

INTEGRATION OF HEALTH AND MEDICAL INNOVATIONS IN RWANDA TO PROMOTE HEALTH EQUITY

Parfait Uwaliraye, Patrick Ndimubanzi, Andrew Muhire, and Valencia Lyle, Ministry of Health, Rwanda

While ministries and health departments around the globe face disparate health concerns, they often share a vision of improving equitable access to quality healthcare—particularly from a gender and age-specific lens—for their constituents. Although this vision is ubiquitous, the procedures involved in bringing it to fruition remain arcane. Nevertheless, Rwanda has made tremendous progress in the area of universal health coverage, advancing the country's health equity agenda.

One of the key catalysts propelling Rwanda's progress in providing equitable access to healthcare is the country's eagerness to adopt technological innovations and swiftly integrate them into the health system. Innovations range from utilizing drones to deliver blood to citizens in the most remote corners of the country to using mobile phones to transmit critical health information collected at the community level to a central database. The innovations in Rwanda's health system ensure the equitable distribution of health services, as well as consistent and reliable information about critical health information at all levels of the health system. Many health policy experts suggest that the synergy of political will and the aforementioned health innovations have fostered Rwanda's health sector achievements.

Health innovations

1. Drones

In Rwanda, as well as many other parts of the world, a considerable portion of the population living in rural areas have limited access to essential medical products, such as blood and vaccines, due to onerous landscapes and gaps in infrastructure.¹ In past years, when essential medical supplies were required to save

lives, healthcare providers would either dispatch an ambulance to transport the patient to a health facility with higher capacity or dispatch a car and driver to the central blood bank to retrieve blood. These processes are especially precarious in situations where the central blood bank is five hours from the health facility. The protracted process of awaiting land vehicles to transport vital medical supplies to patients in critical condition hampered doctors' abilities to save the lives of those patients. The ineffectiveness of this approach encouraged health policymakers to create a novel strategy to quickly deliver lifesaving medical supplies to patients in critical condition.

Through an emphasis on building strong public-private partnerships, the Rwanda Ministry of Health has begun using medical drones to supply lifesaving medical supplies to 21 district hospitals throughout the country. These medical drones ensure that blood products are instantly accessible to the nearly 12 million citizens of Rwanda.²

Since October 2016, the Rwanda Ministry of Health has collaborated with Zipline to integrate drones into the medical-supply infrastructure. Before drones were integrated into the health system, donated blood stored in blood banks in Rwanda would often expire. Rwanda was likely spending over US\$50,000 for the disposal of blood products annually. As a result of this new, comprehensive blood-delivery system, medical doctors are now able to place orders online and receive blood from the distribution center within 30 minutes.³ According to Zipline, blood deliveries to hospitals by drone resulted in blood banks having zero units of expired blood. This highlights several benefits of integrating drones into Rwanda's medical-supply infrastructure.

2. Mobile health (mHealth) as a digital health solution

In addition to the integration of cutting-edge technology to promote health equity, phones are also used as an alternative technological innovation to provide quick, affordable, quality resolutions to ailing citizens. With over 2 million registered users—roughly 30% of the adult population in Rwanda—and over 280,000 consultations performed, digital healthcare through Babyl Rwanda is expanding the provision of healthcare services to individuals throughout the country. Clients must follow three simple steps to access healthcare through Babyl: 1) send an SMS to a specific phone number to request an appointment, 2) transmit a payment using e-transactions with mobile money services, and 3) complete a short consultation with a triage nurse before scheduling a follow-up appointment with the Babyl senior nurse or general practitioner. This digital health solution offered through Babyl Rwanda is promoting access to healthcare in a convenient and cost-effective system.

