New Weapon In The War Against AIDS: Your Mobile Phone

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Introduction to the Theoretical Warfare Battle Plan Against the Invading Disease:

A silent killer took the lives of 2.1 million in 2012. But what was the cause of this shocking statistic? Can it be attributed to a nuclear bomb explosion? Or perhaps did locusts sweep the grasslands and decimate the food supply? While these would make feasible conjectures, these deaths can be attributed to AIDS, a deadly disease that UNAIDS reports is the leading cause of death in Africa (UNAIDS). I personally witnessed the effects of this disease while volunteering for the mobile clinic in northern Thailand. During the summer of 2013, I came across the pediatric HIV/AIDS community, Baan Gerda, the only place in Thailand that offers a family environment for the care of over 85 HIV orphans from fifteen different hill tribal villages 230 km north of Bangkok. Due to the social stigma that surrounds HIV/AIDS, there were minimal volunteers. There was one doctor at the mobile clinic and he was responsible for all of the orphans as well as other adults living with HIV. While there were local health volunteers who pledged to look after these patients, the limited resources delayed treatment. In particular there was a lack of trained healthcare workers, minimal communication between staff and patients, and few treatment facilities. Once I visited the patients at their home, I noticed that every household had access to mobile phones. Surprisingly, all of them had six bars of cellphone signal.

That's when I saw the dots connecting. What if the future of HIV management in resource limited settings could be about turning those six bars of service into saved lives? With the growth of mobile technology in the developing world (17.6 billion texts in 2007 to 21 billion texts in 2009 in the African region alone) (Streicher, 2013), experts have proposed electronically based solutions to healthcare problems that exist both locally and internationally. Current literature lacks coherent research pertaining to the impact of mobile technology on healthcare that delineates how such an impact could help eliminate HIV in resource-limited settings. This paper will stock a theoretical arsenal by establishing a framework for utilizing mobile technology as a weapon against AIDS. The first component of the theoretical framework is Medic Mobile's SIM card

technology that transforms inexpensive phones into sophisticated wireless data collecting terminal using the Kujua software. The next component involves utilizing MAMA's adaptable message technology in order to deliver reminders to the patients. In addition, individuals who have trouble remembering to take their medicine can use WelTelKenya1's open source text message provides reminders. Even further, if a need to train healthcare workers arises, Dr. Maria Zolfo (a specialist in infectious diseases at the Institute of Tropical Medicine in Belgium) proposes that health care workers can learn through e-learning programs that are transmitted to individual's mobile phones. In addition, doctors who need access to health records for HIV/AIDS patients can do so by using the mHealth for Development Project's phone database technology. Another potential problem that may arise is that patients may not sign up for HIV/AIDS testing. This need can be addressed with the *Text to Change* system that has interactive quizzes that spread awareness about the dangers of HIV/AIDS. Even further, a mobile software platform called biNu can transform inexpensive phones into smartphones using cloud technology. Finally the Vodafone Group Foundation's mobile service can answer individual's sensitive health related questions. I affirm that the combination of these existing and proposed applications of mobile technology promises to be an effective method for combatting Africa's number one killer.

Barnett's Hypothesis Pertaining to Limited Treatment Resources: According to a hypothesis in the research paper on *The Social and Economic Impact of HIV/AIDS in Poor Countries* set forth by Dr. Tony Barnett, a professor at the London school of Hygiene and Tropical Medicine, many AIDS cases in developing countries go undiagnosed and untreated because of limited resources (Barnett, 2011, p. 151). Lack of HIV education has led to blood transfusions that involve the reuse of needles and contribute to parental HIV transmission from mother to the fetus of child during pregnancy. Due to the lack of communication and trained healthcare workers, the communities were not well organized and hence did not provide efficient treatments and solutions to the growing epidemic. My argument will rest on the assumption that such mobile technology can be integrated into different areas, one of which includes resource-limited settings. Another assumption of this research is that HIV/AIDS is highly prevalent in resource-limited settings as supported by the UN/WHO regional estimates, which state that the vast majority of HIV infected people, approximately 95% of the total population, live in developing countries (Boyle, 2000). This paper builds off of Barnett's hypothesis in conjunction with existing and proposed technologies in order to establish a theoretical framework that aims to employ the use of mobile devices to tackle the three HIV domains of treatment, training and education in resource-limited settings.

