




OPEN ACCESS

Need for global core competencies in Child Health and the Environment: a Canadian perspective

Irena Buka,¹ Lesley Brennan ,^{1,2} Jamal Tarrabain,² Sadra Aghazadeh,² Marie Noel Brune Drisse³

¹Pediatrics, University of Alberta Faculty of Medicine and Dentistry, Edmonton, Canada

²Children's Environmental Health Clinic, Misericordia Community Hospital, Edmonton, Canada

³WHO, Geneva, Switzerland

Correspondence to

Lesley Brennan, Child Health Clinic, University of Alberta, Pediatrics, 231 16930 87 Ave, Edmonton CAN T5R 4H5, Canada; lesley.brennan@cov.enanthealsklgjlhnhkngpdjiith.ca

Received 27 February 2020

Revised 1 May 2020

Accepted 8 May 2020

ABSTRACT Children are the planet's most valuable resource. Mortality rates and longevity in children are improving; however, morbidity related to early-life exposures is increasing and with it health spending. A focus on identifying and addressing environmental components related to not only chronic childhood illnesses but also major adult mortalities would help contain current healthcare budgets. Child Health and the Environment (CHE) is an emerging discipline dedicated to managing early-life exposures (prenatal and childhood) on health outcomes throughout life. In Canada, as well as around the world, recognition of this area is growing, but progress has been slow and training of physicians is lacking. The WHO works closely with the Children's Environmental Health Clinic in Canada as well as collaborating centres around the world to build awareness of environmental health issues and promote improved care of children. Core competencies in CHE for physicians would provide an important step forward.

Currently, physicians across the globe receive very little training in environmental risk factors, largely due to the absence of core competencies in educational institutions. With commitment, collaboration and collective effort between international health agencies and educational institutions around the world, physicians could be receiving training in a field that benefits humankind by preventing costly diseases.

Building physician competence in Child Health and the Environment (CHE) concepts would facilitate a comprehensive approach to early identification and mitigation of relevant environmental risk factors in all branches of medicine promoting health not only in children but also in the adults they grow up to be.

Many cultures recognise that the health of children is inherent to the survival of the human race.¹ Therefore, public health measures and social supports were instituted resulting in decreased infant mortality, and increased life expectancy, leading to population growth. In addition, medical science provides astounding diagnostic possibilities and treatments for many disorders. While advances have been made, however, new dangers have arisen.

Global environmental exposures present a serious threat to child health,² and this issue warrants further examination and action. Over 25% of child mortalities below the age of 5 worldwide are attributable to harmful environments.³ The sources of these detrimental environments, such as second-hand smoke and air pollution (indoor and outdoor),

and unsafe water, are responsible for 1.7 million deaths in children under 5.³ In addition, many common conditions are on the rise, especially in young people, for example, respiratory disorders, metabolic disorders, neurodevelopmental problems, cardiovascular diseases, hypertension, cancers and obesity.⁴⁻⁶ Evidence is accumulating that many of these chronic issues are related to environmental exposures during early life.^{6,7}

Many early-life exposures *in turn* predispose a child to chronic lifelong conditions such as asthma or neurodevelopmental disorders, which significantly impact both the child and community resources. For example, prenatal pesticide exposure is known to negatively impact mental development in children.⁸ The spiral of needs, once initiated, may necessitate costly interventions from healthcare, as well as social programmes such as education and the judicial system. The economic burden on societies from environmentally related health outcomes is also significantly impacted by the loss of productivity throughout life. An analysis by Trasande and colleagues estimated the cost of environmental disease in children 2008 to be US\$76.6 billion in the USA.⁹ The authors evaluated the health and lifetime productivity costs associated with childhood lead poisoning, prenatal methylmercury exposure, childhood cancer, asthma, intellectual disability, autism and attention deficit hyperactivity disorder, revealing a significant economic loss that could be improved through efforts to prevent exposures to toxic chemicals.⁹

