Published in final edited form as:

J Pediatr Nurs. 2017 ; 36: 157–162. doi:10.1016/j.pedn.2017.06.013.

Urban-Rural Differences in School Nurses' Asthma Training Needs and Access to Asthma Resources

Delesha M. Carpenter, PhD, MSPH^a, Robin Dawson Estrada, PhD, RN, CPNP-PC^b, Courtney A. Roberts, MSPH^c, Alice Elio, RN, MSN^d, Melissa Prendergast, RN, BSN^e, Kathy Durbin, PhD, NCSP^f, Graceann Clyburn Jones, RN^f, and Steve North, MD, MPH^g

^aUniversity of North Carolina, Eshelman School of Pharmacy (Asheville Satellite Campus), 1 University Heights, CPO 2125, Asheville, NC 28804, USA

^bUniversity of South Carolina, College of Nursing, 1601 Greene St., Columbia, SC 29208, USA

^cUniversity of North Carolina, Eshelman School of Pharmacy, 301 Pharmacy Lane, Chapel Hill, NC 27599, USA

^dMountain Area Health Education Center, 123 Hendersonville Road, Asheville, NC 28803, USA

^eCharleston County School District, 75 Calhoun Street, Charleston, SC 29401, USA

^fLancaster County School District, 300 South Catawba Street, Lancaster, SC 29720, USA

^gHealth-e-Schools, Center for Rural Health Innovation, 120 Oak St., Spruce Pine, NC 28777, USA

Abstract

Purpose—Few studies have examined school nurses preferences' for asthma training. Our purpose was to: 1) assess school nurses' perceived asthma training needs, 2) describe nurses' access to asthma educational resources, and 3) identify urban-rural differences in training needs and access to resources in southern states.

Design and Methods—A convenience sample of school nurses ($n = 162$) from seven counties (two urban and five rural) in North Carolina and South Carolina completed an online, anonymous survey. Chi-square tests were used to examine urban-rural differences.

Results—Although most nurses (64%) had received asthma training within the last five years, urban nurses were more likely to have had asthma training than rural nurses ($\chi^2 = 10.84$, $p = 0.001$). A majority of nurses (87%) indicated they would like to receive additional asthma training. Approximately half (45%) of nurses reported access to age-appropriate asthma education materials, but only 16% reported that their schools implemented asthma education programs. Urban nurses were more likely than rural nurses to have access to asthma education programs ($\chi^2 = 4.10$, $p = 0.04$) and age-appropriate asthma education materials ($\chi^2 = 8.86$, $p = 0.003$).

Correspondence to: Delesha M. Carpenter.

Human Subjects Approval Statement

Due to the use of anonymous survey on training needs, this study (#15-3248) was determined not to be human subjects research by the University of North Carolina at Chapel Hill's Institutional Review Board.

Conclusions—Few schools are implementing asthma education programs. Rural nurses may be disadvantaged in terms of receiving asthma training and having access to asthma education programs and materials.

Practice Implications—Schools are an ideal setting for delivering age-appropriate asthma education. By providing school nurses with access to age-appropriate asthma education resources and additional asthma training, we can help them overcome several of the barriers that impede their ability to deliver asthma care to their students.

Keywords

Asthma; School nurse education; Health education; Medications

In 2013, the prevalence of current asthma in children under the age of 18 was 8.3%, making asthma one of the most common childhood chronic conditions in the United States (Akinbami, Simon, & Rossen, 2016). Among youth with current asthma, 33% of children (6–11 years old) and 9% of adolescents (12–19 years old) had poorly controlled asthma, as evidenced by suboptimal spirometry values (Kit, Simon, Tilert, Okelo, & Akinbami, 2016). Poorly controlled asthma can lead to costly emergency department visits and unscheduled office visits, with combined direct and indirect expenses for school-aged children estimated at over five billion dollars per year (Groenewald, Wright, & Palermo, 2015). Asthma is also responsible for approximately 10 million school absences annually (Akinbami, Moorman, & Liu, 2011) and increases the number of physically and mentally unhealthy days that youth experience, which negatively impacts their quality of life (Cui, Zack, & Zahran, 2015; Horner, Brown, & Walker, 2012).

