Kidenga: Community-based Surveillance and Education App

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CHIIC Forum
November, 2016
Kidenga

- A mobile participatory syndromic surveillance app to detect individuals with symptoms suggestive of dengue, Zika, and chikungunya and to track activity of the vectors, *Ae. aegypti* and *Ae. albopictus*
  - Pilot launched Sep 2016
  - Pilot areas include Arizona, South Texas, Florida
Partnerships

- University of Arizona is the project lead. They developed the app and own and maintain the app and the data.
- CDC provided seed funding for the development of the app and technical consultation.
- Skoll Global Threats Fund has sponsored marketing and ongoing maintenance costs and provides technical consultation.
- The app was developed with input from state and local health department stakeholders.
- The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.
Context and Background
Aedes aegypti and Aedes albopictus mosquito-borne diseases

- Yellow fever, dengue, chikungunya, and Zika are growing threats worldwide
  - No symptoms, or mild/moderate symptoms common (particularly dengue/Zika/chikungunya)
  - Severe disease and long-term consequences possible, including birth defects caused by Zika during pregnancy
- Small local outbreaks in the continental US and Hawaii
- Endemic in Puerto Rico and sporadic large outbreaks in Pacific territories
- *Ae. aegypti* and *Ae. albopictus*
  - Distributions projected but not confirmed in some areas; expanding distributions
  - *Ae. aegypti* may be found up to 8 months of the year in the southern U.S., up to 12 months a year in parts of Florida, and Texas \(^1,2\)
  - Highly invasive
  - *Ae. aegypti* and *Ae. albopictus* spread viruses are difficult to control and require significant community engagement
Challenges in *Aedes* mosquito-borne disease control

- **Disease detection: traditional laboratory-based surveillance misses many cases**
  - 2 million dengue cases reported to WHO in 2010\(^3\); estimated 96 million symptomatic cases\(^4\)
  - For symptomatic Zika and dengue cases, presentation is often mild; sick person may not seek medical care

- **Disease control and prevention requires community action**
  - Specific strategies to prevent mosquito-borne disease should be contextualized with local risk information
Participatory surveillance

- **Participatory surveillance systems**
  - Enable the public to directly report on diseases via internet
  - Aggregate data and provide real-time feedback to users and public health agencies
  - May allow for improved public engagement

- Growing evidence indicates that participatory surveillance systems may have high level of accuracy, and greater sensitivity and timeliness compared to traditional healthcare-dependent systems\(^5\)
Features

- Health and mosquito activity survey
- Map of user reported symptoms and confirmed cases
- Newsfeed on the diseases and vectors
- Current disease information, prevention strategies, and treatment/testing information
Registration

- For persons 13 years of age or older
- Participants must provide
  - Email address
  - Zip code of residence
  - Gender
  - Month/year of birth
Survey: Report Now!

- Weekly push notification to report on themselves and family
- No symptoms? Report mosquito activity – Done in 4 seconds
- Symptoms?
  - Symptoms checklist
  - Highest fever
  - Onset date
  - Travel history
  - Medical care
  - Testing
  - Mosquito activity

What symptoms have you experienced during the past week (Mon, August 29 through Sun, September 4)?

- fever
- chills/night sweats
- fatigue
- headache
- cough
- bone pain
- nausea/vomiting
- joint pain
- sore throat
- rash
- diarrhea
- eye rash
- shortness of breath
- pink eye
- body aches
- leg/joint swelling

Next
Disease Tracker: Bi-directional information exchange

**USER GENERATED**

**CONFIRMED HEALTH DEPARTMENT DATA**
Following report

- Opt-in or opt-out for future follow-up (asked only once)
- If reporting symptoms:
  - Directed to education section and warning signs for severe disease
  - Receive email with educational information
  - Receive email with letter for clinicians
Get Mosquito Smart!

