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Raising the standard of Nigerian healthcare outcomes in areas with poor communications through the application of satellite connectivity

UK Space Agency International Partnership Programme

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UK SPACE AGENCY

Contents

Programme overview

The UK Space Agency's International Partnership Programme (IPP) is a five-year, £152 million programme designed to partner UK space expertise with governments and organisations in emerging and developing economies around the world to deliver a sustainable economic or societal benefit. All IPP projects are fully aligned to the United Nations' (UN) Sustainable Development Goals.

Inmarsat has been awarded IPP funding for three projects which began in 2017. This case study covers our project in Nigeria, raising the standard of healthcare outcomes in areas with poor communications through the application of satellite connectivity.

Executive summary

Improvements in healthcare in Nigeria are failing to keep pace with the nation's economic development, with health indicators such as infant mortality rates among the highest in the world. Provision is hampered by poor infrastructure and isolation of poorer rural communities, leaving people with little or no regular medical care provision. These communities are also the most likely to have no access to the internet through fixed or mobile networks, further isolating remote health workers and their patients from medical information and advice.

The IPP Nigeria project introduces satellite-based internet into remote communities to support the delivery of modern health technologies to medical workers and patients. While the original intention of this project was primarily to support health-based use cases and generate high impact outcomes, the project partners are beginning to see new use cases where satcom services could be used to drive other social and economic activity. The focus of the project partners remains on the primary objectives around improved health outcomes, but effort is also being applied to develop other opportunities.

In its first year, the project consortium has worked hard to ensure there is a strong alignment between the project and the needs of key Federal and State stakeholders whose priorities and pain points need to be addressed. A video has been produced which gives a snapshot of how satellite-enabled applications have had an impact on healthcare in remote communities: www.youtube.com/watch?time_continue=7&v=4Lq3g1l9Nh0

By connecting off-grid communities to the internet and modern technology, the project is assuming a role as a socio-economic development catalyst in Nigeria. The link between lack of internet access and poverty alleviation[1] has been established and use cases that are being tested, such as community Wi-Fi, are expected to open social-economic and commercial opportunities to these communities.

Key insights

There are early indications from the project's in-built monitoring and evaluation (M&E) activities that positive outcomes are being delivered after only one year of the two-year programme including, for example, cases where health workers have relied on downloading training videos to:

- Resuscitate a new born baby
- Stop a bleeding patient's post-partum haemorrhage
- Educate pregnant women and nursing mothers on appropriate and effective breast-feeding techniques
- Calibrate an infant's injection to her weight
- Safely remove a patient's placenta

Context

Although one of Africa's largest economies, Nigeria is adversely affected by chronic infrastructure deficits, weak institutions and rural populations that are at great risk of economic and social isolation. There are severe problems with infectious diseases, health indicators such as infant mortality rates remain among the poorest in the world, and improvement has remained slow[2].

Most of Nigeria's population reside outside the cities, in suburban and rural towns. In the most extremely deprived of these locations, people do not have access to power, portable water or telecommunications. Many of the healthcare facilities in these off-grid communities are not accessible by paved roads and patients often travel for hours on dirt tracks to reach them. During the rainy season some of these communities are completely cut off as it is impossible for vehicles to reach them. Health facilities serving them often cater to catchment populations as large as 50,000 people.

Health expenditure accounts for approximately six per cent of Nigeria's overall budget allocation in the last five years and less than one per cent of gross domestic product (GDP). Nigeria's maternal mortality ratio (MMR) is approximately 576 per 100,000 live births, an increase from 545 in 2008, and many of these deaths could be prevented with well-trained and equipped skilled birth attendants (SBAs)[3].

Health workers are usually the first point of contact for poor and sick people living in developing countries; their knowledge and skills are crucial to the health outcomes of their communities. Remote populations are further disadvantaged by the fact that it is very difficult to attract skilled health workers to these areas. When health workers do get assigned, lack of communications and access means they are cut off from the rest of the health system and often feel isolated without professional support.

