

Hacking Africa

An Appropriate Application of Ingenuity



Yaw Anokwa

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hello, my name is yaw anokwa and i am phd student in computer science at uw.

the title of the talk is called hacking africa. i choose it because i figured it'd be controversial enough to get people to show up. the subtitle is stole from the jargon file -- this dictionary of hacker slang, and i think it is the best definition of a hack.

before we get started, i figure i should give you a little background.

i'm originally from ghana. i came to the states when i was about ten. i got into computers literally the day i landed in america, and i haven't stopped since. in high school and college, i ran a pretty successful computer consulting business. i got my bachelors in computer science and another electrical engineering.

when i left college, i worked in the defense industry doing radar for fighter jets and technology to help locate enemy submarines.

i quit that gig and came to grad school at uw. i finished my masters in cs doing work on how we can make everyday devices like phones easier to use.

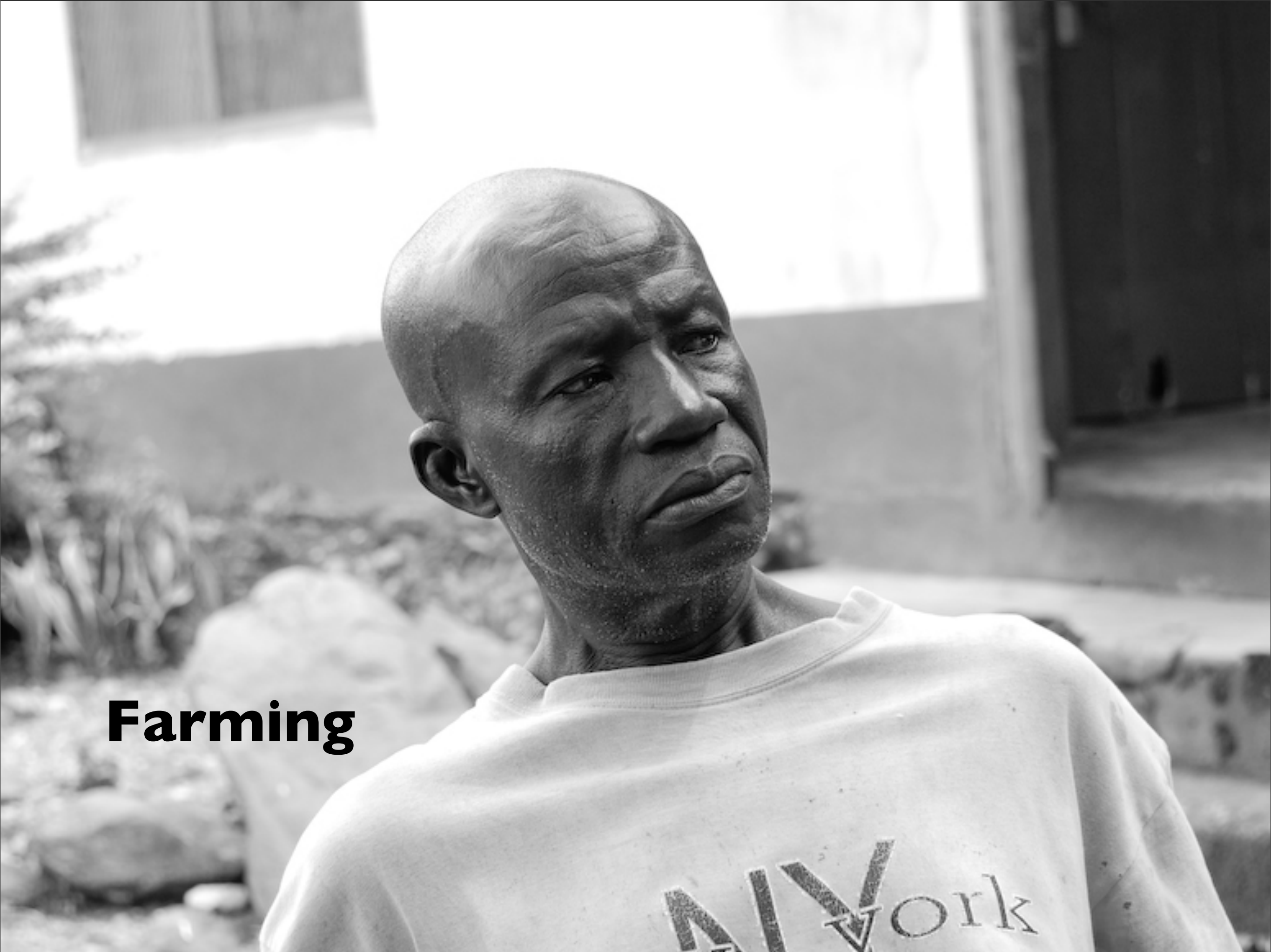
my phd research is on computing systems for developing regions. i focus mostly on phones and healthcare, and these days, i'm working google to bring scale up some ideas i have been working on.