Through national goals set forth as part of Healthy People 2020, the US Office of Disease Prevention and Health Promotion (2016) outlined several objectives to reduce the negative impact of asthma on youth. These asthma-specific objectives include: reducing missed school days due to asthma, reducing hospitalizations and emergency department visits among children, and increasing the number of people who receive formal asthma education, which includes increasing the proportion of people with current asthma who receive written action plans and instruction on how to use their inhalers. Because school-based programs circumvent many of the logistical issues (e.g., limited transportation and parent availability) that often prevent youth from receiving asthma education, school nurses are well-positioned to contribute toward the successful attainment of these objectives (Butz, Kub, Bellin, & Frick, 2013; Christiansen & Zuraw, 2002; Halterman et al., 2012; Horner & Brown, 2014). Indeed, a large body of literature has shown that school-based asthma education improves children's knowledge of asthma, self-efficacy, self-management behaviors, and clinical outcomes (Bartholomew et al., 2006; Butz et al., 2005; Coffman, Cabana, & Yelin, 2009; Joseph et al., 2007; Levy, Heffner, Stewart, & Beeman, 2006; Tinkelman & Schwartz, 2004).

Although school nurses are the most likely school employee to deliver asthma education to students, there is limited quantitative research focused on school nurses' access to asthma education programs and their asthma training preferences, especially for school nurses who work in southern states. Previous studies examining school nurses' asthma-related needs have documented significant barriers, such as lack of funding, inadequate supplies, and time

constraints as deterrents to nurses' ability to provide asthma education to their students (Hanley Nadeau & Toronto, 2016; Hillemeier, Gusic & Bai, 2006a, b; Winkelstein et al., 2006). Indeed, one study of urban and rural school nurses in Pennsylvania found that 85% of nurses reported at least one obstacle to providing asthma management education (Hillemeier et al., 2006b). Because asthma training can increase nurses' confidence to provide effective asthma care to their students, it is important to identify nurses' asthma training needs (Putman-Casdorff & Pinto, 2011; Winkelstein et al., 2006).

The presence of environmental asthma triggers, access to healthcare, and asthma outcomes varies across urban and rural areas. Specifically, urban children with asthma are twice as likely to see a specialist and 2.7 times as likely to receive asthma care in an emergency department than rural children (Yawn et al., 2001). Rural children also may face different environmental challenges than urban children, such as increased indoor exposures to secondary smoke and a higher prevalence of allergic rhinitis and chronic bronchitis (Mujuru et al., 2011; Pesek et al., 2010; Valet et al., 2011). Additionally, school nurse staffing in rural elementary schools has been found to be less comprehensive than in urban areas (Hillemeier et al., 2006b). Although these urban-rural differences may affect the asthma training needs of school nurses, no studies have specifically examined differences in training needs for urban and rural school nurses in the South.

In order to build upon the few previous studies that have examined urban-rural differences in school nurses' asthma training needs, our purpose was to: 1) assess school nurses' perceived asthma training needs; 2) describe nurses' access to asthma educational resources; and 3) identify urban-rural differences in training needs and access to resources. Specifically, this descriptive study adds to previous work by examining urban-rural differences in student asthma education resources and school nurse training needs in two southern states and provides greater detail about the types of educational resources available to nurses and their students in urban and rural counties.

Methods

Participants

School nurses from seven counties (2 urban, 5 rural) in North Carolina and South Carolina were invited to participate in an online 16-item survey. A total of 197 school nurses were invited to participate; 162 completed the survey (participation rate = 82.2%). Because the survey was anonymous and limited to assessing training needs, the Institutional Review Boards at the University of North Carolina at Chapel Hill and University of South Carolina reviewed the survey protocol and determined that it did not constitute human subjects research.

In North Carolina, school nurses who served urban schools and were part of the School Nurse Association of North Carolina (Western region) listserv ($n = 63$) were emailed the survey link by their school nurse supervisor. School nurses ($n = 20$) who participated in the Health-e-Schools program (<http://crhi.org/MY-Health-e-Schools>) were also mailed the survey link. Health-e-Schools is designed to increase access to health care for underserved children and facilitated by school nurses in four rural Western North Carolina counties. In the two

South Carolina counties (one urban, one rural), the lead school nurses emailed the online survey link to all 114 school nurses employed by the school districts. The degree of rurality of the schools was determined based on the 2013 United States Department of Agriculture's Rural-Urban Continuum (RUCA) Codes (Parker, 2011).

Procedure

In order to access the online survey, school nurses clicked on a link that was emailed to them. The survey began with questions about nurses' previous asthma training experiences then asked about their perceived training needs and access to resources. The survey took approximately 5–10 min to complete; there was no incentive to participate.

Instruments

The survey was designed with input from a measurement expert and multiple school nurses in order to address the asthma training topics of importance to them. The survey was also limited to 16 items in order to limit respondent burden.

Previous Asthma Training Experience

Nurses were asked if they had specific training in asthma care (yes/no). If nurses responded that they had received asthma training, they then indicated when they received that training (within the last year, 1–2 years ago, 3–5 years ago, over five years ago), the length of training (<1 h, 1–3 h, >3 h), training mode (in-person/conference, online, other), and whether the training had a specific focus on children (yes/no).

