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Implementing an integrated pest management (IPM) program in child care centers: A qualitative study[☆]



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ABSTRACT

Pesticide use in and around child care centers is a potential health threat to children and staff. The implementation of integrated pest management (IPM) can reduce these risks yet child care providers receive minimal, if any, education concerning pest management. The objectives of this qualitative study are to: (a) develop a model to describe the process of implementing an IPM program in child care centers, (b) identify the facilitators and barriers to implementing an IPM program in child care centers, and (c) examine congruence between IPM practices identified on an IPM checklist with practices reported in qualitative interviews with child care managers. Interviews and IPM checklist observations were conducted with nine child care center managers in California before and after the introduction of a pilot IPM education intervention program. The qualitative analysis of the interviews revealed a four-stage IPM implementation process, from awareness of IPM, recognizing the importance of IPM and learning how to practice it, motivation and the decision to adopt IPM, to the implementation of IPM. A wide range of facilitators and barriers were identified. There was general congruence between the manager interviews and IPM checklist findings on IPM policies, practices, and management. Understanding the process of how an IPM program was implemented in these child care centers and the facilitators and barriers involved in the process can inform planning efforts for future health interventions in child care.

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1. Introduction

Young children in the United States (U.S.) may be exposed to harmful chemicals if they attend child care centers where pesticides are regularly used (Bradman, Dobson, & Leonard, 2010; Lu, Knutson, Fisker-Anderson, & Fenske, 2001; Mir, Finkelstein, & Tulipano, 2010; Shour, 2007). This is a potential public health issue given that the majority of children under six year of age attend child care centers, and a national survey of a

representative sample of child care centers found that 63% of the child care centers used pesticides (Tulve et al., 2006). The policies and practices in child care centers in the U.S. are guided by each state's licensing regulations and national recommendations for health and safety standards (American Academy of Pediatrics, American Public Health Association, & National Resource Center for Health and Safety in Child Care and Early Education, 2011). Caring for our Children: National Health and Safety Performance Standards Guidelines for Early Care and Education Programs, Third Edition, and the U.S. Environmental Protection Agency provide support for reducing the exposure of harmful chemicals in child care by introducing integrated pest management (IPM) as a prevention-based pest management approach (American Academy of Pediatrics et al., 2011; U.S. Environmental Protection Agency, 2012a). For example, an IPM approach emphasizes regular cleaning of facilities, placement of non-toxic sticky traps for insects or rodents, and monitoring for pest problems to prevent problems before they happen. A traditional, non-IPM approach may include routine, monthly spraying for ants, or use of pesticides that linger in the air, such as foggers, to deal with an infestation.

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Pesticide use in child care facilities is concerning because pesticide exposure poses a potential health threat to children, as well as to staff (Baldi, Mohammed-Brahim, Brochard, Dartigues, & Salamon, 1998; Bradman et al., 2011; Horton et al., 2011; Jurewicz et al., 2006; Kass et al., 2009; Makri, Goveia, Balbus, & Parkin, 2004; Morgan et al., 2004, 2007). This is also of concern for the 1.3 million child care center staff in the U.S., 94.5% of whom are women often of child-bearing age, which increases risk for in utero and pregnancy-related pesticide exposure (Bureau of Labor Statistics, 2004).

A 2005 study analyzed national surveillance data and found that 2593 cases of acute pesticide-related illnesses were associated with pesticide exposure in schools between 1998 and 2002 (Alarcon et al., 2005). Although there are no comparable data for child care centers, these exposures would be particularly concerning in child care settings, where children are younger than they are in the K-12 school system, and where large numbers of children spend full days. Nationwide, 63% of all U.S. children 0–5 years old are placed in out-of-home child care for some portion of the workday (Tulve et al., 2006; U.S. Census Bureau, 2009).

Since there is no federal regulation about pest management, 35 out of 52 states and territories developed statewide school pest management legislation (Green, Gouge, & Lame, 2009; Owens, 2009). IPM, a prevention-based approach to pest management, is a component in 21 state's pest management policies (Green et al., 2009).

IPM programs follow a systematic approach to pest control that use pesticides only as a last resort, and focus on prevention, monitoring, identification of pests, and management of pest infestations. The goal of IPM in schools and child care centers is to minimize the risk of pesticide exposure for children, staff, and the environment (Daar, Drlik, Olkowski, & Olkowski, 1997; UCSF California Childcare Health Program, 2011; U.S. Environmental Protection Agency, 1993). Studies have shown IPM to be as or more effective in controlling and preventing pest infestations compared to conventional, pesticide-based practices (Kass et al., 2009; Williams, Linker, Waldvogel, Leidy, & Schal, 2005).

Fifteen states have policies that require the use of IPM in schools and six other states have policies that recommend it (Brajkovich, Hanger, Messinger, & Simmons, 2010; Fournier, Gibb, & Oseto, 2010). Also, few state pest management laws extend to child care centers although young children are at an increased risk of pesticide exposure compared to school-age children. For example, information on the Western U.S. states (i.e., Alaska, Arizona, California, Colorado, Idaho, Hawaii, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming) shows that only 5 out of 13 states have pest management legislations inclusive of child care centers (i.e., Arizona, California, Colorado, Montana, and Washington). Only four Western states do *not* have any laws concerning pest management in school or child care centers (i.e., Idaho, Hawaii, Nevada, Utah) (Western Region School IPM Implementation & Assessment Work Group, 2011). Similar to the trend of school-centric pest management policies, pest management education and research have also primarily targeted schools (Brajkovich et al., 2010).