Weapon #1 in the Theoretical Arsenal: Medic Mobile's Open Source Software and SIM Card

Despite the lack of resources, the World Bank reports that around three-quarters of the world's inhabitants now have access to a mobile phone. The number of mobile subscriptions in use worldwide, both pre-paid and post paid, has grown from fewer than 1 billion in 2000 to over 6 billion, of which nearly 5 billion are in developing countries ('Maximizing mobile' report, 2012). One method for implementing mobile technology into resource-limited settings by many organizations is through means of simple and flexible software applications that can be applied in a variety of healthcare settings. An example of this is *Medic Mobile's* open source software, Kujua Light, a web-application for sending and receiving messages as well as scheduling time-targeted confirmation notes to conventional $10 mobile phones. This application is coupled with a $12-15 hardware parallel SIM that transforms any inexpensive mobile phone into a sophisticated wireless data collection terminal (Figure 1). Once the parallel SIM is installed beneath a carrier's normal SIM card, the Kujua software allows for wireless data collection in remote or Internet inaccessible locations (Medic Mobile, "Impact," 2012).

FIGURE 1. The hardware parallel SIM can be purchased in quantity for $12-15/unit USD ("Bladox-Home," n.d.).

During an interview, Josh Nesbit, a Stanford graduate and CEO of *Medic Mobile*, described his journey from "a somewhat confused and lost pre-med" to becoming Forbes' 20 under 30 young social entrepreneur and founder of *Medic Mobile,* a tech company that uses open source text messaging software to improve healthcare access through disease surveillance, immunization coordination and workforce management

(Nesbit, personal communication, 11 Nov. 2013). With this technology, Nesbit and his company are now improving health outcomes in the world's most challenging environments by providing real-time access to community data, enabling faster communication and allowing for more targeted support to patients and communities. The mobile platform also includes an update to the Kujua v1.0 which includes extra features for supporting optimum communication between community health workers, clinicians and patients (Figure 2). This update enables greater coordination of care, easy event scheduling, and automatic notifications required to support a range of maternal and child health programs (Medic Mobile, 2012b).
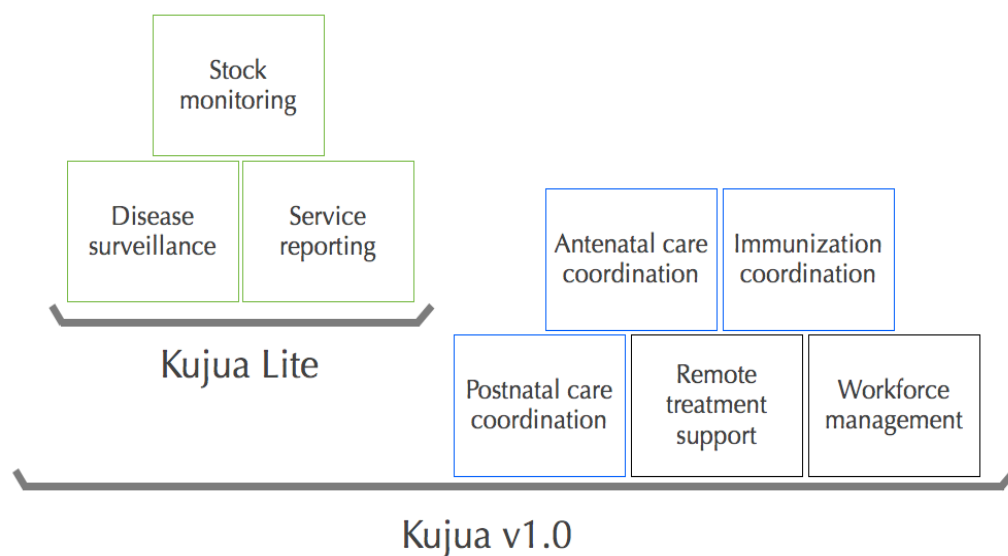

FIGURE 2. Kujua Software application to improving healthcare access (Medic Mobile, n.d.).