Dear Medical Provider,

You are receiving this notification because [Insert patient name] reported symptoms consistent with [Aedes] mosquito-borne viruses, dengue, Zika, and Chikungunya. The information may be useful to a provider evaluating a patient for dengue and Zika.

**Clinical Presentations**

**Dengue:** The incubation period ranges from 3 to 14 (usually 4 to 7) days. Symptoms include sudden onset of high fever, severe headache (forehead), pain behind the eyes which worsens with eye movement, body aches and joint pains, and sometimes rash and nausea/vomiting. Symptoms resolve in 6-7 days if not severe dengue. Clinical info: [http://www.cdc.gov/dengue/clinicallab/](http://www.cdc.gov/dengue/clinicallab/)

**Chikungunya:** The incubation period ranges from 2-8 days (usually 4-7). Symptoms include: rash (not itchy), lower back pain, severe joint pain (with or without the presence of swelling), vomiting, nausea, headaches, chills, fevers. Acute symptoms resolve in 5-7 days, some people may experience joint pain up to two years after infection. Clinical info: [http://www.cdc.gov/chikungunya/hc/](http://www.cdc.gov/chikungunya/hc/)

**Zika:** The incubation period is not clear, but is likely to be a few days. The symptoms are similar to dengue, and include fever, skin rashes, conjunctivitis, muscle and joint pain, malaise, and headache. These symptoms are usually mild and last for 2-7 days. There is an increased risk of Guillain-Barré syndrome with Zika virus.

If you have symptoms, go to the doctor right away if:

1. You or your sexual partner is pregnant or thinking of getting pregnant.

   **OR**

2. You've had a high fever which then drops to 38°C/100°F along with:
   - very bad stomach pain
   - constant throwing up
   - blood in vomit
   - fast and/or difficult breathing
   - bleeding gums
   - extreme tiredness or weak all over the body
   - restlessness

   themselves and sometimes family. When they report symptoms consistent with dengue,
Get Mosquito Smart!

Not all mosquitoes are the same. Two types of mosquitoes can spread Zika, dengue, and chikungunya.

- Aedes aegypti
  - They have white stripes on their legs.
  - These mosquitoes are called *Aedes aegypti* and *Aedes albopictus*.

- Aedes albopictus
  - These mosquitoes live indoors and outdoors.
  - Protect yourself!
Get Mosquito Smart!

Mosquito Lifecycle

Mosquitoes look for standing water in buckets, bowls, animal dishes, flower pots, vases, old tires, and even in plants that collect water.

- Adult female mosquitoes lay eggs in standing water (they only need a capful!). The eggs look like black dirt.
- Mosquito eggs can survive even after the water dries up.
- The eggs hatch into mosquitoes when they are submerged in water.
- The hotter it is the faster this cycle goes.

These mosquitoes live in many different countries, including the United States.

Places in the United States where the mosquitoes that can spread Zika, chikungunya, and dengue might be found.
Get Mosquito Smart!

Where is Zika?

In the world

Countries in the Americas and Caribbean where Zika is spreading.
Last updated: August 30, 2016.

In the United States

Do you have a **fever, rash, joint pain**, or **red eyes**? It could be Zika.

What happens to you?

- The illness is usually mild. The symptoms can last several days to a week.
- People usually don't get sick enough to go to the hospital, and they rarely die of Zika.
- Many people might not even realize they are infected with the Zika virus. Four out of five people who have Zika don't have symptoms! If you're bitten by a mosquito...
Get Mosquito Smart!

Protect yourself and your family

• Wear long-sleeved shirts and long pants.

• Use insect repellent. Always follow instructions on the label.

• Use Environmental Protection Agency (EPA) - registered insect repellents with one of the following active ingredients: DEET, picaridin, IR3535, oil of lemon eucalyptus, or para-methane-diol.

• EPA-registered repellents work the best and for the longest amount of time.

• EPA-registered repellents are safe and effective, even for women who are
What’s New?