Studies have identified various factors that influence school IPM implementation, including state legislation, trainings and educational materials about IPM, and school-specific “champions” of IPM (Fournier et al., 2010; Piper & Owens, 2002). The lessons learned about implementation in schools can be helpful to child care centers trying to comply with new IPM legislation, however, child care centers have different challenges compared to schools. Child care centers are less stable and more stressed financially than schools (Institute of Medicine & National Research Council of the National Academies, 2012). Child care centers have high annual staff turnover rates, sometimes as high as 40% (Alkon, Ramler, & MacLennan, 2003; Bureau of Labor Statistics & U.S. Department of

Labor, 2011; Fournier & Johnson, 2003; Mir et al., 2010; National Association of Child Care Resource & Referral Agencies, 2011), and minimal staff education (Bureau of Labor Statistics & U.S. Department of Labor, 2011; Institute of Medicine & National Research Council of the National Academies, 2012). There is no explicit regulation requiring child care providers to receive training about pesticide use and pest management (American Academy of Pediatrics et al., 2011).

Due to the unique stresses and characteristics of child care centers, implementation of IPM in child care centers may differ from implementation in schools. Studies have shown positive changes in health and safety policies (i.e., handwashing practices) in child care centers following general health and safety intervention programs (i.e., child care health consultation in child care centers) (Alkon, Bernzweig, To, Wolff, & Mackie, 2009; Kotch et al., 2007). Qualitative studies of child care health consultation have identified the roles and responsibilities of the child care health consultants who provide the intervention (Alkon, Farrer, & Bernzweig, 2004; Isbell et al., 2013) and the facilitators and barriers to implementing general health consultation in child care (Farrer, Alkon, & To, 2007). A quantitative study of an IPM intervention in 892 child care programs over a three-year period showed that IPM training in child care centers increased the use of IPM strategies, reduced pest problems, and increased staff knowledge and understanding of IPM (Mir et al., 2010). Another IPM intervention study in 45 child care centers showed positive changes with a decrease in regularly scheduled application of pesticides and the number of centers using pesticides (Anderson, Glynn, & Enache, 2010). An IPM Star Certification for School Systems was developed by the IPM Institute and implemented in 17 school districts. The program showed an increase in the adoption of IPM policies, record-keeping and notification practices, and safe pesticide use (Green, Gouge, Braband, Foss, & Graham, 2007). A pilot IPM program in Indiana schools and child care facilities showed positive changes in clutter reduction, pest-proofing, and pesticide use reduction (Fournier & Johnson, 2003). Our pilot IPM program in California child care centers also showed positive changes in IPM knowledge, a pre- and post-intervention IPM observational checklist of facilities, and creation of IPM policies (Alkon et al., 2012). The majority of IPM studies in child care show that programs are effective, yet these studies have not explored the motivational factors or facilitators or barriers for child care providers to integrate IPM practices into their child care programs.

This study uses a predominantly qualitative design in a pilot study of nine child care centers participating in an IPM intervention program to identify the process of implementing IPM and the congruence of the child care directors' perception of IPM implementation with quantitative IPM observations. This design draws on the strengths of qualitative research to develop a more complete understanding of IPM implementation in child care by describing the process, facilitators, and barriers (Creswell & Plano Clark, 2011). Previous research has focused on quantitative results (Anderson et al., 2010; Fournier & Johnson, 2003; Mir et al., 2010), and this study strives to describe the process of change in IPM policies and practices to help understand quantitative outcomes.

The objectives of this descriptive, qualitative study conducted with nine child care center managers in California (CA) are to:

1. develop a model to describe the process of implementing an IPM program in child care centers,
2. identify the facilitators and barriers to implementing an IPM program in child care centers, and
3. examine congruence between IPM practices identified on an IPM checklist with practices reported in qualitative interviews with child care managers.

2. Method

This study was part of a seven-month IPM program intervention and evaluation study conducted in nine, licensed child care centers (Alkon et al., 2012). This paper focuses on qualitative results using a convergent model including both qualitative and quantitative analyses.

2.1. Participants

The child care centers ($n = 9$) were recruited between September 2010 and December 2010 via purposive sampling for enrollment in this study concurrently with enrollment in the overarching IPM intervention study (Alkon et al., 2012). The number of centers was chosen based on the researchers' budget and available personnel time. Center recruitment was conducted using a list of licensed child care centers and staff contacts in five California counties, and phone calls were made to screen centers for eligibility. Inclusion criteria were (a) centers serving primarily low-income, minority children in a range of age groups, (b) centers expected to be in operation for at least seven subsequent months, (c) centers managing their own garbage removal, and (d) centers located in Los Angeles or the San Francisco Bay Area in California. Centers that serve low-income children were targeted in order to provide education and resources that they might not otherwise have available to them (Mir, 2011).

