the [Joint Statement on Bed Bug Control in the United States](#), which discusses the public health implications of bed bugs and their control. Bed bugs cause a variety of negative physical health, mental health and economic consequences, including

- Various reactions to bed bug bites, ranging from no observable reaction to mild or severe allergic reactions;
- Secondary infections of the skin;
- Mental health implications for people living in infested homes; and
- Time-consuming and expensive control measures.

The management of bed bugs continues to pose a major challenge to state and local governments, private industry and the American public. This strategy provides guidance for how various parts of the government can contribute to minimizing the negative effects of bed bug infestations on human health and the economy.

Priority Area I: Prevention

Prevention is a very cost-effective approach to managing bed bugs. Effective prevention efforts, when taking into account cultural considerations, can work in a wide range of settings. Prevention strategies are particularly effective for owners/agents of shelters, some group homes and other housing accommodations for transient populations where the risk of bed bug introductions and subsequent infestations is high. When prevention fails, site-specific early detection and rapid response measures within the IPM plan can prevent further spread.

To support prevention, the workgroup recognizes the need for

- Increasing general awareness through effective outreach and education programs;
- Increasing accessibility to bed bug information through a dedicated website: www.epa.gov/bedbugs;
- Facilitating communities' ability to educate stakeholders about prevention through the clearinghouse portion of the website;

- Examining the effectiveness of potential prevention techniques through research and other projects;
- Establishing programs to inform employees about the potential for exposure to bed bugs, how to recognize an infestation and what to do if exposure occurs;
- Continuing to inform HUD stakeholders about housing policy; and
- Providing technical information and help when infestations occur in settings under federal oversight, such as during disaster relief efforts or at military sites.

Actions to Improve Prevention

To stop the spread of bed bugs, people living with bed bugs can take steps to reduce the opportunities for bed bugs to migrate to new locations. By developing a strategy in advance, people who travel or have jobs that may expose them to bed bugs can reduce the likelihood of bringing bed bugs home. Integrating prevention strategies into IPM plans can help property owners and agents keep their buildings free of bed bugs.

Education and communication are the foundation for effectively preventing bed bug infestations. Priority Area IV (Education and Communication) provides more information on effective programs. The workgroup also envisions that effective prevention programs will include the following modules:

- Accurate identification of bed bugs (they are easily confused with other pests);
- Early detection of new infestations and/or infestations that may persist after treatments;
- Sources for science-based technical information on bed bugs (particularly for high-risk settings); and
- Open communication about bed bugs and infestations, which will foster collaboration to solve the problem, rather than assigning blame or fostering stigma about infestations.

Creating a prevention program involves three main steps:

- Minimizing movement of bed bugs to new locations;
- Creating living spaces that are less receptive to bed bug infestations; and
- Identifying and eliminating significant infestations that can serve as reservoirs for spreading bed bugs.

The workgroup believes successful community programs will include

- Preventing the movement of bed bugs by
 - Treating existing infestations quickly and notifying all neighbors of the problem to ensure they are on the lookout for bed bugs;
- Making areas less receptive to new infestations by
 - Removing clutter;
 - Installing mattress and box spring encasements (if funds are severely limited, at least encase the box springs);
 - Installing, inspecting, and maintaining interception devices or traps; and
 - Providing clothes dryers hot enough to kill bed bugs.

- Carefully inspecting all used clothing and furniture for bed bugs to avoid bringing them into the home;
- Choosing appropriate control techniques for treating existing infestations to increase effectiveness of treatment and to reduce movement of bugs into adjacent units (although many [registered products](#) are available, every situation is different);
- Encouraging managers or owners of multifamily dwellings, when possible, to invest in
 - Washers and dryers on each floor to reduce the spread of bugs from residents carrying bedding and other items to laundry facilities via the elevator or stairwells; and
 - Portable heating units so that returning travelers can treat their luggage with heat before unpacking.
- Sealing cracks and crevices around baseboards, light sockets, etc., to discourage movement through wall voids;
- Encouraging managers of multifamily dwellings to install door sweeps on the bottom of doors to discourage movement into hallways;
- Implementing IPM plans in high-risk settings (hostels, shelters, etc.), to encourage
 - Inspecting and/or treating incoming personal belongings with a portable heat chamber;
 - Routinely monitoring areas around where people sleep or rest; and
 - Identifying and destroying reservoir populations whenever possible.