Studies have shown that health workers are able to use mobile devices to enhance various aspects of their work (e.g. data collection and reporting, emergency referrals, supervision of and communication between healthcare workers) and personal life (communications with loved ones in cities). In rural areas where there is no mobile coverage, regular access to health information via satellite backhauled support systems improves the ability of health workers to follow treatment protocols and helps to keep their professional skills current, making them more effective.

Communications in Nigeria

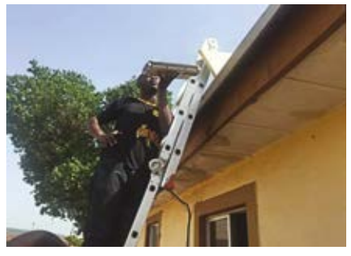
The introduction of the global system for mobile communication (GSM) in Nigeria has transformed lives and the economy of the nation, due to the lack of widespread fixed communications infrastructure outside of the main population centres. The Nigerian Communications Commission reports that there were approximately 90 million mobile internet subscribers in February 2017, up from almost 32 million in February 2013[4]. Mobile devices have improved the sharing of information and knowledge and provide accessible communication channels to many people but there are ongoing issues of connectivity, access, literacy and costs.

An InStrat study of the penetration of 3G wireless services[5] found that most of Nigeria's coverage is concentrated around urban centres and State capital cities. The study found that approximately 47%, or 91 million, of Nigeria's estimated 193 million population is not covered by any 3G network. The situation is most dire in the North Eastern Geopolitical Zone with as much as 65% of the population of some States without mobile network provision. The analysis masks the reality on the ground because these numbers are based on reported 3G area coverage maps. Most of the cell masts in North Eastern Nigeria, for instance, are not functional because of the Boko Haram insurgency. The actual coverage is likely to be less than these estimates.

Project overview

This project addresses a key development need by extending the reach of basic medical services into remote areas of Nigeria. A consortium of partners is working closely with the Nigerian State Health Ministries in Ondo, Kano and the Federal Capital Territory. The project's aims and objectives are:

- To use satellite connectivity to achieve improvements in healthcare, specifically by providing solutions to overcome the challenge of the 'last mile' – the final portion of the connectivity network that physically reaches the service user.
- To sustainably improve health service delivery and strengthen Nigeria's health systems by empowering health workers and enabling better health service data management and utilisation.
- To leverage and demonstrate the unique value proposition of satellite communications to catalyse the emergence of a platform that enables innovative health solutions to reach the last mile and achieve scale in Nigeria, creating the foundation for long-term sustainability.



Seventy five health facilities in Kano and Ondo States and the Federal Capital Territory (FCT) have been supplied with Inmarsat BGAN satellite terminals and a suite of healthcare applications to:

- Provide video-based health worker training
- Improve health systems management and governance using an information system application
- Improve disease surveillance capabilities

The project locations were selected to reflect the geographical diversity of Nigeria and by other criteria including the potential for local institutions to support the project's innovative approaches to solve healthcare delivery problems and ultimately sustainable adoption.

1 Ondo State, located in the South West of Nigeria, is home to approximately 3.5 million people and has the sixth largest GDP of the 36 states, sustained by agriculture, oil and natural gas.

2 Kano State, located in the North West of Nigeria, is home to over 11 million people and has the third largest GDP of the 36 states, sustained by agriculture and commerce.

3 Lagos State, located in the South West of Nigeria, is home to over 11 million people and has the largest GDP of the 36 states, sustained by agriculture and commerce.

4 The Federal Capital Territory Administration (FCTA) is a Nigerian ministry that administers the Federal Capital Territory, centred on Abuja. It is headed by a Minister appointed by the President, assisted by a Permanent Secretary.