All study procedures and consent forms were approved by the Committees on Human Research at the University of California, San Francisco and University of California, Berkeley.

Managers were chosen for interviews due to their low turnover rate and high level of influence (National Association of Child Care Resource & Referral Agencies, 2006; Whitebrook et al., 2006). The non-director managers who participated in this study were appointed by center directors based on their administrative authority to oversee IPM implementation. Managers had worked at their centers for 2–32 years ($M (SD) = 14.9 (11.1)$) and in child care for 8.5 to 35 years ($M (SD) = 24.6 (9.9)$). The majority had an education level of at least a Master's degree (Table 1). Other center characteristics varied greatly. For instance, centers had anywhere from 28 to 200 children ($M = 95$). Child care center building age ranged from 2 to 112 years old ($M = 37$).

2.2. IPM program

The IPM program included a one-and-a-half hour IPM education workshop at each child care center; dissemination of the IPM Toolkit; assessment of IPM practices, policies, and building integrity using an observational IPM checklist; and written and photographic feedback on the IPM checklist. The workshop covered topics such as what is IPM and how to implement it, the California pest management legislation, and the potential health effects of pesticides, and was conducted by a nurse practitioner or child care specialist. Research interviews were conducted by the corresponding author with child care managers during the same period that the pilot IPM education intervention program was introduced at their participating child care centers. The IPM toolkit included an IPM curriculum booklet, pest-specific information sheets written for child care providers and families, posters, and an IPM checklist. A toolbox filled with IPM tools such as caulking and a doorsweep was given to each center to demonstrate what are the common IPM tools and to support their implementation of IPM. The development and quantitative evaluation of this intervention are described in a separate paper, while this paper reports on the qualitative findings (Alkon et al., 2012).

Table 1

Demographic characteristics of managers, centers, and children ($n = 9$ centers, 854 children).

Demographic characteristics	%	<i>n</i>
Manager job title		
# centers ($n = 9$)		
Director	56%	5
Site supervisor	22%	2
Maintenance manager	11%	1
Health and safety specialist	11%	1
Manager educational level		
Bachelor's degree	22%	2
Master's degree or more	78%	7
Center type		
Head Start	33%	3
Private	33%	3
State-funded	33%	3
Children's race		
# children ($n = 854$)		
Latino/Hispanic	60%	512
Caucasian/White	20%	171
Asian/Pacific Islander	8%	68
African American	5%	43
Other groups	4%	34
Mixed Race	3%	26
Children receiving government subsidies	77%	657
Manager experience		
Mean (SD) # centers ($n = 9$)		
Years worked in child care field	24.6 (9.9)	9
Years worked at current center	14.9 (11.1)	9

Reprinted with permission from Alkon et al. (2012). Copyright 2012 by ECRP. The other groups included: Portuguese, Brazilian, and African children as well as others not identified by managers.

2.3. Instruments

The interview was developed by our interdisciplinary team ($n = 6$), which consisted of experts in the fields of environmental health, health care, child care, and IPM. The interview was pilot tested at two child care centers which are not included in this qualitative study. Feedback on clarity and instrument-usability was incorporated into the final version of the instrument.

2.4. Manager interview

2.4.1. Closed-ended interview

The closed-ended interview was a 58-item assessment tool developed to assess pest control practices and compliance with AB 2865 (California's school and child care pest management law).

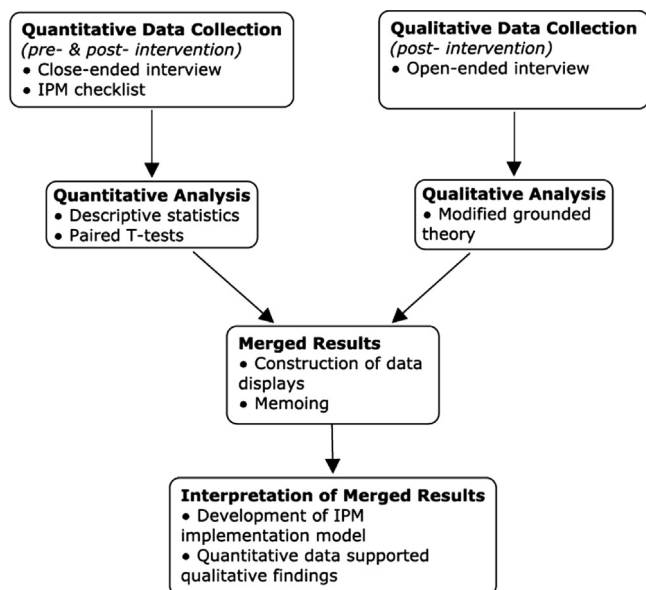


Fig. 1. Convergent parallel design.

It contained questions regarding pets, earthquake supplies, building maintenance and policies, cleaning, sanitizing, pesticide use, and IPM practices. The questions from the interview protocol that are relevant to this paper are included in the online supplementary material A. Center demographics were also included in the closed-ended interview.