Measuring Progress

The following types of data can show whether programs and activities are successfully preventing bed bug infestations:

- Results of inspections such as bed bug numbers from monitoring devices, visual inspections, or numbers of locations where scent-detecting canines alert; and
- Increased knowledge or behavior change of participants completing training or receiving educational materials, as measured by polls and questionnaires.

Priority Area II: Surveillance and IPM for Bed Bugs

Even if residents diligently engage in prevention activities, bed bugs can still infest an area and an infestation may become well established before anyone notices. If an IPM plan is in place that details specific roles in dealing with an infestation, bed bug experts can stop the infestation before it becomes overwhelming. In most cases, the longer an infestation remains unchecked, the harder and more expensive it will be to eliminate. Reliable and cost-effective early detection methods and educational efforts can help communities by lowering overall treatment costs and reducing new infestations.

Effective site-specific IPM plans tailor educational efforts and procedures to the community. The plans also address any factors that could affect program effectiveness, such as

- Cultural considerations,
- Availability of qualified bed bug control professionals,
- Pesticide and applicator availability,

- Potential for pesticide misuse, and
- Financial resources.

Identifying and planning for complicating factors when designing a site-specific IPM plan are important both for budgeting and for anticipating special considerations that could lengthen the time needed to eliminate the infestation. In addition, bed bug populations vary in their level of resistance to pesticide products. If pesticides are used to control bed bugs, it is critical to select those that will be effective against the infestation. Continuing to monitor for pests at the site being treated is a critical element of any IPM-based management program; monitoring provides an objective measure of progress toward the goal of eliminating the infestation.

Bites alone are a very poor indicator of an infestation because people sometimes mistake bites from mosquitoes and other pests as bites from bed bugs. Using community-wide surveillance to identify bed bug sources and identifying ways that bed bugs move between residences can help communities target resources to areas where they will be most effective. Rather than relying on anecdotal information, communities should use IPM best-management practices and reliable surveillance data to verify the presence of living bed bugs when there is a report of bed bugs. Bed bug sightings at schools can help identify potential infestations in the community; however, this information is very sensitive because it has the potential to stigmatize students and their families and should be handled discreetly.

Community control efforts can be significantly improved when the community has access to quality resources and information. The workgroup recognizes the need for collaboration among stakeholders to:

- Provide science-based information and educational materials about the importance of early detection;
- Share success stories about management efforts;
- Identify and promote research activities that may lead to reliable, portable and affordable detection methods;
- Ensure that scientifically sound information is collected and made readily available to stakeholders about bed bugs including effective monitoring and control strategies, properly labeled chemical insecticides and related regulatory requirements;
- Facilitate the incorporation of new discoveries into training, education and communication materials; and
- Encourage funding for basic and applied research on bed bugs, bed bug biology, and effective control techniques and products, and conduct such research or facilitate funding where possible.

Actions to Improve Surveillance and IPM

By having an IPM plan for bed bugs in place, occupants and staff will be able to act quickly and confidently if they find bed bugs. Those living or working at a property can conduct basic bed bug inspections as an added step to existing scheduled routines (for example, housekeeping inspections), which will help minimize costs.

Residents should not serve as the sole source for reporting bed bug infestations. Inspecting every area at risk for bed bug infestation will help find bed bug infestations while they are still relatively easy to eliminate. The frequency of such inspections should be part of the IPM plan, based on the local situation

and conditions. Hiring a pest management professional (experienced specialists who use certified canine bed bug detectors or other effective bed bug monitors) or training specific staff members to conduct intensive inspections can be an effective way to encourage surveillance and IPM efforts.

