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# Universal Health Coverage and Environmental Health: An Investigation in Decreasing Communicable and Chronic Disease by Including Environmental Health in UHC

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Additional information is available at the end of the chapter

<http://dx.doi.org/10.5772/intechopen.69922>

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## Abstract

Over 83% of major diseases are environmentally mediated. These environmental factors include access to clean air and water, nutritional food, adequate shelter and access to health care. As health care systems across the globe struggle to include not only preventive health, but also health literacy in their approaches, it has become apparent that the most feasible system to combine all of these necessities is the universal health care/coverage (UHC) approach. This system also ensures that everyone has access to health services without financial hardship. It is imperative that environmental health (EH) is included in this approach, however, considering the global burden of disease due to environmental health factors. Epidemiological evidence-based approaches such as Water, Sanitation and Hygiene (WASH), have proven the advantage of utilizing these environmental health practices. In order to integrate EH into UHC, a dual multipronged (preventive and clinical) approach can be implemented; however, many are using a multisectoral approach due to the array of public-private partnerships which aid in its success. In alignment with the Millennium and Sustainable Development Goals, nations must make strides to address health disparities, chronic disease and poverty. Low and middle income countries (LMIC) are disproportionately burdened by economic insecurity, global pollution and preexisting issues within their government infrastructure, creating the worst health outcomes in these nations. Bangladesh has some of the worst chronic disease morbidities in the world due to indoor air pollution, rural and urban health disparities and food insecurity. Although the nation has begun to integrate EH into UHC, better coordination among ministries implementing health care is necessary, along with increased monetary allocation from the government. There is also a dire need for more health care providers who possess appropriate skills to work in the public sector. Lastly, more equitable access to services in both rural and urban areas and an improved financing mechanism must be instilled to successfully implement this EH/UHC approach.

**Keywords:** universal health care, universal health coverage, UHC, multipronged approach, multisectoral approach, environmental health, noncommunicable disease, NCD, chronic disease, communicable disease, morbidity, mortality, global disease burden, Millennium Development Goals (MDGs), Sustainable Development Goals (SDGs), Bangladesh

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## 1. Introduction

According to the World Health Organization (WHO), it is estimated that over 100 million people are forced into poverty every year due to out-of-pocket health care expenditures [1]. Although there are numerous factors, including but not limited to social status, environmental agents and cultural aspects, which may contribute to an individual's susceptibility to this statistic, implementing universal health coverage (UHC)<sup>1</sup> would undoubtedly help to diminish this number. By working toward this type of system to ensure good health, economic growth will also follow, benefitting communities holistically rather than unilaterally [2].

The objective of universal health coverage is to ensure that “all people can use health services without financial hardship” [1]. In order for this to be attained successfully, governmental health financing systems must be put into place and encourage collaboration among different governmental levels and agencies. Implementing a UHC system would lessen the gap between rich and poor communities by ensuring health equity, unlike the free market system. The ultimate purpose of UHC, therefore, would be to lower both the disease and financial burden at the community level by providing adequate preventive and clinical health care services to all.

In terms of prevention, environmental health (EH) factors should be addressed within the service-oriented nature of UHC, due to their high attribution to disease [3]. Through counseling and behavioral change models, environmental health factors such as exposures to contaminated air and water can be prevented. Educating communities on these environmental exposures through UHC infrastructure is paramount in successfully addressing these issues and bettering community health. Furthermore, environmental epidemiology is a useful tool in providing evidence-based science to illustrate these successes; Water, Sanitation and Hygiene (WASH) programs via clinics have provided health education counseling on this practice, therefore exponentially decreased infectious and enteric diseases [4].

## 2. Universal health coverage

The fundamental principle of UHC can be found in the 1948 United Nations Universal Declaration of Human Rights constitution; it states that, “Everyone has a right to a standard of living adequate for the health and well-being of himself and of his family, including food,

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<sup>1</sup>Universal Health Coverage can be used synonymously with Universal Health Care—in this manuscript, UHC can in turn be used to reference either phrase.

clothing, household and medical care and necessary social services" [5]. Following this precedent, the Alma-Ata Declaration developed its "Health for All" agenda in 1978, declaring equity to be of utmost importance [5]. In order to make this system feasible, a number of components must be present.

Firstly, the system must be robust and well developed in order to run efficiently and meet all of the priority health needs of its community members. It also must be focused on people-centered, integrated care with foci in both preventive medicine and clinical evaluation and treatment. Primary services should be focused on both communicable and noncommunicable diseases (NCDs), along with maternal and child health. This can be accomplished by: engaging community members through trusting relationships, screening/early detection methods, ensuring capacity to treat diagnosed diseases and providing therapeutic and/or rehabilitative services. The system must also be affordable so that financial hardships are alleviated and equity is achieved; different funding mechanisms to accomplish this are abundant and can be personalized per country. Consequently, a system cannot clearly be implemented without the accessibility to treatments; therefore, there must be access to crucial medicines and other technologies necessary to diagnose and/or treat conditions. Lastly, a sufficient team of trained and passionate healthcare workers, including but not limited to physicians, nurses, community health care workers and health educators (this team may vary depending on patients' needs), grounded in the best available evidence [5].

