

Review of Climate Change and Water-Related Diseases in Cambodia and Findings From Stakeholder Knowledge Assessments

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Abstract

This project aims to increase the resilience of Cambodian communities to the health risks posed by climate change–related impacts on water-related diseases. There are a number of water-related diseases that are present in Cambodia and are likely to be susceptible to climate change. These include diarrheal diseases, typhoid fever, leptospirosis, melioidosis, viral hepatitis, and schistosomiasis. Certain subsectors of Cambodia’s population may be more vulnerable than others with respect to climate change impacts on water and health, including agricultural workers and residents of flood-and drought-prone areas. The current level of understanding on the part of health professionals and other key stakeholders in Cambodia regarding the risks posed by climate change on water-sensitive diseases is relatively low. Strategies by which this understanding might be strengthened are suggested.

Keywords

climate change, water-related diseases, Cambodia, health professionals, vulnerability

Introduction

Cambodia is thought to be one of the most vulnerable countries in the Southeast Asian region to the impacts of climate change,¹ which will likely include increasing air temperatures, increasing frequency and intensity of extreme weather events such as droughts and floods, and alterations in rainfall patterns and the flow of the Mekong river and its tributaries.²

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Among the most significant impacts of climate change around the world, particularly in developing countries such as Cambodia, is the likely detrimental effect on human health. The Southeast Asian region is already considered to be one of the most vulnerable to the health impacts of climate change³ because of a combination of large populations, high rates of poverty, low levels of development and adaptive capacity, and existing high burdens of “climate-sensitive diseases.”

The aim of this project, titled “Developing Research and Innovative Policies Specific to the Water-Related Impacts of Climate Change on Health” (DRIP-SWICCH), was to increase the resilience of Cambodian communities to the health risks posed by climate change impacts on water-related diseases, thus addressing one of the top priorities of Cambodia’s Climate Change Strategy for Public Health (CCSPH). This aim was to be achieved via 3 main outcomes: research, health professional education, and community health promotion.

This article is composed of 3 sections. First, we review the literature on water-related diseases in Cambodia and highlight the importance of this health issue in terms of Cambodia’s overall vulnerability to the health impacts of climate change. Second, we present the results of knowledge assessment surveys conducted during a series of health professional and key stakeholder workshops in Cambodia. Last, we provide recommendations generated from these workshops aimed at reducing the current and future burden of water-borne diseases in Cambodia, in the context of climate change.

Background

In the literature on climate change and its effects on water-related diseases, most of the focus has hitherto been on diarrheal disease (including viral and bacterial gastroenteritis, dysentery, cholera, and other etiologies and manifestations of gastrointestinal infections). Indeed, diarrheal disease was 1 of the 4 key health indicators included in the first World Health Organization Global Burden of Disease assessment to include the health impacts of climate change. This study, based on data from the year 2000, included diarrheal disease along with malaria, malnutrition, and the health impacts of extreme weather events, in estimating the annual global mortality attributable to climate change as approximately 150 000 deaths per year.⁴ There is a large body of evidence linking diarrhea incidence to changes in temperature, rainfall, and humidity, with obvious implications for climate change.⁵⁻⁹

In Cambodia, diarrheal disease is a very significant cause of morbidity and mortality, particularly in children. The Department of Planning and Health Information of the Cambodian Ministry of Health monthly reports demonstrate that diarrheal illnesses constitute the second most common outpatient and inpatient diagnoses (acute respiratory illnesses being the most common). Despite the limited diagnostic capacity in Cambodia at present, previous research findings suggest that the common etiologies of pediatric diarrheal diseases in Cambodia include *Escherichia coli* and rotavirus, with *Shigella* species implicated in cases of dysentery (bloody diarrhea).¹⁰ Cholera also occurs in relatively frequent epidemic cycles in Cambodia, and has been shown to be strongly linked to changes in temperature, rainfall, and other environmental conditions.^{11,12}

