

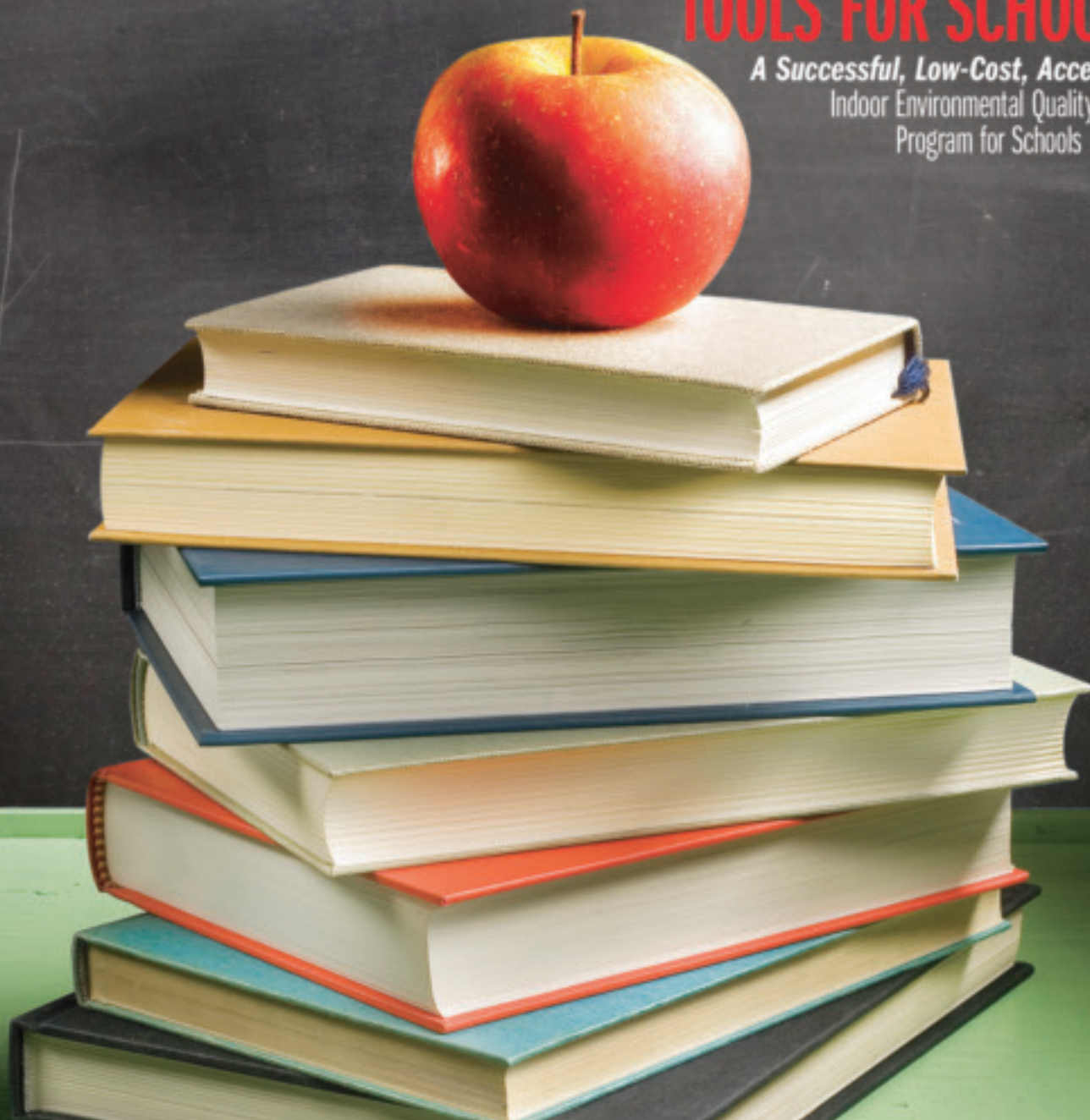
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U.S. EPA's

TOOLS FOR SCHOOLS

*A Successful, Low-Cost, Accessible
Indoor Environmental Quality
Program for Schools*

Environmental Health

ABOUT THE COVER



This month, our feature article examines the successful implementation in Connecticut of the U.S. Environmental Protection Agency's indoor air quality program,

Tools for Schools (TfS), by a multiagency consortium led by the Connecticut Department of Public Health. Tools for Schools is a low-cost, preventive, team-oriented, "action kit" program to improve indoor environmental quality (IEQ) in schools. Evidence is increasing that IEQ affects not only student and staff health but also academic achievement. The Connecticut Department of Public Health conducted a survey that generated qualitative data demonstrating the success of their TfS program.