With an average waiting time to see an emergency center physician of 30-60 minutes in Rwanda, Babyl Rwanda diminishes the time wasted in long queues by providing immediate access to healthcare professionals.⁴ The long waiting times are, in part, a result of the doctor to patient ratios that lie below international recommendations. Given these low ratios, the artificial intelligence (AI) component of Babyl Rwanda becomes extremely valuable. Babyl Rwanda is integrating AI into the Babyl call center, health posts, and health centers. The AI system will serve as a commensurable substitute to in-person consultations with physicians given AI will have the capacity of an expert medical doctor's brain.⁵ The development and expansion of AI technology will serve as an extraordinary tool to support the task sharing and task shifting approaches that are in place to mitigate the shortage of highly skilled health professionals. In addition to reducing time wasted awaiting consultations and assuaging congested waiting areas, Babyl Rwanda will also ensure that healthcare services are affordable to the Rwandan population. As Babyl Rwanda's consultations are quick and convenient, illnesses can be diagnosed and treated earlier—before the patient's symptoms worsen and create a need for extensive and costly medical treatment.

While Babyl Rwanda predominantly promotes healthcare-seeking behaviors in patients, RapidSMS serves as another mHealth innovation that, in contrast, focuses on health service outreach. In 2010, Community Health Workers (CHWs) adopted RapidSMS, a mobile-based process for transferring vital health information about vulnerable community members to a central database to be monitored by doctors and central level staff. Through RapidSMS, the 58,298 CHWs in Rwanda ensure that community members, pregnant women, and infants, in particular, receive the swift healthcare services they require. Additionally, RapidSMS serves as a notification system to ensure that medical professionals are immediately alerted when life-threatening complications arise. With the recent upsurge of malaria cases, severe malaria was added to the RapidSMS system to accelerate referral processes and reduce mortality. Malaria alerts demonstrate that RapidSMS has the flexibility to accommodate conditions that require a specific focus.

Some of the most significant barriers to achieving optimum maternal and child health indexes point to the low reach, quality, and utilization of services. Low reach is largely due to a shortage of human resources needed to expand the coverage of health services. Low coverage for maternal and child health services results in late identification of pregnancy and labor complications, slow response to poor newborn health, and inadequate monitoring of child development.⁶ The integration of the RapidSMS into CHWs' daily work facilitates the expeditious communication between CHWs and medical professionals. This ensures that CHWs can access the clinical information needed to increase the effectiveness of their work, expedite the interventions they are implementing, and improve their confidence in securing the health of their community members (Figure 15.1).

3. Online learning

As the health sector is ever evolving with innovative tools and policies to expand access to high-quality care, there is a need to provide standardized, high-quality trainings to the health workforce to ensure they are prepared to adopt these innovations. To address this need, the Rwandan Ministry of Health developed the health sector e-learning system in January 2018, which combines online distance learning with curtailed virtual face-to-face sessions to offer learners the optimal learning experience.⁷ The online learning affords the health sector workforce the flexibility to build their skills and knowledge at home, during breaks at work, or anywhere an individual has an internet connection, as courses can be taken even on smartphones.

