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TROPICAL, TRAVEL AND EMERGING INFECTIONS (LH CHEN AND F NORMAN, SECTION EDITORS)

Climate Change and Travel: Harmonizing to Abate Impact

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Abstract

Purpose of Review With climate change being the single biggest health threat facing humanity, this review aims to identify the climate-sensitive health risks to the traveler and to recognize the role that travel plays in contributing to the detrimental effects of climate change. With this understanding, adaptations for transformational action can be made.

Recent Findings Travel and tourism, including transportation, food consumption, and accommodation, is responsible for a large percentage of the world's carbon emissions which is contributing to the climate change crisis at an alarming rate. Climate change is a health emergency that is resulting in a rise of significant health impacts to the traveler including increased heat illnesses; food-, water-, and vector-borne diseases; and increasing risk of exposure to emerging infectious diseases. Patterns of future travel and destination choices are likely to change due to climactic factors such as temperature and extreme weather events, forced migration, degradation, and disappearance of popular and natural tourist destinations.

Summary Global warming is and will continue to alter the landscape of travel medicine with expansion of transmission seasons and geographic ranges of disease, increased risk of infections and harmful marine toxins, and introduction of emerging infections to naïve populations. This will have implications for pre-travel counseling in assessing risk and discussing the environmental influences on travel. Travelers and stakeholders should be engaged in a dialogue to understand their "climate footprint," to innovate sustainable solutions, and be empowered to make immediate, conscientious, and responsible choices to abate the impact of breaching critical temperature thresholds.

Keywords Climate change · Travel · Migration · Traveler · Global warming

Introduction

Climate change is a health emergency—a declaration that has been made by 39 countries around the world, jurisdictions amounting to a population over 1 billion citizens. Various international reports, most notably the Lancet Countdown, have exposed not only the unabated rise of health impacts from climate change but also the health consequences of delayed action, providing an imperative to immediate efforts to be taken to lessen the damage [1••, 2••, 3]. The climate-sensitive health impacts include enhanced conditions for respiratory illnesses, mental health, cardiovascular disease, and premature death [1••, 3]. Extreme weather patterns destabilize communities and reduce access to healthcare. Changing environmental conditions increase the suitability for the transmission of water-borne, air-borne, food-borne, and vector-borne pathogens. Currently, 40% of the world lives in tropical areas already seeded in inequities, and those at the highest risk, in underserved populations in low-income and human development index communities, will disproportionately bear the brunt of the impact. Vulnerable populations, including women, children, the elderly, members of minority groups, and those with chronic diseases and disabilities, are also at the highest risk of suffering [1••].

Innovation and resources are needed to identify, prepare for, and adapt to the harmful health impacts of climate change. How will climate alter the landscape of travel and tropical medicine? More importantly, how is the way that we travel contributing to these deleterious changes? This review aims to identify the climate-sensitive health risks to the traveler and to recognize the role that travel plays in contributing to the detrimental effects of climate change.

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Climate Change 101

The last 7 years have been the warmest years on record, with mean global temperatures rising more than 1.1 °C above pre-industrial levels and edging closer to the limit laid out under the Paris Agreement. To prevent reaching a tipping point threshold that could result in catastrophic losses of human life and natural environments, the Paris Agreement calls for all countries to strive towards a limit of 1.5 °C of global warming through concerted climate action [4]. The global average temperature increase of 1.1 °C has already heralded increased frequency and magnitude of extreme weather events from heatwaves, droughts, flooding, winter storms, hurricanes, and wildfires [2••]. Future climate-related risks depend on the rate, peak, and duration of warming and will be much greater if global warming exceeds 1.5 °C [2••]. Even if global warming stabilized at 1.5 °C by the year 2100, some impacts may be long-lasting or irreversible, such as the destruction of certain vulnerable ecosystems [2••]. Warming is caused from anthropogenic emissions—to meet the Paris Agreement goals and prevent dangerous levels of global warming, global greenhouse gas emissions must reduce by half within a decade [1••]. The responsibility will lie on a collective and collaborative examination on how we are individually and as a society contributing to these emissions, and on areas that could be transformed, modified, and adapted to decrease them, thus lessening the impact of climate change.