Bed bugs can be detected before an infestation becomes severe by using devices and practices that facilitate early detection. These include the following:

- Using rip-resistant, bite-proof and escape-proof mattress and box spring encasements that make it easier to see the signs of bed bugs;
- Managing the environment so that when infestations occur they are more easily detected (such as routine cleaning, minimizing clutter, removing evidence of past infestations, using light-colored bedding, etc.);
- Using passive bed bug monitors that intercept and trap bed bugs; and
- Using active monitors that attract bed bugs by releasing heat, carbon dioxide and/or a scent lure.

Dogs can be successfully used as part of a program for early detection of bed bugs or to verify that bed bugs have been eliminated from a residence. However, this success depends on how well both the handler and the dog have been trained and how well they work together as a team. Whenever using dogs or hiring a dog handler, success is most easily achieved if

- The dog and/or team are certified by a nationally recognized association;
- The resident recognizes that dogs are not perfect in detecting bed bugs
 - a positive identification by a dog should always be confirmed by a visual inspection before beginning treatment;
 - a negative result should also be confirmed by another monitoring technique; and
- The team that is hired is a professional dog/handler team with a proven track record.

The federal government has no oversight or advisory role for bed bug surveillance by dog/handler teams. However, several states have begun programs to require training, licensing or certification for dog teams.

Research into basic bed bug biology and behavior shows certain characteristics are common to all bed bugs. Focusing detection efforts on the following characteristics can help reduce costs:

- The majority of bed bugs are found in or near sleeping and resting areas. As an infestation grows within an apartment or home, bed bugs will travel to other locations, making it more difficult, time consuming and expensive to pinpoint every infested area.
- Because bed bugs can move between housing units, the best IPM practice is to inspect adjacent areas or units, units above and below the infested unit, and units across the hall. If a unit is vacant, bed bugs may behave differently (for example, by becoming inactive or more active during the day) while waiting for a new host to arrive.
- Although not preferred hosts, pets and rodents serve as alternate hosts in some circumstances (such as when other hosts suddenly become unavailable or when an infestation is severe). Having these additional hosts can greatly increase the chances of the bugs' survival.

Bed bugs can be difficult to differentiate from other common insects such as carpet beetles, cockroach nymphs or booklice. A qualified expert should confirm the presence of a bed bug infestation before control efforts begin. Once a licensed pest control professional or other expert confirms the infestation, site occupants and staff follow the predetermined IPM plan to efficiently control the infestation. If no IPM plan is in place, follow research-based recommendations available at EPA's bed bug website (www.epa.gov/bedbugs). Each bed bug infestation site is unique, so control options and IPM plans will vary.

The workgroup has also identified the following actions that managers/owners/occupants and pest control professionals can take:

- Encourage discussions with a licensed pest control management company or other professional knowledgeable about the control of bed bugs about appropriate ways to quarantine infested items;
- Advocate for clear guidelines to minimize potential for bed bugs to develop resistance to pesticides; and
- Establish minimum acceptable standards for detecting an active infestation compared with a prior infestation.

Measuring Progress

Sometimes residents or landlords will treat for bed bugs based on anecdotal reports, without proper evidence. Evaluation is essential to ensure that limited resources are used for the treatment methods that will be most effective. Professional organizations have recommended best management practices, but not all of these practices have been adequately evaluated for effectiveness.

Measuring results from surveillance and IPM programs at the federal, state and local levels helps ensure effective and efficient use of resources. The following could demonstrate whether an approach has resulted in better bed bug management:

- Community or locality infestation rates, which indicate successful interventions and likely reduction in new infestations.
- Data showing availability and distribution of information and educational materials from the surveillance system, coupled with data showing increased knowledge of residents and housing employees.
- Documentation showing a reduction in bed bug control expenses over time.
- Inspections, both routine and non-routine, revealing less frequent and smaller populations of bed bugs.
- Verification that infestations are only in one dwelling area (not multiple areas in a home or adjacent units).
- Documentation that monitors and resident surveys that show no activity for months after one or two treatments of an active infestation.
- Satisfaction surveys that show an increase in satisfaction.

Priority Area III: Education and Communication

How much participants know about bed bugs often determines how willing they are to cooperate with prevention and control activities. Knowledge also often determines the outcome of IPM plan implementation. Information about bed bug basics, prevention and control is critical for all stakeholders so they can contribute to pest management efforts. Training and communications materials that are current, targeted, science-based and consistent are key to a successful program. In addition, target audience members are most likely to access the information if it is available in plain language (see www.plainlanguage.gov).

