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A SOCIO-ECONOMIC IMPACT ASSESSMENT OF THE ZIKA VIRUS IN LATIN AMERICA AND THE CARIBBEAN:

with a focus on Brazil, Colombia and Suriname

United Nations Development Programme

The United Nations Development Programme (UNDP)
in partnership with the International Federation of Red Cross and Red Crescent Societies (IFRC)

A Socio-economic Impact Assessment of the Zika Virus in Latin America and the Caribbean: with a focus on Brazil, Colombia and Suriname

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Foreword

Foreword

On February 1, 2016, the Zika virus, primarily spread by the *Aedes aegypti* mosquito, was declared a Public Health Emergency of International Concern due to its association with a surge of birth defects. Zika has since spread throughout Latin America and the Caribbean, with local transmission also reported in parts of the United States of America, Asia and Africa. This type of health-related crisis can undermine hard-earned development gains. Analyzing the socio-economic impact of the Zika virus and extracting lessons learnt, can help reduce the risks of similar hazards in the future by strengthening preparedness and prevention efforts.

The United Nations Development Programme (UNDP), in partnership with the International Federation of the Red Cross and Red Crescent Societies (IFRC), produced this assessment to measure the socio-economic impacts of Zika on countries, families and communities, and to examine institutional responses. A focus of the assessment is the impact of Zika on the most marginalized and vulnerable women, in line with the 2030 Agenda for Sustainable Development and our global commitment to 'leave no one behind'. UNDP's HIV, Health and Development Strategy, 'Connecting the Dots', recognizes reducing inequalities and social exclusion as central to health and development.

The report's key message is simple: Zika is responsible for tangible losses to gross domestic product, estimated to range from US$7–18 billion over 2015–2017 alone, imposing an immediate burden on health care and social welfare systems, and, more long-term, could undermine decades of hard-earned health gains and social development progress. Larger investments in prevention, preparedness and response strategies at the local, national and regional levels would be cost-effective and help deliver on the Sustainable Development Goals.

It is our hope that this report will help to mobilize stakeholders – governments, communities, international organizations, civil society and the private sector – to conduct country-specific assessments of Zika and plan with the goal of improving health and wellbeing for all. Concrete and actionable recommendations are offered as a first step, recognizing that while Zika and other diseases spread by the same mosquito are here for the foreseeable future, their burdens can be reduced and their consequences minimized. As with initial responses, long-term plans and budget allocations should be established with equity considerations for marginalized and vulnerable communities at the forefront. We have learned from recent epidemics, such as Ebola in West Africa, that considering overall costs alone is not enough – *who* bears the costs must be taken into account.

Zika is a testament to how complex health and development challenges must be addressed jointly if we are to truly 'leave no one behind' on the road to achieving the Sustainable Development Goals. We must also remember that Zika will not be the last global health threat. Strengthening prevention efforts, responses and resilience to Zika in Latin America and the Caribbean will better prepare us for the future health emergencies we will face as a global community.

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Executive Summary

Global health threats can devastate communities in social and economic terms and hinder development progress. Disease outbreaks, such as yellow fever, Ebola and influenza, have the potential to increase health and social inequities, hence undermining the 2030 Agenda for Sustainable Development and its vision of 'leaving no one behind.'

The Zika virus, primarily spread by the *Aedes aegypti* mosquito, is one of these threats. While no longer considered a Public Health Emergency of International Concern [1], Zika is arguably still a health crisis and has the potential to hit the poorest and most vulnerable communities the hardest.

This report, *A Socio-economic Impact Assessment of the Zika Virus in Latin America and the Caribbean: with a focus on Brazil, Colombia and Suriname* ('the assessment'), provides an up-to-date analysis of the social and economic implications of the Zika virus. The assessment intends to help shape a multifaceted response by informing governments, international organizations, the private sector and civil society of the broader health and development threats posed by Zika. To do this, a macroeconomic modelling exercise, desk reviews and interviews with affected individuals and representatives from public sector institutions were conducted. The analysis and results are presented here.

The World Health Organization (WHO) estimated that there will be up to four million infected people in Latin America and the Caribbean by early 2017 [2], while other estimates indicate that 80–117 million people and 1.5 million pregnant women globally could become infected before the first wave (2015–2017) of the epidemic concludes [3].

Within the context of considerable uncertainty surrounding the disease's current and projected epidemiology, three scenarios are used in this report to determine the potential impact of Zika on the region, based on varying rates of viral transmission. They are: 1) baseline Zika (current infection rate); 2) medium Zika (20 percent of the population infected); and 3) high Zika (73 percent of the population infected). The high Zika scenario, while a seemingly dramatic perspective, may be most applicable to Caribbean nations because of their small size, isolation, and relatively even terrain (which could enable faster and more extensive spread). These conditions are comparable to French Polynesia, where Zika prevalence reached 73 percent. Unless otherwise specified, estimates illustrated in this Executive Summary are from the medium Zika scenario, which projects 60 million infected individuals between 2015–2017 (throughout the report, reference will be made to the three scenarios).

Three main conclusions can be drawn from our analysis.

- **First, the current Zika epidemic will have a long-term impact, and countries will incur high direct and indirect costs as a result.** In the short term, the cost[1] of the current Zika epidemic will be an estimated US$7–18 billion over three years (across the three scenarios), or an average cost of approximately $1 billion for every five percent rise in infection rate. The largest long-term costs are the direct and indirect costs associated with microcephaly and Guillain-Barré syndrome, with the total lifetime[2] cost potentially approaching $8 billion for microcephaly cases and $3 billion for Guillain-Barré syndrome cases across the region [4]. Of these total costs, the most substantial portion is the lost earnings of people with microcephaly who may be unable to join the labour force.

- **Second, there is a profound equity challenge at the core of the Zika epidemic. The impact is disproportionate**

1. The following cost components are used to estimate the total cost of the epidemic: cost of diagnosing and treating patients, loss of tourism revenue, the value of lost productivity and the long-term direct and indirect costs of disabilities attributable to the disease.
2. Infants with microcephaly face a 20 percent probability of death during the first year, and a life expectancy of 35 years beyond the first year.

on the poorest countries of the region, as well as on the poorest and most vulnerable groups, especially poor women in peri-urban communities. While larger economies, such as Brazil, are expected to bear the greatest share of the absolute cost, the severest impacts will be felt in the poorest countries, which stand to lose 1.13 (Haiti) and 1.19 (Belize) percent of GDP annually (in the high Zika scenario). Rapid urbanization in the region, accompanied by poor sanitation and infrastructure development in some places, provide favourable conditions for the *Aedes aegypti* mosquito to thrive, thus increasing the risk of Zika virus transmission. The assessment highlights how impoverished communities and households already suffer from unequal access to health services, clean water and sanitation and have lower labour force participation, leaving them more vulnerable to the impacts of Zika. Undoubtedly, the disease is negatively influencing progress towards multiple SDGs, including SDG 1 on poverty eradication, SDG 3 on good health and wellbeing and SDG 5 on gender equality and women's empowerment.

- **Third, regional and national preparedness and response strategies require strengthening and must involve communities.** The assessment outlines concerted efforts by all three case study countries to control the spread of Zika. However, persistent social disparities and unequal health service coverage have made it difficult for national responses to reach the most vulnerable groups. This has been further compounded by the scale, inherent uncertainty and unpredictability of the Zika epidemic. National responses have faced several challenges, including modest capacity in surveillance and diagnostic systems, limited attention to prevention efforts and difficulties with resource allocation and coordination. Furthermore, national responses in the region have not been uniform, as witnessed by the varying degrees of achievement and different challenges experienced in the case study countries.

Six recommendations are provided.

- **First, given that Zika is likely to become endemic, budgetary plans should be established accordingly.** Given the projected costs, budgetary contingency plans that allow for strong and comprehensive responses need to be established for countries in Latin American and the Caribbean. Such plans should consider the role to be played by national governments, international donors, regional mechanisms and multilateral banks, such as the Inter-American Development Bank.

- **Second, integrate efforts aimed at multiple mosquito-borne viruses, allowing room to tailor approaches to each disease's unique effects.** Dengue, chikungunya, yellow fever and Zika are all spread by the same species of mosquito. Given the enormous combined cost of these diseases, it is cost-effective for governments to invest in long-term strategies that combat the mosquito rather than the viruses it spreads to humans. Regional work is currently underway to integrate detection, prevention and surveillance of multiple mosquito-borne viruses; individual governments should apply similar integrated approaches to national strategies.

- **Third, put equity considerations at the forefront of Zika strategies and provide adequate social protection mechanisms for those affected.** Estimates suggest that indirect costs will be substantial, with lost income due to new child-care obligations alone potentially representing losses between half a billion and $5 billion for the region in the high Zika scenario. The social protection programme *Bolsa Familia* is providing an added benefit to families of children with microcephaly in Brazil. However, the assessment estimates indirect costs of microcephaly in Brazil at around six times more than the government benefit provides. Hence, social protection systems must provide benefit packages that give financial assistance proportionate to the real costs of care, as well as provide livelihood opportunities for mothers at risk of permanently leaving the labour force.

- **Fourth, promote public policies that support gender equality and promote sexual and reproductive health and rights, targeting affected communities.** Incorporating the human rights of women and girls, including sexual and reproductive rights, is imperative for any Zika response to be effective. Updated and clear guidance on Zika, family planning and prenatal diagnostic services must be made available to all potentially affected persons.

- **Fifth, develop a multisectoral approach to mosquito-borne diseases both nationally and regionally.** The factors that make people vulnerable to mosquito-borne diseases lie to a great extent beyond the health sector; housing, gender disparities, urban planning and resourcing and socio-economic status, among others, all influence vulnerability to infection. For example, a multi-sectoral approach to integrated vector management can be achieved through intensified national action by country-level partnerships working together toward common goals and using agreed strategies, resources and procedures.

- **Finally, engage communities in the fight against Zika.** Communities can be involved in different aspects of prevention, from helping to disseminate public health messages to supporting community-based vector control efforts, monitoring and care. Communities should also be engaged in the response and support to affected families. Success will require behavioural change, active participation of the community and involvement of a broad range of stakeholders including women's and faith-based organizations.

The broad implications of these findings in terms of designing prevention and response strategies that address the needs of all, including the most marginalized, strongly resonate with the pledge of Agenda 2030 for Sustainable Development to leave no one behind, as well as UNDP's Strategy for HIV, Health and Development, 'Connecting the Dots', which aims to reduce inequalities and social exclusion that drive poor health. It is hoped that countries impacted by Zika will consider this assessment's recommendations and will be able to address the impacts of Zika through fiscal planning, adapted and expanded social protection systems, targeting of resources to where needs are greatest, and adopting multisectoral approaches that effectively engage communities.

1. Background

1. Background

1.1 Introduction

Disease outbreaks, aside from having potentially serious consequences for health, can socially and economically devastate communities [5] and undermine national development efforts. While a swift and timely emergency response is a necessary step in controlling the Zika epidemic, there is a growing need to address the quieter effects of the outbreak – the social impacts, economic loss and hardship – which are exacerbated by pre-existing inequities. In line with the overarching vision of Agenda 2030 and the Sustainable Development Goals to leave no one behind, the Zika virus illustrates the need to address health and development issues together.

Since late 2014, Zika has spread at an alarming rate throughout Latin America and the Caribbean, reaching the USA in 2016. The disease has spread primarily through mosquitoes, but also through sexual transmission. Reasons for the rapid spread of the Zika epidemic in Latin America and the Caribbean are unclear,[3] but may in part be explained by the disease's introduction into a large population without pre-existing immunity and to the widespread distribution of Zika's main vector, *Aedes aegypti*, particularly in densely-populated areas [6].

On February 1, 2016, the World Health Organization (WHO) declared the suspected association between Zika virus infection and a surge of serious birth defects in Brazil a Public Health Emergency of International Concern. In April 2016, research confirmed that Zika infection can lead to a range of defects at birth, subsequently termed 'congenital Zika syndrome,' which includes microcephaly, a rare condition associated with incomplete brain development, and other neurological and ocular disorders. A virus highly capable of infecting nerve cells, Zika can also lead to Guillain-Barré syndrome and other neurological complications in adults. In November 2016, WHO declared the end of the Public Health Emergency of International Concern. This was not because the emergency had passed necessarily, but rather to reflect the shift from short-term to long-term planning and response. This followed greater clarity on causation and a recognition that Zika will be present for years as an enduring public health challenge [1].

Zika is the first mosquito-borne pathogen with known teratogenic[4] effects (causing developmental malformations in foetuses) and sexual transmission. Scientists and public health officials are being forced to rethink previously held assumptions about mosquito-borne viruses and the ways to prevent, control and mitigate their impacts.

Beyond its medical and scientific particularities, the Zika epidemic adds to the profound impact of vector-borne diseases. In 2014, before the Zika epidemic arrived in Latin America and the Caribbean, WHO estimated that vector-borne diseases caused more than one million deaths each year and left many people in misery and hardship due to permanent disabilities. The brunt of these diseases is borne most heavily by the world's poorest people, communities and countries [7].

The Zika epidemic also highlights how socio-economic factors shape the progress, outcome and long-term consequences of public health emergencies, which range from the macroeconomic implications for countries to the daily lives of families and communities. The magnitude and unequal distribu-

3. Although the 2014 World Cup football tournament was initially blamed for the entry of the virus in Brazil, the analysis of genomic viral sequences supports an earlier, single introduction event of Zika virus to Latin America around mid-2013, after which the virus has become highly diversified along its geographic expansion.

4. "A teratogen is an agent that can disturb the development of the embryo or foetus. Teratogens can halt pregnancy or produce a congenital malformation (a birth defect). Classes of teratogens include radiation, maternal infections, chemicals, and drugs." Source: Medicinet, http://www.medicinenet.com/script/main/art.asp?articlekey=9334.

tion of Zika's impacts deserves an appropriate, multi-faceted response, tailored to each country's situation and needs.

This report, *A Socio-economic Impact Assessment of the Zika Virus in Latin America and the Caribbean: with a focus on Brazil, Colombia and Suriname* ('the assessment') has the following four main objectives.

1. Project macroeconomic costs of the short and long-term impacts of the epidemic at the regional and national levels, using three different transmission scenarios.
2. Examine the key socio-economic impacts of Zika on those infected by the virus, their households and their communities, using qualitative methods to better understand responses to the epidemic.
3. Analyse some of the main background factors and institutional responses to the epidemic.
4. Propose recommendations for intersectoral policies and strategies to mitigate the impacts of the epidemic.

The assessment informs ongoing discussions among stakeholders – governments, communities, international organizations, civil society and the private sector – to plan for impact mitigation responses for Zika and other outbreaks (current and future) that could threaten individual countries and the continent in the short, medium and long term.

1.2 Methodology

1.2.1 Data collection and analysis

A multidisciplinary team of experts from various institutions utilized the mixed methodology below to conduct this assessment.

- **Desk reviews** to analyse the development and health system components in Latin America and the Caribbean, as well as in the three case study countries.

- **Macroeconomic impact modelling at the regional and national level,** derived from publicly-available national data, to provide a range of outcomes under three scenarios (baseline, medium and high Zika transmission). The scenarios vary by extent of viral prevalence and the extent and efficacy of countermeasures implemented by responding agencies.

- **Consultations with national stakeholders** in the three case study countries including: government agencies overseeing public health, social protection, tourism and economic affairs; university researchers; civil society organizations; and the International Federation of Red Cross and Red Crescent Societies (IFRC) as well as United Nations entities including the Pan American Health Organization (PAHO)/World Health Organization (WHO), the United Nations Population Fund (UNFPA) and the United Nations Children's Fund (UNICEF). Discussions with national stakeholders explored background factors and delineated institutional responses.

- **Informal key informant and group interviews** with frontline health workers, civil society organizations, government representatives, small business owners, communities and individuals affected by the epidemic.

Discussions with those affected by the disease focused on experiences, attitudes and concerns regarding the impact Zika has had on their lives, serving to contextualize and humanize the macroeconomic data. Information gathered through desk reviews and consultations conducted in the case study countries complemented the macroeconomic impacts identified through modelling.

1.2.2 Case study countries

Brazil, Colombia and Suriname were selected as case study countries to provide a snapshot of Latin America and the Caribbean. Considering the epidemic is established in these three countries, as is the presence of neurological disorders associated with Zika, these three countries provide the necessary conditions to investigate the socio-economic impacts.

1.3 Development Context in Latin America and the Caribbean

While countries in Latin America and the Caribbean are very diverse, all have undergone significant social and economic changes over the past few decades. Following strong economic growth throughout the region, employment increased and wage inequality decreased, contributing to an unprecedented reduction in poverty and greater prosperity for all levels of society [8]. Despite this progress, however, pockets of political instability and high levels of income inequality still exist in the region, threatening inclusive growth [9] and the achievement of the Sustainable Development Goals. Indeed, recent data from the World Bank show the rate of decline of income inequality to be slowing, and in some countries stagnating or even going in the opposite direction [10]. This is further compounded by a region-wide economic downturn in the last two years [11].[5] Research suggests that unless Latin America and the Caribbean's economic development is protected by initiating public policies that include social protection, care systems and improved labour quality, millions in the region are at risk of falling back into poverty [9], [12].

- **Inequality continues to be a key issue in the region, despite economic growth.** Latin America and the Caribbean is the most inequitable region in the world, with higher income inequality than regions with higher poverty levels, such as Africa and parts of Asia [13]. According to two indexes that measure living standards in health, education and per capita income to gauge the socio-economic context of countries – the Human Development Index (HDI) and the Multidimensional Poverty Index (MPI) – Latin America and the Caribbean has high levels of income inequality and over 31 million people (69.5 percent in rural areas) live in 'multidimensional poverty' [14], [15]. There is significant variation within the region, ranging from less than five percent living in 'multidimensional poverty' in some countries, 16 percent in Honduras and Nicaragua, around 20 percent in Bolivia and up to 49 percent of the population being 'multidimensionally poor' in Haiti [15].

The region has made impressive strides towards reducing gender inequities and performs well on gender parity measures for education, health and survival – ranking below North America but above the Middle East, Asia and the Pacific and North Africa [16]. Gender inequality still exists and prevents women from realizing their full economic potential [17]. While women's labour participation in the region has increased three percent in the last decade, reaching 53 percent in 2010, women still lag approximately 30 percentage points below their male counterparts. Women also earn less and are overrepresented among the poor, in the informal sector and among the unemployed [17]. The region also has low coverage of reproductive health services. Unmet family planning and antenatal care needs for the poorest quintile of women is almost twice that of the wealthiest women [18].

Moreover, inequality across the region is often categorized by hierarchies of race and rural-urban status, exemplified by (often rural) Afro-descendant and indigenous groups earning the lowest per capita household incomes [19] and experiencing poor health and education outcomes [20]. With this in mind, the assessment refers to vulnerable and marginalized populations, not only in terms of income poverty, but also to reflect groups associated with unfair treatment, discrimination, violence or stigma based on ethnic origin or race, skin colour, sexual identity, gender, religion, migration status, nationality or physical or mental disability [9].

- **Health systems and coverage have improved considerably, but many vulnerable populations remain underserved.** Leveraging the economic and social progress made, most countries in the region have undergone health sector reforms since the 1990s. Reforms have generally increased equity, effectiveness and coverage of health systems, although they varied considerably in the types of strategies adopted. Some countries adopted decentralized, universal health care reforms, while others aimed to achieve universal insurance coverage through managed competition models. Many of these reforms have been credited for creating impressive health gains, such as nar-

5. Specifically, in 2016, Latin America and the Caribbean experienced negative GDP growth (estimated at 1.1 percent), following a contraction of 0.5 percent in 2015.

rowing gaps in health status and health service coverage across socio-economic strata [21]. Nonetheless, notable challenges are faced by health systems in the region, including persisting gaps in coverage and access to services. Approximately 30 percent of the population in the region is unable to afford health care and 21 percent do not seek care because of geographical barriers [22].

- **The seriousness of the effects of Zika on different population groups is determined by the socio-economic level.** The evidence base linking the social determinants of health, such as poverty and social or geographic marginalization, to infectious diseases (e.g. malaria, tuberculosis and Ebola) continues to grow [23]. Like other mosquito-borne diseases, for instance chikungunya and dengue, Zika is a disease that is not randomly or equally distributed across a population. It is often referred to as a 'disease of poverty' [24] because it tends to become endemic in poorer regions in which under-resourced public health infrastructures are ineffective in containing the spread of illnesses. Extreme poverty often coincides with a lack of essential water resources and poor sanitation for example, leading to greater negative effects of diseases on already vulnerable populations [25].

As a region, Latin America and the Caribbean has made enormous progress towards increasing water access. Since 2000, 70 million people have gained access to water sources in urban centres. However, a growing urban population and underfunding of rural water services has led to inequities in water access between urban and rural populations [26]. Furthermore, two-thirds of the region's poor live in urban and peri-urban communities where poverty combines with poor sanitation such that the potential for mosquito-borne disease increases.

Box 1. Zika and Agenda 2030

The 2030 Agenda for Sustainable Development sets out an ambitious, universal and indivisible development agenda for 'people, planet and prosperity,' recognizing that social, economic and environmental progress are interlinked. Through its adoption, world leaders pledged that no one will be left behind, and committed to focusing on the needs of those historically excluded from development progress. Health emergencies impose several interrelated social, economic and environmental costs on households and countries – costs which can hinder progress across Agenda 2030. The Zika virus is a case in point. Its impacts are felt across development goals, and many of the required responses lie in the remit of sectors beyond health. Zika is a wake-up call for why a holistic approach to people, planet and prosperity is necessary.

SDG 3 on health and wellbeing includes a call for the strengthened capacity of countries for early warning, risk reduction and management of national and global health risks. Responding urgently and adequately to Zika would advance this target (3.d), while simultaneously supporting aims to end malaria and neglected tropical diseases, combat water-borne diseases (3.3), achieve universal access to sexual and reproductive health services (3.7), and achieve universal health coverage (3.8). Inadequately addressed, however, Zika will strain the capacities of already overburdened health systems, while impeding progress towards other development goals. For instance, caring for a child with microcephaly or developmental disorders often forces family members, especially women and adolescent girls, to leave the labour market or formal education, contributing to lost productivity, lost opportunity and increasing economic hardship on already marginalized populations. This increasingly common scenario can impede SDG 1 on ending poverty, SDG 4 on quality education, SDG 5 on gender equality, SDG 8 on decent work and economic growth, and SDG 10 on reducing inequalities.

But increased recognition of Zika as a cross-cutting issue, like other complex health and development challenges, gives reason for optimism. Coordinated multi-stakeholder efforts on multiple Agenda 2030 goals and targets would help prevent the spread of Zika (and other mosquito-borne diseases) while strengthening preparedness and resilience. Examples include, but are not limited to: delivering on the promise of universal access to quality health and other basic services; providing clean water and sanitation universally and equitably; addressing inequities in opportunity and outcome; upgrading slums and providing adequate, safe and affordable housing; taking urgent action on climate change and its impacts; and building effective, transparent and accountable institutions.

Indeed, Zika provides an example of how health and development goals need to be addressed jointly, to ensure that no one is left behind. National responses should capitalize on this once-in-a-generation opportunity for co-benefit analysis and planning that the SDGs provide.

Zika and SDG 3: Ensure healthy lives and promote wellbeing for all at all ages

Target 3.3	By 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases.
Target 3.7	By 2030, ensure universal access to sexual and reproductive health-care services, including for family planning, information and education, and the integration of reproductive health into national strategies and programmes.
Target 3.8	Achieve universal health coverage, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all.
Target 3.d	Strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks.

2. Findings

2. Findings

This chapter highlights findings across different aspects of the assessment. Specifically, section 2.1 presents macroeconomic estimations of the potential costs of Zika using three scenarios, 2.2 presents key social impacts of Zika based on qualitative research conducted in Brazil, Colombia and Suriname, and 2.3 presents an analysis of the national Zika responses in these countries, according to key elements of the WHO Zika Strategic Response Plan [27].

2.1 Macroeconomic Impact

This section provides a general assessment of the macroeconomic costs of Zika for all countries in Latin America and the Caribbean between 2015–2017 (referred to as 'short-term costs'), and lifetime costs for people with microcephaly and Guillain-Barré syndrome specifically (referred to as 'long-term costs'), based on three potential infection scenarios. Various policy conclusions are drawn from this analysis, to be considered within the context of social and economic inequities characteristic of the region.

Projections presented in this chapter are economic estimations, generated through modelling exercises that used country-specific data sources and, where these were not available, data from the United States as a proxy. The estimations depict the potential scenarios and impacts of the Zika virus to assist national governments in devising an appropriate response. There are several caveats, assumptions and limitations to this approach (Annex 1). While this study modelled the impacts of the Zika epidemic, a costing of prevention initiatives was not conducted due to limited data. Such a costing exercise would be valuable.

Three Zika scenarios

The high proportion of asymptomatic and undiagnosed infections leads to a high degree of uncertainty in modelling the magnitude of the Zika epidemic. Changes in the assumptions necessarily affect the magnitude of the estimated costs. The following three scenarios are considered.

- **Baseline Zika (current rate of infection):** This scenario assumes that the spread of the infection in each country will follow a pattern similar to that seen since the beginning of the epidemic in the region, as per linear projections based on the data released by country health authorities and published by PAHO [28]. This represents a conservative scenario in which the epidemic will exhibit three equal-sized infection seasons and in which containment efforts through investments in vector control and other prevention efforts are such that the rate of spread of the disease does not increase.

- **Medium Zika (intermediate infection rate):** This scenario assumes that the share of the population infected by Zika in the current epidemic (again assumed to last for three seasons) will be similar to that of recent epidemics of chikungunya and dengue, or around 20 percent [29], [30]. It is assumed that the epidemic will exhibit three equal-sized infection seasons. Under this scenario, prevention and vector control efforts are likely moderate and/or moderately successful.

- **High Zika (high infection rate):** This scenario assumes a cumulative infection rate in the susceptible population of 73 percent, corresponding to the highest incidence on record to date [31]. It is assumed that the epidemic will exhibit three equal-sized infection seasons. Under this scenario, prevention and vector control efforts are likely minimal, ineffective and in need of significant strengthening.

Box 2. Summary of macroeconomic findings

Short-term costs

- *The epidemic will cost between $7–18 billion in Latin America and the Caribbean for the period 2015–2017. This equates to an average of $1 billion in costs for every five percent rise in infection rate.* The magnitude of the estimated economic cost of the epidemic varies considerably across the three infection scenarios: baseline $7 billion; medium $9 billion; and high $18 billion over the entire region. These costs amount to 0.05, 0.06 and 0.12 percent of GDP per year for the region, respectively.
- *The Caribbean is the most affected sub-region, with a negative impact five times greater than that on South America.* In the baseline Zika scenario, the annual short-term costs amount to 0.21 percent of GDP in the Caribbean, 0.07 in Central America, and 0.04 in South America.
- *Brazil is expected to bear the largest share of the absolute cost.* Brazil's costs would be about 14 percent of the total costs of the region in the baseline Zika scenario, 19 percent in the medium Zika scenario and 26 percent in the high Zika scenario.
- *Broadly, in all three scenarios, the highest costs as a fraction of GDP will be felt among the poorest countries* (such as Haiti and Belize).[6]
- *In the short term, the largest cost is loss of international tourism revenues, followed by the direct cost of diagnosing patients.* In the medium Zika scenario, lost tourism revenues account for about 70 percent of total short-term costs and diagnosing patients accounts for more than 20 percent. Lost income from declines in international tourism could reach a total of $6.5 billion overall in the region in the medium Zika scenario, corresponding to 0.04 percent of GDP per year, and $9 billion or 0.06 percent in the high Zika scenario.
- *In the Caribbean, more than 80 percent of the estimated cost over three years is due to reduced revenues from international tourism.* Macroeconomic costs in some countries, such as Barbados, Dominica, Saint Lucia and Saint Maarten, could approach, and in some cases exceed, one percent of GDP per year. Aruba and the US Virgin Islands could exceed two percent of GDP per year. Comparable data from separate surveys indicate that for Latin America and the Caribbean, lost income from reductions in international tourism could reach a total of $10.5 billion over three years or 0.06 percent of GDP annually [32].[7] Losses in tourism revenues will largely be borne by the private sector. Local governments, however, may be affected by declining hotel and other tourism-related tax revenues, as the example of Miami, USA demonstrates [33].
- *The total costs of Zika in the region are comparable to the costs of dengue* [34].[8] Although direct medical costs due to Zika in symptomatic patients are not high because hospitalizations are rare, the large expenses associated with congenital conditions are a significant contributor to the costs associated with the epidemic.

