Implementation and Evaluation of mHealth in Resource Limited Settings

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Mobile technology-based services for global health and wellness

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Overview

• Background

• Implementing mHealth solutions in SSA

• Evaluation of mHealth systems

• Future opportunities
1 Background
Disease burden in sub-Saharan Africa

- Low and middle income countries, esp. sub-Saharan Africa (SSA) bear a disproportionate burden of key global health challenges.

- In 2014, 10.7 million people living with HIV in SSA were receiving ART (~72% of 14.9 million receiving ART globally)\(^1\).

- There were ~214 million new cases of malaria worldwide in 2015. The African Region accounted for ~88% of cases and ~90% of the estimated 438 000 malaria deaths globally.\(^2\)

- ~1.1 million (13%) of the 9 million people who developed TB in 2013 were HIV-positive. The African Region accounts for ~80% of TB deaths among people who were HIV-positive.\(^3\)

1. UNAIDS Factsheets 2014.  
2. Fact Sheet: World Malaria Report 2015  
3. WHO’s Global Tuberculosis Report 2014
Health Systems in SSA

- SSA has weak health systems characterized by poor physical and ICT infrastructure, inadequate and poorly trained health workers, weak policies and organizational capacity, and inadequate financial investment (inc. data systems).

- Weak health systems are linked to poor health outcomes hence the need for innovative tools to support healthcare services.

- eHealth (Health IT) and mHealth have been shown to enhance quality of health care through better adherence to therapeutic guidelines and protocols, informing clinical decisions, and decreasing medication errors.
Introduction to mHealth

- In 2014, ~69% of adult population in Africa owned a mobile phone.¹

- The reducing cost mobile devices and rapid expansion in coverage of cellular networks in many SSA countries has inspired the growth of mHealth.

- SSA countries, like their counterparts in the developed world, need strong Health IT to improve quality of health care.

Mobile Health (mHealth) is the use communication between mobile devices to other devices for the purpose for Healthcare and patient well-being.²

Background - mHealth

- **mHealth has the potential to extend health care services to rural and hard-to-reach areas (e.g. informal settlements/slums) where the most vulnerable and under-served populations live.**

- mHealth can support:
  - **Communication:** health and educational information, reminders (medication, appointments).
  - **Data collection:** emergency response (Ebola outbreak in West Africa), disease surveillance, health surveys.
  - **Monitoring and reporting:** logistics (commodities tracking, ordering), routine reports etc
  - **Clinical decision support:** The number of mobile clinical decision support apps and their inclusion in clinical practices has risen in recent years.¹

¹ Martinez-Perez et al. Literature review.
2 mHealth Implementation in SSA
Implementation capacity (1)

- **Training:**
  - College projects, incubation centers, industry sponsored projects, boot camps, self learning.

- **Design & Development:**
  - Design and dev mainly using open source tools.

- **Deployment:**
  - *Smart phones:* Android and Windows are the most common platforms.
  - *Simple phones:* Unstructured Supplementary Service Data (USSD) for menu based information services.
  - *Voice:* Interactive Voice Recording
Implementation capacity (2)

• Support and enhancements:
  • Vary but are influenced by SLAs, developers’ experience level and funds availability.

• Data privacy and security:
  • Limited existing policies for managing data privacy and security for mobile devices. eHealth policies may not apply perfectly.

• Data quality:
  • As with other data systems, end-user training, experience, time commitment and appreciation of value of data influence quality.
  • Data validation checks built into data entry forms or prompts.
  • Remains a key concern
Policies, Strategy and Standards for mHealth

- Largely non-existent. mHealth not yet integrated with eHealth or Health Informatics policies. *Ghana, South Africa, Kenya have eHealth Strategies based on WHO and ITU toolkit.*

- Projects are often informed by SOW, available (re-usable) tools and expertise and implemented as standalone solutions.

- Countries that have established a health enterprise architecture with interoperable sub-systems are yet to integrate mHealth.

