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Children’s Hospital Boston, Harvard Medical School
Harvard-MIT Division of Health Sciences and Technology
Canadian University Press Annual Conference
– Victoria BC

#NASH74
NASH Plenary Motions
@PlenaryMotion

Motion that nobody else on this bus puke. #nash74
15 Jan 12

Emma Godmere
@godmere

@CUPnash Attention CUPpies: shutting gala down because too many people are sick. Please let us know if you're ill.
#NASH74
15 Jan 12
Potential of Digital Disease Detection

- SMS Messaging
- Micro Blogging
- Internet Searching
- Social Networking
- Emailing
- Blogging
- Internet Chatting
- Online News Reporting
- Video/Radio Reporting
- Health Expert Reporting
Emerging and re-emerging infections, 1996-2010

- Cryptosporidiosis
- Human Monkeypox
- E.Coli O157
- Venezuelan Equine Encephalitis
- Dengue Haemorrhagic Fever
- Ebola Haemorrhagic Fever
- Marburg Haemorrhagic Fever
- Ross River Virus
- Hendra Virus
- Reston Virus
- West Nile Virus
- Legionnaire’s Disease
- Severe Acute Respiratory Syndrome (SARS)
- Malaria
- Typhoid
- Cholera
- BSE
- Lassa Fever
- Yellow Fever
- Lyme Borreliosis
- Echinococcosis
- Diphtheria
- Influenza A (H5N1)
- Nipah Virus
- RVF/VHF
- O’Nyong-Nyong Fever
- Buruli Ulcer
- Multidrug Resistant Salmonella
- nvCJD
Outbreak Database (1996-2009)

- **Disease / Location**
- Date of onset of risk factor
- Date of local mass gathering
- Date of associated wildlife outbreak
- Date of exposure
- Date of symptom onset
- Date of outbreak start
- Date of hospitalization or medical visit
- Date of outbreak detection
- Date of death

- Date of laboratory confirmation
- Date of announcement by a local
- Date of any earlier mentioned report
- Date of ProMED, GPHIN, HealthMap reports
- Date of WHO notification
- Date of DON report (official)
- Date of mass immunization campaign
- Date of implementation of vector control
- Date of declaration of an epidemic raised
- Date of declaration of end of epidemic
Characterize global spatial-temporal trends in the timeliness of outbreak detection and reporting
Figure 2. Boxplots of the median time (and inter-quartile range) between outbreak start and various outbreak “milestones” for a set of WHO-confirmed outbreaks during 1996-2009.

Number of days from outbreak start to outbreak discovery

- **167 days** in 1996
- **20 days** in 2010

### Year of Outbreak Start

<table>
<thead>
<tr>
<th>Year</th>
<th>Time in Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
<td>167</td>
</tr>
<tr>
<td>2000</td>
<td>133</td>
</tr>
<tr>
<td>2004</td>
<td>100</td>
</tr>
<tr>
<td>2008</td>
<td>20</td>
</tr>
</tbody>
</table>

Traditional Public Health Reporting

1. Public
2. Public health practitioners
3. Healthcare workers, Clinicians
4. Ministry of Health
5. World Bodies (UN, WHO, FAO, OIE)

Digital Disease Detection
The Rise of Digital Disease Detection
precisely placed in locations resulting in alerts per day the number of public and private sources we use to access more than 50,000 sites in 10 languages every hour 24/7
Typhoid cases in Mufulira have reached 2,227 with health authorities calling for increased efforts to prevent new infections in Mupambe Township.
10,500 locations
4800 disease patterns
220 species
Case and Death Counts
Bayesian Filtering

Breaking News

Warning

Old News

Context

Not disease related
Bayesian Filtering

Breaking News

Warning

Old News

Context

Not disease related

Articles are categorized using more than 19 million phrases with 91% accuracy.
**Veracruz: reporta agente municipal extraño brote epidémico que ha cobrado dos vidas**

La funcionaria de La Gloria informó que el raro padecimiento ha afectado a 60 por ciento de sus tres mil habitantes con infecciones respiratorias.
Influenza A (H1N1) Reports

Source
- Informal Sources (Media)
- Official Sources (ie: CDC, WHO)

All HealthMap Sources »
View H1N1 on HealthMap »

Category
- Ruled Out
- Suspected Cases
- Suspected Deaths
- Confirmed Cases
- Confirmed Deaths

Zoom to country
- Afghanistan
- Albania
- Algeria
- American Samoa [USA]
- Antigua & Barbuda
- Argentina
- Australia
- Austria
- Azerbaijan
- Bahrain
- Bangladesh
- Barbados
- Belarus
- Bahrain

Date range: 1 Apr - 1 Aug *

View Progression »


Official data is obtained from CDC and WHO daily Influenza A (H1N1) updates. Informal data sources are a subset of reports from the HealthMap database. The case numbers shown are cumulative counts. HealthMap is a public website bringing together disparate data sources to achieve a unified view of the current global state.
Global spread of H1N1 with informal sources