Nesbit notes: "With the information that mobile phones are accessible in developing countries and having conducted my honors thesis on quantitative pediatric HIV, I believe that while mobile phones themselves cannot eliminate HIV, people who have those mobile devices definitely can" (Nesbit, personal communication, 11 Nov. 2013).

Medic Mobile's method of implementing mobile technology in resource limited settings, combined with Barnett's hypothesis that emphasizes the three HIV domains of treatment facilitation, education and trained healthcare worker, illustrates the indispensable role mobile technology could play in improving HIV management in resource limited settings (Figure 3). Medic Mobile's tool helps facilitate treatments through enabling community health workers in rural settings to enroll HIV pregnant mothers into mother to child transmission prevention programs. It also educates the community through SMS notifications about HIV

prevention, antenatal care and immunization. Finally, it assists health care workers by improving the quality of care through means of more efficient stock monitoring and data collection. Mobile technology is therefore being used to facilitate HIV treatments through increasing access, helping patients stay in care through improving knowledge and enhancing the quality of care through assisting healthcare workers.
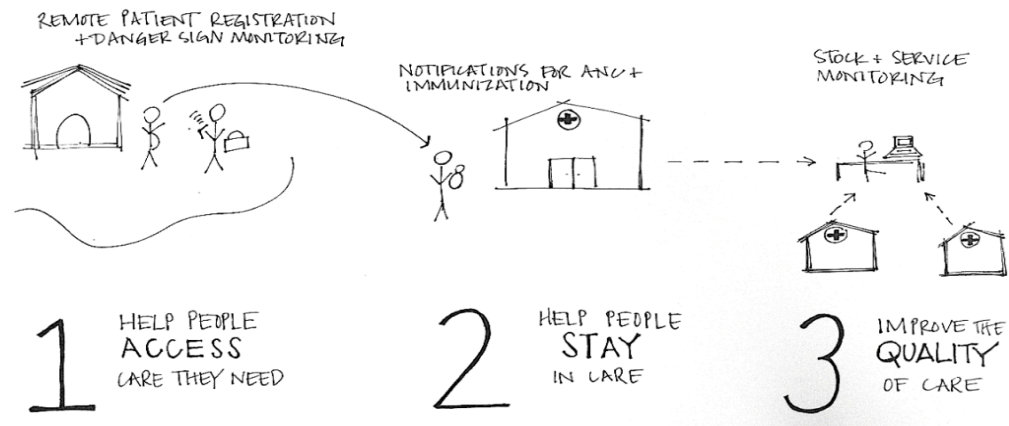

FIGURE 3. High Impact Use Cases of Medic Mobile's application (Medic Mobile, 2012a).

Weapon #2 in the Theoretical Arsenal: MAMA's Adaptable Message Phone Application

Although Medic Mobile's cost effective parallel SIM and open source software show potential in tackling the three HIV domains of treatment, education and training, they overlook the cultural specificities in each setting. I interviewed Dr. Teng Kunthy, the secretary general of National Aids Authority in Cambodia, to see if he would be interested in adopting Medic Mobile's application to improve care for mothers living with HIV in rural Kandal province. He replied, "We would love to use this technology. But, most mothers are illiterate and although most households have mobile phones, their husbands are in control" (Kunthy, personal communication, 08 Nov. 2013). Hence, my theoretical framework will combine Medic Mobile's cost effective technology with the Maternal Action for Mobile Alliance's culturally adaptable model to provide public health benefits at a global scale. The Mobile Alliance for Maternal Action, founded by the USAID, Johnson & Johnson, mHealth Alliance, UN Foundation and Baby Center, is an example of an innovative public-private partnership that supports programs delivering vital health information through mobile phones to mothers in low-resource settings

