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Mary Beth Kaylor

Wright State University - Main Campus, marybeth.kaylor@wright.edu

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Prevalence, Knowledge, and Concern about Bed Bugs: Final Manuscript

Mary Beth Kaylor, PhD, RN

Wright State University

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Abstract

Recent research suggests that the United States and the world are on the verge of a bed bug pandemic. Assumptions have been made that socioeconomic status is not an indicator and that bed bugs are not competent disease vectors. However, little information is available at the local level about the prevalence of bed bugs in private homes. This study aimed to identify prevalence, knowledge, and concern about bed bugs in one village in Ohio. Responses from 96 individuals who completed the Prevalence, Knowledge, and Concern about Bed Bugs (PKCABB) survey were utilized for data analysis. The majority of the sample was white non-Hispanic and about 95% of the respondents in the survey reported that they owned their residence. Only about 6% of the respondents knew someone with bed bugs. Additionally, 50 people (52.1%) reported they were somewhat concerned about bed bugs, despite recent media attention. About 43% of people reported that they had changed their behavior. There were no differences in the responses based on data collection method. For this higher income area the prevalence was dissimilar to the rate reported in the general public (about 20%). This suggests that bed bugs may be an environmental issue effecting low income disproportionately. Confounding issues, such as reluctance to report infestations could have resulted in inaccurately low results. Further research is needed in areas of differing socioeconomic levels. Education is needed for all in the general public related to bed bug prevention and elimination.

Introduction

While modern day sanitation and public health sciences have created living environments in developed countries with near elimination of inhabitation by insects and rodents, the prevalence of infestations of bed bugs in homes, rental housings, department stores, dormitories, and hotels seems to be on the rise in the United States, Canada, Europe, and other geographic locations. Results of a 2010 global study conducted by the National Pest Management Association (NPMA) on bed bugs suggest that the United States and the world itself is on the verge of a bed bug pandemic. This fact coupled with recent research reporting that bed bugs may be possible vectors for transmitting medication resistant bacteria (*Staphylococcus Aureus* and Vancomycin-resistant *Enterococcus faecium*) make understanding the prevalence of infestations, as well as the increasing the public's knowledge and behaviors related to prevention, critical public health issues (Lowe & Romney, 2011).

Review of Literature

Description

Bed bugs, scientific name *Cimex Lectularius*, are wingless insects with an elongated body and six-legs that require nourishment from feeding on the blood of humans and small animals. Bed bugs can range in size and color depending on the life cycle and time of feeding at which they are observed (Sutton & Thomas, 2008). Bed bugs are always visible to the naked eye during all life stages. In the later stages of their lives, mature adults are characterized by a pyramid shaped head, compound eyes, antennae, and a proboscis (Goddard & deShazo, 2009). The bed bugs have a life cycle that consists of six stages, five nymphal and an adulthood, progression through which is marked by molting (Kolb, Needham, Neyman, & High, 2009). Bed bugs turn from nearly white in the early stages to a deep brown as they mature. They generally

grow from about the size of a poppy seed to about a 4-7mm oval shape when they reach adulthood (Thomas, Kihiczak, & Schwartz, 2004).

Under normal conditions a bed bug can live for approximately one year. During this year time a female can hatch up to 500 young bed bugs (Sutton & Thomas, 2008). Bed bugs are generally nocturnal creatures that prefer to live in cracks and crevices of furniture, walls and mattresses during daylight hours (Cleary & Buchanan, 2004). They will be active during the day in heavily infested places. A bed bug will pierce the skin of its victim and insert a small amount of saliva that acts as an anticoagulant and anesthetic in order to obtain the blood meal. The utilization of the anesthetic usually allows the bite to go unnoticed by the victim (Sutton & Thomas). Bites are commonly found in rows on the victim's neck, face, arms, and hands (Parish & Witkowski, 2004).

The puritus that results from the bite of the bug, leaving papules or macules, is often the first sign of the infestation. It is not uncommon for small bites in orderly rows to be seen on individuals. Generally, bites are large and they rise well above the dermis. Blood spots may also be noted on individuals who do not experience a reaction to the bite. Between 5% and 30% of the population does not react to bites (Reinhardt, Kempke, Naylor, & Siva-Jothy, 2009). Secondary infections of the skin can occur as a result of scratching and after repeated exposure the individual may develop a varying level of allergic reaction (Sutton & Thomas, 2008). Other issues from bed bug infestations can include emotional stress and disrupted sleeping patterns (Heymann, 2009).