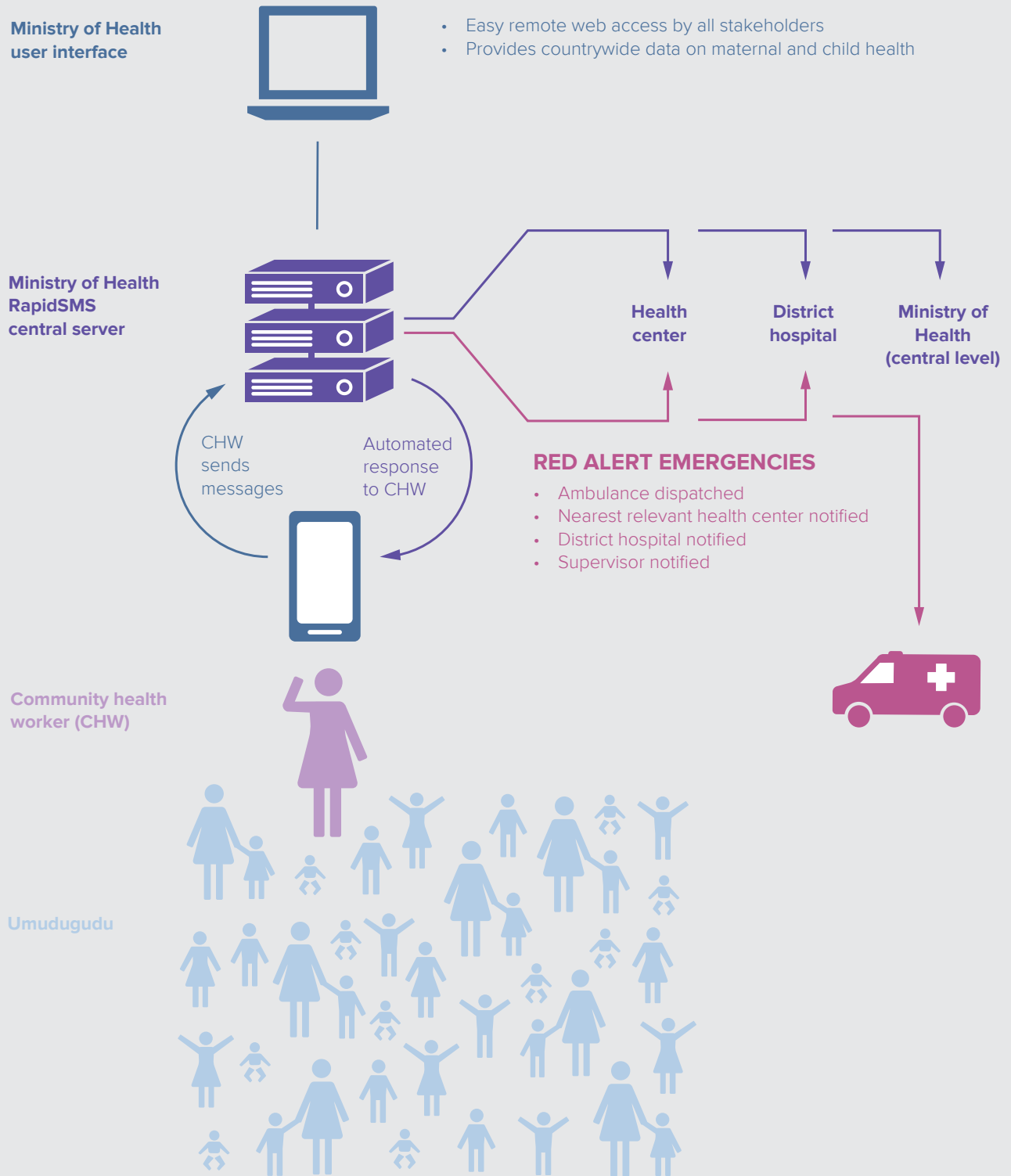
Online training—which offers flexibility in the time, location, and pace that health workers consume new information—averts the absenteeism that is typically associated with health workers' attendance at traditional face-to-face training. A study examining the causes of low health worker performance and outputs in low-income countries recognized that traditional, in-service training was associated with reduced productivity because it served as an authorized absence for staff.⁸

Furthermore, e-learning aims to ensure that the entire population is afforded high-quality health services by providing training to healthcare workers in even the most remote areas of the country. The most recently launched e-learning course was offered to district and private hospital data managers. Data managers, monitoring staff, and evaluation staff—representing all public and several private hospitals throughout the country—enrolled in the course. Through this online training, the Rwanda Ministry of Health was able to ensure that all 60 participants received consistent, high-quality training and were equipped to integrate leading data quality mechanisms into their daily work practices.

A meta-analysis conducted by the United States Department of Education discovered that e-learning users performed modestly better, on average, than students learning the same material through traditional face-to-face instruction.⁹ This improvement in learning outcomes and evidence regarding the cost-effectiveness of online learning have encouraged policymakers to integrate e-learning into their educational initiatives.¹⁰

FIGURE 15.1

RapidSMS Rwanda information flowchart



Source: Scaling Up Nutrition, 2016.