- Standards to guide development of mHealth solutions to promote health information exchange are non-existent. Messaging or terminology standards not employed (e.g. *HL7* or *SNOMED CT*).
Examples of mHealth Projects (Kenya)

- HIV: EID/PCR Test results using SMS printers. Potential for viral load test results.
- Text for Adherence (T4A): Monitoring Adherence to ARVs and reporting problem via USSD based system
- mPEP – Post Exposure Prophylaxis: Reporting HCW need-stick injury and follow-up of PEP thru reminders
- Kenya AIDS Indicator Survey: National household survey (n=30,000)
mHealth in Ebola Response

Collaboration between IBM and AirTel (Sierra Leone's largest mobile provider) to develop a disease-mapping system presented as heat-maps.

Collecting for analysis, sharing and acting upon data gleaned from patients.

PIH software survey patients about Ebola symptoms and share care information.
Challenges Implementing mHealth in SSA

- **Human capacity:**
  - Although varied from one country to another, capacity still limited for development of high quality mHealth solutions.
  - Inadequate training of end-users, including health care workers.

- **Weak infrastructure:**
  - Limited cellular coverage in rural areas where majority of vulnerable populations live. Slow connection. Signal outages. (business sense?)
  - Unreliable/unavailable electric power to keep devices powered (e.g. SMS printers).

- **Costs:**
  - Relatively high cost of data bundles for smart phones, and text or voice calls for basic handsets.
Challenges Implementing mHealth in SSA

- **Legislation, Policies and Standards:**
  - Lack of appropriate legislation to support the integration and scaling of mHealth into mainstream health care services.
  
  - Limited regulatory oversight based on policies and standards to guide quality and safety:
    - Sub-standard mHealth products → wrong clinical or public health decisions → compromised patient safety, quality of care, incorrect public health inference.

- **Inadequate evidence on what works at scale**
Evaluation of mHealth Systems
mHealth Evaluation

- To improve health and reduce health inequalities, rigorous evaluation of technology systems is necessary to generate evidence on safety, benefits and context appropriateness.

- The early state of implementation of mHealth in SSA has a direct correlation with the limited number of published evaluation studies.

- Many of the pilot mHealth projects not designed to scale but intended to demonstrate proof of concept. Evidence on impact at scale is very limited.
IVR and mHealth

- In-service training for nurses and midwives in Senegal
- Prototype mLearning system that uses IVR and SMS on simple mobile phones
- Questions and detailed explanations spaced and repeated over time
- The mLearning system proved appropriate, feasible, and acceptable. It was associated with sustained knowledge gains on contraceptives side effects.

*Not implemented at scale*

Diedhiou et al. mLearning pilot in Senegal
## Sample of Published Work on mHealth in SSA

<table>
<thead>
<tr>
<th>Design</th>
<th>Number (N=45)</th>
<th>Location</th>
<th>Outcome measure</th>
<th>Setting Rural/Urban</th>
<th>Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>RCT</td>
<td>3</td>
<td>Uganda, S. Africa, Kenya</td>
<td>Health facility delivery, tx adherence for blood pressure, adherence to tx &amp; viral suppression</td>
<td>Rural (2) Urban(1)</td>
<td>Reproductive health, HIV, high blood pressure</td>
</tr>
<tr>
<td>Quasi-experimental (Pre-post)</td>
<td>3</td>
<td>Botswana, S. Africa, Uganda</td>
<td>Data quality, injury score, time to stock out,</td>
<td>Rural (1) Urban (2)</td>
<td>TB, commodity/logistics</td>
</tr>
<tr>
<td>Descriptive</td>
<td>17</td>
<td>S. Africa(7), Kenya(4), Mali, Malawi, Nigeria, Senegal, Sudan, Liberia</td>
<td>Inappropriate admission, usability, compliance UHC, CHW learning, diagnosis, knowledge, info access, cost-effectiveness, water quality, data quality</td>
<td>Rural (11) Urban (6)</td>
<td>Burns (Telemedicine), UHC, HIV. mLearning, Malaria, Ebola, Mental health, Water quality, Polio immunization, Reproductive Health</td>
</tr>
<tr>
<td>Qualitative</td>
<td>1</td>
<td>Ghana</td>
<td>Facility delivery</td>
<td>Rural(1)</td>
<td>Maternal and child health</td>
</tr>
<tr>
<td>Not relevant</td>
<td>21</td>
<td>-</td>
<td>-</td>
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<td>-</td>
</tr>
</tbody>
</table>

