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Lead Poisoning: How What We Don't Know Is Hurting America's Children

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The Need for a National Lead Poisoning Surveillance System and Expansion of Targeted Screening In Children

Health Effects of Lead Poisoning

Recent events in Flint, Michigan underscore a devastating issue affecting children in the United States: lead poisoning. Screening and reporting of lead exposure in children is inadequate and many cases of lead poisoning go unnoticed until it is too late. Lead exposure in children has been repeatedly linked with irreversible behavioral problems and cognitive impairment.[1] [2][3]This can occur even at levels where other symptoms of lead poisoning, such as headache, abdominal pain and loss of appetite are not present.[4][5]Thus, lead exposure screening and blood testing must be systematic, rather than awaiting clinical symptoms.

How Are Children Exposed?

The home is the most common source of lead exposure, especially houses built before 1950, when lead-based paint was used. Exposure from parental occupation and food and water supply also occur.[6]For example, water supply was the cause of the many cases of lead poisoning in Flint. Children are especially vulnerable to the effects of lead exposure because their brains are still developing and they are more likely than adults to ingest things in their environment (such as chipping paint). It has also been shown that children absorb more ingested

[1] Liu J, Liu X, Wang W et al. Blood Lead Levels and children's Behavioral and Emotional Problems: A Cohort Study. JAMA pediatrics. 2014;168(8):737-74
[2] Koller, Karin *et al*. "Recent developments in low-level lead exposure and intellectual impairment in children." *Environmental Health Perspectives* 2004: 987-994.
[3] Needleman, H *et al*. The long-term effects of exposure to low doses of lead in childhood: an 11-year follow-up report. NEJM. 1990;322.2: 83-88.
[4] Hurwitz R, Lee D. Childhood lead poisoning: Clinical manifestations and diagnosis. In: *UpToDate*, Post TW (Ed), Waltham, MA. Accessed on February 8, 2016
[5] American Academy of Pediatrics Committee on Environmental Health. Lead exposure in children: prevention, detection, and management. *Pediatrics.* 2005;116.4: 1036.
[6] U.S. Centers for Disease Control and Prevention. Infographic: Prevent Childhood Lead Poisoning. 2013. Retrieved from http://www.cdc.gov/nceh/lead/infographic.htm on February 8, 2016

lead compared to adults.[7] Marginalized populations and lower socioeconomic groups are also at increased risk due to use of older housing and a lack of political and social power to achieve lead removal projects.

Current Policy: Screening, Testing & Reporting

Current recommendations are that all children be screened for lead exposure, however these screening methods have been shown to be extremely inaccurate. For example, the most commonly used screening method, the lead exposure questionnaire, focuses on whether families live in housing built before 1950; studies have shown that 50% of families who do live in such housing think that they do not.[8][9]

The use of Medicaid eligibility for screening is somewhat more reliable but can be difficult to ascertain by doctors. Most clinics use a combination of non-standardized methods. The CDC estimates that at least 4 million children in the US are at high risk for lead exposure, however far fewer of these children are tested each year.[6]

It should be noted that while the CDC recommends that all high-risk children be sent for lead level testing, the US Preventive guide to online casinos for canadians Services Task Force (USPSTF) claims there is insufficient evidence to recommend for or against lead level testing, even in high risk children. While the USPSTF is rigorous in their review of evidence for recommendations, current guidelines were established in 2006 and clearly more research is needed.[10] In terms of reporting, there is currently no requirement for states to report their lead surveillance data to the CDC, though a number of states choose to supply their data voluntarily.[11]

The lack of a nationally coordinated surveillance system leads to incongruent efforts for prevention and exposes an overall lack of data available for use in targeting testing approaches.

Geographic Information Systems (GIS)-Cased Targeted Screening

GIS-based targeted screening uses factors such as previous cases of lead poisoning or identification of housing developments built before 1950 to identify high-risk zip codes or census blocks. Children living in these high-risk areas can then be systematically tested for lead poisoning. A few states, such as Arizona and Illinois, have already begun to use high-risk zip codes to screen children,

[7] Agency for Toxic Substances and Disease Registry. (2010). Case Studies in Environmental Medicine (CSEM): *Lead Toxicity: Who is at Risk of Lead Exposure*? Retrieved from http://www.atsdr.cdc.gov/csem/csem.asp?csem=7&po=7 on February 8, 2016.

[8] Ossiander E. A systematic review of screening questionnaires for childhood lead poisoning. *Journal of Public Health Management and Practice.* 2013; 19.1: E21-E29

[9] Schwab LT, Roberts JR, Reigart J. Inaccuracy in Parental Reporting of the Age of Their Home for Lead-Screening Purposes. *Arch Pediatr Adolesc Med*. 2003;157(6):584-586.