Impact of innovations on the quality of health services

The aforementioned innovations propel the continued strengthening of healthcare services offered in the country. Rwanda is a country that promotes evidence-based innovation and is eager to adopt blockchain, genomics, and precision medicine. The country's leadership ensures that all of these innovations serve the common denominator of equitable access to high-quality healthcare for the entire population. The integration of blood and vaccine delivering drones, mHealth, and online learning into the health system have served to expand equitable access to healthcare across the Rwandan population in the most cost-effective manner.

The blood and vaccine delivering drones, for example, are not only cost-effective in preventing the wastage of blood supplies, but a study found that emergency shipments by drones could be more cost-effective than the use of common transport means (ground ambulances and motorcycles). The analysis not only includes cost savings but also suggests that there is a time-saving element to using drones.¹¹ Rwanda's blood delivering drones also contribute to the country's aspirations of providing healthcare services to the population as the cold-chain capabilities of the drones preserve the quality of vaccines and blood that reach their intended clients.

RapidSMS is the most well-documented innovation because of its contribution to improving the quality of health services in Rwanda. As one of mHealth's digital health solutions, the RapidSMS has contributed to the country's improvements in maternal and child healthcare. As postnatal care is essential for safeguarding the health of newborns and mothers, the introduction of RapidSMS has led to an increase in the total number of postnatal care visits.¹² This increase is significant given that over 50% of pregnant women had not received postnatal care checkups according to the 2014/2015 Demographic and Health Survey.¹³ As RapidSMS assists in the expansion of healthcare services, several stakeholders also suggest that the system contributed to improvements in the quality of services provided both in the community and in health facilities.¹⁴ One example of this includes the testimonies received from district- and community-level healthcare personnel who found that RapidSMS helped them reach their targets for care provision.¹⁵ A less studied mHealth solution is Babyl—Rwanda's largest health service provider.¹⁶ While this innovation is fairly new, the formative evaluations that have been conducted suggest that this innovation is a time-saving solution for both the individuals seeking care and the health system. Mobile consultations are afforded to thousands of Babyl Rwanda users through the medical AI agent that mimics the thought processes of an expert medical doctor's brain which enables it to provide quick and reliable healthcare to Babyl Rwanda's clients.¹⁷

The last health innovation which contributes to health service quality improvement is Rwanda's Health Sector e-Learning System. This system safeguards the equitable distribution of high-quality training to healthcare workers throughout

the country. Preliminary results from course evaluations and pre- and post-training assessments completed by e-learning participants suggest that a majority of participants gain critical knowledge and skills upon completion of these courses and gain confidence in their ability to carry out their daily work responsibilities. As healthcare providers acquire new skills and knowledge through standardized training and experience a boost in confidence in their ability to provide quality healthcare, the healthcare services offered throughout the country will similarly improve.

Main challenges and opportunities

While e-learning has its benefits—such as ensuring the health workforce is properly trained on innovations integrated into the health system—the blended learning approach that is used in the health sector e-learning system may still increase the time healthcare workers spend away from their patients. Additionally, capacity building in areas, such as service delivery, requires numerous practical sessions. These sessions should be complemented through—not replaced by—e-learning courses.

The integration of technology into the health system also requires greater investment in infrastructure. As new systems—such as the delivery of medical supplies by drones—are integrated into the health infrastructure, new policies must be developed to regulate the services and maintain a standard of quality in service delivery. Additionally, the health system in Rwanda must continue to foster strong partnerships with private sector experts to ensure that technology interventions are effectively integrated into health service delivery.

Finally, given the increasing cost of healthcare—caused by an increase in healthcare utilization, life expectancy, and non-communicable diseases—it is of paramount importance to find cost effective ways of providing the best and safest care to all. For example, the Joint United Nations Programme on HIV and AIDS (UNAIDS) noted a substantial decrease in AIDS funding from 13 governments in 2016.¹⁸ Several innovations have been integrated into health systems around the world to reduce the transmission of HIV, such as pre-exposure prophylaxis and HIV self-sampling kits. It is essential that these efforts continue to be funded to ensure countries that have been successful in reducing the incidence of HIV transmission, such as Rwanda, can reach the goal of ending AIDS as a public health threat by 2030.