Training Preferences

Nurses indicated which topics they would like additional training in, including: 1) identifying early warning signs of an attack; 2) school protocol for dealing with an acute asthma exacerbation (asthma attack); 3) medication administration; 4) coordinating care with primary care providers or specialists; 5) identifying and eliminating asthma triggers at school; 6) creating and modifying asthma action plans; 7) strategies for identifying symptoms; and 8) other (all "other" choices in the survey included a fillable text box). They also answered a yes/no question regarding whether they would like additional training in how to effectively communicate the needs of students with asthma to others. If they answered yes, they were then asked with whom, with options including: 1) families; 2) students without asthma; 3) teachers; 4) other school faculty/staff (e.g., coaches, bus drivers, custodians, nutrition staff); 5) healthcare providers; and 6) other outside agencies. Finally, nurses indicated whether they would prefer to receive additional training in-person, online, or via another format, as well as how much time they would be willing to dedicate to such training.

Access to Asthma Education Resources

The survey also assessed school nurses' access to asthma education resources. Three yes/no questions assessed: 1) whether there were student asthma education programs at the nurse's school; 2) if there were age-appropriate asthma education materials available to students; and 3) whether the nurse was willing to show educational videos to students. If nurses

indicated asthma education programs were available, they were asked to specify who administered the education and the name of the program.

Nurses checked which of seven common asthma education topics they thought their students would find most useful. Nurses could select multiple topics, including: 1) how to use an inhaler correctly; 2) how to manage asthma while exercising; 3) how to talk to teachers about asthma; 4) how to talk to friends about asthma; 5) how to keep asthma under control (including recognizing triggers, early signs and symptoms of an asthma attack, and management of an asthma attack while in school); 6) the difference between rescue and control medications; and 7) other.

Demographic Questions

The survey included several demographic questions: school setting in which they worked (elementary school (K-5), middle school (6–8), or high school (9–12)); how long they had worked as a school nurse; gender; age (in years); ethnicity (Hispanic/Latino or not); and race (White, Black, American Indian or Alaska Native, Asian, Native Hawaiian or Other Pacific Islander, or Other race).

Data Analysis

Quantitative data were analyzed using IBM SPSS (Version 23). Descriptive statistics (frequencies, means, standard deviations) were used to characterize the sample and summarize nurses' access to asthma resources and training needs. Chi-square tests were used to examine urban-rural differences in nurses' training preferences and access to resources ($\alpha = 0.05$).

Results

Demographic Characteristics

Table 1 presents the demographic characteristics of the study sample. The overwhelming majority of school nurses were White (96.1%) females, ranging from 32 to 68 years of age. Most nurses (67.9%) worked in elementary schools and 22.2% worked in multiple school settings. On average, respondents had worked as school nurses for approximately nine years. Urban and rural nurses were similar on all demographic characteristics with one exception; urban nurses were approximately 5 years older on average ($t = 2.88$, $p < 0.01$).

Previous Asthma Training Experience

Table 2 presents the previous asthma training experiences of urban and rural school nurses. Taken together, the majority of school nurses ($n = 121$, 74.7%) indicated that they had received specific training in asthma care after completion of their nursing degree; and of those, 93.4% ($n = 113$) indicated that the training focused specifically on childhood asthma. Over half of nurses with specific asthma care training received it within the last five years ($n = 82$, 68.3%). Nurses were most likely to receive this training in-person or at a conference ($n = 104$, 85.2%). Six nurses (4.9%) received online training and 12 nurses (9.8%) received training through other modes, such as through working with an asthma/allergy specialty practice. Nurses in urban settings were more likely to have had asthma training after

completing their nursing degree ($\chi^2 = 10.84$, $p = 0.001$). There were no other urban-rural differences in school nurses' previous asthma training.

Training Preferences

One hundred and forty-one nurses (87.0%) wanted additional training on at least one asthma topic. Rural and urban nurses were equally likely to indicate that they wanted additional asthma training ($\chi^2 = 0.13$, $p = 0.91$). As shown in Table 3, nurses were most interested in learning about eliminating school-based asthma triggers ($n = 89$, 54.9%), coordinating care with primary care providers ($n = 78$, 48.1%), and the protocol for dealing with an asthma attack at school ($n = 73$, 45.1%). There were no significant differences in the topics in which urban and rural nurses wanted additional training (all $p < 0.05$).

One hundred and four (65.0%) nurses were interested in receiving more training in effectively communicating the needs of students with asthma to others. Among those who wanted additional asthma communication training, they were most interested in more information on communicating with families ($n = 78$, 48.1%), teachers ($n = 77$, 47.5%), and other school faculty/staff ($n = 72$, 44.4%). Nurses were less interested in training related to communicating student asthma needs to students without asthma ($n = 44$, 27.2%), healthcare providers ($n = 29$, 17.9%), or agencies outside the school ($n = 3$, 1.9%).