across the developing world (MAMA, n.d.-b). The first MAMA resource has been a set of adaptable mobile messages that were developed by BabyCenter using their stage-based mode and tone, in partnership with a team of experts in maternal, newborn, and child health (Figure 4).
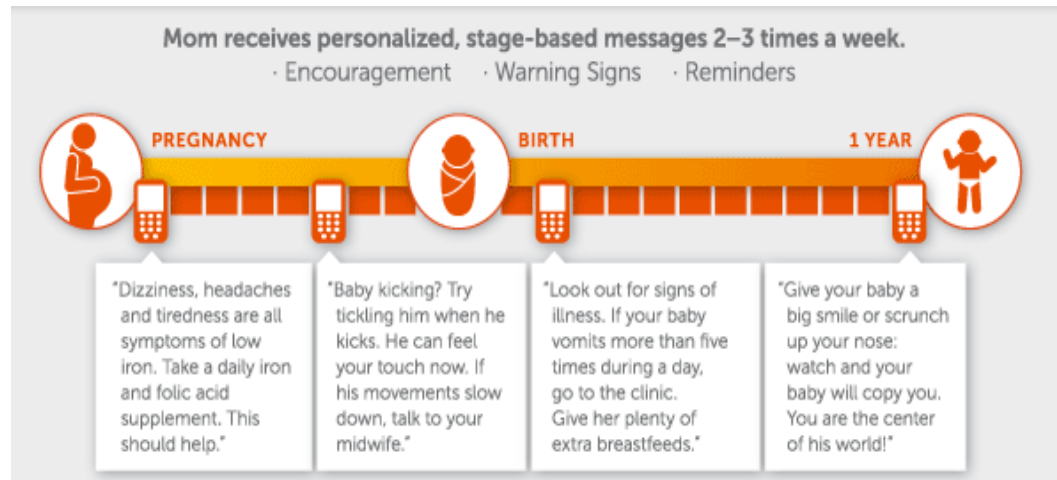

FIGURE 4. How MAMA's adaptable messages works from (MAMA, n.d.-b).

As mentioned by Dr. Kunthy of the National AIDS Authority in Cambodia, most women in the developing countries are illiterate and thus cannot get access to the content the text messages provide. This assumption is supported by the UNESCO Office of Dakar, which states that only 38% of African adults or 153 millions people are illiterate and two thirds of these are women (UNESCO, 2010). Tackling the issue of illiteracy, MAMA's adaptable messages are available in both texts and voice messages. Organizations interested in this software are provided with guidelines of recommended topics, tone and timeline so that they can translate and create voice messages appropriate for expectant mothers in their local settings. Moreover, as supported by Dr. Kunthy and by Dr. William T. Story's qualitative study on *The Husbands' Involvement in Delivery Care Utilization in Rural Bangladesh* from the University of Michigan School of Public Health, in certain cultures, the family dynamic is a barrier to deliver care (Story *et al.*, 2012). It has been suggested that better spousal communication may improve women's maternal health care-seeking behaviors (Story *et al.*, 2012). MAMA addresses this cultural difference through the use of household decision maker messages, which are for husbands and mothers in law. One message, such as "Talk to the mother about finding a trained birth attendant to help the mother through birth and to reduce bleeding," per week is delivered to the husbands to support the mother and baby (MAMA, n.d.-b). Josh Nesbit noted during our interview, "Although we are both very different, with Medic Mobile approaching health care at a broader spectrum and MAMA tackling a

more specific maternal issue, I could definitely see a partnership" (Nesbit, personal communication, 11 Nov. 2013)

According to the UNAIDS global facts and figures sheet, one fourth of pregnancy-related deaths can be linked to HIV in sub-Saharan countries and 1,800 newborns worldwide are infected with HIV. Referring to the CDC HIV/AIDS Fact Sheet about Mother to Child HIV Transmission and Prevention, most pediatric HIV cases arise from the lack of HIV mother to child transmission knowledge (Center for Disease Control and Prevention, n.d.). Hence, MAMA's adaptable messages could be coupled with Medic Mobile's parallel SIM and Kujua open source software to tackle the HIV domain of education. Through combining Medic Mobile's open source application and MAMA's voice and household decision maker messages, HIV positive mothers from different cultures could still receive appropriate mobile counseling and support as well as vital information about treatments needed to prevent HIV infection from being passed on to their babies during pregnancy, delivery and breastfeeding.