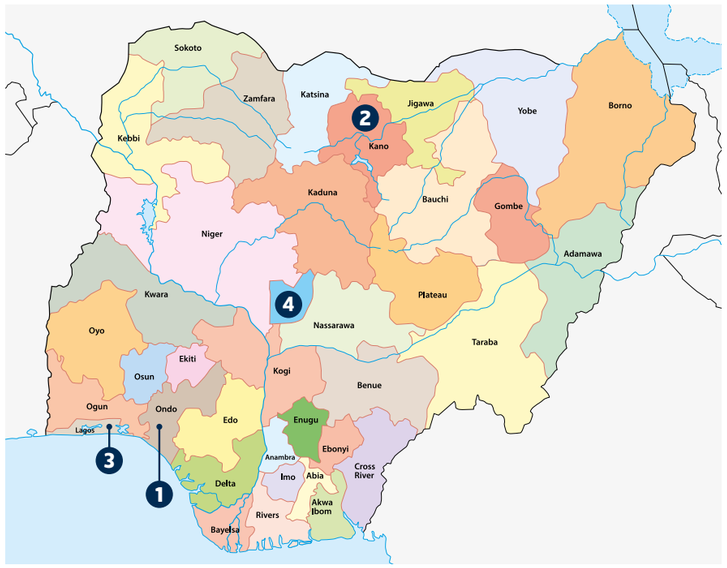


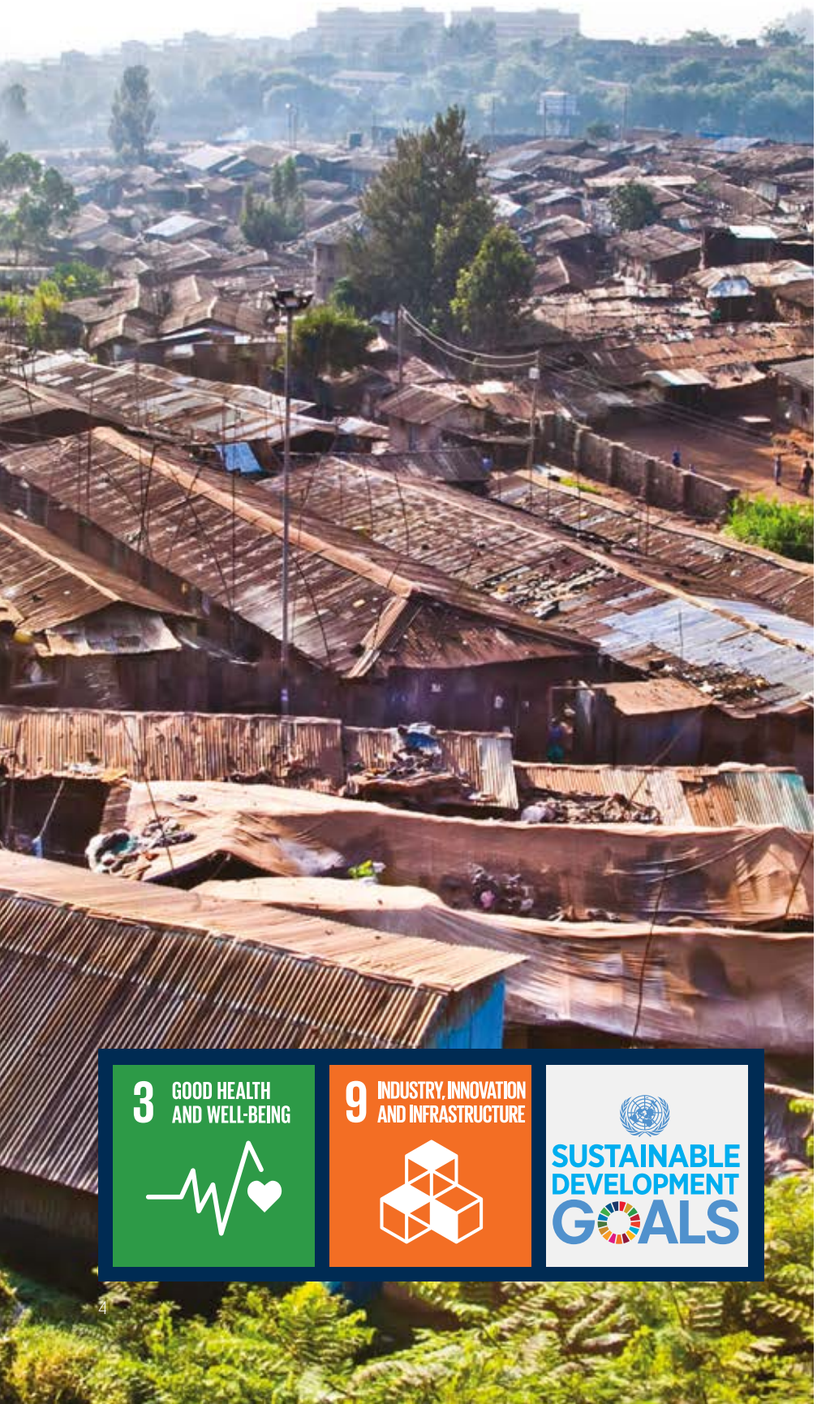
Fig 1: Location map for health clinics involved in the IPP Nigeria project