The Impact of Travel on Climate Change

Tourism

Tourism is responsible for roughly 8% of the world's carbon emissions [5]. The carbon footprint of tourism is comprised by not only transport, but by the energy and commodities purchased by travelers including food, souvenirs, and accommodation [5]. The majority of this footprint is emitted by visitors from high-income countries, with US travelers at the top of the list, followed by China, Germany, and India. Per capita, small island destinations such as the Maldives, Mauritius, and the Seychelles hold the highest destination-based footprints from international tourism—which comprises up to 80% of their national emissions [5]. Global carbon movement, embodied in tourism and traveling, is largely a high-income affair, with travelers exerting higher carbon footprints elsewhere than their own country, and with host countries of popular destinations shouldering a higher footprint from visitors than they would exert themselves [5]. However, there is a delicate balance of economic growth and development that comes attached to tourism in low-income countries that may bear more of the burden. The UNTWO has projected that transport-related CO_2 emissions will grow 25% by 2030 and, recognizing this, has set a basis to scale up climate action to transform tourism to low emission and more efficient operations [6]. This is catalyzed in the Glasgow Declaration on Climate Action in Tourism, urging signatories about the need to accelerate urgent action, coordination, and commitment [7]. The COP27 in Egypt also recognized the cost of doing so, and established the "loss and damage" fund to compensate the developing nations most vulnerable to the climate crisis.

Transportation

Today, transportation is tourism's main source of greenhouse gas emissions, accounting for 5% of all man-made emissions [6, 8]. On average, planes and cars generate the most CO_2 per passenger mile, with tour buses, ferries, and trains coming well behind. In recent years prior to the pandemic lockdowns, the number of people traveling internationally skyrocketed as airfare became more affordable. Projections suggest that travel emissions will make up 12% of total greenhouse emissions by 2025 [6]. Aviation is responsible for 4% of the 1.1 °C rise in the global mean temperature already experienced since the industrial revolution [2••, 6]. To put into perspective, the aviation sector is responsible for 12% of transportation emissions—if it were a nation, it would be among the top 10 global emitters [6]. The total carbon impact of a single flight can be significant—for instance, it would take an acre of forest a year to absorb the same amount of CO_2 emissions of a one-way flight from London to New York and can be equivalent to going car-free for a year [9].

The impact on the coronavirus disease pandemic on global air transport was unprecedented, with up to a 74% drop in global passenger numbers in 2020, a fall of 2.7 billion compared to 4.5 billion in 2019 [10]. During this sharp decline in air travel, carbon dioxide emissions reduced by 5.4% in 2020. However, surprisingly, the amount of CO_2 in the atmosphere continued to grow at about the same rate as in preceding years, and has been attributed to a complex interplay of various factors and atmospheric components [11]. Despite these findings, the resulting reduction in anthropogenic activity did yield a glimpse into a future where emissions can be curtailed, but unfortunately, there has been a quick return back to 2019 emission levels.

The aviation industry needs to do its part to make a bigger climate impact; however, collectively, individual choices to fly responsibly should also be addressed [12]. Advice to travelers to limit their carbon footprint when flying can include choosing economy since flying business emits up to three times more carbon as it takes up more space, opting for direct flights when possible, taking a train as an alternative option to a short-haul flight, altogether skipping the flight and using virtual means of connecting, or taking daytime flights instead of the redeye as there is a heat-trapping effect of contrails and cirrus clouds at night, resulting in a higher greenhouse effect [13]. This small decision could be collectively very impactful, as in 2030, the total number of tourist trips is expected to reach 37.5 billion, of which 17.4 billion will be overnight arrivals—a 45% growth from 2016 [6]. Of note, recently, in an effort to reduce carbon emissions by planes, France has announced a plan to ban short-haul flights where travelers could alternatively take a train in under 2.5 hours—the first time a country has enacted a law prohibiting flights for environmental reasons [14, 15].