The UHC system also requires strategic interventions to address the most paramount causes of disease and mortality. As aforementioned, a wide array of quality health services should be covered involving health promotion, preventive care, clinical treatment, rehabilitation services and palliative care. In order to decide which area takes priority, epidemiological data and context are leveraged along with health systems, socioeconomic development and individuals' expectations [6].

Data have shown that over 83% of major diseases reported by WHO are environmentally mediated [3]. Considering this high attribution, environmental health has become a topic of utmost concern in addressing disease morbidity and mortality. In terms of UHC, preventive care and health promotion have become important foci to address these environmental health disease etiologies (see Appendix A for additional explanatory **Figures 6** and **7**). To better understand the role of environmental health and how to successfully address this disease burden, socioeconomic and racial factors contributing to health disparities must be investigated. Health literacy and access to clean air and water via an individual's built (surrounding) environment are major sources of exposure that have led to high morbidities in developing countries. The main objective in investigating environmental health is to decide which aspects to focus on in UHC, how to successfully communicate these practices and change detrimental behaviors and, lastly, to make the solutions sustainable.

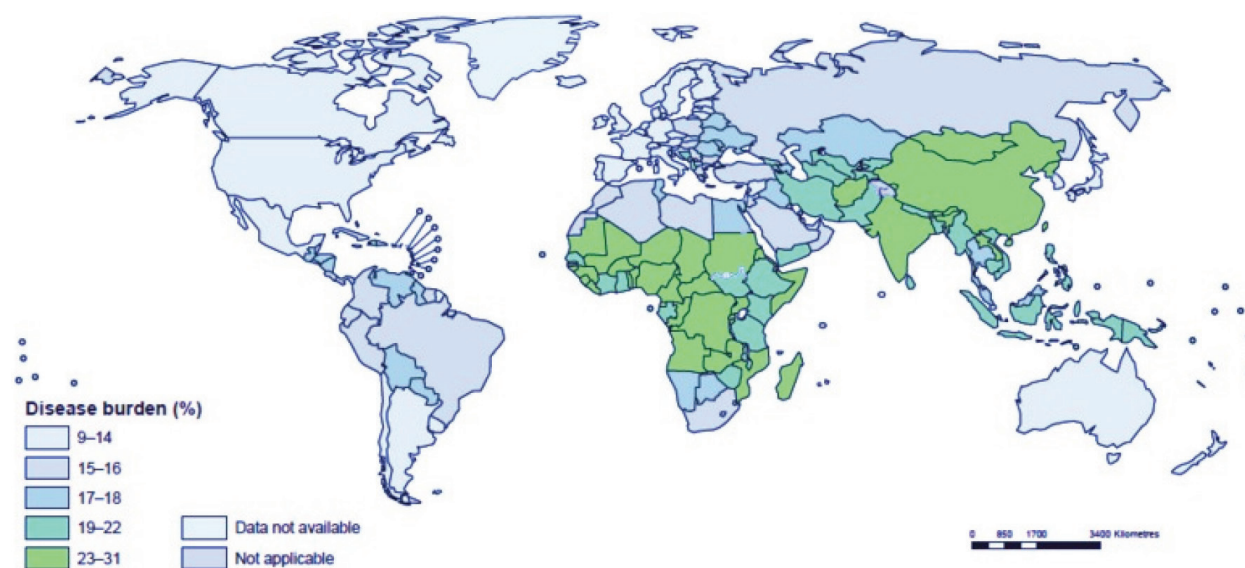
The objective of this paper is to provide the analytical framework for health care systems to integrate environmental health into universal health care. As aforementioned, environmental health accounts for the vast majority of major disease etiologies, therefore, justifying the rationale for making it an imperative part of UHC. The current problem exists in the fact that UHC does not address environmental health; this will later be illustrated within the case study

on UHC in Bangladesh. This paper will also provide the framework on how to incorporate environmental health into UHC using both the two-pronged approach and the multipronged/multisectoral approach as feasible solutions.

### 3. Environmental health

EH is the science behind preventing injury and detrimental exposure to environmental agents that may be physical, chemical, biological or social/cultural. These agents are transmitted primarily by air, water, soil or food [7]. Social/cultural burdens include socioeconomic status (SES), race, ethnicity or any other practices that limit one's social environment or access to healthcare. These factors can be exacerbated by health inequity and the state of climate change, that is, access to healthy and untainted food and water considering one's built environment. EH also includes the assessment and control of disease with environmental etiologies as well, especially those such as vector-borne illnesses such as malaria or diarrheal diseases. The objective is to prevent disease and create health-promoting environments (see Appendix A for additional explanatory **Figures 6 and 7**).

From an epidemiological perspective, because environmental health factors can occur at the individual, household, community, regional and global levels, EH issues have a great impact on global disease burden [6]. As a whole, it is estimated that environmental risk factors contribute to between 25% and 33% of the global disease burden (**Figure 1**) [8, 9]. Moreover, these environmental risk factors can be broken down into communicable versus noncommunicable linkages.



**Figure 1.** Environmental disease burden per country, 2012 (adapted from <https://assets.bwbx.io/images/users/iqjWHBFdfxIU/iI66GxTjwGag/v1/800x-1.png>).