Modern medicine responds to urgent immediate problems with curative solutions and tends to stumble in the face of seeking and applying proactive preventive measures that could reduce the development of chronic illness.¹⁰ As availability of expensive medical technologies and expertise increases, healthcare costs are escalating. Clinical medicine appears to be on a trajectory to provide ever more cures, a natural response to increasing complaints and diagnoses. In Canada, our laudable healthcare system is struggling to meet the rising demands for clinical care.¹¹ This is certainly reflected in health spending.¹²

Surely a large part of the answer lies in better identifying and addressing causative risk factors for the many conditions that have been described as having an environmental component. Such complex problems require interdisciplinary investigations that inspire novel approaches to preventive strategies. Numerous examples in the scientific literature are alerting us to the significant effects that social,



© Author(s) (or their employer(s)) 2020. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

To cite: Buka I, Brennan L, Tarrabain J, et al. *J Epidemiol Community Health* 2020;**74**:1056–1059.

nutritional and chemical factors in early life play on health outcomes not only in childhood but also throughout the entire human lifespan.^{13–16} In addition, children are highly susceptible to the health consequences of climate change, including dramatic fluctuations in air quality, extreme weather and infectious disease.¹⁷

The curative model lends itself to evaluation more readily while the preventive one seems more difficult to evaluate. The value of preventive care is broadly recognised; however, it requires long-term vision, while treatment offers rapid gratification to patients, and as a result, it is still often preferred by the public.¹⁸

CHE is an emerging discipline that addresses early life exposures on outcomes throughout a person's life. It recognises the physical, biological, social and chemical environments as well as their intricate interactions. It considers prenatal and postnatal influences as well as environmental influences on the human genome and transgenerational effects. Central to CHE is the special vulnerability of children through their promise of longevity, unique exposures and dynamic developmental physiology.^{19–21}

Solving clinical dilemmas in CHE involves identifying relevant exposures, assessing related medical conditions, considering latency periods. It also means dealing with conflicts of interest among different groups, some of which may economically benefit from the environmental contaminants or hazards in question.

Symptoms arising from environmental hazards can sometimes be managed with specific medications as in the case of asthma.²² However, some environmentally related disorders and conditions are difficult to manage or may be untreatable, often because the exposure occurred during vulnerable stages of development (ie, prenatal, fetal or early childhood), setting the stage for serious chronic illness or neurological deficits later in life.²³

A traditional environmental approach seeks to identify exposures clearly linked with immediate health effects, for example, forest fire smoke triggering asthma attacks. However, if there is a latency period between an exposure and diagnosis (eg, early-life lead exposure leading to neurodevelopmental consequences), conclusions are often elusive. In addition, some well-documented associations between environmental hazards and children's health are not commonly recognised within the health provider community, such as the link between ambient air pollution and adverse birth outcomes,²⁴ or the impact of pesticides on child neurodevelopment.⁸ During an assessment of a health outcome, more than one environmental risk factor is often identified. A process of prioritisation is then required, which is a challenging task considering the cumulative and interacting effects of many exposures.

The practice of CHE often involves seeking out others within the same home, school or community that may be affected by an identified exposure. Consideration of other health outcomes is also essential as many hazards are associated with a range of health effects. While causality is typically very difficult to assign in CHE, attempts to do so rely on long-established methods.²⁵ This involves relying on the basic concepts of the Bradford Hill criteria within a broader context of interacting environments, health and development, and human behaviour. Once identified and prioritised, mitigation of relevant risk factors is the definitive 'treatment' of environmentally related conditions, while symptoms and diagnoses are managed by conventional medical/surgical modalities. Designated resources for all the steps described are not readily available in Canada within the healthcare delivery budget.

Work carried out in the only CHE clinic in Canada, the Children's Environmental Health Clinic (ChEHC) (www.ChEHC.ca), employs a collaborative approach and interdisciplinary team involving paediatricians, allied health professionals, public health specialists, educators as well as researchers. ChEHC cares for patients from across Canada and observes a variety of health concerns and exposures. Most frequently, parents report respiratory and neurodevelopmental issues in the children. Common exposures include indoor and outdoor air pollution (traffic, industry, wildfires, tobacco smoke, dust, mould, etc), lead and other heavy metals, chemical exposures and exposures in the home.