Weapon #3 in the Theoretical Arsenal: WelTelKenya1's Open Source Text Message

According to the World Health Organization, the leading risk factor for HIV treatment failure is poor treatment adherence, which results from taking inaccurate doses of medication at the wrong time. A successful strategy that enhance adherence is directly observed therapy. This method involves a system where healthcare workers monitor the patients' medication intakes directly at the patients' home (http://apps.who.int/iris/handle/10665/70983). However, due to the lack of trained health care workers, this strategy serves to be inefficient in resource-limited settings. Hence, Dr. Richard Lester, a clinical assistant professor and medical head of University of British Columbia Division of Infectious Disease, developed *WelTelKenya1*, an open source text messaging service that reminds HIV patients to take their medication (Lester *et al.,* 2010). In his paper, he aims to assess whether mobile phone communication between health-care workers and HIV patients in Kenya could reduce HIV-1 viral load measurements, which reflect the burden of infection and the magnitude of HIV viral replication. In addition, he explores how mobile phone communication can improve the adherence to antiretroviral therapy (ART), which combines three antiretroviral drugs to maximally suppress the HIV virus and stop progress of HIV disease (Lester *et al.,* 2010). Results show that patients who receive texting support by using *WelTel Kenya1* have significantly improved rates of HIV-1 viral load suppression and adherence to ART (Lester *et al.,* 2010)**.** Thus, the findings could be used to develop this paper's theoretical framework into an applied model. An example of this application is to combine *MAMA's* adaptable voice messages with an open source medication reminder service similar to that of *WelTel Kenya* 1. The translated voice messages could then be used to remind patients to take

their medications from anywhere in the world as well as reach the illiterate HIV community through means of interactive voice response menus and recorded phone messages.

Weapon #4 in the Theoretical Arsenal: Dr. Maria Zolfo's Proposed Smartphone E-Learning Program

A pilot program tested in Peru called *Mobile Learning for HIV/AIDS Healthcare Worker Training in Resource-limited Settings* is currently tackling the HIV domain of training health care workers through mobile e-learning. To increase the number of trained health care workers in a nation, where 70% of the patients were in need of HIV treatments (Zolfo *et al.*, 2010), Dr. Maria Zolfo, a MD/PhD at the Institute of Tropical Medicine, presents an innovative approach to healthcare worker training through the use of mobile phones as a personal learning environment (Zolfo *et al.,* 2010). Similar to Medic Mobile's cost effective model, Zolfo also notes the limited resources. She takes into consideration the lack of electricity by providing twenty health care workers with individual solar run smartphones (Zolfo *et al.*, 2010). Even further, Zolfo uses telecommunication and a set of three-dimensional learning scenarios simulating interactive clinical cases developed and adapted to Smartphones for a continuing medical education program lasting three months. Through this, healthcare workers were able to learn about the basic HIV/AIDS treatments and communicate with a group of HIV specialists. Zolfo's mobile e-learning model also used text messages to tackle the HIV domain of education. To verify the learning outcomes, she integrated interactive mobile quizzes using multiple-choice questions presented at the end of each module as well as daily text messages to reinforce health care workers' knowledge (Zolfo *et al.,* 2010).