Buying carbon offsets is another consideration—carbon offsets are a credit for emission reductions given to one party that can be sold to another stakeholder who are effecting change to compensate for its emissions [16, 17]. Carbon offsets are typically measured in tons of CO_2-equivalents and are bought and sold through international brokers, online retailers, and trading platforms. Buying offsets helps individuals take into account the environmental costs of air travel [13]. The price per ton of offsets, however, is far below the estimated costs of damage that a ton of carbon pollution will cause via global warming and ocean acidification [18]. Although carbon offsets are a conscious action to take to mitigate emissions when flying, reductions in flights taken, planning longer trips, and using alternative lower emitting transportation means, such as trains, are still impactful options.

Food Consumption and Wastage

Food production is responsible for roughly one-quarter of the world's greenhouse gas emissions [19]. Getting food from farm to table means growing, processing, transporting, packaging, refrigerating, and cooking—all of which require energy and contribute to a meal's carbon footprint. Travel often multiplies this footprint since people tend to indulge more while abroad or on vacation. Wastage of food in tourism is part of a larger global issue. If food waste were a country, it would be the world's 3rd largest emitter of CO_2 [20]. A substantial amount of the food produced for tourism at all-you-can eat hotel buffets and in oversized restaurant portions is discarded [21, 22]. When food is wasted, all the emissions generated in the journey of its production were unnecessary. Globally, less than half of hotels compost their food waste. When this food decomposes in landfills, methane is created which is 21 times more potent at warming than carbon dioxide—methane has accounted for up to 30% of global warming since pre-industrial times [23].

Accommodation

Accommodation accounts for a substantial part of tourism's greenhouse gas emissions with many establishments wasting energy—intensive air-conditioning is often cited as a major culprit; or entertainment infrastructure built in areas destroying protective carbon sink ecosystems such as forests and mangroves [24]. The UNWTO concluded that the accommodation sector is responsible for 21% of CO_2 emissions, compared to other tourism contributors [25]. Accommodation-related emissions could be reduced by reducing energy consumption, increasing infrastructure energy efficiency, using greenery to cool buildings, and switching to renewable energy resources. New technologies adaptations being developed could provide hotel staff with critical data and send alerts to help them manage energy consumption and increase sustainability [22]. Traveler behavior and expectations, such as daily towel and linen changes, can also substantially contribute to energy consumption and wastage. Empowering travelers to make more sustainable choices when planning accommodation can be a powerful tool for change, but they must also be provided with consistent, reliable information and options to make these informed green decisions [26, 27]. Due to widespread regulatory and market policies, accommodation is a sector that has the potential to become carbon–neutral by 2030 if stakeholders strategize for more transformative change [24].

The Impact of Climate Change on the Traveler

Changes in Future Patterns of Travel and Destination Choices

Sea Level Rising Patterns of future travel are likely to change to due climactic factors. Natural factors that tend to attract travelers to specific destinations are being diminished, such as the bleaching of coral reefs in places like the Great Barrier Reef [28, 29]. The thought of the disappearing destination has even led to the recent trend called "last chance tourism," which, unfortunately, can even further perpetrate the fragile conditions with an influx of climate anxious travelers [28]. With 2021 setting a new record for ocean heating, rising sea levels are threatening coastal cities, habitats, and popular tourist destinations, with a projected one foot rise by 2050 [30]. Popular cities such as Jakarta and Rotterdam are planning adaptation measures to cope with prospects of higher sea levels, such as building seawalls, planting mangroves, and rethinking roads [31, 32]. The impact will be even more devastating to small island developing states (SIDS), such as Tuvalu and the Marshall Islands, who are already on the frontlines of climate change, facing low-lying flooding and a battering of increasing tropical storms [33]. Combined, SIDS make up approximately 65 million inhabitants, of which one third live on land less than 5 m above sea level, and where tourism accounts for a substantial economic export, over 50% in SIDS such as the Maldives, Seychelles, and Bahamas [34, 35]. In 2019, over 44 million visitors visited SIDS with an injection of USD 55 billion into the tourism sector. A decline in beach tourism in threatened locations highlights the unique financial vulnerability of these islands to changing travel patterns while already facing an existential threat [36, 37].

