



CCWD

CENTER FOR CHILD WELL-BEING
& DEVELOPMENT



**University of
Zurich**^{UZH}



Longitudinal Study on Child Development Based on Wearable Technologies

Guilherme Lichand, Josipa Majic, Onicio Neto

Symposium on the results and next steps of the UNICEF-UZH Partnership

supported by



 Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Direktion für Entwicklung
und Zusammenarbeit DEZA

Goals

- To follow a cohort of Malawian newborns **for the next 18 years**.
- Every 3 years, structured face-to-face data collection about critical dimensions of child development.
- This will allow us to:
 - Understand children's life journeys and their **critical inflection points**
 - Rigorously evaluate UNICEF Malawi's country program

Goals

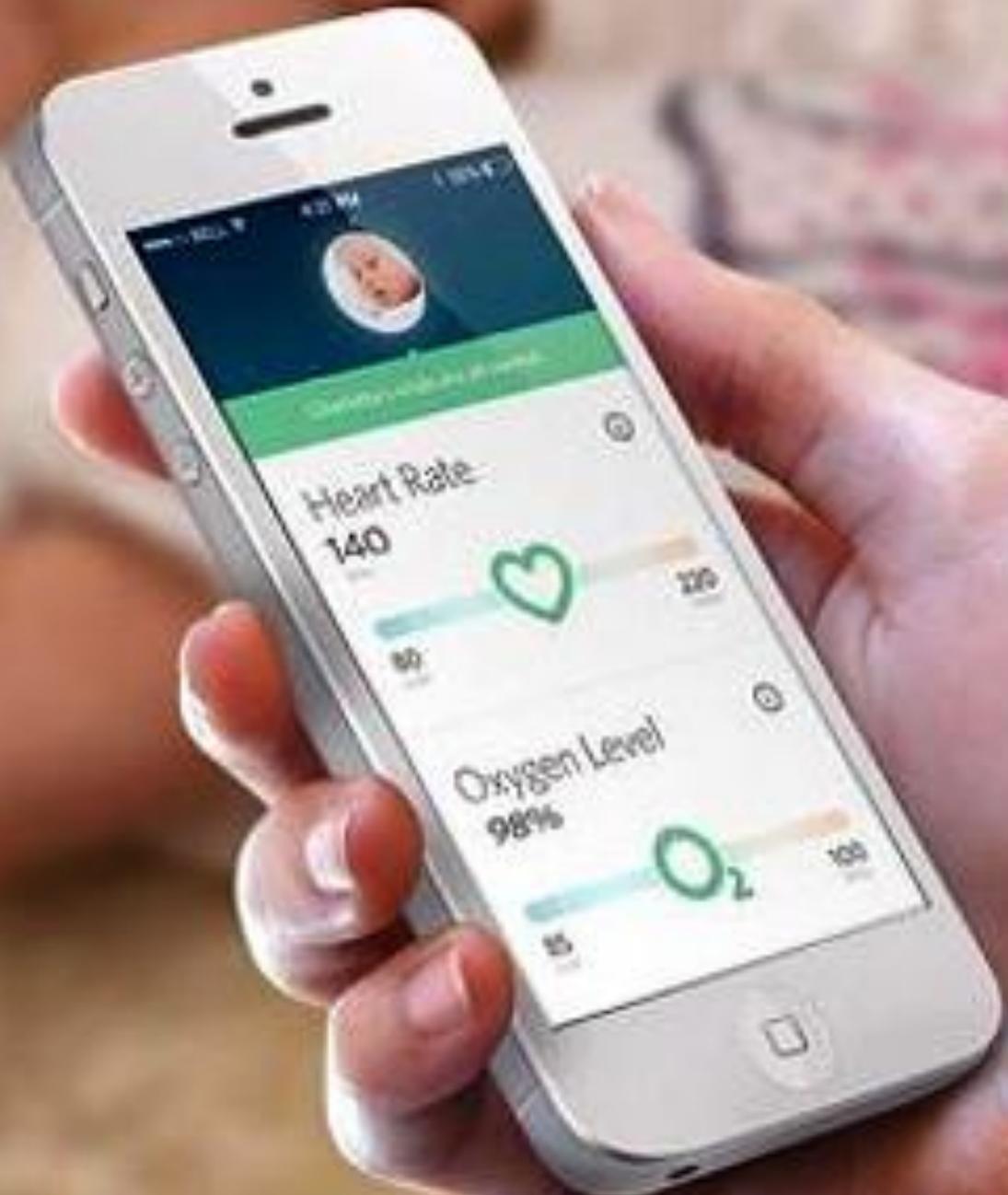
- Recent evidence has documented that **children's bio-markers** – from vital signs to cognitive and non-cognitive skills to markers of toxic stress – are key indicators of child development.
- We plan to collect data on such indicators during face-to-face surveys, drawing on **UNICEF's recently developed modules for ECD** at different ages, and on **field techniques to collect children's markers** that have been successfully employed in similar settings.

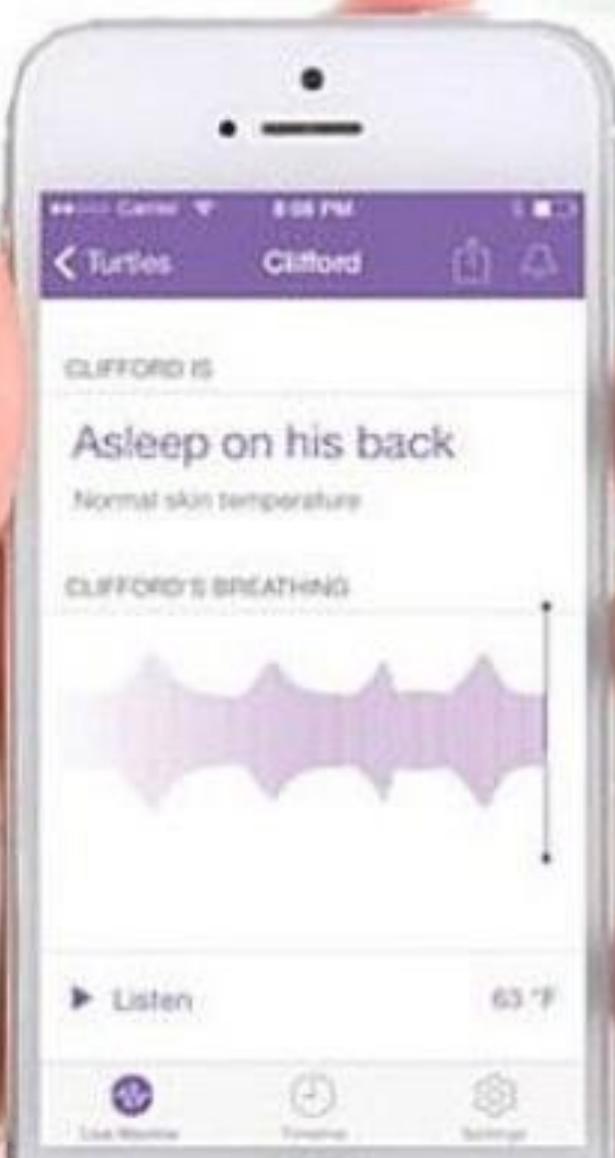
Contributions

- The study will provide a **unique contribution** towards understanding the life journeys of children in Malawi, and towards rigorously evaluating the impacts of UNICEF's country program over the course of these children's lives.
- Beyond that, there may be **opportunities** to expand the scientific boundaries of what we know about child development in poor countries and, with that, to design better programs to serve those children, to the extent that we can draw on the right set of technologies **to change the paradigm of how children's biomarkers are collected in those settings.**



10









12,486
Words

20,000 goal

Connected

6am

10am

2pm

1,000 words

500 words

Who can benefit?

Sense-U Baby Breathing & Rollover Movement Monitor: Alerts You for No Breathing, Stomach Sleeping, Overheating and Getting Cold with Audible Alarm from...

Be the first to review this item | 81 answered questions

Sense-U

Price: **\$89.99** + \$23.59 Shipping & Import Fees Deposit to

Switzerland [Details](#)

Your cost could be **\$79.99**. Eligible customers get a **\$10 bonus** when reloading **\$100**.

In Stock. Sold by [Sense-U](#) and Fulfilled by Amazon. Gift-wrap available.

This item ships to **Zürich, Switzerland**. Want it Thursday, Aug. 23? Order within **20 hrs 20 mins** and choose [AmazonGlobal Priority Shipping](#) at checkout. [Learn more](#)

Deliver to Guilherme - Zürich 8001

Qty: **1** ▾

[Turn on 1-click ordering](#)



[Add to Cart](#)



[Buy Now](#)

[Add to List](#)



[Add to Baby Registry](#)

[Add to your Dash Buttons](#)



About the product

- Portable and easily clip onto your baby's swaddle/sleepbag/onesie/etc(ATTN: Pls avoid waistband area of the clothes thicker than 0.08" or 2mm, in case it breaks the ring accessory)
- Monitor your baby's breathing with audible alarm for no breathing, movement and fast breathing

Who can benefit?

Owlet Smart Sock 2 Baby Monitor - Track Your Infant's Heart Rate & Oxygen Levels

Owlet

★★★★★ 601 customer reviews | 160 answered questions

Amazon's Choice for "owlet baby monitor"



Price: **\$299.00**

Your cost could be \$289.00. Eligible customers get a \$10 bonus when reloading \$100.

