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Pediatric Secondhand Smoke Exposure: Moving Toward Systematic Multi-Level Strategies to Improve Health

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The World Health Organization estimates that, worldwide, more than 50% of children experience secondhand smoke exposure (SHSe) daily, with higher rates of exposure observed in medically-underserved populations.^{1, 2} There is no safe level of SHSe, and routine exposure greatly increases the probability that children will initiate smoking themselves.³⁻⁵ Children's SHSe is linked to sudden infant death syndrome and numerous acute illnesses (e.g., otitis, respiratory infections), as well as asthma, cancers, and cardiovascular disease (CVD) - increasing CVD risk by as much as 20%.^{6, 7} In addition to the direct harmful effects of SHSe on cardiovascular health,^{6, 8-10} SHSe negatively affects children's diets, activity levels, and percent body fat,^{11, 12} which can further impair their cardiovascular health.

Systematic Intervention

Reducing children's SHSe has become a global health priority.¹³ Because children's SHSe is influenced by multiple factors and occurs across multiple contexts, it is understandable that any single SHSe-reduction approach will have limited effectiveness. For example, interventions that target one particular facet of the SHSe problem (e.g., lack of knowledge about SHSe harm) might not address other relevant causes (e.g., parental nicotine dependence, limited enactment of smoke-free laws in public venues, etc.). To improve impact, future efforts should consider comprehensive behavioral- and social-ecological approaches that can guide integrated multilevel approaches. Such approaches can exploit strengths and minimize shortcomings of single-level, evidence-based approaches such as family-, healthcare provider-, community- and wider population-level interventions, while building linkages across levels of intervention to facilitate synergistic intervention effects (See detailed descriptions of ecological models).^{14, 15}

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In 2007, the National Cancer Institute called for better “adoption of evidence-based practices” and better connections across the broad range of stakeholders involved with tobacco control.¹⁶ A similar charge came from the National Institutes of Health in 2009, with recommendations to advance the science of behavior change by testing comprehensive, multilevel approaches to tobacco smoking.¹⁷ The following sections outline key levels of intervention and identify some challenges and opportunities across strategies.

Family-level Interventions

The majority of children's SHSe occurs from parental smoking in the home and car.^{2, 18, 19} Family intervention that promotes parental smoking cessation is a critical cornerstone the most critical element in a comprehensive SHSe-reduction approach. Because parental readiness to engage in SHSe reduction efforts is often higher than their readiness to quit smoking,²⁰ recent behavioral counseling trials in Western countries have aimed to facilitate home smoking bans as their primary objective while encouraging motivation and support to quit smoking as parents' smoke-free home goals are realized²¹. The implementation of more intensive counseling interventions for smoking parents in recent years is a direct response to evidence from earlier, less-intensive trials' nonsignificant effects²²⁻²⁵ and growing concern about third-hand smoke^{26, 27}.

Unlike provider- and population-level interventions, family-level counseling strategies provide intervention intensity necessary to promote lasting smoking behavior change and SHSe reduction in the home. They also have the unique capacity to adapt evidence-based strategies to a family's cultural and systems milieu. Family-level intervention outcomes and program sustainability can only be enhanced by bridging counseling strategies to other levels of intervention. For example, parents enrolled in smoking cessation programs that are linked as a known referral source in pediatric primary care can benefit from the ongoing advice and encouragement pediatricians can provide beyond the end date of a counseling program. An integrated, multilevel approach to protecting children from SHSe points to opportunities for pediatric healthcare providers to improve the quality of advice to parents about SHSe-reduction, as well as the frequency of (a) referrals to existing smoking cessation programs, (b) assisting parents in acquiring nicotine withdrawal aids, and (c) offering ongoing follow-up and support for behavior change challenges and maintenance of treatment gains.

