INCORPORATING PESTICIDE EDUCATION INTO BACCALAUREATE NURSING CURRICULUM

By

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To the Faculty of Washington State University:

The members of the Committee appointed to examine the research project of MARGARET C. (PEGGY) O’NEIL find it satisfactory and recommend that it be accepted.

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Limited curricula and expertise covering environmental health hazards such as pesticides is a challenge for most nursing faculty, yet critical for public health outcomes. A quasi-experimental pilot study was implemented in an undergraduate community health course. National initiatives for medical and nursing education provided a framework where students discussed pesticide exposure risks in order to understand the importance of an environmental health history and identification of vulnerable populations for optimal care planning and referral. Information was presented to students using the public health intervention model, case study teaching strategies, and pre-survey and post-survey evaluations. Results: Pre- and post-aggregate student survey responses achieved statistical significance (p = .001) for opinion and knowledge questions. Student post-survey comments reflected learning and overall satisfaction with case study method. More studies in a variety of nursing programs are needed to determine if this is the most effective method for the integration of pesticide education.

Key Words: CURRICULUM, ENVIRONMENTAL HEALTH, NURSING, PESTICIDES
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>iii</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>ii</td>
</tr>
<tr>
<td>CHAPTER</td>
<td></td>
</tr>
<tr>
<td>1. INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>Purpose of the Project</td>
<td>3</td>
</tr>
<tr>
<td>2. LITERATURE REVIEW</td>
<td>4</td>
</tr>
<tr>
<td>3. FRAMEWORK AND MODEL</td>
<td>7</td>
</tr>
<tr>
<td>4. INTEGRATION INTO EXISTING PLAN</td>
<td>7</td>
</tr>
<tr>
<td>5. RESEARCH DESIGN AND METHODOLOGY</td>
<td>8</td>
</tr>
<tr>
<td>6. ANALYSIS</td>
<td>9</td>
</tr>
<tr>
<td>7. DISCUSSION</td>
<td>11</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>14</td>
</tr>
</tbody>
</table>
Incorporating Pesticide Education into a Baccalaureate Nursing Curriculum

According to the Center for Disease Control (CDC) Environmental Hazards & Health Effects Program, the U.S. uses pesticides in almost 20,000 products and produces over two billion pounds of active ingredients. In addition, there are reports of 10,000 to 20,000 adult pesticide exposures diagnosed throughout the year (CDC NCEH, 2009). “Approximately 20 Americans, mostly children, die annually from pesticide poisoning” (Chalupka, 2001, p. 201), which is preventable in many cases. The Environmental Protection Agency (EPA) found 90% of American households use pesticides, with the majority using more than one product (NPIC, 2009). Chalupka reports few pesticides, except for baits, actually reach targeted pests; the majority contributes to indoor or outdoor contamination. Because Americans spend 90% of their time indoors, chronic long time exposure is gaining more recognition for its impact on health versus a one-time only dose exposure (Davis, 2007; NPIC, 2009). Many exposures are believed to be under-reported or not identified as pesticide exposures (Wakefield, 2001).

Vulnerable populations such as young children, pregnant women, the elderly, or health impaired are impacted the most from pesticide exposure. Over half (57%) of all reported national poisonings are for children under the age of six, with nearly 50,000 children poisoned by pesticides annually (Weiss, Amler & Amler, 2004). Half of all lifetime pesticide exposures occur between birth and 5 years of age (Chalupka, 2001). Young children are especially vulnerable because of their rapid physical growth, immature systems, and social and developmental behaviors which put them at greater risk of exposure as well as sequelae from that exposure (Needham & Sexton, 2000; Weiss et al., 2004). Children are exposed at home, day care, school or outdoors. Interpreting data is a challenge with data bases incomplete and state surveillance unequal (Veal, Lowry, & Belmont, 2007). Because of the knowledge gap between known
exposures and the potential of adverse outcomes, pediatric exposure to pesticides is a significant concern.

