Abstract

Detecting Influenza Epidemics Using Self-reported Data Through Mobile App (FeverCoach)

Myeongchan Kim[1,2], MD; Sehyo Yune[2], MD, MPH, MBA; Hyun Wook Han[3], MD, PhD

[1]MOBILE DOCTOR CO., LTD., Seoul, Republic Of Korea

[2]MIDAS Research Center, Seoul, Republic Of Korea

[3]Department of Biomedical Informatics, School of Medicine, Ajou University, Suwon, Republic Of Korea

Corresponding Author:
Hyun Wook Han, MD, PhD
Department of Biomedical Informatics
School of Medicine
Ajou University
206, World cup-ro
Suwon,
Republic Of Korea
Phone: 82 1062920812
Email: james.hw.han@gmail.com

Abstract

Background: Timely forecast of influenza activity is critical for a public health system to prepare for an influenza epidemic and mitigate its burden. Currently, influenza surveillance relies on traditional data sources such as reports from health care providers, which lag behind real-time by several days to weeks. In an effort to reduce the time lag, internet search information, voluntary web-based records, and electronic health records have been suggested as the alternative data sources for influenza surveillance. However, low specificity, low rate of report, or privacy concerns limits the use of such data.

Objective: FeverCoach mobile application provides tailored information to help caregivers manage a febrile child. Using the self-reported diagnosis data submitted to the app, we developed a new algorithm that accurately predicted the influenza trend in South Korea.

Methods: Users of FeverCoach agreed to the use of de-identified data for research purposes. The app shows information about use of antipyretics and adjuvant way to relieve fever when users enter the child's age, sex, body temperature, and the duration of fever. Users can choose from the list of 21 candidate diseases including Influenza after a physician office visit. Additional information about the disease was provided following submission of the diagnosis. Public influenza-like illness (ILI) data was obtained from the Korea Centers for Disease Control and Prevention (KCDC) website. The data was collected from September 2016 to March 2017. Ordinary least squares linear regression was used to build a model using the data from the app to predict the influenza trend. To perform linear regression, we calculate logit(Pcdc) and logit(Papp) where logit(p) is natural log of p/(1-p), Pcdc is (ILI visit counts)/(total patient visit counts) and Papp is (Influenza report on FeverCoach)/(total diagnosis report on FeverCoach).

Results: We collected 13,014 self-reported diagnoses. Of all users, 81% of the children were under 5 years of age. The animated visualization of spatiotemporal diagnosis report is available online at https://www.youtube.com/watch?v=-8kDXz43gO8. Ordinary least square regression showed significant association between logit(Pcdc) and logit(Papp) (R2=0.860, $P<.001$). Using this regression model, we could detect an influenza epidemic 5 days before the 2016-2017 season's influenza epidemic alert by KCDC.

Conclusions: We found that it is possible to predict influenza epidemics earlier than KCDC with a relatively small amoount data. Collection of specific and accurate data was made possible by targeting a well-defined population.

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KEYWORDS

children; epidemics; health care; human influenza; Mobile health (mHealth)

Figure 1. FeverCoach main screens. (a) input page for fever. (b) information for fever management. (c) input page for diagnosis.