[10] U.S. Preventative Service Task Force. Final Recommendation Statement. Lead Levels in Children and Pregnancy: Screening, December 2006. 2006. Available at: http://www.uspreventiveservicestaskforce.org/Page/Document/RecommendationStatementFinal/lead-levels-in-childhood-and-pregnancy-screening#consider

[11] U.S. Centers for Disease Control and Prevention 1997-2014. National Lead Surveillance. 2015. Retrieved from http://www.cdc.gov/nceh/lead/data/national.htm on February 8, 2016

which has been shown to be both accurate and cost-effective.[12][13][14][15]

Other GIS-based systems, such as census block/tract risk assessment, have also been shown to be highly successf[16][17][18]

Most of these studies implemented GIS-based screening in addition to standard questionnaire-based screening. There are currently no head-to-head effectiveness studies comparing GIS-based screening to other targeted screening methods. One retrospective observational study performed in Kentucky did find that GIS-based methods identified a significant number of additional high-risk children who were missed through normal screening method[19]

Policy Implications

The 2012 Advisory Committee Report on Childhood Lead Poisoning Prevention emphasized the need for primary prevention to eradicate lead exposures. Without knowledge of where these exposures occur, however, this is impossible to accomplish [20] Obviously the current approach is inadequate. In the past, some have advocated for universal testing, but this has largely been deemed costly and burdensome, since children without any risk factors are unlikely to have elevated lead levels. In fact both the CDC and USPSTF recommend against universal testing.[21]

GIS-based targeted screening thus offers a unique solution that balances the need to identify cases of lead poisoning without testing those at low risk.

There are two major barriers to implementation of GIS-based screening: 1) a lack of national data about which zip codes/census blocks have experienced lead

[12] Arizona Department of Health Services. *Targeted Lead Screening Plan for the Prevention of Childhood Lead Poisoning.* December 2014. Accessed on February 8, 2016 from: http://azdhs.gov/documents/preparedness/epidemiology-disease-control/childhood-lead/targeted-lead-screening-plan.pdf.

[13] State of Illinois, Department of Public Health. *Preventing and Screening for Childhood Lead Poisoning: A Reference Guide for Physicians and Healthcare Providers*. Retrieved from http://www.idph.state.il.us/envhealth/Lead_PhysiciansGuide.pdf on February 8, 2016

[14] Rustin C. *Evaluating the Efficacy of a Childhood Lead Poisoning Risk Model as an Accurate Predictor of Lead Exposure*. 2013.

[15] Brown M, Shenassa E, Tips N. Small area analysis of risk for childhood lead poisoning. ERIC Clearinghouse. 2001.

[16] Kaplowitz S, Perlstadt H, and Post L. Comparing lead poisoning risk assessment methods: census block group characteristics vs. zip codes as predictors. *Public Health Reports*. 2010; 125(2): 234-245

[17] Mazur L, Moyer V, Lally P, and Chan W. Evaluation of a lead screening program in Houston, Tex. *Texas Medicine*. 1996; 92(1): 54-57.

[18] Haley V and Talbot T. Geographic analysis of blood lead levels in New York state children born 1994–1997. *Environmental Health Perspectives*. 2004; 112(15): 1577-1582. http://doi.org/10.1289/ehp.7053.

[19] Reissman D, Staley F, Curtis G, and Kaufmann R. Use of geographic information system technology to aid Health Department decision making about childhood lead poisoning prevention activities. *Environmental Health Perspectives*. 2001; 109(1): 89.

[20] Advisory Committee on Childhood Lead Poisoning. *Low Level Lead Exposure Harms Children: A Renewed Call for Primary Prevention. Centers for Disease Control and Prevention*. Jan 4, 2012. Available at: http://www.cdc.gov/nceh/lead/acclpp/final_document_030712.pdf

[21] U.S. Preventative Service Task Force. *Final Recommendation Statement. Lead Levels in Children and Pregnancy: Screening, December 2006*. 2006. Available at: http://www.uspreventiveservicestaskforce.org/Page/Document/RecommendationStatementFinal/lead-levels-in-childhood-and-pregnancy-screening#consider

poisoning and 2) the upfront cost of GIS-based mapping. The first barrier can be addressed through mandatory reporting of lead poisoning cases into a national surveillance system. National surveillance systems offer the ability to understand health problems, develop systematic prevention strategies, and allow for targeted use of resources[22] For example, CDC coordination of surveillance for Central Line Associated Bloodstream Infections (CLABSI) resulted in a significant reduction in CLABSIs and saved over a billion dollars in health care system costs in less than 8 years[23]

The creation such a system for cases of lead poisoning through mandatory state reporting is a large-impact, cost-effective first step that will ensure that cases of lead poisoning are not ignored, and that situations such as that which occurred in Flint do not go unnoticed. This will provide the data necessary to head the advisory committee's advice and work to eradicate lead exposures.

[22] Nsubuga P, White ME, Thacker SB, *et al*. Public Health Surveillance: A Tool for Targeting and Monitoring Interventions. In: Jamison DT, Breman JG, Measham AR, *et al*., editors. *Disease Control Priorities in Developing Countries. 2nd edition*. Washington (DC): World Bank. Chapter 53. 2003. Available from: http://www.ncbi.nlm.nih.gov/books/NBK11770/.

[23] U.S. Centers for Disease Control and Prevention. Vital signs: central line–associated blood stream infections—United States, 2001, 2008, and 2009. *Annals of Emergency Medicine.*2011;58(5): 447-450.