Notes:

- Please add details of the date, time, place and sponsorship of the meeting for which you are using this presentation in the space indicated.
- This is a large set of slides from which the presenter should select the most relevant ones to use in a specific presentation. These slides cover many facets of the problem. Present only those slides that apply most directly to the local situation in the region.
Until about six centuries ago, European artists represented children as miniaturized adults just as we see in the 13th century icon on the left of the slide.

Note: Second picture will appear with mouse click

On the right side of the slide you can see how artists of the Renaissance painted children. By the Renaissance artists realized that children were not simply miniaturized adults: they have big heads, long trunks and short limbs, as seen in this "Madonna and Child" by Raphael.

Despite changes in art, we often forget that children are not little adults. Until the mid-20th century, doctors following the standard medical practices of the industrialized countries understood paediatric exposures as simple extrapolations from adult occupational exposures. By now, we know many of the physiological and behavioural differences between children and adults; with this knowledge, we can build healthy environments that protect children from their unique exposures and allow them to grow and thrive.

Notes: Use images that are regionally or culturally appropriate for illustrating the inaccuracy of thinking of children’s environmental risks simply as scaled down adult risk.

Photos:
• Madonna and Child, Giotto (left); The Niccolini-Cowper Madonna, Raphael (right)
  • Courtesy National Gallery of Art, Washington
All children deserve to grow and develop, play and learn, in a healthy environment where they can reach their full potential as citizens of the world. Sustainable development has at its core healthy children. Health is much more than mere absence of illness; it means protection not only from toxic chemicals, physical injury and infections, but also from poverty, inequity and child labour. It is the responsibility of today's adults to identify hazards and conditions in the complex and changing environments of children that impair their ability to grow and mature safely and in good health.

After this talk, we hope that you will be able to satisfy these four learning objectives:

• Be able to list ways in which risks to children from environmental hazards are different from those for adults.
• Illustrate children's increased and unique vulnerabilities to environmental threats.
• Understand the relationship between children and the environment – starting before conception and continuing throughout development.
• Propose remedial and preventive actions.

Note:
• When discussing environmental determinants of health and disease, the term “child” or “children” can be problematic. Exposures to parents prior to conception, exposures to mothers during pregnancy and exposures to newborns (up to 28 days), infants (28 days to 1 year), young children (1-4), older children (5-9) and adolescents (10-19) can all have profound impacts. It is important to be attentive to how different agencies collect and report childhood health and exposure data since each institution or agency is likely to have a slightly different set of definitions and age categories. For the purposes of this presentation we will use the term children as defined in the United Nations Convention on the Rights of the Child: every human being below 18 years of age, unless under applicable law, majority is attained earlier.

References:


When selecting the slides to include in your presentation, please choose only those of relevance to the region and/or interests of your audience.

We now recognize that children are often at a different and increased risk from environmental hazards compared to adults. There are four large categories of reasons that explain these differences.

1. Children often have different, and sometimes specific, exposures to environmental hazards compared to adults.
2. Due to their dynamic developmental physiology children are often subjected to higher exposures to pollutants found in air, water and food. These exposures may be handled quite differently by an immature set of systems to the way they are dealt with in fully mature, adult systems. Furthermore, the developmental component of a child’s physiology is changing: maturing, differentiating and growing in phases known as "developmental windows". These "critical windows of vulnerability" have no parallel in adult physiology and create unique risks for children exposed to hazards that can alter normal function and structure.
3. Children have a longer life expectancy. Therefore they have longer to manifest a disease with a long latency period, and longer to live with toxic damage.
4. Finally, children are politically powerless; they are defenseless. With no political standing of their own, they must rely on adults to protect them from toxic environmental agents. Each of these points is illustrated in more detail in the following slides.

Image:
- © WHO /Joao Soares Gusmao
We begin with different and specific exposures of children

**Image:**
- © WHO /Joao Soares Gusmao
Children have unique exposure pathways. Environmental exposures to either mother or father can affect the viability and health of a fetus — these are known as “preconception” exposures. Children can be exposed \textit{in utero} to toxic environmental agents that cross the placenta. Such exposures can be chemical (pollutants and pharmaceuticals), physical agents (radiation, heat) and biological (viral, parasitic). They can also be exposed, after birth, to pollutants that pass into their mother’s milk. Neither of these routes of exposure occur in adults or older children.