Long-term costs

- *In the long-term, the most substantial cost components are the direct and indirect costs associated with microcephaly and Guillain-Barré syndrome.* The lifetime medical costs of microcephaly cases could approach $0.9 billion (medium Zika) or $3.3 billion (high Zika), although precise country-specific estimates of these costs are lacking and likely to vary substantially.
- *The lifetime indirect costs related to the care of children with microcephaly are substantial.* Many parents (often the mothers) will withdraw from or not enter the labour force to care for a child with Zika-related congenital conditions. These costs could run in excess of $1.3 billion in the medium Zika scenario and $4.8 billion in the high Zika scenario. These figures likely underestimate the relevant costs because of the difficulties in evaluating the increase in the burden of non-market activities that will often accompany the birth of children with microcephaly. Additionally, the figures likely underestimate the impact Zika will have on infants given that it is now known that microcephaly is one of several developmental disorders caused by Zika. Overall, the total (direct and indirect) lifetime cost of microcephaly cases caused by Zika could exceed $3.0 billion in the baseline Zika scenario, reach $7.9 billion in the medium Zika scenario and $29 billion in the high Zika scenario. The corresponding lifetime costs of Guillain-Barré syndrome cases are $242 million, $2.75 billion and $10 billion.

6. Annex 2, Table 8 contains a full list of total projected costs of the Zika epidemic by country.
7. According to projections of the short-term economic costs of Zika in Latin America and the Caribbean by the World Bank.
8. Shepard et al., 2011, estimates $2.1 billion per year on average in the Americas.

These assumptions are consistent with the most recent available evidence.[9] New knowledge on any aspect of the disease would determine changes in the computed costs. For further information on limitations of computing these estimations, see Annex 1.

The estimated economic cost of the Zika epidemic is driven by four main considerations:

1. costs of detecting, diagnosing and treating the disease;
2. lost productivity due to missed work;
3. direct and indirect costs of Guillain-Barré syndrome and congenital Zika syndrome; and
4. costs associated with 'avoidance behaviour,' most notably the impact on tourism revenues.

For each cost category, total costs (in 2015 US$) are computed for the projected duration of the current epidemic, i.e. 2015–2017 [35]. Additionally, lifetime costs are estimated for people with microcephaly and Guillain-Barré syndrome.

2.1.1 Short-term costs

The total short-term costs include the cost of diagnosing and treating patients, lost productivity due to missed work, the loss due to decreased tourism revenues and annualized portions of the direct and indirect costs associated with microcephaly and Guillain-Barré syndrome. These costs are discussed in the following sub-sections. They are presented as both absolute costs and costs as a percentage of GDP.

Projected number of infected individuals and symptomatic cases

This estimation involves the following assumptions.[10]

- Data on populations at risk are weighted by altitude, thus accounting for environments inhospitable to *Aedes aegypti*.
- An infection rate of 0.85 percent is used.[11]
- The prevalence rate of symptomatic individuals was estimated as 19 percent of total infections [35], [36].

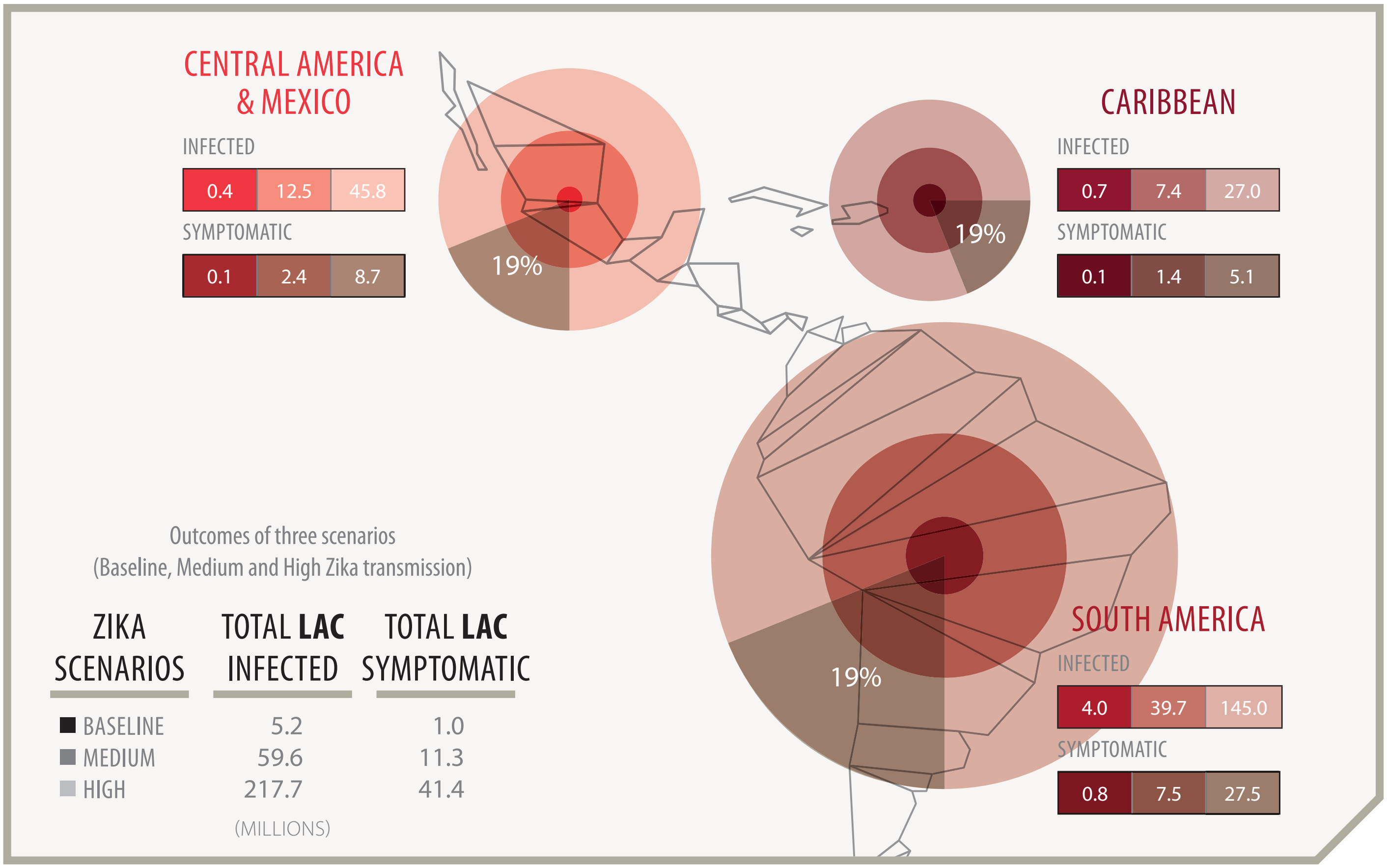
With a total of 5.2 million individuals infected and about one million symptomatic cases over three years, baseline Zika projections are broadly in line with those of WHO, according to which there were to be 3–4 million infected people in Latin America and the Caribbean by early 2017. These figures are based on the statistics reported to PAHO by the affected countries, but likely underestimate the real proportions of the epidemic for several reasons. These include: (1) about 80 percent of infected individuals will remain asymptomatic; (2) only a fraction of those that develop symptoms will seek medical attention and receive a clinical confirmation – we estimate that around 30 percent of symptomatic individuals will be tested; and (3) reporting of confirmed cases to central health authorities in large and geographically diverse countries can be delayed or incomplete.

The medium Zika scenario estimates about 60 million infected individuals and 11 million symptomatic cases throughout the region. The figures in the high Zika scenario are more dramatic, with nearly 218 million infected individuals and 41 million symptomatic patients. The high Zika scenario is most plausible for small island countries in the Caribbean whose environment more closely resembles that of the Yap islands in the Federated States of Micronesia where the highest Zika infection rate to date has been recorded. Other published projections fall within the medium and high Zika scenario estimates. For example, Perkins et al. 2016 estimate that 82–117 million people could become infected in the current epidemic in Latin America and the Caribbean [3].

9. The time of writing was November 2016.
10. For further detail regarding the assumptions used in this estimation, please refer to Annex 1.
11. The 0.85 infection rate was obtained by dividing the total number of projected infected cases by the total population in Latin America and the Caribbean.

INFECTED INDIVIDUALS AND SYMPTOMATIC CASES (2015–2017) (MILLIONS)

FIGURE 1



ZIKA SCENARIOS	TOTAL LAC INFECTED	TOTAL LAC SYMPTOMATIC
BASELINE	5.2	1.0
MEDIUM	59.6	11.3
HIGH	217.7	41.4

(MILLIONS)

Cost of detecting, diagnosing and treating symptomatic individuals

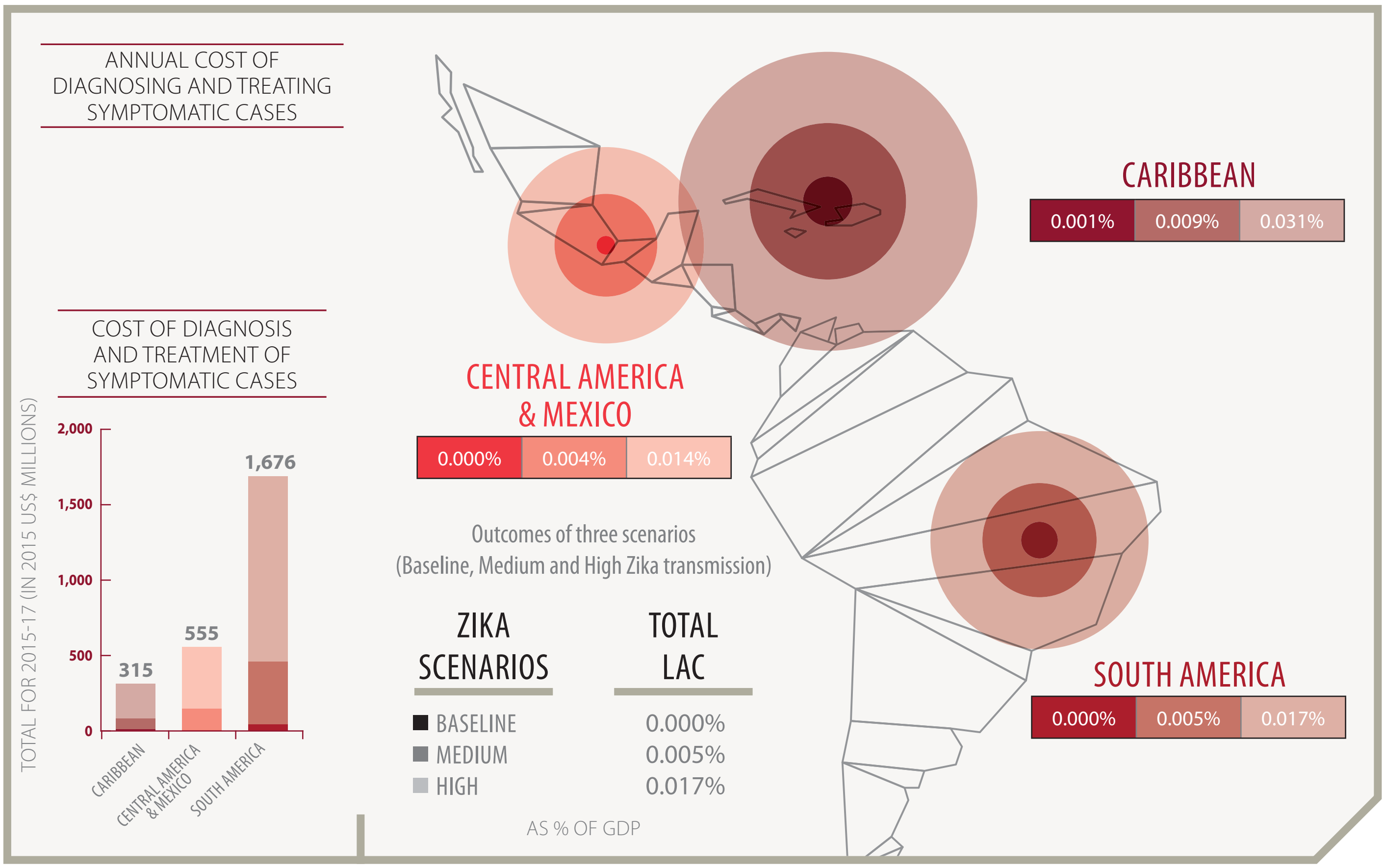
The direct costs of the Zika virus include the resources devoted to detection, diagnosis and treating symptomatic patients. Direct cost estimations include the following assumptions.[12]

- A unit cost of $150 per test was used.
- 30 percent of symptomatic patients will get tested [37].
- Symptomatic patients who are not pregnant will visit an outpatient care provider at most once in relation to the infection.
- Outpatient care costs per the rate in country are used.
- Treatment costs for Zika symptoms entail antipyretics for fever and antihistamines for rashes.
- Country-specific costs are converted into 2015 US$ values.

12. For further detail regarding the assumptions used in this estimation, please refer to Annex 1.

COST OF DETECTING, DIAGNOSING AND TREATING ZIKA (2015–2017) (AS % OF GDP)

FIGURE 2



Large differences exist in the potential direct costs depending on the overall infection rate. For Latin America and the Caribbean overall, these costs amount to $61 million in the baseline Zika scenario, and jump to $0.7 billion in the medium Zika scenario and to $2.5 billion under the high Zika scenario. Annualized and expressed as a percentage of GDP, these costs are minor in the baseline Zika scenario (less than 0.001 percent of GDP per year), and they represent 0.005 and 0.017 percent of GDP in the medium and high Zika scenarios, respectively.

Based on these assumptions, the direct costs of testing and treatment represent a much larger *relative* burden in poorer countries. The medium and high Zika scenarios yield annual costs in the order of 0.07 and 0.27 percent of GDP in Haiti respectively, 0.03 and 0.11 in Nicaragua, and 0.06 and 0.08 percent of GDP in Honduras.[13] These are large burdens.

Lost productivity due to symptomatic individuals missing work

To estimate the value of lost productivity due to absenteeism, the following assumptions were applied.[14]

- The clinical presentation of Zika is usually mild and consists of a self-limiting febrile illness that lasts approximately two to seven days [31], [36].

13. For country level data, see Annex 2, Table 2.
14. For further detail regarding the assumptions used in this estimation, please refer to Annex 1.

- Each symptomatic individual of working age and employed will take an average five days leave of absence.
- Data on population ages 15–64 and employment rates for the year 2015 are accessed from the World Bank's World Development Indicators [38].
- Earnings data were accessed from the Socio-Economic Database for Latin America and the Caribbean [39].

Because Zika causes only mild symptoms in approximately 1 in 5 infected individuals, the productivity loss is relatively contained even under an assumption that each symptomatic employee will miss a full week of work (five working days) due to the disease. In the baseline Zika scenario, the total estimated cost is about $43.5 million over three years, corresponding to less than 0.001 percent of GDP. In the medium and high Zika scenarios, productivity losses amount to 0.003 and 0.012 percent of annual GDP respectively.[15] As shown in Annex 2, Table 3, in the high Zika scenario, the cost of lost productivity is largest in Jamaica, Haiti and Honduras (0.05, 0.04 and 0.05 percent of annual GDP, respectively). The nature and extent of social security initiatives can change who bears the cost: the employer, the employee or across the population if the absence is subsidized by a public social security programme.

FIGURE 3

LOST PRODUCTIVITY DUE TO MISSED WORK

	LOST PRODUCTIVITY, TOTAL 2015–17 (IN 2015 USD MILLIONS)			LOST PRODUCTIVITY, ANNUAL % OF GDP		
	ZIKA			ZIKA		
	BASELINE	MEDIUM	HIGH	BASELINE	MEDIUM	HIGH
CARIBBEAN	4.8	39.2	142.9	0.000%	0.004%	0.014%
CENTRAL AMERICA & MEXICO	2.9	88.0	321.3	0.000%	0.002%	0.008%
SOUTH AMERICA	35.9	367.0	1,339.5	0.000%	0.004%	0.013%
TOTAL LAC	**43.5**	**494.2**	**1,803.7**	**0.000%**	**0.003%**	**0.012%**

Effects on tourism revenues

The potential effects of Zika on foetuses, together with the possibility of sexual transmission of the virus to partners upon returning from travel, are likely to stop people (particularly those who contemplate conceiving) from visiting countries or territories with ongoing disease transmission. This is likely to cause an immediate and short-term decline in tourism revenues. The estimate includes the following assumptions.[16]

- No significant effect on domestic tourism is assumed, as many of these countries will be equally affected by the virus across their territories, thus the focus is on costs resulting from reduced *international* travel.
- Two scenarios for the direct costs on international tourism were considered and are described below.
    1. Figures are based on the negative impact on tourism in Miami (a 2.9 percent decline in hotel bookings

15. For countries for which earnings data for recent years were not available, the average of the three countries in the sub-region (Caribbean, Central America, South America) with the closest GDP per capita was used.

16. For further detail regarding the assumptions used in this estimation, please refer to Annex 1.

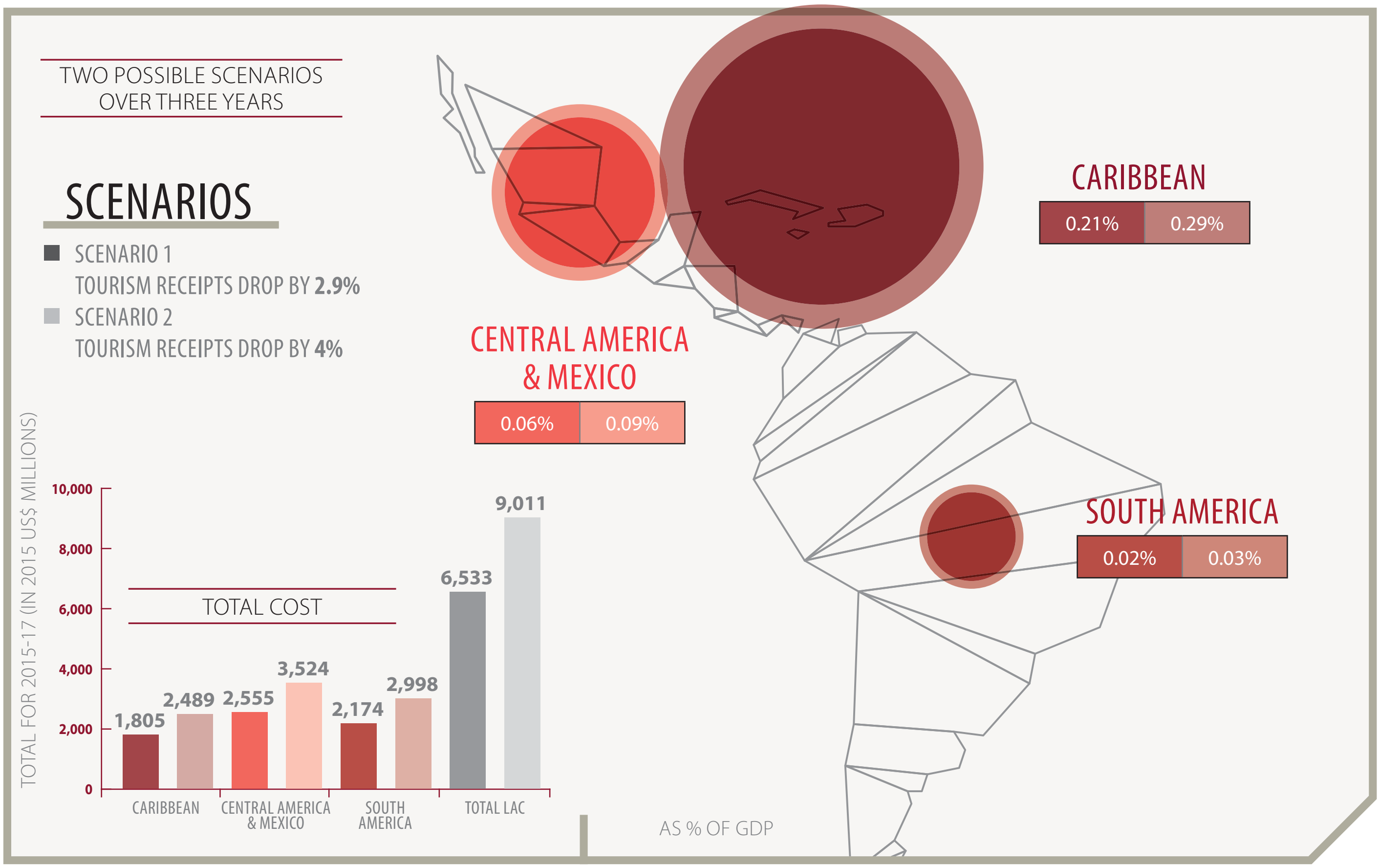
was assumed due to fears of Zika) [40], [41].[17] While the Miami tourism impact estimate includes international and domestic tourism, this figure was used as an estimate of the decline in tourism to Zika-affected areas from non Zika-affected areas, which for most of the Latin America and Caribbean countries (particularly those most affected, namely islands in the Caribbean) mainly consists of international tourism.

2. Prior estimates on the effects of chikungunya and dengue outbreaks on tourism revenues in Thailand and Malaysia were utilized [42]. The fall in tourism revenues in this case was four percent.

Under these two scenarios, the total direct losses to the tourism sector are estimated to be $2.1 billion (scenario 1) and $3 billion (scenario 2) per year for the period 2015–2017.

FIGURE 4

IMPACT ON TOURISM REVENUES (AS % OF GDP)



17. This estimate is based on a study conducted by STR Analytics, commissioned by the Greater Miami Convention and Visitors Bureau. The 2.9 percent estimate includes international and domestic tourism. Nonetheless, this figure is used as an estimate of the decline in tourism to Zika-affected areas from non Zika-affected areas, which for most countries in the region (particularly those most impacted, namely islands in the Caribbean) mainly consists of international tourism.

The total direct losses to the tourism sector are estimated to be $6.5–9 billion over the period 2015–2017. The maximum GDP losses would take place in the Caribbean, as this sub-region is the most reliant on tourism revenues. This would create an annual loss of GDP of 0.21 percent (corresponding to a 2.9 percent drop) and 0.29 percent (corresponding to a four percent drop).

Outside of the Caribbean sub-region (e.g., Brazil), the concentration of infections in certain areas of a country implies that domestic travel might also be affected in some cases. While the figures presented in this estimate are sizable, the two scenarios provide relatively conservative estimates of the potential losses to the tourism sector. Recent data from Miami-Dade County, Florida, USA, indicates that hotel tax revenues declined seven percent in December 2016, following four months of steady decline. This is the longest decline seen in the county since the 2009 global financial crisis [33] and suggests that the potential losses to the tourism sector in Latin America and the Caribbean could exceed our estimations.

Box 3. Zika's effect on the tourism sector in Suriname is hard to isolate

Field interviews show that the effect of Zika on tourism was more noticeable at the beginning of the epidemic, when travellers' warnings were issued and media attention peaked. When describing the impact of the disease on their sector, interviewees mentioned the difficulty of isolating Zika from the general regional economic slowdown and the importance of worker absenteeism as a possible related effect. Messaging from the media was also noted as an influencing factor on the tourism sector in relation to Zika [43]. Below is an excerpt from a conversation with a hotel owner in Suriname.

"We have seen some cancellations, mainly from Holland, other parts of Europe and Curaçao. Many people have told us that it's because of Zika, but the [economic] crisis is also a factor, so we do not know the specific reason well. In Suriname, there is a lack of accurate data. So we do not know the real impact. It is very frustrating. Tourists are worried about the prospect of microcephaly, but when they cancel online we do not know the reason.

I believe the tabloids' treatment of the topic has had an impact on the industry. For example, when, in a newspaper well known in the Netherlands [43], it was announced that a Dutch person died from Zika in Suriname, and the impact was huge. I had chikungunya and many hotel workers had Zika, but the impact of Zika is less than that of chikungunya. With chikungunya, there is more than one week down. It's less with Zika. I have 400 employees. At one point, we had 20 patients with Zika. But in the last two to three months, I have not seen any cases."

Box 4. Business owner perceptions of the socio-economic impact of Zika in Valledupar, Colombia[18]

In the absence of long-term estimations of the economic impact of Zika at the micro level, the perceptions of business owners can illustrate the disease's complicated dynamics. According to a survey by the Chamber of Commerce of Valledupar (a city in north-eastern Colombia), 55 percent of business owners declared that Zika has not affected their economic activities, while the remainder declared a decrease in their income. Out of the latter group, 48 percent declared a decrease in sales, 44 percent a decrease of local visitors and six percent a decline in foreign tourists, while two percent cited a restriction in exportations or other reasons. Upon further investigation, only 13 percent of the overall participants recognized any income losses, mostly in the range of $167 and $330 annually. Pharmacies and drug stores were among those noting to have benefited from the Zika epidemic through increased sales.

Respondents valued the local government's management of and communication on the Zika epidemic, with 70 percent of the respondents concluding that the response was reasonable to excellent. When asked their opinion on the recommendations not to travel or to postpone travelling to areas where the mosquito is present, 42 percent thought these were good or excellent preventive measures, 37 percent reported that these did not affect travellers' decisions and 20 percent felt the recommendations generated alarm and panic among tourists. Regarding their role in the fight against Zika, 55 percent declared undertaking active efforts to eliminate mosquitoes around their commercial establishments or at their homes and six percent informed their employees how to prevent Zika. Thirty-eight percent did not take any measures to further combat the disease. Lastly, the vast majority reported that the economic burden of the Zika epidemic is on affected families, compared to the health care system or the commercial sector.

Total short-term costs

Figures 5 and 6 report the total estimated short-term cost of Zika.[19] Figure 5 shows the total cost in 2015 US$ for the entire duration of the epidemic, assumed to last three years, and Figure 6 shows annual costs expressed as a percent of GDP. Overall, the estimated cost of the current Zika epidemic is nearly $7 billion in the baseline scenario, $9 billion in the medium scenario and about $18 billion in the high scenario. These costs amount to 0.05, 0.06 and 0.12 percent of GDP per year over the three years of the epidemic.