2.4.2. Open-ended interview

The qualitative interview was developed to create a conversation via open-ended questions to understand the process of implementing a new IPM program in child care centers (Patton, 1990; Spradley, 1979). The questions covered the following topics: manager responsibilities, center and statewide policy, IPM knowledge, process of IPM implementation, and current pest management practices (online supplementary material B). Results from a subset of these topics are reported here. The range of topics was designed to give child care managers the opportunity to discuss their experiences with implementing IPM, and the facilitators and barriers they encountered in the implementation process. The interviews were audio-recorded and transcribed.

2.5. IPM checklist

The IPM checklist was a 72-item objective, observational tool to identify IPM prevention and management practices, and pest problems in child care programs (Alkon et al., 2012). It included observation of the garbage storage area, building exterior, landscape and play area, kitchen, bathrooms, common space, classrooms, storage area, and staff area. Each item on the checklist was rated as yes, no, or not applicable, along with a space to include relevant comments. Prior to conducting the IPM checklist, the research assistants were trained by an expert in the field of IPM.

2.6. Data collection procedures

Data were collected via a convergent model, with separate but concurrent quantitative and qualitative data collection and analysis (Creswell & Plano Clark, 2011) (Fig. 1). The center managers were interviewed by the corresponding author on two occasions during the 2010–2011 school year in private rooms at their respective centers. The pre-intervention interview at each center was closed-ended and took place prior to the IPM workshop. The

post-intervention interview included the closed-ended and open-ended questions, and was conducted four-to-six months after the IPM workshop. The average pre-intervention interview lasted 31 min and the average post-workshop interview lasted 34 min (range = 25–45 min). At each visit, an IPM checklist was administered. Field notes and contact summary sheets were recorded after each visit. After completion of the study, center managers were provided with a draft of this manuscript with the IPM implementation model and their feedback was solicited.

2.7. Data analyses

Per the convergent design, qualitative and quantitative data were analyzed separately and were then merged for model development and validation (Creswell & Plano Clark, 2011).

2.7.1. Quantitative analysis

Demographic characteristics of the managers' job title, education, experience, the child care center type, and children's race collected during the closed-ended interviews were summarized with descriptive statistics (Table 1). In addition, quantitative data collected as part of the closed-ended manager interview on specific aspects of IPM and the IPM checklist were summarized at the item level by frequency and percentages. All analyses were conducted using Stata 11.0. Paired *t*-tests were conducted to compare means pre- and post-interview on responses to closed-ended interview questions.

2.7.2. Qualitative analysis

Open-ended interview data were analyzed using principles derived from grounded theory, notably the stepwise creation of a theory based on successive analyses of data (Miles & Huberman, 1994). Open-ended interviews were transcribed, printed, read through, and descriptive codes were assigned to units of text. A sentence or thought was considered a unit of coding (Miles & Huberman, 1994). During early coding, annotations and memos were written to record themes and questions, and to highlight areas for further discussion with co-authors. These memos and discussion helped form inferential codes. The coding scheme was developed inductively as themes emerged from the transcripts (Miles & Huberman, 1994). Coding was iterative. Validation procedures included inductive coding and discussion by three co-authors prior to development of the codebook, and side-by-side coding with codebook by two co-authors and two independent researchers with qualitative experience to determine reliability of codes.

Descriptive and inferential codes were compiled and organized into a comprehensive codebook, with domains and subcodes that were developed emergently. The codebook was organized according to study objectives, with the following major domains: barriers, facilitators, changes since IPM intervention, pest management practices, center relationship with policy, and manager responsibilities. Transcripts and the codebook were imported into HyperRESEARCH 3.0, qualitative research software, to facilitate organization and analysis. Using the software, all nine transcripts were re-coded according to the final codebook. Each domain was read, and data displays and matrices were created to capture frequency and relationships between codes. After construction of data displays, memos were written to identify trends and major themes from interviews.

From the preliminary analysis, a model for successful implementation of an IPM program began to emerge. The model was constructed based on the themes that were discussed by child care managers, such as lack of awareness of IPM (prior to the intervention), learning about IPM and the hazards associated with pesticide use, motivation for adopting IPM, and the process of implementation of IPM. Themes were clustered and organized into a stepwise

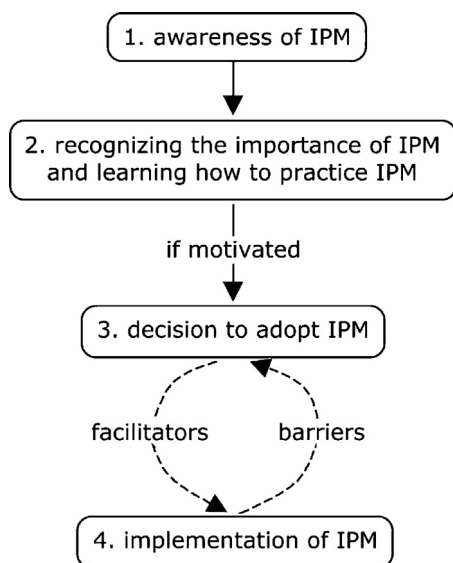


Fig. 2. Child care IPM implementation model.

process to model the implementation process. This process was mapped against Rogers' Innovation-Decision Process to compare and contrast a more global model of implementation (Rogers, 1995). While not used in model-creation, this comparison helped to support the IPM implementation model. Cross-case analysis was performed to compare individual centers to the overall model, and to refine and verify the implementation model (Miles & Huberman, 1994). Each step of the four-step process was analyzed individually. The four steps were derived from the open-ended interviews (qualitative data) and closed-ended interviews (quantitative data). Facilitators and barriers were identified through the coding process, and grouped into subthemes, such as outsider identification of pest problems or lack of money.

