Using Human Movement Data to Derive Dengue Virus Transmission Networks

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Movement patterns and social structure play an important role in modulating human-vector contact rates, affecting transmission dynamics, and the spread and persistence of vector-borne pathogens. For dengue virus (DENV), limited dispersal range of its day-biting vector, *Aedes aegypti*, points to movement of viremic humans as a plausible explanation for the rapid spread of infection across urban environments. We used field data from spatially-explicit semi-structured interviews (SSI) and GPS data-loggers to derive contact networks of individual humans for DENV transmission in Iquitos, Peru. We obtained movement data for 300 participants and expressed their contact network as an undirected bipartite graph representing the locations participants had in common as a consequence of their routine movements. Different measures of network topology were estimated for the full contact network and "key sites" network containing only those locations where exposure to *Ae. aegypti* is most likely (houses and schools). Places where participant's spent the most time outside their home were other residential locations (71% of total time); markets and stores (18%); parks, cemeteries, and recreational areas (3%); and hospitals and health posts (2%). Average degree of a participant (number of locations visited) increased with age from an average (SD) of 2.8 (1.1) for 3–8 year olds to 7.1 (4.3) for 45–69 year olds. The derived key-sites network had a main component with 69% of all the participants, indicating a high degree of connectivity at residential locations. Current targeted vector control programs focus on neighboring homes within 100 m of a diagnosed dengue case's house. Our quantitative empiric contact networks indicate that residential exposure can occur beyond 100 m of a person's home and are consistent with the notion that movement of viremic people is a prime driver of rapid DENV propagation in urban environments.