See page 8.

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A Statewide Multiagency Intervention Model for Empowering Schools to Improve Indoor Environmental Quality

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Abstract A large population of children and adults is potentially exposed to indoor environmental quality (IEQ) hazards in schools. Those with asthma are particularly at risk because IEQ-related hazards in school buildings can trigger asthma episodes. A multiagency consortium created and led by the Connecticut Department of Public Health has successfully implemented and continues to sustain the U.S. Environmental Protection Agency's (U.S. EPA's) Tools for Schools (TfS) program in the majority of Connecticut public schools. TfS is an action kit and program promoting a low-cost, problem-solving team approach to preventing IEQ hazards or improving IEQ. One key to the consortium's success is the array of services it provides to schools, including aggressive outreach and specialized training and consultation. The consortium is also a platform for launching other school IEQ initiatives. The authors present and analyze the consortium model and their efforts at evaluating the impact of TfS in Connecticut.

Introduction

The public is concerned with perceived health impacts linked to poor indoor environmental quality (IEQ) in buildings, particularly in school facilities. The U.S. Environmental Protection Agency's (U.S. EPA's) studies of human exposure to air pollutants indicate that concentrations of indoor air pollutants in buildings and homes may be two to five times, and occasionally more than 100 times, higher than outdoor levels (Axelrod, 2006). Students and staff are exposed to poor IEQ from a wide range of sources in schools, including inadequate ventilation, moisture intrusion, and poor maintenance and operation of heating, ventilation, and air conditioning (HVAC) systems (Daisey, Angell, & Apte, 2003). The most direct cause of poor IEQ is inadequate fresh air

provided by ventilation, regardless of what other factors may contribute to IEQ problems (Connecticut Academy of Science and Industry [CASE], 2000). Moisture intrusion can result in the growth of mold and other microorganisms (Frumkin, Geller, & Rubin, 2006). Other sources in schools include air pollutants related to laboratories, machine and woodworking shops, kitchens, and copying areas (CASE, 2000).

IEQ Health Issues, Impacts, and Potential Solutions

A large population of children and adults is potentially exposed to IEQ hazards in schools. A study published in 2000 found that 68% of Connecticut schools reported having indoor environmental problems (CASE, 2000). Sick building syndrome and building-related ill-

ness are two terms used to describe health impacts experienced by building occupants. Sick building syndrome refers to a range of symptoms such as eye, nose, and throat irritation, headaches, and lethargy. Building-related illness refers to illnesses where a clear causal relationship exists between symptoms and exposure to one or more infectious, toxicological, or immunological agents in an indoor environment. Agents such as bioaerosols in the indoor environment can cause or exacerbate immunological diseases such as asthma and hypersensitivity pneumonitis. Children and teachers with these ailments may experience chronic, even life-threatening, disease if problems are not recognized and corrected at an early stage (CASE, 2000).

The impact of indoor environmental pollutants is not limited to health problems alone. Poor IEQ has also been found to have a negative effect on academic performance and attendance (Earthman, Cash, & Van Berkum, 1995; Mendell & Heath, 2004; Simons, Hwang, Fitzgerald, Kielb, & Lin, 2010). U.S. EPA has compiled an expanding list of articles linking IEQ and academic performance and productivity (U.S. Environmental Protection Agency [U.S. EPA], 2010). With the growing concern about national academic achievement and teacher performance, school reforms to improve achievement and performance should include improved school building conditions.

Growing evidence shows that IEQ health problems can be reduced by making building improvements. The Carnegie Mellon building performance program identified 17 studies documenting the relationship between health and building improvements that improved air quality. The health impacts

improved included asthma, flu, sick building syndrome, respiratory problems, and headaches. These 17 studies found positive health impacts (i.e., reduction in reported prevalence of symptoms) ranging from 13.5% to 87% improvement, with average improvement of 41% (Kats, 2006).