Nurses preferred to receive additional asthma training either online ($n = 105$, 64.8%) or in-person ($n = 74$, 45.7%). On average, nurses were interested in spending approximately 4 h to receive additional asthma training (mean = 3.77; standard deviation = 2.97; range: 0–16 h).

Access to Asthma Education Resources

Only 26 nurses (16.1%) indicated that asthma education programs were available to students at their schools. Age-appropriate materials were available on a limited basis as well, with only 71 nurses (44.9%) affirming access to these materials. Nurses in urban settings were more likely to have access to asthma education programs ($\chi^2 = 4.10$, $p = 0.04$) and age-appropriate asthma education materials ($\chi^2 = 8.86$, $p = 0.003$) at their schools.

The American Lung Association's Open Airways for Schools® (2016), which was developed for use with elementary school students, was the most-commonly cited school-based asthma education program utilized ($n = 11$). One middle school nurse specifically noted the use of Safe Schools (<http://www.safeschools.com/>) modules on medication administration. Formal asthma education programs for high school students were not currently being implemented by nurses; however, nurses noted engaging in one-on-one education with older students. School nurses, an asthma case manager from a local hospital, faculty from nearby teaching hospitals, and health department employees were listed as the personnel who implemented asthma education in schools.

Nurses reported that the following topics would be most useful to their students: how to keep asthma under control, how to use an inhaler correctly, how to tell the difference between a rescue and control medication, and how to manage asthma while exercising (Table 4). Urban nurses indicated that their students would find education about the difference between rescue and control medications more useful than students in rural settings ($\chi^2 = 6.89$, $p = 0.009$).

The vast majority of nurses ($n = 137$, 85.1%) reported that they would be willing to show educational videos to their students with asthma; and the number of urban and rural school nurses indicating interest in videos was not significantly different. Among nurses who indicated they would not be willing to show videos, eleven stated they lacked administrative support to pull students from class, four cited personal time constraints, and two responded that asthma videos should be shown during health classes.

Discussion

This paper presents new information about urban and rural differences in school nurses' training preferences and access to asthma education resources. Overall, less than half of nurses reported that age-appropriate asthma education materials were available at their schools. Furthermore, only 16% of nurses were currently implementing asthma education programs at their schools. School nurses in rural settings were less likely than nurses in urban settings to report having asthma education programs and access to age-appropriate asthma education materials at their schools. Regardless of location, nurses indicated a strong desire to receive additional asthma training.

Only 26 school nurses (16%) reported that their school was implementing an asthma education program for students. A previous study in Pennsylvania found that 58% of schools provided asthma education to students (Hillemeier et al., 2006b), suggesting that students in the Carolinas may have less access to asthma education. This finding is concerning given a large number of asthma education programs are available and have been demonstrated to improve student outcomes (Bartholomew et al., 2006; Coffman et al., 2009; Joseph et al., 2007; Levy et al., 2006; Tinkelman & Schwartz, 2004). For example, Open Airways, Puff City, and Roaring Adventures of Puff (RAP) have all led to decreased medical utilization (e.g. fewer hospitalizations, unscheduled doctors' visits, or emergency department visits) in children and adolescents, and some programs have resulted in fewer missed school days, fewer symptom days and nights, and increased child quality of life (Joseph et al., 2007; Levy et al., 2006; McGhan et al., 2003).

A number of barriers may be responsible for the low asthma program implementation rates among the school nurses we surveyed. A previous study found that only 7 out of 25 school nurses indicated that they wanted to implement asthma education programs in their school (Winkelstein et al., 2006). This finding is likely due to several environmental factors, including lack of appropriate resources to purchase and implement programs, lack of qualified nursing staff due to nurses covering multiple schools, time constraints, and lack of institutional and parental support (Hanley Nadeau & Toronto, 2016). A previous study found that school nurse coverage is lower in rural elementary schools; thus, the time barrier may be even more difficult to overcome for rural school nurses (Hillemeier et al., 2006b). In order to increase the number of schools that offer asthma education to their students, nurses may need to draw upon other health care professionals in the community, such as respiratory therapists, pharmacists, or certified asthma educators, who can volunteer their time to teach students with asthma.