The pending pandemic of bed bugs has had many other non-health related effects in the United States. Legal disputes and discourse over who is economically responsible for the paying for the treatment of bed bugs are common place, especially in rental housing. Local health

departments who are already over worked and underfunded often place bed bugs low on the priority list, especially since bed bugs have historically not been considered disease vectors. Additionally, public agencies are incurring costs to prevent and treat bed bugs in their own facilities. Individuals who have few socioeconomic resources often have little hope for support in handling bed bug eradications. In these situations individuals may resort to over the counter and/or “home grown” materials to treat the infestations, most of which are ineffective and which may be toxic. Bed bugs have been noted to be one of the most difficult infestations to treat by pest management professionals as effective pesticides are not readily available (National Pest Management Association (NPMA), 2011a). Improperly applied pesticides promote greater resistance on the part of the bed bugs to the available treatments and increase the risk of negative health effects among residents, especially vulnerable populations like children and the elderly (Rossi & Jennings, 2010).

Prevalence

Bed bugs have been well documented in history since Greek and Roman times. References to bed bugs can even be found in Christian and Jewish literature (Usinger, 1966). Before the 1940s and 1950s, when pesticides became more readily available, bed bugs were a normal part of life for many Americans (Romero, Potter, Potter, & Haynes, 2007). With the introduction of pesticides it was thought that bed bugs were nearly eradicated in the nation. In 2000 a major United States pest management company, Orkin Inc., reported not receiving any bed bugs complaints. However, in 2003 Orkin reported that they responded to almost 400 calls in more than 30 states (CNN, 2004). Additionally, from 2004 to 2006 the reported number of infestations doubled in San Francisco (May, 2007). Many of these cases were noted by travelers staying in “upscale hotels” (May, 2007).

Bed bugs have become a noted problem in Toronto as well. A 2005 study by Hwang and associates utilized three forms of data collection to examine the issue, a public health call log, a survey of pest management companies, and a survey of homeless shelters. The examination of the telephone call log of Toronto Public Health in 2003 showed 46 calls related to bed bugs. The survey of 34 pest management companies found that 847 bed bug infestations were treated in 2003. Approximately 85% of the responding pest management companies reported an increase in bed bug treatments since 2002. Finally, the researchers identified that 31% of the homeless shelters in Toronto had been previously or were currently infested with bed bugs (Hwang, Svodova, Jong, Kabasele, & Gogsis, 2005). One research article documents the drastic increase in the treatment of bed bugs from 2001 to 2003 in Australia (Doggett, Geary, & Russell, 2004). Researchers found a 400% increase in the request for lab samples for the identification of bed bugs from 2001 to 2004. Additionally, a pest control company noted a 700% increase in the number of infestations from 2001-2004.

While the magnitude of the reemerging of bed bugs in the United States is difficult to quantify due to the lack of coordinated national and international surveillance, there is evidence that infestations are on the rise. The 2010 Comprehensive Global Bed Bug Study (CGBS) was completed by the National Pest Management Association (2010), in conjunction with researchers from the University of Kentucky, to explore the extent of bed bug infestations in the United States and globally. Approximately 1,000 U.S. and international pest management companies were surveyed in order to examine this issue. The most significant finding was that about 95 percent of the pest management companies responded that they have been called to address a bed bug infestation in the past 12 months. However, approximately 1/4th of the participating companies reported coming in contact with a bed bug infestation before 2000. Also, over 3/4th of

the respondents reported that bed bugs are the most difficult pest to exterminate (more than cockroaches, ants, or termites). Therefore, it is reasonable to expect that infestations are common, even in areas of higher socioeconomic status.

The CGBS (NPMA, 2010) had many other significant findings. The survey showed differences in where infestations are found. Over 50% of the responding pest management companies reported treating bed bug infestations in rural areas, 71% reported treating infestations in urban areas, and 80% reported treating infestations in suburban areas. Eighty-nine percent of pest professionals reported treating bed bug infestations in apartments/condos, 88% reported treating bed bug infestations in single-family homes, 67% reported treating bed bug infestations in hotels/motels, and 35% in college dormitories.

The survey also showed that individuals with infestations are disturbed by the situation. The respondents reported that 99% of their clients who had bed bugs were “upset and concerned”, with 77% being “very upset and concerned.” This study provided important information about the treatment of bed bugs by pest management agencies, information crucial to judging the validity of the study is unknown as psychometrics related to the tool and other data elements are not available. Additionally, this study provided information at the national level. Based on the results of the GBBS and other research by Eddy and Jones, it is a reasonable expectation that bed bugs are prevalent in all areas, regardless of the socioeconomic level of the community. The proposed study intends to explore the experiences of higher income residents in a Midwest village.