Number of foodborne illnesses reported each year in the US

10,000
Foodborne Outbreaks Reported to HealthMap in past year
Next Generation Public Health: Participatory Epidemiology
Wednesday, Sep. 09, 2009
Is a Swine Flu Outbreak Coming? Ask Your iPhone
By Bryan Walsh
HealthMap
Outbreaks Near Me

Location, preferences

Relevant real-time alerts

2. **26-year-old falls victim to H1N1 in Mass.**
   8/17/09 8:13 PM
   3 hours 39 min 26 sec ago (NECN: Boston, Mass.) - The H1N1 flu is dominating news headlines today. Massachusetts is reporting its 11th swine flu death, as Boston Mayor Tom Menino looks to prepare for a possible resurgence of the virus this fall. Boston

3. **West Nile virus found in Boston**
   8/13/09 10:18 PM
   By Stephen Smith, Globe Staff For the first time this summer, West Nile virus has been detected in mosquitoes in Boston, city health authorities said today. The infected insects were discovered in Jamaica Plain.
Android
Potential for increased global coverage
HealthMap Hotline

919-MAP-1-BUG (627-1284)
Leave a voicemail or Send SMS
Reporting through the website

Outbreak Missing? Help us by adding it to the map.

Provide an eyewitness report
(something you personally know or heard about)

Headline: Dead crows in park
Disease: Undiagnosed
Location: en Park, Town 1, StateA
Email:
Description: Dozens of dead crows.

Or Share a news report
(a news article you read online)
Submit a disease report:

Headline: 

Disease: Please select a disease

Location: 

Description: 

Upload a related photo (optional): Choose File No file chosen

Email: 

By submitting, you agree to the Terms of Submission.

Submit
PANDEMIC PULSE
KEEP UPDATED ON THE LATEST WORLDWIDE OUTBREAKS THROUGH HEALTHMAP

<table>
<thead>
<tr>
<th>Date</th>
<th>Summary</th>
<th>Disease</th>
<th>Location</th>
<th>Cases</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>19 Sep</td>
<td>Seven students interned at the Santa Fe poisoning in California</td>
<td>Poisoning</td>
<td>Argentina</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19 Sep</td>
<td>PRO/FAF&gt; Cholera - Nigeria (21); (Oyo)</td>
<td>Cholera</td>
<td>Nigeria</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19 Sep</td>
<td>PRO/FAF&gt; Cholera - Nigeria (21); (Oyo)</td>
<td>Cholera</td>
<td>Ibadan, Oyo, Nigeria</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
worldwide user submitted reports
iPhone Submissions vs CDC sentinel surveillance

R² = 0.74
Future of Outbreaks Near Me Mobile

- Engaging the users through recognition
- Providing key public health messaging
- Improved visualization
- And building a disease detective network...
Undiagnosed Events in HealthMap
Validating Undiagnosed Events by Mobile Phone

- 23 Apr - PRO> Undiagnosed deaths - Thailand (06): (CM)
- 21 Apr - PRO/MBDS> Undiagnosed deaths - Thailand (05): Chiang Mai
- 20 Apr - PRO/EDR> Undiagnosed deaths - Thailand (05): (CM)
- 19 Apr - Mystery Thai illness strikes another tourist - World - Canoe.ca
Validating Undiagnosed Events by Mobile Phone

Geo-localized push messages ➔ Validate event
Explore flu trends across the U.S.

We've found that certain search terms are good indicators of flu activity. Google Flu Trends updates flu activity estimates for each state up to two weeks faster than traditional systems.  
Read more »
Google Dengue Trends

Activity Index

Bolivia

Brazil

India

Indonesia

Singapore

- Official Case Counts
- Fitted Data
Dengue activity was estimated using a model that proved accurate when compared to historic official dengue activity data. Data current through September 18, 2011.
Cholera Surveillance in Haiti
HealthMap Pilot, Haiti
Ameliebaron Amélie Baron
La journée avait si bien commencé, collègues de #RFI primés... mais épidémie de choléra officialisée en #Haiti.
21 Oct

wyclef Wyclef Jean
My visit to Sant Nicolas hospital in Saint Marc, As haiti is still fighting Cholera http://plixi.com/p/53255834
27 Oct

jacquiecharles Jacqueline Charles
Sitting w/a father who just lost his 7-year-old to cholera. Reality still has not hit
30 Oct
Using Social Media to Build an Epidemic Curve

Estimate Reproductive Number ($R_0$)

Phase 1: Informal sources 1.54-6.89 compared to official sources 1.27-3.72
Phase 2: Informal sources 1.04-1.51 compared to official sources 1.06-1.73