Extreme Weather from Ocean and Atmospheric Warming Continuous warming of the ocean and atmosphere as a result of climate change is also increasing the number of natural disasters from extreme weather events—including hurricanes, cyclones, wildfires, droughts, and floods [36, 38]. These catastrophic events modify the geographic landscape of a location, but also the ecology of pathogens, increasing the proliferation of and exposure to infectious diseases [38]. Diseases such as cholera, leptospirosis, and diarrheal diseases spread rapidly after storms and floods, putting local populations and travelers at increased risk [38–41]. Synergizing climactic factors intensify the level and frequency of natural disasters, which result in exacerbated outbreaks of disease. This was most recently witnessed in Pakistan after the devastating floods in June 2022, which caused an unprecedented surge of vector-borne diseases such as malaria and dengue, overwhelming the already fragile and damaged country [40]. Health practitioners and travelers must be made aware of the complex dynamic situation of regions affected by climactic hazards, to prepare for and prevent risk of infection and exposures [41].

Implications of Increasing Harmful Algal Blooms Direct health implications can also be attributed to the fallout from ocean warming. Increasing levels of harmful algal blooms (HABS) can lead to human health consequences as well as detrimental effects on tourism and recreation. In coastal zones, swimmers and food gatherers may face closures of contaminated beaches and shellfish areas, which has already occurred in many Northern European countries [42, 43]. HABs lead to increased toxin contamination of seafood and shellfish that can cause an array of respiratory, dermatological, neurological, and diarrheal manifestations of illness and even deaths from the various marine toxins [44]. The effects of one HAB can be wide reaching worldwide through the globalized seafood industry, masking an already underrecognized hazard for travelers [44]. Alongside the usual and increasing culprits of scombroid, ciguatera, and shellfish poisoning, recent travelers to places such as the Caribbean are for sure to have encountered the 24 million tons of sargassum encroaching onto the once pristine white beaches, an unsightly, stinky, and toxic floating brown macroalgae seaweed that can be several feet deep and cover thousands of square miles of ocean [45, 46]. When decomposing, the sargasso releases ammonia and hydrogen sulfide gas, a broad spectrum poison that smells of rotten eggs. Breathing in these toxic gases may cause hypoxic pulmonary, dermatological, and neurocognitive symptoms. In 2018, in Guadeloupe and Martinique, 11,000 cases of suspected sargasso poisoning was reported where patients complained of heart palpitations, shortness of breath, dizziness, vertigo, headache, and skin rashes [46]. Recent NASA satellite observations revealed an unprecedented belt of the brown macroalgae stretching from West Africa to the Gulf of Mexico and south to Brazil, the biggest seaweed bloom in the world [47]. As this "Sargasso Sea" continues to chokehold once pristine beautiful beaches, travelers should be advised to not walk on these beaches, and may altogether be changing their itineraries based on Sargassum Watch Systems which have been developed [48, 49].