Weapon #5 in the Theoretical Arsenal: mHealth for Development Project's Phone eHealth Database

The book *Information Technology Solutions for Healthcare*, written by Professor Kryzsztof Zielinski, the head of the department of computer science at AGH University in Krakow, also provides a complete and thorough survey of the most promising e-health technologies, making this a valuable set of telecare solutions for modern informatics practice. An example of an effective e-health solution that employs cost effective mobile devices similar to that of this paper's argument is the 2012 mHealth for Development Project, which uses wireless technologies such as Bluetooth to allow health care workers to transmit and enable various eHealth data contents and services through conventional mobile phones. (Zielinski *et al.,* 2007). This method is similar to Medic Mobile's use of $12-15 parallel SIM, which turns $10 phones into sophisticated wireless ones. Moreover, mHealth's cost effective projects are highly praised in the *African Business article on Telemedicine Lifeline for Rural Africa*, where Clair Thwaites, the head of Vodafone Foundation and United Nations

Foundation Partnership stated, "This partnership has been focusing on mHealth for three years because mobile phones are becoming more ubiquitous in emerging markets" (Price, p. 15, 2006). By saying so, she is agreeing with this paper's argument that some areas of mobile technology, such as information technology and SMS text alert, could be used to enable patients' adherence to their prescriptions, improve education health awareness programs, facilitate data collection and train healthcare workers.

Weapon #6 in the Theoretical Arsenal: Ugandan *Text to Change* Organization's Interactive Phone Quizzes

The Ugandan based *Text to Change* organization uses a text messaging intervention similar to that of this paper's proposed MAMA's educational messages (Zielinski *et al.,* 2007). *Text to Change* aims to improve awareness about HIV/AIDS treatment and prevention by encouraging the populations to participate in an interactive quiz with the hope that they will be able to retain the information they learned (Zielinski *et al.,* 2007). As a result, there is now a 40 % increase in those going in for HIV tests (Zielinski *et al.,* 2007). The examination of all sources reveals consensus that mobile technology has the potential to revolutionize HIV/AIDS management in developing countries, especially in the areas of improving treatments adherence, training healthcare workers and increasing awareness. It therefore supports the paper's argument that a successful implementation of a theoretical framework could improve HIV management in resource limited setting.

To support the use of a culturally adaptable and cost effective theoretical framework, this paper will demonstrate the importance of negotiating the specificities of culture and resources in each setting. Despite the positive impact of Zolfo's study in using mobile e-learning to train health care workers, there are concerns regarding resource availability. Even though Zolfo takes into account the lack of electricity and provides healthcare workers with portable solar chargers, there is a lack of resources, such as the availability and reliability of mobile networks or other Internet connections, as well as the capacity of health care workers to engage in self-directed learning. Most importantly, while 75 % of the world has access to mobile phones, smartphones make up only 15 % of the global market due to their expense (Hollon, 2013). According to this data, providing healthcare workers with smartphones is not a self-sustainable solution and will not serve the community well in the long run.

Weapon #7 in the Theoretical Arsenal: biNu Cloud-Based Phone Applications

Two software developers with 20 years of IT experience, Gour Lentell and Dave Turner, addressed this problem in 2007 when they developed a mobile software platform called biNu (BiNu, n.d.). This platform allows those with cost effective feature phones to have smartphone-like

experiences through cloud-based apps and services, providing them with immediate access to email, news, books, health information and social features. With over 3 million active users based in the emerging markets of Africa, Asia and Latin America (BiNu, n.d.), this means the world's information library is available through not only smartphones, but also conventional mobile phones. Noting the importance of enabling sophisticated applications to be available to cost effective mobile phones, this paper's theoretical framework therefore provides a method to transform $10 inexpensive phones into a platform for improving HIV management in resource limited settings without internet access through means of $12-15 parallel SIM and open source software.