History of Pesticide Education

The Institute of Medicine identified a need for improved environmental health (EH) training, which spurred the American Medical Association in 1994 to ask for improved pesticide education for health care providers (NEEF, 2003). An initiative to integrate pesticide content into medical and nursing education began in 1998 as a partnership between the EPA and The National Environmental Education & Training Foundation (NEETF), in collaboration with the U. S. Department of Health and Human Services (DHHS), the U. S. Department of Agriculture (USDA), and the U. S. Department of Labor (DOL). The initiative’s goals are to include five pesticide educational competencies in every curriculum. These are: 1) basic knowledge and concepts of pesticides; 2) diagnosis and assessments; 3) treatment, intervention and referrals; 4) risk communication; and 5) reporting requirements and regulations (NEEF, 2003).

Healthy People (HP) 2010 objectives identify pesticides as an EH hazard. Because of critical periods in human development, the HP 2010 focus is to reduce pesticides on food and pesticide exposure as a way to improve overall health (HP 2010). The American Nurses Association in 2007 called for nurses to integrate EH broad principles into their practice using suggested implementation strategies. Pesticide education was not listed specifically to be incorporated in nursing curriculum but falls under the domain of the chemical exposure principle (ANA, 2007). Many nursing programs have a didactic and clinical focus in EH, but little attention has been given to meeting the EPA and NEEF pesticide competencies (Carter, Kaiser, O’Hare, & Callister, 2006; Hewitt, Candek & Engel, 2006).
Purpose of this Project

Given the paucity of pesticide specific baccalaureate curricula, nursing faculty should incorporate student discussion of pesticides within community health courses (L. Hahn, personal communication, March 4, 2009). Expanding student knowledge and awareness of pesticides is critical due to the prevalence of environmental pesticides and heightened risk for children’s health (Rogers, McCurdy, Slavin, Grubb & Roberts, 2009; Wakefield, 2001). Nurses, as primary health care providers, can be instrumental in prevention, intervention, and education in the community to minimize exposure risk (NEEF, 2003). Educating students in community health nursing courses will provide basic knowledge from which they can provide preventative pesticide education and advocacy.

Goals for this project were to: (a) Expand student knowledge of the nursing role and awareness of the pesticide exposure in a vulnerable child population using the five EPA and NEEF competencies and Minnesota’s Public Health Interventions model (Rippke, Briske, Keller, & Strohschein, 2001), and (b) demonstrate the effectiveness of student learning using case study teaching strategies in an undergraduate community health nursing course.

This project was conducted in collaboration with a major northwest university and agriculture and safety health center. N-Methyl carbamate insecticide (Sevin®) was chosen for the exemplar case study due to its similarities to organophosphates (OP) and common use in the home and around children. Like OP, carbamate inhibits cholinesterase enzymes causing nicotinic, muscarinic and central nervous system (CNS) effects, but is more easily reversible than OP (Reigart & Roberts, 1999).
Literature Review

Inclusion criteria was limited to availability of the articles in English, published in the United States, environmental health, pesticide education, exposure to carbamate insecticide or metabolites, inclusion of children under six as study participants, undergraduate nursing curriculum, and, except for case studies, within the past 10 years. Cochrane Library, CINAHL, ERIC and general library search revealed a few related articles. EPA, web-based search links, and article references provided additional articles, case studies, and treatment for carbamate exposure. Of the 48 articles returned using this search strategy, 21 were chosen for further review as most relevant to the project and are discussed below.

Carbamate Insecticide as a Child Health Issue

Widespread pesticide exposure in children was noted in a large study analysis by Adgate et al. (2001) and some metabolites were found in higher limits than previously detected. One book chapter presented an overview of the issues diagnosing OP, carbamate and herbicide exposure and provided the current medical treatment of carbamate exposure in children (Baer, Kirk & Holstege, 2004). Madden (2009) presented a nursing approach for all pediatric poisoning and the challenges of identifying exposure in children. Moses (2005) summarized case studies linking cancer in children to potential non-occupational pesticide exposure and known child pesticide exposure cases to cancer; there was significance \( p < .05 \) in several studies linking various child cancers in children less than 10 years old to household pesticide exposure.