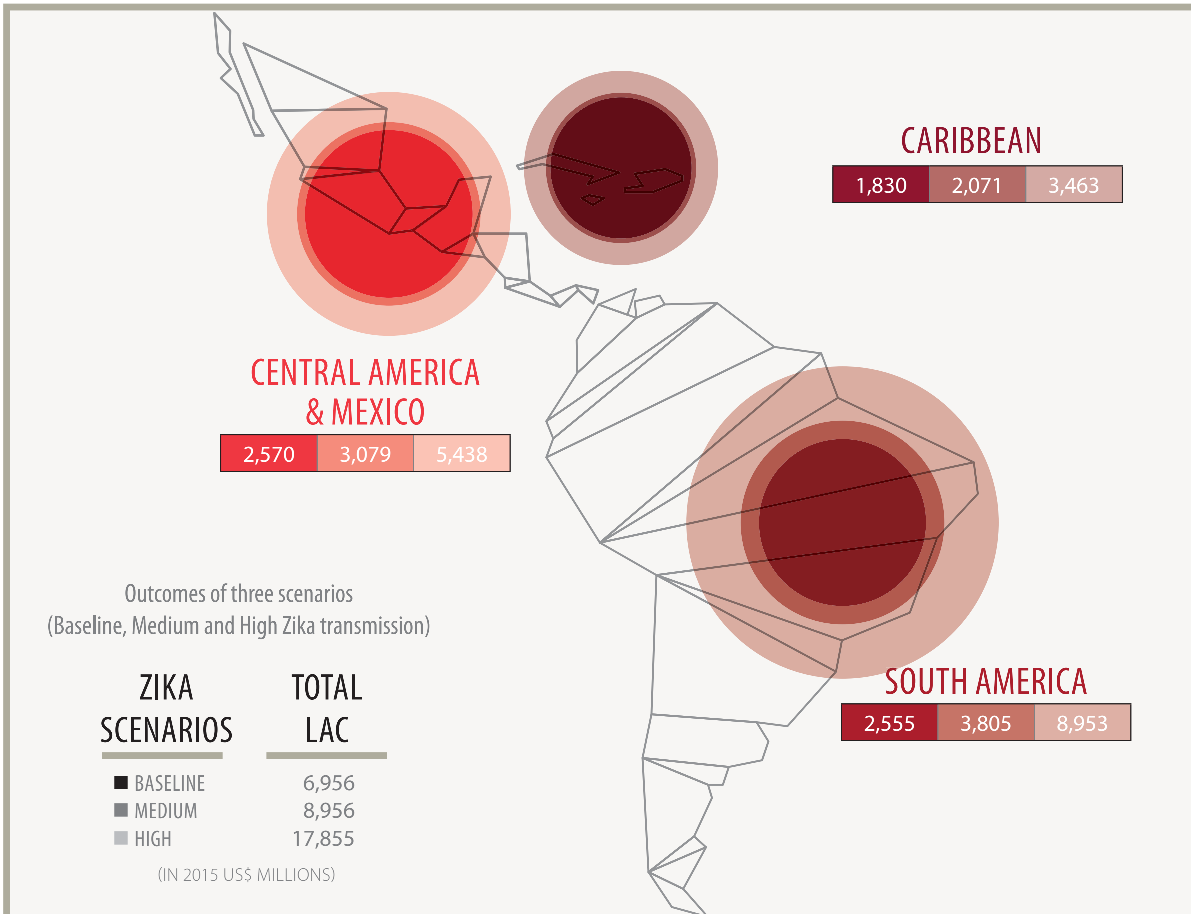
18. In August 2016, a survey was conducted by the local Chamber of Commerce among 342 business owners, including commercial establishments and street vendors ranging from 18 to 65 years old, in Valledupar, State of Cesar, Colombia. Men and women were equally represented in the sample.

19. See Annex 2, Table 8, for country-level data.

TOTAL SHORT-TERM COSTS OF ZIKA (2015–2017)

(IN 2015 US$ MILLIONS)

FIGURE 5



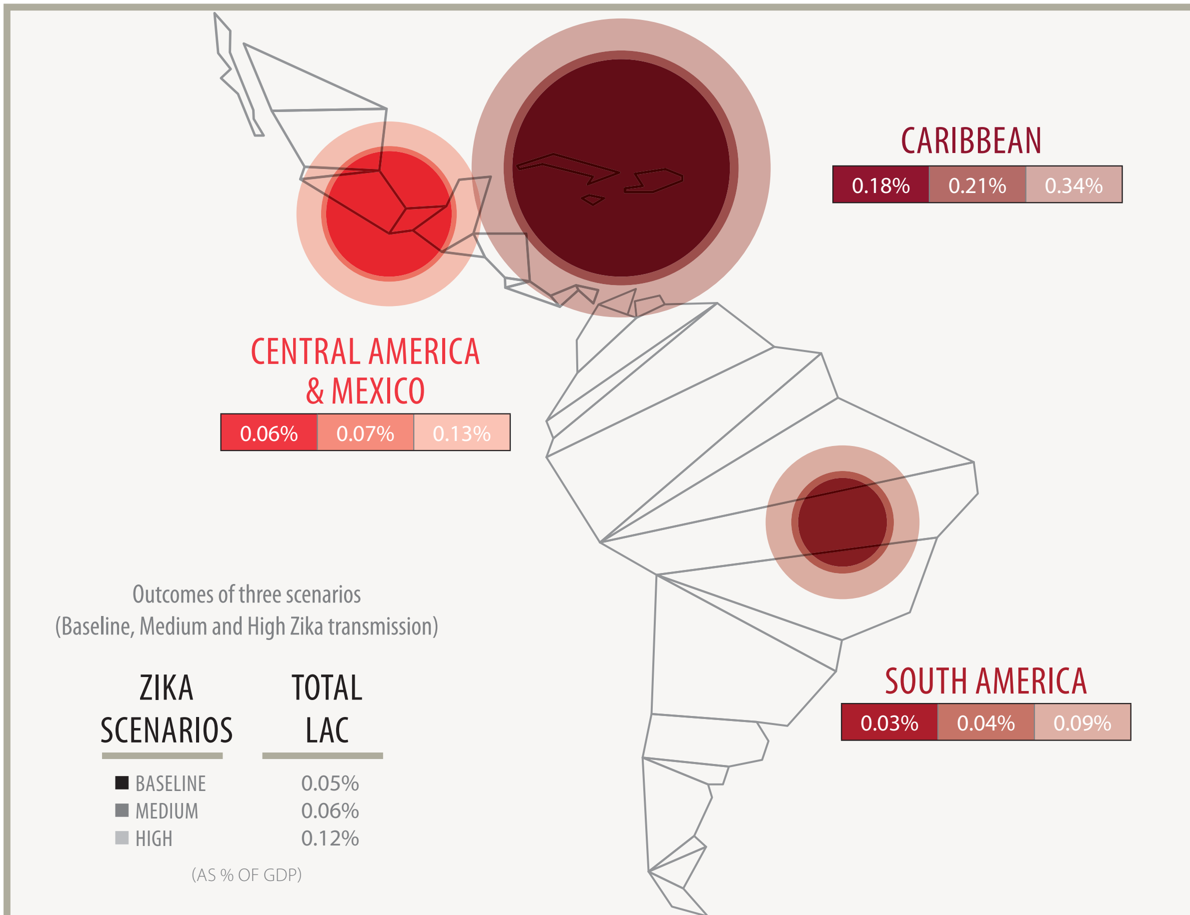
	TOTAL COST (2015–2017) (IN 2015 US$)		
	BASE	MED	HIGH
ANGUILLA	366	111,382	406,546
ARUBA	141,982,821	142,459,071	197,593,762
BARBADOS	86,661,162	88,502,284	127,063,738
BONAIRE, ST EUS-TATIUS & SABA	2,987	1,614,911	5,894,424
CUBA	221,502,277	281,778,519	525,529,293
CURACAO	70,722,897	71,758,681	101,508,584
DOMINICA	11,203,230	11,370,037	16,609,335
DOMINICAN REPUBLIC	491,659,178	556,689,551	918,327,511
GRENADA	10,440,811	11,324,278	17,627,616
GUADELOUPE	8,322,176	2,972,533	10,849,744
HAITI	50,876,512	113,152,322	298,822,076
JAMAICA	197,175,663	218,055,703	350,428,068
MARTINIQUE	12,206,035	2,774,686	10,127,603
PUERTO RICO	300,008,387	327,168,529	514,988,231
S. BARTHELEMY	103,611	49,320	180,017
SAINT LUCIA	30,925,417	32,467,140	48,572,360
SAINT MARTIN	622,639	233,480	852,201
SINT MAARTEN	8,007,030	8,947,762	14,484,733
ST VINCENT AND THE GRENADINES	80,919,365	81,181,045	112,589,316
TRINIDAD AND TOBAGO	33,383	11,209,624	40,915,129
US V. ISLANDS	107,395,307	107,758,233	149,935,950
TOTAL CARIBBEAN	**1,830,771,254**	**2,071,579,091**	**3,463,306,237**

	TOTAL COST (2015–2017) (IN 2015 US$)		
	BASE	MED	HIGH
BELIZE	33,061,881	35,873,714	55,870,054
COSTA RICA	257,448,110	296,102,407	497,211,087
EL SALVADOR	115,236,216	156,881,726	318,766,548
GUATEMALA	136,786,432	188,935,235	380,645,410
HONDURAS	64,442,154	103,359,303	250,434,356
MEXICO	1,445,060,736	1,715,390,053	2,980,460,845
NICARAGUA	38,816,738	71,934,969	174,652,888
PANAMA	479,028,644	510,843,096	780,027,800
TOTAL CENTRAL AMERICA & MEX	**2,569,880,911**	**3,079,320,503**	**5,438,068,987**
ARGENTINA	454,495,784	495,976,647	779,498,863
BOLIVIA	64,068,983	86,839,996	171,569,184
BRAZIL	968,855,815	1,674,408,354	4,649,127,844
COLOMBIA	456,043,252	643,601,745	1,383,719,518
ECUADOR	130,225,265	193,622,724	412,966,094
FRENCH GUIANA	1,849,084	845,251	3,085,167
GUYANA	6,890,484	11,059,182	24,759,566
PARAGUAY	27,401,932	73,446,228	206,048,034
PERU	333,537,513	367,758,428	585,504,214
SURINAME	13,045,623	13,450,759	28,747,619
VENEZUELA	355,152,618	299,411,161	909,919,438
TOTAL SOUTH AMERICA	**2,560,950,058**	**3,860,420,477**	**9,154,945,540**
TOTAL LAC	**6,961,602,223**	**9,011,320,071**	**18,056,320,764**

TOTAL SHORT-TERM COSTS OF ZIKA (2015–2017)

(AS % OF GDP)

FIGURE 6



	ANNUAL COST AS %GDP		
	BASE	MED	HIGH
ANGUILLA	0.00	0.01	0.04
ARUBA	1.83	1.84	2.55
BARBADOS	0.65	0.66	0.95
BONAIRE, ST EUS-TATIUS & SABA	0.00	0.10	0.37
CUBA	0.10	0.12	0.23
CURACAO	0.76	0.77	1.09
DOMINICA	0.69	0.70	1.03
DOMINICAN REPUBLIC	0.24	0.28	0.46
GRENADA	0.36	0.39	0.60
GUADELOUPE	0.03	0.01	0.04
HAITI	0.19	0.42	1.12
JAMAICA	0.47	0.52	0.83
MARTINIQUE	0.04	0.01	0.04
PUERTO RICO	0.10	0.11	0.17
S. BARTHELEMY	0.01	0.01	0.02
SAINT LUCIA	0.72	0.75	1.13
SAINT MARTIN	0.03	0.01	0.05
SINT MAARTEN	0.36	0.40	0.64
ST VINCENT AND THE GRENADINES	3.39	3.41	4.72
TRINIDAD AND TOBAGO	0.00	0.01	0.05
US V. ISLANDS	1.79	1.80	2.50
TOTAL CARIBBEAN	**0.18**	**0.21**	**0.34**

	ANNUAL COST AS %GDP		
	BASE	MED	HIGH
BELIZE	0.63	0.68	1.06
COSTA RICA	0.17	0.19	0.32
EL SALVADOR	0.15	0.20	0.41
GUATEMALA	0.07	0.10	0.20
HONDURAS	0.11	0.17	0.41
MEXICO	0.04	0.05	0.09
NICARAGUA	0.10	0.19	0.46
PANAMA	0.31	0.33	0.50
TOTAL CENTRAL AMERICA & MEX	**0.06**	**0.07**	**0.13**
ARGENTINA	0.03	0.03	0.05
BOLIVIA	0.06	0.09	0.17
BRAZIL	0.02	0.03	0.09
COLOMBIA	0.05	0.07	0.16
ECUADOR	0.04	0.06	0.14
FRENCH GUIANA	0.01	0.01	0.02
GUYANA	0.07	0.12	0.26
PARAGUAY	0.03	0.09	0.25
PERU	0.06	0.06	0.10
SURINAME	0.09	0.09	0.20
VENEZUELA	0.03	0.03	0.08
TOTAL SOUTH AMERICA	**0.03**	**0.04**	**0.09**
TOTAL LAC	**0.05**	**0.06**	**0.12**

2.1.2 Long-term costs

The long-term costs include the direct and indirect lifetime costs associated with microcephaly and Guillain-Barré syndrome cases from this epidemic (2015–2017). These costs are discussed in the following sub-sections. They are presented as absolute costs per country and per case.

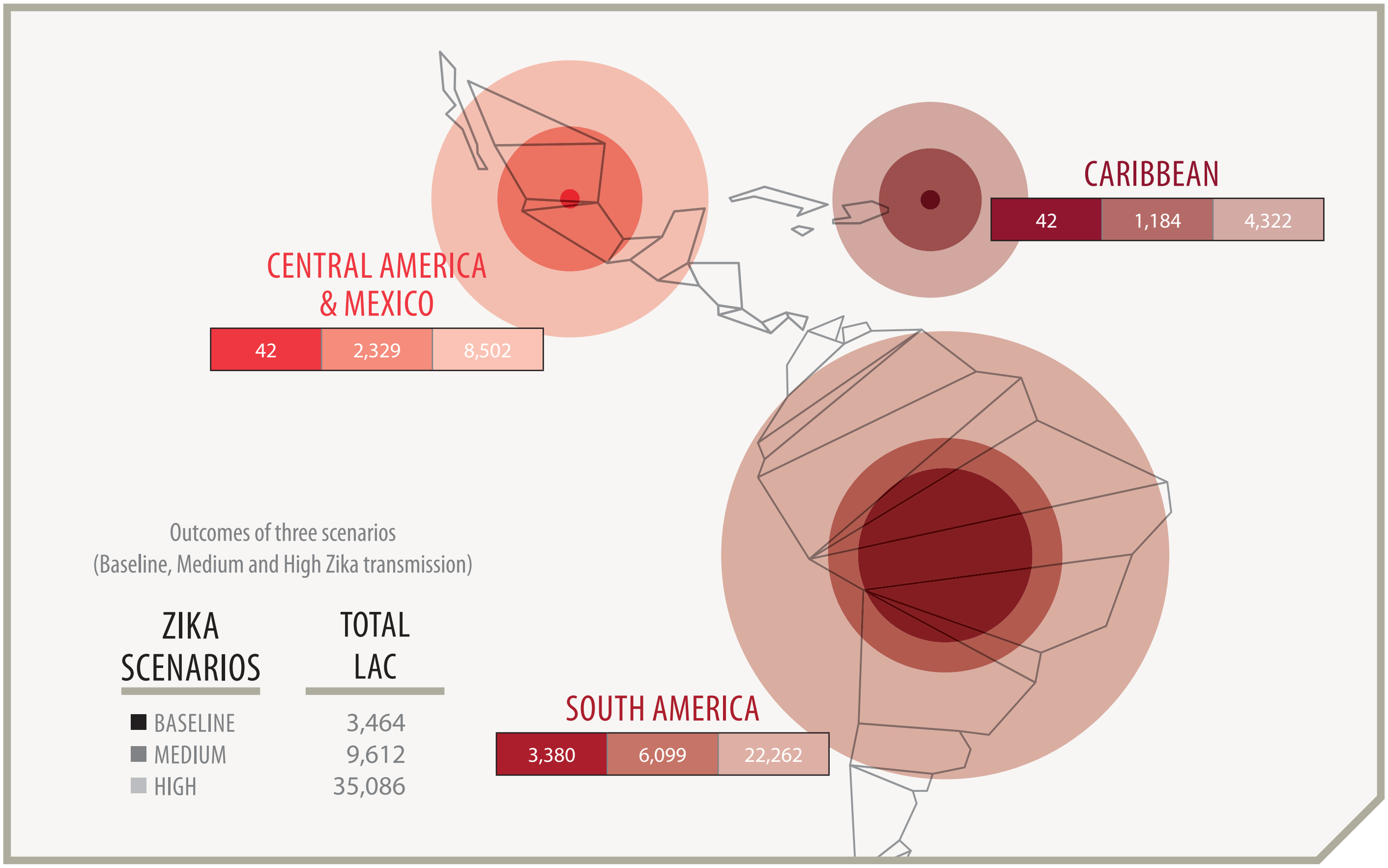
Projected number of microcephaly cases

The projected number of cases for these two conditions include the following assumptions listed below.[20]

- The probability of Zika-related microcephaly occurring during pregnancy is 0.32 percent for all countries, based on reports from the 2013 French Polynesia outbreak [44], [45]. Higher rates implied by current reported trends were applied for Brazil (10.78 percent), Puerto Rico (0.62 percent) and Panama (2.6 percent) in the baseline Zika scenario.[21]

PROJECTED NUMBER OF MICROCEPHALY CASES (2015–2017)

FIGURE 7



20. For further detail regarding the assumptions used in this estimation, please refer to Annex 1.
21. Based on PAHO data, the rate of infants with microcephaly born to Zika infected pregnant women was 10.78 percent in Brazil, 0.62 percent in Puerto Rico and 2.6 percent in Panama, hence these rates have been applied to baseline Zika scenario estimations for these three countries.

- All Zika-infected pregnant women are at risk, regardless of the timing of Zika infection and whether they develop symptoms or not.
- Due to lack of reliable statistics, we did not consider the possibility of miscarriages and stillbirths that could be associated with Zika infection.

Concerning the cost of congenital Zika syndrome, this study concentrates only on microcephaly.

The number of infants with microcephaly due to *in utero* infections could be high in the absence of a strong preventive response and with the prevailing fertility rates in affected countries. It is important to underline the inequities in access to contraception as well as the high number of unwanted pregnancies within these countries [46]. In the baseline Zika scenario (i.e., if current trends continue until the end of 2017), there could be approximately 3,500 babies with microcephaly in the region, close to 750 of which will die within their first year. In the medium Zika scenario, there could be up to 9,500 with the congenital condition across the region. About 6,000 of those babies will be born in South America.

Costs of microcephaly

The estimation for costs of microcephaly includes the following assumptions.[22]

- Infants with microcephaly face a 20 percent probability of death during the first year, and average life expectancy of 35 years beyond the first year [4].
- This estimate uses direct and indirect cost data for the case of intellectual disability in the United States [47].
- Direct costs include lifetime medical expenses ($180,004 per case), and lifetime non-medical expenses ($133,812 in 2015 values) [47].
- Indirect costs include the lost productivity caused by increased morbidity and premature mortality of the person with microcephaly ($993,354) using 2015 US$ [47].[23]
- Indirect costs also include the value of earnings lost due to reductions in labour force participation among carers of children with microcephaly who survive the first year of life. The analysis assumes that one parent will withdraw from the labour force, and estimates the lost productivity using average earnings (one year in 20 percent of the cases, and thirty-five years for the remaining 80 percent).
- Those who survive past the first year face a lifelong dependency on social and medical care systems (cost data was used for the case of intellectual disability in the United States) [47].

The total lifetime costs associated with microcephaly cases (for the region, cumulative) amount to about $3 billion in the baseline Zika scenario, $7.9 billion in the medium Zika scenario and up to $28.9 billion in the high Zika scenario.[24] Most of these costs are incurred in South America. Brazil accounts for about 40 percent of these costs in the medium and high Zika scenarios, and for more than 90 percent in the baseline Zika scenario.[25] This is in part due to Brazil's large population and size of its economy, but also because a higher rate (10.78 percent) of microcephaly was applied to Brazil, based on current estimated rates of microcephaly. The frequency of microcephaly cases varies substantially between countries in the region, with Brazil reporting the highest rates, ranging between 1–13 percent [45]. These are consistent with the rate applied in the assessment.

There are few studies that have measured the lifetime costs of microcephaly. A recent study in Puerto Rico estimated the lifetime direct medical and non-medical costs of Zika-associated microcephaly at $3,788,843 [48]. However, the study utilized data from private health insurance systems of the United States, hence it is significantly higher than our estimate of direct medical and non-medical costs in Puerto Rico, at $257,150.

Two important factors regarding the costs of microcephaly should be noted. First, several recent studies have found a widening range of abnormalities that pertain to congenital

22. For further detail regarding the assumptions used in this estimation, please refer to Annex 1.
23. The Bureau of Labor Statistics' Consumer Price Index Inflation Calculator (www.bls.gov/data/inflation_calculator.htm) was used to convert 2004 US cost data values to 2015 US$. The World Bank's Purchasing Power Index was then used to convert values to country-specific costs.
24. Details by country can be found in Annex 2 Tables 5A and 5B.
25. As can be seen in Annex 2, Table 5B. Per patient costs, over the lifetime and by country, are presented in Annex 2, Table 5A.

LIFETIME COST OF MICROCEPHALY (IN 2015 US$ MILLIONS)

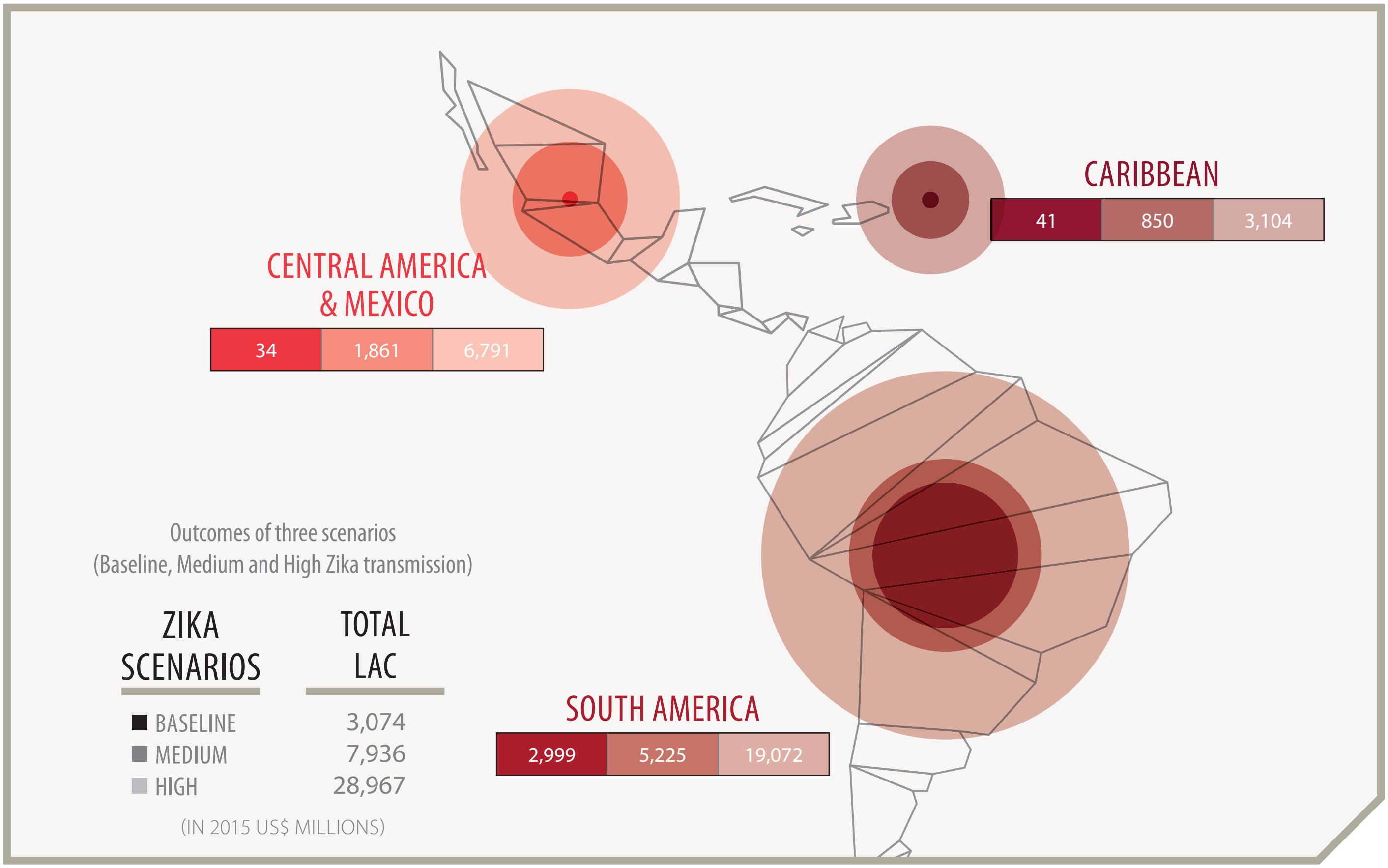
FIGURE 8

	DIRECT LIFETIME MEDICAL COSTS (2015 US$ MILLIONS)	DIRECT LIFETIME NON-MEDICAL COSTS (2015 US$ MILLIONS)	LOST PRODUCTIVITY DUE TO INCREASED MORBIDITY AND PREMATURE MORTALITY (2015 US$ MILLIONS)	LOST PRODUCTIVITY DUE TO CAREGIVING PARENT WITHDRAWING FROM THE LABOUR FORCE (2015 US$ MILLIONS)	**TOTAL COST** (2015 US$ MILLIONS)
	BASELINE				
CARIBBEAN	5.0	3.7	27.3	5.1	41.1
CENTRAL AMERICA & MEX.	3.9	2.9	21.5	5.8	34.1
SOUTH AMERICA	337.0	250.5	1,857.9	553.6	2,999.0
TOTAL LAC	**345.9**	**257.1**	**1,906.7**	**564.5**	**3,074.2**
	MEDIUM				
CARIBBEAN	102.0	75.8	562.4	110.1	850.4
CENTRAL AMERICA & MEX.	215.7	160.4	1,189.3	295.3	1,860.6
SOUTH AMERICA	594.4	441.9	3,277.1	911.8	5,225.2
TOTAL LAC	**912.2**	**678.1**	**5,028.7**	**1,317.2**	**7,936.2**
	HIGH				
CARIBBEAN	372.3	276.8	2,052.7	402.0	3,103.8
CENTRAL AMERICA & MEX.	787.4	585.3	4,340.8	1,077.8	6,791.3
SOUTH AMERICA	2,169.7	1,612.9	11,961.3	3,328.1	19,072.0
TOTAL LAC	**3,329.4**	**2,475.0**	**18,354.8**	**4,807.9**	**28,967.1**

Zika syndrome. These include neurological, ocular, hearing and skeletal disorders, causing decreased brain volume, cerebral calcifications, ventriculomegaly, delayed myelination, corpus callosum and cerebellar abnormalities, amongst others, in infants [49], [50], [51]. Hence, the presence of microcephaly alone is not enough to make a diagnosis for the developmental harms caused by Zika, since infants without microcephaly could still have been infected by Zika during gestation and display significant developmental disorders as a result [49]. Microcephaly is now thought to be found in the most severe cases of congenital Zika syndrome, as the virus can still cause significant brain damage in babies with normal-sized heads [52]. These findings imply that the estimations in this study for the projected number of microcephaly cases and the costs of treating and caring for these infants, likely *underestimates* the true cost of Zika's impact on infants, as the assessment's estimations only capture microcephaly cases.