In Stock. Sold by [Owlet Baby Care](#) and Fulfilled by Amazon. Gift-wrap available.

This item does not ship to **Zürich, Switzerland**. Please check other sellers who may ship internationally. [Learn more](#)

Deliver to Guilherme - Zürich 8001

Qty: 1 ▾

[Turn on 1-click ordering](#)



Add to Cart



Buy Now

Add to List

Add to Baby Registry

What benefits?

★★★★★ **Peace of Mind!**

By [Amazon Customer](#) on August 30, 2017

Verified Purchase

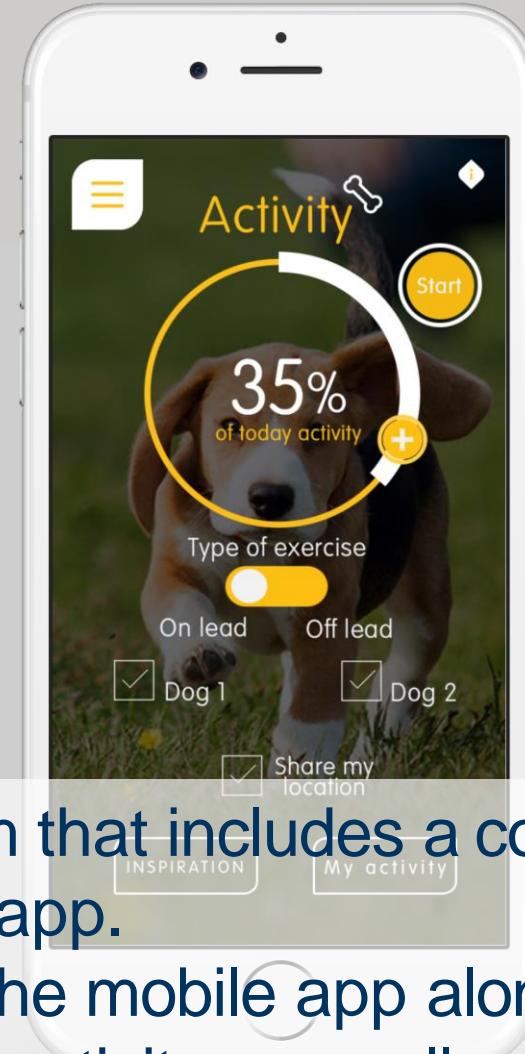
This monitor is great. I love that I can go on my phone, see exactly what my little son's readings are, and go right to sleep without worrying. We have had one false alarm, but it was due to the sock slipping, and we sleep with the bassinet right in front of our faces so we can jump into action if need be. We had debated about getting this monitor because it is so expensive, but it is 100% worth it.

★★★★★ **Peace of mind is priceless.**

By [MsV8r](#) on April 19, 2018

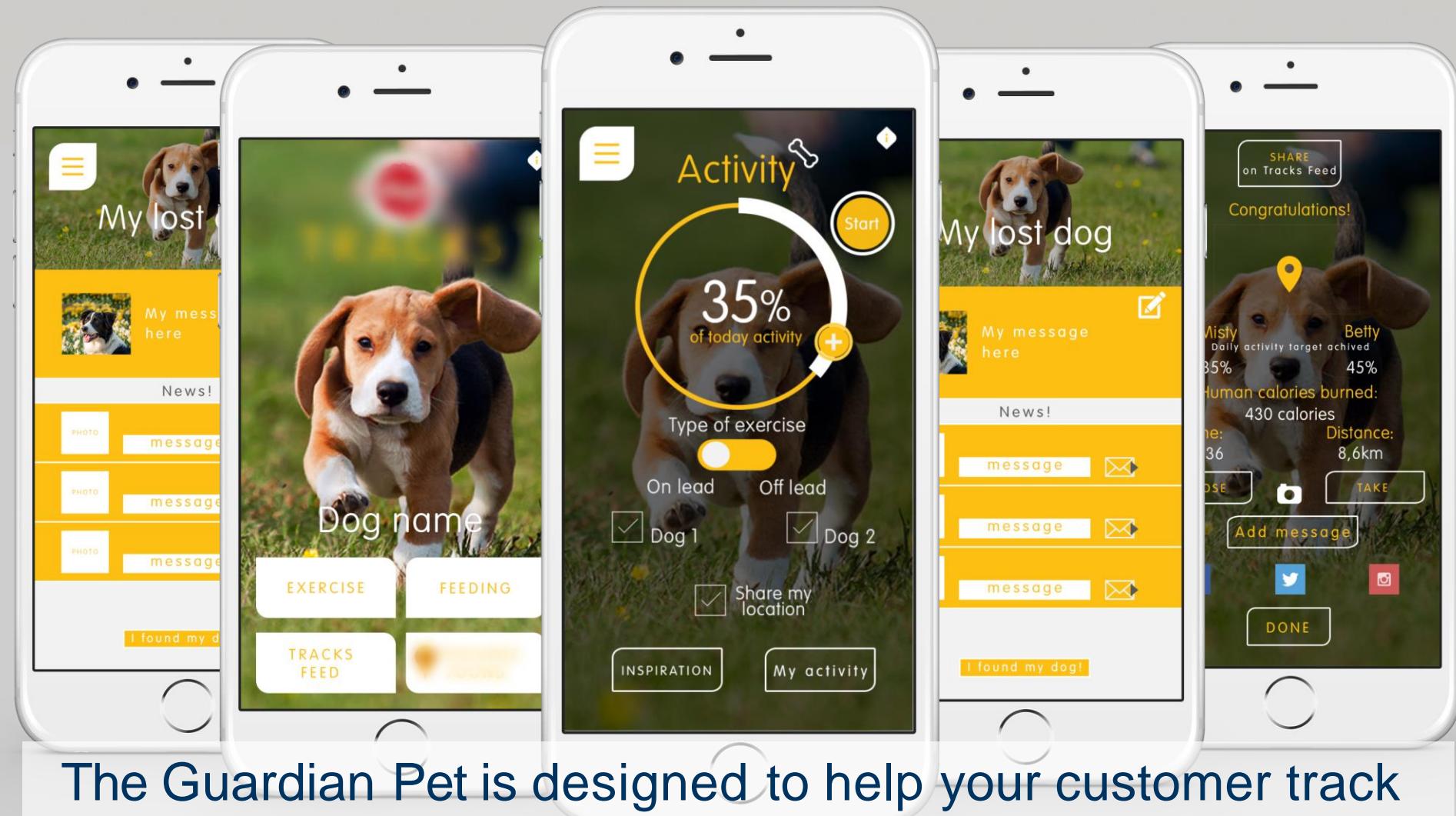
Verified Purchase

This is an essential for anxious new parents. I sleep so much better knowing that I'll get an alarm at the first sign of trouble with my little one. The only time we ever get false alarms is when we're out of range from the base which you want to happen because it's ensuring that the product is going to work all night. The range of the sock is pretty decent and shouldn't give you a problem as long as the baby is sleeping in the same room as the base. The app is a nice thing to be able to have because it gives you live vital sign readings and notifies you if the base disconnects or if there are any vital sign issues. I know the price tag looks steep but I figure you can't really put a price on safe sleep for your little one.



It works as a connected system that includes a collar clip + mobile app.

The system can also work with the mobile app alone, and the customer enters the activity manually.



The Guardian Pet is designed to help your customer track their pets and get personalized feeding plans – delivered at their doorstep.

Meanwhile

In Malawi...



FLETCHER-GONG/A/PHOTOSHARE

In Silicon Valley...