CHE in Canada began about 2 decades ago when the Pediatric Environmental Health Specialty Unit network was initiated.²⁶ While in Canada specific and dedicated funding is not available, the clinical component has been absorbed into the Alberta healthcare delivery budget. The University of Alberta has supported the education and research components.

Due to the broad scope of environmental health concerns complicated by the interdisciplinary nature of possible solutions, ChEHC underwent an engagement process seeking detailed input from numerous stakeholders into its agenda and organisation. One of the outcomes of this process was the development of an advisory board that supports various aspects of the programme.²⁷ Decisions made following an assessment of children regarding local environmental hazards may be multifaceted and complex. The advice provided by the multistakeholder advisory board has taught physicians where and how to advocate for specific policy changes in critical clinical situations. They have provided perspective, direction and support as ChEHC faces new and sometimes challenging issues. It has helped advance the CHE agenda forward and offers a valuable network of collaborators.

There has been a global movement towards recognition of CHE. In 2002, The Commission for Environmental Cooperation under the North American Free Trade Agreement launched a trinational initiative to identify CHE concerns.²⁸ A key concern was lack of CHE education and training in health providers globally.²⁹ The WHO responded by developing training modules on over 35 CHE topics.³⁰ These training modules are designed to help healthcare professionals learn the essentials of current CHE issues and transfer this knowledge to the community. The modules are continuously updated and expanded. The lack of health professional training in CHE recognised internationally led to the creation of a fellowship programme in the USA.³¹

In 2009, in Canada, the paucity of CHE training was noted with the majority of CHE education available only at the post-graduate level.³² Therefore, access is limited to those with special interest. More recently, Canadian family physician trainees report inadequate training in environmental health, which they considered an important topic.³³

Awareness of the impact of environmental exposures on child health worldwide is growing,³⁴ and parents include environmental disorders among the highest concerns for their children.³⁵ It is time to move this emerging subspecialty forward. Experts believe that to move the CHE agenda forward requires competence by physicians in the susceptibility of early life to environmental exposures and the effects on human health throughout the lifespan. Basic concepts to identify environmental links to health outcomes need to be solidly embraced by physicians and the community.

A fundamental approach to CHE includes an awareness of the potential causative exposures for many common as well as rare clinical conditions. Education on CHE therefore needs to occur

much earlier in training of physicians, during periods that general health concepts are taught. This level of competency could be uniform globally and stimulate interest in later speciality training.

Training physicians to identify, assess and manage environmental risk factors requires interest and collaboration from higher education institutions around the world.

Understanding the impact of early-life environmental exposures on subsequent health outcomes in children and throughout the lifespan is likely to compel further action. This action may be directly through clinical work, research, education, health policy or advocacy.

Perhaps an important next step is for professional organisations at the local, national and international level to request global competencies for physicians in CHE. This will not only raise awareness of essentially fundamental concepts but also lead to their increased endorsement. Hopefully, this will lay the path for a collaborative effort to develop and publish the finalised core competencies in CHE.

It is critical to note the importance of health policy in protecting and improving the health of children globally. Children are highly vulnerable to the impacts of environmental exposures, especially those living in low- and middle-income countries and in low-socioeconomic status environments.^{36, 37} Governments and policymakers around the world must make children a priority in decision-making processes. Policies that regulate industrial and consumer chemicals require companies to test the toxicity of chemicals that may be released, incorporating new assessment technologies and evaluate the effects of exposed populations should be considered.³⁸ Such actions would not only help prevent disease but also help ease the burden on the healthcare system and reduce costs.

CHE is a fundamental and emerging discipline that presents an opportunity to prevent common chronic symptoms and disorders by assisting families with identification and mitigation of relevant environmental risk factors. It is a field in need of increased attention and promotion. While the only children's environmental clinic in Canada, also a designated WHO collaborating centre in CHE, includes in its mandate education of health professionals (www.ChEHC.ca), the work done by the centre is still a mere 'drop in the bucket'. This may change if basic knowledge and practice on CHE became part of the required competencies for physicians.