Although pest control companies are on the front lines of the bed bug battle, they vary in their ability and willingness to train employees and educate clients. In addition, existing training curricula frequently lack the latest, science-based information about bed bugs.

To improve the quality of education and training materials, the workgroup recognizes the need for

- Defining core competencies for groups that need training or education;
- Setting audience-specific learning objectives (based on core competencies) for diverse stakeholders involved in bed bug management;
- Ensuring sufficient numbers of effective trainers to help convey consistent information and quality delivery;
- Promoting current, science-based messages (pulling from multiple websites or training from some sources can give an incomplete or incorrect understanding of bed bugs and their management);
- Tailoring messages to the target community using cultural considerations and current needs, recognizing that settings at risk for infestation (for example, offices, shelters, group homes, hostels, camps, etc.) may routinely have uninformed people rotating in and out;
- Reducing the costs of developing and disseminating high-quality education, training and communications materials for all stakeholders;
- Understanding that the greatest cost savings may result from prevention programs;
- Refining models of community coordination to serve as templates for minimizing costs; and
- Communicating with people who have different learning styles or those who rely on electronic communications such as social media as their primary source for learning.

Actions to Improve Education and Communications

Training efforts will reach the most people in the most effective way when they use current information based on standardized learning objectives that demonstrate core competencies. In addition to bed bug-specific training programs, cooperating with broader training programs to discuss bed bugs (such as Healthy Homes, IPM, and training for management of other pests) can be cost effective. Training can be provided in classrooms, at the workplace, and through webinars. Regardless of format, regularly updating training programs is necessary to keep information current.

Developing a federally endorsed set of core competencies and learning objectives for bed bug training may help define the level of training needed in a bed bug management program. A professional

certification program indicating a level of knowledge, experience and educational ability would help consumers select a qualified training provider. Interaction among communities could lead to more effective and efficient use of resources. Costs can be significantly reduced by using existing strategies for communications and instructional design whenever possible. Greater use of the clearinghouse portion of EPA’s bed bug website could help management programs format and tailor communications to a target audience. The website

- Provides accurate information on bed bug management from unbiased sources;
- Discredits myths linking sanitation, poverty and immigration status to bed bugs;
- Offers consistent information; and
- Promotes more efficient communications on a local level.

For example, the clearinghouse could be a repository for educational materials like in-depth extensive training developed by professionals, including videos on how to inspect, caulk crevices, make your bed an “island,” or prevent bed bug transport.

Measuring Progress

Measuring the success of a training program is critical to determining whether those resources are being used productively. Core competencies should align with measureable learning objectives and the objectives should be audience-specific for the various stakeholders and/or sectors involved in bed bug management. Once developed, communities could use these standard objectives to measure the level of training expertise in a community. Nationally, achievement of objectives could be compared across communities to measure success in communication and training programs.

Likewise, communicators can track efforts and evaluate the results to support efficient use of resources and improve effectiveness of messages. Ideally, target audiences have the opportunity to provide feedback. By using the feedback, communities can provide valuable information to those developing messages for use in public forums and social media.

The following are examples of data that could assess the effectiveness of communication strategies and messages:

- Documented results from satisfaction surveys of customers who pay to have pest management professionals rid their homes/facilities of bed bugs;
- Results from focus groups during development of communication strategies and after dissemination to determine whether the target audiences receive the messages, understand them, and take the recommended steps to prevent or control bed bug infestations;
- Evaluations of training from interviews of participants to determine their perceptions about the effectiveness of communication strategies; and
- Before and after surveys analyzing training participants’ behavior changes with regard to bed bugs.

Priority Area IV: Research

When the numbers and geographical distribution of bed bugs began to increase, pest-specific knowledge was based on previous, limited research. Since then, our understanding of bed bugs and their management has improved. Newer research about bed bugs answered many questions and allows program planners and the American public to more effectively manage infestations.