However, in addition to diarrheal disease, there is a much longer list of diseases that are transmitted by water (via contact, ingestion, inhalation, skin penetration, etc), or are otherwise affected by water (eg, contamination of potable water supplies, altered geographic range or habitat of vectors or vertebrates that transmit zoonoses, interaction with soil saprophytes to bring them closer to the surface) and are thus susceptible to climate change. Such diseases, which have been shown to exist in Cambodia, include typhoid fever,^{13,14} leptospirosis,^{15,16} melioidosis,¹⁷⁻¹⁹ hepatitis E,²⁰ schistosomiasis,²¹ and arsenicosis.²² Again, there is substantial evidence linking most of these diseases to changes in climatic conditions, with significant international concern mounting over the prospect of increasing burdens of these diseases with climate change, particularly for leptospirosis,²³ melioidosis,²⁴ and schistosomiasis.²⁵

This longer list of water-related climate-sensitive diseases was considered in various aspects of the DRIP-SWICCH project, although the main focus remained on diarrheal disease, given its proportionately large burden of disease and the lack of routinely collected surveillance data and diagnostic capacity for other water-related diseases in Cambodia.

Certain subsectors of Cambodia's population may be considered to be more vulnerable than others with respect to climate change impacts on water and health. These groups include residents of flood-and drought-prone areas²⁶ and certain occupations (eg, rice farmers and other agricultural workers). Both of these groups may be considered at increased risk of exposure to diseases transmitted via contact with pooled water (such as that which occurs in rice paddies or during flood conditions), notably diarrheal disease, melioidosis, and leptospirosis.

People living in poverty may also be considered to be at higher risk,²⁷ which may be partly because of their limited abilities to access improved water and sanitation facilities. A "knowledge, attitudes, and practices" survey carried out by the Ministry for Rural Development in 2010 found a strong correlation between households that had latrines and those which treated water appropriately and practiced safe hygiene. This suggests that factors such as income and education are likely linked with health-protective behaviors such as latrine use, water treatment, and hand hygiene. Similarly, a 2003 World Bank report on the "poverty-environment nexus" in Cambodia showed a close statistical and spatial correlation between poor households and lack of access to safe water, with likely negative implications for childhood diarrhea and mortality.²⁸

With the above in mind, the DRIP-SWICCH project conducted a series of workshops throughout Cambodia, aimed at assessing and improving the current level of knowledge of key stakeholders (particularly senior health sector staff) regarding the burden of water-related diseases in Cambodia, their links with climate, and strategies to reduce these burdens of disease now and into the future.

Methods

A series of surveys were conducted over 3 stakeholder workshops (consisting mostly of health professionals) in Phnom Penh, Siem Reap, and Kratie in August and September 2013. The surveys consisted of a combination of multiple choice and open-ended questions, which were informed by the (limited) literature on climate change and health knowledge assessments,^{29,30} as well as the aforementioned literature on specific water-related diseases in Cambodia.

The survey was drafted in English and translated into Khmer; both English and Khmer versions of the questions were provided on the survey. The survey contained 20 questions: The first 5 related to the participants' background, followed by 5 general questions regarding participants' level of understanding about climate change and its impacts on health. The final 10 open-ended questions encouraged participants to identify priority climate-sensitive health risks in Cambodia, to explain what they knew about the specific water-sensitive diseases mentioned above, and to suggest strategies for limiting the effects of climate change and its impacts on health in Cambodia.

Workshop participants had the option of responding in either English or Khmer. The surveys were distributed at the beginning of the workshops, thus participants were aware of the topic of the workshop (broadly, climate change, water and health) but had not received any information regarding specific water-related diseases in Cambodia prior to completing the surveys. The survey responses were then translated back into English (where applicable) and the results compiled and synthesized according to thematic areas.

The remainder of the workshops focused on providing information regarding the relationship between climate variables and climate-sensitive, water-related diseases, and discussion of strategies to minimize the current and future burden of these diseases in the context of climate change. Workshop participants were provided with information, education, and communication materials on these topics for ongoing self-and peer education.