Clinic-level, Provider Interventions

Given the frequency of contact between pediatricians and parents,²⁸ there is extraordinary opportunity for pediatric healthcare providers to improve child health by addressing parental smoking. Parents view pediatric provider advice to be credible in general, and brief advice about smoking cessation and reducing SHSe can motivate parents to consider smoking behavior change.^{29, 30} While most pediatricians are aware of Public Health Service Guidelines for parental tobacco intervention, they have yet to embrace their role in SHSe reduction and in helping parents quit smoking.³¹ Pediatric provider adherence to tobacco intervention guidelines continues to lag because of many clinic-level barriers to implementation (e.g., perceived lack of time, lack of tobacco-specific training) and lack of confidence.^{20, 24, 29, 32, 33} Clinic quality improvement (CQI) interventions have been implemented recently to improve provider advice to smoking parents.^{20, 34} However, even when the quality and frequency of advice improves, advice alone is insufficient to promote lasting smoking behavior change. There is an opportunity for CQI programs to enhance the impact of provider-level interventions by integrating provider or clinic-level advice with broader community-level approaches and more intensive family-level strategies. Such linkages could create reciprocal, synergistic treatment effects that not only capitalize on

providers' credibility, improve provider knowledge of referral resources, and exploit the continuity of care parents receive from providers, but also relieve providers from the burden of delivering the necessary, intense counseling components that promote sustained smoking behavior change.

Community-level interventions

Behavioral ecological models provide a framework that explains how social reinforcement of smoking restrictions and shifts in smoke-free norms at one level (e.g., community) can contribute to shifts in norms, attitudes about smoking, and smoking behavior at other levels (e.g., the home).³⁵ Efforts at the community level can help bolster social norms that support the evidence-based consensus that SHSe is not healthy for anyone - children in particular. Efforts to promote broad shifts in pro SHSe-reduction norms can include education on the dangers of smoking and exposure to SHS provided in school curriculums^{36, 37} as well as in afterschool programs, and community-based children's clubs. Community-based child health promotion programs, such as *Women, Infants and Children* (WIC) and *Head Start* can model smoke-free settings and encourage parents to do the same in their homes.³⁸ Voluntary smoke-free policies or smoke-free social events also help assimilate social norms that support SHSe-reduction into routine community activities. In addition to active strategies at a community-level, broader, more implicit strategies can facilitate shifts in attitudes and beliefs toward SHSe-reduction norms. For example, smoke-free media campaigns have been effective in reducing SHSe as well as modifying youth perceptions of tobacco use.^{39, 40} Media campaigns targeting at-risk communities also can help educate parents about the dangers of children's SHSe and encourage the use of existing resources that may be available to them, such as telephone quit lines, quit support groups, or distribution of free or low-cost NRT.

Policy interventions

Finally, policy interventions to promote smoke-free environments can serve as the backbone to this multi-level model. Policies that prohibit smoking in public places⁴¹ have been successful in reducing exposure to secondhand smoke for youth.⁴² Policies that create smoke-free environments in settings where children frequent, such as cars,⁴³ daycare centers,⁴⁴ public parks⁴⁵ and zoos⁴⁶ are necessary to ensure safe environments frequented by children. In the U.S., states and local jurisdictions have implemented innovative efforts to explore additional protections such promote shifts in perceived norms about smoking. Likewise, laws that promote SHSe reduction in public spaces can implicitly encourage parents to consider adopting family-level smoking restrictions or entering counseling to facilitate smoking cessation.^{48, 49} Finally, smoke-free laws provide impetus for communities to encourage consistent smoke-free environments across public and private contexts – a goal endorsed by the U.S. EPA³⁸ and consistent with IOM recommendations for tobacco control treatment integration across systems.¹⁶

Future Multi-level Interventions

The next steps to improve services and programs designed to protect children from SHSe should comprise explicitly integrated, multiple points of intervention where behavioral science and health policy can address SHSe at the family-, provider-, and community levels.¹⁷ Current approaches to intervention and control are limited in their potential impact when implemented at a single level, disjointed from efforts conducted simultaneously. SHSe interventions must focus on environmental factors (e.g., smoke-free policies),^{50, 51} social factors (e.g., pediatrician recommendation),⁵² individual factors (e.g., motivation to change; nicotine dependence; coping skills training) and family systems factors (e.g., family norms

and support for smoking behavior change).^{21, 22} The failure to develop multilevel approaches remains a critical barrier to progress in the field.⁵³

Intervention research and policy experts recognize that in many underserved and low income communities, lack of resources may impede near-term implementation of multilevel tobacco control strategies. In such communities, the implementation of SHSe-reduction efforts at any single level of intervention will be a critical and positive first step to protecting children. Nonetheless, even initial SHSe-reduction efforts can avoid simplistic, single-level action plans by acknowledging the multifactorial nature of SHSe and working toward long-term goals that expand initial gains into more comprehensive programming.