Noncommunicable diseases kill 38 million people per year. Furthermore, nearly three-quarters of these diseases occur in low and middle income countries (LMIC), providing evidence for inequity. Some of the major noncommunicable diseases identified by WHO due to their mortality include cardiovascular disease, cancer, respiratory disease and diabetes [10]. Air pollution, particularly particulate matter (PM) from traffic, cooking stoves and incineration, to name a few environmental etiologies, has been linked to cardiovascular disease in a number of epidemiological studies over the past decade [11]. Cancer can be linked to a plethora of toxic chemicals found anywhere from personal care products and cleaning products and to crops contaminated with toxic molds; many of these can be found on the United States Agency for Toxic Substances and Disease Registry (ATSDR) Priority List, signifying their significance in terms of human exposure, toxicity and frequency of exposure [12]. Respiratory diseases can also be linked to chemical exposure and similar etiologies of cardiovascular disease, that is, air pollution (tobacco smoke and PM), exposure to asbestos and other occupational trade industry exposures (wood and leather dust) [13]. Conclusively, diabetes can clearly be linked to individuals' access to healthy food (food deserts) and their ability to maintain a well-balanced diet. Food deserts are a global health equity issue, also found in even high-income countries such as the USA.

Alternatively, communicable diseases, otherwise known as infectious diseases, are found almost entirely in LMIC. Major risk factors for these outbreaks include flooding, likely caused by global warming and climate change. Flooding contaminates drinking water sources and stimulates mold growth in both crop fields and containers holding water or crops, which leads to an array of water-borne diseases and epidemics including cholera, hepatitis A, typhoid fever and leptospirosis. Additionally, due to the attraction of insects, namely mosquitos, to these environments, vector-borne diseases such as Ebola, dengue, malaria, yellow fever, gangue hemorrhagic fever and West Nile fever have all increased exponentially. Developmental birth defects such as neural tube defects (NTDs) can also result from these diseases, that is, the Zika virus and microcephaly. The lack of availability to clean water also leads to diarrheal disease and ear, nose and throat infections. Additionally, social/cultural practices can contribute to transmission of disease such as the practice of burning an Ebola corpse, which occurred in the Ebola epidemic most recently. Tuberculosis can also be transmitted by corpses along with other blood-borne viruses and gastrointestinal infections [14]. Some communicable diseases can also be contracted at rapid rates by the built environment, for example, tuberculosis, influenza and other air-borne disease causing agents due to overcrowding—prisons in countries such as Russia and slums in many other countries, namely India.

To put the health equity across countries in perspective, in LMIC, lower respiratory infections are the third leading cause of death, while chronic obstructive pulmonary disease (COPD) is the sixth leading cause of death. Disproportionately, when looking at children between the ages of 0 and 14, lower respiratory disease is actually ranked second, while diarrheal disease is ranked third [6]. Globally, more than a third of the disease burden due to environmental factors falls on children [15]. Considering all of these environmental risk factors, the top risk factors have been identified as unimproved water and sanitation and air pollution.

## 4. Global initiatives

Due to the continuous interaction between the environment and poor health outcomes, the following global development goals have been identified as contributors/targets to address environmental health. Clearly, environmental stability must be the ultimate goal to alleviate the aforementioned environmentally mediated diseases; in order to accomplish this, however, both poverty and poor baseline health must be addressed [16]. Each goal includes a number of target objectives and timeframes to accomplish in order to alleviate detrimental aspects of each goal.

### 4.1. Millennium Development Goals

All of the eight main Millennium Development Goals (MDGs) are applicable to driving EH practices in countries that are part of the UN. Additionally, considering the weight they carry globally, this further justifies the need to include EH within UHC. The main Goal (7) is to ensure environmental sustainability. To ensure sustainability within one's environment is to provide a healthy built environment, free of excess disease and risk factors. Secondly, Goal (4) is to reduce child mortality. This goal is one of utmost importance due to the fact that over a third of the global disease burden falls on children [15]. Goal (1), which aims to eradicate extreme poverty and hunger, is also directly related to environmental health. Similarly to children's high risk, disproportionate burdens of disease cultivate among groups with low SES exacerbating the disease burden; this is a primary focus considering communicable diseases and their high rates of transmission, especially in areas of low SES. Furthermore, Goals (3) and (5) align with gender equality and empowering women/improving maternal health. This vulnerable group, alongside children and low income, also is especially susceptible to disproportionate levels of environmental risk factors, that is, indoor smoke from cooking and childbirth complications. The need for EH within UHC to lessen this disparity and risk is vital, especially in developing countries where access to care and cultural norms prove to be additional obstacles to ensure good health. Of course, Goal (6), to combat HIV/AIDS, malaria and other diseases, has a direct correlation to EH prevention strategies. Additionally, more educated mothers have been shown to have fewer and healthier children [17]. This is directly correlating MDG Goal (2), which is aimed at achieving universal primary education. Lastly, global partnerships for development, Goal (8), are an important concept, especially within lower income countries. As shown previously, disease burden is disproportionately high in these countries, causing stress on both the communities and the economies. The need for better infrastructure and aid from higher income countries is an important factor to consider, despite the fact that this goal is not directly correlated to in country UHC and EH. In country, multisectoral approaches can help lessen this stress partially also.