Case counts  Hospitalizations  HealthMap  Twitter

crowdbreaks

Official submission to the Now Trending Challenge
A collaboration with HealthMap

www.crowdbreaks.com
gastroenteritis

change prev. day: -8.33%  |  change prev. week: +83.33%

14 days ago  |  7 days ago  |  past 24 hours

Keywords (counts last day):

All keywords (33)

vomit (13), food poisoning (8), vomiting (3), stomach virus (0), colitis (5), stomach flu (2), stomach bug (0), upset stomach (0), gastritis (0), vomiting (1), norovirus (0), gastroenteritis (1), rotavirus (0)

May 9, Rabies case confirmed in Kennebec County - Kennebec Journal

Rabies | CrowdRaves Twitter Trends

Pittsfield, Massachusetts, United States
Direct Public Health Reporting
flu near you
do you have it in you?
Thank you for registering for the Flu Near You project! Now it's time to start your first survey.

**What symptoms have you experienced in the past week?**
- [x] Fever
- [ ] Cough
- [ ] Sore throat
- [ ] Shortness of breath
- [ ] Chills/night sweats
- [ ] Fatigue
- [ ] Nausea or vomiting
- [ ] Diarrhea
- [ ] Body aches
- [ ] Headache

What was your highest temperature measured?
- [ ] less than or equal to 99.9°F
- [ ] Not measured

**What day did you start feeling ill?**

Did you receive the flu vaccine after July 31, 2011?
- [ ] Yes
- [ ] No
- [ ] Don't know

Did you receive the flu vaccine last year (between July 31, 2010 - July 31, 2011)?
- [ ] Yes
- [ ] No
- [ ] Don't know

Submit
**APHA Challenge**

**Individual Top Awards**
- 1st: $25,000
- 2nd: $15,000
- 3rd: $10,000

Awarded to top three individuals with highest total number person-forms

Minimum Threshold eligibility: 10,000 person-forms
(one form allowed per person per week)

**Group Top Awards**
- 1st: $50,000
- 2nd: $25,000
- 3rd: $15,000

Awarded to top three groups with highest total number person-forms divided by number of persons in group

Minimum Threshold eligibility: 100,000 person-forms
(one form allowed per person per week)
Flu Activity in Your Area

User submitted flu reports in Boston, Massachusetts, United States in the past month.

Week ending: 1/15/2012

User contributed data: (colors determined by current week of data)
- Green: No symptoms reported
- Yellow: Some symptoms reported
- Red: At least 1 person with ILI

Additional flu data:
- User Contributed Flu Activity
- CDC Flu Activity
- Google Flu Trends ILI

No Report | No Activity | Sporadic | Local | Regional | Widespread
Age Distributions

Users

Household members
Linking Surveillance with Prevention: HealthMap Flu Vaccine Finder
HealthMap flu vaccine finder

HealthMap is now running Flu Vaccine Finder!

With the 2011-2012 flu season winding down, many providers are no longer stocking the flu vaccine. As a result, HealthMap Flu Vaccine Finder is currently preparing for the 2012-2013 flu season. Locations will be added and updated as we approach the Fall. To date, a number of large providers have already submitted their data directly to HealthMap. Sign up if your data is not included.

CVS/pharmacy
294 Harvard Street
Brookline, MA 02446
M-F 8a-10p, Sa-Su 8a-8p

CVS/pharmacy
1322 Beacon Street
Brookline, MA 02446
M-F 8a-7p, Sa 8a-5p, Su 9a-6p

CVS/pharmacy
400 Washington Street
Brookline, MA 02446
M-F 8a-10p, Sa 8a-6p, Su 9a-6p

Shaw's Osco Pharmacy 798
1065 Commonwealth Ave
Boston, MA 02215

Osco Pharmacy
1065 Commonwealth Ave
Boston, MA 02215

CVS/pharmacy
1266 Commonwealth Avenue
Allston, MA 02134
M-F 8a-10p, Sa-Su 8a-8p

CVS/pharmacy
350 Longwood Avenue
Boston, MA 02215
M-F 8a-8p, Sa 8a-6p, Su 9a-6p

CVS/pharmacy
300 Longwood Avenue
Boston, MA 02115
Conclusions

• Value in the fusion and visualization of distributed electronic resources (online epidemic intelligence, social networks, mobile technology)

• Novel Internet-based collaborative systems can play an important complementary role in gathering information quickly and improving coverage and accessibility.

• These early efforts at tapping the power of digital tools demonstrate important steps in improving health systems as well as engaging the public as participants in the public health process.
HealthMap Team

- Clark Freifeld, MA
- David Scales, MD PhD
- Susan Aman
- Leila Amerling, MBA
- Emily Chan, MSc
- Rumi Chunara, PhD
- Annie Gatwood, PhD
- Mikaela Keller, PhD
- Sumiko Mekaru, DVM, MVM
- Katelynn O'Brien
- Amy Sonricker, MPH

Funding