Two authors discussed current issues and challenges in developing methods for identifying and monitoring pesticide exposure in young children at a national level (Cohan Hubal, Sheldon, Zufall, Burke & Thomas 2000; Needham & Sexton, 2000). Johnston, Rogers, Cross & Sochan (2005) and Phillips (2006) were skeptical about the lack of progress in
protecting children from pesticide exposure and cited the need for improved research. Overall, the articles provide common themes pertaining to known pesticides in the child's environment, difficulty identifying specific exposures to pesticides, and a need for universal standards in monitoring exposures within the vulnerable child population.

**Carbamate Exposure Cases in Children**

Four cases of child exposure to carbamate insecticide in the home or garden setting were found in the literature: (a) a one year old American boy (Howes, 1992), (b) a 16 month old American child (Garber, 1987), (c) a four year old Italian child (Santinelli et al., 2006), and (d) a six year old American boy (Baer et al., 2004). All cases presented with similar symptoms, treatment, and outcomes.

**Incorporating Pesticide Education into Nursing Curricula**

Larsson & Butterfield (2002) identified getting “environmental health listed as a requirement or competency in undergraduate nursing education” (p. 308) as a critical step. Several (14) journal articles on content or strategies for incorporating EH concepts into undergraduate nursing curriculum were found. No studies were found specifically incorporating pesticide education into undergraduate nursing curricula, but studies with exemplars integrating EH concepts into the curriculum or that provide a content guide for pesticides are discussed below.

An implementation process incorporating EH into undergraduate curriculum for didactic and field experience was provided by Sweeney and de Peyster (2005). Student and faculty recommendations identified the need to use one faculty to lead revisions and implementation, reinforce EH concepts in other courses, and provide complimentary student clinical experiences. Carter et al. (2006) proposed having students analyze and present an EH issue in order to connect
core knowledge and expected application competencies. Wright (2003) developed a successful public health nurse education partnership with graduate and undergraduate students using several didactic and interdisciplinary clinical learning activities, including the movie “Erin Brockovich”. Wright used a pretest-posttest for local environmental issues and a posttest to evaluate awareness and the effectiveness of teaching strategies.

Chalupka (2001) identified pesticides as an essential EH component for nursing education. EH education and the NEEF initiatives to include pesticide discussion and EH relationships with the community were stressed by Wakefield (2001) for all nurses and curricula. Hewitt et al. (2006) discussed incorporation challenges and successes and did include pesticide effects on EH. When evaluating undergraduate student needs, Hewitt found students inaccurately preferred providing client education as a first nursing intervention and had a greater challenge identifying sentinel events. McCurdy et al. (2004) reported on NEEF sponsored medical and nursing work groups who identified the need for more child EH in the curriculum and strategic integration opportunities. Rogers et al. (2009) evaluated the NEEF Children’s Environmental Health Faculty Champions Initiative which was presented in 2004 as a strategy to increase health care provider’s knowledge of environmental health concepts. Train-the-trainer or “Faculty Champions” approaches were found to sustain faculty incorporation of pediatric pesticide education in curricula.

Within the literature, there is disconnect between encouraging integration of more EH content into nursing curriculum and what the authors identify as being done in practice. Only 4 articles discussed a process rather than the content of how EH was incorporated into the nursing curriculum (Carter, et al., 2006; Hewitt, et al., 2006; Sweeney & de Peyster, 2005; Wright,
2003). Gaps in the literature include case study exemplars of carbamate or any pesticide when incorporating this content into the didactic nursing curriculum.

**Framework and Models**

The project used the Minnesota Public Health Intervention model (Rippke, et al., 2001) as a framework to integrate pesticide education into the undergraduate nursing course. This model addresses public health interventions at the individual or family, community, and systems levels with a population-based focus at each level of practice. The overall emphasis of this model is primary prevention-keeping problems from occurring rather than reacting to an issue. The framework is intended to encourage students to look at all aspects and levels of intervention for a vulnerable child population pesticide exposure. Student independence in developing awareness and knowledge about pesticides and EH was encouraged within a context of prior learning about basic public health and pediatric concepts and principles, and a global approach to issues.