Increasing Temperatures and Heatwaves Heat waves are one of the deadliest extreme events that are increasing in frequency, intensity, and duration, however are less discussed as a travel concern as they are less visible, more widespread, and deleterious impacts harder to quantify [50]. Record temperatures in 2020 set record high heatwave exposure among people older than 65 and children younger than 1 year, populations with a higher than average risk of heat-related death [1••]. Heat is one of the largest weather-related causes of death in high-income countries, with increasing morbidity and mortality in people with cardiopulmonary, age-related vulnerability, and other chronic diseases [51]. Travel medicine must start incorporating education around risks of unrecognized heat exposures and heat-related illnesses, such as heat stroke, exhaustion, and dehydration, and incorporate heat action plans into their travel consults. With prevention and proper recognition of vulnerable populations, adaptations can be made to incorporate sustainable solutions and effective cooling interventions at the individual and community level [52]. Many travel itineraries were changed to accommodate earlier or altered locations this year due to extreme heat in various popular destinations; and subsequently, travelers discovered that cancelation policies did not allow for refunds or coverage.

Changes in Disease Epidemiology and Geographic Patterns of Transmission

Geographic Expansion of Vector-Borne Diseases Climate factors, such as temperature, rainfall, and meteorological events, which are being intensified by the ongoing emission of greenhouse gases, can influence disease epidemiology, thus changing the landscape of travel and tropical-related medicine [39]. Vector-borne diseases are an example of this, where climate factors can influence vector suitability of habitats for survival, breeding, and transmission [53•]. With many neglected tropical diseases previously confined to subtropical and tropical areas of the world, including Chagas disease, leishmaniasis, malaria, rabies, and snakebites, predictions anticipate changes in geographic range and transmission periods, resulting in disease incursion and emergence in regions and populations previously unaffected [54, 55]. In Europe, for example, climate change is thought to be a key factor in the spread of the Asian tiger mosquito *Aedes albopictus*, the vector which can transmit dengue, chikungunya, and Zika, as well as *Phlebotomus* sandfly species, which can transmit leishmaniasis [55, 56].

Many temperate regions and high-income countries are now suitable for vector-borne disease transmission that were previously not present [56].

The impact of climate change on vector-borne ecosystems is complex, as it can influence the circulation and dissemination patterns of migratory birds, which can be carrier or reservoir hosts of many mosquito-borne and tick-borne zoonotic pathogens [57]. The shift in bird migration routes secondary to climate factors is thought to be a key factor in the increasing spread of mosquito-borne West-Nile virus (WNV) and tick-borne zoonotic pathogens such as Lyme disease into parts of Canada and Northern Europe, as well as tick-borne encephalitis into parts of Northern Europe [58]. With increasing suitability for habitat with climate change, trans-Saharan bird migration from Africa to Europe has also been implicated in the emergence of new zoonotic pathogens in Europe. These include the introduction of the mosquito-borne Usutu virus (USUV) and the dissemination of new tick-borne pathogens such as Crimean-Congo hemorrhagic fever virus, representing novel threats to human health [59, 60]. As vector-borne diseases expand into new unchartered territories, surveillance and awareness of changes in disease patterns will be needed; and thorough travel histories will become more clinically relevant and important.

The Threat of Emerging Arboviruses The *Aedes aegypti* mosquito, the vector for many arboviral diseases including dengue, chikungunya, yellow fever, and Zika, is sensitive to climate variability, having a higher thermal optimum for viral transmission [61]. Already in the last two decades, there has been the largest increase in global abundance, with an anticipated increase of 30% by the end of the century in a low carbon emission scenario [62]. There has been an expansion of geographical distribution of these vectors into more temperate areas, with subsequent increasing cases of travel-related arboviral infections such as chikungunya [63]. Dengue cases around the world have surged in the last few years, with the largest number of dengue cases ever reported globally in 2019, and with projections that it will impact 60% of the world's population by 2080—Mexico alone predicted to have a possible 40% increase of annual dengue incidence [64–67]. With autochronous transmission reported in France, Croatia, and the USA, there is threat of ongoing outbreaks in Europe and North America [68]. Recently, an autochronous case of the Usutu virus, a *Culex*-borne emerging arbovirus of African origin, was also reported in France [69]. Similar to WNV, Usutu virus has the potential to become an important human pathogen of concern; with its rapidly expanding geographical distribution, it is an arbovirus on the rise [60]. Predictions of arboviral shift include further expansion risk of chikungunya into Central and South America, with an estimated increase of 7.5 million cases by mid-century with unmitigated temperature increase [54]. Over 1.3 billion new people could be exposed to Zika virus risk as thermal suitability for Zika transmission expands into East Africa, high-income North America, East Asia, Western Europe, North Africa, and the Middle East [70]. Along with the threat of travel-related introduction of these viruses into naïve populations, challenges arise around surveillance, public health management of new outbreaks in already resource-strained systems, underdiagnosis, and inappropriate management of unfamiliar infections by health professionals.