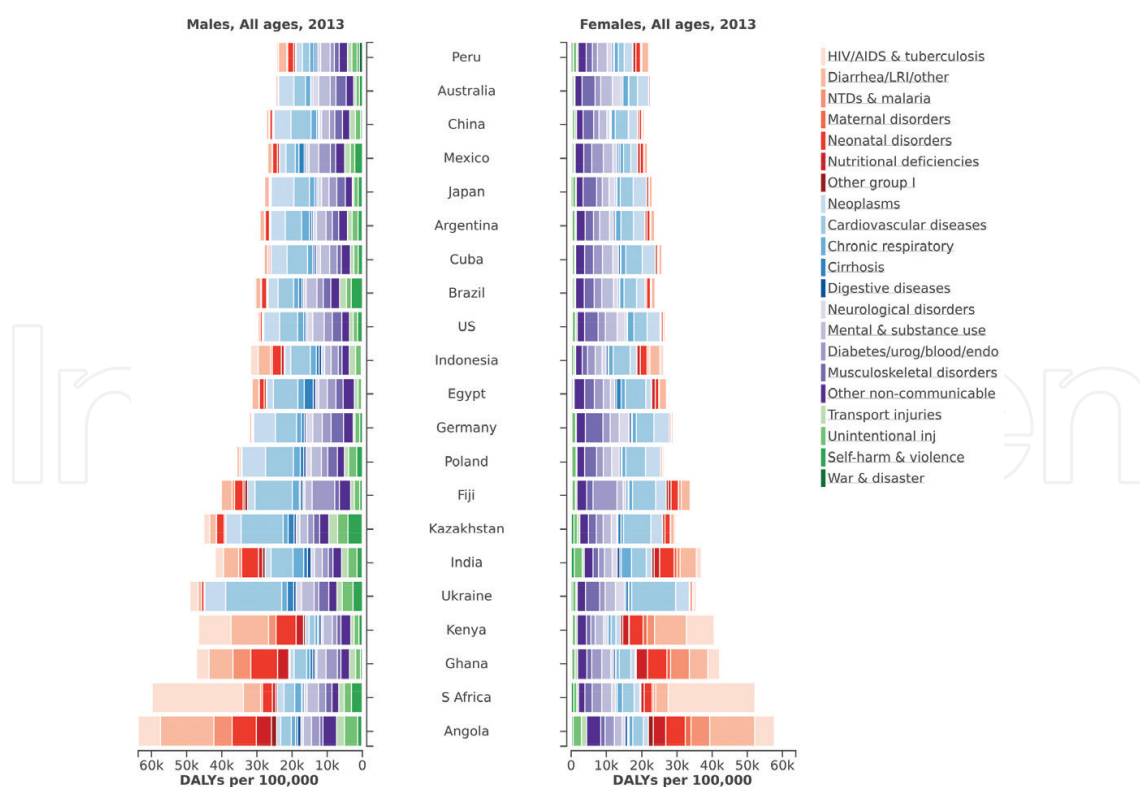
### 4.2. Sustainable Development Goals

The Sustainable Development Goals (SDGs) were created in 2015 by the United Nations and are significant in addressing environmental exposures and therefore decreasing morbidity and mortality. By creating clean, sustainable environments and teaching individuals healthy practices, environmentally mediated diseases associated with the previously mentioned diseases

and poor health outcomes, that is, cholera, diarrhea, COPD, cancer, adverse birth outcomes, etc., can be addressed in a global, systematic manner. The burden of many of these diseases, both communicable and noncommunicable, can be alleviated in part by the MDG and SDG. These goals are the driving force for sustainable environmental health practices in countries that are part of the UN.

All of the SDGs can also be utilized to show the need for EH integration within UHC, as they have a direct correlation to EH and sustainability. They include: Goal (3) good health and well-being, Goal (6) clean water sanitation, Goal (13) combat climate change and impact, Goal (7) affordable and clean energy, Goal (9) industry, innovation and infrastructure, Goal (11) sustainable communities, Goal (12) responsible consumerism and production and lastly, Goals (14) and (15) life below water and on land. Specific examples of their exposures can be found previously in the EH section, that is, climate change and flooding, toxicological exposures within food, and morbidity and mortality of pollution sources.

**Figure 2** shows the contrasting distribution of all major communicable and noncommunicable diseases (and injuries) across countries. The figure illustrates the disproportionate burden these majorly environmental mediated communicable diseases have on LMIC, namely Africa. Most importantly, however, it shows the prevalence of noncommunicable (chronic) disease across these countries in relationship to the disability adjusted life years (DALYs), which illustrate overall disease burden. Although communicable diseases disproportionately burden LMIC, overburdening of NCDs is found among all countries, despite economic status.



**Figure 2.** Burden of disease by cause, country, and gender (2013 estimates)—produced by IHME Viz Hub (adapted from <https://ourworldindata.org/burden-of-disease/>).



