Climate Change: The challenge of forecasting emergence and resurgence of vector-borne diseases

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There is clear evidence that weather and climate (long term averages of weather conditions) affect the biology of vectors and pathogens that they carry. Recent reports of increasing global temperature (climate change) and greater variation in precipitation in time and space may therefore have impacts on the transmission of vector borne diseases, both due to changes in human behavior and the effects on vector and pathogen biology. However the role of climate as a driving force for the emergence and resurgence of vector borne diseases is still fiercely debated, as these events are also linked to intrinsic and extrinsic non-climatic factors.

Increased frequency of extreme weather events, prolonged rainy seasons, variations in water availability and associated water storage behavior, increases in ambient temperature and migration may all provide opportunities for increased vector breeding and range expansion. The emergence of vector resistance to insecticides and limited methods of control in new areas of urbanization with associated poor water storage and sanitation practices further exacerbates this spread.

Human population movements and other commercial activities (for example via the used tyre trade) facilitate the rapid transport of both vectors and pathogens into new areas allowing colonization if the climate is conducive to their survival. These expansions have been documented to some extent in the dengue vector *Aedes albopictus* to new geographical regions. Expansion of vectors into areas with no population immunity to a disease provides the opportunity for explosive outbreaks of vector borne disease upon introduction of the pathogen. Human activities due to deforestation and the reclamation of agricultural farm lands may altered vector breeding habitats and thus increase vector-man contact. Occurrence of malaria in high altitude areas has been partly due to these human activities and is an indirect link with climate change.

Whilst there is general agreement that climate change is taking place and will continue for several decades, there is a complex matrix of factors, which may lead to increased transmission of vector borne disease. Control programs must be aware of these factors. We have strong evidence and direct experiences that public health interventions can protect populations from vector borne diseases, under almost any weather conditions. Climate change should be an additional argument for effective, flexible and globally coordinated disease prevention and control.

气候变化:对新发和再肆虐虫媒传染病预测的挑战

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有明确证据表明天气和气候因素可以影响媒介生物及其携带的病原体。近来的全球变暖以及降雨在时间空间上的巨大变化通过影响对人类行为和媒介及病原体,影响虫媒传染病的传播。然而,气候因素在虫媒传染病的新发和再肆虐过程中的作用还存在争议,因为这些传染病事件往往和各种非气象因素有关。

极端天气事件的频繁发生、雨季的延长、水源及相关的储水方式的变化、环境温度的增高和人口的迁移等因素都可能增加媒介的孳生地并扩大分布范围。同时媒介的抗性变化以及城市化进程中各种因素对控制手段的限制进一步促进了这种扩张的态势。

人口的移动和各种商业活动(如旧轮胎贸易)为媒介生物及病原体的迅速传播提供了便利条件。登革热媒介白纹伊蚊的扩散就是一个很好的例子。如果一个地区的人群对某种疾病缺乏免疫力,相关媒介生物的引入就使虫媒传染病的暴发成为可能。一旦有病原体输入,则可能出现大暴发。人类砍伐森林和农业用地的扩增都可能改变媒介的孳生地并增加人和媒介接触的机会。疟疾在高海拔地区出现的原因,主要就是人类活动和气候变化的结果。

我们对气候正在发生的变化并将在随后的几十年内持续的问题已达成共识，但还是有许多其他因素会导致虫媒传染病的增加。相关的控制则必须了解这些因素。充足的证据和经验表明，不管在什么天气条件下，公共卫生干预可以保护人群免受虫媒传染病的危害。在探讨有效的、灵活的全球合作的疾病预防和控制时，气候变化将是一个重要的话题。

Dengue in the Greater Mekong Sub-region: status, epidemiology and control

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【Abstract】 Dengue is one of the most serious public health problems in the Greater Mekong Sub-region (GMS). The disease is principally transmitted by the vector mosquito, *Aedes aegypti*, and primarily targets children. Four dengue serotypes co-circulate with a single serotype predominating during most outbreaks. *Ae. aegypti* often breeds in household-associated water storage containers which are common in many areas of the GMS. A 2007 outbreak in the region resulted in over 151 000 cases and 512 deaths, with widespread cases in a variety of epidemiological settings.

Increasing incidence of dengue outbreaks are products of increased vector density caused by unplanned urbanization and associated water storage and sanitation habits that form ideal breeding sites for *Ae. aegypti*. Rapid population growth and increased mobility, both within and between countries, result in efficient viral dispersion and increased outbreaks.

Chemical larvicides can be used for outbreak mitigation, but are costly and logistically difficult to distribute on a very wide scale for outbreak prevention. A sustainable, cost-effective method of prevention is urgently required. Low cost and sustainable community based integrated vector control measures should be further developed and made operational. These measures together with improved environmental sanitation and piped water offer the best hope of achieving a reduction in dengue vector density.

The GMS is under rapid economic transformation including accelerated, intensive urban development. Further population movements are anticipated for the future which will likely result in a increased regional dengue burden. Management and control of dengue and dengue haemorrhagic fever should become a greater priority. A concerted effort involving communities, government, decision makers, non-government organizations and the international community is urgently required to address the continued spread of the virus.

大湄公河亚区的登革热：现状、流行病学和控制

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【摘要】 登革热是大湄公河亚区最严重的公共卫生问题之一。该传染病在当地主要由埃及伊蚊传播，主要是儿童发病。在大量的暴发流行中，4种血清型经常同时出现，但以一种血清型为主。埃及伊蚊主要孳生于人工储水容器中，而这种容器在该区域非常普遍。2007年的暴发导致151 000例病例，其中512例死亡。

没有合理规划的城市发展以及相关的储水和卫生习惯为埃及伊蚊提供理想孳生场所，从而导致登革热流行的增加。人口及其流动的快速增长，无论是在国内还是国际，都导致了病毒的扩散和暴发的增加。

化学灭蚴剂可以用于疫情控制，但费用较高，而且大范围用于控制时运输难度也较大。一种可持续的，性价比高的防治方法是迫切需要的。低成本、可持续、以社区为基础的媒介生物综合控制方法需要进一步发展和可操作化。这些措施结合环境卫生治理和自来水供应，是达到减少媒介密度的最大希望。

大湄公河亚区正经历着快速的经济转变，包括不断加速的城市发展。预计进一步的人口流动会导致区域性登革热负担的增加。登革热和登革出血热的控制和管理将变得更加重要。社区、政府、决策者、非政府组织和国际社会应该一起努力，尽快解决病毒的不断扩散问题。