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ABSTRACT

Using a prediction market to forecast dengue fever activity

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Objective
The objective of this project is to use prediction markets to forecast the spread of dengue.

Introduction
Dengue is a mosquito-borne viral disease, and there is considerable evidence that case numbers are rising and geographical distribution of the disease is widening within the United States, and around the world.

The accuracy and reporting frequency of dengue morbidity and mortality information varies geographically, and often is an underestimation of the actual number of dengue infections. As traditional methods of disease surveillance may not accurately capture the true impact of this disease, it is important to gather professional observations and opinions from individuals in the public health, medical, and vector control fields of practice. Prediction markets are one way of supplementing traditional surveillance and quantifying the observations and predictions of professionals in the field.

Prediction markets have been successfully used to forecast future events,[1–4] including future influenza activity.[5] For these markets, we divided the possible outcomes for each question into multiple mutually exclusive contracts to forecast dengue-related events. This differed from many previous prediction markets that offered single sets of yes-no questions and used 'real' money in the form of educational grants. However, with more detailed contracts, we were able to generate more refined predictions of dengue activity.

Methods
Participants are given $100 of a valueless currency with which to trade. The future values of these contracts depend on the outcome of selected dengue-related events. On 17 August 2010, we opened contracts that specified (1) the total number of the United States dengue cases in 2010, (2) the percentage increase in clinical dengue in the Americas in 2010, and (3) the number of states that will report locally acquired dengue cases in 2010.

For each question, we offered multiple mutually exclusive contracts. For example, for the number of cases by the end of 2010 question, we provide contracts specified on five possible categories: (1) 150 or less, (2) 151–200, (3) 201–250, (4) 251–300, and (5) 301 or more. Traders buy and sell contracts with one another at prices that depend on their beliefs about the likelihood of the underlying event. These prices can be interpreted as the consensus probabilities of event occurrence.

Results
As of 9 September 2010, 28 active participants were trading on the markets. A total of 333 transactions occurred, with a total of 752 contracts being traded. The current predictions on the total number of the United States dengue cases are plotted in Figure 1. The height of each shaded region at any particular date represents the predicted probability, as of that date, that the corresponding event will occur. For example, on 4 September 2010, market prices indicated a 45 chance of 251–300-US dengue cases—the most likely outcome. Prices of other contracts predict that the percentage increase in the Americas in 2010 will most likely be between 75 and 100 (51 chance), and only 1 state will report locally acquired dengue cases in 2010 (43 chance).

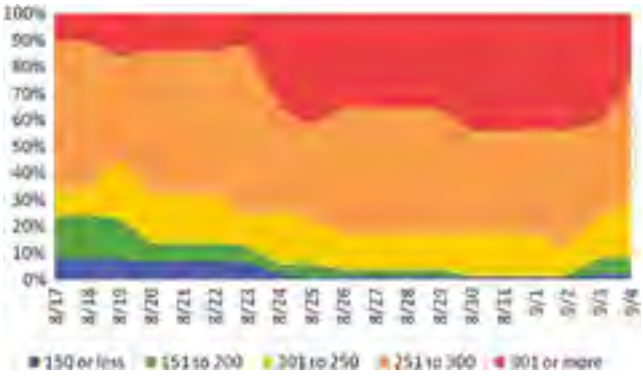

Figure 1 Probability distribution of case count outcomes.

Conclusion

The consensus opinion of each dengue market has reflected changes in dengue activity. This demonstrates the potential of markets as useful tools for disease surveillance through aggregating the experience and knowledge of experts.

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