Public Concern

The NPMA (2011b) conducted a second study about bed bugs, “Bed Bugs in America”, with the intent of focusing on the general public. The study found that “One out of five

Americans has had an infestation in their home or they know someone who has encountered bed bugs at home or in a hotel” (NPMA, 2011b, ¶ 2). Notable differences in bed bug infestations were found in relationship to rural status (3x times higher in urban than in rural areas) and section of the country (17 percent of respondents in the Northeast; 20 percent in the Midwest; 20 percent in the South; and 19 percent in the West encountered bed bugs).

The study also showed that about 80% of respondents were concerned with encountering bed bugs at hotels, 52% were concerned about encountering them in public transportation, and 49% were concerned about encountering them in movie theaters. It was also revealed that Americans are changing their behaviors to decrease their risk of bed bug infestations. Over a quarter of respondents have inspected or washed clothing after traveling, 25% have inspected their hotel room, and 12% have altered or canceled arrangements to travel due to concerns about bed bugs. Additionally, misconceptions about a bed bug’s ability to transmit disease and factors that are likely to increase an individual’s chance of having a bed bug infestation were reported (NPMA, 2011b). While this study provided valuable insight into the prevalence and knowledge among the general public, there is little information available about the scientific rigor of the study and therefore it is unknown the extent to which the findings are valid. Also, this study focused on the entire population of the United States. The study presented in the current paper examined a single village in the Midwest which has a higher level of income.

Concern Among Public Health Professionals

Public health officials generally agree that bed bugs are a public health issue. The United States Environmental Protection Agency and the Centers for Disease Control and Prevention declared bed bugs a public health pest of concern in 2010. A survey of public health officials from the Association of Ohio Health Commissioners, the National Environment Health

Association, the Central Ohio Bed Bugs Summit, and the Council of Aging found that, on average, 90% of respondents believed bed bugs to be a public health concern. Additionally, 73% of the respondents considered bed bugs to be an environmental justice issue (Eddy & Jones, 2011).

In Ohio, the Central Ohio Bed Bug Task Force (COBBTF) was formed in 2008 to “address the growing number of bed bug infestations in Franklin County (2001, ¶1)”. More than 40 different organizations collaborate on the task force, representing local and state governments, local and state health departments, social service agencies, pest control companies, educational systems and fire departments to name a few. The task force works to prevent the spread of bed bugs by providing education, publishing best practices documents, and acting as a resource for those who are in contact with bed bugs. With no operating budget, the collaboration is experiencing greater requests for educational sessions and has few means of collecting prevalence data for the area it serves.

Research Questions

Despite what is known about bed bugs, there is limited ability for public health and other health officials to track the prevalence in bed bugs at the local level in the United States. At this time there is no required reporting system for bed bug infestations and no legal authority for health departments to require private pest management companies to provide data about the residents to whom they have provided services, nor is a private home owner required to inform the health department or any other governmental entity. Local health departments are typically contacted by low income individuals who are unable to pay for the extermination of the infestation or because the land lord is unwilling to provide treatment. At this time, the assumption exists that socioeconomic status is not associated with bed bugs. Therefore, the need

to gather prevalence and other related data about bed bug infestations in the central Ohio area is an important area for applied research in public health. The study reported in this paper was designed to meet this need through the utilization of the research questions presented in Table 1.

Table 1

Research Questions for the Prevalence, Knowledge, and Concern about Bed Bugs Study

-
1. What is the prevalence of bed bugs in one village in Ohio?
 2. What is the level of concern about bed bugs in one village in Ohio?
 3. What is the level of knowledge about bed bugs in one village in Ohio?
 4. Have individuals changed their behavior due to bed bugs in one village in Ohio?
 5. Are there significant differences in response rates based on the data collection method?
 6. Are there significant differences in the results of the first 4 research questions based on the data collection method?
-

Methods

Design

The study utilized a descriptive cross sectional design to examine the prevalence, treatment, and knowledge about bed bugs. The study included primary data collection through three phases; telephone survey, mailed survey, and internet survey (via Facebook). Human subjects approval was obtained from the Wright State University Institutional review board prior to the start of the research.

Sampling

The sample for the study included men and women age 18 and over who reside in New Albany, Ohio. The sample was selected unsystematically. The Village of New Albany is a suburb of Columbus with a population of approximately 7,724 people. The median yearly

income of New Albany residents is \$102,180 and over half of the residents hold at least a Baccalaureate degree (Village of New Albany, 2011). Two hundred phone numbers were selected for phase one of the study. Two hundred addresses were selected from the state auditor's website for phase two of the study. Finally, the phase three sample included all those individuals who were a friend of the Village's Facebook page (approximately 200 people). See Table 2 for sample numbers.

