Application of wireless inhaler sensors to enhance asthma surveillance and inform municipal interventions







Meredith Barrett, PhD VP, Science & Research

nature International weekly journal of science

Rise of the citizen scientist

From the oceans to the soil, technology is changing the part that amateurs can play in research. But this greater involvement raises concerns that must be addressed.

Science is not just for scientists these days. Going on a scuba-diving holiday this summer? Share the temperature data from your dive computer with researchers eager to plug holes in sparse records for inshore areas. Nervous about possible pollution from a nearby fracking project? Ease your concerns by helping to collect and analyse air samples as part of a monitoring project. Stuck at home as the rain pours down?

Technology can make scientists of us all. Data churned out by the rapid spread of consumer gadgets equipped with satellite navigation, cameras and a suite of other sensors, and the ease of sharing the results digitally, are driving the boom in citizen science. Volunteers can already identify whale songs from recordings, report litter and invasive species, and send in the skeletons of fish they have caught and consumed. But "Asthma is both an individual condition and a broader indicator of community health."



People

Improve knowledge of individual sensitivity to weather, pollen, air quality, other triggers to improve daily self-management



Populations

Identify regional drivers of respiratory disease (eg, traffic, stationary polluters, air quality, pollen)

Healthy Louisville 2020



Creating a Healthier City



Policy

Use data to target interventions at the time and place where they will have the largest impact





500KHOSPITALIZATIONS2MED VISITS10MOFFICE VISITS25MMISSED DAYS SCHOOL/WORK





35% of global burden of respiratory disease is attributable to preventable environmental exposures

- Indoor air quality (smoke, mold, pets)
- Outdoor air quality (air pollution, pollen, work exposures)
- Second-hand tobacco smoke



Management of respiratory disease has not changed in decades. The current approach is manual, complex, inconvenient and time consuming.



SAMPLE DIARY:



* Fill in the brand name of your medicine, dose, and number of times per day you take it.

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Asthma Control Test

This survey was designed to help you describe your asthma and how your asthma affects how you feel and what you are able to do. To complete it, please mark an X in the one box that best describes your answer.

 In the <u>past 4 weeks</u>, how much of the time did your <u>asthma</u> keep you from getting as much done at work, school or at home?



\rightarrow Limitations of traditional asthma surveillance

Data:

- Diaries
- Healthcare utilization
- National surveys of patient reported data

Issues:

- Retrospective, delays
- Aggregated, low spatial resolution
- Recall error

GPS-enabled, wireless sensors can passively collect data on when, where and how often a person uses their inhaled medications



> Personalized approach leveraging sensors, analytics and education

User Acquisition



Passive Sensors



Care Management Services



Patient / Caregiver Tools

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Robust Infrastructure and Analytics



Care Team Tools





Collecting geo-tagged medication use data from citizens to improve understanding of asthma in Louisville, KY

Louisville: One of the top 20 "most challenging places to live with asthma in the US" -Asthma & Allergy Foundation of America #1 "Spring Allergy Capital" in US -Asthma & Allergy Foundation of America GENTY INAGES

ightarrow Asthma 4th most frequent cause of hospitalizations, COPD 3rd



ecolus, Kentucky Cabinet



Robert Wood Johnson Foundation





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AIR WATER & SOIL

AMERICAN LUNG ASSOCIATION











FAMILY Allergy & Asthma Breathe Right... Live Well.











AIR Louisville Goals (people – populations - policy)

- 1. Improve asthma and COPD outcomes among residents.
- 2. Identify hotspots of respiratory disease in the community, and better understand how environmental drivers are influencing these patterns.
- 3. Create a direct loop from data collection to local policy action.
- 4. Increase public awareness of air quality and respiratory disease in Jefferson County.
- 5. Create a sustainable partnership that will be supported into the future by local selfinsured employers and health plans.



Hotspots of rescue inhaler use

- •"Hottest" hotspot in downtown urban core
- •2 additional hotspots around major freeway interchanges
- •Exploring impact of traffic emissions

- 1. Su et al. 2016. Environmental Health Perspectives.
- 2. Smith et al. 2014. APHA.
- 3. Van Sickle, et al. 2014. APHA.
- 4. Barrett et al. 2014. APHA.



Only 31% of rescue inhaler use occurred in residential areas

Broad variability in individual asthma "home ranges" of inhaler use estimated using minimum convex polygons



GENTY INAGES Higher weed pollen count associated with more inhaler use

HOTTER TEMPERATURES MEAN MORE INHALER USE





Tree canopy has a protective effect

Helping Louisville prioritize community interventions



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The City's Strategic Plan: 5 Objectives and 21 Goals

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Louisville Urban Tree Canopy Assessment



"Compassion and data are transforming my city."

"[AIR Louisville] is making public health resonate in our policy conversations. It's citizen science. It's about asthma, about air, but it's also about rebuilding trust in government and that link to citizenship." – Greg Fischer, Mayor of Louisville, KY



Patients can serve as key investigators in their own health experience, and can act as citizen scientists to enhance population health knowledge and inform cities in their decision-making.



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Thank you



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