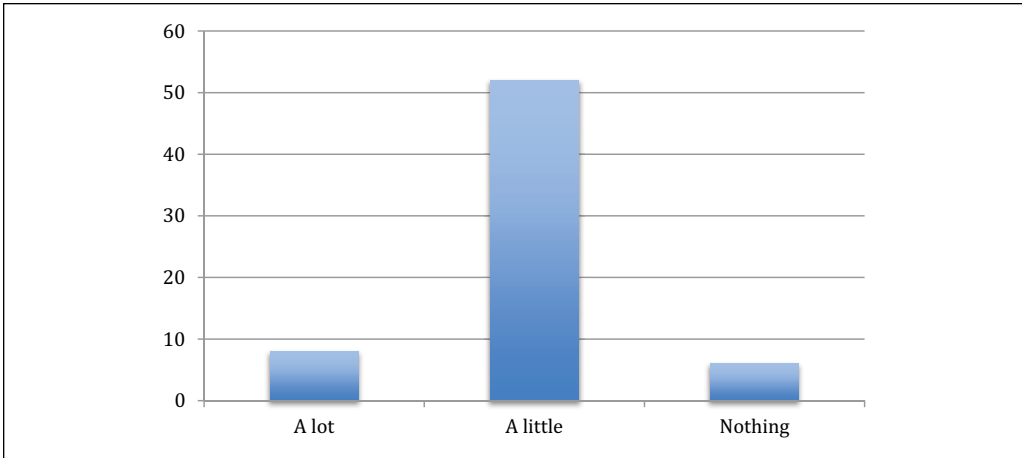


Figure 1. Respondents' self-reported level of understanding about climate change.

Results

Demographics

A total of 66 respondents completed the self-assessment of climate change and health knowledge and understanding. Almost one third (21) of respondents were from Phnom Penh, with 21 other provinces were also represented. The majority of respondents (49) worked in a health capacity. The majority of respondents were older than 40 years (47), with just less than half of the respondents aged between 40 and 50 years (31). Just less than one quarter (15) were aged between 30 and 40 years, and a small number (3) were in the 20- 30-year age group. Respondents displayed a generally high level of education. Most respondents (41) reported holding a bachelor's degree (including medicine). A small number indicated that their highest level of education was high school (4) or a diploma (2). Just more than one fifth of respondents indicated that they held a master's degree (14).

Level of Understanding of Climate Change

Respondents were asked to indicate their level of understanding about climate change on a 3-point scale (Figure 1). The majority identified that they knew "a little" about climate change (52), with the remainder indicating they either knew "a lot" (8) or "nothing" about climate change (6).

Climate Change: Causes and Effects

Almost all respondents (65) agreed that climate change was already happening, with the 1 remaining respondent indicating "don't know." The majority of respondents provided 1 or more responses regarding causes of climate change (47), while a small number (6) did not provide any response. The most common answer (for 32 respondents) related to deforestation and the destruction of the environment. Industrial pollution and waste were noted by a small number (14), and others responded with broader causes, such as "human activities" (13), and "natural" causes (8). A small number of respondents nominated increasing temperatures (4) and ozone depletion (4) as causes of climate change. An increase in human population (3) was also identified by a small number as a cause of climate change. Some respondents combined causes and effects in their answers, such as deforestation and drought.

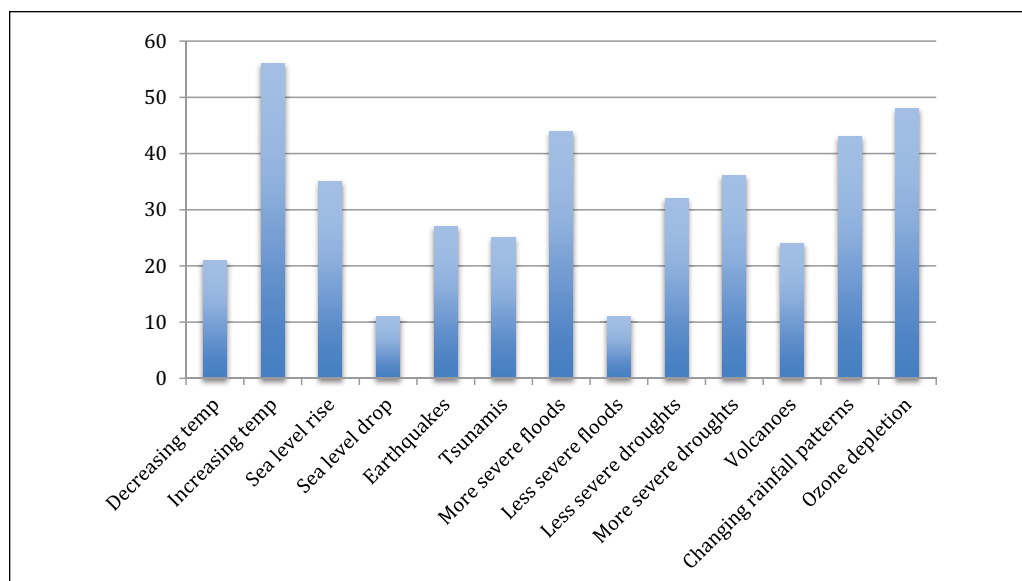


Figure 2. Phenomena identified by respondents as associated with climate change (multiple responses allowed).

