Advancing the Science of Children's Positive Health in the National Institutes of Health Environmental Influences on Child Health Outcomes (ECHO) Research Program

Christopher B. Forrest, MD, PhD[1,2], Courtney K. Blackwell, PhD[2], and Carlos A. Camargo, Jr, MD, DrPH[3]

Launched by the National Institutes of Health in 2016, the Environmental influences on Child Health Outcomes (ECHO) Program is a 7-year initiative designed to advance knowledge of environmental exposure effects on the health of the nation's children (for more information, see www.echochildren.org). ECHO includes 84 individual cohort studies, with an anticipated combined sample of more than 50 000 children. These studies will contribute existing and newly collected data on a broad array of environmental exposures, which are measured from before birth to 5 years of age, and outcome data in four domains assessed from birth through adolescence: airways (eg, asthma); obesity; pre-, peri-, and postnatal outcomes (eg, low birth weight, small for gestational age); and, neurodevelopment (eg, autism, cognition). During the program launch, ECHO leadership added a fifth outcome area that is universally applicable to all children (and thus relevant to all cohorts) and that provides high value to science and children themselves. Stemming from ECHO's goal of understanding the developmental origins of child health, ECHO calls this new area positive health, which also complements the other outcome areas that focus on risk, disorder, and illness.

Concept of Health

Scientists from across ECHO began defining the scope of positive health by focusing on the broad, multidimensional concept of health. Recognizing that health is an elusive concept—both difficult to define and measure—ECHO scientists reviewed commonly used frameworks for guidance, beginning with the 1948 definition from the World Health Organization[1]: [Health is a] "state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity." By rejecting the biomedical view of health as absence of disease, the World Health Organization specified what health is, rather than merely defining health by what it is not. Although this definition introduced a positive orientation into the concept of health and focused attention on well-being, it was criticized for its ideal of "complete" health. Because no one could ever have complete physical, mental, and social well-being, health was unattainable.

In 1986, the International Conference on Health Promotion redefined health as biopsychosocial resources that help individuals realize their aspirations and fulfill their everyday needs.[2] This definition expresses a common motif regarding health's instrumental value as a means to an end (eg, fulfilling goals) and not the objective of life itself. More recent theoretical models support this theme,[3] and ECHO ultimately adopted the 2004 definition from the Institute of Medicine[4]: [Health is] "the extent to which individual children . . . are able or enabled to: a) develop and realize their potential; b) satisfy their needs; and c) develop the capacities that allow them to interact successfully with their biological, physical, and social environments." This definition emphasizes health's instrumental value, its multifocal environmental influences, and the importance of human functioning. The definition incorporates a developmental perspective and includes a systems view of health resulting from dynamic interactions between individuals and their environments.

Positive Health

If health comprises a set of resources that are used to adapt to environmental challenges, satisfy needs, and reach a person's goals, then it stands to reason that these resources can be useful assets that strengthen an individual's health (ie, a concept we term positive health), but also negative challenges (eg, illnesses, disorders, impairments) that threaten health. These positive health assets can be biological (eg, body structures and functions), functional (eg, sleep–wake function, emotional regulation), behavioral (eg, activity, eating), or experiential (eg, person-reported assessments of feelings, functional status, overall health) (**Figure**). Positive health assets are genetically endowed or acquired and modified over time, shaped by dynamic and continuous interactions between individuals and their physical, family, and social environments.

Many health outcomes are dimensional attributes, having both negative and positive continua. Lung health may be assessed as optimal or suboptimal lung function; growth may be examined as optimal or suboptimal energy balance; perinatal outcomes include both low and normal birth weight; and

ECHO	Environmental influences on Child Health Outcomes Program

From the [1]Applied Clinical Research Center, Department of Pediatrics, Children's Hospital of Philadelphia, Philadelphia, PA; [2]Department of Medical Social Sciences, Northwestern University Feinberg School of Medicine, Chicago, IL; and [3]Department of Emergency Medicine, Massachusetts General Hospital, Boston, MA

Funded by the National Institutes of Health (NIH) (UG3 OD-023253 and U24 OD-023319). The NIH had no role in the writing of the report or decision to submit it for publication. The authors declare no conflicts of interest.

https://doi.org10.1016/j.jpeds.2018.02.004

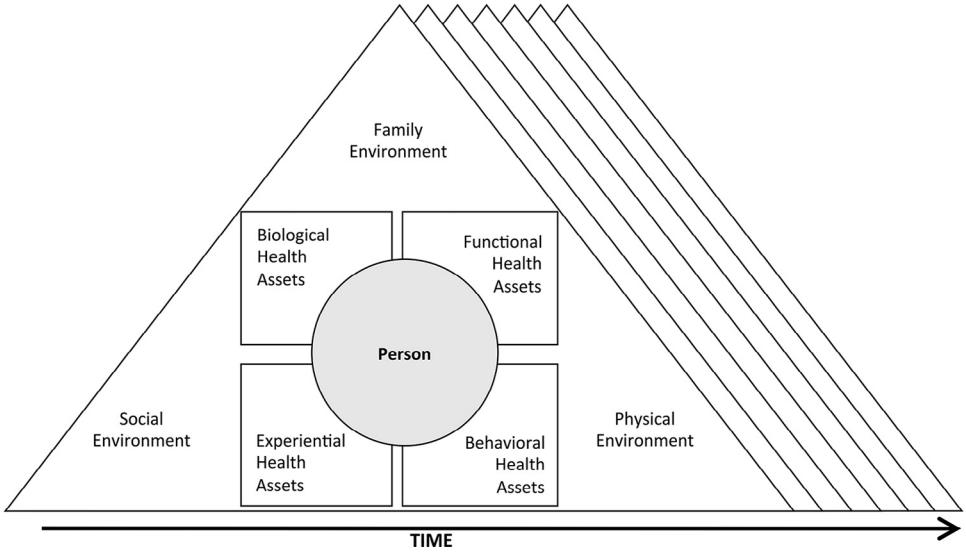

Figure. ECHO model of positive health. Biological, functional, experiential, and behavioral health assets of a person are shaped by their environmental interactions. The *repeated triangles* indicate that these interactions occur continuously over the lifespan. Current health depends on past health as well as current person–environment interactions.