Children also have pathways of exposure that differ from those of adults due to their size and developmental stage. For example, young children engage in normal exploratory behaviours including hand-to-mouth and object-to-mouth behaviours, and non-nutritive ingestion which may dramatically increase exposure over that in adults.

Children’s physical differences also cause them to reside in a different location in the world, i.e. closer to the ground. Pollutants such as mercury, solvents and pesticides are concentrated in their breathing zone and deliberate applications of pesticides and cleaning solutions make them more readily accessible to small children. Because they are small, they have a high surface area to volume ratio and can have dramatically higher absorption through dermal contact than adults.

And, they may have much more limited ability to understand and move out of danger, both from toxic agents and dangerous situations which could result in injury. This characteristic is obvious in the pre-ambulatory phase, but persists through exploratory toddler behaviour and even into the high-risk behaviours seen in adolescence.

References:
Increasing evidence from animal studies is identifying risks to offspring from exposure to environmental toxicants prior to conception both to mothers and fathers. Human data are limited but consistent with animal studies.

Exposures to human ova can occur during fetal life when all ova develop and remain in the prophase of the cell cycle – as well as during later life up to and including the full development of the ovum during a normal ovulation cycle. Evidence supporting vulnerability to environmental exposures includes increased nondisjunctional events with increasing maternal age and transgenerational effects in male and female grandchildren of grandmothers exposed to DES during pregnancy.

Exposure to sperm are more easily studied and data suggest an increased risk of some birth defects with paternal occupational exposures including pesticides and ionizing radiation.

References:

Image:
• © WHO /Tom Pietrasik
Until the disasters of phocomelia caused by thalidomide and clear cell carcinoma caused by diethylstilbestrol, it was widely believed that the placenta formed an impregnable, protective barrier between the mother and the child. Now we know that this is far from true. Many pharmaceuticals cross the placenta as do many pollutants. Some pollutants such as lead, mercury, and PCBs can be stored in maternal tissues for years before pregnancy (known as maternal body burden) and be passed along to the fetus. In addition, physical environmental hazards such as radiation and heat can harm a growing fetus. The issue of environmental health of children begins with the parents, and concerns about new exposures begin before birth.

References:


Breastfeeding

Breast milk is the safest and most complete nutrition for infants
- Mothers should avoid toxic exposures
- Milk (human, cow, sheep) can be a marker of environmental contamination
- DDT, DDE, PCBs, TCDD (dioxins), nicotine, lead, methylmercury, alcohol
- Morbidity rarely seen
- Unusual exposure event
- Mother also ill

Breast milk is another unique source of exposure for very small children. It is clear that many environmental chemicals pass into breast milk, particularly lipophilic chemicals. Morbidity from such exposures is rare and is associated with unusual high-exposure events during which the mothers are also ill. Consequently, fear of chemical exposures should not cause a healthy mother to cease breastfeeding. For example, it is known that mercury, PCBs, lead and other POPs are present in human breast milk, but this route of exposure has not been shown to be damaging in the absence of maternal illness. Furthermore, the milk of other mammals, such as cows, often used as the basis for infant formula, is also subject to environmental contamination, and may contain higher levels of some pollutants than human milk. The condition of human milk is thus an important indication of the level of environmental contamination in the world the infant is entering, but human breast milk should still be the food of first choice for any infant of a healthy mother.

Notes: Replace with image of nursing mother appropriate to the region/country.

References:
Exploratory behaviour is exemplified by hand-to-mouth activity; developmentally maximum in children between 1 and 3 years of age. This graph shows estimates of soil and dust consumption of children and adults in the USA made by the US Environmental Protection Agency (EPA). The average child ingests three times as much soil and dust as an adult, but a child in the upper percentile can ingest more than six times more soil and dust (200 mg/day) than an adult. Children often learn by putting things in their mouths and can ingest significant quantities of contaminated soil, dust and dirt at early ages.