Mosquitoes Reaching New Heights: Elevation In travel medicine, advice is often given that mosquito-borne virus transmission is considered a minimal risk over elevations of 2000 m. The changing epidemiology of dengue infections in Nepal over the last 20 years has demonstrated a stark geographical expansion of latitude and altitude. The *Aedes* vectors have since been found in high-altitude areas of Nepal, likely the result of vector habitat expansion due to global warming of mountain areas [71]. Of note is that Nepal only became endemic to dengue in 2006—the first reported dengue case to Nepal was in 2004, imported from India by a Japanese foreigner [71]. With over 50,000 cases reported in 2022, Nepal is a prime example of a new emerging disease increasing burden and geographic spread by latitude and elevation, introduced by a traveler, but now also affecting the landscape of novel risk for travelers to the area [72].

Temperature Variability and Malaria Transmission Risk The effects of changing temperatures on vectors and subsequent disease transmission are not all the same, which gives variability in predictions of geographic redistribution of disease. Thermal performance curves are used to predict the way temperature can affect and shift vector and host physiology and the ability to adapt to climate-mediated ecosystem changes [58]. For example, malaria transmission by the *Anopheles gambiae* mosquito peaks at 25 °C, whereas dengue transmission by *Aedes aegypti* peaks at 29 °C [73, 74•]. The warming temperatures in the tropics, could therefore, drive a shift in climates more suitable to malaria transmission, such as in sub-Saharan Africa, to those more suitable to arboviruses. In this "Battle of the Buzz" as climate suitability increases for arboviruses, these underrecognized emerging diseases could expand and overtake the public health burden of malaria in Africa [73]. Some models of malaria vector and pathogen suitability have projected shifts depending on the region within Africa, and some have projected expansion to higher altitudes in Southern and Eastern Africa, Asia, Latin America, and the Middle East [41, 75]. There will need to be increased research, surveillance, awareness, and education around these emerging diseases for locals, travelers, and the scientific community [76].

The Great Climate Migration We cannot talk about travel and climate change without recognizing migration as one of the defining occurrences of our time, often redistributing the fabric of the quilt of our societies. The single greatest impact of climate change could be on human migration [43]. Migration has many drivers, including political, economic, social, cultural, and environmental factors [77••]. Climate change can be the main precipitating event, but can also interact with other factors to be an influential force [77••]. Climate disruption is expected to uproot over 200 million migrants by 2050, those forcibly displaced referred to as "climate migrants" or debatably "climate refugees," with Sub-Saharan Africa, South Asia, and Latin America being the three regions most heavily affected [78]. But migration can also be considered to be an adaptation strategy in response to the consequences of climate change, with concerted efforts between and within nations harmonizing to abate impact [77••, 79]. These significant shifts in population distributions via migration and travel, whether forced or not, can also introduce novel pathogens to naïve populations, as has been witnessed for example by the importation of chikungunya into Italy; coronaviruses internationally via air travel; the Zika virus epidemic in the Americas; schistosomiasis in Corsica, France; and most recently, the outbreaks and spread of monkeypox globally [70, 77••, 80–84]. As we progress through the shifting climate, we will continue to see an ever-increasing interplay of the role that travel, migration, and globalization have on the dispersion and introduction of emerging infectious diseases, combined with climate variability and increasing suitability, altering the geographic distribution as we know it.