neurodevelopmental outcomes can include adaptive or maladaptive self-regulation. These examples make the important point that more positive health is generally better up to some optimum level. In some cases, such as birth weight, the health continuum has an optimal plateau with negative health at the tails (small and large for gestational age). In other cases, such as lung function, there is probably an asymptote that bounds the maximal level.

Virtually all of health science has focused on examining and treating the negative side of these continua—pathology, impairments, risks, and distress—which is appropriate, given the focus of healthcare on alleviating suffering. In contrast, the study of positive health promotes an understanding of the developmental pathways for those biological, functional, behavioral, and experiential health assets that promote goal attainment and needs satisfaction as well as individuals' subjective experiences of life as happy, satisfying, and meaningful (ie, well-being). Positive health research focuses on such topics as the factors that strengthen bones, rather than the causes of fractures; it evaluates the developmental pathways for children's happiness and life satisfaction, rather than the origins of anxiety and depression. Positive health assets enhance an individual's adaptability, which buffers them from exposures and experiences that cause ill health. Promoting positive health, therefore, not only holds the potential for helping individuals thrive, it also can reduce the risk of disease and suffering.

Measurement of Positive Health

Most biological measures of heath provide precise measurements on the negative side of the health continuum and either no or highly imprecise measurement on the positive side. We can assess decreased glomerular filtration rate as an indicator of kidney failure, but we have a more limited ability to evaluate kidney health in terms of positive attributes that promote the adaptability of kidneys to challenges, such as number of nephrons. In fact, assessing biological positive health assets is an area ripe for innovation. Scientists are better at understanding an individual's positive health experiences because of advances in pediatric patient–reported outcomes. The National Institutes of Health Patient-Reported Outcomes Measurement Information System initiative (see www.healthmeasures.net) has demonstrated that children as young as 8 years old can reliably and validly report on their health, and that parents can report for even younger children.[5] Patient-Reported Outcomes Measurement Information System initiative Pediatric Positive Health measures that are currently available include global health (general health perceptions across physical, mental, and social dimensions), positive affect (happiness, contentment, and joy), life satisfaction (evaluations of life as good), meaning and purpose (cognitive appraisals of life as meaningful and hopeful), peer relationships (quality of friendships), family relationships (feelings of belonging and involvement with one's family), physical activity (perceived amount and intensity of exercise and movement), and sleep health (sleep quality and daytime wakefulness).

By focusing on positive health in longitudinal studies across the pediatric age range, ECHO researchers will study how it develops during childhood, with a special focus on determining whether there are sensitive periods when exposures (eg, genetics, living conditions, health status) or biopsychosocial transitions (eg, puberty, changes in school, parental divorce) have disproportionate effects. ECHO will also address how children's interactions with their social environments (eg, family,

peers, school) influences their positive health in childhood, and ultimately in adulthood. Given the diversity of participants across ECHO cohorts, researchers also have the unique opportunity to investigate differences in positive health trajectories across sociodemographic sub-groups (eg, race, ethnicity, socioeconomic status).

Conclusion

ECHO is an ambitious research program—in size, rigor, and duration—and the addition of positive health as a priority outcome across all the cohorts provides a unique opportunity to not only understand differential effects of environmental exposures across diverse populations but to redefine how researchers, clinicians, and children themselves think about the concept of "health." Ultimately, by taking this multidimensional perspective that addresses both challenges to health and positive health assets, ECHO is poised to significantly advance scientific understanding of the developmental pathways that help explain how children can lead happy and healthy lives. ■

Submitted for publication Nov 1, 2017; last revision received Jan 19, 2018; accepted Feb 1, 2018

Reprint requests: Christopher B. Forrest, MD, PhD, Applied Clinical Research Center, Roberts Pediatric Research Center, 2716 South St, Room 11-473, Philadelphia, PA 19146. E-mail: forrestc@email.chop.edu

References

1. World Health Organization. WHO definition of Health, Preamble to the Constitution of the World Health Organization as adopted by the International Health Conference, New York, 19-22 June 1946; signed on 22 July 1946 by the representatives of 61 States (Official Records of the World Health Organization, no. 2, p. 100) and entered into force on 7 April 1948.
2. World Health Organization. The Ottawa Charter for Health Promotion. Adopted on 21 November 1986. http://www.who.int/healthpromotion/conferences/previous/ottawa/en/. Accessed April 21, 2017.
3. Forrest CB. A living systems perspective on health. Med Hypotheses 2014;82:209-14.
4. National Research Council and Institute of Medicine. Children's health, the nation's wealth: assessing and improving child health. Washington (DC): National Academies Press; 2004.
5. Forrest CB, Bevans KB, Tucker C, Riley AW, Ravens-Sieberer U, Gardner W, et al. Commentary: the patient-reported outcome measurement information system (PROMIS®) for children and youth: application to pediatric psychology. J Pediatr Psychol 2012;37:614-21.