## 5. Intersection

### 5.1. Environmental health through UHC

Considering the high burden of environmental factors on human disease, universal health coverage can be accomplished significantly through improving environmental health. This is especially true in the aspects of health promotion and disease prevention within UHC. Conclusively, as mentioned previously within the EH section, the main aspects of environmental health that can be investigated in this aspect include:

- Indoor and outdoor pollution—that is, air pollution leading to respiratory issues
- Food safety—that is, mold growth due to climate change (flooding) and cancer
- Hygiene and sanitation—that is, need for clean water to lessen diarrheal diseases
- Vector control—that is, to mitigate vector-borne diseases such as dengue and Zika virus
- Solid waste management—that is, to ensure that water sources are not contaminated
- Occupational health and industrial hygiene—that is, understanding higher occupational exposures and ensuring worker safety across governmental agencies

These major environmentally mediated global health issues can be integrated into UHC, utilizing the “two Pronged” approach, which includes both (1) preventive and (2) treatment aspects [6]. The preventive portion invests in education and major infrastructure, that is, sewage, water treatment and scrubbers on coal-fired boilers. The services included in the prevention aspect also include health education and delivery of services to communities who are challenged in their access to appropriate health care. On the other hand, the treatment side integrates both environmental and occupational health data into the physician’s assessment alongside ability and resources in order to “prescribe” reduced exposures, that is, mold within the household and occupational allergens [6]. This could also be viewed as a pre- versus post-exposure scenario, with the main focus on mitigating environmental health exposures.

This two-pronged approach can better address environmental health by focusing on the service aspect. As aforementioned, access to health care is a major issue in both developing countries and even developed countries, which encompasses health disparities, primarily due to SES. In order to address these components, the appropriate services must be offered. In some cases, diagnostic tests may prove useful in prescribing correct medications for communicable diseases, while consultations in prevention measures for environmental exposures can be effective in others. It is without a doubt that health consultations from community health care workers and ideally primary health care (PHC) providers should be a priority. PHC is important to assess the patient’s health in a holistic manner and applies the most appropriate service. Diagnostics tests may be out of reach for individuals in resource-limited countries and/or low-income areas, however, proving the need for a different service delivery system. Global initiatives (MDG and SDG) can aid in lessening the disease burden overall, therefore applying less pressure to localized services. It is plausible to utilize epidemiological methods to inform global or even national policy in order to reduce exposures. This would lessen the economic and resource burdens at the local level.

## 5.2. Integrating environmental health with UHC

Because of the fact that health insurance alone cannot mitigate all of these environmental health factors, a “multipronged” approach has been suggested to alleviate this issue. In general, the three pillars of this approach include (1) responding to existing demand, (2) anticipating healthcare needs and (3) addressing underlying (structural) issues. Responding to demand is imperative in order to provide affordable, equitable high-quality health services from a pluralistic health system. Secondly, in an era of rapid growth and both health and social transition, anticipating community health care needs is an imperative factor to account for. Lastly, in order to make a sustainable system, underlying issues must be addressed to ensure progress [6]. The variance of these three pillars can be personalized per country for optimal success [18, 19]. A recent report by the World Bank Report on universal health coverage for Inclusive and Sustainable Development shows the diversity of this approach. As seen in **Figure 3**, countries in Groups 2 and 3 have implemented or are working toward a multipronged approach [19]. **Figure 3** illustrates the diversity of this approach and flexibility in order to meet the needs of a particular nation. Bangladesh is seen in Group 1 as a pilot multipronged approach to UHC. This case study will be discussed in the next section; it is important to follow early stage programs and survey their effectiveness in UHC.

A “multisectoral” approach could also be employed to include environmental health factors. This can be accomplished by engaging other instrumentalities of universal health care including (1) health care delivery systems, (2) individuals within the health workforce, (3) health facilities and/or communication networks and (4) governmental agencies and legislators. Delivery systems, health workforce and communication networks can be primarily effective in spreading awareness and mobilizing efforts at the community level, within households. This

	<i>Group 1</i>	<i>Group 2</i>	<i>Group 3</i>	<i>Group 4</i>
Status of UHC policies and programs	Agenda setting; piloting new programs and developing new systems	Initial programs and systems in place, implementation in progress; need for further systems development and capacity building to address remaining uncovered population	Strong political leadership and citizen demand lead to new investments and UHC policy reforms; systems and programs develop to meet new demands	Mature systems and programs: adaptive systems enable continuous adjustments to meet changing demands
Status of health coverage	Low population coverage; at the early stage of UHC	Significant share of population gain access to services with financial protection, but population coverage is not yet universal and coverage gaps in access to services and financial protection remain	Universal population coverage achieved but countries are focusing on improving financial protection and quality of services	Universal coverage sustained with comprehensive access to health services and effective financial protection
Participating countries	Bangladesh Ethiopia	Ghana Indonesia Peru Vietnam	Brazil Thailand Turkey	France Japan

Note: UHC = universal health coverage.

**Figure 3.** UHC program countries (adapted from <http://apps.who.int/medicinedocs/documents/s21582en/s21582en.pdf>).

could educate individuals on the importance of environmental health, including sanitation and ventilation, especially when using indoor cook stoves fueled by biomass [20]. Alternatives such as kerosene or gas energy sources could be encouraged along with handwashing techniques and the use of mosquito nets to lessen vector-borne disease. The use of outreach infrastructure could also be vital in integrating networks from microcredit activities with environmental health initiatives [6].