Alternatively, technology-based education may offer a practical and sustainable way for both urban and rural nurses to provide asthma education to their students. For example, a recent study found that school nurses were able to use brief videos to significantly improve children's inhaler technique (Carpenter et al., 2016). In the current study, 85% of nurses were willing to show educational videos to their students with asthma, and there were no differences in willingness to show videos for urban and rural nurses. Given that children and adolescents prefer technology and video-based education (Ayala et al., 2006; Geryk et al., 2015), future work should explore how these types of interventions can be feasibly implemented by school nurses in the school setting. Nurse feedback suggests that videos would need to be brief and appropriate administrative support would need to be in place for education videos to be successful.

Our research found that access to formal asthma education programs may be especially lacking for middle and high school students, and previous research shows that few asthma education programs are developed and implemented specifically for students with asthma in this age-group (Berg, Tichacek and Theodorakis, 2004; Magzamen et al., 2008). This finding is important because adolescents often do not optimally self-manage their asthma. For example, controller medication adherence rates are generally low for pediatric patients, ranging from 50% to 70% (Burgess, Sly, & Devadason, 2011). Additionally, adolescents face age-specific pressures that may influence their self-management behaviors, such as being non-adherent to their asthma medications because they do not want to use inhalers in front of their friends (Ayala et al., 2006). Moreover, recent research has shown that adolescents may be overconfident in their ability to use their inhalers correctly (Alexander et al., 2015). Taken together, these findings suggest that efforts should be made to disseminate age-appropriate asthma education programs, such as Puff City and other middle/high school programs (Joseph et al., 2007), to older students who may benefit from additional school-based asthma education.

The vast majority of school nurses in our sample were interested in receiving additional asthma education, and there were no urban-rural differences in nurses' training preferences. Nurses were particularly interested in receiving training on identifying and eliminating school-based asthma triggers, the protocol to implement during an asthma attack, and coordinating asthma care with students' primary care providers. Given the time constraints facing nurses, asthma training should be carefully crafted to meet their needs (Hanley Nadeau & Toronto, 2016; Winkelstein et al., 2006). Nurses were willing to devote approximately 4 h to training and were equally interested in an online or in-person training format. Previous studies that have evaluated the effects of online and in-person school nurse asthma education training programs have found modest improvements in knowledge and confidence regardless of training format (Putman-Casdorff & Pinto, 2011). Online training modules may offer the benefit of allowing nurses to tailor their educational experience, by selecting the topics that are greatest of interest to them, while also allowing them to incorporate training into their busy work schedules.

Limitations

This study is limited by the use of a convenience sample of school nurses in two states; findings may not generalize to other parts of the country. The small sample size of rural nurses ($N = 37$) may have limited our ability to detect small to moderate differences in the asthma resources and training preferences of urban and rural school nurses. Furthermore, the results should be interpreted with caution due to a potential selection bias, whereby only the most motivated school nurses completed the survey, which could overestimate nurse interest in receiving additional asthma training. Additionally, nurses may have responded with socially desirable answers, which could also result in overestimating nurse interest in receiving additional asthma training. We also did not assess the educational level of nurses, so we were unable to explore differences in training preferences by educational level. Despite these limitations, this survey yielded new data regarding urban and rural school nurses' access to asthma education resources and their asthma training preferences.

Conclusions

Over 8% of young people under the age of 18 have a diagnosis of current asthma (Akinbami et al., 2016). Offering school-based asthma education could help curtail the negative impact of asthma on children and adolescents' quality of life, while also contributing to the successful attainment of the Healthy People 2020 asthma goals. Our results highlight that there is great opportunity to increase the number of students who receive school-based asthma education, particularly middle and high school students and students in rural areas. School nurses are willing to receive additional asthma training via online and in-person training formats in order to learn how to more effectively provide asthma education to their students.

Implications for School Health

In our survey, we found that that over half of schools are not providing asthma education programs to their students. Additional studies that examine whether these results can be replicated with a national survey of schools are warranted given that schools are an ideal setting for delivering age-appropriate asthma education. Additionally, qualitative studies that provide in-depth insights into the challenges school nurses encounter to obtaining and delivering asthma education in urban and rural schools are an important area for future research. Because many effective school-based asthma education programs exist (Bartholomew et al., 2006; Coffman et al., 2009; Joseph et al., 2007; Levy et al., 2006; Tinkelman & Schwartz, 2004), efforts should be made to disseminate these curricula to school nurses so that they have age-appropriate teaching materials readily available.

Most nurses in our sample desired additional asthma training, which is encouraging given that training can increase nurses' knowledge and confidence to provide asthma education services to their students (Butz et al., 2005; Putman-Casdorph & Pinto, 2011). However, rural nurses were significantly less likely to have had access to post-nursing school asthma training, a finding consistent with previous research on disparities in rural-urban school nursing continuing education (Ramos, Fullerton, Sapien, Greenberg, & Bauer-Creegan, 2014). Tailored asthma training using telehealth or online course technologies could address

access barriers experienced by rurally-located school nurses, such as distance or time constraints. Online and in-person training formats that are 4 h or less and focus on salient asthma topics such as those indicated by our survey participants are likely to be most welcomed by nurses. By providing school nurses with access to age-appropriate asthma education resources and additional asthma training, we can help them overcome several of the barriers that impede their ability to deliver asthma care to their students.