Building physician competence in CHE concepts would facilitate a comprehensive approach when dealing with a clinical concern. In addition to treating diseases and mitigating the relevant specific environmental risks in affected communities, this would help to generate evidence and increase the awareness that is necessary to promote health and prevent diseases through healthy environments. In particular, physicians being trained into clinical paediatrics need to receive the necessary education and training to prepare for a significant shift towards incorporating CHE into a holistic preventive health paradigm within clinical paediatrics.

Contributors IB developed the paper concept, identified content and wrote the first draft. LB contributed to content and to subsequent drafts. JT and SA contributed content and reviewed drafts. MNBD critically reviewed proposal, contributed to design and content of review.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Not required.

Provenance and peer review Commissioned; externally peer reviewed.

Data availability statement There are no data in this work.

Disclaimer The authors alone, and not their organisations, are responsible for the views and content of this article.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

ORCID iD

Lesley Brennan <http://orcid.org/0000-0002-7543-3324>

REFERENCES

- 1 UNICEF. Global goals: sustainable development for every child's future. Available <https://www.unicef.ca/en/global-goals-sustainable-development-for-every-child's-future> (accessed 24 Jun 2019)
- 2 World Health Organization (WHO). Inheriting a sustainable world? Atlas on children's health and the environment. Geneva, 2017. Available file:///C:/Users/lesleybrennan/Downloads/9789241511773-eng%20(3).pdf
- 3 World Health Organization (WHO). *The cost of a polluted environment: 1.7 million child deaths per year says the WHO*. Geneva: World Health Organization, 2017
- 4 Dick S, Doust E, Cowie H, et al. Associations between environmental exposures and asthma control and exacerbations in young children: a systematic review. *BMJ Open* 2014;4:e003827.
- 5 Grandjean P, Landrigan PJ. Neurobehavioural effects of developmental toxicity. *Lancet Neurol* 2014;13:330–8.
- 6 Sly PD, Carpenter DO, Van den Berg M, et al. Health consequences of environmental exposures: causal thinking in global environmental epidemiology. *Ann Global Health* 2016;82:3–9.
- 7 Boekelheide K, Blumberg B, Chapin RE, et al. Predicting later-life outcomes of early-life exposures. *Environ Health Perspect* 2012;120:1353–61.
- 8 González-Alzaga B, Lacasaña M, Aguilar-Garduño C, et al. A systematic review of neurodevelopmental effects of prenatal and postnatal organophosphate pesticide exposure. *Toxicol Lett* 2014;230:104–21.
- 9 Trasande L, Liu Y. Reducing the staggering costs of environmental disease in children, estimated at \$76.6 billion in 2008. *Health Aff* 2011;30:863–70.
- 10 Morgan MW, Zamora N, Hindmarsh MF. An inconvenient truth: a sustainable health-care system requires chronic disease prevention and management transformation. *Healthcare Pap* 2007;7:6.
- 11 Denton FT, Spencer BG. Chronic health conditions: changing prevalence in an aging population and some implications for the delivery of health care services. *Can J Aging/La Revue Canadienne Du Vieillessement* 2010;29:11–21.
- 12 Dodge DA, Dion R. Chronic healthcare spending disease: a macro diagnosis and prognosis. *CD Howe Institute Commentary*, 327, 2011.
- 13 Slopen N, Loucks EB, Appleton AA, et al. Early origins of inflammation: an examination of prenatal and childhood social adversity in a prospective cohort study. *Psychoneuroendocrinology* 2015;51:403–13.
- 14 Martins VJ, Toledo Florêncio TM, Grillo LP, et al. Long-lasting effects of undernutrition. *Int J Environ Res Public Health* 2011;8:1817–46.
- 15 Vrijheid M, Casas M, Gascon M, et al. Environmental pollutants and child health: a review of recent concerns. *Int J Hyg Environ Health* 2016;219:331–42.
- 16 Freire C, Ramos R, Puertas R, et al. Association of traffic-related air pollution with cognitive development in children. *J Epidemiol Community Health* 2010;64:223–8.
- 17 Ahdoot S, Pacheco SE. Global climate change and children's health. *Pediatrics* 2015;136:e1468–1484.
- 18 Meertens RM, Van de Gaar VM, Spronken M, et al. Prevention praised, cure preferred: results of between-subjects experimental studies comparing (monetary) appreciation for preventive and curative interventions. *BMC Med Inform Decis Mak* 2013;13:136.
- 19 Landrigan PJ, Etzel RA, eds. *Textbook of children's environmental health*. New York: Oxford University Press, 2014.
- 20 American Academy of Pediatrics, Council on Environmental Health. *Pediatric environmental health*. Etzel RA, ed. Itasca, IL: American Academy of Pediatrics, 2019.
- 21 Wigle DT. *Child health and the environment*. New York, NY: Oxford, 2003.
- 22 Bush A, Saglani S. Management of severe asthma in children. *Lancet* 2010;376:814–25.
- 23 Heindel JJ, Balbus J, Birnbaum L, et al. Developmental origins of health and disease: integrating environmental influences. *Endocrinology* 2016;2016:17–22.
- 24 Ha S, Hu H, Roussos-Ross D, et al. The effects of air pollution on adverse birth outcomes. *Environ Res* 2014;134:198–204.
- 25 Lucas RM, McMichael AJ. Association or causation: evaluating links between environment and disease". *Bull World Health Organ* 2005;83:792–5.
- 26 Paulson JA, Karr CJ, Seltzer JM, et al. Development of the Pediatric Environmental Health Specialty Unit network in North America. *Am J Public Health* 2009;99:S511–S516.
- 27 Wine O, Buka I, Day A, et al. Building a children's health and environment research agenda in Alberta, Canada: a multi-stakeholder engagement process. *Gateways Int J Community Res Engagement* 2019;12.