2.7.3. Congruence analysis

The model that emerged from the qualitative data was re-examined with the quantitative data from the closed-ended interviews and IPM checklist, as per the convergent design (Creswell & Plano Clark, 2011). Memoing was performed and data displays were constructed to determine the relationship between the qualitative and quantitative data. To further test this model, center managers were invited to give input on whether or not the proposed IPM implementation model was congruent with their centers' experience.

3. Results

The qualitative themes emerged to form a set of steps that child care center staff progressed through to successfully implement the IPM program: (1) awareness of IPM, (2) recognition of the importance of IPM and learning how to practice it, (3) motivation and decision to adopt IPM, and (4) implementation of IPM, including facilitators and barriers (Fig. 2). Congruence was established by examining and corroborating qualitative and quantitative results. Each section below highlights managers' experiences in each of the steps of progression in the implementation of the IPM program, in their own words. Quotes were chosen to represent the voice of at least three managers so as to portray common themes rather than individual opinions, unless noted otherwise. Quotes are identified with the type of manager who spoke them and their participant number in parentheses.

3.1. Awareness of IPM

One prominent theme that emerged from the manager interviews was a general lack of awareness about pest management prior to participation in this study. Before the intervention, only two of the managers knew what IPM was. Without staff awareness of an alternative or of their potential harmful effects, pesticides had been applied outdoors in four of the participating centers, and indoors in three of the centers in the six months prior to the study.

Managers reported that this was the first official center-wide training on any type of pest management at 100% of the child care centers. When asked where they got their information about safe pest management, three of managers said they had not read any information about pest management before this intervention. They explained that not only had they not received training on pest management in the past, but they also were not aware of alternatives to pesticide-based pest management.

Before, I didn't know that there was another way of controlling pests instead of the spray.

- Director (#8)

In addition to being unaware of alternatives to pesticides, managers also expressed that they were unaware of the potential danger that pesticides pose to children, staff, and the environment.

In the past, we used to just buy the cans of spray and we didn't realize how harmful that was. That's why it's important to learn more about the different materials that are available, and try to use what is least harmful, especially for the children.

- Director (#3)

In contrast, one manager reported that her staff had previously avoided use of pesticides due to their potential harmful effects, but that they were unaware of the practice of IPM.

3.2. Recognizing the importance of IPM and learning how to practice IPM

After attending the IPM education workshops, managers reported a new understanding of the adverse health effects that may come from pesticide exposure, state laws about usage and parent notification, and how to handle a pest infestation internally versus when to call for outside support. All managers (100%) felt more capable of dealing with a pest infestation after the intervention. In particular, there was a shift in emphasis from managing infestations to preventing them.

Knowing about IPM has changed how we view rodents and cleanliness and all that stuff. So if we have pests getting in our classrooms, how are they getting in? That hasn't always been the focus; the focus has been on how do we get rid of them.

- Health and safety specialist (#6)

In addition to learning about the laws and potential hazards around pesticide use in child care centers, managers also learned how to practice IPM. Managers attributed this new knowledge to IPM workshops and other accompanying educational materials.

Many managers reported feeling empowered by the knowledge of how to handle a pest infestation, and the option to handle the situation internally. Whereas before, many managers immediately called a pest management professional if there was an infestation, with their new knowledge about IPM, they felt they and their staff had other options. Managers noted the importance of viewing pest management as "everyone's business."

IPM seems much safer and more effective when you focus [on cleanliness and building structure] rather than just calling our pest man to come out and solve our issues. It gets the team

involved in a different way, not being an outside person's job to come in and solve this. It gets the team thinking what they can do, how they're handling their site.

- Health and safety specialist (#6)

3.3. Motivation and decision to adopt IPM

When asked why they believe IPM is important, managers' answers ranged from past experiences with pesticides, to health and safety, to providing quality care. The majority of managers discussed children's health and well-being. Managers told stories of previous experiences with foggers or indoor spraying, noting the residual smell and effect on air quality.

Even at home I had been using the spray, the spray, always the spray. When I saw ants I had to use the spray. But now, since I know about IPM, I avoid those sprays. We breathe it in, and then it causes so many problems, health problems.

- Director (#8)

The health of the children and staff were frequently acknowledged as the motivation to not spray pesticides. Three managers explained that children at their centers suffer from asthma, and that their asthma was exacerbated by fumes or aerosolized pesticides.

Most of the kids have asthma, and they are very sensitive to those smells, so not using the spray has helped.

- Director (#8)

Providing quality care and complying with national standards and state licensing were also listed as reasons to adopt IPM.