Utilizing pertinent governmental agencies and legislators is also invaluable to integrating environmental health in specific trades and in general occupational health practices. This relationship to individuals with power could also make equipment available, or aid in subsidizing the purchase of, which aims to improve environmental health, that is, gas-powered stoves, mosquito nets and water sanitation systems. Legislation could be developed and implemented in specific areas for the safety of large groups, for instance, food safety, waste management and occupational health. Policy could too be integrated with local government to support public-private partnerships; Ministries of Public Health, Ministry of Health, Ministry of Environment or Forest/Agriculture and Ministry of Education can all be leveraged here. With support from these powers, community-level efforts to spread awareness about the importance of environmental health in order to control the burden and spread of disease could be a long-term solution to alleviate these health-deteriorating factors. Unfortunately, education will not be the end all solution, however, due to the interconnectivity of universal poverty. Ensuring access to healthy environments is vital in one's overall health to mitigate environmental health factors, which leads to NCDs and a wide array of chronic diseases that put many people out of work and into poverty.

## 6. Case study: Bangladesh

In a country whose population exceeds 156 million people and is embedded deep within South Asia (a continent that contains of nearly 40% of the world's poverty) it is a feat that they have accomplished so much over the past four decades [21, 22]. With the help of the World Health Organization, Bangladesh has met a multitude of Millennium Development Goals over these four decades, particularly in terms of maternal and child health. Maternal mortality and both infant and child mortality along with malnutrition have all declined [23]. Concurrently, poverty rates and the number of people living in hunger have declined up to 30% since the 1970s as well [22]. All of these factors have also helped individuals to live longer; the life expectancy in Bangladesh (70 years) exceeds the global average of 69 years [23]. Despite these facts and the future promise they bring, there are still major public health problems that persist in Bangladesh, especially in terms of environmental health.

Bangladesh still ranks in the bottom four countries for maternal health [23]. This may be due to a number of delays in giving birth including the social/cultural decision to come to the health care facility, issue of transportation in getting to the facility and the question of whether the health care facility has the adequate services to aid in delivery (midwives, medications, ability to perform blood transfusions, etc.) Additionally, although child malnutrition

is decreasing, poor nutrition is still a main issue of concern, considering that nearly half of Bangladeshi children prior to 1-year-old and up to 5-year-old suffer from anemia; a third of children are also underweight [23].

Some major communicable diseases include those which are food and water-borne including diarrhea, hepatitis A and E and typhoid fever. Vector-borne diseases are unequally distributed across the population and consist primarily of dengue fever and malaria. Below is a chart highlighting the access to unimproved water and sanitation services, the major contributors of diarrhea, a condition which kills over 2 million children under five annually in Bangladesh [22] (see **Figure 4**).

Additionally, due to the slums, there is also a high rate of tuberculosis (TB) transmission; Bangladesh ranks within the top 10 globally for TB burden [23]. Obviously, this is unequally distributed across the population, concentrating in poor and uneducated communities.

Noncommunicable diseases include many chronic diseases such as cardiovascular and respiratory diseases, cancer and diabetes. This is dependent on socioeconomic status and literacy due to the etiology of cardiovascular and respiratory diseases/infections (namely COPD, acute lower respiratory infection) due to indoor cook stoves that use biomass for fuel, along with access to healthy foods [24]. Moreover, these numbers are increasing in correlation to the surge in urbanization [23]. The first national study conducted showed roughly 1 in 3 women and 1 in 5 men (age 35 and older) had elevated blood pressure, while about 1 in 10 had elevated blood glucose, a biomarker indicating diabetes. Conclusively, cancer is also the sixth leading cause of death [23] (see **Figure 5**).

Because environmental health includes factors determined by not only environmental exposures, but also SES, and therefore political influences and built environment, EH is a multisectoral problem, which requires an equivalently holistic solution [22].

<b>Drinking water source:</b>	<b>Sanitation facility access:</b>
<b>improved:</b>	<b>improved:</b>
urban: 86.5% of population	urban: 57.7% of population
rural: 87% of population	rural: 62.1% of population
total: 86.9% of population	total: 60.6% of population
<b>unimproved:</b>	<b>unimproved:</b>
urban: 13.5% of population	urban: 42.3% of population
rural: 13% of population	rural: 37.9% of population
total: 13.1% of population (2015 est.)	total: 39.4% of population (2015 est.)

**Figure 4.** Statistics on access to clean water and sanitation facilities in Bangladesh (adapted from <https://www.cia.gov/library/publications/the-world-factbook/geos/bg.html>).

<b>Environmental burden of disease (preliminary), per year</b>				
Estimates based on Comparative Risk Assessment, evidence synthesis and expert evaluation for regional exposure and WHO country health statistics 2004				
DALYs/1000 cap (World - lowest: 13, highest: 289)				<b>64</b>
Deaths				<b>323 500</b>
% of total burden				<b>24%</b>
Environmental burden by disease category [DALYs/1000 capita], per year				% burden
Disease group	World's lowest country rate	Country rate	World's highest country rate	preventable through healthier environments
Diarrhoea	0.2	16	107	
Respiratory infections	0.1	7.7	71	
Malaria	0.0	0.6	34	
Other vector-borne diseases	0.0	1.9	4.9	
Lung cancer	0.0	0.4	2.6	
Other cancers	0.3	1.1	4.1	
Neuropsychiatric disorders	1.4	2.2	3.0	
Cardiovascular disease	1.4	3.5	14	
COPD	0.0	1.9	4.6	
Asthma	0.3	1.3	2.8	
Musculoskeletal diseases	0.5	0.6	1.5	
Road traffic injuries	0.3	2.0	15	
Other unintentional injuries	0.6	7.4	30	
Intentional injuries	0.0	1.3	7.5	
<b>Other indicators</b>	indicates how preventable environmental burden of disease compares with other countries		indicates how preventable burden of environmental disease is spread across disease groups in the country	
Use of leaded gasoline			No	(2008)
Overcrowding			NA	
Malnutrition (% stunting)			47%	(2006)

Figure 5. Bangladesh environmental burden of disease (adapted from Ref. [6] presentation).

