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Anticipating the international spread of Zika virus from Brazil

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In May, 2015, locally acquired cases of Zika virus—an arbovirus found in Africa and Asia-Pacific and transmitted via *Aedes* mosquitoes—were confirmed in Brazil. The presence of *Aedes* mosquitoes across Latin America, coupled with suitable climatic conditions, have triggered a Zika virus epidemic in Brazil, currently estimated at 440 000–1 300 000 cases.¹ Viraemic travellers have now introduced Zika virus into at least 13 additional countries, where susceptible *Aedes* mosquitoes have become infected and perpetuated local transmission cycles. In Brazil, a precipitous surge in infants born with microcephaly and the detection of Zika virus RNA in the amniotic fluid of affected newborns has been reported.¹ We sought to identify high-risk international pathways for the dispersion of Zika virus and global geographies conducive to autochthonous transmission.

We created a global Zika virus spread model by adapting a seasonal model for dengue that integrates global ecological niche data for *Aedes aegypti* and *albopictus* and worldwide temperature profiles.^{2,3} In Brazil, we identified airports within 50 km of areas conducive to year-round Zika virus transmission. We mapped the final destinations of international travellers departing from these airports from September, 2014, to August, 2015, using worldwide flight itinerary data from the International Air Transport Association. We used LandScan, a gridded global population dataset, to estimate numbers of people living in geographies at risk for autochthonous Zika virus transmission.

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9.9 million travellers departed from the aforementioned Brazilian airports for international destinations, with 65% to the Americas (figure), 27% to Europe, and 5% to Asia. Traveller volumes were greatest to the USA (2 767 337), Argentina (1 314 694), Chile (614 687), Italy (419 955), Portugal (411 407), and France (404 525). China and Angola received the highest volume of travellers in Asia (84 332) and Africa (82 838), respectively. Argentina, Italy, and the USA have more than 60% of their populations residing in areas conducive to seasonal Zika virus transmission, whereas Mexico, Colombia, and the USA have an estimated 30.5, 23.2, and 22.7 million people, respectively, living in areas conducive to year-round transmission.

In parallel to the recent experience with chikungunya,⁴ Zika virus has the potential to rapidly spread across Latin America and the Caribbean. With no vaccine or antiviral therapy available, possible interventions include: personal protection (ie, repellent use) and daytime avoidance of mosquito bites (especially pregnant women until more is known about the association between Zika virus infection and microcephaly); daytime avoidance of mosquito bites among Zika virus-infected individuals to disrupt human to mosquito to human transmission cycles (80% of infected individuals are asymptomatic and the remainder have clinical syndromes overlapping with dengue and chikungunya);⁵ and community-level mosquito surveillance and control measures. The summer Olympic Games in Brazil in August, 2016, heighten the need for awareness of this emerging virus.

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Figure.

Final destinations of travellers departing Brazil by potential for autochthonous Zika transmission