Research activity can be divided into two areas: basic and applied. Basic research answers questions about the biology of the bed bug in its environment and its association with hosts. Not every basic research study results in a practical application, but unexpected answers to basic research questions may lead to innovative solutions. Peer-reviewed basic research on topics such as colony growth, movement behavior and the pest's apparent inability to transmit pathogens that cause human diseases would improve the current body of knowledge about this pest.

Applied research provides new methods for IPM or new information that allows better pest control as part of an IPM program. Such research activity may lead to new tools or evaluation of existing tools. Applied research can also bring together many techniques into a clear, site-specific IPM plan to test the effectiveness of the plan.

Research pertaining to the priority areas will likely come from

- Academic institutions (for example, departments of entomology, schools of medicine, schools of public health, departments of social work, departments of communication, departments of consumer economics, and schools of architecture);
- Private industry (for example, include insecticide manufacturers, product formulators, venture companies, pest control); user group associations (for example, builders, hoteliers, private housing groups, insecticide manufacturers);
- International research entities; and
- Federal, state and local governments.

Because both basic and applied research will provide the foundation for new, more effective control options, the workgroup recognizes the need to

- Promote partnerships that leverage resources and expertise;
- Integrate the results of peer-reviewed research into management programs through education, training and communications;
- Further investigate potential health effects from bed bugs, including potential to trigger an allergic reaction;
- Improve access to study sites and the potential use of human subjects;
- Quantify the costs for control, prevention and the value of tailoring intervention efforts to unique communities;
- Develop inexpensive, practical control and prevention protocols for residents owners and managers;
- Improve access to research colonies, including field strains;
- Maintain defined strains of bed bugs with known resistance to insecticides;

- Create a source of reagents (for example, plasmids, antibodies, DNA and other materials), samples, or testing protocols; and
- Integrate results with international collaborators to make research and, ultimately, control more effective and less costly.

Actions to Improve Research

Research is important to improve bed bug management techniques. Basic research is often the source of innovative new solutions, while applied research directly supports information used in establishing pest control best practices. Both are necessary to build a foundation of knowledge that can be used to develop solutions.

Basic research topics may include

- Basic biology of modern bed bug populations;
- Health effects caused by bed bugs;
- Property damage caused by bed bugs;
- Potential of bed bugs to transmit pathogens; and
- Bed bug gene sequencing and genomics to help advance current research and technological approaches.

Applied research topics may include

- How human activities influence bed bug infestations and affect control;
- Evaluation of existing methods for detection, prevention and control;
- New methods for detection, prevention and control; and
- Integration of various methods into clear, understandable, reduced risk and reliable IPM plans.

Regardless of research questions, the workgroup suggests researchers use the following guiding principles in their work:

- Strive to serve all members of American society with appropriate control techniques;
- Minimize costs while maximizing the benefits from the products of research efforts; and
- Communicate results effectively and efficiently to stakeholders.

Meetings that bring researchers together could include forums for discussion of strategies for research, technology, etc. Researchers may coordinate scientific efforts with professionals from other specialties to develop new solutions and to use methods as effectively as possible. For example, working with scientists studying related organisms could help inform approaches relevant to bed bugs. The following systems may facilitate federal/academic/industrial partnerships:

- Small Business Innovation Research: a program that enables small businesses to explore their technological potential and provides the incentive to profit from commercialization.
- Cooperative Research and Development Agreement: an agreement between one or more federal laboratories and one or more nonfederal parties through which the federal laboratory provides personnel, services, facilities, equipment or other resources toward the conduct of specified research or development efforts.

- **Specific Cooperative Agreement:** An agreement between a federal agency and another party that describes in detail a jointly planned and executed research program or project of mutual interest between the parties to which both contribute resources.

Measuring Progress

Like all of the other priority areas, measuring research efforts is critical to evaluating and directing research funding. Improvements in basic research can be measured by looking for increases in number of

- Publication of research outcomes in peer-reviewed journals;
- New patents;
- Shared resources that can be used by the bed bug research community;
- Research projects that contribute to solutions; and
- Trained bed bug biologists.