The impact of
those technologies
is nearly zero

What could the impact be

If we could put those
technologies to use
**where they are most
needed?**

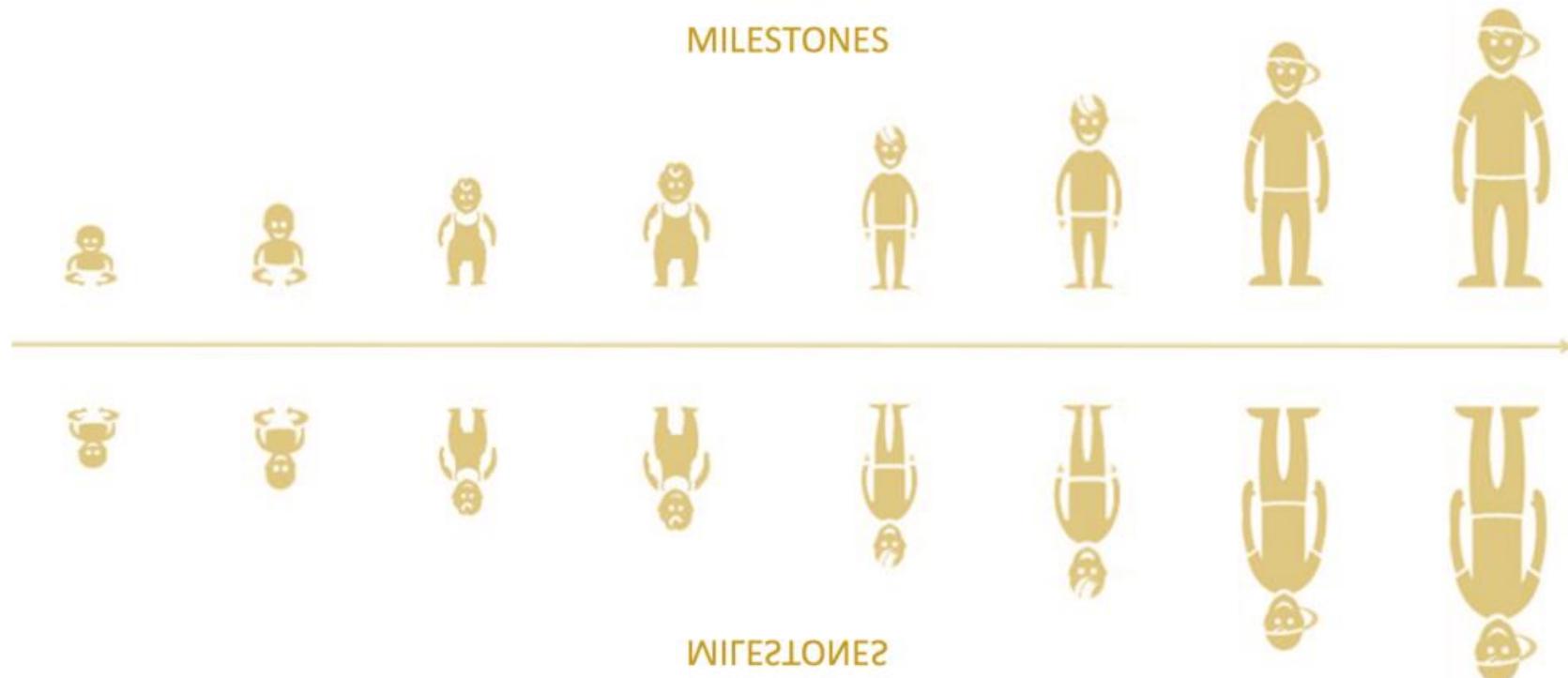




Why this matters...

Designing programs
without good data
is very hard

Children's life journeys and inflection points



Why this matters...

Highly treatable
diseases are still
leading causes of
child mortality

Diarrhea: Common Illness, Global Killer

Diarrhea kills 2,195 children every day—more than AIDS, malaria, and measles combined.



2,195

Children die daily of
diarrhea — that's like losing
nearly 32 school buses full
of children each day

1 in 9

Child deaths are due to diarrhea

Diarrheal diseases account for 1 in 9 child deaths worldwide, making diarrhea the second leading cause of death among children under the age of 5. For children with HIV, diarrhea is even more deadly; the death rate for these children is 11 times higher than the rate for children without HIV.

Despite these sobering statistics, strides made over the last 20 years have shown that, in addition to rotavirus vaccination and breastfeeding, diarrhea prevention focused on safe water and improved hygiene and sanitation is not only possible, but cost effective: every \$1 invested yields an average return of \$25.50.

Learn how simple and inexpensive interventions to prevent and treat diarrhea can save the lives of children around the world.



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Focus Groups



Evidence from focus groups

1. Parents struggle with early detection of malaria and anemia

Evidence from focus groups

2. Parents would welcome technologies that could help detect and treat earlier

The challenge...

If it were easy, it
would already be
solved

Smartphones are more common in Europe, U.S., less so in developing countries

Percent of adults who report owning a smartphone



Note: Percentages based on total sample.

Source: Spring 2015 Global Attitudes survey, Q71 & Q72.

Malawi

- ~85% living in rural areas
- 4% of households with access to electricity
- 48% own a cell phone, but very low smartphone penetration (let alone internet)

Creative ways
to **collect,**
store and
transfer data
can generate
impactful
solutions!



What is it?

Khushi Baby (KB) is a mobile app for community health workers that interfaces with a digital necklace worn by patients via Near Field Communication, or NFC. The patient record data is synced to the cloud and displayed on our analytics dashboard, where insights can be acted upon by health officials. More than just another approach to digitize the record keeping process, the Khushi Baby system presents a novel

Malawi...

...is very innovative!





A community in Kasungu in central Malawi is introduced to the unmanned aerial vehicle (UAVs) – being tested for transportation, connectivity, and imagery.

©UNICEF/UN070228/Chisiza

“Malawi has over the years proved to be a leader in innovation and it is this openness to innovation that has led to the establishment of Africa’s first drones testing corridor here in Malawi,” said Malawi’s Minister of Transport and Public Works, Jappie Mhango.

“We have already used drones as part of our flood response and we can see the potential for further uses, such as transportation of medical supplies, which could transform lives in remote rural communities.”

Press Release LILONGWE, Malawi/NEW YORK, 29 June 2017 –
The Government of Malawi and UNICEF today launched an air corridor to test potential humanitarian use of unmanned aerial vehicles (UAVs), also known as drones. The corridor is the first in Africa and one of the first globally with a focus on humanitarian and development use.

It is centred on Kasungu Aerodrome, in central Malawi, with a 40km radius (80km diameter) and is designed to provide a controlled platform for the private sector, universities and other partners to explore how UAVs can be used to help deliver services that will benefit communities.

Flying drones or otherwise...

Need cost-effective ways

to capture data at

high-frequency...

just like smartphones would

But before...

Which
children's bio-markers
can we track?



IDGuardian

Biometric Research

Contact:
josipa@idguardian.co

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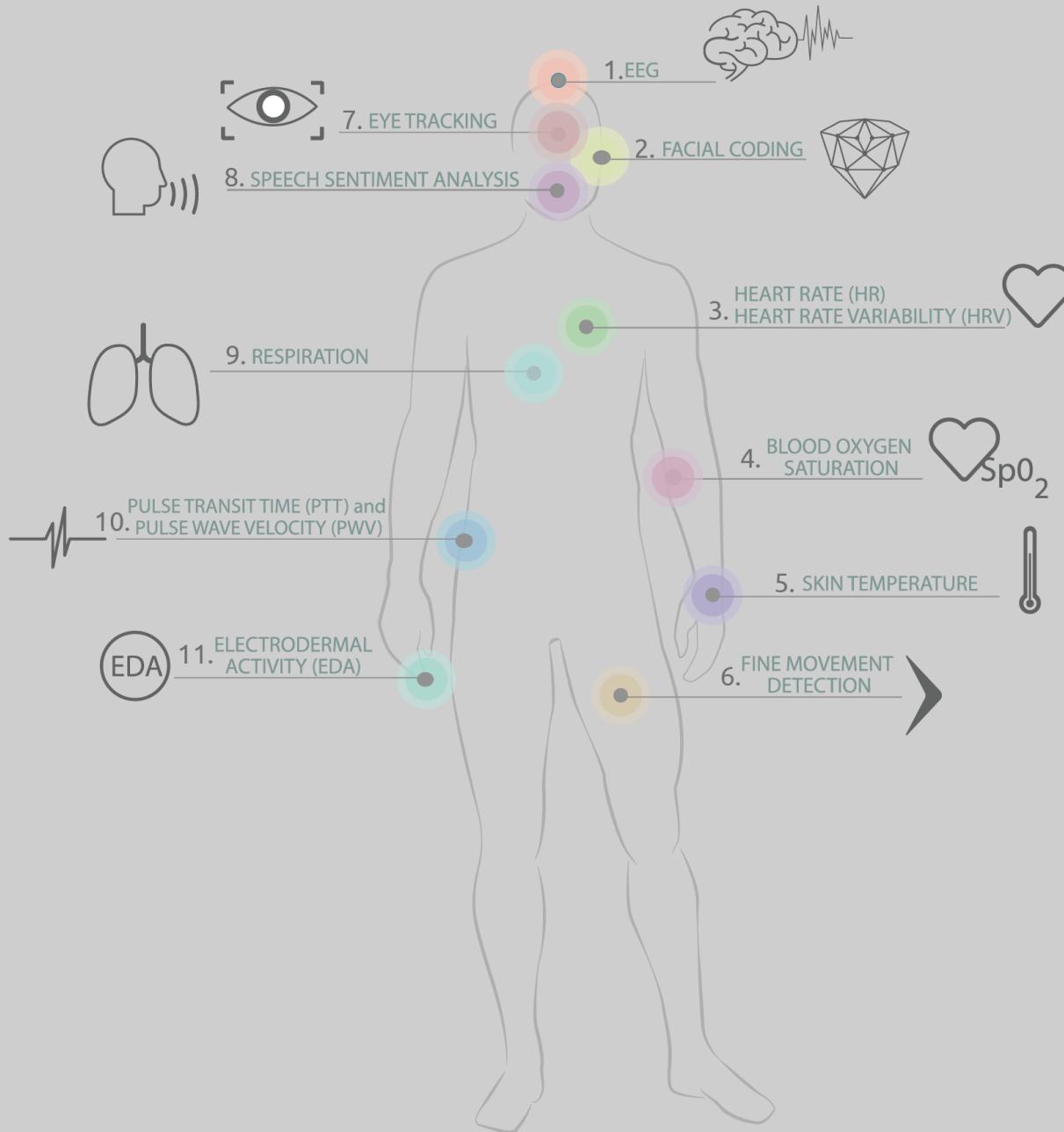
1. IDINSIGHTS

IDI research design uses a combination of traditional market research techniques and biometric data gathered from wearable devices to detect, identify and validate emotional reactions and triggers.

ID Insights (IDI) is a platform that harnesses the growing power of wearable technology to provide invaluable insight into human emotions and behavior.



Biometric data we can collect



Teddy the Guardian

Product description

Teddy the Guardian is the first smart teddy bear on the market, your own personal guard equipped with sensors that measure and monitor your little one's well-being.