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References

1. World Health Organization. [Accessed December, 2011] http://www.who.int/tobacco/research/secondhand_smoke/faq/en/index.html
2. Wipfli H, Avila-Tang E, Navas-Acien A, et al. Secondhand smoke exposure among women and children: evidence from 31 countries. *Am J Public Health*. Apr; 2008 98(4):672–679. [PubMed: 18309121]
3. Farkas A, Gilpin E, White M, Pierce J. Association between household and workplace smoking restrictions and adolescent smoking. *JAMA*. 2000; 284(6):717–722. [PubMed: 10927780]
4. Klein EG, Forster JL, Erickson DJ, Lytle LA, Schillo B. The relationship between local clean indoor air policies and smoking behaviours in Minnesota youth. *Tob Control*. Apr; 2009 18(2):132–137. [PubMed: 19103639]
5. Seo DC, Torabi MR, Weaver AE. Factors influencing openness to future smoking among nonsmoking adolescents. *J Sch Health*. Jun; 2008 78(6):328–336. [PubMed: 18489466]
6. Weiss ST. Cardiovascular effects of environmental tobacco smoke. *Circulation*. Aug 15.1996 94(4): 599. [PubMed: 8772673]
7. Metsios GS, Flouris AD, Angioi M, Koutedakis Y. Passive smoking and the development of cardiovascular disease in children: a systematic review. *Cardiol Res Pract*. 2011:2011. Article ID 587650.
8. Neufeld EJ, Mietus-Snyder M, Beiser AS, Baker AL, Newburger JW. Passive cigarette smoking and reduced HDL cholesterol levels in children with high-risk lipid profiles. *Circulation*. Sep 2; 1997 96(5):1403–1407. [PubMed: 9315524]
9. Pitsavos C, Panagiotakos DB, Chrysohooou C, et al. Association between exposure to environmental tobacco smoke and the development of acute coronary syndromes: the CARDIO2000 case-control study. *Tob Control*. Sep; 2002 11(3):220–225. [PubMed: 12198272]
10. Pope CA 3rd, Eatough DJ, Gold DR, et al. Acute exposure to environmental tobacco smoke and heart rate variability. *Environ Health Perspect*. Jul; 2001 109(7):711–716. [PubMed: 11485870]
11. Burke V, Gracey MP, Milligan RA, Thompson C, Taggart AC, Beilin LJ. Parental smoking and risk factors for cardiovascular disease in 10- to 12-year-old children. *J Pediatr*. Aug; 1998 133(2): 206–213. [PubMed: 9709707]
12. Byrd RS, Howard CR. Children's passive and prenatal exposure to cigarette smoke. *Pediatr Ann*. Dec; 1995 24(12):640–642. 644–645. [PubMed: 8747706]
13. World Health Organization. International Consultation on Environmental Tobacco Smoke (ETS) and Child Health; January 11-14, 1999; Geneva, Switzerland.
14. Hovell, MF.; Wahlgren, DR.; Gehrman, C. The behavioral ecological model: Integrating public health and behavioral science. In: DiClemente, RJ.; C. R.; K. M., editors. *New and emerging models and theories in health promotion and health education*. San Francisco, CA: Josey-Bass Inc; 2002. p. 347-385.