LIFETIME COST COMPONENTS OF MICROCEPHALY
(IN 2015 US$ MILLIONS)

FIGURE 9



Second, and in regard to lost productivity, field interviews confirmed that social and cultural factors often force the mother to become the primary (or only) caregiver in the vast majority of cases. This is one of the main reasons underlying the gendered impact of the Zika epidemic in the region, since it is reasonable to assume that the mother will withdraw from (or never join) the formal labour force and forego an average of 35 years of wages to take care of her child. Much of this work is not recognized in the formal economy, such as unpaid, home-based work.[26]

Costs per microcephaly case in each country are in the range of $800,000 to $1 million, with the highest costs in the Caribbean and lowest in South America (Figure 10). The cost per case is calculated by applying the direct and indirect costs (explained above in assumptions) of microcephaly to each country's purchasing power parity.[27]

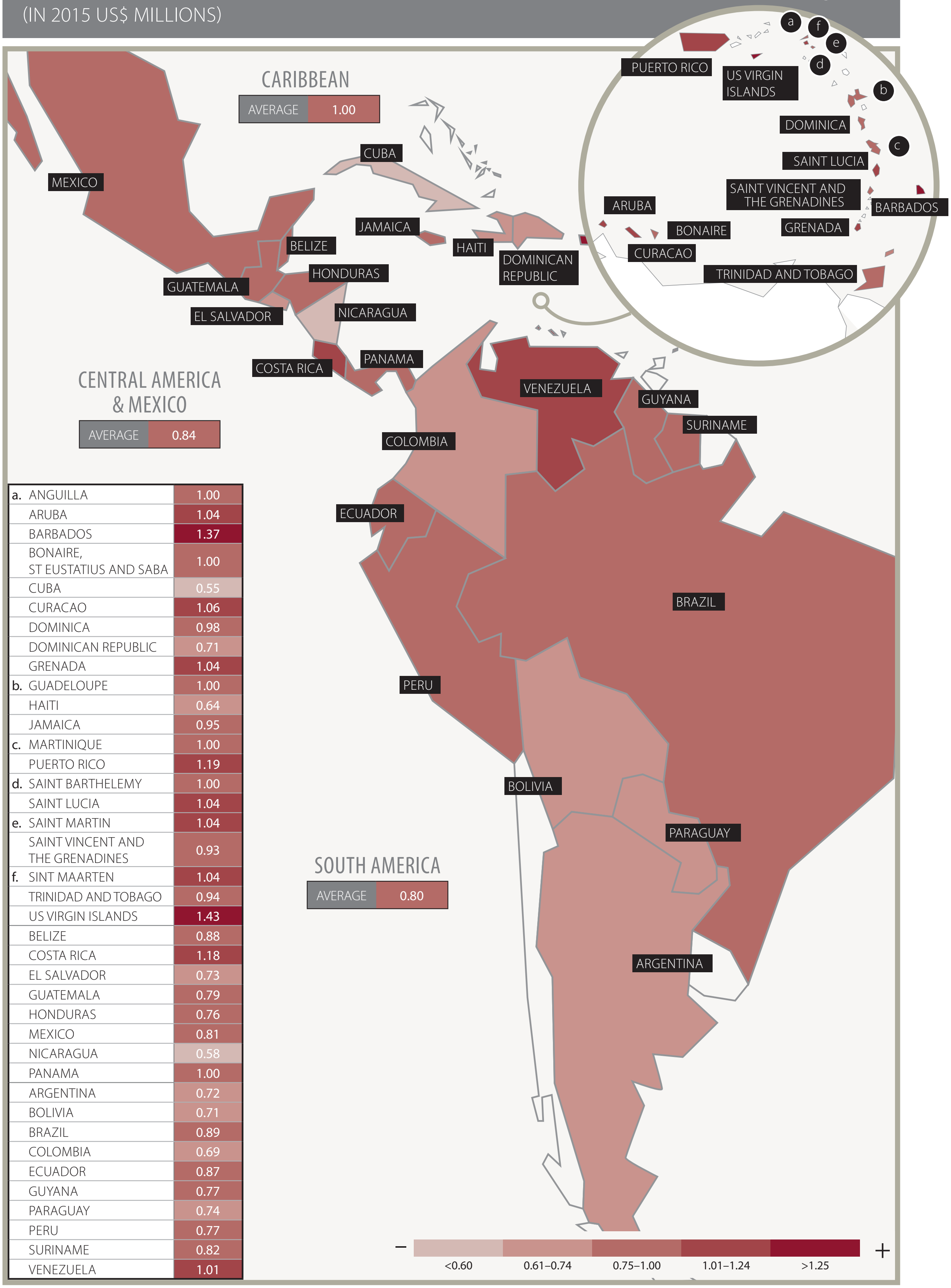
26. Clearly, the presence of a child with microcephaly will decrease the productivity of such work. Unfortunately, it is extremely difficult to attach a monetary value to different types of work in the informal sector. The best way to measure the productivity loss for any woman potentially affected by the epidemic is through the wages she could earn in the formal labour market.

27. Purchasing power parity is an adjustment made on the currency exchange rate equal to the purchasing power of each country's currency.

LIFETIME COST PER CASE OF MICROCEPHALY

(IN 2015 US$ MILLIONS)

FIGURE 10



a. ANGUILLA	1.00
ARUBA	1.04
BARBADOS	1.37
BONAIRE, ST EUSTATIUS AND SABA	1.00
CUBA	0.55
CURACAO	1.06
DOMINICA	0.98
DOMINICAN REPUBLIC	0.71
GRENADA	1.04
b. GUADELOUPE	1.00
HAITI	0.64
JAMAICA	0.95
c. MARTINIQUE	1.00
PUERTO RICO	1.19
d. SAINT BARTHELEMY	1.00
SAINT LUCIA	1.04
e. SAINT MARTIN	1.04
SAINT VINCENT AND THE GRENADINES	0.93
f. SINT MAARTEN	1.04
TRINIDAD AND TOBAGO	0.94
US VIRGIN ISLANDS	1.43
BELIZE	0.88
COSTA RICA	1.18
EL SALVADOR	0.73
GUATEMALA	0.79
HONDURAS	0.76
MEXICO	0.81
NICARAGUA	0.58
PANAMA	1.00
ARGENTINA	0.72
BOLIVIA	0.71
BRAZIL	0.89
COLOMBIA	0.69
ECUADOR	0.87
GUYANA	0.77
PARAGUAY	0.74
PERU	0.77
SURINAME	0.82
VENEZUELA	1.01

Projected number of Guillain-Barré syndrome cases

The estimation for costs of Guillain-Barré syndrome includes the following assumption.[28]

- The probability of Guillain-Barré syndrome cases among Zika-infected individuals is 1 in 4,000 [53].

The number of Guillain-Barré syndrome cases could be even higher than microcephaly cases for all sub-regions in most scenarios. There could be up to 52,000 cases of Guillain-Barré syndrome, with potentially 14,000 (medium) and 1,000 (baseline) projected in the other scenarios.

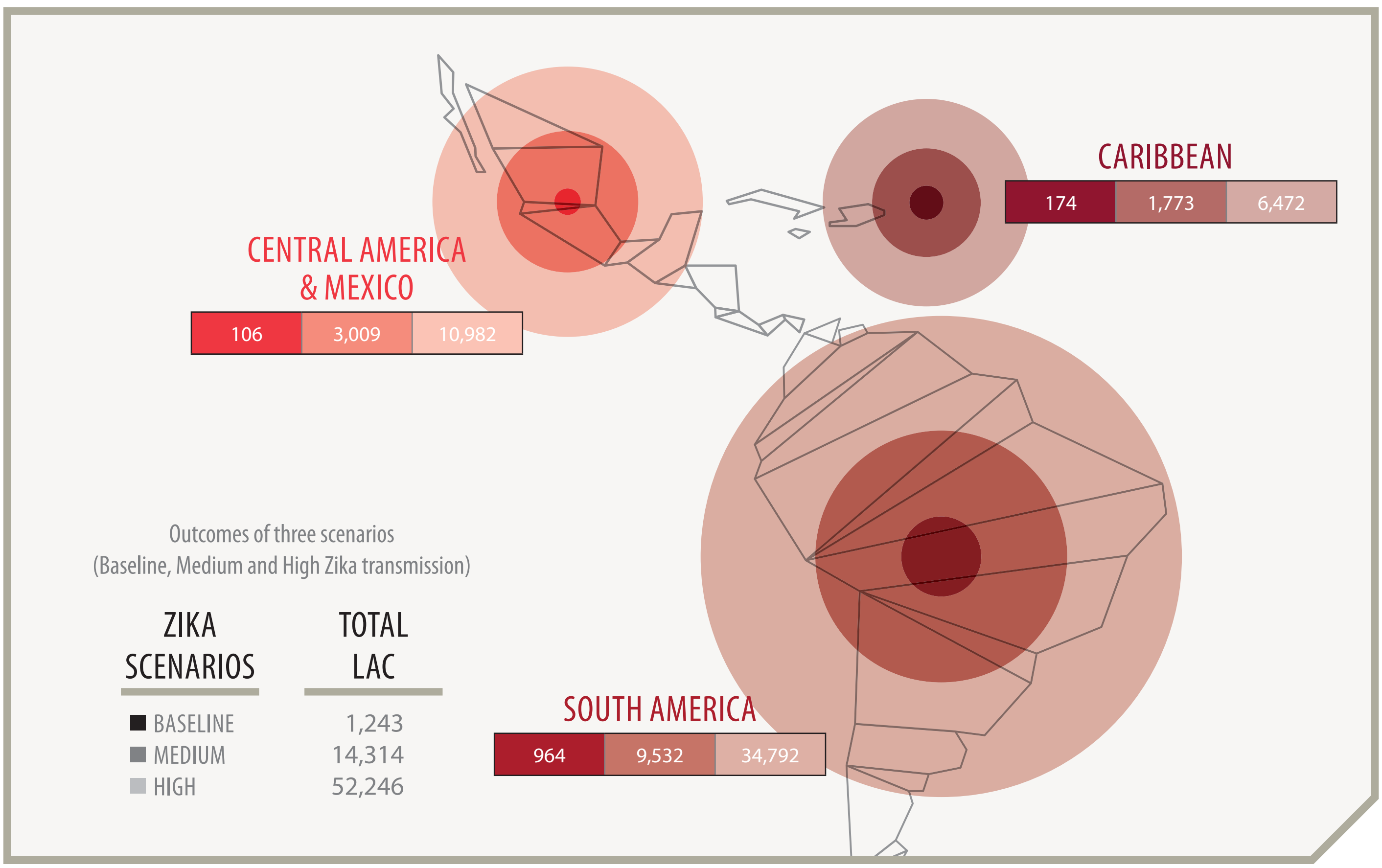
Costs of Guillain-Barré syndrome

This projection assumes that lifetime medical expenses are an estimated $56,840 and indirect expenses (inclusive of lost productivity due to increased morbidity and premature mortality) are $343,374 per Guillain-Barré syndrome case [54].

The total costs associated with Guillain-Barré syndrome amounts to about $242 million in the baseline Zika scenario, and jump to $2.7 billion in the medium Zika scenario and more than $10 billion in the high Zika scenario. As with microcephaly costs, most of these costs are incurred in South America.[29]

PROJECTED NUMBER OF GUILLAIN-BARRÉ SYNDROME CASES (2015–2017)

FIGURE 11



28. For further detail regarding the assumptions used in this estimation, please refer to Annex 1.

29. Annex 2, Tables 6A and 6B, show the estimated costs per case by country.

LIFETIME COST COMPONENTS OF GUILLAIN-BARRÉ SYNDROME (IN 2015 US$ MILLIONS)

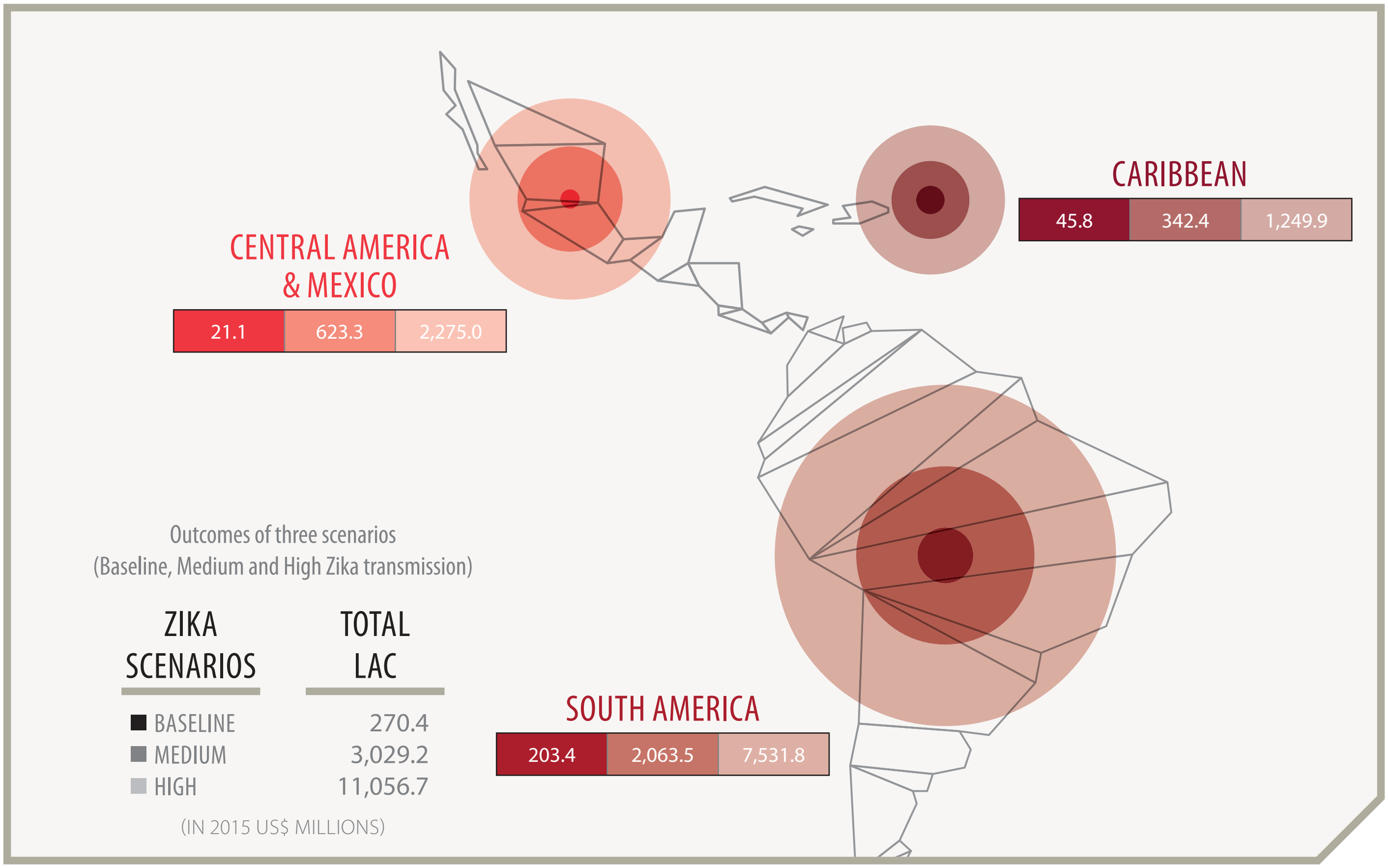
FIGURE 12

	DIRECT LIFETIME COSTS (MEDICAL CARE) OF GBS (2015 US$ MILLIONS)	INDIRECT LIFETIME COSTS (LOST PRODUCTIVITY DUE TO MORBIDITY AND PREMATURE DEATHS) OF GBS (2015 US$ MILLIONS)	**TOTAL COST OF GBS** (2015 US$ MILLIONS)
	BASELINE		
CARIBBEAN	6.5	39.3	45.8
CENTRAL AMERICA & MEXICO	3.0	18.1	21.1
SOUTH AMERICA	28.9	174.5	203.4
TOTAL LAC	**38.4**	**232.0**	**270.4**
	MEDIUM		
CARIBBEAN	48.6	293.8	342.4
CENTRAL AMERICA & MEXICO	88.5	534.8	623.3
SOUTH AMERICA	293.1	1,770.4	2,063.5
TOTAL LAC	**430.2**	**2,599.0**	**3,029.2**
	HIGH		
CARIBBEAN	177.5	1,072.4	1,249.9
CENTRAL AMERICA & MEXICO	323.1	1,951.9	2,275.0
SOUTH AMERICA	1,069.7	6,462.1	7,531.8
TOTAL LAC	**1,570.3**	**9,486.4**	**11,056.7**

LIFETIME COSTS OF GUILLAIN-BARRÉ SYNDROME

(IN 2015 US$ MILLIONS)

FIGURE 13

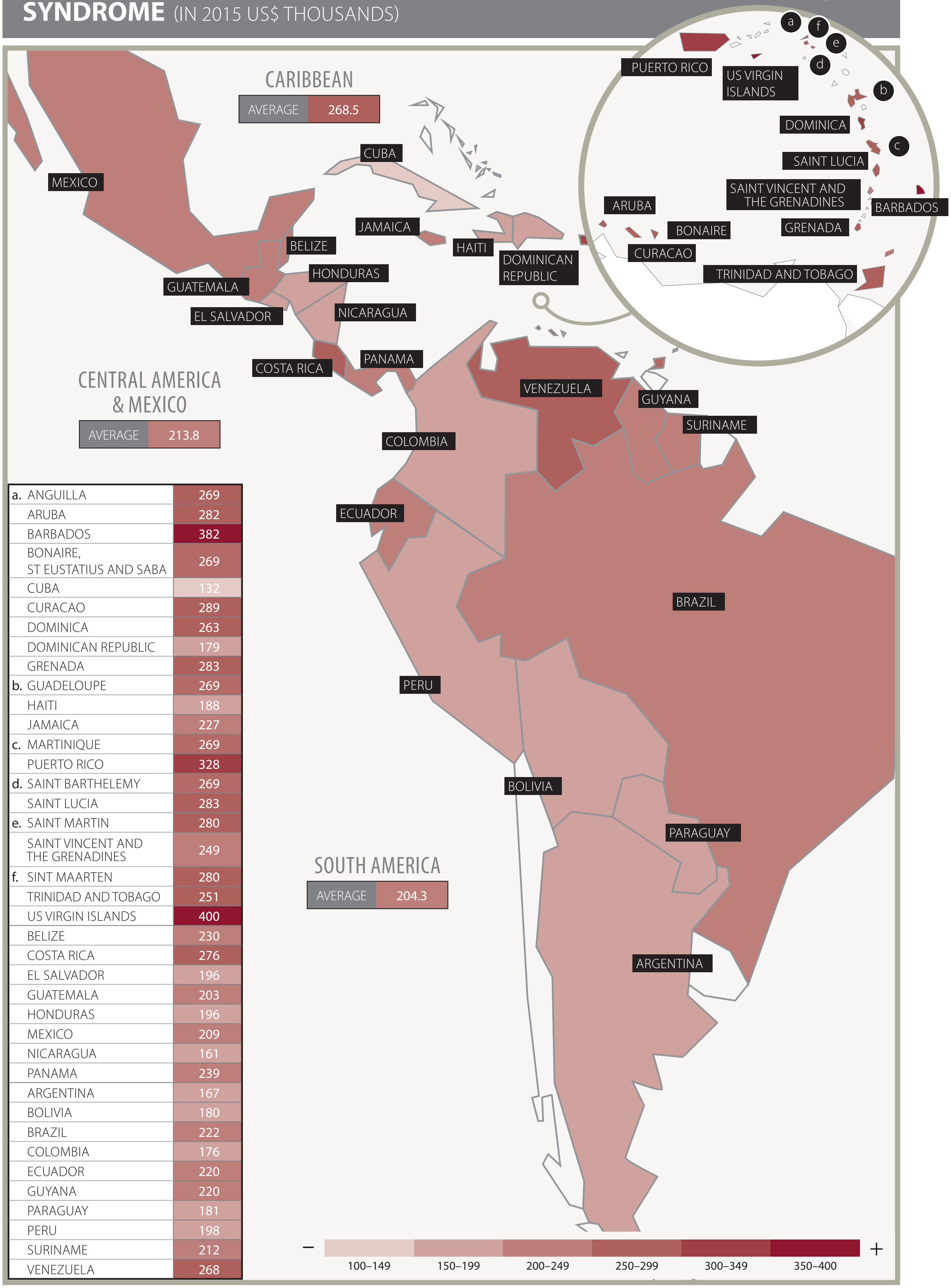


Costs per case for Guillain-Barré syndrome are in the range of $200,000–270,000, with the highest costs in the Caribbean and lowest in South America. Figure 14 displays the cost per case in each country,[30] which was calculated by applying the direct and indirect costs (explained above in assumptions) of Guillain-Barré syndrome to each country's purchasing power parity.

30. Details by country can be found in Annex 2, Table 6A.

FIGURE 14

LIFETIME COST PER CASE OF GUILLAIN-BARRÉ SYNDROME (IN 2015 US$ THOUSANDS)



a. ANGUILLA	269
ARUBA	282
BARBADOS	382
BONAIRE, ST EUSTATIUS AND SABA	269
CUBA	132
CURACAO	289
DOMINICA	263
DOMINICAN REPUBLIC	179
GRENADA	283
b. GUADELOUPE	269
HAITI	188
JAMAICA	227
c. MARTINIQUE	269
PUERTO RICO	328
d. SAINT BARTHELEMY	269
SAINT LUCIA	283
e. SAINT MARTIN	280
SAINT VINCENT AND THE GRENADINES	249
f. SINT MAARTEN	280
TRINIDAD AND TOBAGO	251
US VIRGIN ISLANDS	400
BELIZE	230
COSTA RICA	276
EL SALVADOR	196
GUATEMALA	203
HONDURAS	196
MEXICO	209
NICARAGUA	161
PANAMA	239
ARGENTINA	167
BOLIVIA	180
BRAZIL	222
COLOMBIA	176
ECUADOR	220
GUYANA	220
PARAGUAY	181
PERU	198
SURINAME	212
VENEZUELA	268

2.2 Social Impact

Health emergencies can have extensive long-term consequences that may undermine decades of social development and hard-earned health gains, weaken health systems and hinder progress towards the Sustainable Development Goals. Health crises can expose weaknesses, particularly in the health sector and broader social support infrastructure, and can deepen pre-existing inequities.

Zika is a health crisis and, as such, is predicted to exacerbate poverty, widen gender inequities, including through additional caregiving responsibilities on women and girls and the reduction in workforce participation of women, and impact the psychological wellbeing of those affected. Zika is also expected to place a strain on services and social protection systems, especially in the poorest communities where Zika is concentrated. This could create an added layer of mistrust and frustration between communities and public sector institutions if expectations are not met.

Left unaddressed, these consequences could serve to further entrench structural social and economic inequities as well as exacerbate governance challenges in the case study countries. Similar dynamics could be expected to occur in other countries throughout the region.

This section draws together excerpts from discussions with members of Zika-affected communities, including parents of children with microcephaly, front line health workers, institutional partners and civil society, and suggests that Zika could have considerable long-term social impacts, particularly for the most vulnerable. While the full extent of the social impact will likely not be apparent for some time, the qualitative research conducted in Brazil, Colombia and Suriname provides insight into potential key impacts.

2.2.1 Exacerbating poverty and inequities

Poverty, infrastructure inequality (such as in access to essential water and sanitation as well as health services) and disparities in access to information and prevention support are factors that contribute to a greater risk of disease transmission – and a heavier economic burden – for vulnerable parts of the population [25].

Interviews with professionals and Zika-affected families revealed that microcephaly cases were perceived to be more common among families of low socio-economic status. This is consistent with findings from recent studies of microcephaly in north-eastern Brazil [55], [56] which found that most reported cases occurred in low-income families, suggesting that the epidemic could contribute to widening socio-economic inequities. For instance, the majority of women in Brazil who have given birth to babies with microcephaly or other disorders associated with congenital Zika syndrome tend to be young, single, Afro-descendant, poor and live in small cities or peri-urban areas [56].

> ***"The profile of those most susceptible to Zika are young mothers, 18–24 years old, with their first child. They are of low socio-economic status. They come from the peripheries of cities. There are very few cases from the middle class. It usually affects the lower social class, which experiences financial difficulties."***
>
> **Psychologist (Colombia)**

While Latin America and the Caribbean has seen powerful results in alleviating poverty and increasing access to water and sanitation services [26], all three case study countries continue to experience a noticeable divide between rural, urban and peri-urban populations in accessing safe water and adequate sanitation sources.

In Suriname, one third of households in the rural interior do not have access to safe drinking water. Less than half of all households have access to adequate sanitation. This greatly increases their risk of water-related diseases, including mosquito-borne diseases [57].

Recife, the 'centre' of the Brazilian Zika epidemic, has a history of water-related infections that primarily affect poor neighbourhoods [58]. Deficient water supply and sanitation (including waste disposal) systems, particularly in highly populated, poor urban neighbourhoods, were pointed out among the main reasons households are routinely forced to store drinking water for domestic use, providing the ideal conditions for mosquito breeding and increasing the risk of infection.

> *“We have 33 municipalities with a lack of water service provision. Like Campina Grande; five days without water per week, with rationing. There are municipalities with water only one day a week. There is a lack of investment in water resources. In these areas, poor families live crammed into small houses. Where there is no water distribution, families have to accumulate and store it in containers during the day, enabling mosquito breeding sites.”*
>
> **Local public health officer (Brazil)**

The distribution of microcephaly, Guillain-Barré syndrome and other Zika-related poor health outcomes, and the concentration in poor communities, is an important social consequence, especially in light of the pledge of the 2030 Agenda on Sustainable Development to ‘leave no one behind.’ While it has been surmised that there could be other reasons for the high number of Zika cases in north-eastern Brazil, including co-infection with other diseases such as dengue, low yellow fever vaccination rates [56] or the north-eastern region being Zika’s entry point to Latin America and the Caribbean, it is clear that poverty has a role to play [59]. In addition, Colombia’s vast majority of Zika cases have occurred along the Caribbean coast, one of the poorest regions of the country.

Poor families are not only burdened with an excessive ex-ante risk (they are more likely to be exposed to the Zika virus), but also pay a higher cost in terms of household finances, health and quality of life [60] given that they often do not have the resources to seek adequate care and support once affected.

UNDP’s 2016 Human Development Report for Latin America and the Caribbean, *Progreso multidimensional: bienestar más allá del ingreso (Multi-dimensional progress: well-being beyond income)* [9], warns that development progress is not always linear. Protecting the achievements in the region to prevent millions from falling back into poverty requires paying critical attention to shocks and an explicit focus on populations that have historically suffered from discrimination and exclusion. The report also calls for an investment in social protection and care systems that can prevent setbacks.

The Zika virus has exposed weaknesses in existing health systems in some places, and reinforced the need to bolster or introduce new social protection instruments for affected families. Brazil has shown exemplary leadership by preparing a package of social benefits as part of the country’s conditional cash transfer programme *Bolsa Familia*. This national programme has made important strides towards reducing poverty and inequality [61], and offers families with children with microcephaly an additional payment of Brazilian Reais (BRL) 880 monthly (approximately $274). At the same time, insecticides were offered to families receiving benefits to support prevention efforts. It is unclear how long these benefits will be offered to families. Moreover, transportation and out-of-pocket costs for diagnostic tests and drugs, combined with lost income due to increased childcare responsibilities (a role usually assumed by the mother), commonly exceed this financial aid.

Macroeconomic estimations conducted for the assessment suggest relatively large (direct and indirect) care costs for children with microcephaly over their lifetime. For indirect costs, lost income due to new childcare obligations alone could represent losses of $0.5–4.8 billion for the region, depending on the scenario. In Brazil, indirect costs of microcephaly were estimated at $1,707 per month, which is around six times the added *Bolsa Familia* benefit provided to families with children with microcephaly. Respondents suggested that the brunt of these costs will be borne mainly by the affected families and hence cause enormous financial strain on low-income families, even if receiving welfare benefits, which could push them deeper into poverty.