Respondents were presented with 13 separate environmental phenomena and requested to identify which ones they believed to be associated with climate change. Multiple responses were allowed. Almost all respondents provided at least 1 accurate response, although many respondents provided a mix of both accurate and inaccurate responses (eg, volcanoes as well as increasing rainfall). The top 4 phenomena reported were “increasing temperature” (56), “ozone depletion” (48), “more severe floods” (44), and “changing rainfall patterns” (43) (see Figure 2).

Level of Understanding About the Impacts of Climate Change on Human Health

Most respondents indicated that they knew “a little” about the impacts of climate change on human health (56), with the remainder (10) indicating that they knew “a lot” (Figure 3).

A range of health conditions were noted by respondents as being affected by the climate. This question was open-ended. The majority of respondents (55) reported at least 1 accurate health problem; however, these were often a mix of accurate and inaccurate responses. The most common response was diarrheal disease, which was nominated by almost three quarters (49) of respondents. Perhaps surprisingly, acute respiratory disease was the second most common response (21), followed by a cluster of diseases that received small numbers of nominations—typhoid (13), skin infections (12), flu (12), dengue (12), malaria (11), and malnutrition (9). A small number of respondents also indicated the mental health effects of climate change (2).

Awareness of, and Risk Factors for, Specific Water-Related Diseases in Cambodia

The majority of respondents (42) correctly identified at least 1 risk factor for diarrheal diseases, although some of these also included 1 inaccurate response. The most commonly reported risk factor for diarrheal diseases was water quality (18), followed by poor hygiene (16) and floods (14). Unclean food (5), water quantity (4), and drought (4) were also nominated as risk factors for diarrheal diseases. A small number of respondents also noted increasing temperatures (2), low

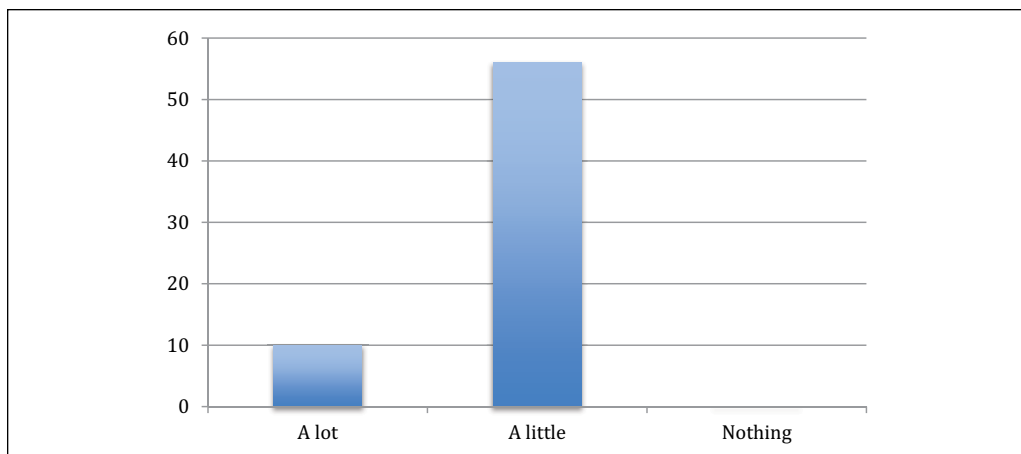


Figure 3. Respondents' self-reported level of understanding about the impacts of climate change on human health.

education (2), and crowding (2) as risk factors. Some respondents noted effects of diarrheal diseases (such as death, dehydration), rather than risk factors.

One third of respondents provided a partially correct answer when asked to define typhoid fever, correctly identifying it as a bacterial disease, with some mentioning the bacteria *Salmonella*. Almost three quarters (50) provided partially correct answers in relation to how typhoid is transmitted. The most common response provided was unclean food (38), followed by drinking water (23). A small number noted poor sanitation and hygiene in general (11), with some noting direct contact/body fluids (5) and transmission being via the oral (5) or fecal–oral route (5).