Table 2

Ns for Each Phase of the Prevalence, Knowledge, and Concern about Bed Bugs Study

Phase	N
One	200
Two	200
Three	200

Instrumentation/Measurement

The Prevalence, Knowledge, and Concern about Bed Bugs (PK CABB) survey was utilized in this study. This survey consisted of 19 multiple choice and fill in the blank questions. The survey was designed by the principal investigator. Face validity was established for the tool through consultation with professionals in the academic setting as well as in practice (Polit & Beck, 2010). The survey consisted of five general sections; prevalence, concern, knowledge, behaviors, and demographics.

Procedures

Phase one procedures: Telephone

Individuals were selected by chance to participate in the study utilizing an on-line version of the White Pages. Participants were contacted from a University phone line. The participants

were asked to complete the survey utilizing an approved script. In the event that the individual did not answer, another attempt to contact the individual was made (up to 3 times) in order to obtain participation in the survey. Participant calls occurred on weekends, evenings, and during the daytime to maximize the response rate.

Phase two procedures: Mail

A modified version of the Total Design Method (Dillman, 2000) was utilized in phase two of the study. Each chosen participant was sent up to three letters. The letters were personally addressed to each participant in blue ink. The first letter contained a signed cover letter which clearly explained the purpose of the study, how the participant was chosen, and why their participation in the study is needed. The participant was provided with a self addressed stamped envelope to utilize to return the survey. Non-respondents were sent an identical packet of information at two weeks if they had not responded to the survey. The only difference was a modified letter was utilized in the second mailing thanking those that already completed the survey and asking them to disregard the letter. Approximately two weeks after the second packet was mailed, a third and final packet was mailed which contained another copy of the survey and invitation to participate. In the event that a packet was returned, a new address was selected, until two hundred valid addresses were mailed packets.

Phase three procedures: Facebook

For the third phase of the study the survey was built into Survey Monkey. Once the survey was entered a personalized link to the survey was created and added to a short paragraph for posting on Facebook. The paragraph explained the survey purpose, anonymity, and requested that the survey was only taken once. The paragraph and survey link was posted on the Village of New Albany's Facebook page by the public information officer. Approximately two weeks after

the initial posting the announcement was posted a second time. The announcement was posted three times in total.

Data Analysis

The paper surveys from the phone and mail survey were entered into PASW 18.0 (formerly SPSS). The data from Survey Monkey was downloaded as an Excel document from Surveymonkey.com and recoded to be placed in PASW18.0 for data analysis. A significance level of $p=.05$ was utilized.

Research question one: Self reported prevalence

Research question one examined the self reported prevalence of bed bugs, including place of contact with bed bugs, and method of identification/treatment of bed bugs. Descriptive statistics were utilized to answer this question. Frequencies were calculated for each of the responses to the first five questions.

Research question two: Level of concern

The second research question examined the level of concern about bed bugs among individuals. Again, descriptive statistics were utilized to answer this question. Frequencies were calculated from the responses from question six.

Research question three: Level of knowledge

The third research question aimed to explore the level of knowledge about bed bugs in one village in Ohio. This was accomplished by examining the responses to questions seven and ten on the tool. Frequencies were calculated for the responses to each of the questions

Research question four: Behavior change

Research question four examined if individuals had changed their behavior due to bed bugs. Percentages of individuals responding to each of the choices for two questions were

calculated. Question eight provided a yes or no response to if individuals have changed their behavior and question nine allowed for the identification of the behavior that had been changed.

Research question five: Response rate

For data analysis of question five the response rates for each of the data collection methods were calculated. They were calculated by dividing the number of people who responded to the study by the number of people invited to participate.

Research question six: Data collection method

The final question explored if there are any significant differences in the results of the first four research questions based on the data collection method that was utilized. To accomplish this, a series of ANOVA tests were conducted with method of data collection as the grouping variable. The results of the four questions were utilized as the dependent variables in the analysis.

Results

The results for the demographics and questions one through four were based on the data from phase one and two only. Due to the method of data collection in the third phase the researchers were unable to guarantee that those results are from independent samples and not from someone who answered the survey already by phone or mail. Therefore data analysis only includes the responses to the mail and phone survey (N=96).

Demographics

About 90% of the respondents in the survey lived in a house. Additionally, 95% reported that they owned their residence. A little less than one-half of the survey participants reported that they did not have anyone under the age 18 living in their home. About 80% reported that they did not have anyone over the age of 65 living in the home. The self reported household income

was greater than \$100,000 a year for more than half of the sample and no one reported an income less than \$10,000 a year. The vast majority were non-Hispanic Caucasian (almost 90%). Almost 40% of the sample had 1 or 2 individuals in the household (see Table 3).