Our goal is to provide quality care for all the children. As much as we can, you know, because nothing is perfect, but we really do try our best to live up to the quality care that we would like to give at the center.

- Director (#7)

Managers were so compelled by the notion of preventive pest management that three of them held workshops with or shared information with parents, and many began practicing IPM in their own homes after the intervention.

3.4. Implementation of IPM

Managers explained the changes that they undertook at their centers after they decided to adopt IPM. They noted significant changes in sanitation practices, and that they began to monitor their centers for potential pest problems. They emphasized their new efforts to prevent pest problems before they occurred.

I've been keeping an eye on my maintenance staff, just to make sure they're doing a proper cleaning and thorough inspections for any gaps, any webbing, any traces of rat droppings, anything that needs to be cleaned up. . .

- Maintenance manager (#5)

Managers also discussed their staff's new attitude toward food, both in relation to food preparation and art in the classrooms.

We are not doing any more artwork with Cheerios or food items, and I think that we learned that we have to be a little bit cleaner. Just, you know, disinfect a little bit more, sanitize a little bit more.

- Director (#9)

In addition to changes in day-to-day practices, managers described changes in how they handled pest infestations, contracted pest management professionals, and applied pesticides. Managers at four of the centers reported that they had designated

a staff member to coordinate IPM implementation, and managers at three centers reported a decrease in the spraying of pesticides.

In fact we did have a rodent infestation in our outside storage. We learned what we should do and that it was beyond our scope. We needed to call in facilities to handle that situation. So we recognized it was beyond what we could take of ourselves, and then we took those steps necessary to solve that situation.

- Site supervisor (#2)

Although all the participating managers chose to implement some aspects of IPM, the extent and magnitude of these changes varied by center. For instance, all managers initiated physical changes to their facilities, and at least began discussions about changes in sanitation and pest management practices. At one center, the staff continued to rely on the services of a pest management company to oversee IPM implementation rather than appointing an internal IPM manager, while also increasing their own incorporation of IPM into their sanitation practices.

To understand the process of implementation and why some centers adopt an IPM policy but fail to implement it, managers were asked about the facilitators and barriers that they encountered while implementing IPM in their centers.

3.4.1. Facilitators

Despite differences in center characteristics, a coherent set of facilitators emerged from the manager interviews. Having the necessary support to learn about IPM, identify problem areas, and make changes was a key theme that was highlighted during discussions of successful implementation. The managers who were able to make the most significant changes in their pest management practices and building facilities were those who had adequate support from staff or contractors to enact these changes. Support was further delineated into four categories of facilitators of IPM implementation: identifying potential pest management problem areas, learning how to solve problems, having support from staff and assistants, and having people to fix problems (Table 2).

3.4.2. Barriers

Some of the barriers mentioned during the manager interviews included lack of control (i.e., regarding building maintenance, repair, or sanitation practices on shared property), lack of money, division of labor and lack of communication between staff involved in pest management (Table 2). The barriers were more disparate than the facilitators, with less consistency across centers regarding common barriers in the implementation process. Common barriers that were identified by multiple managers are described in Table 2. The majority of barriers were only mentioned by one manager, and they are described below.

Children's age was an issue for a center serving younger children.

The age of our children makes IPM harder to implement. They're toddlers, and they tend to be messier, and they tend to have more spills and things.

- Site supervisor (#1)

Finding time to implement IPM was a barrier at another center, while other managers found it convenient to incorporate IPM strategies into existing cleaning practices.

I guess time is a factor, I mean when can you do it, you know? We have only a certain amount of time that we can really devote to this.

- Director (#4)

Table 2
Facilitators and barriers to IPM implementation.

Category: Theme	n=9	%	Manager quote
Facilitators			
<i>Identifying potential pest management problem areas</i>			
Outsider identification of pest problems	8	89%	We weren't looking at the building [with a pest management perspective]. It helped us look at things in a new way.-Site supervisor (#2)
<i>Learning how to solve pest management problems</i>			
Reliable information source and IPM training workshop and Toolkit	8	89%	With the resources [from IPM workshop], the staff can rely on us giving them the right information and whatever they might need to get the job done.-Maintenance manager (#5)
<i>Having support from staff and assistants</i>			
Everyone on same page	7	78%	As long as I have the support of the staff, [implementing pest management] will work.-Director (#7)
Many resources available to work on projects	5	56%	We have a lot of assistants, students, volunteers. . .-Site supervisor (#1)
<i>Having people to fix problems</i>			
Existing staff who can help implement IPM	7	78%	I have a handyperson who can come in and handle all of the small things.-Director (#4)
PMP or contractor who can help implement IPM	8	89%	[A pest management professional (PMP) that uses IPM strategies] comes every month and checks all of the classrooms inside and outside, and the playground, and they change the materials needed to control pests accordingly.-Director (#3)
Barriers			
Division of labor and lack of communication	4	44%	I am in charge of 15 staff, so I have to make sure that everyone is following our policies, and keeping the area safe and clean.-Maintenance manager (#5)
Lack of control	5	56%	The building belongs to us, but the land belongs to the city. They used to come every three months and fumigate the whole site, but we had no control of the pesticides that they were using.-Director (#3)
Lack of money	5	56%	Initially we looked at some [pest management issues] and, when [the office manager] was putting the work orders in, there were budget issues. . .-Health and safety specialist (#6)

Table 3
Changes in IPM policies and prevention practices pre- and post-intervention (n=9).