Lack of IEQ Standards

Although there are federal Occupational Health and Safety Administration (OSHA) workplace standards for a variety of specific chemicals applicable to manufacturing/industrial workplaces where the chemicals are used, no enforceable federal or Connecticut government standards exist for indoor air quality in schools, workplaces, or homes. Moreover, current environmental regulations offer limited protection of the general public against many sources of indoor pollutants that endanger human health because the present regulatory approach focuses on outdoor emissions sources rather than indoor pollutants, despite the fact that most exposure occurs indoors (Steinemann, 2004). Despite the lack of standards and laws, useful guidelines exist, such as the American Society of Heating and Refrigerating Engineers (ASHRAE) Standard 62-2007, "Ventilation for Acceptable Indoor Air Quality." Also, many states have performance-based standards, but they lack resources for monitoring and enforcing those standards (Environmental Law Institute, 2007).

A Nonregulatory Intervention Approach

U.S. EPA's Innovative Response Tool

U.S. EPA developed an effective program to assist schools to identify and address IEQ problems, which they refer to as the U.S. EPA IAQ (indoor air quality) Tools for Schools (TfS) program. The program is based around an "action" kit that promotes a low-cost, preventive, problem-solving team approach to improve IEQ. The kit is used by a school-based committee or "building team" made up of administrators, teachers, maintenance staff, school nurses, and parents to investigate and then categorize and prioritize their findings by need (i.e., severity of health effects and number of people affected) and cost. Short- and long-term strategies are then developed by the building team to assist the schools in remediating IEQ hazards identi-

fied by the teams' investigations. Emphasis is placed on identifying low or no-cost solutions, such as reducing classroom clutter and ensuring ventilation supply and return vents are not blocked. The program kit was developed out of the need to overcome two important challenges: the lack of federal or state contaminant-based indoor air standards to provide a traditional regulatory response to IEQ problems in schools, and budgetary issues that have generally made building maintenance a lower priority for school districts (Ellerson, 2010).

Given these two challenges, the TfS program is a nonregulatory, proactive, and collaborative effort to prioritize and respond to school IEQ problems using existing resources. The centerpiece of the program is the development, training, and support of the school-based teams. The teams comprise representatives of the school community working together, and provide an ongoing mechanism to assess problems and facilitate improvements. These teams also educate building staff, who can then mobilize a buildingwide response to IEQ problems, including occupant-caused problems. These TfS building teams are more likely to have a greater impact on IEQ improvements than an indoor air quality consultant who may occasionally visit and inspect a building, as the building teams provide ongoing assessment and response. TfS building teams must be sustained, however, to be effective.

U.S. EPA's strategy to encourage schools and school districts to implement TfS has been to directly distribute the kit, work with national school-based organizations to publicize and promote the program, and to bring school staff and administrators to the yearly national TfS symposium to provide information and training with the hope that these representatives would return to implement TfS.

Connecticut's Comprehensive Statewide Interagency Strategy

In Connecticut, a consortium of state agencies and organizations has taken the TfS program and developed a comprehensive method of implementing the program on a broad scale. As we will show in this article, Connecticut's method has proven to be effective. Initially, the Connecticut Department of Public Health's (CT DPH's) efforts to promote the TfS program in Connecticut saw limited success. The

initial strategy was to contact school districts and school-based organizations to encourage adoption of the program. After limited success, CT DPH determined that school districts have limited time, resources, and incentives to implement the TfS program without formal assistance. Thus, in 1999, the CT DPH, U.S. EPA, and an advocacy group created the idea of pooling resources to provide coordinated training and technical assistance to Connecticut's school districts. This collaborative statewide effort has been very successful, assisting over 67% of Connecticut public schools to implement the program. It has grown into a statewide consortium, the Connecticut School Indoor Environment Resource Team (CSIERT), led by CT DPH, and includes 24 agencies and organizations. The overall goal of CSIERT is to improve IEQ in Connecticut schools, principally by implementing and sustaining the TfS program in every Connecticut public school building.

The consortium provides the following services:

- Outreach and education to promote TfS in school systems.
- A two-session training program to assist school districts in implementing the program. The training program utilizes a participation/empowerment workshop model.
- Additional training and web-based services to assist school districts to sustain their TfS program.
- Ongoing consultation with TfS committees to set priorities and address specific technical questions.
- Specialized training and consultation services for facilities and custodial staff.