Weapon #8 in the Theoretical Arsenal: Vodafone Group's Mobile Health Answer Service

Another important aspect that the theoretical framework focuses on is its ability to implement mobile technology in culture specific settings. In addition to the cultural differences in terms of literacy and household decision makers mentioned previously, there are other cultural specificities that should be negotiated before project implementation. Through platforms similar to that of biNu and Medic Mobile's parallel SIM and open software, Vodafone Group Foundation is now using mobile technology to help deliver healthcare to remote areas that have little access (Price, 2006). As part of the foundation's objective, it has funded the One World International Project which sets up a health information and advice service that is delivered through SMS and telemedicine technology for remote communities in Africa (Price, p. 5, 2006). People are able to ask private questions related to sensitive health issues such as HIV/AIDS and receive non-judgmental and speedy feedback. It also allows physicians to interview patients about sexual behaviors through telecommunication. By observing that sex is considered a social stigma in certain cultures, Vodafone Group Foundation is able to tackle the physicians' challenge of not receiving accurate interview answers. In addition, access to HIV/AIDS information also gives the people the means to have more control over the circumstances. They no longer have to rely solely on the stigma imposed on them by their communities but could now reach out to experts.

Addressing the Waged Opposition:

Although the previous study by Lester suggests that mobile technology via SMS improves ART adherence, other studies oppose these results. For example, the scientific research paper *The Cameroon Mobile Phone SMS (CAMPS) Trial: A Randomized Trial of Text Messaging versus Usual Care for Adherence to Antiretroviral Therapy* conducted by Dr. Lawrence Mbuagbaw, a public health physician working for US Peace Corps and Bafut HIV/AIDS treatment Centre, shows that the use of motivational SMS did not significantly improve adherence to ART (Mbuagbaw *et al.,* 2012). His findings should be analyzed in comparison to Lester's trials in

Kenya, which show some improved adherence rates after twelve months. However, the interventions used here were somewhat different. While Mbuagbaw's trial used motivational messages, with the intention to produce a change in adherence behavior, and no compulsory feedback, Lester's trial used a simple SMS inquiry on the participants' health and was therefore interactive. Moreover, Lester's trial enrolled participants who had recently initiated ART as opposed to Mbuagbaw's trial. Another important difference is that while Lester's participants were from an area where people living with HIV are more socially acceptable, Mbuagbaw's trial used patients from a village in Cameroon, where there is still a lot of stigma associated with HIV. Although Mbuagbaw did not include the term "HIV" in the content of the text messages, he did include "medications" and gave a clinic number, which could arouse suspicion by non-participants reading the message. While the risk of disclosure of status has been mentioned in Lester's trial, Mbuagbaw's trial documented multiple cases of withdrawal citing privacy reasons, suggesting the flaws in the assumption that even though a case works in one cultural setting it will always work in another, as can be seen by the comparison of these two similar studies that provide different results.

The Battle Plan: Establishing the Future Tenets of Mobile Technology Design on HIV/AIDS Management
In conclusion, the ideal way to combat the AIDS crisis within the context of the three HIV domains of treatment, training, and education is to combine eight features of mobile technology. This one streamlined model is applicable in varied cultural environments and resource-limited settings. Hence, organizations that aim to tackle the issues of HIV/AIDS in developing countries should consider adopting this paper's proposed model. Though such sweeping change may seem difficult given the novelty of using mobile technology in certain cultural settings and the limitations on organization budget, the combination of eight mobile features can be a remarkably flexible and cost effective solution. For example, a rural hospital in Malawi could minimized the 35 miles travel costs between the hospital and the patient's homes through the inclusion of cost effective solutions such as the $10 mobile phones with Medic Mobile's $12-15 parallel SIM and Kujua open source software (Medic Mobile, 2012b). MAMA's growing community of 288 organizations in 68 countries, projected to reach 140 million women, also proves that adaptable messages are successfully being adopted to help mothers all over the world (MAMA, n.d.-b). With all of the mentioned methods combined, the benefits of this paper's argument to tackle HIV in resource-limited settings are priceless.

So whenever I return back to the village of 85 HIV orphans in rural Thailand or anywhere else in the world, I hope that to see patients and healthcare workers taking out their mobile phones and using their newly programed eight weapons as a defense against the invading disease. With

their theoretical battle plan embedded in their mobile phones I have no doubt that they will be one step closer to declaring ceasefire and establishing an AIDS-free generation.

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