Item	# centers (%)	
	Pre-intervention	Post-intervention
Written policy for use of pesticides	1 (13%)	4 (44%)
Written policies include IPM	0 (0%)	4 (50%)
Tracking system for building maintenance	5 (56%)	8 (89%)
Tracking system for cleaning and sanitizing	4 (50%)	6 (75%)
Know what IPM is	2 (22%)	9 (100%)
Designated IPM coordinator	1 (13%)	5 (56%)
Tried to use IPM	4 (50%)	8 (89%)
Reported that using IPM worked	4 (67%)	8 (100%)
Pesticides sprayed outside in the last 6 months	4 (44%)	1 (11%)
Pesticides applied by 'other'	8 (100%)	0 (0%)

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3.5. Congruence between IPM checklist and interviews

In order to supplement qualitative data to document the adoption and implementation of IPM, quantitative measures from the IPM checklist were used to document objective changes in IPM policies and practices (Table 3). There were many observable sanitation changes and physical repairs made, including a decrease in the number of damaged window screens (39%); the

number of cracks, crevices or holes around cabinets, or in the walls, roof, or foundation (23%); and the amount of spilled liquids or garbage around garbage cans and dumpsters (33%). In addition to changes made, there was a decrease in the instances of pest infestations on the post-intervention checklist. There were ten instances of pests noted on the pre-intervention IPM checklist observation, compared to no instances of pests noted on the post-intervention observation. The detailed quantitative results are summarized in another paper (Alkon et al., 2012). The qualitative self-report measures from manager interviews were supported by findings from an objective IPM checklist (Table 4). The managers at centers where we documented the most change on the IPM checklist emphasized their new awareness and teamwork around pest management.

We're very alert and aware. I have several teachers who are just so dedicated to making [IPM] happen that it keeps us all alert. Our staff is excellent in knowing what's good practice.

- Director (#4)

Alternatively, a common theme among centers where we documented the least change on the IPM checklist was a continued reliance on a pest management professional or outside contractor, rather than internalization of the responsibility.

They come every month and check all the classrooms inside and outside and the playground, and they change the materials that they need to control pests accordingly. We are very happy with their services.

- Director, (#3)

Table 4
Congruence between IPM checklist and interviews.

Theme	Qualitative data	Quantitative data
Awareness of IPM	"I think for me it was important to learn about IPM because before I didn't know that there was another way of controlling pests other than with pesticide sprays." - Director (#8)	<ul style="list-style-type: none"> • 1st IPM training for 100% of centers • 22% knew the term IPM pre-intervention • 44% of centers applied pesticides outdoors and 33% applied pesticides indoors in last 6 months
Recognizing the importance of IPM and learning how to practice it	"Knowing about IPM has changed how we view rodents and cleanliness and all that stuff. So if we have things getting in our classrooms, how are they getting in? That hasn't always been the focus, the focus has been on how do we get rid of them." - Health and safety specialist (#6)	<ul style="list-style-type: none"> • Prior to the workshop, centers got their information on pest management from: PMPs (44%), fliers or research on the internet (22%), or "we don't" (33%). • 100% of managers mentioned feeling more capable of dealing with a pest infestation after the intervention
Motivation and decision to adopt IPM	"It's important for the health of the children. A healthy environment. . . If you are not going to provide a healthy environment to the children, it will affect their growth and development." - Director (#7)	<ul style="list-style-type: none"> • 44% of the centers incorporated IPM into their written policies • 56% of centers mentioned current informal policies and changes in practice • 33% shared information with parents and now practice IPM at home
Implementation of IPM	"We don't use chemicals. We use bait stations now and try to use preventive measures in order to not find ourselves in a position where we would need to use something stronger." - Site supervisor (#2)	<ul style="list-style-type: none"> • See Table 3

Using the convergent parallel design with parallel and then simultaneous analysis of qualitative and quantitative methods helped to create a comprehensive and congruent implementation model. Furthermore, the center managers who commented on the qualitative summaries of the manager interviews said that the model represented their experiences of implementing IPM. Together with the convergent parallel design, the managers' review of the model and manuscript helped validate the process of triangulation.

4. Discussion

IPM is an important health and safety approach that is novel for the child care community. Despite statewide legislation for schools and child care programs to implement IPM, it is not yet implemented to capacity in most U.S. child care centers. Research studies have documented the gap between health and safety legislation and community-based implementation programs, yet few studies explain the processes involved with implementing a new health and safety program.

This qualitative study allowed for development of an IPM implementation model to describe the stepwise process experienced by the child care center managers who participated in an IPM intervention program. The convergence of qualitative and quantitative data showed that the managers and staff initially had a low level of awareness about IPM and the harmful effects of pesticides until they attended an IPM workshop. At the workshop, they learned the value of IPM in protecting children's health and safety and how to practice IPM in their child care centers. Next, they expressed their motivation to adopt IPM and ultimately to implement IPM into their child care center practices and facility maintenance. The facilitators to implementing IPM include identifying potential pest problems, learning how to solve IPM problems and having personnel who support and utilize the IPM approach. This model of IPM implementation may be relevant to the development of future health and safety interventions in child care centers.