Furthermore, the TfS program has been utilized as a "platform" to facilitate implementation of other IEQ programs and initiatives, moving it well beyond its original mission of implementing TfS. These other programs include diesel bus fumes and pesticide use reduction, and the promotion of laboratory cleanout and green cleaning programs. Through the twin resources of technical and training expertise, and an established network of school contacts, the consortium is also able to respond to emerging issues. For example, we note that the consortium has expanded its training programs to include guidance to facilities staff on effective infection control measures regarding H1N1 flu for school facilities staff.

Consortium Strategy Components

The CSIERT has incorporated a number of components that have led to its success in implementing TFS in a majority of Connecticut school systems. These components include the following.

1. **An active group of statewide school stakeholder organizations and agencies working together to promote and assist in the implementation of the program.** The consortium consists of both school-based organizations and health-based agencies that bring skills, knowledge, and contacts to implement and support TFS on a large scale. School-based organizations include the two state teachers' unions, the principals' union, and state associations representing superintendents, facilities directors, and school business officials. These organizations provide regular, sustained outreach and contacts to the effort, including communication with their members about school IEQ and TFS. This regular communication has assisted in encouraging momentum among other districts to implement the TFS program. CSIERT member health agencies—the CT DPH, Connecticut's OSHA program, two academic occupational and environmental medicine programs, and the Connecticut chapter of the American Lung Association provide direct outreach, training, and technical support to the school districts.
2. **A mandatory district pretraining “buy-in” presentation.** Before CSIERT will agree to assist school districts, a mandatory “buy-in” presentation is delivered to all school district administrators (including all principals). This strategy has been effective in ensuring the support and involvement of the key administrators to make TFS implementation successful.
3. **An empowerment-modeled training program that is regularly evaluated and improved upon.** The first priority of the consortium was to develop a training program to assist underresourced school districts to implement TFS. The two-part, five-hour training program utilizes a hands-on, empowerment workshop model using participatory training techniques. The basics of school IEQ health and utilizing the TFS kit to set up and execute an assessment and action plan are covered, along with a group “walk-through” exercise in

TABLE 1

Tools for Schools (Tfs) Survey Objectives

Objective

- To document indoor environmental quality (IEQ) problems and potential exposures.
- To document the use of Tfs to make changes that correct/reduce/eliminate IEQ problems.
- To identify barriers to implementing Tfs.
- To identify whether Tfs has reduced potential exposures to IEQ hazards in schools.
- To identify whether Tfs has improved health in schools.

the school training site. Local health departments are encouraged to attend the two-part training and participate in the school walk-through investigations that follow the training program.

4. **A comprehensive strategy to assist school districts to sustain their Tfs program.** To ensure that district Tfs programs are sustained over the long term, the consortium has developed a comprehensive strategy. This includes regular outreach to the district Tfs contacts, a “refresher” workshop, an “advanced Tfs for custodial and facilities maintenance staff” workshop, periodic regional “information-sharing” meetings of district Tfs team members and district coordinators, and a consortium Web site to share information about IEQ improvement techniques. In addition, regular contact from CSIERT and its member organizations contribute to sustaining the district-based programs.
5. **A holistic IEQ approach.** Although the emphasis of CSIERT and the training program has been on addressing traditional indoor air quality problems such as ventilation and mold, the consortium's training program has integrated other school IEQ issues, such as integrated pest management (IPM), radon, laboratory chemical clean outs, green cleaning protocols, providing adequate ventilation while conserving energy, and high performance (green) school regulations and resources. A free green cleaning protocol consultation service was recently added to the CSIERT program while funding was available.

Accomplishments of the CSIERT Consortium

- Outreach to all Connecticut school districts: A key consortium strategy has been an aggressive outreach campaign aimed at school district executive staff. All 166 Connecticut public school districts have been contacted and formal presentations have been made to the executive staff of over 145 school districts.
- Extensive implementation of Tfs: Early on, consortium members identified training as crucial to schools implementing Tfs. Using their two-part training program, the consortium has conducted 400 workshops and trained Tfs building teams in 67% of Connecticut's public schools. This has resulted in over 7,200 school staff, parents, and others being trained in 154 of Connecticut's 166 school systems.
- Sustaining Tfs: The consortium developed a “refresher” workshop to help districts sustain their programs. This workshop has been conducted for over 360 schools (36%) in 60 districts. The consortium has also developed a special training module for school custodians and facilities staff. This module is offered to participating districts and provides more advanced training in IEQ source identification, green cleaning, and infection control. Around 510 schools (50%) in 44 districts have been trained. CSIERT has also developed a Web site for building team members, school administrators, and the public to provide resources for sustaining Tfs. The site includes an information sharing forum to exchange IEQ tips and advice (www.csiert.tfsiaq.com).