15. Stokols D. Translating social ecological theory into guidelines for community health promotion. *Am J Health Promot.* Mar-Apr;1996 10(4):282–298. [PubMed: 10159709]
16. National Cancer Institute. US Department of Health and Human Services National Institutes of Health, National Cancer Institute. *Greater Than the Sum: Systems Thinking in Tobacco Control.* Bethesda, MD: NIH; 2007. Vol Tobacco Control Monograph No. 18
17. National Institutes of Health Science of Behavior Change. NIH Science and Behavior Change Meeting; Bethesda, MD. 2009.
18. Jarvis MJ, Goddard E, Higgins V, Feyerabend C, Bryant A, Cook DG. Children's exposure to passive smoking in England since the 1980s: cotinine evidence from population surveys. *BMJ.* Aug 5; 2000 321(7257):343–345. [PubMed: 10926591]
19. U.S. Department of Health and Human Services. *The Health Consequences of Involuntary Exposure to Tobacco Smoke. A Report of the Surgeon General.*
20. Winickoff JP, Park ER, Hipple BJ, et al. Clinical effort against secondhand smoke exposure: development of framework and intervention. *Pediatrics.* Aug; 2008 122(2):e363–375. [PubMed: 18676523]
21. Collins, BN.; Nair, US.; Jaffe, K.; Hovell, MF.; Wileyto, EP.; J, AM. Behavioral counseling with maternal smokers in underserved communities is effective in reducing young children's SHS exposure; Baltimore, MD. 2010.
22. Emmons KM, Wong M, Hammond SK, et al. Intervention and policy issues related to children's exposure to environmental tobacco smoke. *Prev Med.* Apr; 2001 32(4):321–331. [PubMed: 11304093]
23. Gehrman CA, Hovell MF. Protecting children from environmental tobacco smoke (ETS) exposure: a critical review. *Nicotine Tob Res.* Jun; 2003 5(3):289–301. [PubMed: 12791524]
24. Priest N, Roseby R, Waters E, et al. Family and carer smoking control programmes for reducing children's exposure to environmental tobacco smoke. *Cochrane Database Syst Rev.* 2008; (4):CD001746. [PubMed: 18843622]
25. Wong GY, Wolter TD, Croghan GA, Croghan IT, Offord KP, Hurt RD. A randomized trial of naltrexone for smoking cessation. *Addiction.* Aug; 1999 94(8):1227–1237. [PubMed: 10615738]
26. Matt GE, Quintana PJ, Destailats H, et al. Thirdhand tobacco smoke: emerging evidence and arguments for a multidisciplinary research agenda. *Environ Health Perspect.* Sep; 119(9):1218–1226. [PubMed: 21628107]
27. Protano C, Vitali M. The new danger of thirdhand smoke: why passive smoking does not stop at secondhand smoke. *Environ Health Perspect.* Oct.119(10):A422. [PubMed: 21968336]
28. Horwitz, SM.; Bell, J. The failure of community settings for the identification and treatment of depression in women with young children., in *Community- Based Mental Health Services for Children and Adolescents With Mental Health Needs.* In: Fisher, WH., editor. *Research in Community and Mental Health.* Oxford, United Kingdom: Elsevier Sciences; 2006. p. 13-31.
29. Lancaster T, Stead L. Physician advice for smoking cessation. *Cochrane Database Syst Rev.* 2004; (4):CD000165. [PubMed: 15494989]
30. Rustin TA. Techniques for smoking cessation: what really works? *Tex Med.* Feb; 2001 97(2):63–67. [PubMed: 11233062]
31. Tanski SE, Klein JD, Winickoff JP, Auinger P, Weitzman M. Tobacco counseling at well-child and tobacco-influenced illness visits: opportunities for improvement. *Pediatrics.* Feb; 2003 111(2):E162–167. [PubMed: 12563090]
32. Collins BN, Levin KP, Bryant-Stephens T. Pediatricians' practices and attitudes about environmental tobacco smoke and parental smoking. *J Pediatr.* May; 2007 150(5):547–552. [PubMed: 17452234]
33. Mueller DT, Collins BN. Pediatric otolaryngologists' actions regarding secondhand smoke exposure: pilot data suggest an opportunity to enhance tobacco intervention. *Otolaryngol Head Neck Surg.* Sep; 2008 139(3):348–352. [PubMed: 18722210]
34. Hall N, Hipple B, Friebely J, Ossip DJ, Winickoff JP. Addressing Family Smoking in Child Health Care Settings. *J Clin Outcomes Manag.* Aug; 2009 16(8):367–373. [PubMed: 20448841]
35. Hovell MF, Hughes SC. The behavioral ecology of secondhand smoke exposure: A pathway to complete tobacco control. *Nicotine Tob Res.* Nov; 2009 11(11):1254–1264. [PubMed: 19776346]