- 28 Commission for Environmental Cooperation (CEC). Children's health and the environment in North America. 2018. Available <http://www.cec.org/background-materials/childrens-health-and-environment-north-america>
- 29 Commission for Environmental Cooperation (CEC). Education and training on children's health and the environment for healthcare professionals: status and opportunities. 2003. Available <http://www3.cec.org/islandora/en/item/1893-education-and-training-childrens-health-and-environment-healthcare-en.pdf>
- 30 World Health Organization (WHO). Children's environmental health: training package for health care providers. 2019. Available <https://www.who.int/ceh/capacity/train-package/en/>
- 31 Etzel RA, Crain EF, Gitterman BA, *et al.* Pediatric environmental health competencies for specialists. *Ambulatory Pediatrics* 2003;3:60–3.
- 32 Wiseman CL, Stefanovic IL. Children's health and environment education and training for health care professionals in Canada: assessing gaps, barriers, and needs. *Int J Occup Environ Health* 2009;15:410–5.
- 33 Sanborn M, Grierson L, Upshur R, *et al.* Family medicine residents' knowledge of, attitudes toward, and clinical practices related to environmental health: multi-program survey. *Can Family Physician* 2019;65:e269–e277.
- 34 World Health Organization (WHO). *Don't pollute my future! The impact of the environment on children's health* (No. WHO/FWC/IHE/17.01). World Health Organization, 2017.
- 35 Garbutt JM, Leege E, Sterkel R, *et al.* What are parents worried about? Health problems and health concerns for children. *Clin Pediatr (Phila)* 2012;51:840–7.
- 36 Suk WA, Ahanchian H, Asante KA, *et al.* Environmental pollution: an under-recognized threat to children's health, especially in low-and middle-income countries. *Environ Health Perspect* 2016;124:A41–A45.
- 37 O'Lenick CR, Winquist A, Mulholland JA, *et al.* Assessment of neighbourhood-level socioeconomic status as a modifier of air pollution: asthma associations among children in Atlanta. *J Epidemiol Community Health* 2017;71:129–36.
- 38 Landrigan PJ, Goldman LR. Children's vulnerability to toxic chemicals: a challenge and opportunity to strengthen health and environmental policy. *Health Aff* 2011;30:842–50.