References:

Figure:
Children are smaller than adults; they live in a different zone in the world. Here is an example of different exposures in different breathing zones. Measurements inside homes following pesticide applications find that due to patterns of evaporation (re-volatilization), concentrations are always highest closest to the floor, where children live. Compounded by their higher rate of breathing, children are exposed to more contaminants than are adults. In addition we know that significant pesticide residues can remain on plush toys after application and undergo re-volatilization and secondary deposition for two or more weeks, leading to increased exposures through non-nutritive ingestion as discussed in relation to the previous slide.

These images from WHO show how children inhabit a different zone from that of the adults standing in the background. Note the small girl with her fingers in the mouth and the baby, who is unable to move from the cot.

References:


Photos:
© WHO/Diego Rodriguez (left) and © WHO (right)
Children do not recognize danger

- Pre-ambulatory children are unable to remove themselves from danger
- Pre-reading children cannot read warning signs & labels
- Pre-adolescent / adolescent children may take unreasonable risks due to cognitive immaturity and "risk-taking" behaviours

References:
We proceed to children’s unique physiology

**Image:**
- © WHO /Joao Soares Gusmao
Children have a dynamic physiology that is not only turned up to “high” because of growth demands, but also vulnerable to damage during differentiation and maturation of organs and systems. Xenobiotics, or foreign chemicals, are handled differently by a developing body than they are by an adult one.

- Their needs for energy, water and oxygen are higher, because they go through an intense anabolic process.
- Absorption is different and frequently increased because children are anabolic and active. They are geared to absorb nutrients very efficiently. This is exemplified most classically by lead. Lead follows calcium, which is essential for skeletal and cellular growth. A child will absorb between 40% and 50% of a given ingested dose of lead, whereas a non-pregnant adult will absorb between 3% and 10%. Nutritional deficiencies, particularly anaemia, which is common in rapidly growing children, will increase lead absorption.
- Some xenobiotics are dangerous when ingested and need to be detoxified by metabolism. Others are not dangerous when ingested but become dangerous when metabolized. Whatever the type of xenobiotic, these processes are likely to be different in children, but unfortunately not in predictable ways. Particularly during gestation and in the first 6–12 months of life, important metabolic pathways such as cytochrome P450 systems and glutathione conjugation are significantly less efficient than later in life. Most known toxicants are detoxified in the body, so immaturity of these systems increases the duration of residence and amount of any given internal dose.
- Distribution is different from that in adults and varies with age. For example, the blood–brain barrier differs in the developing brain versus the adult brain, so substances such as lead readily cross into the developing central nervous system (CNS).
- Elimination may be decreased in early postnatal life. For example the glomerular filtration rate (GFR) of newborns is substantially less than that of adults, and premature infants will experience even lower rates. The figure shown illustrates the increase in GFR over time.

All of these physiological processes are likely to be different in children from those in adults, but unfortunately not in predictable ways.

Finally, children’s systems continue to grow, mature and change through adolescence. If disrupted during critical periods, damage may be severe and lifelong. Environmental hazards may operate to harm a developmentally dynamic child by mechanisms that do not operate in the adult.

References:


Figure:

The difference in size and proportion between children and adults means that dermal exposures may be greater. Except for premature infants and newborns, children’s skin presents the same barrier to dermal exposures as that of adults, but there is more of it on a surface area to volume basis. Infants have a surface area to volume ratio more than double that of adults, and in young children the ratio is almost double that of adults. Also, children tend to have more skin exposed and more cuts, abrasions and rashes than adults; this could easily lead to increased dermal absorption as a proportion of body weight.

References:


Figure:

Children breathe more air per kilogram of body weight than adults at rest, as shown here. An infant breathes at a rate about five times that of an adult and children ages 3 to 5 years old breathe at a rate 60% more than adults do. Children also tend to be more physically active than adults. Therefore, environmental toxicants found in the air, both indoors and outdoors, will be delivered to children at higher internal doses than to adults. These toxicants include ozone, oxides of nitrogen, particulate matter, lead, mercury as well as molds, volatile organic compounds (VOCs), and other air toxicants.