In addition to those increases listed above, the following may indicate an improvement in applied research:

- Transfers of intellectual property;
- Translation of research into operational manuals and other sources of information for those who manage bed bugs;
- Improved, more effective products available to the public and businesses;
- Improved communication with the public and businesses;
- A current baseline of the problem;
- Comparison of the outcome of interventions to a baseline; and
- New strategies for detection, prevention and control.

Conclusions

Integrating several methods for controlling bed bugs in response to IPM surveillance data is likely to be more successful against bed bugs than application of any single method. Reducing bed bug populations throughout a community provides an opportunity to reduce the probability of new infestations. With few exceptions, the federal government does not have a role in direct interventions against bed bugs, but it does have an important role in providing reliable information, coordinating stakeholders and providing resources for research to achieve long-term solutions. Many other stakeholders such as nongovernmental organizations, state and local governments, school associations and community coalitions have been active in efforts to manage the bed bug problem. Their input has been important in crafting this strategy.

Since problems associated with bed bugs increased in the United States, research and development has produced better products and methods for control. As improvements continue, indications are that IPM is the best approach in most situations. Public awareness and dissemination of accurate information is helpful for earlier detection, greater chances of successful elimination of infestations, reduction in spread of infestations and more efficient use of resources.

This strategy advocates a logical, integrated approach to bed bug management, with a focus on cooperation among all levels of government and communities. Effective implementation of this strategy should decrease costs to communities and achieve better bed bug control. Continuous measurements of progress will be key to efficient use of resources and essential to prevent the reoccurrence of widespread infestations in the United States.

Appendix A: Key Elements of Successful Bed Bug Management

Although bed bug management programs vary regionally, successful programs frequently share common elements. The workgroup has identified five key elements generally found in well-run, successful programs:

- **Collaboration** - Programs that draw on the strengths of the various participants and include diverse stakeholders are better able to improve outcomes and broaden the reach of their efforts. That is, they accomplish more as a group than as independent programs.
- **Plain Language, Targeted** - Materials and educational efforts are most likely to be effective when project planners define the audience, customize materials for that audience and target delivery of materials. Developing resources and educational programs in plain language helps audiences find what they need, understand what they find and use what they find to meet their needs (see <http://www.plainlanguage.gov/>).
- **IPM-Based** - Bed bug control is most successful when it uses an integrated pest management (IPM) approach. IPM is an effective and safe approach to pest management that relies on a combination of common-sense practices that present the least possible hazard to people, property and the environment. IPM takes advantage of all appropriate pest management options including the judicious use of pesticides. IPM programs use current, comprehensive information on the life cycles of pests and their interaction with the environment to create programs that are efficient, effective and safe. A site-specific IPM plan helps ensure use of standard operating procedures and coordination of the efforts of everyone who has a role in pest management. More information on IPM can be found in the USDA National Roadmap for Integrated Pest Management (http://www.csrees.usda.gov/nea/pest/pdfs/nat_ipm_roadmap.pdf).
- **Science-Based** - Recommendations are most likely to be consistent and successful when project planners base them on objective, accepted scientific evidence. Recommendations based on assumptions results in wasted or duplicative effort and resources.
- **Evaluated for Measurable Success** - Developing sustainable programs, especially over time or distance, is most easily accomplished by evaluating the success of individual intervention efforts. When communities objectively measure the success of their community-wide communication and control efforts, they are better able to use resources most effectively and at lower costs. Sharing successful results is also important for improving quality of efforts across communities and to support efficient use of resources.

Appendix B: The Federal Bed Bug Workgroup

A recommendation from the first National Bed Bug Summit led five federal agencies to establish the Federal Bed Bug Workgroup in August 2009. The current workgroup comprises representatives from the Centers for Disease Control and Prevention (CDC), the Department of Defense (DoD), the Environmental Protection Agency (EPA), the Department of Housing and Urban Development (HUD), and the U.S. Department of Agriculture (USDA). The workgroup is a cooperative effort; no single federal agency has the lead in the fight against bed bugs. Because each agency's mission influences its bed bug work, the individual missions and agency-specific activities are listed below.

[Centers for Disease Control and Prevention \(CDC\)](#)

CDC collaborates to create the expertise, information and tools that people and communities need to protect their health – through health promotion; prevention of disease, injury and disability; and preparedness for new health threats.