Systematic reviews

• Kallander K et al, 2013: mHealth approaches and lessons for increased performance and retention of community health workers in low- and middle-income countries: a review. web review. Uganda and Mozambique.
  - Although there is vast documentation of project process evaluations, there are few studies demonstrating an impact on clinical outcomes. There is also a lack of mHealth applications and services operating at scale in LMICs. The most commonly documented use of mHealth was 1-way text-message and phone reminders to encourage follow-up appointments, healthy behaviors, and data gathering.

• Aranda-Jan et al, 2014: Systematic review on what works, what does not work and why of implementation of mobile health (mHealth) projects in Africa. PubMed and OvidSP. Studies included (n=44). Outcomes:
  - patient follow-up and medication adherence (n = 19),
  - data collection/transfer and reporting (n = 10),
  - staff evaluation, monitoring and guidelines compliance (n = 4),
  - disease surveillance and intervention monitoring (n = 4),
Systematic reviews

- Allsop J *et al*, 2016: *The state of mHealth development and use by palliative care services in sub-Saharan Africa: a systematic review of the literature*. Studies included (n=5). 13 electronic databases. Outcomes:
  - Descriptive analysis has shown that existing mHealth interventions for palliative care services in SSA are limited in number and are being developed for use at the palliative treatment, guidance and coordination stage of care provision. Levels of detail about the development and structure of interventions are low.

- Sondaal SF *et al*, 2016: *Assessing the Effect of mHealth Interventions in Improving Maternal and Neonatal Care in Low- and Middle-Income Countries: A Systematic Review*. Studies included (n=27), covered LMICs. Results included intervention (n=12) and descriptive studies (n=15). Outcomes:
  - Increased ANC attendance, skilled attendant at birth, vaccination rates
Evidence on Ebola and mHealth

- The Ebola epidemic in West Africa: 28,599 cases; > 11,299 deaths from 2013 – 2016.¹

- Exposed the weak state of health systems in West Africa and lack of a robust data management system to monitor the epidemic.

- High penetration of mobile phone subscriptions in Guinea (63/100 people), Liberia (60/100 people), and Sierra Leone (44/100 people).²

- Papers published on the use of mobile technologies in Ebola response (n=3)

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¹ US Centers for Disease Control and Prevention
² World Bank. Mobile cellular subscriptions per 100 people.
Future Opportunities for mHealth in SSA
Future opportunities (1)

• LMICs (inc. SSA) have perhaps the greatest potential to extend access to health care by using mobile technologies to integrate rural and remote areas into the health system.

• Academia, private and public partnerships: E.g. HP East Africa, Clinton Health Access Initiative (CHAI), Strathmore University and Kenya’s Ministry of Health (MOH) opened an IT education lab to help improve access to healthcare for citizens throughout Kenya. *mHealth component, standards for interoperability?*

• Government involvement and integration of mHealth interventions into the healthcare system is encouraging. *Needs appropriate legislation + policies to formalize.*

• Ongoing extension of electric power and cellular coverage to rural areas.
Future opportunities (2)

- In 2010, a meeting of the heads of eight global health agencies and the Global Health Information Forum (GHIF) recommended an increase of investments to strengthen country health information systems.¹

- **Untapped areas:**
  - *The main focus in Sub-Sahara Africa (and other developing regions), is improving access to basic health care, remote diagnosis, remote monitoring and prevention.*²
  - *Other mHealth investment drivers are the increase in mobile access, the development of high quality networks, health care apps and the demand for wearables.*²

- Use of evaluation and reporting frameworks such as GEP-HI and STARE-HI could guide rigorous studies to provide.

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2. Deloitte: Opportunity for mHealth in SSA; 2015
Disclaimer

The findings and suggestions in this presentation are those of the author and do not necessarily represent the official position of the Centers for Disease Control and Prevention/the Agency for Toxic Substances and Disease Registry.
Asante – Thank you!

For more information please contact Centers for Disease Control and Prevention

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