**Figure:**
Oral exposures are also likely to be greater in children. Children are anabolic and actively building their bodies. They need more calories per unit of body weight than adults. Therefore, toxicants that are carried in food will be delivered at 2–4 times higher rates in young children than in adults.

Children also tend to have a restricted diet with a higher proportion of fruits and vegetables at young ages, so that pollutants such as pesticides or mycotoxins present in these foods are likely to be delivered in higher quantities to children.

Notes: Diets vary regionally and ethnically, so special mention of children’s diets may need to be modified.

Figure:
Hydration is another oral exposure likely to be increased in children. Children need more water per unit of body weight than adults. Therefore, toxicants in water will be delivered to young children at 2–5 times the adult rate.

Notes: Diets vary regionally and ethnically, so special mention of children’s diets may need to be modified.

Figure:
Absorption

A child is building a “body for a lifetime”

The demands of rapid growth and development
- Require higher breathing rate, caloric and water intakes
- Satisfied by enhanced absorption and retention of nutrients

For example:
- GI absorption of lead in toddler: 40–50% of oral dose
- GI absorption of lead in non-pregnant adult: 3–10%

For a given oral dose of water-soluble lead, a child can absorb 40-50% of the lead while an adult only absorbs 3-10%.

References:
We know a lot about how chemicals are metabolized (or biotransformed) by children from pharmaceutical data — illustrated by the next three slides. A relatively new database is available on the web site of Clark University/Connecticut Department of Public Health and sponsored by the U.S. Environmental Protection Agency (EPA). It is a rich source of pharmacokinetic information specifically developed to look at differences between children and adults with the setting of regulatory limits in mind. This graph is a composite assessment of 40 drugs for which there are complete data across these age categories. Not surprisingly, there are highly significant differences in average half-life showing slower elimination in the very young than in adults (depicted by the green line).

Pre-term = pre-term neonate; FT = full-term neonate; w = week; m = month; y = year

**Figure:**
When the authors looked at substrates metabolized in the liver by P450 enzymes by age they found even more differences. Not only was elimination slower in the infants, but more rapid elimination was seen in children aged from 6 months to 12 years than in adults. This provides an important reminder that not all ages of children are alike, and children in some cases, and at some stages, may be able to eliminate xenobiotics more efficiently than adults!

CYP = cytochrome P450 pathways; Pre-term = pre-term neonate; FT = full-term neonate; w = week; m = month; y = year

**Figure:**
But here is the ultimate message. Although, in general, infants eliminate pharmaceuticals more slowly than adults and older children may eliminate drugs more rapidly than adults, there is very high variability even between closely related drugs that share the same metabolic pathways. For example, in the comparison of the half-life of caffeine in neonates and adults, the difference in half-life was 13X greater than the difference between neonates and adults for theophylline. Generalizations are not possible — and the authors concluded that the standard safety factors used to account for age differences in pharmacokinetic models may be inadequate to protect young infants.

It is important to remember that, when xenobiotics require metabolic “activation” before they become toxic, this higher metabolic capacity in the older children may make them more susceptible to toxicants than are adults and young infants.

CYP = cytochrome P450 pathways

**Figure:**

Nitrates and methaemoglobinemia

Special problem for infants

- Increased exposure from contaminated well-water
- Increased “activation” as nitrates convert to nitrites
- Increased toxicity: fetal haemoglobin more easily oxidized
- Decreased “detoxification”: 50% capacity of NADH-dependent reductase

Nitrates are examples of environmental contaminants that are gaining importance because of increasing agricultural run-off and pollution of groundwater in many locations.

Nitrates in water — the highest exposure to water occurs in babies aged less than 6 months who are not breastfed, because they consume more water per kg body weight than adults.

Nitrates must be activated to nitrites before they become dangerous — this is more efficiently accomplished in newborns because they have a higher pH in their gastrointestinal tract.

Nitrites oxidize haemoglobin from ferrous to ferric, forming methaemoglobin, which is incapable of carrying oxygen. This condition is termed methaemoglobinaemia. Fetal haemoglobin, normally present in young infants, is much more easily oxidized than adult haemoglobin.