The majority of respondents did not provide a correct definition of leptospirosis in answer to this open-ended question. Only a small number provided a very generally accurate response, such as noting that it is bacterial (5) and an infectious disease (5). Many respondents (21) did not provide any response to this question. The most common responses given to modes of leptospirosis transmission was via animals (12), and through food (9). Direct contact (4) and via small insects (5) were also identified as modes of transmission.

The majority of respondents did not provide a correct definition of melioidosis. Most respondents did not provide any answer (43). Inaccurate answers included identifying it as a virus (1) (although some ambiguity was noted in the translation of the words for “bacteria” and “virus” from English into Khmer). The majority of respondents did not identify a transmission mode for the disease. Of those that did, water (8) was the most common response, followed by food (5), and skin (4).

The majority of respondents did not provide a correct definition of schistosomiasis. Many respondents did not provide any answer (25). A small number (9) identified it as a parasite. There were a variety of answers in response to the transmission mode of the disease, with the most common response being through water (10), snails (10), feet/skin (10), and food (6).

A small number of respondents (13) correctly identified hepatitis as a viral disease (albeit this information was provided in the question), but no further detail was provided in these responses. Ten respondents did not provide an answer to this question. Many respondents provided differential modes of transmission depending on the type of hepatitis (A-E). Many respondents identified blood as a key transmission mode (29), followed by food (25) and sex (20) as main modes of transmission. A small number noted direct contact (9), injecting (7), water (6), body fluids (5), and sharing equipment (5) as other modes of transmission.

Strategies to Limit the Effects of Climate Change and Its Impacts on Health in Cambodia

Suggestions to limit the effects of climate change were varied and fairly oversimplified. The most common response was in relation to forestry—more than one third of respondents suggested the strategies of either planting trees (reforestation) or stopping deforestation (29). The next most common response was reducing greenhouse gas emissions and educating the public, which were each identified by a smaller group of respondents (8). Small numbers of respondents identified other suggestions, including reducing the use of transport or using public transport (2), recycling (1), avoiding plastic (2), reducing chemical use in agriculture (1), saving energy (1), environmentally friendly development (1), and safe waste disposal (1). Governance issues were suggested as important strategies for 5 respondents, including multisectoral cooperation, policies, planning, and the following of government policies. Nine respondents did not respond or did not know an answer to this question.

The top 3 responses to limit the effects of climate change on health were public education (including health education) (12), good hygiene (11), and the preservation of forests (10). Other suggestions included safe water (8), national government regulations (7), healthy eating (5), caring for the environment (5), healthy lifestyles (3), and infection control (3). A small number (3) also indicated education for health professionals on climate change and health as a strategy to limit the effects of climate change on health. Almost one quarter of respondents (16) did not provide any response to this question.

A combination of environmental impacts and associated health effects were identified by respondents as presenting the greatest risk to human health in Cambodia. The top 3 issues were nominated as flood (14), infectious diseases (12) and drought (11). Storms (7), deforestation (6), increasing temperatures (5), and malnutrition (5) were also risks identified by respondents. A small number of respondents identified other risks, including earthquakes, (2) poverty (2), and food (2).

Discussion

The majority of respondents (most of whom were health professionals) knew a little about climate change and its links to health. There was widespread acknowledgment that climate change is occurring; however, a significant level of confusion exists in relation to the causes of climate change. The majority of respondents were aware of some of the causes of climate change and could identify at least 1 climate change-related phenomenon; however, many also inaccurately identified certain natural phenomena as effects of climate change (eg, ozone depletion, volcanoes, and tsunamis).

Respondents identified diarrheal diseases as having strong links with climate change, and the majority could correctly identify at least 1 risk factor for these. Low levels of knowledge exist around the nature, risk factors, prevention, and management of typhoid fever, leptospirosis, melioidosis, and schistosomiasis; respondents showed higher (although still poor) levels of knowledge around modes of transmission of these infectious diseases, compared with definitional understanding.

Respondents appeared to associate strong links with deforestation as both a cause of climate change and as a means by which to limit it (via reduction thereof, or reforestation).