Requirement for a space-based solution

With vast swathes of Nigeria not covered by land-based communication networks, a satellite-enabled solution is essential. These unconnected areas are often home to the poorest communities who can benefit the most from all that mobile health technology has to offer.

Satellite connectivity provides the only viable solution to the last mile challenge. Satellite networks are highly reliable when compared to terrestrial networks. They are not susceptible to issues such as infrastructure loss in natural disasters and conflict.

UN Sustainable Development Goals targeted



Project consortium

- Inmarsat – the world's leading provider of global mobile satellite communications
- InStrat Global Heatlth Solutions – providing project implementation and local support
- Nuffield Centre for International Health and Development of the University of Leeds – monitoring and evaluation (M€E)

The University of Lagos, University of Abuja and Bayero University are providing M€E ground support and Epi Africa is monitoring and evaluating EWORS, a disease surveillance and notification application.

Solution development

The project uses satellite connectivity to deliver a range of mobile health applications to the participating clinics. Inmarsat's Broadband Global Area Network (BGAN) is an L-band geostationary satellite broadband network. Small, lightweight mobile and portable terminals provide on-demand data rates at up to 512 kbps or dedicated streaming at up to 650 kbps, enabling Internet Protocol (IP) access to broadband data (internet, Streaming IP, email, SMS) and voice simultaneously.

InStrat mobile health solutions provided for the project are:

- **CliniPAK** – a computer-based point-of-care data capture and decision support tool that allows health workers to collect patient health information on tablets and send the pertinent data points and information to remote servers through the mobile satellite network. Aggregated data is analysed and used for better patient care and to support evidence-based policy decision making and programme management.
- **VTR Mobile** – a training application that can be used on any smart phone, tablet or laptop/desktop computer. VTR supports multi-media training content including text, audio- and video-based training. The application features module tests that users must pass in order to ensure that learning is taking place. A pass grade may be required for proceeding to subsequent modules, after which certification can be provided to successful trainees. Once users log on and download the training content, which is then stored locally on the device, they can view the content as often as they want without incurring additional data costs.
- **EWORS** – an Early Warning Disease Outbreak Recognition application that enables the detection of disease outbreaks earlier than is possible with traditional paper-based surveillance. EWORS allows the electronic collection and analysis of routine clinical and non-clinical data to inform the likelihood of occurrence of a disease outbreak in a given geography. State and local Disease Surveillance Officers are notified when increased activity of disease syndromes are detected.

The project is planned to cover 27 months and the core part of the mobile healthcare application service was implemented over approximately six months from March 2017. This included BGAN terminal set-up; solar panel installations; training health workers; designing reporting templates etc. All applications – CliniPAK, VTR Mobile and EWORS – were turned on in November 2017 at the end of the core implementation phase.

The second part of the project is focused on understanding the use and impact of the service and identifying improvements and future uses cases. A full Monitoring and Evaluation (M€E) process has been put in place to allow the success of the service to be measured and reported.

More recently the project partners have begun a pilot of the use of WhatsApp voice and instant messaging for health workers who are without any means of communication in rural areas. Contrary to expectations that the service would primarily be used for social media and family communications, the predominant use has been for peer to peer consultations and telemedicine support.