> *“All the women [in this group] are subsidized, they do not pay for consultation and prescriptions. When the price of the drug was raised and they could not afford it, then they bought juices instead. They recognize that it has affected them financially; they have had to buy medication and juices. The price of the medication then doubled and so did the ingredients of juices. They found that those shop tenders have benefited from the epidemic.”*
>
> **Pregnant woman in community mothers’ group (Colombia)**

"We have five children, this is the fifth. I receive a family pension of BLR 400 [$125] a month [through Bolsa Familia]. That's all we have to live, because my husband can no longer work, and he has to help me because I can no longer take care of them all. We are now surviving, but it's hard. We have no support from the state or prefecture. It is enough for nothing more than food. When I worked, I used to earn around BLR 250–300 per week [$78–93 per week or approximately $312–372 per month]."

Mother of baby with microcephaly (Brazil)

2.2.2 Widening gender inequality

Countries in Latin America and the Caribbean have made considerable improvements in gender equality over the past few decades. However, the 2016 UNDP Human Development Report's Gender Inequality Index, which incorporates metrics for reproductive health, empowerment and economic activity, indicates that the three case study countries each have higher gender inequality than the regional average [62].

Because it can disrupt embryo and foetal development, Zika has specifically reopened the debate on women's sexual and reproductive health and rights. Even prior to the Zika outbreak, WHO alerted that an estimated 95 percent of the 4.4 million pregnancy terminations annually in the region are conducted in unsafe conditions, resulting in 12 percent of all maternal deaths [63]. A 2010 survey of young urban women in Brazil concluded that one in five women had received an abortion, irrespective of their religion, with a higher frequency among those with a lower level of education [64]. In this context, a rights-based response to Zika, which stresses the need to respect, protect and fulfil the human rights of all impacted by the virus, should be considered. Such an approach would include a focus on women's access to comprehensive sexual and reproductive health services including respect for women's decision-making; access to accurate and comprehensive information; access to contraception; and access to maternal health care, including family planning and prenatal diagnostic services as laid out in the Beijing Declaration and Platform for Action and the International Conference on Population and Development Programme of Action [65].

Evidence shows that requests for abortion services in Latin American countries affected by Zika have increased significantly (for example, through a web-based non-profit organization providing access to abortion medication, such as misoprostol). The reported increases in demand ranged from more than 100 percent in Brazil to 30 percent in El Salvador [66]. In countries like Brazil and Suriname, where the legal boundaries of abortion are more restrictive than in Colombia, respondents recognized the existence of clandestine or illegal terminations. Restrictive abortion policies in the region are further compounded by the fact that microcephaly and other disorders associated with congenital Zika syndrome can only be accurately detected through an ultrasound late in the second trimester or early in the third trimester, which is generally beyond the most liberal of abortion policies in the region.

"We do not know how many people are using abortion, because it is not allowed, but that does not mean it does not happen. We know of cases of abandonment or infanticide of the newborn by the mother herself, for the psychological damage. It is very sad."

Ministry of Health worker (Brazil)

"Abortion is officially illegal in Suriname. I think that is only permitted when the woman's health is in danger. But sometimes they are done unofficially. I heard that Cytotec[31] is used."

Health worker (Suriname)

With evidence indicating that women are increasingly attempting to terminate pregnancies, regardless of restrictive laws, and risking their lives and health in the process, the potential for the Zika virus to widen gender and health inequities must be acknowledged. But gender inequality could also widen because of the disproportionate demand on women and girls to serve as caregivers for family members. While this study was not able to quantify the exact number of women and girls (*vis-à-vis* boys and men) pulled out of school or the formal or informal labour force to care for a child or relative affected by Zika, in other epidemics (including HIV), evidence suggests that the burden falls disproportionately on women [67].

31. Cytotec is a brand name for misoprostol, a medication used to terminate a pregnancy.

There are persistent gender inequities in labour force participation in Latin America and the Caribbean. Women still earn less than men, are more likely to be unemployed and work in lower quality jobs. In the case study countries, female participation in the labour market is decidedly lower than their male counterparts, with Suriname having considerably lower female participation than the regional average [68]. Respondents commented on how difficult it is for working-age mothers to combine work with caring duties, causing them to withdraw from the labour force; this has a potentially negative impact on their livelihoods and may lead to permanent withdrawal from the labour market [69].

"My life stopped. I finished my studies and I wanted to take a course in college but cannot do anything. I cannot work. I see my friends work and I say [crying], 'My God, what did I do with my life?' I went and got pregnant and I'm staying still in time. I do not have someone to leave my child with, my mother cannot look after her. I would have taken advantage of life more, studied more."

Mother of baby with microcephaly (Brazil)

"I look forward to working again in the future. We want to buy a car seat for the baby, because she doesn't sit. And so we can have a little more freedom. But we do not know how much it costs. We can't make short-term plans to start paid work, and there is uncertainty about the economy in the medium term."

Mother of baby with microcephaly (Brazil)

"In our house my mother is the only bread winner. I finished my studies, I became pregnant and did not get to work. The father of the baby disappeared. At home, we only have the 'benefit' for special children, like a minimum salary [880 BLR – $275 a month]. The benefit is not enough. I have to perform miracles to pay for everything: transportation, medical tests and medication. I am waiting to have her tested for two months, my baby is already seven months and she did not have these tests. The only tests that have already been done I paid for on my own, I have not gotten anything from the SUS [Unified Health System]. Nothing. And I looked online, I complained, but nothing."

Mother of baby with microcephaly (Brazil)

Finally, there is also a need to take into consideration men's role in preventing the spread of the Zika virus and, perhaps in some cases, preventing pregnancies in areas of Zika risk. Too often, the onus is put solely on women regarding sexual and reproductive health, but men also must play an important role.

2.2.3 Increased stigma and challenges to the wellbeing of those affected

While short-term physical health needs are often prioritized during a health crisis, the impact of unaddressed psychosocial needs and social support for impacted individuals, caregivers, families and communities are often large and persist for years past the end of an emergency [70]. This may be compounded by stigma and feelings of guilt when public health and other messaging places the burden and responsibility of prevention on individuals themselves, and when the rights of persons with disabilities are not respected. Many respondents called attention to the stigma they faced.

"I do not like walking down the street. People judge me as if I got pregnant knowing that the child would be born that way. They say it's the fault of the mother for becoming pregnant in the midst of the epidemic. They say they will spend money on these children, that they will die within three to four years. Some say, as in the Bible, that these children are 'the end times' which are 'an abomination,' many things."

Mother of baby with microcephaly (Brazil)

"Precisely, when a woman receives information about preventing a pregnancy, the feeling of guilt, and responsibility, increases among those pregnant."

Red Cross psychologist (Brazil)

"People asked, 'Why did she become pregnant, why did she want to have children?' But I knew nothing of Zika at that time. I only heard about it when I was eight-months pregnant. People think that the mother has the baby while knowing the risk, but it was not the case."

Mother of baby with microcephaly (Brazil)

Respondents admitted that women from higher socio-economic status were far more responsive to public health messages directed at postponing pregnancy than were women from lower socio-economic status. The latter were not empowered enough nor did they have sufficient access to information, resources and services to enable decisions. Indeed, in the state of Pernambuco, Brazil, where the highest volume of Zika cases has been reported, the birth rate fell by approximately seven percent in 2016. However, private clinics that provide services to wealthier clientele reported a drop as high as 45 percent [71]. At the same time, given the high frequency of sexual violence and unplanned pregnancies in the region, particularly among teenagers, and the unequal access to reproductive and sexual health information and services, including due to religious obstacles, there was concern that public health messaging to delay pregnancies assumed that women would be able to understand and act on the recommendation.

"The problem about the recommendation of delaying a pregnancy is that there are many people who have no education nor means to delay it. These girls are 14–16 years old, poor, and then they become pregnant. These messages, the way they are communicated, they are targeting the middle class and do not have the desired impact on the poorest."

University professor (Brazil)

While progressive action towards universal health coverage has the potential to respond to the particular needs of children with disabilities and can strengthen social support systems for families and communities impacted by Zika, there was concern that the demand for psychological support is much greater than the existing capacity.

"Since 2008, there has been the Family Support Health Unit in Brazil. Every municipality has at least one Family Support Health Unit team. It is a recommendation from the Ministry of Health that these teams should have at least one specialist in mental health. Right now, not all the units are able to meet the high demand for psychological support. Neither can the Aloe Mae programme [a phone-based programme that follows up with pregnant women over time to reduce maternal mortality] provide enough support."

Local public health officer (Brazil)

Community involvement, including that of faith-based organizations, women's groups and other civil society organizations, was not raised by respondents, but evidence from other health epidemics has shown that involving and empowering communities can help fight stigma, strengthen health system capacity and offer support to affected families [72].

2.2.4 Exposing governance challenges

To address persistent social disparities, the health systems of both Colombia (*Sistema General de Seguridad Social en Salud*) and Brazil (*Sistema Único de Saude*) adopted decentralized, universal health care reforms in the 1990s. Both reforms have been credited for creating impressive health gains [73], such as stronger health system capacity, better access to services and reductions in regional disparities in health service access. Suriname's health system began the transition towards universal health care coverage in 2013; however, their system still provides vastly disparate coverage rates [74]. Despite gains in coverage and access to health services, widespread regional and social inequalities remain significant challenges for all three countries and the region as a whole.

"The problem in access to health services for the poorest people does not refer to access to basic services. There is a large network of obstetricians, for example, that allows all women to make prenatal and postnatal follow-up. The problem is the specialized diagnostic tests, which are not available everywhere. There is a great asymmetry between states, in terms of health technologies. The north-east region has historically been less prepared, with fewer resources."

University professor (Brazil)

The Zika virus has exposed existing inequities in the health system. It has also exposed an inability to meet the rights of children with microcephaly, required under the United Nations Convention on the Rights of Persons with Disabilities [75], such as educational, social and other support services to families. Some respondents expressed frustration at long wait times and the lack of government support. Similarly, a recent study found that some Latin Americans lack confidence in their government's ability to respond to Zika, and were unsure how it is spread [76]. Mismatches between expectations of citizens and the ability of institutions to deliver can create governance challenges.

> *Regarding medical examinations, consultations with other specialists and medicines, there is a long wait time. It is absurd. Our consultations should have some priority, because we need to attend many. The man at the health post taking appointments told me there's a long waiting list. Not only for me but also for many other mothers. I am not able to leave my child in day care because she does not move and must always be carried. And moreover, I have to take her to the doctor...every week I go several times. I go to FUNAD[32] twice a week, the paediatrician once a month, the neurologist every three months and then also to community health several times (for vaccines, etc.).*
>
> **Mother of baby with microcephaly (Brazil)**

2.3 Health System Management

This section analyses the national Zika responses of the three case study countries, by examining: surveillance systems, prevention interventions, clinical protocols, coordination and communication and private sector responses.

2.3.1 Surveillance systems

Despite health sector reforms aiming to increase health system equity, effectiveness and quality, surveillance systems in the region remain heterogeneous and often limited in some critical areas. Surveillance of the Zika epidemic has been particularly challenging for health systems in the region, as these largely rely on passive reporting of symptomatic cases from health care services, hence many symptomatic and asymptomatic cases are not captured. While surveillance systems throughout the region have limitations in representing the prevalence of Zika, they are key to determining epidemic trends.

Colombia has made commendable, concerted efforts to disaggregate data in surveillance systems by age, sex, ethnicity, municipality and type of insurance (i.e., subsidized vs. contributive schemes). As a reflection of the country's surge in microcephaly cases, Brazil's surveillance system focused more on detecting microcephaly. Although countries such as Brazil and Colombia increased their testing capacity across their network of national and state-based laboratories, the lack of easy and affordable point-of-care tests has hindered the confirmation of cases, particularly in areas with limited health capacities. An added challenge is that of specificity, especially in areas where dengue and chikungunya are known to co-circulate alongside Zika. Public health officials of one case study country admitted that they stopped reporting chikungunya cases at some point in 2016 because of their inability to distinguish chikungunya from Zika with any certainty. The analysis of case study country health systems demonstrates that countries with smaller economies often have modest laboratory capacity, usually relying on a single central laboratory, at which most of the country's surveillance and research capacity resides.

Furthermore, the resourcing of detection systems for Zika has been challenging for many countries in the region. Reporting of congenital and neurological malformations in babies requires sophisticated techniques, such as image, molecular or pathology diagnostics and trained personnel, which can be costly and not readily available in under-resourced and rural regions. The lack of trained personnel in primary and specialized health services delayed the provision of national surveillance data, particularly at the beginning of the epidemic. This was particularly challenging for Brazil, which experienced a rapid increase in Zika cases followed by an unprecedented surge of microcephaly cases, clustered in impoverished regions. Brazil's microcephaly cases represent 96 percent of all reported cases in Latin America and the Caribbean,[33] with thousands of cases still under investigation [77]. Colombia and Suriname have both reported cases of microcephaly, however in much lower numbers than Brazil.

The reasons for this clustering and varying incidence of Zika-related microcephaly remain unclear. Respondents offered their own explanations, including the utilization of different baseline measurements of congenital defects and a highly sensitive but unspecific case definition of microcephaly used at the beginning of the epidemic, resulting in an over-reporting of suspected cases. Brazil's Ministry of Health has launched

32. FUNAD is a government funded disability support centre in Pernambuco state, Brazil.
33. As of Epidemiological Bulletin of Week 36, 5-11 September 2016.

an investigation into the reasons for the clustering of microcephaly cases in the north-eastern region, where 90 percent of the country's microcephaly cases have been confirmed. Socioeconomic factors, among other hypotheses, are being investigated. The Brazilian government's effort to understand the country's epidemic is necessary and welcomed.

While the scale and timing of Zika outbreaks may have taken governments in the region by surprise, stronger and more sensitive detection systems would enable a more accurate understanding of the disease, possible co-factors for microcephaly clustering, and patterns of spread [56]. Furthermore, resourcing of detection systems is a challenge. This assessment projects that, without a strengthened response, all three case study countries will incur tangible costs due to the consequences of the Zika virus. The projected costs range between $1–2 billion (Brazil), $0.5–0.7 billion (Colombia) and $10–22 million (Suriname) in the baseline and medium Zika scenarios, corresponding to a percentage of lost GDP of 0.02–0.04 (Brazil), 0.05–0.08 (Colombia) and 0.07–1.5 (Suriname).[34] It is assumed that significant portions of these costs will be borne by state and government actors. Hence, considering the negative GDP growth in Latin America and the Caribbean (especially for Brazil) over the last two years, the Zika epidemic poses a potential obstacle to these countries' economic growth, as well as to the effectiveness of national response interventions.

2.3.2 Prevention interventions

Prevention interventions have varied in extent, quality and economic capacity across the region. Most prevention interventions focus on scaling-up of vector management strategies already in place for other mosquito-borne viruses. These include the involvement of communities to eliminate neighbourhood mosquito breeding sites, targeted fumigation and risk communication messages. Brazil increased human and financial resources to conduct vector control by mobilizing the armed forces. The effort, branded #ZikaZero, was part of a larger campaign by public health and military agencies to inspect buildings for stagnant water and eliminate potential breeding grounds.

Messages around prevention of sexual transmission from public institutions have been inconsistent. Aside from religious and cultural influences, another factor was the lack of guidance from international organizations on pregnancy management in the context of Zika virus infection, especially in the beginning of the epidemic when the evidence linking Zika and microcephaly had not been established. Guidance notes have since been updated [78] and provide additional clarity on some of the more sensitive aspects. Even so, for many international organizations, awareness campaigns have not included Zika as a sexually-transmitted disease, highlighting the need for governments to expand prevention efforts beyond vector control and risk communication to include comprehensive sexual and reproductive health services.

2.3.3 Clinical protocols

Many countries in the region have issued clinical protocols to guide health care and psychological support for those affected by Zika. This includes guidance for primary and specialized health-care services to treat the general population, pregnant women and babies with congenital defects. Brazil and Colombia have led the way in this regard. In the context of limited access to primary and specialized health care services for low-income populations, Brazil's Community Health Promotion Agents play a key role in providing information for Zika prevention and treatment to households.

> ***"The Community Health Promotion Agent is a health professional, with a salary and initial training. The agents work in collaboration with 'endemic agents' of the dengue control programme. For example, when I see a place with mosquitoes, I call the endemic agents so they can clean the area. We support that programme by visiting houses, identifying suspected cases of Zika or dengue and referring them to the Health Unit so they can be notified as cases. Our neighbourhood is among the top ten with mosquitoes and Zika cases of the municipality. There are around 40,000 inhabitants and 49 community health agents."***
>
> **Community Health Promotion Agent (Brazil)**

34. See Table 8 of Annex 2 for further details.

Brazil, in particular, with the largest number of microcephaly cases, is also expanding its coverage of more complex diagnostic exams and rehabilitation centres. However, central and local institutions face the challenge of ensuring that these policies are implemented at all levels and that frontline health workers have access to diagnostic tools and therapeutics, as well as adequate training on how to manage congenital Zika syndrome cases. Respondents agreed that psychosocial support initiatives are likewise not sufficient to address the increasing challenges.

2.3.4 Coordination and communication

In the context of considerable uncertainty, coordination and communication among stakeholders has been challenging, especially when moving from an emergency to long-term planning.

Brazil was the first country in the region to report local transmission of Zika, and the first to alert the international community of an increase in microcephaly cases. Given the uncertainty that surrounded the beginning of the epidemic, Brazil's first response was to declare a state of emergency and intensify vector control efforts. To make the matter more complex, the country was already in the public eye due to its political context and the 2016 Olympic and Paralympic Games.

"The change of government has had a serious impact on the management of the epidemic. Many public health posts have been in transition, hence no key technical advice has been provided to the Minister for decision-making. For example, the technical advisers for the malaria control programme, which has been very positive, must also manage a chikungunya, dengue and Zika response. You need a technical body which we do not have."

University professor (Brazil)

Colombia, on the other hand, had more time to prepare for a response, and hence benefited from Brazil's experience. As a result, Colombia's response incorporated the lessons learned and shared by Brazil, including geographic and health service coverage issues. A government representative echoed the importance of facilitating coordination and communication between countries in Latin America and the Caribbean:

"Brazil has provided crucial help for Colombia, we have had coordination, exchange of information and experience, at a more technical and scientific level. Colombia's experience with dengue and chikungunya has been valid for the response and the development of a system of surveillance."

Government official (Colombia)

In contrast, other countries in the region with lower Zika virus infection rates have had more modest and fragmented responses in terms of scope and resources mobilized. In some countries, both government officials and community members revealed a certain scepticism concerning the association between congenital malformations and Zika, because no microcephaly cases had been confirmed in the country at the time the interviews took place. Some stakeholders noted that there had not been an efficient risk communication strategy put in place to combat rumours.

2.3.5 Private sector responses

Considering the potential impact of Zika on businesses and tourism, the systematic lack of engagement of private sector actors in aspects of the response is a notable gap. Encouragingly, examples of innovative approaches that involve the private sector were mentioned throughout the interviews, including the development of mobile applications to monitor mosquito breeding sites and share information. However, the utility of such applications in low-income areas lacking public infrastructure was questioned by respondents.

"Among the 150 families that are under my responsibility, none of them use the mobile phone application. They do not know how to use it. Maybe the youngsters know, but they do not use it. In reality, they prefer to come to the health centre to tell us if the neighbour has a mosquito breeding site, or to tell the endemics agents, but they only pass by every three months."

Community health worker (Brazil)

The declaration of Zika as a Public Health Emergency of International Concern in February 2016 prompted several public health security measures related to international trade and travelling, such as attempts to eliminate breeding sites in goods, containers and transportation. While these are necessary precautions, the lack of coordination between countries at a global scale hindered the operation of commercial companies and led to potentially large economic losses.

> ***"[The Zika response] was a stressor and barrier for trade. [Country x] did not communicate those new measures officially; instead, they released communications and put pressure on importation companies, that in turn, communicated to [our] exporting companies. But they did it once the ships were already at sea. The economic impact was huge for the exporting company. The prolonged stay of that ship in that port waiting for these procedures to be solved has a big cost."***
>
> **Professional at a national public health agency (Colombia)**

3. Recommendations

3. Recommendations

The scale, timing and unpredictability of the Zika epidemic has, at times, overwhelmed the capacity of public infrastructure and systems of some countries in Latin America and the Caribbean, including the three case study countries of Brazil, Colombia and Suriname. Economic and social impacts include widening inequality and larger burdens on the most vulnerable populations. The extent, inclusiveness and quality of the Zika response has varied from country to country. This chapter summarizes the assessment's three main findings, providing recommendations for Latin America and the Caribbean specific to each of them.

First, the current Zika epidemic will have a long-term impact, and countries will incur high direct and indirect costs as a result.

Though some research suggests that the current Zika epidemic may end within two to three years due to 'herd immunity', another large-scale Zika epidemic is possible within the next decade, and smaller outbreaks could occur during the intervening period [35].[35] Similarly, the WHO's call [1] for a long-term planning approach to Zika responses implies that the virus will become endemic, similar to malaria, chikungunya and dengue. The magnitude of the economic impact could have significant effects on public spending. Therefore, focusing on short-term strategies only, in the context of budgetary constraints, is a tangible risk for most countries. Amid a regional economic slowdown, the implications of Zika for health spending and social protection systems are not to be regarded as a temporary emergency.

Overall, the cost of the current Zika epidemic will be an estimated $7–18 billion over three years (across the three scenarios), or $2.3–6 billion per year. This equates to an average of $1 billion cost for every five percent rise in infection rate. These costs amount to 0.05–0.12 percent of GDP per year for the whole region. The Caribbean is the most affected, with an impact five times that on South America.

The highest costs as a fraction of GDP will be felt among the poorest countries, such as Haiti and Nicaragua, where the impact could be up to 1.19 percent of GDP annually (per the high Zika scenario). Among all the countries, Aruba is the hardest hit, with at least 1.83 percent of GDP loss annually, ranging up to 2.56 percent in the high Zika scenario.

The lowest scenario costs of Zika in Latin America and the Caribbean are comparable to the cost of dengue, estimated at $2.1 billion per year on average in the Americas [35]. The absolute costs of the Zika epidemic are very high. Depending on the scenario, costs for the region range between three and eight times those of the 2009 H1N1 epidemic in Mexico [79], during which most of the impact consisted of tourism losses.

RECOMMENDATIONS

R1.

Given that Zika is likely to become endemic, budgetary plans should be established accordingly. Generalized under-investment in health emergency preparedness at the global, regional and national level leaves populations increasingly susceptible to emerging health threats. Contingency plans need to be established with extra financial resources for the potential impacts on social welfare provisions, trade, tourism and foreign direct investment. In particular, the tourism sector could be significantly impacted, as shown by the assessment's estimations and the recent seven percent decline in hotel tax revenues in Miami, USA [33]. Contingency budgetary plans should consider the role to be played by national

35. Herd immunity refers to the resistance to the spread of a contagious disease within a population. This usually occurs if a sufficiently high proportion of individuals are immune to the disease.

governments, international donors, regional mechanisms and multilateral banks, such as the Inter-American Development Bank. Furthermore, investments in health service provision must be made. Governments must provide integrated, patient-centred health services for early diagnosis, treatment and follow up for those affected by Zika. This may entail financing targeted surveillance of Zika in the most vulnerable groups, funding psychosocial support and rehabilitation services for families who have children with congenital Zika syndrome and supporting integrated services offered by a wide range of providers.

R2.

Integrate efforts aimed at multiple mosquito-borne viruses, allowing room to tailor approaches to each disease's unique effects. Dengue, chikungunya, yellow fever and Zika are all spread by the same vector, *Aedes aegypti*, which is endemic in impoverished and less developed regions. This assessment's findings highlight the importance of effectively preventing and managing the negative impacts of mosquito-borne diseases in an integrated manner, particularly targeting low-income and vulnerable populations. Given the similarities in vector management strategies for all mosquito-borne viruses, it is cost-effective to coordinate efforts against *Aedes aegypti.* Rather than joining the long list of neglected diseases, Zika needs to be counteracted specifically with other mosquito-borne diseases. PAHO-led work is underway to integrate detection, surveillance and prevention of mosquito-borne viruses. A similar approach to integrated prevention responses by governments in the region is essential. It is paramount when conducting integrated approaches to mosquito-borne diseases to consider the specific effects of each virus, such as Zika being the only one known to cause birth defects in babies.

Second, there is a profound equity challenge at the core of the Zika epidemic. The impact is disproportionate on the poorest countries of the region, as well as on the poorest and most vulnerable groups, especially poor women in peri-urban communities.

Areas of concern include the lack of adequate health and water and sanitation services as well as social protection mechanisms for those living in low-income areas. Furthermore, gender inequities were found to be cross-cutting across most social impacts. Addressing these issues is imperative to make progress towards not just public health but across the 2030 Agenda for Sustainable Development.

RECOMMENDATIONS

R3.

Put equity considerations at the forefront of Zika strategies and provide adequate social protection mechanisms for those affected. Social protection programmes and care systems must be adapted and strengthened to reach those most in need, including women, girls and persons with disabilities. Babies with microcephaly and other disabilities are at risk of abandonment by one parent (usually the father) in the first few years of life, hence it is important that parents receive the support they need to nurture their children and raise them without stigma [80]. One example is the $50 million fund established by the Jamaican Government to provide support for families of babies with Zika-related microcephaly. Adequate financial, social and educational resources and services are needed to support individuals with disabilities and their families, such as those required under the Convention on the Rights of Persons with Disabilities [75]. Another example is the added benefit distributed through *Bolsa Familia* in Brazil for parents of children with microcephaly.[36] Caregiver withdrawal from the labour force, potentially permanently, is a serious and compounding issue. Social protection systems must address education and livelihood opportunities for those negatively impacted by Zika. Other countries can draw from good examples within the region, and devise or adapt their own disability care packages.

R4.

Promote public policies that support gender equality and promote sexual and reproductive health and rights, targeting affected communities. A rights-based approach must prioritize women's access to comprehensive sexual and reproductive health services, including the following components:

36. However, some mothers reported challenges in relation to accessing the benefit as well as the limitations of the benefits package in covering costs. Furthermore, the assessment estimated that the indirect costs of microcephaly in Brazil is around six times the *Bolsa Familia* supplement.

respect for women's decision-making; access to accurate and comprehensive information; access to contraception; and access to maternal health care, including family planning and prenatal diagnostic services [65].[37] These components are critical to Zika responses, and the epidemic offers a unique opening to promote women's sexual and reproductive health and rights. As a region, Latin America and the Caribbean has the third highest teen fertility rate in the world and exhibits a slower decline in teenage pregnancies than other regions [81], hence teenage pregnancy needs to be considered in any Zika response. Furthermore, international and national institutions should update guidelines for the prevention of the sexual transmission of Zika to include sexual and reproductive health and rights, and messaging must target both men and women of different age groups, with special regard for reaching peri-urban, rural and lower-income communities. Countries wishing to adopt new strategies, for example blanket testing of all pregnant woman,[38] must simultaneously protect sexual and reproductive health and rights [82].

Third, regional and national preparedness and response strategies require strengthening and must involve communities.

This assessment demonstrated targeted efforts from some case study countries. Gaps, however, were found in detection systems, prevention efforts, resource allocation and coordination. While partners and international agencies should be ready to respond with the necessary financial and technical support, governments and local authorities will need to devise targeted strategies that address the inequitable impacts of the epidemic.

RECOMMENDATIONS

R5.

Develop a multisectoral approach to mosquito-borne diseases both nationally and regionally. The factors that shape vulnerability to mosquito-borne diseases lie largely beyond the health sector – housing, gender, socio-economic status and urban planning and resourcing, for example, all influence vulnerability [83]. When devising response strategies, national ministries of health must proactively engage with other national institutions and with a wide range of stakeholders (e.g., civil society organizations, international organizations, communities, other line ministries and the private sector). Comprehensive plans are key to establishing and maintaining flexible, updated and evidence-based risk communication channels. The positioning of health as a central, cross-governmental issue has led to the more frequent use of multisectoral action frameworks to combat disease, such as malaria [83].