TABLE 2

Indoor Environmental Quality (IEQ) Problems Identified by Tools for Schools (TfS) Survey Respondents and Population Potentially Exposed to IEQ Hazards

IEQ Problem	# Schools Reporting the Problem (N = 77)	%	Potentially Exposed Population	
			# Students	# Staff
Ventilation problems				
Air vents obstructed	35	45	22,134	1621
Filters need upgrading or replacing	36	47	20,914	2041
HVAC units & ventilators need cleaning	29	38	17,788	1646
Temperature/dryness/humidity need improving	45	58	26,504	2330
Arts/sciences room needs ventilating	16	21	11,281	897
Outdoor air intakes need improving	24	31	14,191	1255
Source reduction problems				
Radon remediation needed	12	16	1132	121
Asbestos remediation needed	14	18	6999	505
Cleaning products need replacing with "greener products"	46	60	16,395	1182
General cleaning improvement needed	47	61	26,726	2302
Carpet cleaning or removal needed	19	25	26,318	2445
Overuse of pesticides	10	13	11,239	899
Art/science materials need replacing with "greener products"	13	17	8495	541
Classroom animal dander exposure	26	34	8423	944
Bus idling policies lacking	56	73	15,773	1455
Water identification problems				
Inspections of leaks, spills, moisture	41	53	31,891	2828
Plumbing problems	11	14	21,003	1812
Roof problems	46	60	23,703	2211
Basement or crawlspace needs upgrading	18	23	8060	583
Removal of water-damaged materials needed	35	45	26,614	2393
Other problems				
Renovations to classrooms, buildings	29	38	9879	872

- Tools for Techs: A project to implement TfS in Connecticut's technical high schools was conceived, developed, and is presently being implemented by CSIERT. This project,

called "Tools for Techs," arose from the need to adapt the traditional TfS program to the needs of vocational technical high schools. These schools have multiple

trade instruction areas (carpentry, auto mechanics, cosmetology, etc.) with specific contaminant sources. Materials and training modules were developed to supplement the traditional U.S. EPA kit and CSIERT training program. Eight of the 17 technical high schools have adopted TfS. This project was awarded a U.S. EPA National Excellence Award in December 2008.

- Cleaning for Health program: A national public health movement is in place to implement green cleaning programs in schools. CSIERT offered a "Cleaning for Health" program that provided free evaluations and consultations to school districts to assist them in evaluating green cleaning options.
- Ongoing ability to respond to emerging issues: With the recent state law requiring Connecticut schools to use green cleaning products, CSIERT has upgraded the custodial training workshop and "Cleaning for Health" consultation service described above. The recent H1N1 flu outbreak necessitated development of an additional training module to assist school districts and their facilities staff to respond to infection control issues. The consortium also responded to the recent energy crisis, by providing information about maintaining adequate ventilation while conserving energy.

Evaluation Methodologies: Does It Work?

Measuring the success of environmental health interventions is a challenging and difficult endeavor. Connecticut schools collect limited data about school facility conditions, and school nurses are not required (and often not equipped) to collect surveillance data on IEQ-related health outcomes. Efforts led by the CT DPH to evaluate the impact of TfS have collected some useful but generally qualitative data on positive health outcomes after implementation of IEQ interventions.

Evaluation Methodology

Although ample anecdotal evidence exists that U.S. EPA's TfS program is successful in both identifying and remediating indoor air quality problems and improving health outcomes among staff and students, little quantitative evaluation data exist to demonstrate that success. In 2003, CT DPH surveyed schools that had implemented

TABLE 3

Indoor Environmental Quality (IEQ) Problems, Hazards, Interventions, and Populations With Reduced or Eliminated Exposures