Combining your child's favourite toy and cutting edge, touch-based technology, Teddy the Guardian becomes the most child friendly way to check up on your little one.

By holding Teddy's paw the medical data is seamlessly shared and managed under your fingertips.



What does it do

Teddy's sensors measure:

1. Object and body temperature



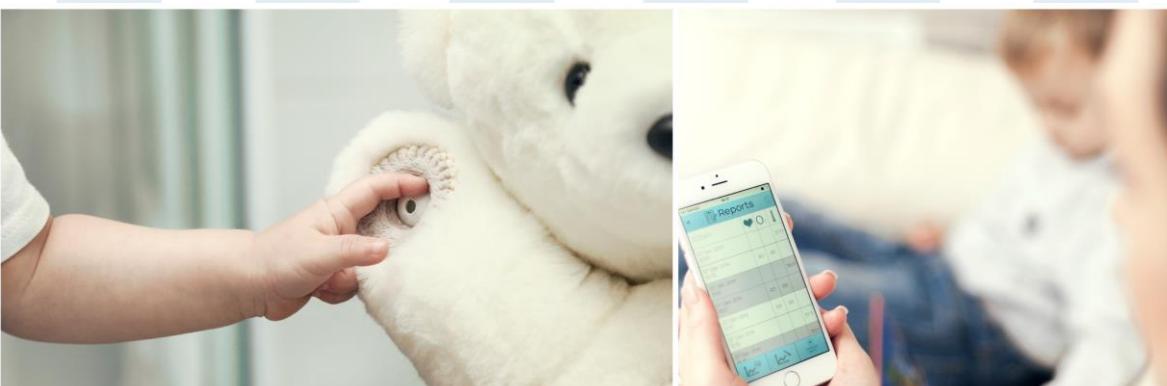
3. Heart rate



4. Blood oxygen level



Sensor board has a Bluetooth low energy communication built-in through which it communicates with a central collector, a smart device with a companion App.



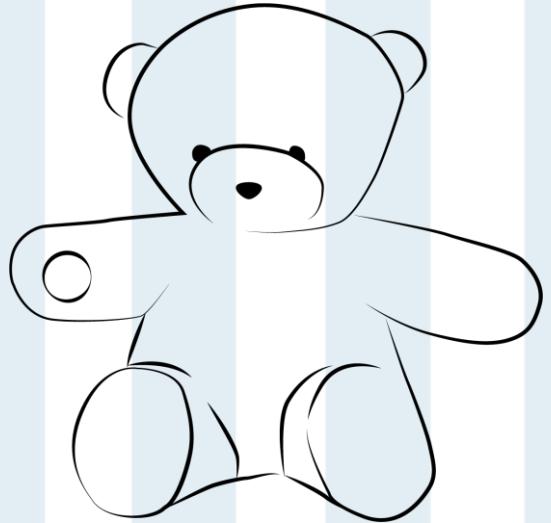
How does it work

Teddy's paw measures your child's vitals within seconds and makes them visible by simply pressing a button on your mobile app.

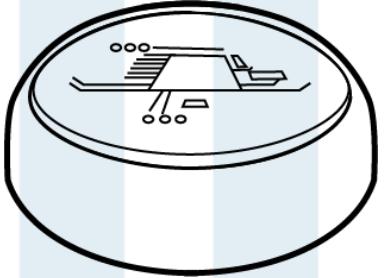
Teddy the Guardian app collects data, displays the history of results and generates alarm in case a preconfigured threshold limit is reached.



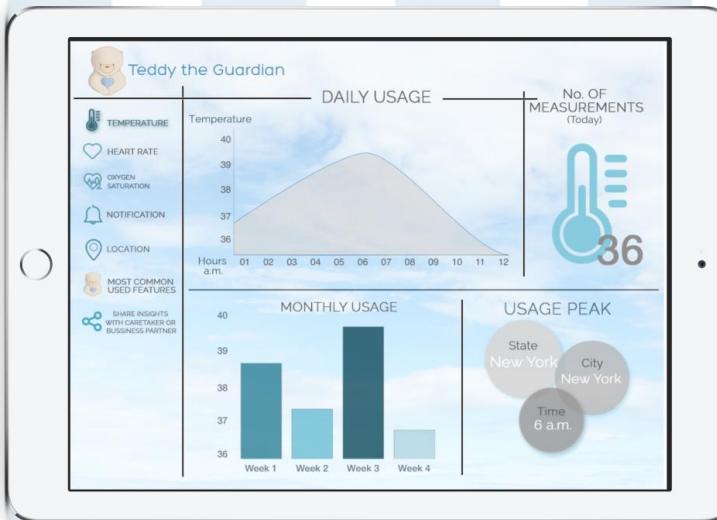
Package includes



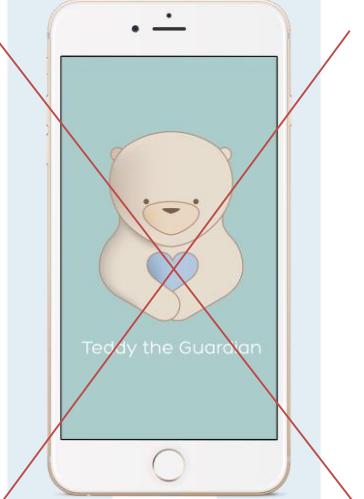
1. Teddy the Guardian
plush toy



2. Sensor in plastic enclosure



4. Dashboard



3. Proprietary app

Are we missing a central piece?

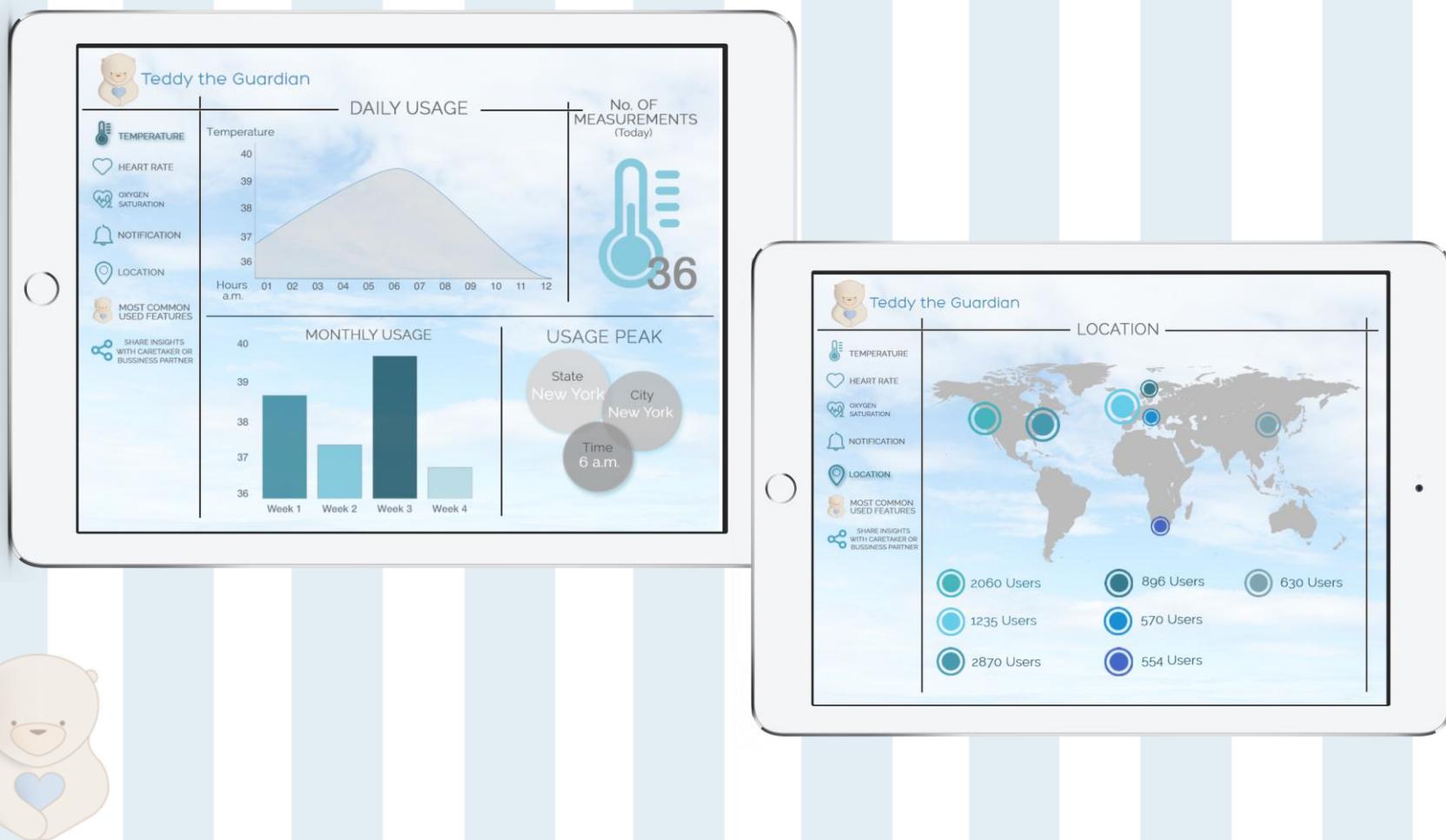
Aggregate beats individual data:

1. Dashboards inform policy
2. Can trigger warnings (more soon)
3. Individuals misread data



Dashboard

With an easy to use hardware for end consumers, our B2B clients get a fully customised backend and biometric insights dashboard.



the GUARDIAN BUTTONS



Vodafone
Foundation

the GUARDIAN BUTTONS

Turn any object into a connected, bio-sensing device using a modular and detachable system with a companion mobile app.