Table 3

Demographics of Sample Completing the Bed Bug Survey (N=96)

	Number	Percent
Residence		
House	90	93.8
Condo	2	2.1
Apartment	4	4.2
Home ownership		
Rent	3	3.1
Own	92	95.9
Refused to answer	1	1.0
Children under 18		
None	44	45.8
1	11	11.5
2	26	27.1
3 or more	15	15.6
People over the age 65		
None	79	82.3
1	8	8.3
2	8	8.3
Refused to answer	8	1.0
Number of people in the house		
1	9	9.4
2	27	28.1
3	11	11.5
4	23	24.0
More than 4	26	27.0
Race		
White Non-Hispanic	85	88.5
White Hispanic	3	3.1
African American	4	4.2
Asian	2	2.1
Refused to Answer	2	2.1
Income		
10,000-20,000	4	4.2
20,001-40,000	1	1.0
40,001-60,000	5	5.2
60,001-100,000	8	8.3
100,001-200,000	25	26.0
Greater than 200,000	23	24.0
Refused to Answer	30	31.2

Research question one: Self reported prevalence

Six out of the 95 individuals that responded to the survey item for this question reported that they knew someone who had bed bugs. Out of these six individuals one was a neighbor, one was a friend, one was a relative, and the other three responded “other”. One individual reported that he/she has been in contact with bed bugs in the work environment and two individuals reported that they had been in contact with bed bugs in an “other” setting.

Table 4

Self Reported Prevalence

Person with Bed Bugs	Number
Neighbor	1
Friend	1
Relative	1
Other	3

Research question two: Level of concern

About 20% (18 people) of the respondents reported that they were very concerned about bed bugs. Additionally, 50 people (53.7%) responded that they were somewhat concerned about bed bugs. About a quarter of the sample reported that they were not at all concerned about bed bugs. See Table 5 for full results of the question.

Table 5

Self Reported Concern about Bed Bugs (N=93)

	Number	Percent
Very Concerned	18	19.3
Somewhat Concerned	50	53.7
Not at all Concerned	25	26.9
Missing	3	3.2

Research question three: Level of knowledge

Approximately 43% of the sample responded that they knew a lot or a moderate amount about bed bugs. About one-half of the sample reported that they knew a little about the insect. Only about three percent said that they knew nothing about bed bugs. Full results are presented in Table 6.

Table 6

Self Reported Knowledge about Bed Bugs (N=95)

	Number	Percent
A Lot	8	8.4
Moderate Amount	33	34.7
A Little	51	53.7
Nothing	3	3.2

Research question four: Behavior change

When asked if they had changed any behavior because of bed bugs, about 43% of people reported that they had. Of those that reported they had changed their behavior, about 40% stated that they checked bed and sleeping areas when away from home (i.e. at hotel). About 10%

reported inspecting items before purchasing and 10% reported changing another behavior. See Table 7 for full results of the question.

Table 7

Self Reported Behavior Changes due to Bed Bugs (N=96)

	Number	Percent
Not traveling certain places	3	3.1
Not going to movie theaters	3	3.1
Checking bed/sleeping area when away from home	40	41.7
Inspective items before purchasing	9	9.4
Not going to garage sales	5	5.2
Not going to thrift/second hand stores	5	5.2
Other	10	10.4

Research question five: Response rate

The response rates for the phone and mail survey were 14% and 34% respectively. Only 14 people responded to the on-line survey, yielding a response rate of 7%. Therefore, there was a notably higher number of individuals who responded to the phone and mail survey than the on-line survey. See Table 8 for response rates by data collection method.

Table 8

Survey Response Rates by Method of Data Collection

Method	# Responding/# Possible
Phone	28/200
Mail	68/200
Facebook	14/200

Research question six: Data collection method

Results from the four ANOVA tests showed that there was no difference in the responses to the question about bed bug prevalence based on the method of data collection, $F(2,106)=.636$, $p=.532$. There was also no significance difference in concern about bed bugs based on method of data collection, $F(2, 103)=.262$, $p=.572$. Additionally, no difference by method of data collection was seen in response to the question about bed bug knowledge, $F(2,105)=.206$, $p=.671$. Finally, with regards to the question of if the individual has changed their behavior, no significant was seen by method of data collection, $F(2,106),=.921$, $p=.401$. See Tables 9 through 12 for ANOVA results.