IEQ Problem	Potential IEQ Exposure Hazard	# Schools Reporting Intervention ^a of IEQ Problem	Potential Exposures Reduced or Eliminated Through Intervention	
			# Students	# Staff
Ventilation problems				
Air vents obstructed	CO ₂ , temperature too hot/cold, humidity too high/low	28	18,622	1249
Filters need upgrading or replacing	Particulate matter, CO ₂ , bioaerosols ^b	29	17,204	1682
HVAC units & ventilators need cleaning	Particulate matter, CO ₂ , bioaerosols	22	13,639	1245
Temperature/dryness/humidity need improving	Temperature too hot/cold, humidity too high/low	24	15,022	1134
Arts/sciences room needs ventilating	Paints, glues, solvents, other lab chemicals, and arts supplies	11	8674	674
Outdoor air intakes need improving	Mold, car/bus exhaust, tobacco smoke	13	8891	739
Source reduction problems				
Radon remediation needed	Radon	1	366	39
Asbestos remediation needed	Asbestos	9	5985	413
Cleaning products need replacing with "greener products"	Various VOCs ^c	7	12,238	839
General cleaning improvement needed	Particulate matter, bioaerosols	25	14,568	1178
Carpet cleaning or removal needed	Particulate matter, bioaerosols	31	17,758	1570
Overuse of pesticides	Pesticides	16	9338	749
Art/science materials need replacing with "greener products"	Paints, glues, solvents, other lab chemicals, and arts supplies	5	5430	275
Classroom animal dander exposure	Animal dander	7	3647	430
Bus idling policies lacking	Diesel exhaust (includes nitrogen dioxide, CO, and particulate matter)	17	10,730	975
Water identification problems				
Inspections of leaks, spills, moisture	Mold	37	19,965	1641
Plumbing problems	Mold	20	11,631	938
Roof problems	Mold	30	16,382	1477
Basement or crawl space needs upgrading	Mold	7	5958	387
Removal of water-damaged materials needed	Mold	33	17,661	1538
Other problems				
Renovations to classrooms, buildings	Paints, roofing tars, solvents, particulate matter	14	8311	716

^a Intervention means that a school has repaired the IEQ problem or scheduled it for repair.

^b Bioaerosols: products that become airborne that are produced by living organisms; includes mold, bacteria, viruses, dust mites, cockroach excretions, animal antigens, and pollens.

^c VOCs: volatile organic compounds; includes organic solvents used in paints, glues, other art supplies, cleaning products, carpet adhesives, copy machines, and formaldehyde released from resins in building materials.

TfS to evaluate whether Connecticut's TfS program was successful in identifying and correcting IEQ problems in schools. Table 1 outlines the 2003 TfS survey objectives. CT DPH developed and mailed the survey questionnaire to TfS building team coordinators

at all 177 Connecticut schools that had implemented the program at the time of the mailing (May 2003). The TfS coordinators were asked to answer all questions except those pertaining to health. The school nurse was asked to answer the health questions.

Follow-up phone calls were made to increase participation. A total of 77 schools (44%) responded. Survey results are shown in Tables 2 and 3.

In 2005 and 2006, CT DPH collected health outcome data from school nurses

TABLE 4

Connecticut School Districts With Documented Health Outcome Data

School District	# Schools Reporting	Health Outcome	Result
Waterford	5	Number of IEQ health complaints	74% decrease in one elementary school, from 152 to 40 after TfS implementation 66% (or greater) decrease in nine out of 13 elementary classrooms
Hamden	12	Rate of absenteeism	Absenteeism cut by more than 50% after TfS was implemented in one elementary school (484 days to 203 days) in one year
North Haven	6	Decrease in reported respiratory-related illnesses	48% decrease in reported cases of respiratory-related illnesses
		Reduction in clinic visits	Number of clinic visits decreased by 11% (4978) two years after TfS was implemented
Chester	1	Asthma-related office visits	Number of asthma-related health office visits decreased over four years from 463 to 82 after major TfS recommendations implemented
		Absenteeism	Sickness-related absences decreased by 860 in one year after all the TfS recommendations were implemented
Hartford	~30	Number of asthma incidents	Number of asthma incidents declined 21%, from 11,334 to 8929 in one year, after TfS was implemented in most schools
Amity Region 5	3	Number of IEQ complaints	IEQ-related complaints were reduced from 18 in 2002–2003 to two in 2005–2006
		Asthma-related office visits	Asthma-related school nurse visits decreased from 234 to 30 over the same time period

in several school districts and a workers' compensation insurance provider to evaluate whether implementation of TfS resulted in measurable health outcomes in schools. School nurses from six school districts (approximately 50 schools) collected data on absenteeism, asthma-related office visits, and respiratory complaints, and either provided it directly to CT DPH or to school district administrators. These data are presented in Table 4. Workers' compensation data was compiled by the Connecticut Interlocal Risk Management Association (CIRMA), an insurance provider for many Connecticut school districts.