USAID’s Country Office for Bangladesh is aimed at building capacity of pertinent government organizations to “reduce environmental health risks through research, policy advice, and awareness raising activities” [24]. The major goals are aimed at addressing (1) indoor air pollution (IAP), (2) occupational health and (3) arsenicosis [24]. IAP and arsenic have become priorities due to the detrimental effects (i.e., neurological impairments, diabetes, hypertension, heart attack and cancer) and exposure distribution. Arsenic is especially concerning due to the fact that it has been identified in shallow tube wells which supply drinking water to communities throughout Bangladesh, many of them rural and poor [25]. Additionally, women and children are disproportionately burdened by IAP due to their extended hours in the household; nearly 92% of the population use solid biomass for fuel, which creates extensive IAP.

Of course environmental health education is an important factor to use in the multisectoral approach also. This effort could educate Bangladeshi people on the importance of understanding arsenic poisoning, indoor air pollution and occupational health exposures which pose health risks. It could also encourage individuals to use cleaner energy sources or if financially limited, well-designed, improved stoves; this would decrease IAP by at least 50% but possibly up to 90% [24]. Occupational exposures are an important factor to consider due to

workers' high frequency and magnitude of exposure. This is also important considering the preexisting tension between entrepreneurs and industry—the stigma that compliance and administrative costs deter worker productivity.

WHO Bangladesh worked in collaboration with Bangladeshi personnel to provide training and awareness programs to necessary occupations (i.e., safety officers, inspectors and physicians) [24]. The team also contributed by provided technical support to develop manuals on indoor air pollution, create a national framework for IAP health impact, national strategy for health and safety (in both English and Bangla), and create a data profile of construction sectors on health and safety (base data for construction injury prevalence) and training health care workers to evaluate and treat arsenic-related illnesses. More studies are currently being developed with a focus on occupational health and arsenic exposures and clinical solutions [24].

Other nongovernmental organizations (NGOs) such as the Environment and Social Development Organization (ESDO), are also working toward improving environmental health across Bangladesh. Their main objectives include (1) protecting the environment, (2) reducing poverty, (3) increasing literacy rates and education, (4) empowering woman in rural communities and (5) improving sanitation and health services. Foci are improving livelihoods, SES and environmental education in the most vulnerable parts of Bangladesh [26]. As seen in the multisectoral approach, it is important to have these private-public partnerships, with NGOs building capacity and relationships with community members, increasing success rates.

Notwithstanding all of these efforts, more can certainly be done to combat the burden on environmental health on the population of Bangladesh. Government health expenditures were recorded to be only 2.4% of the GDP in 2014 [21]. Additionally, only less than 62% of the population can read and write, with education expenses being only 2.2% of the GDP [21]. As aforementioned, health disparities plague the country due to SES; these poor literacy rates and minimal government monetary contribution have exacerbated the environmental health exposures and poor health outcomes without a doubt.

Recognizing that the health care system of Bangladesh has gone through a number of changes since their independence in 1971, some great accomplishments and improvements have been made. MDG 4 reducing childhood mortality was achieved before the 2015 target. Additionally, a number of other key indicators have made improvements including TB, diarrhea and malaria [27]. Nonetheless, there are quite a few improvements, which could be made in the current health care system, collaboratively creating the need for a better multisectoral and multipronged approach:

- Better coordination among different ministries implementing primary health care services (both rural and urban areas)
- Need for more health care providers with appropriate skill sets in public sector
- Higher allocation of government budget and less individual out-of-pocket expenses
- Create more equitable access to health care services among rural and urban areas and consistent health financing mechanisms

The current inequitable access to services is the greatest limitation in ensuring universal health care coverage in Bangladesh [27]. As the program currently stands, it is also inadequate in addressing environmental health due to the SES disparity across the country, lack of trained professionals and surveillance of environmental issues, which cause many communicable and noncommunicable diseases along with infrastructure.

## 7. Sustainability

Firstly, the appropriate approach to integrating EH and UHC must be chosen based on the country's status and needs. All components of this approach must contain clear (SMART) objectives and build collaboration between private and public sectors. Secondly, the approach must be efficient. It has been shown that 20–40% of resources spent on health care are wasted [1]. In implementing universal health care systems, it is imperative to utilize health care services efficiently. This can be addressed in a variety of timeframes—at the “pre” public health community level by educating community members on environmental health exposures and the “post” clinician level, prescribing generic medications and lastly implementing policies, which protect the health of the public [1].

LMIC are notoriously blindsided when it comes to protecting workers' health, especially in terms of child labor and environmental exposures; therefore, public-private partnerships and legislation will be very useful in providing long-term solutions here. Additionally, international efforts to lessen environmental contaminants can be strengthened. This is a much larger issue than EH and UHC, but some of the international topics include global warming and climate change, import and export of goods leading to additional water and air contaminants, global health disparities and inequity in food quality for high- and low-income populations.