Infectious diseases, the health effects of droughts and floods, and malnutrition were nominated by workshop participants as the greatest risks to human health posed by climate change. This response reflects the top priorities identified in Cambodia's Climate Change Strategic Plan for Public Health, which may indicate some level of awareness of workshop participants of this Strategy or the work that preceded it, although this was not specifically elucidated in the survey.

Education, good hygiene and government regulations were suggested as ways to limit the effects of climate change on health.

The process of assessing the level of knowledge of key stakeholders (predominantly senior health sector staff) regarding the relationship between climate change and water-related diseases in Cambodia was open to several sources of error and bias. Principal among these was the need for several steps of translation between English and Khmer, combined with the synthesis of survey responses via simplification and categorization. On balance, it is most likely that these processes under-represented the level of understanding of those surveyed, rather than the reverse.

Nevertheless, the weight of evidence collected suggests that the current level of knowledge among this relatively highly educated community regarding the links between climate and water-related diseases, and awareness regarding several specific water-related diseases associated with high morbidity and mortality in Cambodia, can and must be improved.

Finally, the limitations of this study must be acknowledged. These include, *inter alia*, the error introduced via the processes of translation (of the survey questions from English into Khmer, and the results from Khmer back to English); the difficulties for the respondents in dealing with new concepts (eg, climate change and health, adaptation) and technical terms (eg, melioidosis, mitigation), independent of the aforementioned translation issues; the relatively small number of respondents surveyed (limiting the statistical power of the study) and the potential lack of representativeness of the respondents, which were possibly skewed toward more highly educated health professionals, given the individuals (Ministry of Health staff were overrepresented) and provinces (particularly the relatively wealthy, populous provinces of Phnom Penh and Siem Reap) that were included.

Conclusion/Recommendations

The relatively low levels of understanding demonstrated by those surveyed represent a substantial opportunity for ongoing health professional education in the fields of communicable diseases and climate change and health. The DRIP-SWICCH workshops also generated a series of recommendations aimed at reducing the current and future burden of water-related diseases in Cambodia. These recommendations, summarized in Box 1, were compiled in the latter stages of the workshops, once participants had engaged in education, information sharing and knowledge exchange activities regarding climate change and water-related diseases, and the potential impacts thereof, in Cambodia. These recommendations, although not necessarily specific to climate change impacts on water-related diseases, nevertheless represent a useful framework for the health sector to commence systems strengthening—and adaptation—in relation to water-related diseases in Cambodia.

Box 1. Recommendations from stakeholder workshops for reducing the current and future burden of water-related diseases in Cambodia (in the context of climate change).

- Update and improve health promotion materials related to water-related diseases, water safety, hygiene and sanitation
- Develop information, education and communication materials on water-related diseases, for dissemination via diverse media (including television, radio and during sporting events)
- Improve water quality and sanitation at the household and community level
- Improve laboratory diagnostic capacity for water-related diseases
- Update and improve clinical and therapeutic guidelines on water-related diseases
- Build the capacity of health professionals in the prevention, diagnosis and management of water-related diseases

(continued)

Box 1. (continued)

- Conduct further research (including quantitative epidemiology and qualitative studies such as knowledge, attitudes and practices) on water-related diseases in Cambodia
- Develop appropriate regulations and legislation to protect against water contamination/pollution
- Reinforce and improve existing solid and liquid waste management
- Promote reforestation, particularly of watersheds
- Support curriculum development in the area of the health impacts of climate change, including water-related diseases (for schools and postgraduate training institutions)
- Encourage public-private partnerships in activities related to water, sanitation, hygiene, health, and climate change adaptation
- Conduct a regional forum on water-related diseases (in the context of climate change)
- Review and improve disaster risk reduction protocols (in the context of hydrometeorological events such as floods and droughts)
- Support initiatives for training of health staff in relation to water-related diseases and the health impacts of climate change and natural disasters
- Create an agency or body for “One Health” (the nexus of animal, environmental, and human health)
- Enhance surveillance and outbreak response for water-related diseases
- Support environmental protection legislation
- Ensure “environmentally friendly” development, and the incorporation of “health in all policies”
- Ensure adequate stockpiling of medicines and equipment in high-risk areas (eg, flood-prone communities) to protect against outbreaks of water-related diseases.

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