Development programmes need to be an essential component of disease control [83]. A development-oriented, multisectoral approach to vector management, for instance, means that a wide range of stakeholders is engaged and that the aims of vector control are met by joint efforts and coordination. Resourcing such efforts is not simply a matter of securing cash donations; major advances can be made at little or no cost to health or Zika programmes. For example, improved sanitation is a development objective, not simply a vector control action. For the private sector, eventual additional costs should be seen as an integral part of 'doing business' in sites of Zika transmission and areas with risk of resurgence; a return on investment may be realized even in the short term.

R6.

Engage communities in the fight against Zika. The close association of the *Aedes aegypti* mosquito with humans – breeding and living in or around people's houses – implies a critical role of the community in Zika control. Unless the community actively reduces mosquito numbers, protects against bites and seeks early diagnosis, general vector control, such as insecticide spraying campaigns, will have limited effect on Zika and other mosquito-borne diseases [84].

An effective way to address mosquito-borne virus outbreaks is through community-based integrated vector management approaches. Integrated vector management is acknowledged

37. As laid out in the Beijing Declaration and Platform for Action and the International Conference on Population and Development Programme of Action.

38. Thailand's announcement to test all pregnant women in affected provinces for Zika is welcome. With a few exceptions, abortion is illegal in Thailand. The government has suggested, however, that abortion may be possible for birth defect cases linked to Zika.

as a core component of the WHO's Zika Strategic Response Plan [27] and aims to improve the efficacy, cost-effectiveness, ecological soundness and sustainability of mosquito control. It incorporates components of: (i) advocacy, risk communication for behaviour change, community engagement and legislation; (ii) collaboration within the health sector and with other sectors; (iii) integrated approach to disease control; (iv) evidence-based decision-making; and (v) capacity-building [27]. Recent studies of dengue have demonstrated that community-based, integrated control of *Aedes aegypti*, when thoroughly implemented, is able to reduce not only the mosquito density but also the transmission of the virus [85], [86], [87].

The assessment found significant gaps in national responses to Zika in terms of mobilizing community capacity and local assets in endemic and epidemic prone areas. The role of communities goes beyond controlling the mosquito and is an integral part of awareness campaigns, outreach, monitoring and care. Community mobilization is required to sustainably increase health system capacity (particularly in relation to human resources) and to realize adequate prevention and care management [88]. Furthermore, engaging the community in the Zika response can lead to stronger community partnerships, boost resilience and build leadership [88], [89]. It can also help reduce stigma. To carry out effective outreach and monitoring activities, community health workers need to be trained in communications, prevention and care approaches. The Jamaican government has adopted this approach, and pledged to train 1,000 community workers to conduct Zika community awareness and prevention activities [90].

Moreover, it may benefit countries to tackle Zika at the community level by engaging, in particular, women's groups and faith-based organizations. This has been found to be a cost-effective strategy and has led to improvements in caregiving practices, better maternal and child health and reduced mortality in rural, low-resource settings around the world (and particularly in Africa where there has been a recent increase in Zika infections) [91], [92]. Faith-based organizations and women's groups can directly provide some health-related services, support community-led networks and provide the knowledge, skills and tools needed to conduct social mobilization in their own communities [93]. The need for community engagement and mobilization is crucial in settings with limited surveillance and detection systems and low treatment capacity [94].

Conclusion

Conclusion

Given that Zika impedes efforts to tackle poverty and advance both economic and human development, addressing it requires going beyond purely health-related considerations to addressing the social and environmental factors that perpetuate it.

This assessment outlines the substantial macroeconomic costs associated with Zika, which will particularly burden smaller economies in the region. In the long-term, the costs of microcephaly and Guillain-Barré syndrome are likely to be considerable. The sizable economic costs of Zika, which are comparable to the costs of other diseases spread by the same mosquito, highlights the need to exert a concerted effort to control *Aedes aegypti* mosquito in an integrated manner. Control of *Aedes aegypti* is difficult but possible, as has previously been demonstrated with respect to urban yellow fever [95].

National responses in the region have faced several challenges, including modest capacity in surveillance and diagnostic systems, as well as long-standing disparities in health service coverage. Government agencies and public health institutions need to expand their efforts to respond to health emergencies such as Zika by broadening the scope of non-health sectors involved in the response. Re-orienting disease responses from a health sector responsibility to a broader development effort is not only crucial for the efficacy of disease programmes but particularly strategic in light of Agenda 2030 principles on cross-sectoral linkages and the growing role played by national governments in response to diseases, such as Zika. Furthermore, national responses should involve affected communities in disseminating health messages, controlling the *Aedes aegypti* mosquito through integrated vector management approaches and offering support to affected families.

Financial resources need to be made available for contingency plans, the provision of integrated health services and an integrated approach to controlling multiple mosquito-borne diseases.

Zika is affecting low-income groups and women disproportionately. Several long-term social impacts were raised by individuals, frontline health workers and families affected by microcephaly. If governments are to close the gap in access and uptake of health services for these low-income and vulnerable groups, addressing the wider issues of social inequity is essential. This will include social welfare and pro-poor fiscal planning for impact mitigation of Zika, enhanced social protection programmes, the promotion of sexual and reproductive health and rights and more effective health spending.

This assessment presents six recommendations that the governments of Latin America and the Caribbean can explore in greater detail. Such work should commence with country-specific studies and case examples to determine the exact costs and impacts of Zika at national and local levels. Among other things, this may entail exploring effective governance structures for multisectoral coordination and participation, fiscal planning for integrated mosquito-borne disease responses and developing social protection policies and initiatives for those affected by Zika. Tools also need to be developed to facilitate critical governance functions, such as planning, financing and costing in relation to Zika.

Zika reminds us that all countries and peoples remain vulnerable to emerging infectious diseases and that a disease that may primarily affect poorer populations has wide ranging social and economic implications for entire communities, regions and nations. It also provides insight into the fact that to prepare for and respond to growing infectious disease challenges, health and development goals must be addressed together. This is the crux of the Sustainable Development Goal era: an inclusive view on progress that demands that 'no one is left behind'. If we neglect protection of the rights of people with disabilities and fall short of improving daily conditions for families in poverty, do not address gender inequality, and fail to take climate change and the impact that environmental degradation has on disease vectors seriously, public health will increasingly be at risk and social and economic progress for all will remain precarious.

Annexes

Annex 1. Methods and Assumptions

Economic Modelling and Estimation

1. Overall approach

The assessment estimated the economic cost of the Zika epidemic in Latin America and the Caribbean as the sum of four main components:

1. costs of detecting, diagnosing and treating the disease;
2. lost productivity due to missed work;
3. direct and indirect costs of Guillain-Barré syndrome and microcephaly; and
4. costs associated with 'avoidance behaviour,' most notably the impact on tourism revenues.

For each cost category, total costs (in 2015 US$) were computed for the entire duration of the current epidemic, which is expected to last three years [35]. Although the exact period will vary across countries, for convenience the 2015–2017 period was considered.

This annex provides details about the methods, data and the assumptions used in the calculations of the above costs.

The next annex includes country level data. Please note that the underlying numbers are rounded to the nearest integer, hence there may be some differences in summation.

GENERAL LIMITATIONS AND CAVEATS

- There remains uncertainty in relation to the real magnitude of the Zika epidemic, due to the high proportion of asymptomatic and undiagnosed infections. Surveillance has depended completely on passive reporting of symptomatic cases from health care settings, omitting all symptomatic cases not clinically confirmed, as well as asymptomatic cases. In addition, the full extent of the effects among infected individuals, particularly those born to Zika-infected mothers, are not yet understood. As a broad range of ocular, hearing and neurological conditions are starting to emerge, termed congenital Zika syndrome, the disease's full spectrum is not completely recognized, and little is known about the incidence, growth and extent of neurological outcomes in infants with congenital Zika syndrome in the first months of life and later in life. These limitations pose significant challenges to the exercise of computing the economic cost of the epidemic, particularly in the long-term.
- There are some major data gaps that make components of the analysis difficult. Most relevant are the lack of country-specific costs associated with diagnosing and treating: those infected by Zika, those that develop complications such as Guillain-Barré syndrome, pregnant women with Zika, and infants with microcephaly or other Zika-related conditions. Systematic collection of reliable cost data across countries is needed to produce estimations with reasonable precision. In cases where country-specific data was not available, we used other comparable sources.
- The assumptions adopted were consistent with the most recent available scientific evidence at the time of writing, in November 2016. New knowledge suggests Zika causes a wider spectrum of long-term neurological conditions than initially thought (as discussed in the above point) as well as effects on human adult brain cells [96]. These and subsequent developments of the disease would undoubtedly produce changes in the computed costs.
- Possible general equilibrium effects (which could produce changes in other sectors of the economy) or interactions between different sectors of the economy are not considered in the assessment.
- The potential fertility effects are extremely difficult to estimate and were not considered in this report. These costs will likely vary substantially across countries based in part on institutional factors such as policies on sexual and reproductive health and rights. Any reduced fertility during the epidemic is most likely going to be offset by increased fertility after the epidemic. Large differences in the size of birth cohorts (abnormally smaller cohort sizes

during the epidemic, followed by larger cohorts in the years following the epidemic) are likely to pose challenges to countries' education, health care and related public sector systems.

2. Scenarios

ASSUMPTIONS AND METHODOLOGY

As mentioned above, there is still considerable uncertainty about the incidence of Zika and the full range of effects it can cause. These limitations pose formidable challenges to the exercise of computing the economic cost of the epidemic. Considering this uncertainty, three scenarios were applied to provide a broad range of possible outcomes based on previous Zika and other mosquito-borne disease epidemics.

- **Baseline Zika (current rates of infection):** this scenario assumes that the spread of the infection in each country will follow a similar pattern to the one observed over the period January 2015–July 2016, according to linear projections based on data released by each country's health authority and published in PAHO's cumulative case report on 14 July 2016 [28]. It is assumed that the epidemic will exhibit three equal-sized infection seasons and investments in vector control and prevention are such that the rate of spread of the disease does not increase. This scenario also assumes continued investments in prevention including vector control, and that country statistics reported to PAHO by the affected countries are accurate and complete (i.e., they capture all symptomatic cases).
- **Medium Zika (intermediate infection levels):** this scenario assumes that the population at risk (*) of Zika infection in the current epidemic (again assumed to last for three seasons) will be around 20 percent, or similar to that of two recent epidemics: 1) chikungunya in Puerto Rico [30]; and 2) dengue in Nicaragua [29]. This scenario also assumes that investments in vector control and prevention will be moderate and/or moderately successful.
- **High Zika (High infection levels):** this scenario assumes that the population at risk (*) of Zika infection in the current epidemic (again assumed to last for three seasons) will be around 73 percent, corresponding to the highest incidence of Zika to date in the Island of Yap [31]. Under this scenario, prevention and vector control efforts are assumed to be minimal or ineffective.

Infection rates estimated for recent outbreaks of Zika and other infectious diseases such as chikungunya and dengue fall within the bounds defined by our scenarios. The infection rate estimated for the 2013–14 Zika outbreak in French Polynesia was 66 percent [44], [97], and the overall prevalence reported for the most recent outbreak of chikungunya in Puerto Rico was 23.5 percent [30], which both lie between our medium and high scenarios.

(*) Data on the "Population at risk" are obtained from a study by Messina et al. (2016) [98], which accounts for factors affecting the environmental suitability for transmission of the virus (i.e. altitude, biogeography, climate and degree of urbanization). Information on the "population at risk" was not available for the following countries/territories, hence the average percentage of the three closest Caribbean countries with available data were used: Anguilla, Bonaire, St Eustatius and Saba, Curaçao, Saint Barthelemy, Saint Martin, Sint Maarten.

LIMITATIONS/CAVEATS

- The likelihood that a given scenario will eventuate depends on socio-geographical factors (i.e., geography, climate and urbanization); the extent and effectiveness of countermeasures put in place by governments (i.e., resources spent on vector control); and the effectiveness of communication campaigns to promote protective measures (i.e., the use of mosquito repellents or an increase is contraceptive use to avoid pregnancy).

3. Projected number of infected and symptomatic individuals (Annex 2, Table 1)

DATA, ASSUMPTIONS AND METHODOLOGY

Baseline Zika: It was assumed that the spread of the infection in each country will follow a similar pattern as seen over the period January 2015–July 2016, according to linear projections based on data released by countries' health authorities and published in PAHO's cumulative case report on 14 July 2016 [28]. Following Ferguson et al. (2016) [35], 'confirmed cases' indicate cases with laboratory confirmation, and 'suspected cases' indicate cases that were clinically diagnosed without laboratory confirmation. Based on these numbers, and the assumption that approximately 19 percent of infected individuals will be symptomatic [35], [36], we estimated the total number of infected cases as the 'number of confirmed cases' divided by 19 percent.

Medium and High Zika: The estimated number of infected individuals in the medium and high Zika scenarios are 20 percent (medium) and 73 percent (high) of the 'population at risk' in each country. The number of symptomatic individuals was estimated as 19 percent of the infected [35], [36].

LIMITATIONS/CAVEATS

- The estimates under the "baseline" scenario likely underestimate the number of infected and symptomatic individuals. This is due to two considerations: first, only a fraction of those that develop symptoms will seek medical attention, and second, reporting of suspected and confirmed cases to central health authorities in large and geographically diverse countries such as Brazil can be delayed.
- The report did not consider the possible unequal burden of Zika across different socio-economic groups within countries. In line with previous studies, in all scenarios it was assumed that the probability of infection and the displaying of symptoms were equal across socio-demographic groups [35], [36], [99]. However, some aspects of the Zika epidemic such as transmission from mother to foetus create a disproportionately large economic burden (in addition to psychological and social burdens) on women. Moreover, evidence from dengue outbreaks strongly suggests that low socio-economic status individuals are more likely to be affected [101].

4. Cost of detecting, diagnosing and treating symptomatic individuals (Annex 2, Table 2)

DATA, ASSUMPTIONS AND METHODOLOGY

Cost of testing: Based on information on the number of suspected and confirmed cases [28], as well as data from the CDC on the percentage of patients tested who are positive for the disease [37], we estimate that about 30 percent of symptomatic patients will be tested. In the absence of country-level information on the cost of tests, US test costs were used. Cost estimates have been reported to range between $120–$180 per test. The average cost of $150 per person tested was assumed and applied uniformly across all countries).

Outpatient care costs: Because Zika is a relatively mild illness in the general population [36], it is assumed that symptomatic patients will visit an outpatient care provider at most once. Some symptomatic individuals will not visit an outpatient care provider due to the mild nature of the disease. However, the potentially serious complications associated with Zika may lead others (displaying symptoms unrelated to Zika) to visit an outpatient care provider to ascertain whether they have the virus. Country-specific estimates of outpatient care costs were obtained from the WHO CHOICE database (*) [100]. Country-specific costs were converted to 2015 US$ using exchange rates from the World Bank's World Development Indicators [38]. Treatments prescribed for the symptoms include antipyretics for fever and antihistamines for rashes [36]. It was assumed that these treatments would cost $10 per person (applied uniformly across all countries).

(*) The WHO CHOICE database did not include data for the following countries/territories: Anguilla, Aruba, Bonaire, St Eustatius and Saba, Curaçao, French Guiana, Guadeloupe, Martinique, Puerto Rico, Saint Barthelemy, Saint Martin, Sint Maarten. For these countries, costs were imputed using the average of the three closest countries in the region by GDP per capita.

LIMITATIONS/CAVEATS

- The research team was unable to access any information on the cost of testing at the country level and the assessment had to rely on cost estimates from the US.
- Due to data unavailability, the medical costs associated with additional testing for pregnant women (both for suspected and confirmed cases of Zika) were not included.
- Data on current testing coverage by country are not available, making it difficult to estimate the proportion of symptomatic patients who will seek care.

5. Lost productivity due to missed work (Annex 2, Table 3)

DATA, ASSUMPTIONS AND METHODOLOGY

The clinical presentation of Zika is usually mild and consists of a self-limiting febrile illness that lasts approximately 2–7 days [31], [36]. Hence, to estimate the value of lost productivity due to absenteeism it is assumed that each symptomatic individual of working age and employed will take an average of 5 days leave of absence. Data on population aged 15–64 and employment rates for the year 2015 (*) were obtained from the World Bank's World Development Indicators [38]. Earnings data are obtained from SEDLAC (**) [39].

(*) The World Development Indicators database did not include data on working age population and/or employment rates for the following countries/territories: Anguilla, Bonaire, St Eustatius and Saba, Guadeloupe, French Guiana, Martinique, Saint Barthelemy. For these countries, the information was imputed using the average of the three closest countries by GDP per capita.

(**) Earnings data from SEDLAC data were available for the following countries (the most recent available year is indicated in parentheses): Argentina (2014), Bolivia (2014), Brazil (2014), Colombia (2014), Costa Rica (2014), Domi-nican Republic (2014), Ecuador (2014), El Salvador (2014), Guatemala (2014), Honduras (2014), Mexico (2014), Nicaragua (2014), Panama (2014), Paraguay (2014), Peru (2014), Uruguay (2014), Venezuela (2006), Belize (1999), Guyana (1992–1993), Haiti (2001), Jamaica (2002), Surinam (1999). In the absence of earnings information for the year 2015, earnings growth rates obtained from ECLAC – CEPALSTAT were applied [102]. For countries with missing earnings data (i.e., all those not included in the list above), average earnings in the three closest countries in the region by GDP per capita were used. Earnings expressed in local currency units were converted to 2015 US$.

LIMITATIONS/CAVEATS

- Earnings data for recent years are unavailable for a considerable number of countries and were thus imputed.
- The rate of infection and the probability of being symptomatic are assumed to be uniform in the population. However, if the disease disproportionally affects individuals of low socio-economic status, the impacts of lost productivity will be unevenly distributed.

6. Costs associated with Guillain-Barré syndrome and microcephaly (Annex 2, Tables 4, 5A, 5B, 6A and 6B)

DATA, ASSUMPTIONS AND METHODOLOGY

Guillain-Barré syndrome

Frequency of Guillain-Barré syndrome cases: The frequency of Guillain-Barré syndrome among Zika-infected individuals is unclear. A probability of Guillain-Barré syndrome equal to 0.024 percent (approximately 1 in 4,000 infected patients) is assumed, following reports from the Zika outbreak in French Polynesia [53].

Lifetime costs of Guillain-Barré syndrome: In the absence of country-level costs in Latin America and the Caribbean, we followed Alfaro-Murillo et al. 2016 [47] and applied cost estimates from the US. Lifetime direct (medical) expenses per case are estimated at $56,840 and indirect expenses (inclusive of lost productivity due to increased morbidity and premature mortality) at $343,374 per Guillain-Barré syndrome case [54]. For each country, US costs were multiplied by the ratio of purchasing power parity (PPP) conversion factor to the market exchange rate obtained from the World Bank's World Development Indicators. The PPP conversion factor was not available for Anguilla, Bonaire, St Eustatius and Saba, Guadeloupe, Martinique, and Saint Barthelemy. For these countries, costs were imputed using the average of the three closest countries in the region by GDP per capita.

Microcephaly

Frequency of microcephaly cases: The frequency of microcephaly cases associated with Zika infection during pregnancy remains unclear and seems to vary between outbreaks and even between (and in some cases within) countries in Latin America and the Caribbean. The assessment used a 0.95 percent probability of microcephaly due to Zika infection in the first trimester of pregnancy (implying a 0.32 probability per pregnancy) following reports from the 2013 Zika outbreak in French Polynesia [44], [45]. We adopted this assumption for all countries except Brazil, Puerto Rico and Panama in the baseline scenario, where higher rates implied by current trends were used (10.78 percent, 0.6 percent, and 2.6 percent respectively). Due to a lack of reliable statistics, we did not consider the possibility of miscarriages and stillbirths that could be associated with Zika infection. We assume that all Zika-infected pregnant women are at risk of giving birth to a baby with microcephaly, regardless of whether they develop symptoms or not [103].

In the absence of country-specific data, the number of Zika-infected pregnant women was estimated as follows: 1) the number of births per year in each country, obtained from the World Bank's World Development Indicators [38], was adjusted by the proportion of "population at risk of Zika" from Messina et al. (2016) [98]. Next, the infection rate corresponding to each scenario was applied to the adjusted number of births to give the total estimated number of Zika-infected pregnant women.

Lifetime costs of microcephaly: Following Alfaro-Murillo et al. 2016 [48], cost data for the case of intellectual disability in the United States were used; these costs are originally from Honeycutt et al. (2003) [4]. The direct costs include medical expenses and nonmedical costs. Lifetime medical expenses amount to $180,004 per case, and lifetime nonmedical expenses are estimated at $133,812 (in 2015 US$). Indirect costs include lost productivity caused by increased morbidity and premature mortality of people with microcephaly. This cost was estimated at $993,354 (again expressed here in 2015 US$) [4]. For each country, US dollar costs were multiplied by the ratio of PPP conversion factor to market exchange rate obtained from the World Bank's World Development Indicators [40].

A study in Puerto Rico estimated the lifetime direct medical and non-medical costs of Zika-associated microcephaly at $3,788,843 [49]. This is significantly lower than our estimate of direct medical and non-medical costs in Puerto Rico, at $257,150. Given that the research utilized data from private healthcare insurance systems of the United States, it is expected that the estimates would differ so greatly.

Another indirect cost of microcephaly (which is not included in the intellectual disability calculations conducted by Honeycutt et al. 2003 [4], but applied in this estimate) is the value of earnings lost due to reductions in labour force participation among parents of children with microcephaly who survive the first year of life. For this cost component, it was assumed that one parent will withdraw from the labour force, and their lost productivity was computed using average earnings. Because 20 percent of babies with microcephaly die within the first year, and 80 percent have an expected life of up to 35 years, the lost productivity for the parent was estimated as one year of lost earnings for 20 percent of the cases, and 35 years for the remaining 80 percent. See above point '5. Lost productivity' for details on data sources of labour income.

LIMITATIONS/CAVEATS

- Country-specific data on costs associated with microcephaly or Guillain-Barré syndrome are not available, and thus US cost data were used. As noted for other estimations, systematic collection of reliable country-specific cost data is needed.
- In the absence of reliable country-specific infection rates, this report assumed the same rate for all countries (except for Brazil, Puerto Rico and Panama). However, the frequency of microcephaly cases varies substantially between countries in Latin America and the Caribbean, with Brazil reporting the highest rates, ranging between 1–13 percent [45]. Moreover, the number of infants with microcephaly due to in utero infections will depend on the strength of preventive response in the affected countries, including access to contraception.
- The report concentrated on providing risk estimates for Guillain-Barré syndrome and microcephaly. However, other neurological, ocular and hearing disorders in babies with normal-sized heads have been reported, and some other effects on adults are suspected.

7. Lost tourism revenues (Annex 2, Table 7)

DATA, ASSUMPTIONS AND METHODOLOGY

- Country-specific data on revenues from international tourism for 2015 were obtained from the World Bank's World Development Indicators [38]. Data was not available for the following countries/territories: Anguilla, Bonaire, St Eustatius and Saba, Guadeloupe, Martinique, Saint Barthelemy, Saint Martin, French Guiana.
- At the time of writing, there had not been rigorous studies conducted of the causal effects of Zika on tourist flows or tourism revenues. For this report, two scenarios for the direct costs on international tourism were applied (*). The first scenario is based on a 2.9 percent decline in hotel bookings in Miami estimated by STR (2016) [41]. In a second scenario, estimates of the effects of chikungunya and dengue outbreaks on tourism revenues in Thailand and Malaysia were used [42]. The fall in tourism revenues in this case was 4 percent.

LIMITATIONS/CAVEATS

- At the time of writing, there had not been rigorous studies conducted of the causal effects of Zika on tourist flows or tourism revenues. The figures presented in this report need to be considered with caution.

(*) Effects on domestic tourism were assumed to be negligible, because many of the affected countries will be equally impacted by the virus across their territories. However, in some cases the infection affects disproportionally certain areas while leaving other areas unaffected; in such cases, there will likely be effects on domestic tourism as well.

Consultations with National Stakeholders and Key Informants

Information gathered through desk reviews and consultations conducted in the focus countries complement the macroeconomic impacts identified through modelling.

National stakeholders

Consultations were held in the three case study countries with representatives of national-level agencies (including government agencies overseeing public health, social protection, tourism and economic affairs; university researchers and other civil society institutions); and international organizations (International Federation of the Red Cross and Red Crescent Societies) and United Nations agencies, including: PAHO/WHO, UNFPA and UNICEF. Discussions with national stakeholders analysed background factors and delineated institutional responses.

Key informants

Informal key informant and group interviews were held with frontline health workers, civil society organizations, government representatives, small business owners, communities and individuals affected by the epidemic. Discussions with those affected by the disease focused on experiences, attitudes and concerns regarding the impact Zika has had on their lives, serving to contextualize and humanize the macroeconomic data.