Detoxification is less efficient in babies because they possess half of the detoxification capacity of one of the two enzyme systems that can repair methaemoglobin.

Thus, children exposed to nitrates are at increased risk of methaemoglobinaemia, where blood cannot adequately supply tissues with oxygen.

This example shows not only how exposures may be different, but also how metabolic immaturity may increase the harm done by an environmental chemical.

Notes: Exclusive breastfeeding of small infants for the first 6 months eliminates this threat from nitrates in drinking water.

References:

Outline

- Different and specific exposures
- Unique physiology
- Windows of development
- Systems development
- Longer life expectancy
- Politically powerless

Image: © WHO /Joao Soares Gusmao
The fetus is connected to the mother through the placenta, where gas and nutrient exchange can occur. Exposure to chemicals such as pollutants or drugs can affect the metabolism of the mother or fetus and disturb development at or after the developmental stage.

Physiological differences between children and adults are not only manifest in immature metabolic pathways. Because important systems are still differentiating and growing, children have unique susceptibilities not seen in adults — and critical time windows for those susceptibilities. This slide illustrates the significance of the timing of exposure. The critical times are as follows: preconception; gestation; postnatal, especially the first few years of life.

There has been an explosion of knowledge about child development in past decade or so, and it is hard to remember that it was only about 50 years ago that the discovery was made that the fetus is vulnerable to exposures. The phocomelia epidemic resulting from use of thalidomide by pregnant women was an early and dramatic example of the ability of chemicals to traverse the placenta and damage the fetus. It was found that thalidomide administered during a small, 4-day window between gestational days 20 and 24, possibly increased the risk of autism. More than one system of the fetus can be susceptible and different pathology may occur depending upon the dose and timing of exposure in utero.

Now we know that other exposures during gestation, some of which are listed here, can harm the systems of the developing child. We also know that preconception exposure of parents, as well as postnatal exposure of both parents, can harm children.

Notes:
- It is important to point out the different responses to insults shown on the bottom bar of the figure. Significant insult during the embryonic phase will result in pregnancy loss (first 2 weeks) or major organ malformation. During the fetal stage, damage is more subtle and related to system dysfunction.

References:

Figure:
Preconception paternal exposures are now increasingly recognized as important to the health and development of the fetus. Such exposures may increase the chance of certain diseases or adverse pregnancy outcomes as seen in the offspring. This is supported by research in animals and may well have a genetic or epigenetic mechanism.

Notes: You may want to stress exposures/occupations that are regionally specific if there are data to support prenatal or preconception effects.

References:
Mothers’ exposures both prior to conception and during pregnancy are associated with a variety of outcomes including spontaneous abortion, stillbirth or neonatal death, poor intrauterine growth, major birth defects and functional deficits.

PCB= polychlorinated biphenyls
DES= diethyl stilbestrol

Notes: You may want to stress exposures/occupations that are regionally specific if there are data to support prenatal or preconception effects.

References:
Outline

- Different and specific exposures
- Unique physiology
- Windows of development
- Systems development
- Longer life expectancy
- Politically powerless

Image:
- © WHO /Joao Soares Gusmao
And we know that growth continues through adolescence. This is not only physical growth, but also the maturation and continued differentiation of physiological functions. This graph shows the dramatic growth of major organs as well as their very different trajectories. Not only do the organs grow, but their function also matures and modifies at different life stages, through the end of adolescence.

Figure:

As an example, let’s look at the central nervous system (CNS). This diagram shows CNS development beginning with the prenatal period at the top of the diagram and progressing chronologically to the postnatal period at the bottom of the diagram. You can see that neurodevelopment continues through the second decade with significant changes in myelination, synaptogenesis and neurotransmitter distribution throughout the maturation phase.

Furthermore, the way the brain develops is determined in part by the interaction an individual has with the environment. Studies in musicians who began playing an instrument at a young age have shown variations in brain architecture and activity compared to non-musicians.