To further extend the potential catalytic effect of the project, the partners are beginning to test different offering models that allow satellite internet to reach wide off-net populations at affordable costs. Models being tested include broadcasting satellite internet to entire communities via Wi-Fi towers, allowing local merchants to sell local subscription vouchers to residents for access to the network; and the provision of mobile satellite internet in service packages to communities or use cases where mobile terminals will be used to provide internet only when it is needed. By limiting the subscription in this manner, the cost of satellite internet is brought down to level where it is most affordable.

Early indications are that satellite connectivity has the potential to provide platforms for communities to respond to new and locally grown commercial opportunities.

Sustainability model

The IPP consortium has identified all critical actions that will lead to successful project outcomes and sustainability. These include identifying customers, their pain points and priorities and ensuring that the project value propositions address them; ensuring that the project objectives and funding strategy fall within the Government Funding Framework; identifying critical steps that must be taken to achieve sustainability and developing a practical plan to take those steps; ensuring that business models that include satcom are financially viable for the States; that there is a plan to ensure that local capacity exists to manage the service in Nigeria and that all identified risks have mitigation strategies.

The formal evaluation of the project validates the impact through quantitative reviews as well as qualitative interviews by Nuffield Centre for International Health and Development of the University of Leeds.

InStrat held a Sustainability Workshop with director level participants from each project State in Abuja, Nigeria in March 2018. The key outcomes of the meeting were a unanimous endorsement of the project value propositions and an affirmation to support the consortium's sustainability efforts. The consortium is confident that it will deliver sustainability for the IPP Nigeria project before the March 2019 end date.

By connecting off-grid communities to the internet and modern technology, the IPP project is increasingly assuming a role as a socio-economic development catalyst in Nigeria. Interest in the project has been generated from other parts of the Nigerian government and private sector to ensure adoption of the project approach in five additional areas:

- Social development: The Ondo State Government has adopted mobile BGAN terminals for its Okada (Commercial Bike Riders) registration programme, a poverty-alleviation scheme, and its ICT Innovation Hub.
- Civic election process: The Independent National Elections Commission (INEC) is currently exploring the possibility of adopting BGAN for civic elections polling results transmission in Nigeria.
- Agriculture: InStrat has received positive enquires for agricultural use cases including transmission of site geo-mapping data and real time updates on rainfall patterns, soil conditions, etc. to optimise local agricultural output.
- Defence and security: Monitoring Nigeria's borders and areas of civil unrest using drones supported by Inmarsat technology

Summary of findings to date

According to the University of Leeds Midline Evaluation Report, interactions with project stakeholders indicated that the project is contributing to improved patient care in intervention health facilities.

Specifically, policymakers, facility heads and health workers across the States cited how they have been empowered through high quality video training and regularly used the videos to provide life-saving care to pregnant women and their infants. There are also indications that service users have found the treatment and care they received in the live months of the project (November 2017 to April 2018) more acceptable, linking their satisfaction to the fact that health workers referred to relevant videos to guide them to provide more appropriate care.

CliniPAK Electronic Health Data Management

Health workers at facilities participating in the project are equipped with CliniPAK and are now able to capture patients' health data and upload it via satellite internet to InStrat cloud servers. The data is used for two important purposes:

- CliniPAK data is pushed back to facility devices for recall when patients return for follow-up visits. This allows clinicians to provide care to patients based on their history and is expected to reduce treatment errors and increase outcomes.
- Aggregated data, analyses and insights are provided to State Ministries of Health to provide a fact-based mechanism for State decision-making on public health programmes.

Data is presented in a form that allows it to be aggregated or compared with data from existing sites which have communications coverage (fixed/mobile).