Conclusion

Rwanda's receptiveness to, and interest in, the adoption of innovative solutions to public health challenges has led to the country's remarkable progress—both in enhancing health equity and towards achieving universal health coverage. As one of the first countries in the world to utilize drones as a method of equitably distributing health products to citizens throughout the country, Rwanda has embraced the idea of integrating

technology into the health system to provide high-quality, equitable services to the population.

Furthermore, the country's adoption of mHealth—to deliver quick and effective health services, reduce waiting room congestion at health facilities, and communicate the health emergencies which occur in the community to medical experts in the capital—safeguards the equitable distribution of high-quality services to the entire population. As the health sector's effective use of drones and mobile devices are used for delivering high-quality services, the proper uses of these health innovations require high-quality training. The adoption of innovations such as an e-learning system targeting the health workforce ensures that healthcare professionals are proficient in utilizing these innovations countrywide.

While the health sector may encounter challenges in the implementation of these health innovations, the amalgamation of strong political will and good governance involving the contributions of other sectors in Rwanda enables the health sector to push forward and find solutions to those challenges. Some of the contributions from other sectors include:

- collaboration with the Republic of Rwanda Ministry of Infrastructure, which includes the civil aviation mandate to ensure the availability of well-established regulations for blood and vaccine delivering drones to operate in Rwanda;
- the country's mobile phone penetration, which crept up to 76.1% in February 2018, driving the expansion and success of mHealth services;¹⁹ and
- significant investment in expanding internet connectivity, especially fiber optic telecommunication networks across the country, ensuring the feasibility of the e-learning system.

Beyond the technological innovations, the contributions from other sectors suggest that health technology is not the sole force driving the expansion of health equity throughout the country. The Ministry of Health's appetite for reaching across sectors to improve collaboration, coordination, and communication has made immeasurable contributions to the health sector's success in implementing these technological innovations. The commitment of CHWs and the private sector to use technology to reach citizens in even the most remote areas of the country suggests that partnerships between internal and external actors are essential to providing affordable, effective, and high-quality health care to the population.

The Government of Rwanda's readiness to partner with technology experts from the private sector further propels their success in integrating technology innovations into the health system. Technological progress does not always equate to health equity; however, the Government of Rwanda remained mindful of its intention to integrate technology that furthers equitable access to high-quality services into the health system. This has driven its success in using technological innovations to achieve inclusive and equitable health for the population.

Notes:

- 1 Zipline, n.d.
- 2 Ackerman et al, 2018.
- 3 Glauser, 2018.
- 4 Pascasie et al., 2013.
- 5 Kantengwa, 2017.
- 6 Mwendwa, 2016.
- 7 Lyle et al., 2018.
- 8 Dovlo, 2005.
- 9 U.S. Department of Education, 2010.
- 10 Bartley et al., 2014.
- 11 Würbel, 2017.
- 12 Würbel, 2017.
- 13 National Institute of Statistics Rwanda, 2016.
- 14 Ruton et al., 2016.
- 15 Musabyimana et al., 2018.
- 16 Babyl, n.d.
- 17 Rwanda Guide, 2018.
- 18 UNAIDS, 2016.
- 19 The New Times, 2018.