Survey/Other Data Results*Documenting IEQ Problems and Potential Exposures*

Table 2 summarizes the results related to the first objective of the aforementioned 2003 survey—i.e., documenting IEQ problems and potential exposures. The most commonly reported IEQ problems concerned ventilation, pollutant/contaminant source reduction, and moisture. Table 2 also lists the number of students and staff potentially exposed to or affected by these IEQ problems. The potentially exposed population data was estimated by CT DPH based on the published

student enrollment and staffing at each of the responding school districts (Connecticut Department of Education, 2007). The numbers of students and staff represent an upper estimate of how many people could be impacted by IEQ hazards from each particular IEQ problem. As Table 2 shows, these estimated populations are very large.

Table 3 presents the number of schools that reported interventions to address an identified IEQ problem, and potential exposure hazards that could be associated with each IEQ problem. CT DPH defined an "intervention" as meaning that a school has repaired the IEQ problem or scheduled it for repair. Potential exposure hazards were identified by CT DPH based on a review of scientific literature. IEQ pollutants listed in Table 3 are pollutants that the literature commonly associates with the IEQ source/problem identified by schools (CASE, 2000; Mendell & Heath, 2004; Shendell, Barnett, & Boese, 2004; U.S. EPA, 2000). Table 3 illustrates that TfS programs have reduced actual or potential exposures to a wide variety of IAQ pollutants. As suggested in Table 3, a significant number of students and staff have potentially benefited from these interventions that have or will reduce or eliminate the potential exposure.

Documenting Health Outcomes

Table 4 summarizes the results of health outcome data collected from six school districts (approximately 50 schools). The data report positive health outcomes (decreases in IEQ-related health complaints, reported cases of respiratory-related illnesses, asthma-related office visits, absenteeism). A decrease in asthma-related office visits was the most commonly reported health outcome. Chester Elementary School reported the most compelling health data (from 463 yearly asthma-related office visits to 82 over a four-year period). The TfS team led by the school nurse was also able to link these outcomes to improvements achieved by the TfS process, including carpet removal.

In addition, CIRMA documented decreases in IEQ-related workers compensation claims. CIRMA reviewed claims data from 45 districts with TfS. Fifteen districts (32%) had a decrease in IEQ-related claims. The average decrease per district using TfS was 3.6 claims, and the severity of claims decreased by \$56,705, or 87%.

Chester Elementary Case Study

During the 2001–2002 school year, Chester Elementary School in Chester, Connecticut, had a population of 335 students in kindergarten through 6th grade. The school nurse had seen a pattern of frequent visits for asthma exacerbations along with complaints of headaches, dizziness, and sinus congestion. There were 4,650 visits with 463 total asthma exacerbations requiring medication intervention, including one case requiring hospitalization. The nurse determined that most of the asthma exacerbations occurred while students were in classrooms and only a minority due to exertion.

The Chester school administration worked with the Connecticut Department of Public Health (CT DPH) and the Connecticut School Indoor Environment Resource Team (CSIERT) to implement the Tools for Schools (TfS) program. An introductory “buy-in” presentation was conducted with the school administrators. A TfS building team was organized and included the nurse, principal, a teacher, the head cus-

todian, and a parent. An initial workshop was conducted by CT DPH/CSIERT staff to instruct the team on the TfS process. The team, using the TfS kit, surveyed the staff on building conditions, “mapped” their findings on a school blueprint, and identified some initial problems. A second workshop was conducted by an industrial hygienist to train the TfS team on conducting a visual walkthrough, with the actual walkthrough conducted soon after. The team identified four areas of immediate concern:

1. The school was completely carpeted and was very dirty. The carpet was 11 years old and had never been cleaned. Most of this carpet was on a concrete slab with mold found under the carpet in several rooms.
2. Ceiling tiles had many watermarks with mold growth from a leaking roof.
3. The unit ventilator intakes were clogged in most classrooms, so the dirty room air was being recirculated.

4. Signs of recent mice activity were observed in many classrooms.

The TfS team recommended these issues be fixed and resolved. All the carpeting in the school was replaced with tile floors, all the leaks in the roof were fixed, the unit ventilators were cleaned and repaired with higher quality filters, and a pest program was initiated.