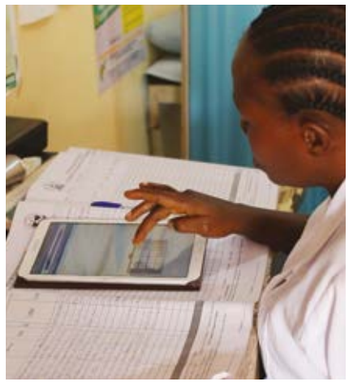
The CliniPAK Theory of Change is that improved availability of patient level clinical data will allow evidence-based decision-making which will improve health outcomes and ultimately reduce mortality.

VTR mobile health worker training

The project has demonstrated the potential for VTR to be the only scalable low-cost mechanism to train health workers regardless of their location. Test results, health worker feedback and M€E assessment reports have established that health worker learning, knowledge and capacity is increasing in project facilities and that there are improved care delivery standards. Several direct lifesaving interventions have been attributed directly to VTR. Health workers have relied on the training videos to:

- Resuscitate a newborn baby (Odode BHC, Ondo State)
- Stop a patient's post-partum haemorrhage (Wumi PHC, FCT)
- Educate pregnant women and nursing mothers on appropriate and effective breast-feeding technique
- Calibrate an infant's injection to her weight
- Remove a patient's placenta safely

According to the midline evaluation report, findings from interviews demonstrated satisfaction and acceptance of VTR by health workers, facility heads and policymakers as an important tool for enhancing the quality of training and standard of health care delivery. By helping to increase the knowledge and competence of health workers to handle basic emergency conditions, the objective of deploying VTR in intervention Local Government Areas (LGA) of each State has been largely achieved.



EWORS disease surveillance and response

To date under the project, routine facility-based disease surveillance forms have been digitised in three LGAs in Lagos and Ondo States and they can now report the disease surveillance data in real time. The M€E mid-line assessment reported:

- EWORS has helped increase disease reporting rates in pilot LGAs – from 20% to 65%
- Speed and accuracy of data analysis and interpretation has significantly increased
- Disease surveillance activities in pilot LGAs are better than in other (non-pilot) LGAs
- Users experience reduced data entry errors with EWORS than paper-based processes
- Accurate real causes of morbidity by local area can now be tracked allowing pre-emptive action by authorities.

Conclusions

By providing satellite internet connectivity to off-grid health facilities, the project has allowed modern health technologies to reach these communities for the first time. Health workers are now being trained; patients' health history is now part of treatment protocols; lives are increasingly being improved and saved; workers are now communicating with peers elsewhere.

Initial M€E results show that State Ministries of Health are now getting more complete and accurate data to inform policy decisions; health worker test scores are improving; and disease surveillance is now assuming a more proactive footing.

These accomplishments have been noticed by multiple powerful stakeholders. State Governments of Nigeria who are directly benefiting from the project have unanimously called for the expansion of the mobile health applications CliniPAK, VTR and EWORS, supported by satellite in off-grid locations, while others have approached InStrat to consider extending these services to their state.

By connecting off-grid communities to the internet and modern technology, the IPP project is increasingly assuming a role as a socio-economic development catalyst in Nigeria. Diverse non-health public and private sector players have recognised the potential for satellite communications to bridge the connectivity gap in use cases that have far-reaching implications for business, society and governance in Nigeria. The project consortium has identified and is exploring use cases in defence and security; election monitoring; agriculture; community Wi-Fi and more.

1 ITU BROADBAND.18 (2017): The State of Broadband 2017: https://www.itu.int/pub/S-POL-BROADBAND.18-2017

2 USAID Nigeria Country Development Cooperation Strategy 2015-2020: https://www.usaid.gov/sites/default/files/documents/1860/Nigeria_CDCS_2015-2020.pdf

3 Health care financing in Nigeria: Implications for achieving universal health coverage, Uzochukwu et al: https://www.researchgate.net/publication/276201203_Health_care_financing_in_Nigeria_Implications_for_achieving_universal_health_coverage

4 Nigerian Communications Commission Vanguard News: https://www.vanguardngr.com/2017/07/internet-users-nigeria-hit-91-6m/

5 Open Signal coverage maps: https://opensignal.com; National Population Commission of Nigeria, National Bureau of Statistics: https://www.citypopulation.de/php/nigeria-admin.php

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