- Violinists must precisely place the fingers of the left hand on the strings of the violin in order to play the correct pitch. MRI data showed that the cortical area of violinists’ brains devoted to the left hand, but not the right, is expanded compared to non-players. The size of the expansion was correlated with the age at which a player began practicing; the younger a violinist began to play, the greater the size of the corresponding cortical area. Notably, the cortical area expansion was not correlated with amount of practice; this is a critical window of development where timing not dose makes the difference! If activity can alter brain architecture, so can toxic exposures.

- Functional MRI of children nine to 11 years of age who had undergone four years of musical training showed increased activation in certain parts of the brain when asked to detect differences in rhythm or melody compared to controls with no musical training. Positive exposure to musical training was linked to enhanced brain activity. Similarly, a negative or toxic exposure may have a detrimental effect on brain activity and even brain structure in developing children.

MRI: Magnetic Resonance Imaging is a technique used to view structure and anatomy in the body.
fMRI: functional MRI is a technique used to measure and map brain activity.

References:

Figure:
The respiratory system develops through non-linear growth, beginning in the prenatal period. For example, alveolar development begins in the third trimester. At birth a baby has only about 30-50% of the alveoli he or she will have in adulthood. In the post-natal period, alveolar development occurs most rapidly in the first two years of life, though it may continue for many years.

Certain types of exposures during these growth periods are known to have adverse consequences on structure (e.g. second-hand tobacco smoke, particulates and ozone) and function (e.g. poor indoor air quality and outdoor ozone).

Reference:

Figure:
There is strong evidence that exposure to air pollution impairs lung function and lung function development in children. A birth cohort study of 614 mother-child pairs in the Boston area found that even at low levels within US EPA standards, childhood exposure to ambient air pollution and local traffic was associated with reduced lung function in mid-childhood around eight years of age.

Fewer studies have been published on the effect of household air pollution on respiratory development. However, a study following 3273 children between six and 13 years of age in four Chinese cities found that use of coal as a household fuel was associated with lower lung capacity, especially when no ventilation was available.

On a positive note, studies in southern California, where ambient air pollution has been reduced over several decades, found that declining levels of the pollutants NO₂, PM₂.₅ and PM₁₀ were associated with improvements in lung function growth from 11 to 14 years of age. This indicates that the negative effects of exposure to air pollution may be mitigated by improving air quality.

The developing respiratory systems of children are highly vulnerable to environmental effects. It is incumbent upon us to improve air quality in order to prevent stunted growth and long-term effects to children.

References:

Image:
• © WHO /Sergey Volkov
Increased onset of asthma, as depicted in this graph, has been reported in areas with high ozone levels. The relative risk of developing asthma was 3.3 for children living in areas with high ozone levels who participated in three or more sports, compared to children living in the same areas who played no sports. In low-ozone communities, athletic children did not experience increased risk of developing asthma compared to non-athletic children in their communities, suggesting that exposure to ozone in polluted areas was what caused the onset of asthma in athletic children. Although this study has not yet been replicated, it is the first prospective study to suggest a link between high levels of exposure to outdoor ozone pollution and the onset of asthma in children.

Similar examples of ongoing vulnerability and critical windows of development can be cited for other major organs and systems.

References:

Figure:
Outline

- Different and specific exposures
- Unique physiology
- Windows of development
- Systems development
- Longer life expectancy
- Politically powerless
Children, ideally, are around longer in the world than adults. Not only do they live longer, allowing more time in which to develop diseases with long latency, but they also have longer to live with disabilities. In addition, they inherit the world we are creating, with all its problems and promises.

So these three main characteristics of children:
1. unique and different types of exposures;
2. dynamic developmental physiology; and
3. longer life expectancy
represent the scientific reasons that children are not little adults with respect to environmental hazards. An important difference is that the unique issues of the timing of exposure with respect to critical windows enlarges on the old concept of toxicology captured in the phrase “the dose makes the poison” to become “the dose and the timing make the poison”.

Two examples:
• Asbestos exposure in children and cancer many years after it
• Childhood exposure to lead and its relationship with adult hypertension and mortality

Notes: This image may be replaced with one showing a regionally appropriate baby.