Discussion

The Climate Change-Inequality Nexus

Traveler privileges are tipping the scales of inequality as the number of people who can afford to travel grows alongside tourism's environmental footprint. Between 2010 and 2020, climate-related disasters killed fifteen times more people in highly vulnerable countries, which were responsible for less than 3% of global emissions, than in the wealthiest countries [2••]. Between 2030 and 2050, climate change is expected to cause 250,000 additional deaths per year due to malaria, diarrhea, and heat stress [3]. The 46 least developed countries that make up 40% of the world's poorest are highly vulnerable to these compounded shocks, being disproportionately affected by and at the forefront of the climate crisis [85, 86]. There is a great opportunity to combine the overarching framework of the Sustainable Development Goals (SDG) and how they can relate to choices for responsible travel—by examining the areas of climate action, life below water, responsible consumption, decent work and economic growth, reduced inequalities, sustaining cities and communities, and developing partnerships for the goals [87, 88•]. There is a fine interplay, dependency, and domino effect of factors—even recognizing the deleterious role that high-income travelers can have on vulnerable impoverished tourist destinations must be supported with strategies to improve health and education, reduce inequalities and wastage, and spur economic growth, all while tackling climate change and working to preserve fragile ecosystems.

Practical Implications for Pre-travel Counseling?

Risk, in the context of travel medicine, refers to the possibility of harm during the course of travel. Travel medicine is based on assessing a traveler's risk at destination and the concept of taking measures to reduce risk. As climate changes the landscape of travel risks due to global warming, understanding the major climate-associated health implications faced by travelers will be pivotal to educating and preparing them (41) Discussing air pollution linked to respiratory exacerbations, heat illnesses and associated morbidity linked to rising temperatures, and keeping up-to-date with the changing epidemiology of vector-borne diseases and emerging infectious diseases will be necessary.

Proposals to reduce the "climate footprint" of a traveler—the beneficial or detrimental influence that can be had on another person or community in relation to climate factors our actions and choices impact—should be addressed. From measuring carbon emissions, to ethical and behavioral considerations in methods and frequency of travel, to serving as sentinels and vehicles for the spread of disease, creating awareness of the "climate footprint" of a traveler, how it can be measured, and how it can be addressed should be integrated into the pre-travel consultation. By promoting education and ethical travel choices to decrease emissions, our goal should be to create a more sustainable future for destinations, communities, and travelers.

Conclusion: Harmonizing to Abate Impact

We are witnessing a climate crisis which cannot be ignored as we increasingly experience its destructive effects. As we emerge from the pandemic, we are well-suited to take advantage of this unique moment in time to address some of the greatest systemic climate challenges caused by the acceleration of travel and tourism in recent years. Now, more than ever, there is a need to examine the impact that we as travelers have on ecosystems, economies, populations, and future generations. Sustainability and responsibility need to be interwoven and embedded within the framework of travel medicine as well as developing a collaborative platform to discourse innovative and adaptive solutions. By being examples leading innovation and change, we can hope to have a positive and beneficial butterfly effect in the actions that we take. We are at a critical juncture that is beyond using incremental measures to adapt but requiring transformative change at every level of society. Although the task at hand can seem daunting, thousands of small individual choices and actions will summate to transformative outcomes and necessary change. Engaging stakeholders, industry, individuals, travelers, and the scientific community will be monumental in assessing the projected situation, establishing goalposts, discarding current habits of consumption, and replacing them with inventive, integrative, and harmonizing actions to abate the impact of climate change.

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Compliance with Ethical Standards

Conflict of Interest Aisha Khatib is Chair of the Responsible Travel Interest Group of the International Society of Travel Medicine, and a voting member of CATMAT- the Committee to Advise on Tropical Medicine and Travel, an expert advisory body to the Public Health Agency of Canada.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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- •• Of major importance

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