The modules measure:

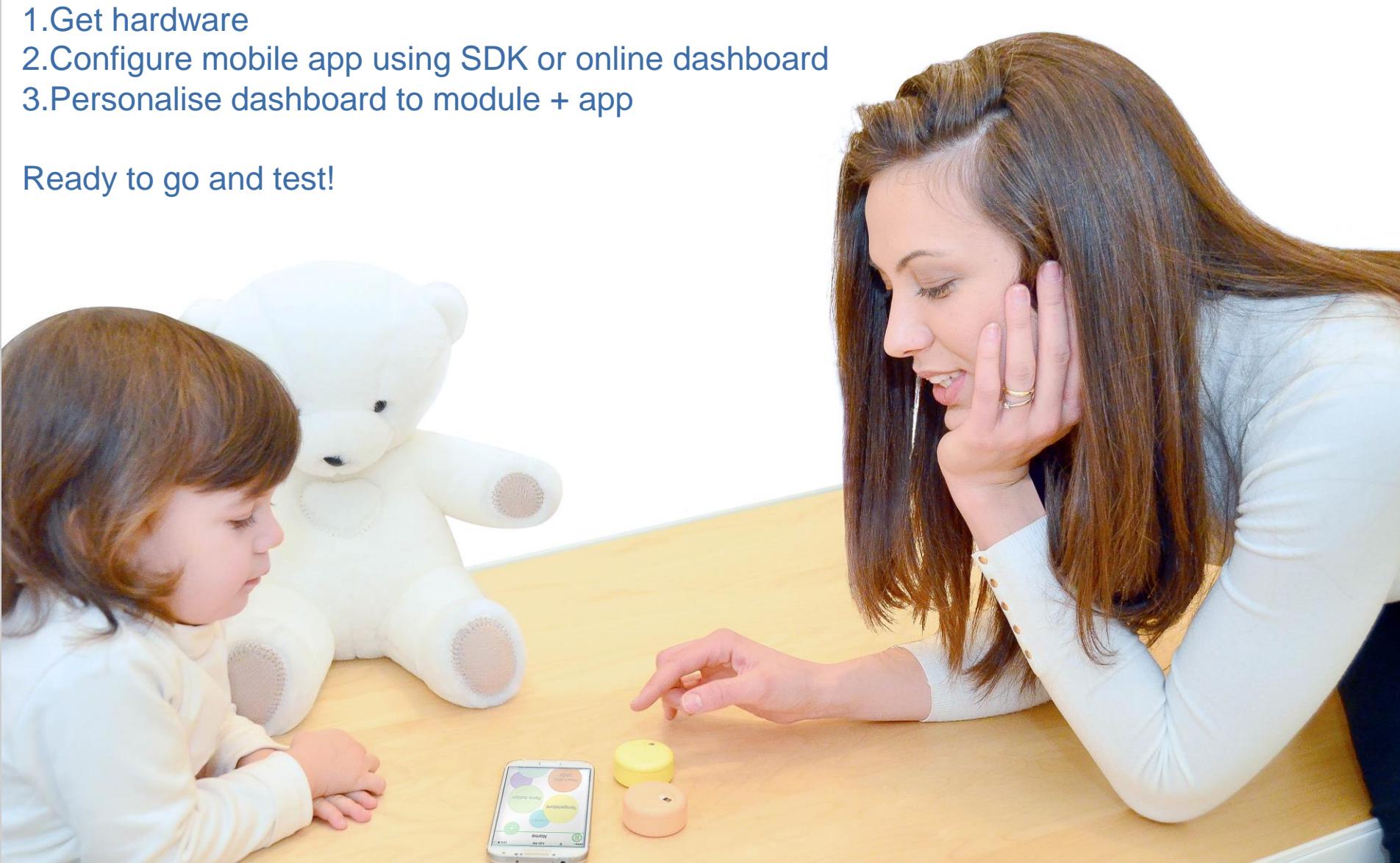
- 1.Object and ambient temperature
- 2.Heart rate and Sp02
- 3.Galvanic skin resistance (perspiration)
- 4.Movement and position measurement
- +
5.Programmable button



2.How does it work?

- 1.Get hardware
- 2.Configure mobile app using SDK or online dashboard
- 3.Personalise dashboard to module + app

Ready to go and test!



5. Create a solution for you and your community

Create a device that would fit your and the needs of your community. Use your knowledge and creativity and create the one you would like to see – in minutes.

The Guardian Buttons kit is the perfect place to start – safe, pre-configurable and fun to use with our modules that are cute as a button



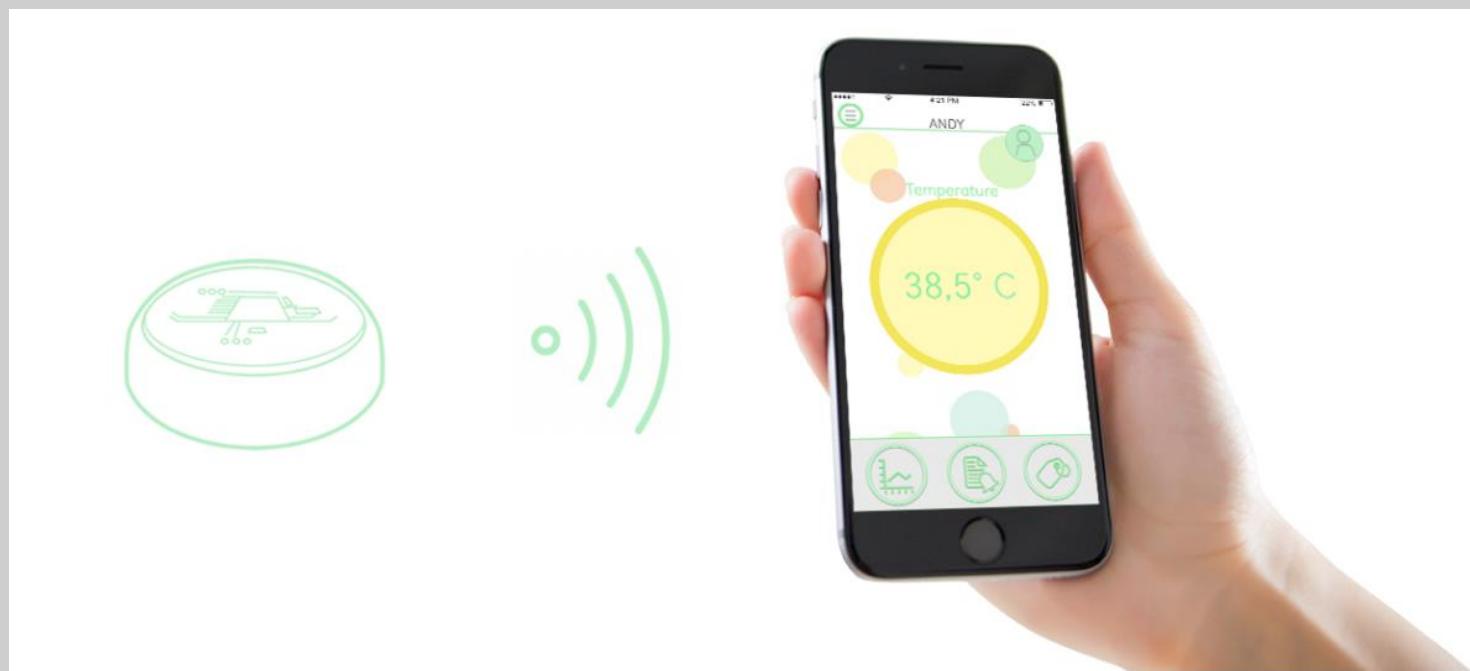
6. How do final solutions look like?

Our solutions range from looking like toys, to wearables and modules that get embedded in everyday furniture. The goal is to make it as simple and easy to use – fully adapted to the local context and environment.



9.Consists of:

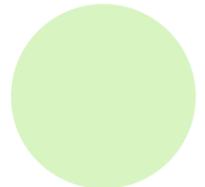
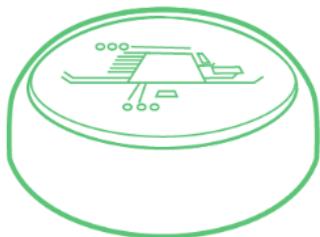
- 1) Hw module in plastic enclosure and firmware
- 2) Configurable mobile app system
- 3) Backend and dashboard



9.Consists of: the hardware

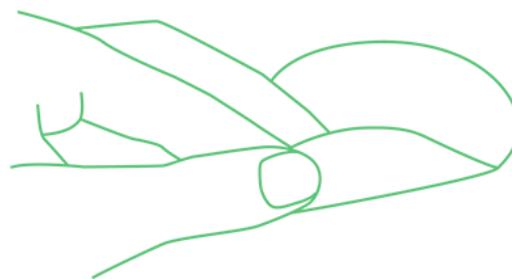
1st step:

Each module has a customized suite of biosensors with a coin battery and BLE that enables the device to communicate with a dedicated mobile App.