Table 9

ANOVA Results for Differences in Responses by Data Collection Method

Response	Between Groups <i>df</i>	Within Groups <i>df</i>	<i>F</i>	<i>p</i>
Prevalence	2	106	.636	.532
Concern	2	103	.562	.572
Knowledge	2	105	.400	.671
Behavior	2	106	.921	.401

Discussion

Despite the commonly held assumption that bed bugs are not associated with socioeconomic status, only approximately 6% of the sample reported that they knew anyone with bed bugs and no one reported bed bugs in their own home. This is surprising as it is notably less than the 20% prevalence of bed bugs reported in the literature (NPMA, 2011b). The results do support the argument by Eddy and Jones (2011) that bed bugs are an environmental justice issue

as about half of the sample in this study reported an income of \$100,000 a year or more. Due to the fact that the area is a higher income area, if bed bugs were discovered it is reasonable they could be exterminated in a timely manner, preventing persistent reservoirs of the pest. Therefore, financial and educational resources aimed at areas of lower economic status may be appropriate.

This study also found that almost 3/4th of the sample reported that they were somewhat or very concerned about bed bugs, which is similar to the reported concern level in the NPMA survey (2011b). This shows that there is considerable concern about bed bugs among this population. However, over half of the participants reported they knew little or nothing about bed bugs, which is of great concern. Due to the high level of public concern, which has been validated by recent findings that mechanical transmission of Methicillin *Staphylococcus Aureus* is possible, general education about bed bugs is critically needed (Lowe & Romney, 2011). The message about how to prevent bed bugs does seem to be reaching some of the public, as evidenced by the fact that about half of the individuals in the sample have changed behavior because of bed bugs. There still does seem to be a need for education related to the need for inspecting purchases and checking bedding when sleeping away from home.

With the popularity of social media sites, it was surprising to find that the response rate was so low to the posting on the Facebook, only 7%. For those that responded, there were no significant differences in the results between the internet survey, the phone calls, and the mail survey. This was a concern as the researcher had little control of who filled out the survey. Considering the low cost and relatively small amount of time that is needed to collect data via Facebook and Survey Monkey this method should continue to be explored. Future research is needed on what incentives could be offered to raise response rates for this methodology.

Limitations

There are several limitations of this survey that must be acknowledged. First, the sample size in the project was small. The sample obtained was not necessarily sufficient to provide a “representative sample” of the general population. This limits the generalizability of the results. It may be that those who had bed bugs chose not to participate at a disproportionate rate. Further studies are needed with a larger sample size to validate the findings of the studies.

Another limitation of the study was that it utilizes a self reporting survey tool. The individual may not be willing to admit via phone or in writing that they have had bed bugs in their home. This would result in an underrepresentation of the prevalence of bed bugs in the community. An additional limitation of this study was related to the village utilized in the study. The village is an area of higher income. Therefore, the results may not be generalizable to cities where income levels are lower. Future studies are needed with a variety of socio-economic areas to validate findings or identify differences. Additionally, more research is needed in areas where multi-family housing is common. The prevalence of multi-family housing is low in the geographic area utilized in this study.

There are a few limitations that were specific to the data collection method that was utilized. With the utilization of the phone survey, we only those with a phone number that is listed in the phone book were able to be contacted. This study utilized a social media tool (Facebook) in phase three. Any individual can become a friend of the village’s page; they do not have to be a resident of village in order to have access. In order to address this issue the survey asked for the respondent’s zip code so that those who do not report the New Albany zip code could be excluded.

Conclusion

In conclusion, it does not appear that there will be a safe, inexpensive, and effective treatment for bed bugs in the near future. Additionally, on top of the well known devastating physiological and psychological effects, more evidence is surfacing relating to their ability to potentially spread serious medication resistant diseases. Therefore, there is great need to educate the general public about prevention. Assistance for treatment of bed bugs for the low income and elderly who may live in area of persistent bed bug infestations is vital to breaking the chain of infection for the impending bed bug pandemic.

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Appendix A

MPH Culminating Experience Score Sheet

Student Name: _____

Project Title: _____

Project Manuscript		
Abstract	Overview of the manuscript. Limit to 250 words.	
Introduction	Overview of the project with an emphasis on rationale and purpose. Limit to 1 page maximum	
Purpose Statement (or Research Questions)	State the purpose(s) of the project. Each purpose or question to be examined should be limited to one brief paragraph.	
Review of Literature	Review of the scope of the literature. Synthesize and discuss reviewed research to identify strength, weaknesses, trends, and opportunities. Provide theoretical and/or conceptual rationale.	
Methods Appropriate to quantitative or qualitative data as applicable	A. Sampling and Subjects/Participants Identifies subjects, sampling, rules for exclusion/inclusion, power analysis (as needed)	
	B. Measurement Identification of independent and dependent variables. All variables defined and operationalized. Valid measurement tools for all variables.	
	C. Data Collection and Analyses Method of data collection and specific statistical analyses.	
	D. IRB or LACUC approval	
Results & Data Analysis	Presents descriptive and inferential data. Includes the use of tables and/or figures. Uses the correct statistical analysis.	
Discussion	Discussion and interpretation of main findings. Public health implications and recommendations. Limitations of the study.	
References	Complete references on all cited works.	
Appendices	Must contain Public Health Competencies and any support materials such as IRB letters, instruments, letters of support, SPSS coding sheets, raw data.	
Oral Presentation		
Presentation	Rationale, purpose, methods, key findings and recommendations. Minimum of 20 minutes with time for questions and answers.	