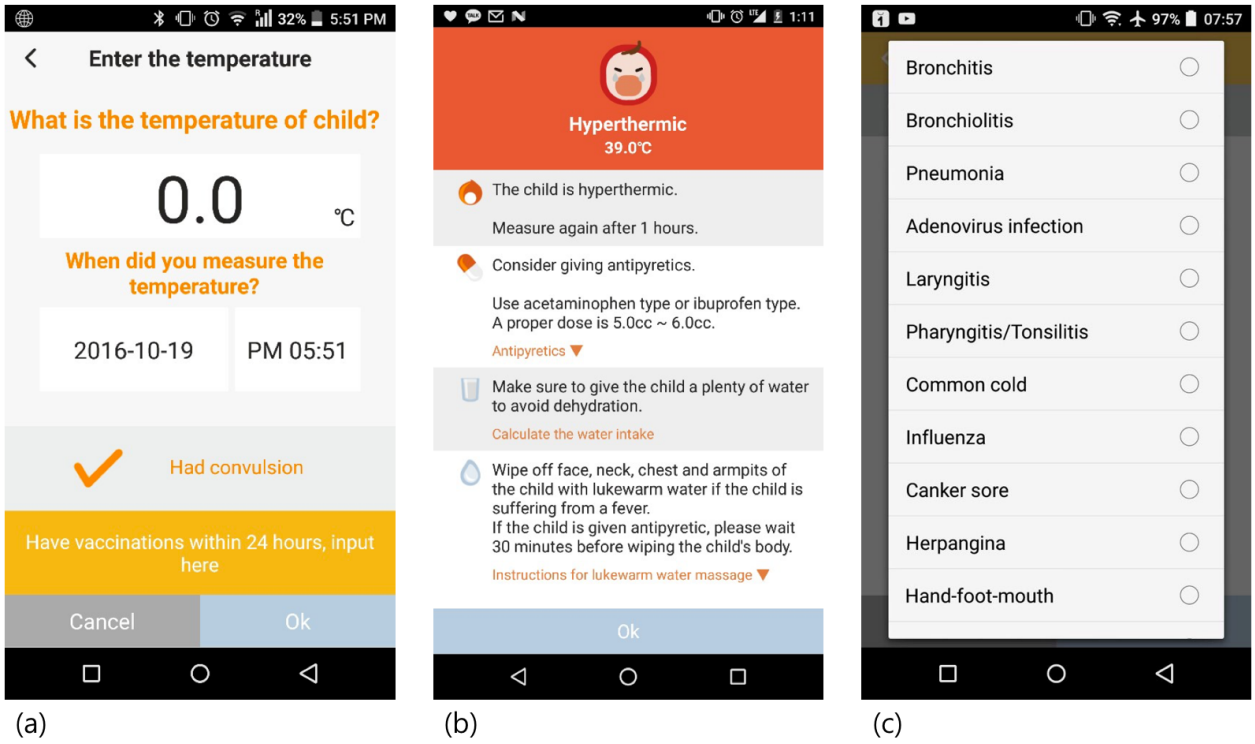


Figure 2. Visualization of spatiotemporal diagnosis report. Green circles indicate diagnosis data except Influenza and Red circles show input of Influenza diagnosis. Diameters of circles present time proximity from each reporting date of diagnosis. (a) Influenza reports on the 25th November, 2016. (b) Influenza reports on December 7th, 2016 : a day before epidemic alert of KCDC. (c) status on December 23rd, 2016. (d) status on January 28th, 2017.