36. Franks A, Kelder SH, Dino GA, et al. School-based programs: lessons learned from CATCH, Planet Health, and Not-On-Tobacco. *Prev Chronic Dis.* Apr.2007 4(2):A33. [PubMed: 17362624]
37. American Academy of Family Physicians. [Accessed April 9, 2012] Tar Wars: A tobacco-free education program for kids from the American Academy of Family Physicians. <http://www.tarwars.org/online/tarwars/home.html>
38. Environmental Protection Agency. [Accessed April 9, 2012] Promoting Smoke-free Homes for Head Start Families. <http://www.epa.gov/iaq/headstart/index.html>
39. Wakefield M, Flay B, Nichter M, Giovino G. Role of the media in influencing trajectories of youth smoking. *Addiction.* May; 2003 98(Suppl 1):79–103. [PubMed: 12752363]
40. Wakefield M, Terry-McElrath Y, Emery S, et al. Effect of televised, tobacco company-funded smoking prevention advertising on youth smoking-related beliefs, intentions, and behavior. *Am J Public Health.* Dec; 2006 96(12):2154–2160. [PubMed: 17077405]
41. [Accessed April 9,2012] Campaign for Tobacco Free Kids. <http://www.tobaccocontrolaws.org/>
42. Dove MS, Dockery DW, Connolly GN. Smoke-free air laws and secondhand smoke exposure among nonsmoking youth. *Pediatrics.* Jul; 126(1):80–87. [PubMed: 20530079]
43. Centers of Disease Control. Report USGs. New Frontiers for Tobacco Control: State Laws Restricting Smoking in Vehicles. 2006.
44. Centers of Disease Control. State Tobacco Activities Tracking & Evaluation System, State Smoke-free Indoor Air Fact Sheet: Day Care Centers. 2009
45. Municipalities with Smokefree Park Laws. [Accessed April 9, 2012] 2012. <http://www.no-smoke.org/pdf/SmokefreeParks.pdf>
46. Municipalities with Smokefree Zoo Laws. [Accessed April 9, 2012] 2012. <http://www.no-smoke.org/pdf/SmokefreeZoos.pdf>
47. Mills AL, White MM, Pierce JP, Messer K. Home smoking bans among u.s. Households with children and smokers opportunities for intervention. *Am J Prev Med.* Dec; 41(6):559–565. [PubMed: 22099231]
48. Chang HY, Wu WC, Wu CC, Cheng JY, Hurng BS, Yen LL. The incidence of experimental smoking in school children: an 8-year follow-up of the child and adolescent behaviors in long-term evolution (CABLE) study. *BMC Public Health.* 11:844. [PubMed: 22051222]
49. Thomson G, Wilson N. Public attitudes to laws for smoke-free private vehicles: a brief review. *Tob Control.* Aug; 2009 18(4):256–261. [PubMed: 19052041]
50. Jackson C, Dickinson D. Can parents who smoke socialise their children against smoking? Results from the Smoke-free Kids intervention trial. *Tob Control.* Mar; 2003 12(1):52–59. [PubMed: 12612363]
51. Gilpin E, Pierce J. Demographic differences in patterns in the incidence of smoking cessation: United States 1950-1990. *Ann Epidemiol.* 2002; 12:141–150. [PubMed: 11897171]
52. Chilmonczyk BA, Palomaki GE, Knight GJ, Williams J, Haddow JE. An unsuccessful cotinine-assisted intervention strategy to reduce environmental tobacco smoke exposure during infancy. *Am J Dis Child.* Mar; 1992 146(3):357–360. [PubMed: 1543187]
53. Klerman L. Protecting children: reducing their environmental tobacco smoke exposure. *Nicotine Tob Res.* Apr; 2004 6(Suppl 2):S239–253. [PubMed: 15203824]