The issue of manpower also comes into play when considering the challenges of providing a stable environment for UHCs to flourish. As mentioned previously, intergovernmental agency collaboration and community engagement are vital in EH and UHC in order for the health system and environmental component to work in sync. In order for the EH within UHC to be addressed successfully, programs must provide sustainable solutions to environmental health exposures. The Bangladesh case study proves the need to implement a multipronged and multisectoral approach to ensure success of EH within UHC. Developing relationships through sectors at the regional and local levels would strengthen the likelihood of long-term sustainability after specific programs or projects have ended.

## 8. Conclusion

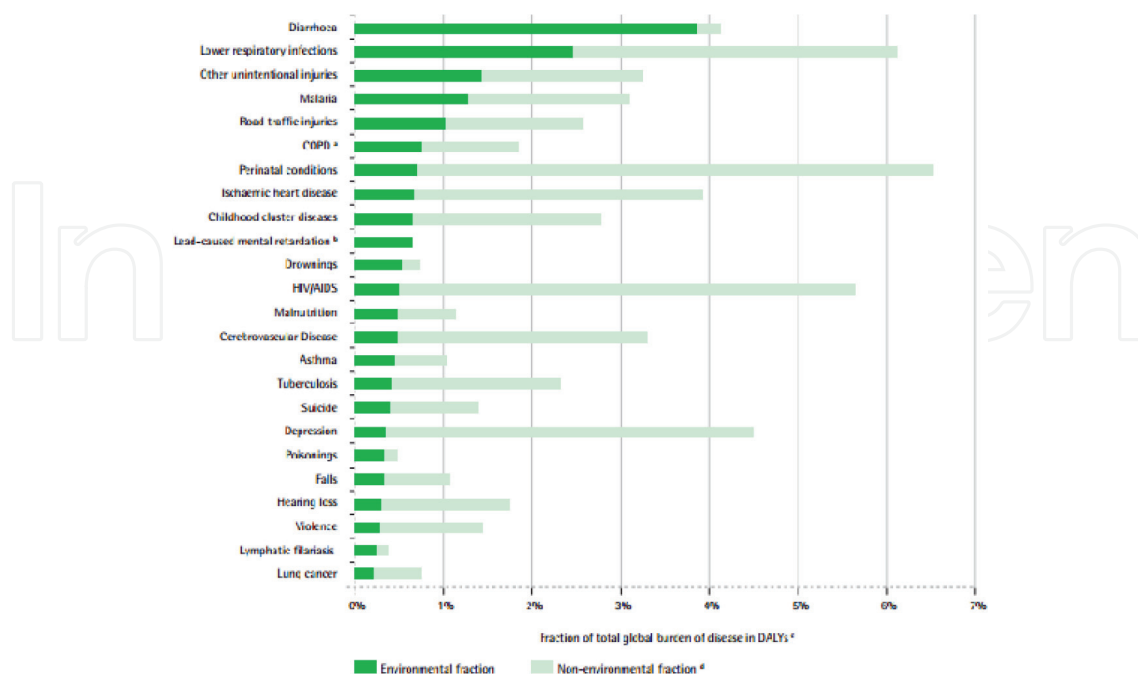
As stated by Margaret Chan, Director-General of WHO, “Universal Health Coverage is the single most powerful concept that public health has to offer” [28]. Environmental health must be included within the implementation of a universal health care system due to the high burden of environmentally mediated diseases (~83%) [3]. This further justifies the importance of integrating the two. Despite the multitude of challenges as seen in the Bangladesh case study, there

are a wide variety of options to utilize in integrating EH and UHC. By doing so, this ensures people have access to healthy (built) environments and government spending on health care costs associated with many NCDs such as chronic diseases, can be decreased. In LMIC where the burden of disease is highest, the UHC multisectoral approach would be the most beneficial.

Lessons learned from many UHC programs, specifically the Bangladesh case study, include the need for collaboration among sectors, increase in federal health care spending, inclusion of environmental health in UHC and focus on prevention methods. The proper services must also be integrated in order to successfully address health disparities in urban versus rural (or higher versus lower income) areas due to the possible difference in feasibility of service. Opportunities for improvement are plentiful in terms of strengthening the current pilot system through innovative delivery of services, appropriate approaches and implementing policy. As seen in the MDG and SDG, global efforts are being made to address EH and lessen the disease burden, but more can be done at the national policy level as well, especially making more stringent standards.

In conclusion, by implementing country-specific UHC approaches, focusing sufficient government spending on health care (including training health care professionals) and engaging public-private partnerships to successfully target environmental health at the community level, universal health care can be achieved. This would not only create healthier individuals to enter work force and contribute to the economy, while reducing absenteeism, but also reduce poverty by addressing the roots of the problem—the vicious cycle of inequitable health care due to chronic disease and SES.

## Appendix A



**Figure 6.** Diseases with the largest environmental contribution (adapted from [http://www.who.int/quantifying\\_ehimpacts/publications/preventingdisease.pdf](http://www.who.int/quantifying_ehimpacts/publications/preventingdisease.pdf)).





Figure 7. Environmental sources of exposure and impact on health (adapted from <http://www.neha.org/about-neha/definitions-environmental-health>).

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