Acknowledgments

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

References

- Akinbami LJ, Moorman JE, Liu X. Asthma prevalence, health care use, and mortality: United States, 2005–2009. *National Health Statistics Reports*. 2011; 12(32):1–14.
- Akinbami LJ, Simon AE, Rossen LM. Changing trends in asthma prevalence among children. *Pediatrics*. 2016; 137(1):1–7. DOI: 10.1542/peds.2015-2354
- Alexander DS, , Geryk L, , Arrindell C, , DeWalt DA, , Weaver MA, , Sleath B, , Carpenter DM. Are children with asthma overconfident they are using their inhalers correctly?. *Journal of Asthma* 2015
- American Lung Association. About Open Airways for Schools 2016 Retrieved from <http://www.lung.org/lung-health-and-diseases/lung-disease-lookup/asthma/asthma-education-advocacy/open-airways-for-schools/about-open-airways.html?referrer=https://www.google.com/>
- Ayala GX, Miller DL, Zagami E, Riddle C, Willis S, King D. Asthma in middle schools: What students have to say about their asthma. *Journal of School Health*. 2006; 76(6):208–214. DOI: 10.1111/j.1746-1561.2006.00098.x [PubMed: 16918840]
- Bartholomew LK, Sockrider MM, Abramson SL, Swank PR, Czyzewski DI, Tortolero SR, ... Tyrrell S. Partners in schools asthma management: Evaluation of a self-management program for children with asthma. *Journal of School Health*. 2006; 76(6):283–290. DOI: 10.1111/j.1746-1561.2006.00113.x [PubMed: 16918856]
- Berg J, Tichacek MJ, Theodorakis R. Evaluation of an educational program for adolescents with asthma. *Journal of School Nursing*. 2004; 20(1):29–35. [PubMed: 14731108]
- Burgess S, Sly P, Devadason S. Adherence with preventative medication in childhood asthma. *Pulmonary Medicine*. 2011; 2011doi: 10.1155/2011/973849
- Butz A, Kub J, Bellin MH, Frick KD. Challenges in providing preventive care to inner-city children with asthma. *Nursing Clinics of North America*. 2013; 48(2):241–257. DOI: 10.1016/j.cnur.2013.01.008 [PubMed: 23659811]
- Butz A, Pham L, Lewis L, Lewis C, Hill K, Walker J, Winkelstein M. Rural children with asthma: Impact of a parent and child asthma education program. *Journal of Asthma*. 2005; 42(10):813–821. DOI: 10.1080/02770900500369850 [PubMed: 16393717]
- Carpenter DM, Alexander DS, Elio A, DeWalt D, Lee C, Sleath BL. 2016Using tailored videos to teach inhaler technique to children with asthma: Results from a school nurse-led pilot study. *Journal of Pediatric Nursing*.
- Christiansen SC, Zuraw BL. Serving the underserved: School-based asthma intervention programs. *Journal of Asthma*. 2002; 39(6):463–472. [PubMed: 12375704]
- Coffman JM, Cabana MD, Yelin EH. Do school-based asthma education programs improve self-management and health outcomes? *Pediatrics*. 2009; 124(2):729–742. DOI: 10.1542/peds.2008-2085 [PubMed: 19651589]
- Cui W, Zack MM, Zahran HS. Health-related quality of life and asthma among United States adolescents. *Journal of Pediatrics*. 2015; 166(2):358–364. DOI: 10.1016/j.jpeds.2014.10.005 [PubMed: 25454936]