Annex 2. Estimates of the Economic Impact at Country Level

Table 1: Projected number of Zika cases (infections and symptomatic), 2015–2017, by country and scenario

Country	Population (2015)	Population "At risk"	Projected number of Zika infected			Projected number of symptomatics		
			Baseline Zika	Medium Zika	High Zika	Baseline Zika	Medium Zika	High Zika
Anguilla	16,418	13,342	10	2,668	9,740	2	507	1,851
Aruba	103,889	58,929	215	11,786	43,018	41	2,239	8,173
Barbados	284,215	208,750	8,071	41,750	152,388	1,533	7,933	28,954
Bonaire, St Eustatius and Saba	228,693	185,851	82	37,170	135,671	16	7,062	25,778
Cuba	11,389,562	10,210,277	10	2,042,055	7,453,502	2	387,991	1,416,165
Curacao	158,040	128,434	2,130	25,687	93,757	405	4,880	17,814
Dominica	72,680	46,866	6,842	9,373	34,212	1,300	1,781	6,500
Dominican Republic	10,528,391	8,675,705	39,656	1,735,141	6,333,265	7,535	329,677	1,203,320
Grenada	106,825	90,638	20	18,128	66,166	4	3,444	12,571
Guadeloupe	468,450	340,374	231,148	68,075	248,473	43,918	12,934	47,210
Haiti	10,711,067	9,128,822	21,815	1,825,764	6,664,040	4,145	346,895	1,266,168
Jamaica	2,725,941	2,467,882	25,605	493,576	1,801,554	4,865	93,780	342,295
Martinique	396,874	325,657	337,693	65,131	237,730	64,162	12,375	45,169
Puerto Rico	3,474,182	3,406,551	22,143	681,310	2,486,782	4,207	129,449	472,489
Saint Barthelemy	7,267	5,906	2,898	1,181	4,311	551	224	819
Saint Lucia	184,999	184,250	3,267	36,850	134,503	621	7,002	25,555
Saint Martin	31,754	25,805	16,592	5,161	18,838	3,152	981	3,579
Saint Vincent and the Grenadines	109,462	110,160	82	22,032	80,417	16	4,186	15,279
Sint Maarten	38,817	31,545	256	6,309	23,028	49	1,199	4,375
Trinidad and Tobago	1,360,088	1,243,344	850	248,669	907,641	162	47,247	172,452
US Virgin Islands	103,574	49,622	4,343	9,924	36,224	825	1,886	6,883
Total Caribbean	**42,501,188**	**36,938,711**	**723,728**	**7,387,742**	**26,965,259**	**137,508**	**1,403,671**	**5,123,399**
Belize	359,287	305,843	51	61,169	223,265	10	11,622	42,420
Costa Rica	4,807,850	3,566,735	9,771	713,347	2,603,717	1,856	135,536	494,706
El Salvador	6,126,583	6,286,668	110,673	1,257,334	4,589,268	21,028	238,893	871,961
Guatemala	16,342,897	5,844,765	23,157	1,168,953	4,266,678	4,400	222,101	810,669
Honduras	8,075,060	5,932,218	269,585	1,186,444	4,330,519	51,221	225,424	822,799
Mexico	127,017,224	32,219,350	8,050	6,443,870	23,520,126	1,530	1,224,335	4,468,824
Nicaragua	6,082,032	5,347,533	3,943	1,069,507	3,903,699	749	203,206	741,703
Panama	3,929,141	3,178,895	15,434	635,779	2,320,593	2,933	120,798	440,913
Total Central America & Mexico	**172,740,074**	**62,682,007**	**440,665**	**12,536,401**	**45,757,865**	**83,726**	**2,381,916**	**8,693,994**

Country	Population (2015)	Population "At risk"	Projected number of Zika infected			Projected number of symptomatics		
			Baseline Zika	Medium Zika	High Zika	Baseline Zika	Medium Zika	High Zika
Argentina	43,416,755	5,310,322	17,718	1,062,064	3,876,535	3,366	201,792	736,542
Bolivia	10,724,705	2,811,572	1,290	562,314	2,052,448	245	106,840	389,965
Brazil	207,847,528	120,650,969	2,310,063	24,130,194	88,075,207	438,912	4,584,737	16,734,289
Colombia	48,228,704	29,541,853	998,414	5,908,371	21,565,553	189,699	1,122,590	4,097,455
Ecuador	16,144,363	7,007,980	24,888	1,401,596	5,115,825	4,729	266,303	972,007
French Guiana	250,377	221,282	96,816	44,256	161,536	18,395	8,409	30,692
Guyana	767,085	575,566	61	115,113	420,163	12	21,872	79,831
Paraguay	6,639,123	5,550,561	2,898	1,110,112	4,051,910	551	210,921	769,863
Peru	31,376,670	4,143,292	840	828,658	3,024,603	160	157,445	574,675
Suriname	542,975	555,975	34,474	111,195	405,862	6,550	21,127	77,114
Venezuela	31,108,083	22,215,781	527,628	4,443,156	16,217,520	100,249	844,200	3,081,329
Total South America	**397,046,368**	**198,585,153**	**4,015,091**	**39,717,031**	**144,967,162**	**762,867**	**7,546,236**	**27,543,761**
Total LAC	**612,287,630**	**298,205,871**	**5,179,483**	**59,641,174**	**217,690,286**	**984,102**	**11,331,823**	**41,361,154**

NOTES:

Data on total population are from the World Development Indicators [38]. Data on the "Population at risk" are from Messina et al. (2016), who account for factors affecting the environmental suitability for transmission of the virus (e.g. elevation, biogeography, climate and urbanization) [98]. Information on the "population at risk" was not available for the following countries/ territories: Anguilla, Bonaire, St Eustatius and Saba, Curacao, Saint Barthelemy, Saint Martin, Sint Maarten. We used the average percentage of the three closest countries in the region.

See Annex 1: ***Methods and Assumptions, Section 3*** for details on assumptions, data sources and calculations.

Table 2: Cost of diagnosing and treating symptomatic patients

Country	Cost of diagnosing the disease and treating symptomatic patients Total for 2015–17 (in 2015 US$)			Annual cost of diagnosing the disease and treating symptomatic patients, as % of GDP		
	Baseline Zika	Medium Zika	High Zika	Baseline Zika	Medium Zika	High Zika
Anguilla*	122	31,661	115,564	0.000	0.003	0.012
Aruba*	2,552	139,838	510,408	0.000	0.002	0.007
Barbados	110,769	573,020	2,091,523	0.001	0.004	0.016
Bonaire, St Eustatius and Saba*	972	441,022	1,609,732	0.000	0.027	0.100
Cuba	123	24,595,883	89,774,974	0.000	0.011	0.039
Curacao*	25,276	304,772	1,112,417	0.000	0.003	0.012
Dominica	81,217	111,271	406,140	0.005	0.007	0.025
Dominican Republic	461,568	20,195,670	73,714,197	0.000	0.010	0.037
Grenada	249	219,932	802,753	0.000	0.007	0.027
Guadeloupe*	2,742,551	807,703	2,948,115	0.010	0.003	0.010
Haiti	232,755	19,479,902	71,101,642	0.001	0.073	0.267
Jamaica	303,796	5,856,249	21,375,310	0.001	0.014	0.051
Martinique*	4,006,708	772,780	2,820,645	0.014	0.003	0.010
Puerto Rico*	262,723	8,083,698	29,505,497	0.000	0.003	0.010
Saint Barthelemy*	34,390	14,014	51,151	0.004	0.002	0.007
Saint Lucia	38,921	438,994	1,602,328	0.001	0.010	0.037
Saint Martin*	196,860	61,236	223,511	0.011	0.003	0.012
Saint Vincent and the Grenadines	968	260,211	949,770	0.000	0.012	0.042
Sint Maarten*	3,038	74,857	273,226	0.000	0.003	0.011
Trinidad and Tobago	12,547	3,670,247	13,396,402	0.000	0.004	0.016
US Virgin Islands	87,392	199,725	728,995	0.001	0.003	0.012
Total Caribbean	**8,605,495**	**86,332,685**	**315,114,301**	**0.001**	**0.009**	**0.031**
Belize	596	712,210	2,599,566	0.000	0.013	0.049
Costa Rica	118,073	8,620,356	31,464,300	0.000	0.006	0.021
El Salvador	1,262,704	14,345,309	52,360,377	0.002	0.018	0.068
Guatemala	260,428	13,146,384	47,984,303	0.000	0.007	0.025
Honduras	2,965,348	13,050,488	47,634,281	0.005	0.022	0.079
Mexico	103,825	83,109,104	303,348,231	0.000	0.002	0.009
Nicaragua	42,540	11,538,458	42,115,370	0.000	0.030	0.111
Panama	187,032	7,704,255	28,120,533	0.000	0.005	0.018
Total Central America & Mexico	**4,940,546**	**152,226,565**	**555,626,962**	**0.000**	**0.004**	**0.014**

Country	Cost of diagnosing the disease and treating symptomatic patients Total for 2015–17 (in 2015 US$)			Annual cost of diagnosing the disease and treating symptomatic patients, as % of GDP		
	Baseline Zika	**Medium Zika**	**High Zika**	**Baseline Zika**	**Medium Zika**	**High Zika**
Argentina	220,300	13,205,082	48,198,550	0.000	0.001	0.003
Bolivia	14,114	6,150,016	22,447,557	0.000	0.006	0.023
Brazil	25,178,187	263,003,428	959,962,511	0.000	0.005	0.018
Colombia	13,031,345	77,116,348	281,474,672	0.001	0.009	0.032
Ecuador	286,291	16,123,063	58,849,181	0.000	0.005	0.019
French Guiana*	1,148,714	525,099	1,916,612	0.008	0.004	0.013
Guyana	670	1,254,659	4,579,506	0.000	0.013	0.048
Paraguay	32,482	12,440,561	45,408,048	0.000	0.015	0.055
Peru	9,749	9,618,951	35,109,170	0.000	0.002	0.006
Suriname	413,642	1,334,194	4,869,809	0.003	0.009	0.033
Venezuela	6,942,865	58,465,893	213,400,509	0.001	0.005	0.019
Total South America	**47,278,358**	**459,237,295**	**1,676,216,126**	**0.0005**	**0.0046**	**0.0167**
Total LAC	**60,824,399**	**697,796,545**	**2,546,957,389**	**0.0004**	**0.0046**	**0.0168**

NOTES:

Country-specific outpatient care costs were from the WHO CHOICE database [100]. Country-specific costs were converted to 2015 US$ using exchange rates from the World Bank's World Development Indicators [38]. For the countries indicated with * in the table, the WHO CHOICE dataset did not include cost information, and the average in the three closest countries by GDP per capita was used.

See Annex 1: ***Methods and Assumptions, Section 4*** for details on assumptions, data sources and calculations.

Table 3: Value of lost productivity from absenteeism due to Zika

Country	Lost productivity, total 2015–17 (in 2015 US$)			Lost productivity, annual % of GDP		
	Baseline Zika	Medium Zika	High Zika	Baseline Zika	Medium Zika	High Zika
Anguilla*	68	17,839	65,112	0.000	0.002	0.007
Aruba*	1,522	83,408	304,441	0.000	0.001	0.004
Barbados*	57,239	296,103	1,080,778	0.000	0.002	0.008
Bonaire, St Eustatius &Saba*	548	248,486	906,973	0.000	0.015	0.057
Cuba*	67	13,322,784	48,628,161	0.000	0.006	0.021
Curacao*	14,363	173,190	632,144	0.000	0.002	0.007
Dominica*	45,736	62,660	228,711	0.003	0.004	0.014
Dominican Republic	235,401	10,299,847	37,594,441	0.000	0.005	0.019
Grenada*	138	122,546	447,291	0.000	0.004	0.015
Guadeloupe*	1,545,238	455,085	1,661,059	0.005	0.002	0.006
Haiti	35,464	2,968,094	10,833,544	0.000	0.011	0.041
Jamaica	282,822	5,451,935	19,899,564	0.001	0.013	0.047
Martinique*	2,257,503	435,408	1,589,239	0.008	0.002	0.006
Puerto Rico*	92,326	2,840,769	10,368,806	0.000	0.001	0.003
Saint Barthelemy*	19,376	7,896	28,820	0.003	0.001	0.004
Saint Lucia*	22,592	254,818	930,087	0.001	0.006	0.022
Saint Martin*	110,917	34,502	125,933	0.006	0.002	0.007
Sint Maarten*	569	152,939	558,226	0.000	0.007	0.025
St Vincent and the Grenadines	1,712	42,176	153,944	0.000	0.002	0.006
Trinidad and Tobago*	6,220	1,819,658	6,641,751	0.000	0.002	0.008
US Virgin Islands*	27,444	62,721	228,932	0.000	0.001	0.004
Total Caribbean	**4,757,267**	**39,152,865**	**142,907,956**	**0.000**	**0.004**	**0.014**
Belize*	349	417,195	1,522,762	0.000	0.008	0.029
Costa Rica	149,847	10,940,125	39,931,456	0.000	0.007	0.026
El Salvador	547,300	6,217,762	22,694,830	0.001	0.008	0.029
Guatemala	158,640	8,008,146	29,229,731	0.000	0.004	0.015
Honduras	1,742,985	7,670,871	27,998,679	0.003	0.013	0.046
Mexico	54,334	43,493,221	158,750,256	0.000	0.001	0.005
Nicaragua	11,644	3,158,251	11,527,615	0.000	0.008	0.030
Panama	197,142	8,120,728	29,640,658	0.000	0.005	0.019
Total Central America & Mexico	**2,862,242**	**88,026,298**	**321,295,988**	**0.000**	**0.002**	**0.008**

Country	Lost productivity, total 2015–17 (in 2015 US$)			Lost productivity, annual % of GDP		
	Baseline Zika	Medium Zika	High Zika	Baseline Zika	Medium Zika	High Zika
Argentina	155,784	9,337,928	34,083,437	0.000	0.001	0.002
Bolivia	9,325	4,063,506	14,831,797	0.000	0.004	0.015
Brazil	24,093,783	251,676,089	918,617,723	0.000	0.005	0.017
Colombia	6,652,984	39,370,749	143,703,234	0.001	0.004	0.016
Ecuador	225,933	12,723,860	46,442,088	0.000	0.004	0.015
French Guiana*	700,370	320,152	1,168,556	0.005	0.002	0.008
Guyana	177	330,773	1,207,320	0.000	0.003	0.013
Paraguay	25,520	9,774,161	35,675,688	0.000	0.012	0.043
Peru	6,790	6,699,638	24,453,678	0.000	0.001	0.004
Suriname*	217,212	700,614	2,557,241	0.001	0.005	0.017
Venezuela*	3,800,075	32,000,445	116,801,625	0.000	0.003	0.010
Total South America	**35,887,953**	**366,997,914**	**1,339,542,388**	**0.000**	**0.004**	**0.013**
Total LAC	**43,507,461**	**494,177,077**	**1,803,746,332**	**0.000**	**0.003**	**0.012**

NOTES:

Calculations are based on earnings data from SEDLAC [39] and ECLAC – CEPALSTAT [102]. For countries with missing recent earnings data (indicated with * in the table), average earnings in the three closest countries by GDP per capita in the region were used.

See Annex 1: ***Methods and Assumptions, Section 5*** for details on assumptions, data sources and calculations.

Table 4: Projected number of babies with microcephaly and number of Guillain-Barré syndrome cases

Country	Projected number of babies born to Zika-infected mothers (2015–17)			Projected number of babies born with microcephaly (2015–17)			Projected number of GBS cases (2015–17)		
	Baseline Zika	Medium Zika	High Zika	Baseline Zika	Medium Zika	High Zika	Baseline Zika	Medium Zika	High Zika
Anguilla	0	102	371	0	0	1	0	1	2
Aruba	2	358	1,307	0	1	4	0	3	10
Barbados	111	1,515	5,531	0	5	18	2	10	37
Bonaire, St Eustatius and Saba	2	1,648	6,016	0	5	19	0	9	33
Cuba	0	62,769	229,106	0	199	726	0	490	1,789
Curacao	34	971	3,544	0	3	11	1	6	23
Dominica	106	437	1,594	0	1	5	2	2	8
Dominican Republic	1,051	108,549	396,203	3	344	1,255	10	416	1,520
Grenada	1	1,044	3,812	0	3	12	0	4	16
Guadeloupe	3,897	3,074	11,219	12	10	36	55	16	60
Haiti	715	136,664	498,823	2	433	1,580	5	438	1,599
Jamaica	484	20,049	73,179	2	63	232	6	118	432
Martinique	5,870	2,685	9,799	19	9	31	81	16	57
Puerto Rico	325	19,826	72,365	2	63	229	5	164	597
Saint Barthelemy	46	45	164	0	0	1	1	0	1
Saint Lucia	76	1,677	6,120	0	5	19	1	9	32
Saint Martin	326	243	887	1	1	3	4	1	5
Saint Vincent and the Grenadines	2	1,053	3,845	0	3	12	0	5	19
Sint Maarten	4	246	898	0	1	3	0	2	6
Trinidad and Tobago	17	10,668	38,938	0	34	123	0	60	218
United States Virgin Islands	34	313	1,141	0	1	4	1	2	9
Total Caribbean	**13,100**	**373,935**	**1,364,862**	**42**	**1,184**	**4,322**	**174**	**1,773**	**6,472**
Belize	2	4,208	15,360	0	13	49	0	15	54
Costa Rica	165	31,604	115,355	1	100	365	2	171	625
El Salvador	2,954	63,645	232,306	9	202	736	27	302	1,101
Guatemala	346	95,078	347,035	1	301	1,099	6	281	1,024
Honduras	6,474	75,468	275,460	21	239	872	65	285	1,039
Mexico	59	363,241	1,325,829	0	1,150	4,198	2	1,547	5,645
Nicaragua	109	65,293	238,321	0	207	755	1	257	937
Panama	374	37,016	135,107	10	117	428	4	153	557
Total Central America & Mexico	**10,482**	**735,554**	**2,684,773**	**42**	**2,329**	**8,502**	**106**	**3,009**	**10,982**

Country	Projected number of babies born to Zika-infected mothers (2015–17)			Projected number of babies born with microcephaly (2015–17)			Projected number of GBS cases (2015–17)		
	Baseline Zika	Medium Zika	High Zika	Baseline Zika	Medium Zika	High Zika	Baseline Zika	Medium Zika	High Zika
Argentina	59	55,899	204,030	0	177	646	4	255	930
Bolivia	12	40,311	147,136	0	128	466	0	135	493
Brazil	30,445	1,066,096	3,891,251	3,283	3,376	12,322	554	5,791	21,138
Colombia	14,871	279,578	1,020,460	47	885	3,231	240	1,418	5,176
Ecuador	346	87,380	318,936	1	277	1,010	6	336	1,228
French Guiana	2,902	2,921	10,661	9	9	34	23	11	39
Guyana	1	6,584	24,031	0	21	76	0	28	101
Paraguay	80	71,163	259,744	0	225	823	1	266	972
Peru	3	49,506	180,696	0	157	572	0	199	726
Suriname	967	5,928	21,638	3	19	69	8	27	97
Venezuela	11,360	260,671	951,449	36	825	3,013	127	1,066	3,892
Total South America	**61,047**	**1,926,036**	**7,030,033**	**3,380**	**6,099**	**22,262**	**964**	**9,532**	**34,792**
Total LAC	**84,630**	**3,035,525**	**11,079,668**	**3,464**	**9,612**	**35,086**	**1,243**	**14,314**	**52,246**

NOTES:

See Annex 1: ***Methods and Assumptions, Section 6*** for details on assumptions, data sources and calculations.

Table 5A: Per-case lifetime costs of microcephaly

Country	(1) Direct medical costs per case (in 2015 US$)	(2) Direct non-medical costs per case (in 2015 US$)	(3) Indirect costs per case (in 2015 US$)	Total cost per case (1+2+3)
Anguilla**	120,769	89,777	787,221	997,767
Aruba*	126,719	94,200	820,024	1,040,942
Barbados*	171,985	127,850	1,069,575	1,369,411
Bonaire, St Eustatius and Saba**	120,769	89,777	787,221	997,767
Cuba*	59,401	44,158	448,906	552,465
Curacao*	129,943	96,597	837,799	1,064,338
Dominica*	118,098	87,791	772,496	978,384
Dominican Republic	80,727	60,010	566,122	706,859
Grenada*	127,109	94,490	822,175	1,043,774
Guadeloupe**	120,769	89,777	787,221	997,767
Haiti	84,662	62,936	497,297	644,895
Jamaica	102,050	75,862	775,249	953,162
Martinique**	120,769	89,777	787,221	997,767
Puerto Rico*	147,501	109,649	934,595	1,191,744
Saint Barthelemy**	120,769	89,777	787,221	997,767
Saint Lucia*	127,163	94,530	822,470	1,044,163
Saint Martin*	126,003	93,668	816,077	1,035,748
Saint Vincent and the Grenadines*	112,036	83,285	739,081	934,403
Sint Maarten*	126,003	93,668	816,077	1,035,748
Trinidad and Tobago*	112,895	83,924	743,816	940,635
United States Virgin Islands*	180,004	133,811	1,113,783	1,427,598
Total Caribbean (average)	**120,769**	**89,777**	**787,221**	**997,767**
Belize*	103,586	77,003	701,957	882,547
Costa Rica	124,203	92,330	959,516	1,176,048
El Salvador	88,293	65,635	579,851	733,778
Guatemala	91,173	67,776	629,164	788,112
Honduras	88,351	65,678	607,388	761,416
Mexico	93,867	69,778	641,948	805,594
Nicaragua	72,383	53,808	452,819	579,010
Panama	107,620	80,002	816,243	1,003,865
Total Central America & Mexico (average)	**96,184**	**71,501**	**673,611**	**841,296**

Country	(1) Direct medical costs per case (in 2015 US$)	(2) Direct non-medical costs per case (in 2015 US$)	(3) Indirect costs per case (in 2015 US$)	Total cost per case (1+2+3)
Argentina	75,215	55,913	590,072	721,200
Bolivia	80,974	60,195	565,776	706,945
Brazil	100,068	74,389	717,040	891,497
Colombia	78,990	58,720	549,354	687,065
Ecuador	98,759	73,415	697,838	870,012
Guyana	98,974	73,575	602,388	774,936
Paraguay	81,542	60,617	595,740	737,900
Peru	88,850	66,049	610,532	765,432
Suriname*	95,294	70,839	656,750	822,883
Venezuela*	120,582	89,638	796,164	1,006,384
Total South America (average)	**91,925**	**68,335**	**638,165**	**798,425**
LAC (average)	**108,003**	**80,287**	**724,078**	**912,367**

NOTES:

Direct costs include (A) medical costs and (B) non-medical costs; indirect costs include (C) the lost productivity due to increased morbidity and premature mortality of individuals with microcephaly, and (D) the lost productivity due to care giving parent withdrawing from the labor force. For costs A, B and C, given the absence of country-specific costs, following Alfaro Murillo et al. 2016 [47], cost data for the case of intellectual disability in the USA were used; these costs are originally from Honeycutt et al. 2003 [4]. For (D), country-specific market earnings were used as proxy for the value of time devoted by parents to care for children with microcephaly. * indicates that recent earnings data were missing and that average earnings in the region were used. ** indicates average costs in the region were used due to missing data.

See Annex 1: ***Methods and Assumptions, Section 6*** for details on assumptions, data sources and calculations.

Table 5B: Total lifetime costs of microcephaly (table 1 of 3: Baseline Zika)

Country	Baseline Zika				
	Direct medical costs	Direct non-medical costs	Lost productivity due to increased morbidity and premature mortality	Lost productivity due to caregiving parent withdrawing from the labour force	Total cost (in 2015 USD)
Anguilla	62	46	343	63	514
Aruba	764	568	4,212	732	6,277
Barbados	60,212	44,760	331,944	42,512	479,428
Bonaire, St Eustatius and Saba	580	431	3,199	583	4,794
Cuba	27	20	150	56	254
Curacao	13,838	10,287	76,288	12,931	113,343
Dominica	39,500	29,364	217,764	40,615	327,243
Dominican Republic	268,555	199,638	1,480,533	402,798	2,351,525
Grenada	207	154	1,142	198	1,701
Guadeloupe	1,490,274	1,107,837	8,215,815	1,498,425	12,312,351
Haiti	191,738	142,534	1,057,046	69,205	1,460,523
Jamaica	156,369	116,241	862,056	325,839	1,460,506
Martinique	2,244,730	1,668,682	12,375,094	2,257,007	18,545,513
Puerto Rico	287,029	213,371	1,582,376	236,295	2,319,070
Saint Barthelemy	17,637	13,111	97,233	17,734	145,714
Saint Lucia	30,640	22,777	168,916	29,258	251,591
Saint Martin	130,220	96,803	717,897	125,493	1,070,413
Saint Vincent and the Grenadines	719	534	3,963	779	5,995
Sint Maarten	1,664	1,237	9,173	1,604	13,678
Trinidad and Tobago	6,125	4,553	33,765	6,588	51,030
United States Virgin Islands	19,197	14,271	105,832	12,950	152,249
Total Caribbean	**4,960,087**	**3,687,219**	**27,344,740**	**5,081,665**	**41,073,711**
Belize	506	376	2,787	639	4,307
Costa Rica	64,907	48,250	357,829	143,603	614,589
El Salvador	825,957	613,998	4,553,463	870,898	6,864,316
Guatemala	99,939	74,292	550,959	138,699	863,889
Honduras	1,811,204	1,346,409	9,985,085	2,466,469	15,609,167
Mexico	17,583	13,071	96,933	23,314	150,900
Nicaragua	24,931	18,533	137,443	18,521	199,428
Panama	1,047,116	778,403	5,772,701	2,169,119	9,767,339
Total Central America & Mexico	**3,892,141**	**2,893,332**	**21,457,200**	**5,831,263**	**34,073,936**

Country	Baseline Zika				
	Direct medical costs	Direct non-medical costs	Lost productivity due to increased morbidity and premature mortality	Lost productivity due to caregiving parent withdrawing from the labour force	Total cost (in 2015 USD)
Argentina	13,961	10,378	76,966	32,559	133,864
Bolivia	3,196	2,376	17,618	4,711	27,901
Brazil	328,505,015	244,203,376	1,811,033,450	542,873,214	2,926,615,055
Colombia	3,719,843	2,765,249	20,507,326	5,363,028	32,355,445
Ecuador	108,241	80,464	596,728	168,109	953,542
Guyana	425	316	2,342	244	3,326
Paraguay	20,612	15,323	113,636	36,957	186,528
Peru	958	712	5,281	1,301	8,253
Suriname	291,842	216,949	1,608,912	402,422	2,520,125
Venezuela	4,337,820	3,224,639	23,914,207	4,727,012	36,203,678
Total South America	**337,001,912**	**250,519,782**	**1,857,876,466**	**553,609,556**	**2,999,007,716**
Total LAC	**345,854,140**	**257,100,333**	**1,906,678,405**	**564,522,483**	**3,074,155,363**

NOTES:

See Annex 1: ***Methods and Assumptions, Section 6*** for details on assumptions, data sources and calculations.

Table 5B: Total lifetime costs of microcephaly (table 2 of 3: Medium Zika)

Country	Medium Zika				
	Direct medical costs	Direct non-medical costs	Lost productivity due to increased morbidity and premature mortality	Lost productivity due to caregiving parent withdrawing from the labour force	Total cost (in 2015 US$)
Anguilla	38,820	28,858	214,015	39,033	320,726
Aruba	143,640	106,779	791,881	137,644	1,179,944
Barbados	825,248	613,471	4,549,556	582,662	6,570,938
Bonaire, St Eustatius and Saba	630,301	468,552	3,474,820	633,748	5,207,420
Cuba	11,807,055	8,777,104	65,091,764	24,136,184	109,812,107
Curacao	399,537	297,007	2,202,627	373,359	3,272,530
Dominica	163,314	121,404	900,343	167,921	1,352,983
Dominican Republic	27,748,784	20,627,833	152,977,805	41,619,572	242,973,995
Grenada	420,392	312,510	2,317,602	401,607	3,452,111
Guadeloupe	1,175,441	873,797	6,480,152	1,181,870	9,711,259
Haiti	36,639,204	27,236,775	201,990,292	13,224,352	279,090,624
Jamaica	6,479,046	4,816,380	35,718,692	13,500,914	60,515,032
Martinique	1,026,727	763,246	5,660,300	1,032,343	8,482,616
Puerto Rico	9,260,505	6,884,055	51,052,750	7,623,657	74,820,967
Saint Barthelemy	17,210	12,793	94,878	17,304	142,185
Saint Lucia	675,225	501,947	3,722,485	644,781	5,544,439
Saint Martin	96,994	72,103	534,723	93,473	797,294
Saint Vincent and the Grenadines	373,750	277,837	2,060,465	405,083	3,117,135
Sint Maarten	98,177	72,983	541,248	94,614	807,022
Trinidad and Tobago	3,813,789	2,835,086	21,025,247	4,102,080	31,776,201
United States Virgin Islands	178,197	132,467	982,390	120,210	1,413,264
Total Caribbean	**102,011,355**	**75,832,989**	**562,384,034**	**110,132,413**	**850,360,791**
Belize	1,380,427	1,026,179	7,610,232	1,744,337	11,761,175
Costa Rica	12,430,179	9,240,321	68,527,020	27,501,054	117,698,573
El Salvador	17,794,848	13,228,297	98,102,201	18,763,095	147,888,441
Guatemala	27,450,287	20,405,938	151,332,207	38,096,505	237,284,937
Honduras	21,114,352	15,695,944	116,402,481	28,753,200	181,965,976
Mexico	107,971,495	80,263,626	595,242,020	143,167,354	926,644,494
Nicaragua	14,966,120	11,125,483	82,507,551	11,118,362	119,717,517
Panama	12,614,849	9,377,600	69,545,096	26,131,888	117,669,432
Total Central America & Mexico	**215,722,557**	**160,363,387**	**1,189,268,806**	**295,275,795**	**1,860,630,545**

Country	Medium Zika				
	Direct medical costs	Direct non-medical costs	Lost productivity due to increased morbidity and premature mortality	Lost productivity due to caregiving parent withdrawing from the labour force	Total cost (in 2015 US$)
Argentina	13,313,986	9,897,323	73,399,407	31,050,448	127,661,163
Bolivia	10,336,555	7,683,967	56,984,968	15,237,595	90,243,086
Brazil	337,827,384	251,133,420	1,862,427,257	558,278,959	3,009,667,021
Colombia	69,932,719	51,986,439	385,535,949	100,824,457	608,279,564
Ecuador	27,326,898	20,314,213	150,651,967	42,441,369	240,734,448
Guyana	2,063,502	1,533,961	11,375,992	1,183,207	16,156,661
Paraguay	18,375,457	13,659,909	101,303,071	32,946,006	166,284,443
Peru	13,928,905	10,354,441	76,789,431	18,922,466	119,995,243
Suriname	1,788,946	1,329,863	9,862,379	2,466,783	15,447,971
Venezuela	99,535,451	73,992,457	548,734,489	108,465,834	830,728,231
Total South America	**594,429,802**	**441,885,993**	**3,277,064,911**	**911,817,124**	**5,225,197,830**
Total LAC	**912,163,714**	**678,082,369**	**5,028,717,751**	**1,317,225,332**	**7,936,189,166**

NOTES:
See Annex 1: ***Methods and Assumptions, Section 6*** for details on assumptions, data sources and calculations.