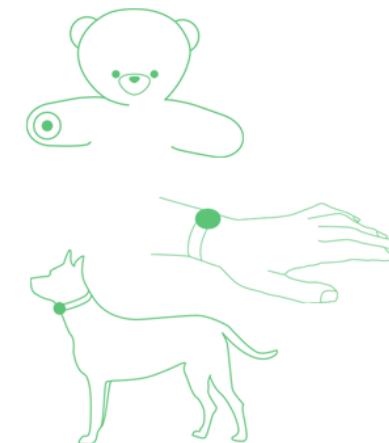
2nd step:

The module has a proprietary adhesive system enabling it to get attached and detached to a number of surfaces from plastics to various fabrics.



3rd step:

The customized module can now be attached to any object, turning the product experience into a seamless, bio-sensing and interactive system.



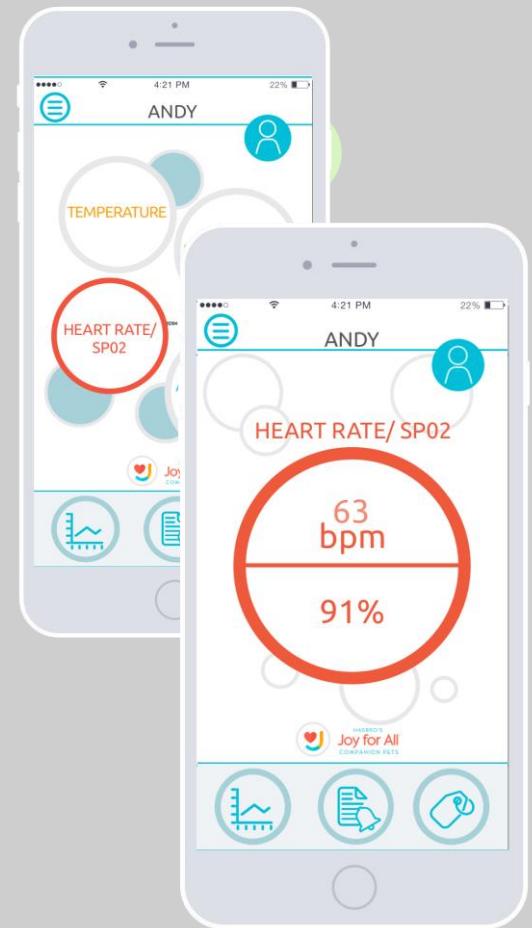
Some ideas

Attached to chitenge



Some ideas

With HSA for sessions during check-ups or examination



Some ideas

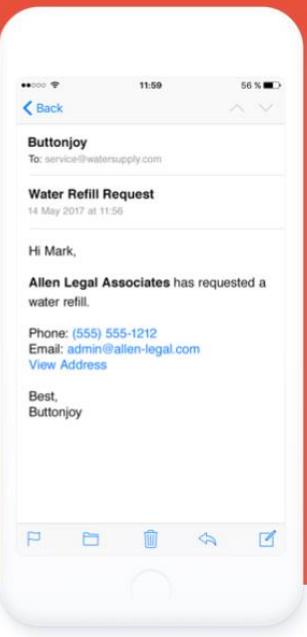
Button at house wall

**Wifi buttons that email, text,
log data, and more...**

Easy web management. Custom
branding available.

Buy Buttons

Manage Buttons



Data storage and transmission...

For continuous use:

- WiFi Suitcase, Drones (TBD)

For episodic usage (HSAs):

- Connected smart device

So what?

What could be achieved
with such data?

1. Understanding children's life journeys



... at high frequency, and at income levels for which very little is known to date.

1. Understanding children's life journeys



- What are the impacts of exclusive breastfeeding?
- Of early stimulation?
- Of better hygiene?
- Of violence against children?

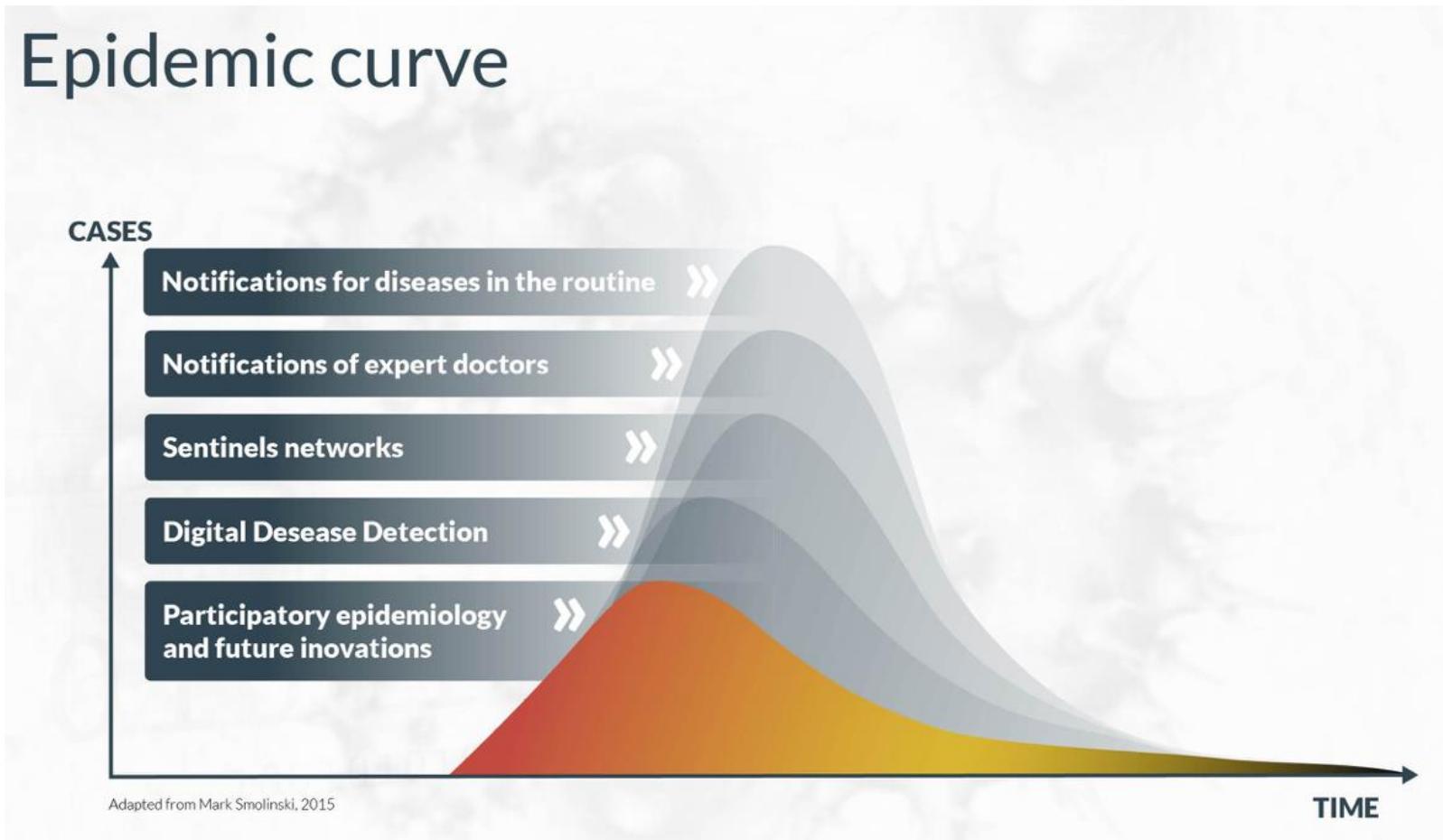
2. Setting up Early Warning Systems



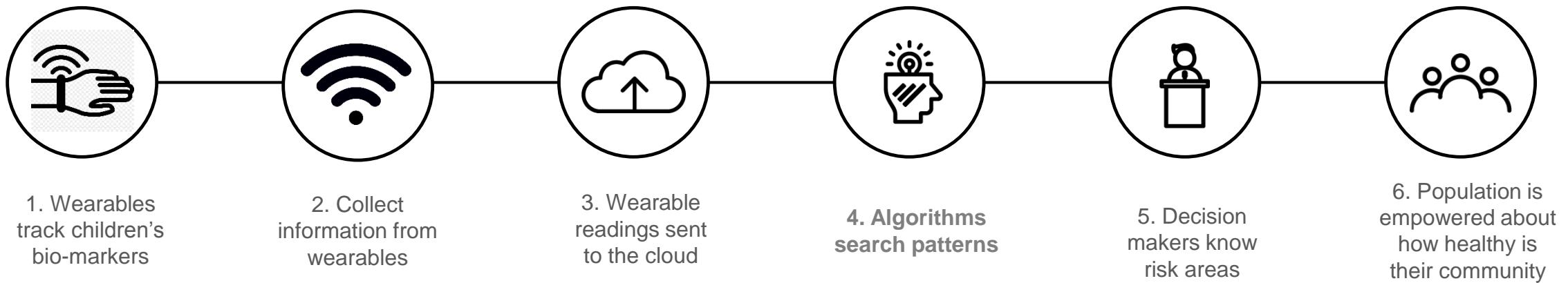
... drawing upon epidemiological approaches to activate behaviors of families and community health workers.

Digital Disease Detection (DDD) & Early Warning Systems

Epidemic curve



Digital Disease Detection (DDD) & Early Warning Systems



Digital Disease Detection (DDD) & Early Warning Systems

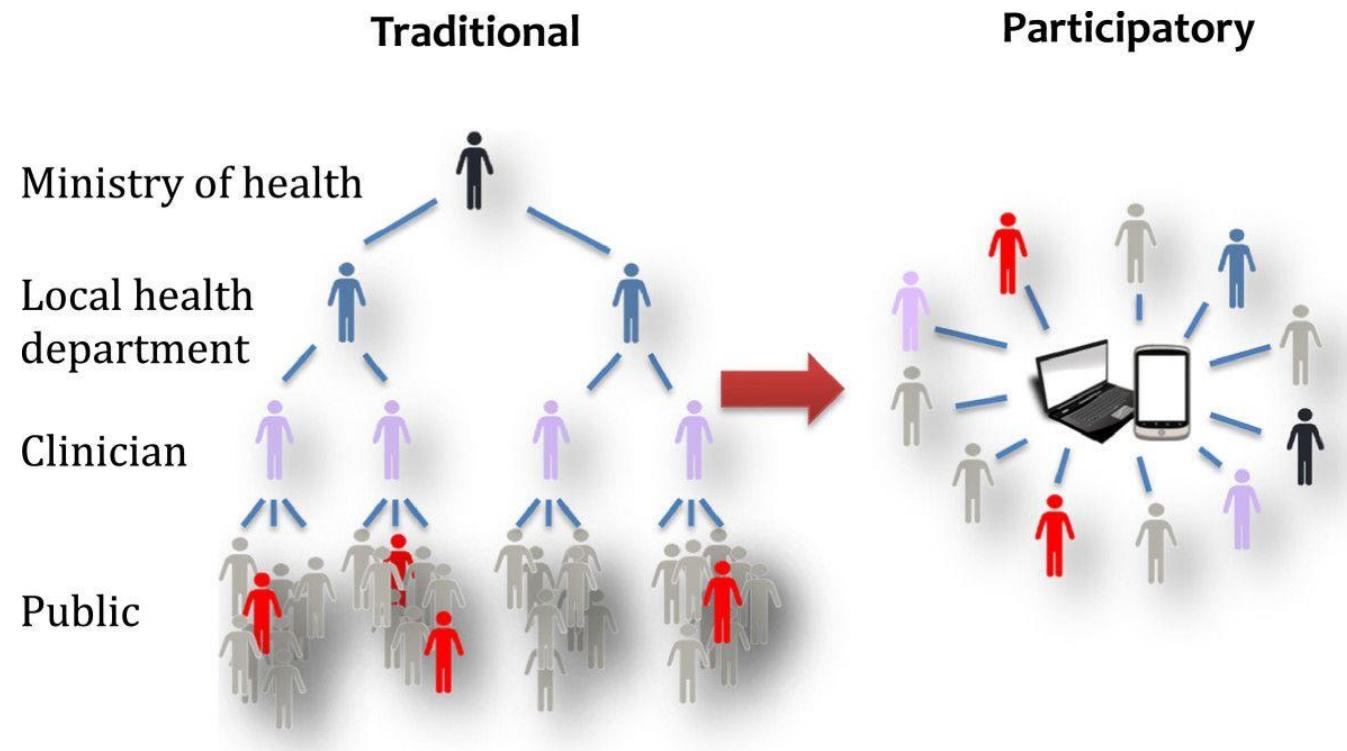
Table. Description of the systems or platforms of digital detection of diseases.

Title	Country, base year	Strategy type	Data source	Main objectives	Interaction platform
ProMED	USA, 1996	A	Secondary	Collecting data in cyberspace related to diseases and conditions.	Website and mobile application
GPHIN	Canada, 1997	A	Secondary	Collecting data in cyberspace related to diseases and conditions.	Website
InfluenzaNet	The Netherlands and Belgium, 2003 Portugal, 2005 Italy, 2008 UK, 2009	B	Primary	Collecting information on influenza-like illness data, made available to the population.	Website and mobile application
HealthMap	USA, 2006	A, B	Primary and secondary	Spatializing epidemiologically relevant information, made available to the population via web.	Website and mobile application*
MedISys	Italy, 2007	A	Secondary	Collecting data in cyberspace related to diseases and conditions.	Website
Salud Boricua	USA (for Puerto Rico only), 2008	B	Primary	Spatializing information on acute febrile syndrome (dengue fever, influenza, leptospirosis) data, made available to the population.	Website
Flu Near You	USA, 2011	B	Primary	Spatializing information on influenza-like illness data, made available to the population.	Website and mobile application
Dengue na Web (Dengue in the Web)	Brazil, 2011	B	Primary	Spatializing information on data related to dengue fever.	Website
Observatório da Dengue (Dengue Observatory)	Brazil, 2011	C	Primary	Spatializing tweets related to dengue fever.	Website
Saúde na Copa (Healthy Cup)	Brazil, 2014	A, B	Primary and secondary	Detecting possible changes in the epidemiological pattern of acute disease occurrence in 12 Brazilian host cities during the 2014 FIFA World Cup.	Website and mobile application
Guardiões da Saúde (Guardians of Health)	Brazil, 2016	B	Primary and secondary	Detecting in advance aggregates of cases of diarrhoeal, respiratory, and exanthematic syndromes in Brazil.	Website and mobile application

A: Mining of epidemiologically relevant data on the web; B: Participatory surveillance (Active crowdsourcing); C: Data mining on Twitter (Passive crowdsourcing)

* Made by the application Outbreaks Near Me.

Digital Disease Detection (DDD) & Early Warning Systems



Digital Disease Detection (DDD) & Early Warning Systems

JMIR PUBLIC HEALTH AND SURVEILLANCE

Leal Neto et al

Table 1. Symptoms, syndromes, and diseases searched using Healthy Cup app.

Symptoms	Syndromes		Diseases						
	Respiratory	Diarrheal	Rash	Influenza	Measles	Rubella	Cholera	Acute diarrhea	Dengue
Fever	X	X	X	X	X	X	-	X	X
Cough	X	-	X	X	X	X	-	-	-
Sore throat	X	-	-	X	-	-	-	-	-
Nausea	-	X	-	-	-	-	-	X	-
Joint pain	-	-	X	-	-	-	-	-	X
Headache	-	-	X	-	-	-	-	-	X
Diarrhea	-	X	-	-	-	-	X	X	-
Rash	-	-	X	-	X	X	-	-	X
Bleeding	-	-	X	-	-	-	-	-	X
Shortness of breath	X	-	-	X	-	-	-	-	-

Digital Disease Detection (DDD) & Early Warning Systems

Syndemic approach (Merrill Singer, 2009)

- “Synergic Epidemic”
- ≠ co-morbidity;
- Simultaneous occurrence increase the burden of disease;
- Not only biological factors involved;
- Useful when community health is been considered in the context;

Digital Disease Detection (DDD) & Early Warning Systems

population level and impact disease pathologies at the individual level.⁵

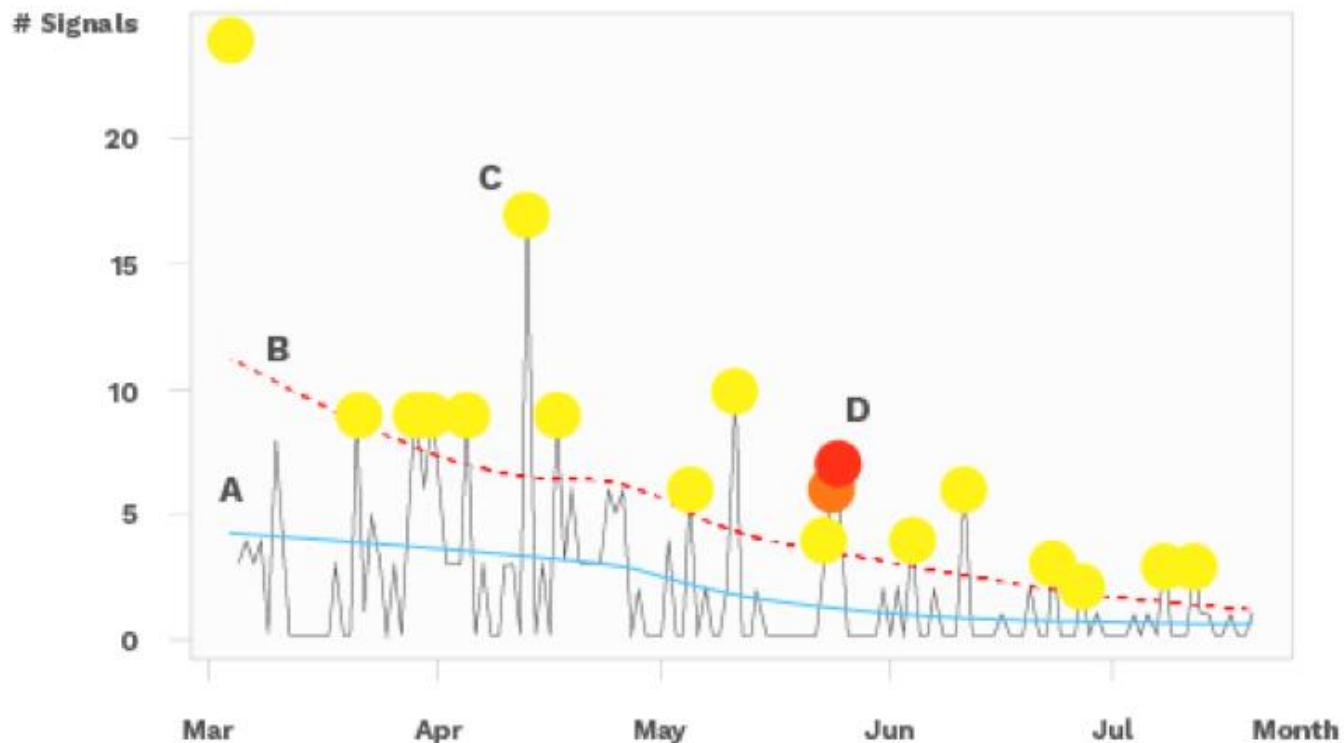
The syndemics concept has three core features. Syndemics involve the clustering of two or more diseases within a population; the biological, social, and psychological interaction of those diseases; and the large-scale social forces that precipitate disease clustering in the first place.⁶ Originally developed by medical anthropologists to make sense of HIV/AIDS,^{5,7} the theory of syndemics offers an innovative way of understanding why diseases cluster together in populations disproportionately affected by poverty, social exclusion, gender-based violence, climate change,

Digital Disease Detection (DDD) & Early Warning Systems

Early warning systems

- Based in algorithms of Local Regression (Loess function);
- Works well with zero inflation;
- Runs in the cloud with window timeframe defined (cronjobs);

Digital Disease Detection (DDD) & Early Warning Systems



- A = Loess function;
- B = Upper range;
- C = When the signal exceed one time the upper range;
- D = When the signal exceed 3 times in a row;

Each peak could be represented in the end-user layer by a alert signal with 3 colours.



University of
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Digital Disease Detection (DDD) & Early Warning Systems

The screenshot shows a web-based dashboard titled "EARLY WARNING SYSTEM". The left sidebar contains a navigation menu with sections for "Dashboard", "CCWD EWS" (Surveys, Tables, Maps), and "DATABASE" (Reports, Widgets, Maps). The main content area is titled "Past Alerts" and displays two alerts: "Diarrhea Important alert - increased 3 times in a row" (red background) and "Fever Important alert - exceed 1 time" (yellow background). Below this is an "Alert" section with two items: "Fever" (yellow background, "Fever in the village XYZ has increased in the last 24h, 37 children reports") and "Diarrhea" (pink background, "Diarrhea in the village ABC and KLM has increased in the last 24 hours, 12 adults and 3 children reports"). The URL in the browser bar is http://www.ccwd.uzh.ch/dashboard_malawi.html.

Digital Disease Detection (DDD) & Early Warning Systems

Challenges

- Balance between sensitivity and specificity;
- Signal processing;
- Actions to do when the alert has been triggered;

Evidence from focus groups

3. HSAs have a hard time covering all villages, and would benefit from info on how to prioritize

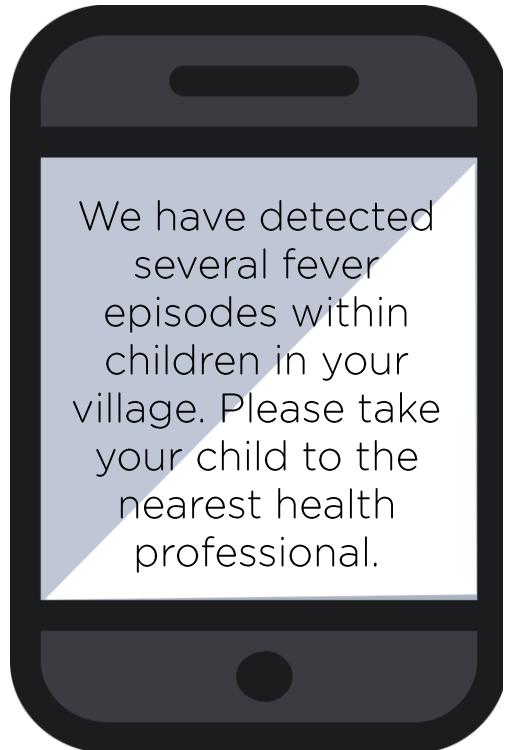
Evidence from focus groups

4. HSAs and parents would appreciate getting health messages on the phone

EARLY WARNING SYSTEMS

Integration with SMS

Message to families



Message to HSAs



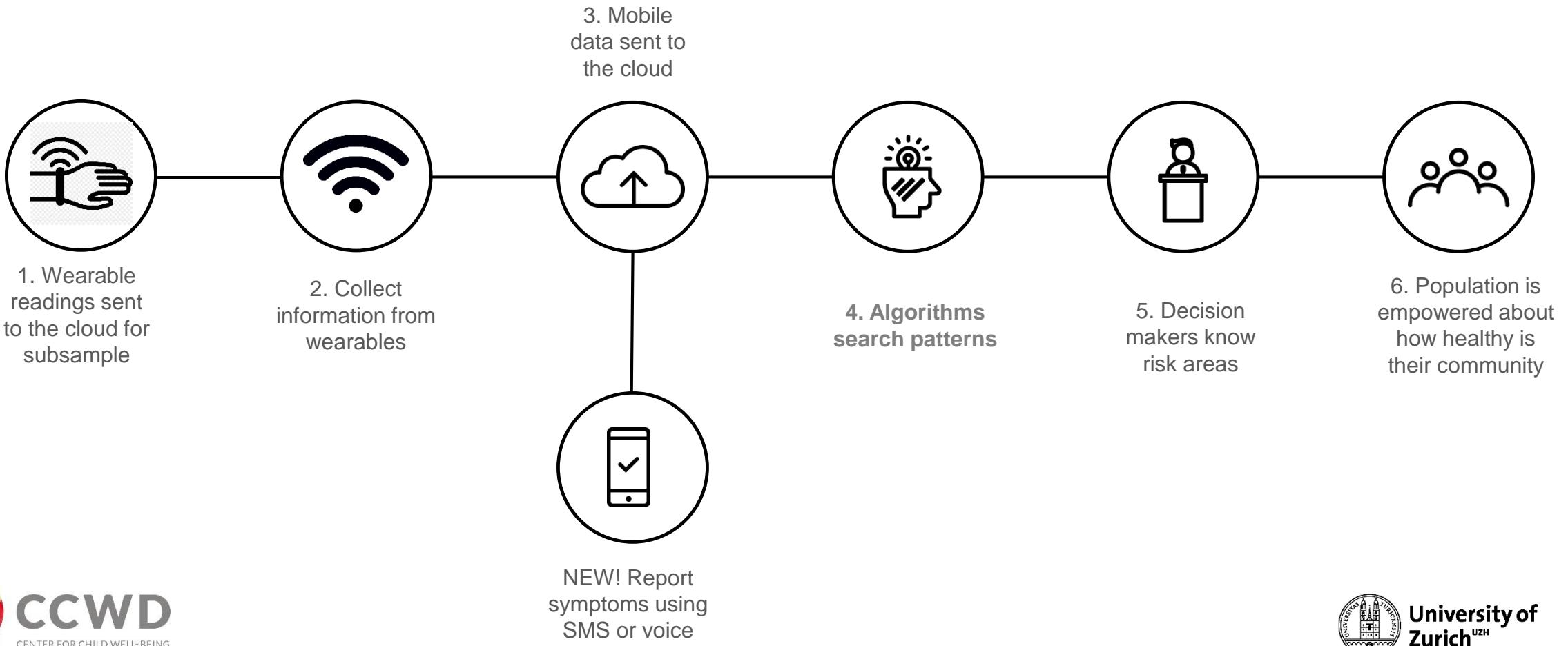
What about where wearables are not available?

How to scale up?

Evidence from focus groups

5. HSAs and parents would like to communicate more and without costs

Digital Disease Detection (DDD) & Early Warning Systems



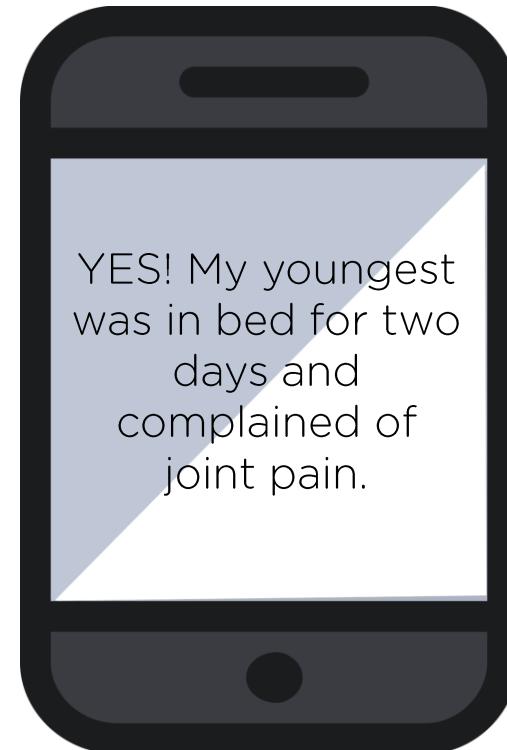
CALIBRATING PROXIES

Crowdsourcing (SMS ou IVR)

UNICEF Survey



Caregiver's answer



Machine Learning
can find what
answers'
characteristics
are *predictive* of
data captured by
wearables
+

Trigger messages
to HSAs and
families

3. Evaluating UNICEF's programs



... at high frequency and at no additional cost.

4. Artificial Intelligence



... for referral services in the context of the Social Cash Transfer or of home visiting programs.

... for M4D behavior change campaigns.

Leapfrogging



We need and value your inputs!

www.ccwd.uzh.ch