References:

- Ackerman, E., & Strickland, E. (2018). Medical delivery drones take flight in East Africa. *IEEE Spectrum*, 55(1), 120-125. Retrieved from <https://ieeexplore.ieee.org/abstract/document/8241731>
- Babyl. (n.d.). Retrieved from <http://www.babyl.rw/>
- Bartley, S. J., & Golek, J. H. (2014). Evaluating the Cost Effectiveness of Online and Face-to-Face Instruction. *Educational Technology & Society*, 7(4), 167-175.
- Dovlo, D. (2005). Wastage in the health workforce: some perspectives from African countries. *Human Resources for Health*, 3(6). Retrieved from <https://human-resources-health.biomedcentral.com/articles/10.1186/1478-4491-3-6>
- Glauser, W. (2018). Blood-delivering drones. *CMAJ*, 190(3), E88-E89. Retrieved from <https://europepmc.org/articles/pmc5780273>
- Kantengwa, S. (2017). Babyl Rwanda on providing digital healthcare. *The New Times*. Retrieved from <https://www.newtimes.co.rw/section/read/222717>
- Lyle, V., & Muhire, A. (2018). With high costs and worker absenteeism associated with in-person trainings of health workers, can eLearning be the remedy? *eLearning Africa*. Retrieved from <https://ela-newsportal.com/with-high-costs-and-worker-absenteeism-associated-with-in-person-trainings-of-health-workers-can-elearning-be-the-remedy/>
- Musabyimana, A., Ruton, H., Gaju, E., Berhe, A., Grépin, K. A. et al. (2018). Assessing the perspectives of users and beneficiaries of a community health worker mHealth tracking system for mothers and children in Rwanda. *PLoS One*, 13(6). Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5991741/>

- Mwendwa, P. (2016). Assessing the fit of RapidSMS for maternal and new-born health: perspectives of community health workers in rural Rwanda. Development in Practice. Retrieved from https://www.researchgate.net/profile/Purity_Mwendwa/publication/287375589_Assessing_the_fit_of_RapidSMS_for_maternal_and_new-born_health_perspectives_of_community_health_workers_in_rural_Rwanda/links/5b5a02d20f7e9bc79a6684e6/Assessing-the-fit-of-RapidSMS-for-maternal-and-new-born-health-perspectives-of-community-health-workers-in-rural-Rwanda.pdf
- National Institute of Statistics Rwanda (2016). Rwanda Demographic and Health Survey 2014-15. Retrieved from <http://www.statistics.gov.rw/publication/demographic-and-health-survey-20142015-final-report>
- Pascasie, K. & Mtshali, N. G. (2013). A descriptive analysis of Emergency Department overcrowding in a selected hospital in Kigali, Rwanda. *African Journal of Emergency Medicine*, 4(4), 178-183. Retrieved from <https://www.sciencedirect.com/science/article/pii/S2211419X14000044>
- Ruton, H. & Musabyimana, A. (2016). 2016 Rwanda: Rwanda RapidSMS impact evaluation. Retrieved from https://www.unicef.org/evaldatabase/index_95032.html
- Rwanda Guide. (2018). BabyI's chatbot to enhance digital healthcare platform. Retrieved from <https://rwandaguide.info/post-details/babyls-chatbot-to-enhance-digital-healthcare-platform>
- Scaling Up Nutrition. (2016). How Rwanda Rapid SMS Works Illustration. Retrieved from <https://scalingupnutrition.org/news/monitoring-performance/photo-4-how-rwanda-rapid-sms-works-illustration-02/>
- The New Times. (2018). Rwanda's mobile telephone penetration rate rises to 76.1%. Retrieved from <https://www.newtimes.co.rw/section/read/231156>
- UNAIDS. (2016). The collapse of global AIDS funding. Retrieved from http://www.unaids.org/en/resources/presscentre/featurestories/2016/july/20160719_funding
- U.S. Department of Education. (2010). Evaluation of Evidence-Based Practices in Online Learning. Retrieved from <https://www2.ed.gov/rschstat/eval/tech/evidence-based-practices/finalreport.pdf>
- Würbel, H. (2017). Framework for the evaluation of cost-effectiveness of drone use for the last-mile delivery of vaccines. Retrieved from https://log-cluster.org/sites/default/files/gm_files/master_final_project_heike_wurbel_13_jun2017_003.pdf
- Zipline. (n.d.). Our Progress, Daily Deliveries Across Rwanda & Ghana. Retrieved from <http://www.flyzipline.com/>