Students must receive a "1" in all categories to pass.

Scoring: 0 = Does not meet the standard; 1 = Meets or exceeds the standard

Appendix B

Prevalence, Knowledge, and Concern about Bed Bugs (PK CABB) survey

1. Do you know anyone who currently has Bed Bugs?
 - 1) Yes
 - 2) No (Skip to Question 6)
 - 3) Don't Know
 - 4) Refused to answer

 2. Who do you know that currently has Bed Bugs?
 - 1) Neighbor (Skip to Question 5)
 - 2) Relative (Skip to Question 5)
 - 3) Friend (Skip to Question 5)
 - 4) Co-worker (Skip to Question 5)
 - 5) Self
 - 6) Other (Skip to Question 5)

 - 7) Refused to answer (Skip to Question 5)
-
3. How were the bed bugs identified?
 - 1) Health Department
 - 2) Pest Control Service
 - 3) Self identified
 - 4) Other

- 5) Don't know
-
4. How have you treated for Bed Bugs?
 - 1) Professional exterminator
 - 2) Over the counter method (if yes ask for name of the method)

- 3) Combination of numbers 1 & 2
- 4) Sanitation Measures (Laundering, vacuuming, sealing cracks/crevices)
- 5) No treatment
- 6) Other
- 7) Refused to answer
-
5. Have you been in contact with Bed Bugs in any place outside of your home?
 - 1) Work
 - 2) Hotel
 - 3) Shopping Center
 - 4) Airport
 - 5) Bus
 - 6) Other

-
- 7) Refused to answer
6. How concerned are you about Bed Bugs?
- 1) Very concerned
 - 2) Somewhat concerned
 - 3) Not at all concerned
 - 4) Refused to answer
7. How much do you feel you know about Bed Bugs? Would you say...
- 1) I know a lot about Bed Bugs
 - 2) I know a moderate amount about Bed Bugs
 - 3) I know a little bit about Bed Bugs
 - 4) I know nothing about Bed Bugs
 - 5) Refused to answer
8. Have you changed any behaviors (such as going to the movies, going to garage sales, self inspection at hotels, ect.) because of Bed Bugs?
- 1) Yes
 - 2) No (Go to Question 10)
 - 3) I don't know (Go to Question 10)
 - 4) Refused to answer (Go to Question 10)
9. What behaviors have you changed (circle all that apply)?
- 1) Not traveling certain places
 - 2) Not going to movie theaters
 - 3) Checking bed and sleeping area when away from home (ie at hotel)
 - 4) Inspecting items before purchasing
 - 5) Not going to garage sales
 - 6) Not going to thrift or second hand stores
 - 7) Other
-
10. Who would you call if you thought you had Bed Bugs in your home?
- 1) Landlord
 - 2) Local Health Department
 - 3) Pest Control Service
 - 4) No one
 - 5) Other
-
- 6) Refused to answer
11. What kind of home do you reside in?
- 1) House (Skip to 13)
 - 2) Apartment
 - 3) Condo (Skip to 13)

- 4) Manufactured (Mobile) Home (Skip to 13)
- 5) Other (Skip to 13)

-
- 6) I don't know (Skip to 13)
 - 7) Refused to answer (Skip to 13)

12. Approximately how many units are in your apartment building?

13. Do you rent or own your home?

- 1) Rent
- 2) Own
- 3) Neither
- 4) Refused to answer

14. How many children under age 18 reside in your home?

- 1) None
- 2) 1
- 2) 2
- 3) 3
- 4) 4
- 5) 5
- 6) Other

7) Refuse to answer

15. How many people over age 65 reside in your home?

- 1) None
- 2) 1
- 3) 2
- 4) 3
- 5) 4
- 6) Other

7) Refuse to answer

16. How would you describe your race?

- 1) White Non-Hispanic
- 2) White Hispanic
- 3) African American
- 4) Asian
- 5) More than one
- 6) Other