CDC offers live and online courses about the importance of IPM, including the biology and control of pests. The course trains environmental health, public health, pest management, and other professionals in the principles of effective pest control, including bed bugs, and offers a special field-based exercise that trains participants to conduct an inspection of a potentially infested bedroom.

[Department of Agriculture \(USDA\)](#)

The USDA Research, Education, and Economics mission areas, the National Institute of Food and Agriculture (NIFA) and the Agricultural Research Service (ARS) provide federal leadership in creating and disseminating knowledge spanning the biological, physical, and social sciences related to agricultural research, extension, and higher education.

NIFA's mission is to lead food and agricultural sciences by supporting [research](#), [education](#), and [extension](#) programs in the Land-Grant University System and other partner organizations. Funding from NIFA supports bed bug researchers and extension personnel at several Land-Grant universities. EPA's dedicated bed bug website includes science-based information developed by these university experts.

This work leverages other efforts in ARS on chemical ecology of insects and development of new insecticides. This work has resulted in the discovery of new kinds of chemical attractants for bed bugs and new insecticides effective against resistant bed bugs. ARS' problem-solving orientation focuses on bringing together many scientific skills to find innovative solutions.

[Department of Defense \(DOD\)](#)

DoD addresses bed bugs and their management from three different perspectives and through multiple agencies. Technical consulting, information sharing, educational efforts and control actions may involve uniformed and civilian entomologists at each of these levels:

- Policy: The Armed Forces Pest Management Board (AFPMB) provides overall information and develops and provides general policies, guidance, training and consultation on pest management to other DoD elements and whomever they support.
- Technical training: Preventive medicine staff members and pest management professionals (PMPs) receive routine periodic technical and certification training and guidance, as needed, by service-specific regional or national agencies.
- Bed bug management: Bed bug management programs and specific actions are carried out at the local level using IPM strategies and techniques, involving all local stakeholders. Those typically include members of the affected human populations, local public health or medical authorities, facilities managers and DoD military, civilian or appropriate contracted PMPs.

The Armed Forces Pest Management Board (AFPMB) is an arm of DoD that recommends policy, provides guidance, and coordinates the exchange of information on all matters related to pest management throughout the DoD. The AFPMB's mission is to ensure that environmentally sound and effective programs are available to prevent pests and disease vectors from adversely affecting DoD operations.

[Department of Housing and Urban Development \(HUD\)](#)

HUD's mission is to "create strong, sustainable, inclusive communities and quality affordable homes for all. HUD is working to strengthen the housing market to bolster the economy and protect consumers; meet the need for quality affordable rental homes; utilize housing as a platform for improving quality of life; build inclusive and sustainable communities free from discrimination; and transform the way HUD does business."

HUD promotes a collaborative approach to bed bug management in public and Indian housing (HUD Notices PIH 2011-22, PIH 2012-17, respectively, and H 2012-5).

While bed bug infestations are not limited to the housing sector, quality housing and strong communities are undermined by the presence of bed bug infestations. Prevention and control of bed bug infestations are enhanced by the team approach to the problem when affected and vulnerable housing providers, residents, pest management professionals, public health professionals and others focus their different perspectives and resources on the common problem. HUD is particularly concerned about effects on vulnerable populations, including underserved groups, such as elderly and disabled individuals, and owners and residents who lack the resources to effectively deal with bed bug infestations. Education of all involved parties, especially with regard to prevention methods, is a priority for HUD.

[Environmental Protection Agency \(EPA\)](#)

EPA's mission is to protect human health and the environment.

For bed bugs, like other pests of public health significance, EPA has a statutory charge to ensure that the pesticides are (1) safe and (2) effective against the pests on their labels. EPA's Office of Pesticide Programs works to ensure that pest management professionals and the public have access to the latest information on effective bed bug control tools. EPA realizes that certain bed bug populations in communities across the nation are becoming more resistant to many of the existing pesticides. EPA is also working to educate the general public, pest professionals and public health officials about bed bug biology and IPM, both of which are critical to long-term bed bug control.