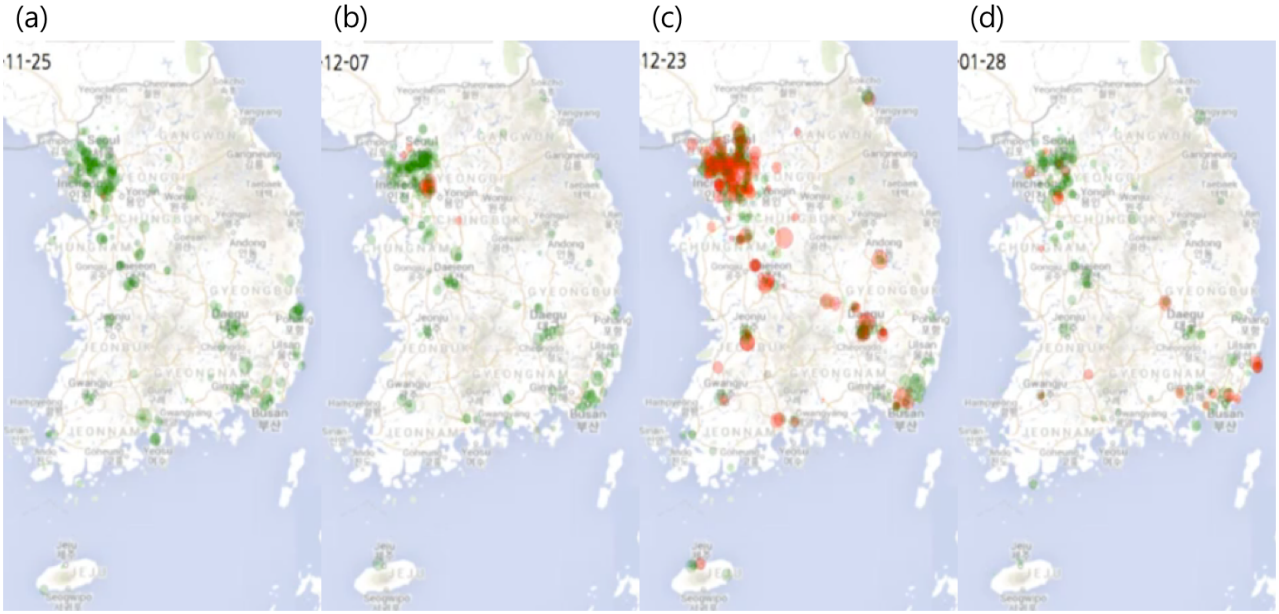
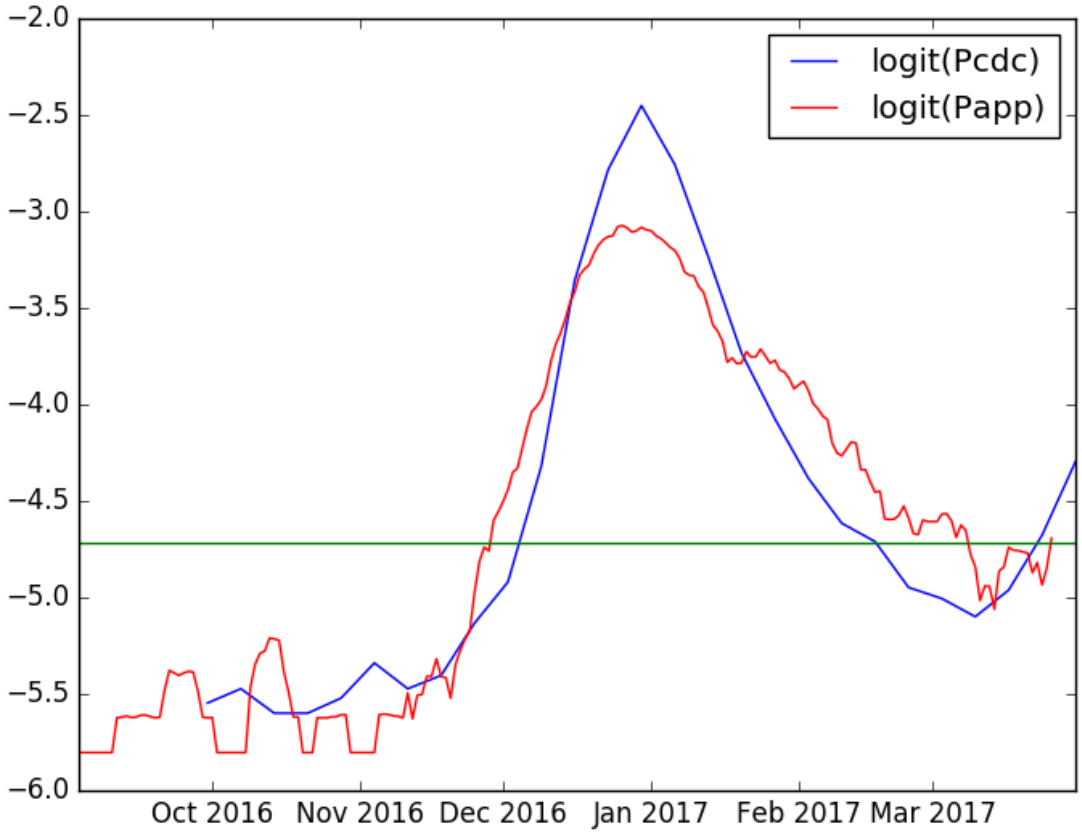


Figure 3. A comparison between CDC ILI data and FeverCoach data arranged by detection date : Pcdc = (ILI visit counts)/(total patient visit counts) and Papp = (Influenza report on FeverCoach)/(total diagnosis report on FeverCoach). Red line shows prediction of our regression model , blue line shows logit (Pcdc) and green line shows KCDC's influenza epidemic alert standard : fraction of ILI visit = 0.0089.



Multimedia Appendix 1

Data visualization of influenza report through FeverCoach from 2016 Nov to 2017 Jan. Red circles mean influenza report, green circles mean other diagnosis report. Circles are appeared from 5 days before of reporting date, and they have the biggest size on reporting date. Shrinking and disappearing takes 5 days.

[MOV File, 8MB-Multimedia Appendix 1]

Multimedia Appendix 2

Full poster.

[PDF File (Adobe PDF File), 9MB-Multimedia Appendix 2]

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