Case studies have been successful for student learning by encouraging critical thinking and concept retention, are conducive to group work and flexible as a teaching strategy (Emerson, 2007). The case study in this project provided the students with a life-like situation using questions to stimulate awareness and knowledge of the issues for individual/family, community and systems interventions. Validation of thinking, problem-solving, and knowledge retention was facilitated using online group discussion.

**Integration into Existing Course Plan**

This baccalaureate nursing curriculum had a two credit upper level community health nursing course with an associated practicum and included a unit on environmental health. Integrating pesticide education within the environmental health content provided the best fit for didactic student learning. A learning objective was added that provided a case study, the students
would discuss the nurse’s role in assessing, diagnosing, intervening, evaluating and educating a population at risk for pesticide exposure.

Students were invited to take the online pretest before they began the readings. The purposeful, peer-reviewed survey used a variety of question styles including: opinion scale, yes/no, multiple choice, and open ended comments. This pilot survey was developed by the researcher based upon EPA and NEEF initiative goals. The purpose was to evaluate student opinion and knowledge of pesticide exposure, the nursing role and child and home risk factors. Using the online program, student responses were made anonymous to ensure confidentiality.

In addition, learning activities included randomly dividing the students into small groups where all were required to post to a group discussion with either an initial posting or a response based on the readings and resources provided. Reading resources included textbook, journal articles, online resources and the case study. The students were given one week to post their group responses then a lecture was presented to the class. The presentation included key points as outlined in the EPA and NEEF nursing curriculum competencies, the nurse’s role, and a summary of the students’ online discussion postings. Two weeks after the discussion and presentation the students retook the same survey. The EH unit exam included a child vulnerability for exposure and a home assessment screening question similar to those in the pre and post-survey, and was taken the third week after the lecture.

Results

Study Participants

Of the 127 students in the course, 119 completed the pretest with 22 male and 97 female; similar representative numbers (N=116) completed the posttest. The most common age group in the pretest was 18 to 25 years (N = 84) and the second most common group was 26 to 35 years
(N = 28). Race and ethnicity obtained pre and posttest was not linked specifically to the data.

The majority of students were Caucasian.

**Data Collection**

This project used a pretest, posttest design. SPSS version 17.0 was utilized to generate frequencies, bar charts and non-parametric analysis. EH unit post exam questions were tabulated for percent of correct answers.

**Data Analysis**

The post opinion questions had a Cronbach’s reliability score of .63, indicating the group responses for these questions approached internal consistency. Data were analyzed using frequency and bar graph to represent response changes. Chi square analysis examined if there was a difference between pre and post categorical questions. Overall, self-reported knowledge response data shifted positively from 65% least knowledgeable pretest to 69% highly knowledgeable posttest. Comparison of pre and post categorical question responses with knowledge rating reached statistical significance (p = .001, df 1-4) for all question types.

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<thead>
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<th>df</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opinion Questions</td>
<td>p = .001</td>
<td>2-4</td>
</tr>
<tr>
<td>Dichotomous Questions</td>
<td>p = .001</td>
<td>2-3</td>
</tr>
<tr>
<td>Multiple, Multiple Choice Questions</td>
<td>p = .001</td>
<td>1-2</td>
</tr>
<tr>
<td>Self Reported Knowledge Rating</td>
<td>p = .001</td>
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</tr>
</tbody>
</table>

The study used Pearson’s correlation to analyze data grouped between posttest opinion questions and self-reported pesticide knowledge in order to determine if there was a correlation between responses in these two areas. It was thought that student opinions pertaining to pesticide specific statements would correlate to general self-reported pesticide knowledge. The findings were mixed: the first question regarding nurses’ role approached significance (r = .18; p = .059).
Post knowledge and post example question screening for child exposure was positively correlated \( (r = .26; p = .005, n = 116) \). Students who rated their post pesticide knowledge as high were more likely to strongly agree with the post environmental health child screening statement. However, safety of home pesticide use and public health nurse community support role did not statistically correlate with self-reported knowledge.

Using Mann-Whitney nonparametric correlation there was a statistically significant difference in the opinion role question and pre-knowledge ranking \( (p = .34) \). In the pretest, seventy-eight students ranked themselves as least knowledgeable and seven students ranked themselves as highly knowledgeable. When the same analysis was done using the posttest, significance was not achieved, but 70 students rated themselves as highly knowledgeable and only five students rated themselves as least knowledgeable. Thus, there was a positive shift from “least knowledgeable” to “highly knowledgeable” from the pretest to the posttest. This positive shift of self-rated pesticide knowledge correlated with knowledge improvement in student recognition of pesticides, child and home risk factors, child risk screening questions and the nurse’s role.
Student comment frequencies regarding lack of knowledge were tabulated for pre and posttest. For the pretest 19.3% of students commented on lack of pesticide knowledge, which dropped to 6% on the posttest. Posttest EH unit evaluation questions were tabulated for percent correct. Child vulnerability characteristics were answered correctly by 75.2% of the students. This demonstrates an improvement compared to a multiple choice posttest question where 26% of students correctly identified all child characteristics and 69% were partially correct. For the second question regarding home assessment and child pesticide screening 88.8% of the students answered correctly, with 97% of the higher scoring students answering correctly, compared to a similar posttest home risk factors question where 74% of the students answered correctly.

Frequencies for all questions pre and posttest indicate positive directional learning and awareness of pesticides and environmental health issues. Student pretest responses of uncertain in the opinion and dichotomous questions decreased posttest with a corresponding increase in agree or strongly agree. An uncertain response certainly indicates lack of knowledge.

Discussion

Implications for Pesticide Curriculum

As indicated by the student self-report knowledge results, this project successfully integrated pesticide education into the nursing curriculum. Overall, students gained basic knowledge and concepts of pesticides with the exception of disinfectants (identified only 66% posttest) (NEEF Goal #1). Improved recognition of challenges with diagnosis and assessments in young children was noted on posttest results (NEEF Goal #2). In discussions, students quickly recognized the specific treatment for Carbamate exposure and initial interventions and referral (NEEF Goal #3). Risk communication addresses the education of clients regarding routes of exposure and minimizing home risks (NEEF Goal #4). This was partially met in that students
showed improvement recognizing oral and dermal routes in addition to inhalation, but only 84% recognized residue in foods or water as a risk. The majority (69%) of students learned reporting requirements by recognizing the need for mandatory reporting in the state and 79% identified on posttest that pesticides are required to have a child hazard label (NEEF Goal #5).

All EPA and NEEF pesticide guidelines were not addressed in depth and the short-term knowledge gained by the majority of students may not indicate long-term competency. Student responses in the online discussion board were not analyzed qualitatively but might provide more insight regarding student knowledge and learning requirements in future studies. Compared to other studies, this study provided an insertion point, process, content, and evaluation guidelines for incorporating pesticide concepts. The Minnesota Public Health model provided a framework for the case study discussion when addressing client needs for primary, secondary and tertiary interventions. Student self-report of knowledge gained and satisfaction comments regarding the case study approach indicate this was a successful teaching strategy. Further research is needed to assess knowledge retention, student application of knowledge to other EH cases or populations, and transferability to other baccalaureate or community college curricula.

**Limitations of the study**

Limitations of the study included use of a non-randomized convenience sample. Students had the option to not participate and eight students did not take the pretest and 12 students did not take the posttest. The use of a new online program and establishment of survey responses as anonymous meant an inability to match pre/posttest individual student responses. With no way to determine which students were represented at both time periods mortality and attrition may have affected results. Lack of group participation by some students may have impacted learning. History within the groups was not explored. Self-reported one group studies inherently contain
maturation bias. The learning curve for faculty could have impacted content and student interpretation of the questions.

**Summary**

Undergraduate baccalaureate nursing students showed overall improvement in knowledge and awareness of pesticide exposure in a vulnerable child population, the five EPA and NEEF competencies, and the public health nurse role. Empowering nurses to be at the front line in preventing pesticide exposure will only improve the environmental health of the community and vulnerable populations. Our global environmental health may depend upon it.
References


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http://www.epa.gov/oppfead1/safety/healthcare/healthcare.htm#Cooperative