References:

Photo:
• © WHO/Yoshi Shimizu.
Outline

- Different and specific exposures
- Unique physiology
- Windows of development
- Systems development
- Longer life expectancy
- Politically powerless

Image:
- © WHO /Joao Soares Gusmao
The fourth characteristic category takes us into the realm of laws, policy and advocacy.

- Children have no political voice.
- They are defenseless in a world that adults have created for them and vulnerable to environmental hazards.
- Children do not vote.

There’s a long tradition of advocacy in paediatrics with respect to speaking out against abuse and neglect and speaking for toy and product safety. Since the 1990s paediatricians and other professionals have been advocating for changes in laws and regulations that will specifically protect children from environmental harm. There are a variety of mechanisms, either proposed or in effect, designed to improve children’s environmental health. They range from local initiatives, rules and laws to international treaties and resolutions. It is critical that practitioners of children’s environmental health become and stay politically active, in all countries.

Photo:
- © WHO/Anna Kari
Health and environment professionals have a critical role to play in maintaining and stimulating changes that will restore and protect children’s environmental health.

Understanding environmental influences will allow us to create spaces that keep our children healthy. So, as we look to our political and personal lives to support sustainable development, we can look to our practices for ways to enhance the environmental health of our patients.

All of us can do something.

At the one-to-one patient level we can include environmental etiologies in our differential diagnoses and in our preventive advice. We can be dissatisfied with the diagnosis of “idiopathic” and look hard for potential environmental causes of disease and disability.

We can publish sentinel cases and develop and write up community-based interventions.

We can educate our patients, families, colleagues and students didactically.

Finally, we can become vigorous advocates for the environmental health of our children and future generations. It is not enough to be an informed citizen; we need to write letters and articles, testify at hearings and approach our elected officials with educational and positive messages, avoiding “scares” and “alarmism”, but providing evidence for action and clear proposals for remedial and preventive activities.

And, we can recognize that as professionals with an understanding of both health and the environment, we are powerful role models. Our choices will be noticed: they should be thoughtful and sustainable.

Photo:
- © WHO/Yoshi Shimizu
This beautiful picture was drawn by a child in India. It serves as a reminder that we must recognize the risks to our children and assume our responsibilities for preventing them, because we hold our future in our hands — and it is our children.

Thank you.

Photo
- © WHO SEARO/HRIDAY (www.hriday-shan.org)
Acknowledgements for current version

Reviewers: Katherine M. Shea (US), Fiona Goldizen (Australia), Julia Gorman (WHO Intern)
Initial edits by Kathy Prout (WHO)
Final review, technical and copy-editing: Gloria Chen (WHO Consultant)
WHO CEH training project coordinator: Marie-Noël Bruné Drisse (WHO)
WHO is grateful to the ISDE for organizing the working meeting of the Training Package in 2016.
This publication was made possible with financial support from the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety, Germany.
Update: February 2019
Design by L'IV Com Sàrl, Villars-sous-Yens, Switzerland.
Acknowledgements from past versions

WHO is grateful to the US EPA Office of Children’s Health Protection for financial support that made this project possible and for some of the data, graphics and text used in preparing these materials for a broad audience.

First draft prepared by Katherine M. Shea (USA).

With the advice of the Working Group Members on the Training Package for the Health Sector: Cristina Alonzo (Uruguay); Yona Amitai (Israel); Stephen Boese-O’Reilly (Germany); Stephania Borgo (ISDE, Italy); Irena Buka (Canada); Ernesto Bugno (ISDE, Italy); Ulian Coma (Argentina); Ruth A. Etzel (WHO); Ligia Fruchtengarten (Brazil); Amalia Laborde (Uruguay); Leda Nemer (WHO/EURO); Jenny Pronczuk (WHO); Roberto Romizzi (ISDE, Italy); Christian Schweizer (WHO/EURO); Katherine M. Shea (USA).

Reviewers: Giorgio Tamburlini (Italy); Ima Makalinao (Philippines); Irena Buka (Canada), Ruth A. Etzel (USA)

Update: November 2014

WHO CEH Training Project Coordination: Jenny Pronczuk
Medical Consultant: Katherine M. Shea (USA)
Technical Assistant: Marie-Noel Bruné
Editing: Kathy Prout
Suggested citation: