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School Indoor Environmental Quality Assessments and Interventions: Benefits of Effective Partnerships in California

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ABSTRACT

Public, private, government, and university stakeholders have focused increasing attention on children's environmental health. Priority areas have been healthy school environments including indoor air and environmental quality (IEQ); susceptibilities of children to environmental factors and associated illness; and, understanding exposure to biological, chemical, and physical agents. As multidisciplinary teams, studies and intervention demonstrations in California public schools were conducted. A common theme among them was a "partnership," the collaboration between stakeholders from the aforementioned sectors. Federal funding and local bond measures for planning, maintenance, and modernization of school facilities have recently been authorized. Therefore, beneficial "partnerships" should be established to conduct needed IEQ, environmental health, and productivity research, development and demonstration. This commentary describes benefits for stakeholders and five strategies for future effective collaborations.

Introduction

Completed or ongoing studies in California, [1-7] Texas, [5,7] Minnesota, [8] and Michigan [9] have focused on school indoor air and environmental quality (IEQ), respiratory health and productivity indicators, pesticide exposures, and/or ambient air quality at schools and at adjacent neighborhoods. A common theme among them was a "partnership," the collaboration between stakeholders in the public, academic, private, and government sectors. As multidisciplinary teams of environmental health scientists, epidemiologists, physicians, and engineers, we have conducted studies and intervention demonstrations in California public schools. These studies investigated IEQ, energy efficiency, and/or respiratory health through comparison of standard and advanced building envelopes, heating, ventilation, and air conditioning system technologies, and interior finish materials, or relationships between reported respiratory health and personal or environmental factors. Technician surveys, questionnaires, and indoor and outdoor air monitoring were conducted. The formation of effective "partnerships" led to varied benefits, i.e., achieving short and long-term research goals and needs of stakeholder groups.

Background

Public, private, government, and university stakeholders in the United States and abroad have focused increasing attention on children's environmental health. Priority areas include healthy school environments; susceptibilities of children to environmental factors and associated illness; and, understanding sources and routes of exposure to biological, chemical, and physical agents including molds, volatile toxic and odorous organic compounds, pesticides, and noise. Respiratory health, neurological and physical development, and academic productivity are major concerns. Children spend the majority of their time inside [10-12]. Since half the year a significant

portion of this time is in school facilities, good IEQ in schools is essential. To date, school IEQ data were sparse [13-15].

During the past decade, American public schools have faced many issues. Federal and state initiatives to reduce class size have targeted K-3 grade levels, with the goal of reducing the student-to-teacher ratio to 20. Student populations have increased rapidly, especially in growing urban areas and border regions subject to immigration. Most important, public schools have faced chronic shortages of financial, technical, and human resources for overdue maintenance, modernization, expansion and/or replacement of facilities and curriculums [16-19]. With respect to both indoor and outdoor microenvironments, numerous concerns included:

- Playground equipment composition and safety
- Pesticide applications with associated notification and exposure issues
- Historic use of school sites, potential contamination
- Electricity crises and higher energy costs affecting quantity and quality of lighting, ventilation, and space conditioning (temperature, relative humidity)
- IEQ factors, e.g., noise levels, thermal comfort.

Good IEQ, promoted by adequate continuous ventilation with filtered outdoor air, should result in improved health and productivity. Furthermore, innovative designs can achieve these with greater energy efficiency, critical for tight budgets. Such changes are important, given environmental linkages with respiratory health outcomes. For example, although causal mechanisms of childhood asthma incidence and exacerbation are not completely understood, asthma has been the top cause of school absenteeism in the United States [20].

Collaborations Benefited Research Goals and Stakeholder Interests

Research teams and public schools

Collaborations benefited research teams by providing easier access to key local information on the communities, targeted school districts (SDs), and schools. In California studies, important information included languages to be spoken or used in recruitment letters and questionnaires, and provisions for personal safety and monitoring equipment locations, storage, and safety.

Consistent and politely repeated verbal, written, and person-to-person communications from research staff were vital in establishing and maintaining understanding and trust. This included respect for ideas, concerns, and responsibilities of SDs and school staff. Improved mutual understanding between stakeholders allowed more successful planning and implementation. Other benefits were enhanced data interpretation and means for future dissemination of results and implications. In California, pertinent research-relevant information included:

- Administrative structures and contact information
- School year calendars with vacations and standardized testing periods requiring no disruptions
- Product (manufacturer, attributes) and architect preferences
- Current environmental health and safety (EH&S) issues including IEQ
- Relevant policies such as use of non-toxic/organic teaching materials and cleaning compounds or least toxic integrated pest management.

In California, SDs and schools appreciated the help of government and university researchers in assessing products and potential impacts on exposure, health, and productivity.

Record keeping and oversight of school facility practices, in general, were limited, and SDs had no clear, independent way of sharing experiences.

Research teams and private sector stakeholders

Research teams understood and respected interests of private sector stakeholders. The private sector provides construction, furnishings, teaching and cleaning products, which may have specific impacts on the school or classroom environments. Human variability and errors in installation, application, use, operation and/or maintenance were recognized and expected to occur unpredictably. Although motivated by both profit and liability concerns, private companies in these sectors, when offered opportunities for research collaboration as in one California study, [3-5] were often interested in developing and/or providing improved products and advanced technologies for greater energy efficiency and improved IEQ. Collaborative interactions can also enhance documentation and feedback on safety, performance, maintenance, and durability of products and services. Cost-effective facility improvements needed by schools with finite resources should result.

Summary

The scientific community benefited from research on exposure pathways and sources at schools. Private sector stakeholder awareness of IEQ was raised. Students, teachers, principals and custodians received environmental science and health education. The practical information led to improvements in sanitation and classroom operation, which provided for early preventive interventions.

Conclusions

Federal funding and local bond measures for planning, maintenance, and modernization of school facilities have recently been authorized. For beneficial "partnerships" to conduct

needed IEQ, environmental health, and productivity research, development and demonstration in schools, our experiences have identified key strategies for effective use of these resources. These include:

1. Increase local knowledge about target communities, SDs, and schools.
2. Create and maintain respect and trust, and effective written and oral communications, with stakeholders during project planning, implementation, and interpretation of results.
3. Field technicians working on-site, especially in classrooms, must respect collaborators. School environment and health assessments are dynamic; consideration of collaborator ideas improved the science.
4. Non-intrusive, non-invasive, non-disruptive protocols, coupled with environmental science, health, or energy classes for students, were successful in California.

Researchers and stakeholders working together can build, improve, operate and maintain healthy school environments.

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