i primarily work in rwanda, tanzania and uganda on systems for delivery of healthcare. about half the time is spent in the field, which is awesome.

this talk is pretty informal, so ask any questions you want at any time. i have some pictures i want to show, and then some projects i want to talk about. i will leave space at the end for questions...

What needs hacking?

Where can we apply appropriate and ingenious technology?



Farming

this is my uncle.

he farms palm nut trees in ghana. he has a cell phone which knows how to use. that technology can help him answer questions he has.

for example, what are the best practices for growing palm nut trees? of the five near by markets, where should i sell my palm oil? should i grow peppers instead?

Education



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this is a child at a rural hospital in rwanda.

good teachers don't like working in rural places where children like these live. education is the key to surviving in the global market place.

how do we education the children of the poor? could we give them phones with educational material? or ship video recorded from the best school in the country to them?

Business



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this is off the coast of tanzania where local fishermen are being squeezed out of their waters. to compete, they need to organize and maybe get a loan.

if they do, what are low cost ways for the micro finance agency to track payments? software automation and transactions performed over a cell network can help drive down costs.

Health



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this child likely has an ear infection which can easily be treated.

but what about his mother? if she has hiv and tb. how will her complex care be managed at a rural hospital? recording keeping is important and computers can help here.

Hack I

Medical Record Systems

Rwanda Scale Up

- Began in 2005 as first Partners in Health project in Africa. Strong partnerships with Ministry of Health, Clinton and Gates Foundations and TED.
- Scale up PIH model of health nationwide with services including HIV/TB, family planning, malnutrition, community health workers, housing, employment, schooling.
- Started in Rwinkwavu and in two years has grown into two hospitals and four health clinics. Training center and third hospital are being built.
- Technology is playing an important role in the scale up and OpenMRS is the vehicle.



in 94, one million rwandans were killed in 100 days while the world stood by and did nothing. 13 years later, the genocide has brought a lot of public attention and funding to the country, and the government has used this funding to turn things around.

the rwanda scaleup was part of bill clinton's ted prize to build a healthcare system in rwanda. so the clinton foundation, the gates foundation and the ministry of health all pitched in to build this health care system. partners in health was the ngo brought in to do the work on the ground.

partners in health is an ngo which does healthcare in poor communities. if you don't know pih and it's founder paul farmer, i encourage you to check out mountains beyond mountains which chronicles paul work in haiti.

the most significant bit, here is that pih is known for hiv and tb care for the poor, but they do it in a comprehensive and community based way. with pih, when patients are hungry, they are fed. when they are homeless, houses are built. it's very expensive, but it works. and although it worked in haiti for 30 years, it had never been scaled up and so rwanda was a chance to prove it could scale.

rwinkwavu, where i was based was where the scaleup is happening. it's a former mining town and the district hospital pih built up has a catchment area on 425k. it's been two years and the scaleup is showing great results.

this is jennipher who is this bright eyed friendly little girl. you can see the turnaround in these images. she's still in rwinkwavu, but these days, she's a little spoiled but is clearly much healthier.

this turn around is more than doctors and medicine though, because to do this on a large scale, you need technology and that's where openmrs comes in.

Deploying OpenMRS

- Open-source, enterprise electronic medical record system for resource-constrained healthcare environments. Modular design with active developers and users worldwide.
- Unlike malaria, HIV/TB needs good records and so OpenMRS chosen system to be used nationwide. Rwanda has 6000 chronic care patients in the system.
- Clinicians fill out paper forms, data team enters the data into the system, reports generated and data analyzed.



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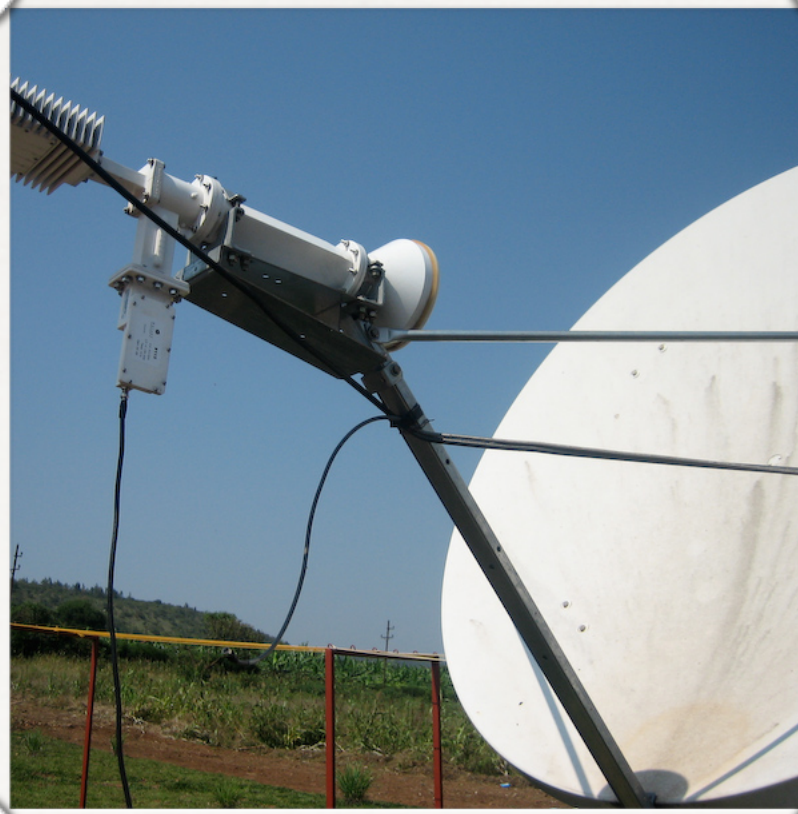
openmrs is a medical record system that is used worldwide, and you can tell from the picture in the bottom that the participants are all over the world. if you are interested in helping in the developing world from the comfort of your couch, you can join the project, add code – there is a lot of work to be done.

openmrs is important because unlike malaria, with hiv/tb you really need to keep track of regimens and symptoms to do the best care. also, by tracking every service (food, pharmacy, etc) the patient encounters you can do much better reporting and tracking. rwanda has chosen this for nation wide deployment and has 6000+ patients.

it's not just code. openmrs is hard because of infrastructure challenges (power, deploying networks, good interfaces, local capacity etc). part of the scaleup deals with the other challenges.



Six months in rural Rwanda



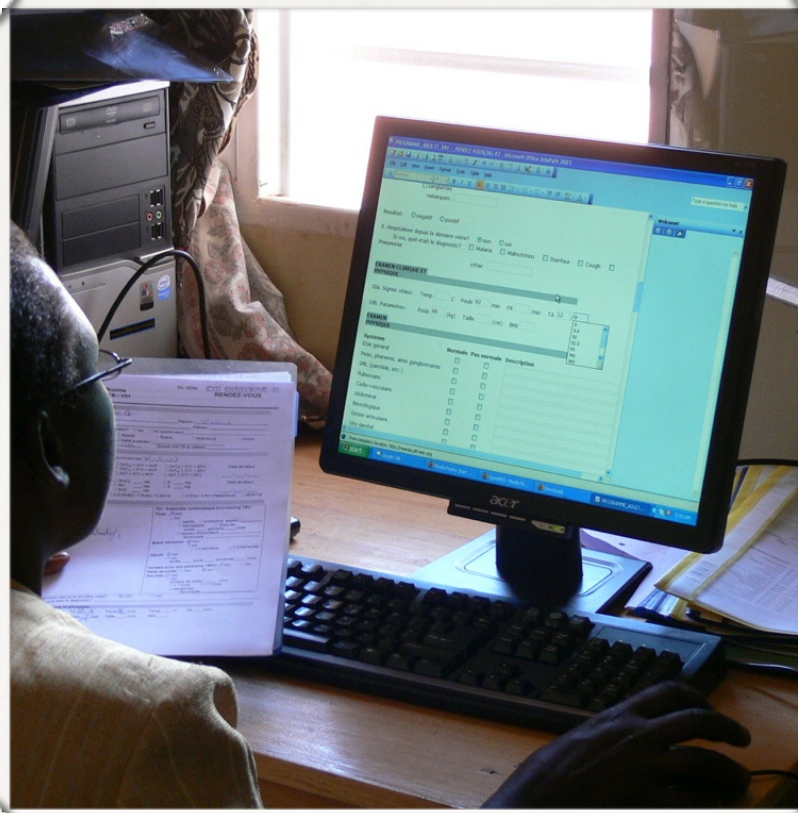
Deploying infrastructure



Training ICT staff



Observing clinical care



Managing data team

Sample Patient

IMB ID 44003685-C
 Gender Female
 Age 28 yrs (~Jan 1, 1980)
 Last Visit 1 month ago (Dec 14, 2007)
 Habimana Samuel, Mulindi

X-RAY, CHEST
 Comments: No previous diagnoses

CD4 IN THE LAST 6 MONTHS

Test	Result	Date	Comments
4	740.0	May 8, 2007	
4	313.0	Sep 13, 2006	

ADVERSE EFFECTS

Adverse Effect	Date	Comments
ISH, SEVERE	Nov 15, 2006	
RIPHERAL NEUROPATHY	Nov 15, 2006	
ISH, MINOR	Nov 15, 2006	

SYMPTOMS

Symptom	Date	Comments
EIGHT LOSS	Sep 13, 2007	

DRUGS

Order	Dose	Frequency	Start Date	Stop Date	Comments
omune-40	1.0 tab(s)	2/day x 7 days/week	Oct 25, 2006		

CHARTS

- PULSE**: Line graph showing pulse rate from Oct-07 to Dec-07.
- WEIGHT (KG)**: Line graph showing weight from Jan-07 to Sep-07.
- CD4 COUNT**: Line graph showing CD4 count from Oct-06 to Apr-07.

Adding to OpenMRS

spent six months living in rural rwinkwavu at the district hospital.

each of pih's six sites (2 hospitals and 4 health centers) have some infrastructure. they all have vsat, wifi, gsm, solar power, so there is a lot to deploy and maintain.

along with the infrastructure comes training of the local technical staff. mostly a lot of hardware repair, keeping the network up and computers virus free.

observing care and how doctors both local and foreign work and interact.

make sure data was entered correctly, and reports were done, etc.

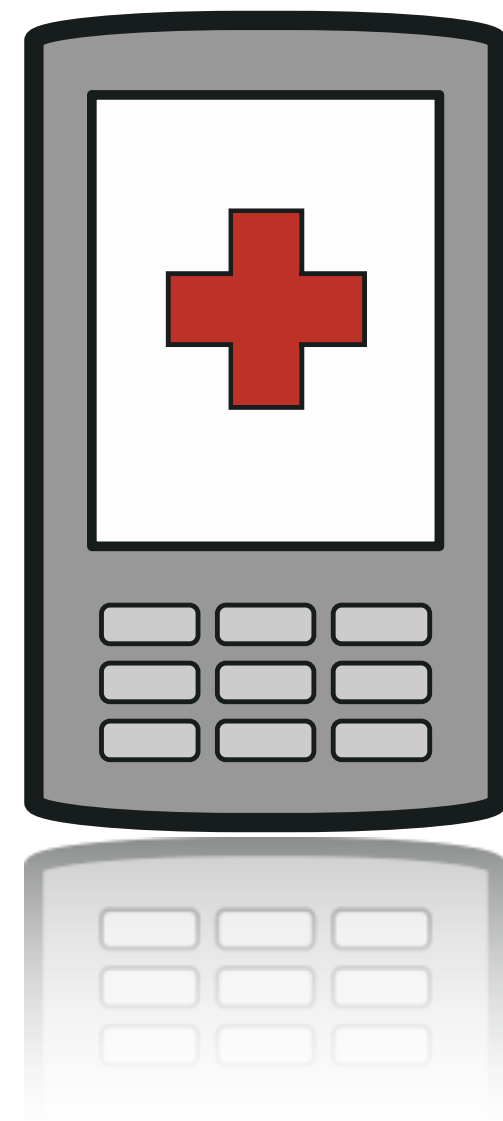
finally added a lot of bug fixes, usability changes, and some new functionality to openmrs. this is a a one page patient summary which doctors can use to get a broad overview of a patient.

Hack 2

Community Health Workers

CommCare

- CommCare is a project to aid community Health Workers (CHWs). CHWs make house hold visits to provide very basic care.
- For effective care, CHWs must keep track of a great deal of information, from patient records to remembering follow up visits.
- CommCare is software on phones to help CHWs with planning and performing their job.



CommCare is a project to aid community Health Workers (CHWs), who are the first--and often only--medical professionals that people see in rural areas of low-income countries.

People living in extreme poverty often delay seeking care until it is too late for them to be helped. CHWs make house hold visits to provide very basic care.

However, for CHWs to provide effective care, they must keep track of a great deal of information, from patient records to remembering follow up visits.

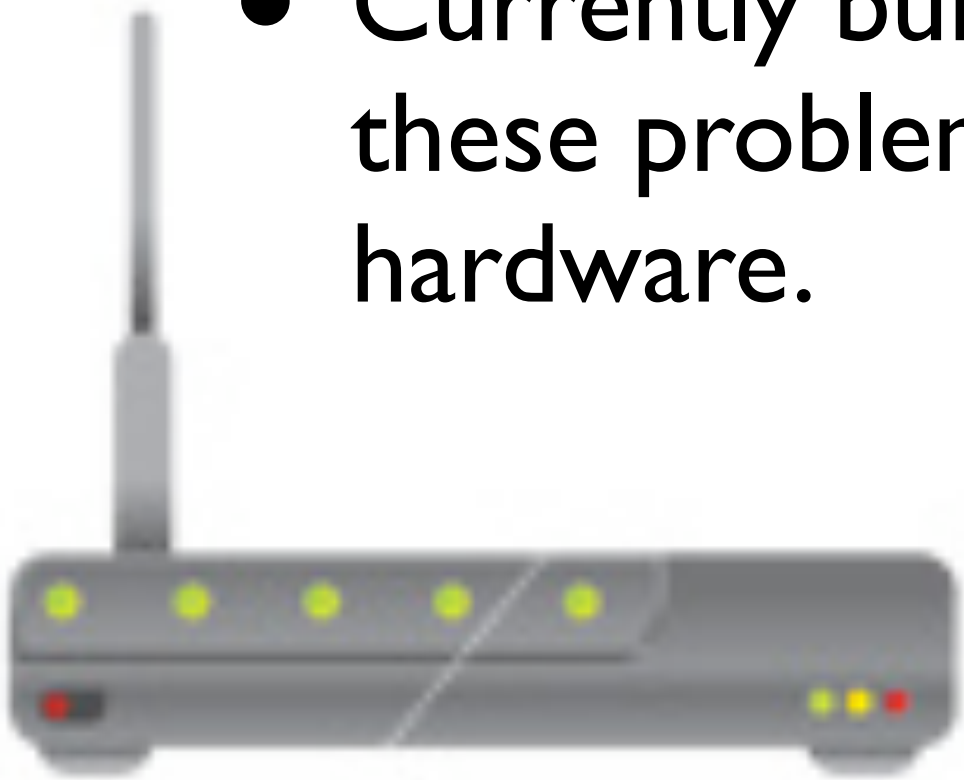
CommCare is software that we are developing to run on mobile phones to aid CHWs with planning and performing their job.

Hack 3

Networking Infrastructure

Über Router

- For network administrators who must manage the common slow connections in low-income regions, providing users good service is really hard.
- Currently building firmware to address these problems on commercially available hardware.



For network administrators who must manage the common low bandwidth, high-latency, intermittent connections in low-income regions, providing users the "best" (or even adequate) service is a nontrivial problem.

While optimizing throughput is important, we argue that latency is an important and often ignored component of network performance. The intrinsically high latencies seen in the developing world are exacerbated by excessive queueing from traffic patterns which often swamp links with miss-sized queues.

We are currently building firmware to address these problems on commercially available hardware.

Hack 4

Clinical Tools

e-IMCI

- To reduce child mortality rates in low-income countries, health organizations created Integrated Management of Childhood Illness (IMCI).
- IMCI are medical algorithms to guide less trained, health workers through classification and treatment.
- Problems include expensive training, lack of supervision and a tendency to adhere to protocols.
- e-IMCI puts IMCI onto a PDA and shows great promise in Tanzania.



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To reduce child mortality rates in low-income countries, the WHO United Nations Children's Fund, and others have created the Integrated Management of Childhood Illness (IMCI) program.

At the core are a set of medical algorithms, designed to guide less trained, health workers step-by-step through the classification and treatment of children from 0-5 years old. The program is currently implemented in over 80 countries worldwide. Research has shown that following IMCI leads to better health outcomes.

The problem is that it is not commonly used. There are a number of reasons including: expense of training, lack of sufficient supervision and a tendency to adhere to protocols less rigorously over time.

e-IMCI is a project to put the IMCI child health protocols onto a PDA to improve service delivery at the point of care. An initial pilot suggests that the software leads to better adherence to the IMCI protocol. We are now in the process of running a larger validation study to gather even more data. This project is part of a larger effort to bring evidenced based medicine to front line health workers in rural areas of low-income regions.

Hack 5

Transportation

*Bus

- Project that aims to provide reliable transport in Kyrgyzstan by providing riders with reliable bus route data.
- Riders in Kyrgyzstan have no idea when their buses will arrive and may have to wait for long periods of time.



- Buses will have a GPS module installed to relay location over SMS to a central server. Riders can then use SMS to query location and arrival times.

*bus is a project that aims to provide reliable transportation in Kyrgyzstan by providing riders with reliable bus route data.

Currently, riders in Kyrgyzstan have no idea when their buses will arrive and may have to wait for long periods of time.

With the *bus system, buses in Kyrgyzstan will have a GPS module installed that relays location information over SMS to a central server. Riders can then use SMS to query where their buses are and when they are expected to arrive at a certain location.

Hack 6

Income Generation

Empower Artists

- Empower Artists has teamed up with SIFE, a Heritage University group, to allow artisans in remote regions to sell their art to the world.



- Goal is to offer a field kit that universities can use to record information on local art and create product listings on a e-commerce website.
- Hopes to foster a relationship between artist and customer that will lend insight and meaning to each piece of art.

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There is also some work done locally with underserved populations.

Empower Artists has teamed up with SIFE, a Heritage University group, to allow artisans in remote regions to sell their art to the world.

We will offer a field kit that universities can use to record information on local art and create product listings on our e-commerce website.

This site will provide artists with access to a wider range of customers and a chance for increased compensation.

By focusing on artists' personal stories, we hope to foster a relationship between artist and customer that will lend insight and meaning to each piece of art.

Can I hack to help?

Why are computer scientists uniquely equipped to help?

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i feel that computer scientists are uniquely to solve some of these problems. besides the stereotypical guy in his mom's basement, i really think cs teaches you a set of skills needed to solve all sorts of problems.

the challenges i've seen require people who want to travel, live in the field and write code for the people who need it the most.



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so. if you are interested, there is a group at uw that i'm a part of called change. if you want to find out what we are doing, sign up on the mailing list and we can work together!

you can also email me.

and with that, are there any questions?