- Geryk LL, , Arrindell CC, , Sage AJ, , Blalock SJ, , Reuland DS, , Coyne-Beasley T, , ... Carpenter DM. Exploring youth and caregiver preferences for asthma education video content; *Journal of Asthma* 2015 16
- Groenewald CB, , Wright DR, , Palermo TM. Health care expenditures associated with pediatric pain-related conditions in the United States; *Pain* 2015 951957
- Halterman JS, Fagnano M, Montes G, Fisher S, Tremblay P, Tajon R, ... Butz A. The school-based preventive asthma care trial: Results of a pilot study. *Journal of Pediatrics*. 2012; 161(6):1109–1115. DOI: 10.1016/j.jpeds.2012.05.059 [PubMed: 22785264]
- Hanley Nadeau E, Toronto CE. Barriers to asthma management for school nurses: An integrative review. *Journal of School Nursing*. 2016; 32(2):86–98. DOI: 10.1177/1059840515621607 [PubMed: 26656476]
- Hillemeier MM, Gusic ME, Bai Y. Rural and urban children with asthma: are school health services meeting their needs? *Pediatrics*. 2006a; 118(3):1097–1103. [PubMed: 16951003]
- Hillemeier MM, Gusic M, Bai Y. Communication and education about asthma in rural and urban schools. *Ambulatory Pediatrics*. 2006b; 6(4):198–203. DOI: 10.1016/j.ambp.2006.04.004 [PubMed: 16843250]
- Horner SD, Brown SA, Walker VG. Is rural school-aged children's quality of life affected by their responses to asthma? *Journal of Pediatric Nursing*. 2012; 27(5):491–499. DOI: 10.1016/j.pedn.2011.06.012 [PubMed: 22920660]
- Horner SD, Brown A. Evaluating the effect of an asthma self-management intervention for rural families. *Journal of Asthma*. 2014; 51(2):168–177. DOI: 10.3109/02770903.2013.855785 [PubMed: 24188732]
- Joseph CL, Peterson E, Havstad S, Johnson CC, Hoerauf S, Stringer S, ... Strecher V. A web-based, tailored asthma management program for urban African-American high school students. *American Journal of Respiratory and Critical Care Medicine*. 2007; 175(9):888–895. DOI: 10.1164/rccm.200608-1244OC [PubMed: 17290041]
- Kit BK, Simon AE, Tilert T, Okelo S, Akinbami LJ. Differences in spirometry values between US children 6–11 years and adolescents 12–19 years with current asthma, 2007–2010. *Pediatric Pulmonology*. 2016; 51(3):272–279. DOI: 10.1002/ppul.23238 [PubMed: 26152859]
- Levy M, Heffner B, Stewart T, Beeman G. The efficacy of asthma case management in an urban school district in reducing school absences and hospitalizations for asthma. *The Journal of School Health*. 2006; 76(6):320.doi: 10.1111/j.1746-1561.2006.00120.x [PubMed: 16918863]
- Magzamen S, Patel B, Davis A, Edelstein J, Tager IB. Kickin' asthma: School-based asthma education in an urban community. *Journal of School Health*. 2008; 78(12):655–665. DOI: 10.1111/j.1746-1561.2008.00362.x [PubMed: 19000242]
- McGhan SL, Wong E, Jhangri GS, Wells HM, Michaelchuk DR, Boechler VL, ... Hessel PA. Evaluation of an education program for elementary school children with asthma. *Journal of Asthma*. 2003; 40(5):523–533. DOI: 10.1081/JAS-120018785 [PubMed: 14529102]
- Mujuru P, Salana H, Kellam N, Howell C. Challenges to childhood asthma intervention delivery in hard-to-reach small rural communities a school-based approach. *Journal of Asthma & Allergy Educators*. 2011; 2(5):225–232. DOI: 10.1177/2150129710395751
- Office of Disease Prevention and Health Promotion. Healthy People 2016 p.2020. Retrieved from <https://www.healthypeople.gov/>
- Parker T. USDA Economic Research Service-Rural-Urban Continuum Codes 2011 Retrieved from <http://www.ers.usda.gov/data-products/rural-urban-continuum-codes>
- Pesek RD, Vargas PA, Halterman JS, Jones SM, McCracken A, Perry TT. A comparison of asthma prevalence and morbidity between rural and urban schoolchildren in Arkansas. *Annals of Allergy, Asthma & Immunology*. 2010; 104(2):125–131. DOI: 10.1016/j.anai.2009.11.038
- Putman-Casdorph H, Pinto S. Preliminary testing of an asthma distance education program (ADEP) for school nurses in Appalachia. *Journal of School Nursing*. 2011; 27(6):411–415. DOI: 10.1177/1059840511420162 [PubMed: 21859947]
- Ramos MM, Fullerton L, Sapien R, Greenberg C, Bauer-Creagan J. Rural-urban disparities in school nursing: Implications for continuing education and rural school health. *The Journal of Rural Health*. 2014; 30(3):265–274. DOI: 10.1111/jrh.12058 [PubMed: 24612383]

- Tinkelman D, Schwartz A. School-based asthma disease management. *Journal of Asthma*. 2004; 41(4): 455–462. [PubMed: 15281331]
- Valet RS, Gebretsadik T, Carroll KN, Wu P, Dupont WD, Mitchel EF, Hartert TV. High asthma prevalence and increased morbidity among rural children in a Medicaid cohort. *Annals of Allergy, Asthma & Immunology*. 2011; 106(6):467–473. DOI: 10.1016/j.anai.2011.02.013
- Winkelstein ML, Quartey R, Pham L, Lewis-Boyer L, Lewis C, Hill K, Butz A. Asthma education for rural school nurses: Resources, barriers, and outcomes. *Journal of School Nursing*. 2006; 22(3): 170–177. DOI: 10.1177/10598405060220030801 [PubMed: 16704287]
- Yawn BP, Arch GM III, Love MM, Hueston W. Do rural and urban children have comparable asthma care utilization? *The Journal of Rural Health*. 2001; 17(1):32–39. [PubMed: 11354720]

Table 1

Demographic characteristics of nurses (N = 162).