4.1. Awareness

Awareness of an issue is a critical first step in changing behavior and practice to improve health outcomes. This study adds to a growing body of research that documents a lack of awareness about IPM in child care centers, despite legislation that encourages or

requires its implementation ([Bradman et al., 2010](#); [Mir et al., 2010](#)). It demonstrates the impact of education in increasing awareness and beginning the process of pest management change in child care centers. It should not be assumed that creation of statewide policies or legislation will translate to awareness in child care centers.

4.2. Information

The second theme that emerged from this study is the importance of a noteworthy information source. Though child care standards are changing, they have traditionally focused on maintaining pest-free centers, rather than pesticide-free centers, which may inadvertently compel centers to routinely spray pesticides to keep pests out ([National Association for the Education of Young Children, 2012](#)). Additionally, since IPM is not often incorporated into child care center staff training, staff are not always informed about the potential dangers associated with pesticide use. In a 2008 survey of CA child care center staff, 30% of respondents considered pesticide use to be safer than alternative pest management methods ([Bradman et al., 2010](#)). This is consistent with the wide variety and sometimes lack of information sources on pest management that was found in this study. Incorporating IPM education into child care staff training may alleviate this problem and, not only dispel any myths about pest management, but also compel staff to use non-pesticide-based, preventive approaches. This need for up-to-date and reliable information on environmental health in child care centers may be partially met by U.S. Environmental Protection Agency's recently developed, child care-specific website ([U.S. Environmental Protection Agency, 2012b](#)).

4.3. Protecting children

Many managers talked about the importance of "putting the children first." Understanding the potential adverse health effects associated with pesticide exposure motivated child care managers to change their centers' pesticide use and approach to pest management. This interest in the health effects of pesticide exposure was also found in the study by Mir et al., where managers identified the importance using IPM to protect children's health and safety ([Mir et al., 2010](#)). An interest in health helped to personalize the importance of IPM, and change the focus from following a set of regulations to protecting children's health. Clear delineation of the importance and relevance of IPM helped bridge the

disconnect between awareness of IPM and implementation of IPM, and inspired managers to promote the use of IPM in their centers. In general, this illustrates the utility of educating child care staff about the significance of new policies and practices.

4.4. Inclusion of all staff and managers

The majority of managers recounted their satisfaction that the IPM education workshop was targeted for all the staff. By attending the workshop together, managers expressed that everyone was “on the same page” regarding pest management. It set the stage for future implementation of IPM and, in some cases, managers followed up with staff meetings, IPM workdays, and parent workshops. IPM implementation may involve various staff depending on the type of child care center, staffing, and organization, and may be subject to barriers such as staff time and budget. To the extent that it is logistically possible, getting everyone involved is an important goal to facilitate center-wide awareness and support of IPM.

4.5. Management support

Similar to other studies, the authors of this study found that working directly with managers facilitated the implementation of an innovative educational intervention program (Alkon et al., 2009; Crowley & Kulikowich, 2009). The manager's capacity to oversee and make decisions provided the leadership needed to implement new IPM practices, or appoint an appropriate person to do so. Managers are a suitable target population for interventions given that they have a lower turnover rate than staff, and therefore can sustain change, transfer knowledge, and train new staff (Whitebrook et al., 2006).

4.6. Strengths and limitations

This study was unique in summarizing open- and closed-ended interviews to identify the process of implementing a new IPM program. It described barriers and facilitators experienced during implementation, and congruence was noted between qualitative report of change and objective IPM checklist findings. Nevertheless, this study also had limitations. Qualitative research allows for exploration and understanding of phenomena or processes that have not been well-researched, but does not produce generalizable findings. Qualitative studies often have much smaller and less representative samples, which is appropriate for under-researched areas like IPM in child care centers. The purposive sampling may introduce selection bias related to the recruitment of child care centers. Similarly, the fact that the interviews and IPM checklist were administered by the same person is a possible source of bias. It is not known if the steps to implementing an IPM program are similar to other health interventions in child care centers. Future studies with a larger, more representative sample of child care centers and comparisons to other health intervention programs are needed to test this implementation model.

5. Conclusion

This qualitative study proposes a model of implementing an IPM program in child care centers, based on interviews with child care managers who participated in an educational intervention. This emphasis on pest management is timely. The third edition of *Caring for our Children*, national health and safety performance standards for out-of-home child care programs, included a new section on IPM (American Academy of Pediatrics et al., 2011). The current standards and guidelines for child care centers and environmental health encourage the use of IPM (American Academy of Pediatrics Council on Environmental Health, 2012;

National Association for the Education of Young Children, 2012; U.S. Environmental Protection Agency, 2012a). These changes in child care-specific health standards, combined with increased educational efforts targeted for child care providers and managers, can help to reduce pesticide use and, ultimately, improve children's health.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.ecresq.2014.02.005>.

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