The results were remarkable. By the 2003–2004 school year, only 82 asthma exacerbations occurred, and in 2005–2006, only 61 occurred, with no environmental triggers noted. All were exertion or cold induced. A dramatic decrease also occurred in headaches, dizziness complaints, and sinus difficulties. Absenteeism also decreased markedly.

Note. Ted Wislocki, RN, BSN, former school nurse at Chester Elementary School, contributed to this sidebar article.

Study Limitations

Our survey and data evaluation had several limitations. First, the response rate was low (44%). School personnel have many time demands; responding to voluntary surveys would likely be given a low priority. Second, we believe that some school administrators were reluctant to provide information regarding the state of their facilities or a lack of action regarding their TfS program. Third, the TfS coordinator completing the survey form may not have had access to the most up-to-date information. As a result, responses to a self-reporting survey tool are difficult to verify for accuracy. In addition, an inherent self-selection bias exists because schools and districts with more active TfS programs were more likely to participate in the survey.

Although we obtained health outcome data from six school districts, our 2003 survey did not obtain enough useful data from the nurses' survey responses to support conclusions about whether implementation of TfS resulted in improved health in schools. Historically, school districts have not been required to systematically collect and report data useful in assessing

IEQ-related symptoms and illness. Schools have, however, recently been required to collect asthma data. The lack of baseline health data made it difficult to demonstrate improvements in health outcomes resulting from the TfS-related improvements in the schools. Although we lack rigorous quantitative data, the data we obtained supports the anecdotal evidence we have heard. One compelling piece of anecdotal evidence is detailed in the case study above.

What Have We Learned? What Do We Recommend?

Schools Have IEQ Problems, but Few Resources

Schools in Connecticut have documented IEQ problems, but few resources to address them. After 10 years meeting with school staff, conducting hundreds of trainings with teachers, custodians, nurses and parents, as well as touring hundreds of school facilities, we can report that it is evident that schools in Connecticut regularly face myriad IEQ problems, yet generally have limited resources. Maintenance budgets are almost always the first

to be reduced when funding is low, and this fiscal problem is exacerbated by the present budget crisis facing the state. We recommend that state health and education departments and local health departments provide ongoing technical assistance to school districts to address IEQ problems. Adequate funding to cover proactive maintenance and building improvements should be ensured for all schools, as there is a correlation between building maintenance and academic performance (Earthman et al., 1995).

Using the Collaborative Team Approach, TfS Is Effective in Addressing IEQ Problems

Our experience indicates that U.S. EPA's TfS program is an effective and practical intervention to address IEQ problems in schools. Trained teams of school staff, parents, and students can effectively assess school IEQ problems, educate fellow staff, develop a prioritized action plan, and work with the school administration to address problems. Two essential components for success are strong support by school administrators and

an active, ongoing communication plan. In an era of increased budget constraints, it becomes even more important that staff work collaboratively—through the teams—with custodial staff to keep the building clean and safe. Therefore, all school districts should implement the TFS program, including re-recruiting, training, and providing support to building-based teams. Finally, TFS can be successfully used as a platform on which to implement school environmental health initiatives such as green cleaning.

A Statewide Multiagency/Organization Approach Is Viewed as the Best Model for Implementing and Sustaining TFS

Connecticut's consortium model has made it feasible to establish and maintain the TFS program in a large majority of school districts with limited resources (CT DPH, 2011). The success of this model can be attributed to these components:

- an active group of statewide school stakeholder organizations and agencies;
- an empowerment-based training program;
- an ongoing strategy to assist school districts to sustain their TFS program; and
- a comprehensive approach that addresses all aspects of IEQ, including chemical and pesticide use, green cleaning protocols, and reducing diesel bus fumes.

In our view, U.S. EPA and other agencies should encourage and provide support to states for such efforts, including targeted funding. Also, national school stakeholder organizations should encourage their state affiliates to participate in these efforts.

Difficulty of Collecting Empirical Data to Evaluate TFS

It is difficult to collect empirical data to comprehensively evaluate school IEQ-related interventions such as TFS. Agencies face re-

source (time and money) and data collection obstacles to documenting evidence-based outcomes regarding the efficacy of the TFS program. A key obstacle is the lack of consistently collected baseline health data from the school nurse office. The larger, more systemic problem is the lack of integration of school nurses in the public health surveillance system. State and national efforts to establish and expand a National Environmental Health Tracking system should seek to bring school nurses into the system. 🐼

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