- RSS newsfeed
- Searches for any news item with Zika, dengue, and chikungunya
- Shareable
- Users in select pilot areas may receive press releases issued by their state or local public health department related to the diseases and their vectors
Stakeholders and Marketing
Stakeholders and Marketing

- **Usefulness of surveillance data contingent on**
  - A large and consistent group of diverse community users, especially in low risk areas
  - Strategies to integrate health reports for high-risk populations who may not have smartphones
  - Buy-in from public health departments to use the data and advocate for this novel surveillance tool
    - Local health departments serving as spokespersons for the app

- **Community interest in Zika virus emergence will be leveraged, specifically targeting AZ, TX, and FL**
  - English and Spanish radio public service announcements in select Arizona markets
  - Press releases
  - Social marketing campaign

- **Evaluation planned to assess acceptability and impact of both surveillance tool and educational tool**
Obstacles and Speed bumps

- **Surveillance**
  - Obtaining and maintaining a large user-base
  - Determining appropriate special scale for presentation
  - Ethics and legal issues
  - Evaluation of data for which there is no other sentinel surveillance system for comparison

- **Education**
  - Identification of standard data streams for timely data presentation to user
  - Tailoring messaging by jurisdiction
    - Level of risk for a community evolves with time
    - Guidelines for testing
    - Public health contacts

- **Managing diverse stakeholder interests**
Future directions
Reach: Kidenga 1.1

- Spanish version currently under development for Spanish speaking populations in the US
Reach: V2. Community Health Worker (CHW) Real Time Surveillance and Outreach

- Kidenga v1 relies on individual smartphone ownership

- Target: Develop a CHW interface in Kidenga for information exchange
  - CHW access hard-to-reach communities
  - Allow more rapid detection of outbreaks in these communities
  - Better prepared CHW with near real-time knowledge about the outbreak and prevention pushed out by health departments
Engage: Kidenga V3. The Mosquito Hunt Game

- Context: Kidenga V1.0 relies on sustained community interest for reporting
- Gap: People may lose interest
- Target: Educational mosquito hunt game; points for reporting symptoms & areas where mosquitoes can lay eggs.
- Rationale: 70% of teachers reported increasing student engagement with games⁶.
- Expected outcomes:
  - Increased individual participation in core Kidenga app.
  - Educational tool for CHW to engage children.
  - Children act as health messengers to family⁷.
Tailored Climate Driven Alerts

- Context: Kidenga V 1.0 focuses downstream on disease data
- Gap: Early warning about heightened mosquito activity can motivate action and reduce transmission risk.
- Target: Develop shareable spatially and temporally targeted messaging about mosquito activity to users to motivate action.
- Rationale:
  - Mosquito activity is linked to weather conditions\(^7\).
  - Personalized health messaging is more effective\(^8\).
  - Climate change projected to change areas and times for mosquitoes\(^9\).
Summary

- A mobile participatory syndromic surveillance app to detect individuals with symptoms suggestive of dengue, Zika, and chikungunya and to track activity of the vectors, *Ae. aegypti* and *Ae. albopictus*
  - Pilot launched Sep 2016
  - Pilot areas include Arizona, South Texas, Florida
- Also a platform for education and public health messaging, including local alerts
- Collaborative effort between University of Arizona and state and local health departments
- Spanish version under development
- Next steps include efforts to expand user base and geographic reach for high risk populations and areas.
References

2. Reiskind MH, Lounibos LP. Spatial and temporal patterns of abundance of Aedes aegypti L. (Stegomyia aegypti) and Aedes albopictus (Skuse) [Stegomyia albopictus (Skuse)] in southern Florida.
Acknowledgements:

Arizona Department of State Health Services
City of Laredo Health Department
City of McAllen Health Department

University of Arizona: Kacey Ernst, Kathy Wirt, Andrea Rivera, Chris Schmidt
Skoll Global Threats: Jennifer Olsen, Adam Crawley
CDC: Alba Phippard, Alina Shaw
University Corporation for Atmospheric Research: Andy Monaghan

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