Table 5B: Total lifetime costs of microcephaly (table 3 of 3: High Zika)

Country	High Zika				
	Direct medical costs	Direct non-medical costs	Lost productivity due to increased morbidity and premature mortality	Lost productivity due to caregiving parent withdrawing from the labour force	Total cost (in 2015 US$)
Anguilla	141,694	105,333	781,155	142,469	1,170,652
Aruba	524,286	389,743	2,890,366	502,401	4,306,797
Barbados	3,012,156	2,239,170	16,605,880	2,126,717	23,983,922
Bonaire, St Eustatius and Saba	2,300,598	1,710,213	12,683,091	2,313,181	19,007,083
Cuba	43,095,749	32,036,429	237,584,939	88,097,072	400,814,189
Curacao	1,458,308	1,084,074	8,039,589	1,362,761	11,944,733
Dominica	596,097	443,125	3,286,253	612,913	4,938,388
Dominican Republic	101,283,062	75,291,592	558,368,988	151,911,438	886,855,080
Grenada	1,534,431	1,140,662	8,459,248	1,465,866	12,600,207
Guadeloupe	4,290,358	3,189,358	23,652,554	4,313,825	35,446,095
Haiti	133,733,094	99,414,230	737,264,567	48,268,885	1,018,680,776
Jamaica	23,648,518	17,579,787	130,373,225	49,278,338	220,879,868
Martinique	3,747,554	2,785,849	20,660,095	3,768,051	30,961,548
Puerto Rico	33,800,843	25,126,801	186,342,537	27,826,349	273,096,530
Saint Barthelemy	62,816	46,696	346,303	63,160	518,976
Saint Lucia	2,464,571	1,832,108	13,587,070	2,353,452	20,237,202
Saint Martin	354,028	263,176	1,951,740	341,177	2,910,121
Saint Vincent and the Grenadines	1,364,186	1,014,106	7,520,697	1,478,555	11,377,544
Sint Maarten	358,348	266,388	1,975,555	345,341	2,945,631
Trinidad and Tobago	13,920,329	10,348,065	76,742,151	14,972,590	115,983,135
United States Virgin Islands	650,417	483,506	3,585,722	438,766	5,158,412
Total Caribbean	**372,341,444**	**276,790,410**	**2,052,701,725**	**401,983,307**	**3,103,816,887**
Belize	5,038,558	3,745,553	27,777,346	6,366,832	42,928,289
Costa Rica	45,370,153	33,727,170	250,123,621	100,378,847	429,599,791
El Salvador	64,951,195	48,283,285	358,073,033	68,485,297	539,792,810
Guatemala	100,193,549	74,481,673	552,362,555	139,052,243	866,090,019
Honduras	77,067,387	57,290,194	424,869,054	104,949,179	664,175,814
Mexico	394,095,955	292,962,234	2,172,633,373	522,560,842	3,382,252,403
Nicaragua	54,626,339	40,608,014	301,152,561	40,582,022	436,968,936
Panama	46,044,197	34,228,240	253,839,599	95,381,390	429,493,426
Total Central America & Mexico	**787,387,333**	**585,326,361**	**4,340,831,143**	**1,077,756,652**	**6,791,301,488**

Country	High Zika				
	Direct medical costs	Direct non-medical costs	Lost productivity due to increased morbidity and premature mortality	Lost productivity due to caregiving parent withdrawing from the labour force	Total cost (in 2015 US$)
Argentina	48,596,047	36,125,229	267,907,836	113,334,134	465,963,246
Bolivia	37,728,428	28,046,480	207,995,134	55,617,222	329,387,263
Brazil	1,233,069,952	916,636,982	6,797,859,489	2,037,718,202	10,985,284,625
Colombia	255,254,423	189,750,503	1,407,206,215	368,009,267	2,220,220,408
Ecuador	99,743,178	74,146,877	549,879,680	154,910,998	878,680,733
Guyana	7,531,781	5,598,959	41,522,369	4,318,704	58,971,813
Paraguay	67,070,417	49,858,668	369,756,210	120,252,921	606,938,216
Peru	50,840,504	37,793,708	280,281,424	69,067,001	437,982,638
Suriname	6,529,653	4,854,000	35,997,684	9,003,759	56,385,095
Venezuela	363,304,396	270,072,468	2,002,880,884	395,900,294	3,032,158,042
Total South America	**2,169,668,779**	**1,612,883,875**	**11,961,286,924**	**3,328,132,502**	**19,071,972,079**
Total LAC	**3,329,397,556**	**2,475,000,646**	**18,354,819,792**	**4,807,872,461**	**28,967,090,455**

NOTES:
See Annex 1: ***Methods and Assumptions, Section 6*** for details on assumptions, data sources and calculations.

Table 6A: Per-case lifetime costs of Guillain-Barré syndrome

Country	(1) Direct medical costs per GBS case	(2) Indirect costs per GBS case	Total costs (1+2) per GBS case (in 2015 US$)
Anguilla**	38,134	230,367	268,501
Aruba	40,014	241,727	281,742
Barbados	54,282	327,922	382,204
Bonaire, St Eustatius and Saba**	38,134	230,367	268,501
Cuba	18,757	113,313	132,071
Curacao	41,032	247,878	288,910
Dominica	37,292	225,282	262,573
Dominican Republic	25,491	153,993	179,485
Grenada	40,137	242,472	282,609
Guadeloupe**	38,134	230,367	268,501
Haiti	26,734	161,501	188,235
Jamaica	32,225	194,670	226,895
Martinique**	38,134	230,367	268,501
Puerto Rico	46,576	281,371	327,948
Saint Barthelemy**	38,134	230,367	268,501
Saint Lucia	40,154	242,574	282,728
Saint Martin	39,788	240,362	280,150
Saint Vincent and the Grenadines	35,378	213,720	249,098
Sint Maarten	39,788	240,362	280,150
Trinidad and Tobago	35,649	215,358	251,007
United States Virgin Islands	56,840	343,374	400,214
Total Caribbean (average)	**38,134**	**230,367**	**268,501**
Belize	32,709	197,599	230,309
Costa Rica	39,220	236,928	276,148
El Salvador	27,880	168,426	196,307
Guatemala	28,790	173,920	202,710
Honduras	27,899	168,537	196,435
Mexico	29,640	179,059	208,700
Nicaragua	22,856	138,078	160,934
Panama	33,983	205,295	239,279
Total Central America & Mexico (average)	**30,372**	**183,480**	**213,853**

Country	(1) Direct medical costs per GBS case	(2) Indirect costs per GBS case	Total costs (1+2) per GBS case (in 2015 US$)
Argentina	23,751	143,480	167,230
Bolivia	25,569	154,466	180,035
Brazil	31,599	190,889	222,488
Colombia	24,943	150,682	175,624
Ecuador	31,185	188,392	219,577
Guyana	31,253	188,801	220,054
Paraguay	25,749	155,550	181,298
Peru	28,056	169,490	197,547
Suriname	30,091	181,781	211,872
Venezuela	38,076	230,021	268,097
Total South America (average)	**29,027**	**175,355**	**204,382**
LAC (average)	**34,103**	**206,020**	**240,123**

NOTES:

Cost estimates from the USA were used. Lifetime medical expenses per case are estimated at $56,840 and indirect expenses at $343,374 per GBS case; these figures are originally from Frenzen 2004 [54]. For each country, USA costs were multiplied by the ratio of PPP conversion factor to market exchange rate obtained from the World Bank's World Development Indicators [38].
** indicates average costs in the region were used due to missing data.

See Annex 1: ***Methods and Assumptions, Section 6*** for details on assumptions, data sources and calculations.

Table 6B: Total lifetime costs of Guillain-Barré syndrome (table 1 of 3: Baseline Zika)

Country	Baseline Zika		
	Direct medical costs	Indirect costs	Total costs (2015 US$)
Anguilla	94	566	660
Aruba	2,065	12,478	14,543
Barbados	105,141	635,163	740,304
Bonaire, St Eustatius and Saba	750	4,530	5,280
Cuba	46	279	325
Curacao	20,979	126,733	147,712
Dominica	61,232	369,906	431,137
Dominican Republic	242,612	1,465,636	1,708,248
Grenada	197	1,192	1,389
Guadeloupe	2,115,478	12,779,738	14,895,216
Haiti	139,968	845,557	985,526
Jamaica	198,023	1,196,267	1,394,290
Martinique	3,090,591	18,670,455	21,761,047
Puerto Rico	247,520	1,495,284	1,742,804
Saint Barthelemy	26,527	160,249	186,776
Saint Lucia	31,485	190,206	221,691
Saint Martin	158,437	957,125	1,115,562
Saint Vincent and the Grenadines	696	4,203	4,898
Sint Maarten	2,445	14,770	17,215
Trinidad and Tobago	7,273	43,937	51,210
United States Virgin Islands	59,239	357,867	417,106
Total Caribbean	**6,510,798**	**39,332,141**	**45,842,939**
Belize	402	2,429	2,831
Costa Rica	91,969	555,589	647,557
El Salvador	740,543	4,473,666	5,214,209
Guatemala	160,002	966,582	1,126,585
Honduras	1,805,049	10,904,413	12,709,462
Mexico	57,266	345,946	403,212
Nicaragua	21,630	130,669	152,299
Panama	125,883	760,468	886,351
Total Central America & Mexico	**3,002,743**	**18,139,761**	**21,142,505**

Country	Baseline Zika		
	Direct medical costs	Indirect costs	Total costs (2015 US$)
Argentina	100,998	610,133	711,131
Bolivia	7,919	47,840	55,759
Brazil	17,518,752	105,831,876	123,350,628
Colombia	5,976,796	36,106,200	42,082,996
Ecuador	186,270	1,125,272	1,311,542
Guyana	461	2,784	3,245
Paraguay	17,911	108,204	126,116
Peru	5,655	34,162	39,817
Suriname	248,965	1,504,014	1,752,979
Venezuela	4,821,625	29,127,741	33,949,366
Total South America	**28,885,353**	**174,498,227**	**203,383,579**
Total LAC	**38,398,895**	**231,970,129**	**270,369,023**

NOTES:
See Annex 1: ***Methods and Assumptions, Section 6*** for details on assumptions, data sources and calculations.

Table 6B: Total lifetime costs of Guillain-Barré syndrome (table 2 of 3: Medium Zika)

Country	Medium Zika		
	Direct medical costs	Indirect costs	Total costs (2015 US$)
Anguilla	24,422	147,535	171,957
Aruba	113,183	683,748	796,932
Barbados	543,908	3,285,780	3,829,688
Bonaire, St Eustatius and Saba	340,185	2,055,076	2,395,261
Cuba	9,192,778	55,534,147	64,726,925
Curacao	252,956	1,528,125	1,781,081
Dominica	83,890	506,787	590,677
Dominican Republic	10,615,366	64,128,089	74,743,455
Grenada	174,622	1,054,904	1,229,526
Guadeloupe	623,025	3,763,733	4,386,758
Haiti	11,714,335	70,767,029	82,481,363
Jamaica	3,817,262	23,060,318	26,877,580
Martinique	596,087	3,600,998	4,197,085
Puerto Rico	7,615,922	46,008,262	53,624,184
Saint Barthelemy	10,810	65,303	76,112
Saint Lucia	355,124	2,145,325	2,500,449
Saint Martin	49,284	297,727	347,011
Saint Vincent and the Grenadines	187,067	1,130,082	1,317,148
Sint Maarten	60,246	363,950	424,196
Trinidad and Tobago	2,127,552	12,852,674	14,980,226
United States Virgin Islands	135,385	817,867	953,252
Total Caribbean	**48,633,407**	**293,797,459**	**342,430,866**
Belize	480,189	2,900,851	3,381,040
Costa Rica	6,714,524	40,562,861	47,277,385
El Salvador	8,413,150	50,824,365	59,237,515
Guatemala	8,076,903	48,793,079	56,869,983
Honduras	7,944,014	47,990,286	55,934,300
Mexico	45,839,712	276,920,573	322,760,285
Nicaragua	5,866,842	35,441,958	41,308,799
Panama	5,185,411	31,325,393	36,510,804
Total Central America & Mexico	**88,520,745**	**534,759,366**	**623,280,111**

Country	Medium Zika		
	Direct medical costs	Indirect costs	Total costs (2015 US$)
Argentina	6,053,953	36,572,307	42,626,259
Bolivia	3,450,724	20,846,038	24,296,761
Brazil	182,995,375	1,105,486,521	1,288,481,896
Colombia	35,369,234	213,667,760	249,036,994
Ecuador	10,490,192	63,371,908	73,862,100
Guyana	863,431	5,216,039	6,079,470
Paraguay	6,860,153	41,442,616	48,302,769
Peru	5,579,792	33,707,874	39,287,667
Suriname	803,031	4,851,162	5,654,193
Venezuela	40,602,924	245,284,807	285,887,730
Total South America	**293,068,809**	**1,770,447,031**	**2,063,515,840**
Total LAC	**430,222,961**	**2,599,003,856**	**3,029,226,817**

NOTES:
See Annex 1: ***Methods and Assumptions, Section 6*** for details on assumptions, data sources and calculations.

Table 6B: Total lifetime costs of Guillain-Barré syndrome (table 3 of 3: High Zika)

Country	High Zika		
	Direct medical costs	Indirect costs	Total costs (2015 US$)
Anguilla	89,140	538,503	627,644
Aruba	413,120	2,495,681	2,908,801
Barbados	1,985,263	11,993,098	13,978,360
Bonaire, St Eustatius and Saba	1,241,674	7,501,029	8,742,702
Cuba	33,553,640	202,699,638	236,253,278
Curacao	923,291	5,577,656	6,500,946
Dominica	306,200	1,849,771	2,155,971
Dominican Republic	38,746,085	234,067,527	272,813,612
Grenada	637,371	3,850,400	4,487,772
Guadeloupe	2,274,041	13,737,626	16,011,667
Haiti	42,757,321	258,299,655	301,056,976
Jamaica	13,933,006	84,170,162	98,103,168
Martinique	2,175,717	13,143,642	15,319,359
Puerto Rico	27,798,115	167,930,155	195,728,271
Saint Barthelemy	39,456	238,354	277,810
Saint Lucia	1,296,202	7,830,436	9,126,637
Saint Martin	179,886	1,086,702	1,266,588
Saint Vincent and the Grenadines	682,793	4,124,798	4,807,592
Sint Maarten	219,898	1,328,416	1,548,314
Trinidad and Tobago	7,765,564	46,912,259	54,677,823
United States Virgin Islands	494,154	2,985,216	3,479,370
Total Caribbean	**177,511,936**	**1,072,360,725**	**1,249,872,661**
Belize	1,752,689	10,588,106	12,340,796
Costa Rica	24,508,013	148,054,443	172,562,456
El Salvador	30,707,997	185,508,932	216,216,929
Guatemala	29,480,698	178,094,740	207,575,438
Honduras	28,995,651	175,164,545	204,160,197
Mexico	167,314,950	1,010,760,091	1,178,075,040
Nicaragua	21,413,972	129,363,145	150,777,117
Panama	18,926,750	114,337,683	133,264,433
Total Central America & Mexico	**323,100,720**	**1,951,871,686**	**2,274,972,406**

Country	High Zika		
	Direct medical costs	Indirect costs	Total costs (2015 US$)
Argentina	22,096,927	133,488,919	155,585,846
Bolivia	12,595,141	76,088,038	88,683,179
Brazil	667,933,118	4,035,025,802	4,702,958,920
Colombia	129,097,705	779,887,322	908,985,027
Ecuador	38,289,202	231,307,465	269,596,666
Guyana	3,151,522	19,038,544	22,190,067
Paraguay	25,039,559	151,265,547	176,305,106
Peru	20,366,242	123,033,742	143,399,984
Suriname	2,931,064	17,706,740	20,637,804
Venezuela	148,200,672	895,289,544	1,043,490,216
Total South America	**1,069,701,153**	**6,462,131,662**	**7,531,832,815**
Total LAC	**1 570 313 809**	**9 486 364 073**	**11 056 677 882**

NOTES:
See Annex 1: ***Methods and Assumptions, Section 6*** for details on assumptions, data sources and calculations.

Table 7: Direct losses from decreased international tourism revenue

Country	Scenario 1: Tourism receipts drop by 2.9%		Scenario 2: Tourism receipts drop by 4%	
	3-year loss (in 2015 US$)	Annual loss, % of GDP	3-year loss (in 2015 US$)	Annual loss, % of GDP
Aruba	141,975,300	1.83	195,828,000	2.53
Barbados	86,304,000	0.65	119,040,000	0.89
Cuba	221,502,000	0.10	305,520,000	0.13
Curacao	70,644,000	0.76	97,440,000	1.05
Dominica	10,962,000	0.68	15,120,000	0.94
Dominican Republic	490,419,000	0.24	676,440,000	0.34
Grenada	10,440,000	0.36	14,400,000	0.49
Haiti	50,286,000	0.19	69,360,000	0.26
Jamaica	196,185,000	0.47	270,600,000	0.64
Puerto Rico	299,106,000	0.10	412,560,000	0.13
Saint Lucia	30,798,000	0.71	42,480,000	0.99
Saint Vincent and the Grenadines	8,004,000	0.36	11,040,000	0.49
Sint Maarten	80,910,000	3.39	111,600,000	4.68
United States Virgin Islands	107,184,000	1.79	147,840,000	2.47
Total Caribbean	**1,804,719,300**	**0.21**	**2,489,268,000**	**0.29**
Belize	33,060,000	0.63	45,600,000	0.86
Costa Rica	256,998,000	0.17	354,480,000	0.23
El Salvador	111,795,000	0.14	154,200,000	0.20
Guatemala	136,068,000	0.07	187,680,000	0.10
Honduras	55,854,000	0.09	77,040,000	0.13
Mexico	1,444,809,000	0.04	1,992,840,000	0.06
Nicaragua	38,715,000	0.10	53,400,000	0.14
Panama	477,630,000	0.31	658,800,000	0.42
Total Central America & Mexico	**2,554,929,000**	**0.06**	**3,524,040,000**	**0.09**

Country	Scenario 1: Tourism receipts drop by 2.9%		Scenario 2: Tourism receipts drop by 4%	
	3-year loss (in 2015 US$)	Annual loss, % of GDP	3-year loss (in 2015 US$)	Annual loss, % of GDP
Argentina	453,966,000	0.03	626,160,000	0.04
Bolivia	64,032,000	0.06	88,320,000	0.09
Brazil	644,061,000	0.01	888,360,000	0.02
Colombia	425,169,000	0.05	586,440,000	0.07
Ecuador	129,369,000	0.04	178,440,000	0.06
Guyana	6,873,000	0.07	9,480,000	0.10
Paraguay	27,318,000	0.03	37,680,000	0.05
Peru	333,297,000	0.06	459,720,000	0.08
Suriname	8,961,000	0.06	12,360,000	0.08
Venezuela	80,562,000	0.01	111,120,000	0.01
Total South America	**2,173,608,000**	**0.02**	**2,998,080,000**	**0.03**
Total LAC	**6,533,256,300**	**0.04**	**9,011,388,000**	**0.06**

NOTES:

Data on revenues from international tourism at the country level for 2015 were obtained from the World Bank's World Development Indicators [38]. Data was not available for the following countries/territories: Anguilla, Bonaire, St Eustatius &Saba, Guadeloupe, Martinique, Saint Barthelemy, Saint Martin, French Guiana.

See Annex 1: ***Methods and Assumptions, Section 7*** for details on assumptions, data sources and calculations.

Table 8: Total projected costs of the current Zika epidemic

Country	Total short-term cost 2015–2017 (in 2015 US$)			Total short-term cost Annual as % of GDP		
	Baseline Zika	Medium Zika	High Zika	Baseline Zika	Medium Zika	High Zika
Anguilla*#	366	111,382	406,546	0.00	0.01	0.04
Aruba*	141,982,821	142,459,071	197,593,762	1.83	1.84	2.55
Barbados*	86,661,162	88,502,284	127,063,738	0.65	0.66	0.95
Bonaire, St Eustatius &Saba*#	2,987	1,614,911	5,894,424	0.00	0.10	0.37
Cuba*	221,502,277	281,778,519	525,529,293	0.10	0.12	0.23
Curacao*	70,722,897	71,758,681	101,508,584	0.76	0.77	1.09
Dominica*	11,203,230	11,370,037	16,609,335	0.69	0.70	1.03
Dominican Republic	491,659,178	556,689,551	918,327,511	0.24	0.28	0.46
Grenada*	10,440,811	11,324,278	17,627,616	0.36	0.39	0.60
Guadeloupe*#	8,322,176	2,972,533	10,849,744	0.03	0.01	0.04
Haiti	50,876,512	113,152,322	298,822,076	0.19	0.42	1.12
Jamaica	197,175,663	218,055,703	350,428,068	0.47	0.52	0.83
Martinique*#	12,206,035	2,774,686	10,127,603	0.04	0.01	0.04
Puerto Rico*	300,008,387	327,168,529	514,988,231	0.10	0.11	0.17
Saint Barthelemy*#	103,611	49,320	180,017	0.01	0.01	0.02
Saint Lucia*	30,925,417	32,467,140	48,572,360	0.72	0.75	1.13
Saint Martin*#	622,639	233,480	852,201	0.03	0.01	0.05
Sint Maarten*	8,007,030	8,947,762	14,484,733	0.36	0.40	0.64
St Vincent and the Grenadines	80,919,365	81,181,045	112,589,316	3.39	3.41	4.72
Trinidad and Tobago*	33,383	11,209,624	40,915,129	0.00	0.01	0.05
US Virgin Islands*	107,395,307	107,758,233	149,935,950	1.79	1.80	2.50
Total Caribbean	**1,830,771,254**	**2,071,579,091**	**3,463,306,237**	**0.18**	**0.21**	**0.34**
Belize*	33,061,881	35,873,714	55,870,054	0.63	0.68	1.06
Costa Rica	257,448,110	296,102,407	497,211,087	0.17	0.19	0.32
El Salvador	115,236,216	156,881,726	318,766,548	0.15	0.20	0.41
Guatemala	136,786,432	188,935,235	380,645,410	0.07	0.10	0.20
Honduras	64,442,154	103,359,303	250,434,356	0.11	0.17	0.41
Mexico	1,445,060,736	1,715,390,053	2,980,460,845	0.04	0.05	0.09
Nicaragua	38,816,738	71,934,969	174,652,888	0.10	0.19	0.46
Panama	479,028,644	510,843,096	780,027,800	0.31	0.33	0.50
Total Central America & Mexico	**2,569,880,911**	**3,079,320,503**	**5,438,068,987**	**0.06**	**0.07**	**0.13**

Country	Total short-term cost 2015–2017 (in 2015 US$)			Total short-term cost Annual as % of GDP		
	Baseline Zika	Medium Zika	High Zika	Baseline Zika	Medium Zika	High Zika
Argentina	454,495,784	495,976,647	779,498,863	0.03	0.03	0.05
Bolivia	64,068,983	86,839,996	171,569,184	0.06	0.09	0.17
Brazil	968,855,815	1,674,408,354	4,649,127,844	0.02	0.03	0.09
Colombia	456,043,252	643,601,745	1,383,719,518	0.05	0.07	0.16
Ecuador	130,225,265	193,622,724	412,966,094	0.04	0.06	0.14
French Guiana*#^	1,849,084	845,251	3,085,167	0.01	0.01	0.02
Guyana	6,890,484	11,059,182	24,759,566	0.07	0.12	0.26
Paraguay	27,401,932	73,446,228	206,048,034	0.03	0.09	0.25
Peru	333,537,513	367,758,428	585,504,214	0.06	0.06	0.10
Suriname*	13,045,623	13,450,759	28,747,619	0.09	0.09	0.20
Venezuela*	355,152,618	299,411,161	909,919,438	0.03	0.03	0.08
Total South America	**2,560,950,058**	**3,860,420,477**	**9,154,945,540**	**0.03**	**0.04**	**0.09**
Total LAC	**6,961,602,223**	**9,011,320,071**	**18,056,320,764**	**0.05**	**0.06**	**0.12**

NOTES:

The figures in this table include the total costs for the 2015–2017 period. For GBS, 3/15 of the lifetime costs were included. For microcephaly, 3/35 of the lifetime costs were included. * indicates some data were imputed. # indicates that data on tourism costs are not included because of missing information. ^ indicates that GBS and microcephaly related costs were not included due to missing information.

See Annex 1: ***Methods and Assumptions*** or details on assumptions, data sources and calculations.

Table 9: Total short-term cost per capita

Country	Cost per capita (total short term cost / total population)		
	Baseline Zika	Medium Zika	High Zika
Anguilla*#	1	7	25
Aruba*	1,367	1,371	1,902
Barbados*	305	311	447
Bonaire, St Eustatius &Saba*#	1	7	26
Cuba*	19	25	46
Curacao*	447	454	642
Dominica*	154	156	229
Dominican Republic	47	53	87
Grenada*	98	106	165
Guadeloupe*#	18	6	23
Haiti	5	11	28
Jamaica	72	80	129
Martinique*#	31	7	26
Puerto Rico*	86	94	148
Saint Barthelemy*#	14	7	25
Saint Lucia*	167	175	263
Saint Martin*#	20	7	27
Sint Maarten*	73	82	132
St Vincent and the Grenadines	2,085	2,091	2,901
Trinidad and Tobago*	1	8	30
US Virgin Islands*	1,037	1,040	1,448
Total Caribbean	**43**	**49**	**81**
Belize*	92	100	156
Costa Rica	54	62	103
El Salvador	19	26	52
Guatemala	8	12	23
Honduras	8	13	31
Mexico	11	14	23
Nicaragua	6	12	29
Panama	122	130	199
Total Central America & Mexico	**15**	**18**	**31**

Country	Cost per capita (total short term cost / total population)		
	Baseline Zika	Medium Zika	High Zika
Argentina	10	11	18
Bolivia	6	8	16
Brazil	5	8	22
Colombia	9	13	29
Ecuador	8	12	26
French Guiana*#^	7	3	12
Guyana	9	14	32
Paraguay	4	11	31
Peru	11	12	19
Suriname*	24	25	53
Venezuela*	11	10	29
Total South America	**6**	**10**	**23**
Total LAC	**11**	**15**	**29**

NOTES:

The total costs from Appendix Table 8 were divided by each country's total population in 2015. * indicates some of the cost data were imputed. # indicates that data on tourism costs are not included because of missing information. ^ indicates that GBS and microcephaly related costs were not included due to missing information.

See Annex 1: ***Methods and Assumptions*** or details on assumptions, data sources and calculations.

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