7) Refused to answer

17. What is your household income?

1) Below 10,000

2) 10,000-20,000

3) 20,001-40,000

4) 40,001-60,000

5) 60,001-100,000

6) 100,001-200,000

7) Greater than 200,000

8) Refused to answer

18. How many people reside in your home?

1) 1

2) 2

3) 3

4) 4

5) 5

6) Other

7) Don't Know

8) Refused to answer


19. What is your zip code?

Appendix C

IRB Approval Letter



Office of Research and Sponsored Programs
201J University Hall
3640 Col. Glenn Hwy.
Dayton, OH 45435-0001
(937) 775-2425
(937) 775-3781 (FAX)
e-mail: rsp@wright.edu

DATE: December 27, 2010
TO: Mary Beth Kaylor, Ph.D., Faculty
Nursing
Christopher Eddy, Faculty
FROM: B. Laurel Elder, Ph.D., Chair 
WSU Institutional Review Board
SUBJECT: SC# 4337
'Prevalence, Knowledge, and Concern About Bed Bugs in Ohio: A Pilot Study'

This memo is to verify the receipt and acceptance of your response to the conditions placed on the above referenced human subjects protocol/amendment.

These conditions were lifted on: 12/27/2010

This study/amendment now has full approval and you are free to begin the research project. If this is a VA proposal, you must still receive a letter of approval from the Research and Development Committee prior to beginning the research project. This implies the following:

1. That this approval is for one year from the approval date shown on the Action Form and if it extends beyond this period a request for an extension is required. (Also see expiration date on the Action Form)
2. That a progress report must be submitted before an extension of the approved one-year period can be granted.
3. That any change in the protocol must be approved by the IRB; otherwise approval is terminated.

If you have any questions concerning the condition(s), please contact Jodi Blackledge at 775-3974.

Thank you!
Enclosure

Appendix C Continued

IRB Approval Letter Page 2

RESEARCH INVOLVING HUMAN SUBJECTS

SC# 4337

Continuing Review

ACTION OF THE WRIGHT STATE
UNIVERSITY
EXPEDITED REVIEW
Assurance Number: FWA00002427

Title: *'Prevalence, Knowledge, and Concern About Bed Bugs in Ohio: A Pilot Study'*

Principal Investigator: Mary Beth Kaylor, Ph.D., Faculty
Nursing
Christopher Eddy, MD

The Institutional Review has approved the continued use of human subjects on this project, with conditions previously noted. The conditions have been removed. If the protocol and/or other documents used in the project have been amended within the past five years, you will be requested to submit a new protocol incorporating these amendments.

REMINDER: Federal regulations require prompt reporting to the IRB of any changes in research activity [changes in approved research during the approval period may not be initiated without IRB review (submission of an amendment), except where necessary to eliminate apparent immediate hazards to subjects] and prompt reporting of any serious or on-going problems, including unanticipated adverse reactions to biologicals, drugs, radioisotope labeled drugs or medical devices.



Signed

Chair, WSU-IRB

Date: December 03, 2010

IRB Meeting Date: December 13, 2010

This approval is effective only through: December 3, 2011
To continue the activities approved under this protocol you should receive the appropriate form(s) from Research and Sponsored Programs (RSP) two to three months prior to the required due date. If you do not receive this notification, please contact RSP at 775-2425.

Appendix D

Competencies Achieved

Section	Competency
Domain #1: Analytic Assessment Skill	Defines a problems
Domain #3: Communication Skills	<p>Applies ethical principles to the collection, maintenance, use, and dissemination of data and information</p> <p>Applies data collection processes, information technology applications, and computer systems storage/retrieval strategies</p> <p>Communicates effectively both in writing and orally, or in other ways</p> <p>Solicits input from individuals and organizations</p> <p>Listens to others in an unbiased manner, respects points of view of others, and promotes the expression of diverse opinions and perspectives</p>
Domain #5: Community Dimensions of Practice Skills	Establishes and maintains linkages with key stakeholders
Domain #6: Basic Public Health Sciences Skills	<p>Describes the role of government in the delivery of community health services</p> <p>Identifies how public and private organizations operate within a community</p> <p>Identifies the individual's and organization's responsibilities within the context of the Essential Public Health Services and core functions</p> <p>Defines, assesses, and understands the health status of populations, determinants of health and illness, factors contributing to health promotion and disease prevention, and factors influencing the use of health services</p> <p>Identifies and applies basic research methods used in public health</p> <p>Applies the basic public health sciences including behavioral and social sciences, biostatistics, epidemiology, environmental public health, and prevention of chronic and infectious diseases and injuries</p> <p>Identifies and retrieves current relevant scientific evidence</p> <p>Identifies the limitations of research and the importance of observations and interrelationships</p> <p>Develops a lifelong commitment to rigorous critical thinking</p>