	Urban (N = 125)		Rural (N = 37)	
	n (%) or Mean $\pm$ SD		n (%) or Mean $\pm$ SD	
Work setting ^a				
Elementary school (K-5)	84	(67.2)	26	(70.3)
Middle school (6-8)	43	(34.4)	9	(24.3)
High school (9-12)	34	(27.2)	7	(18.9)
Two or more settings	31	(24.8)	5	(13.5)
Years worked	9.4	± 5.9	7.1	± 6.0
Range: (urban: 0.07-25; rural: 1-20) ^b				
Gender ^c				
Male	1	(0.8)	0	(0)
Female	121	(99.2)	36	(100)
Age in years ^{d,*}	50.5	± 9.0	45.3	± 8.8
Range: (urban: 32-68; rural: 32-64)				
Ethnicity ^e				
Hispanic, Latino, or Spanish origin	2	(1.7)	0	(0)
Race ^f				
White	115	(96.6)	33	(94.3)
Black	4	(3.4)	1	(2.9)
Other race	0	(0)	1	(2.9)

^aNurses could select multiple school settings, so totals do not add to 100%.^b2 urban and 5 rural nurses did not respond to this question.^c3 urban and 1 rural nurse did not respond to this question.^d13 urban and 6 rural nurses did not respond to this question.^e5 urban nurses did not respond to this question.^f6 urban and 2 rural nurses did not respond to this question.* Significant t-test ($p < 0.01$).

Table 2

Previous school nurse asthma training experience (N = 162).

Topic	Urban	Rural
	n (%)	n (%)
Received asthma training after completing nursing degree ^{a, *}	101(80.8)	20(54.1)
Received pediatric-focused asthma training after completing nursing degree ^b	95(94.1)	18(90.0)
When asthma training was received ^c		
Within last year	25(25.0)	5(25.0)
1–2 years ago	46(46.0)	6(30.0)
3–5 years ago	15(15.0)	7(35.0)
Over 5 years ago	14(14.0)	2(10.0)
Mode of previous asthma training ^{d, *}		
In-person	33(32.7)	9(42.9)
At a conference	56(55.4)	6(28.6)
Online	4(4.0)	2(9.5)
Other	6(5.9)	0(0.0)
Two or more training modes	2(2.0)	4(19.0)

^a n = 125 for urban nurses and n = 37 for rural nurses.^b n = 101 for urban nurses and n = 20 for rural nurses since only nurses who received asthma training were asked this question.^c n = 100 for urban nurses (1 did not respond to this question) and n = 20 for rural nurses.^d n = 101 for urban nurses and n = 20 for rural nurses.^{*} Significant chi-square test (p < 0.01).

Table 3

Topics for which school nurses would like more training (N = 162).

Topic	Urban (N = 125)	Rural (N = 37)
	n (%)	n (%)
Identifying and eliminating asthma triggers at school	71(56.8)	18(48.6)
Coordinating care with child's primary care provider	63(50.4)	15(40.5)
Protocol for dealing with attack at school	55(44.0)	18(48.6)
Strategies to help children document symptoms	48(38.4)	11(29.7)
Identifying early warning signs of an asthma attack	42(33.6)	14(37.8)
Creating and modifying asthma action plans	43(34.4)	8(21.6)
Medication administration	34(27.2)	6(16.2)
No additional training desired	14(11.2)	5(13.5)

Table 4

Asthma education topics nurses believed students would find most useful (N = 162).

Topic	Urban (N = 125)	Rural (N = 37)
	n (%)	n (%)
How to keep asthma under control	113(90.4)	33(89.2)
How to use an inhaler correctly	113(90.4)	31(83.8)
The difference between a rescue and controller medication *	108(86.4)	25(67.6)
How to manage asthma while exercising	96(76.8)	30(81.1)
How to talk to teachers about asthma	60(48.0)	18(48.6)
How to talk to friends about asthma	60(48.0)	17(45.9)

Note: Nurses could select multiple topics.

* Significant chi-square tests ($p < 0.01$).