NEW CITIES FOUNDATION

Urban E-health Project in Rio

Santa Marta community, Rio de Janeiro

Research and Analysis from the New Cities Foundation Task Force in Rio de Janeiro

Please cite this publication as:

New Cities Foundation (2013), *An Urban E-Health Project in Rio*, [online] Available: http://www.newcitiesfoundation.org/wp-content/uploads/PDF/Research/New-Cities-Foundation-E-Health-Full-Report.pdf

The New Cities Foundation would like to thank the following individuals for their thought leadership, suggestions, and participation in this project: Dr. Hans Dohmann, Marcelo Santoro and Andrea Haddad from the City of Rio de Janeiro's Secretariat of Health; Reinaldo Garcia, Clara Gaymard, Daniel Meniuk, Henrique Carvalho, Greg Farrett, Gustavo Saraiva and Alexandre Alfredo all from GE. The Foundation also thanks Prof. Denizar Vianna Araujo, Michelle Quarti and Ricardo Garcia from the Universidade do Estado do Rio de Janeiro; Caroline Marques, Dr. Pedro Hakme, Dr. Fernando Chapermann, Dr. Julia Wambier, Dr. Ana Maria Guedes, Arlene Lopes, Ana Claudia Pinnas, Sancler Correa, Julio Cezar Costa, Sonia Oliveira, David Velasco from the Clinica da Familia in Santa Marta; Heitor Gottberg and Amos Maidantchick from Cisco. Finally, the New Cities Foundation would like to thank Orange for their initial involvement in the project. Special thanks to Janaina Herrera and Rosalie Marin from the New Cities Foundation.

Written by Naureen Kabir Collings, Director of Research, New Cities Foundation.

Table of Contents

Executive Summary

Healthcare systems in emerging countries are at a turning point, one that is defined by interrelated demographic and epidemiological changes: namely, a population that is aging, and a shift from infectious diseases to complex chronic conditions such as hypertension, diabetes, obesity and heart disease. This new reality poses a serious challenge in cities, particularly in low-income or underserved communities characterized by harsh living conditions and a lack of access to healthcare and other public services. This two-pronged transition is placing an unprecedented strain on healthcare systems in emerging countries that are already hemmed in by limited resources.

To address this challenge, the New Cities Foundation set up a **Task Force on E-health**, working in close collaboration with the Municipality of Rio de Janeiro, GE Healthcare and the State University of Rio de Janeiro (UERJ). The objective: to test a replicable, cost-effective healthcare model that leverages technology to provide improved access to primary healthcare in an underprivileged urban community. (The term primary healthcare refers to the main point of consultation for patients and the mechanism by which patients gain access to any specialists they may need.) The Task Force sought answers to the following questions:

- Can the use of e-health technology bring **cost savings to the public healthcare system while improving access to healthcare** in an underserved urban community?
- Does e-health **improve the consultation experience** for health professionals as well as for patients?
- Does it help the public healthcare system **address chronic disease conditions** among elderly low-income patients?

The Task Force equipped a primary care health clinic in the community of Santa Marta in Rio de Janeiro with an e-health kit (developed by GE) consisting of a backpack that contained various tools to measure health indicators. For the pilot project, the clinic staff made home visits to attend to a sample of 100 elderly patients suffering from chronic diseases and mobility issues, with the goal of producing a comprehensive diagnosis using this e-health backpack. Patient data was also collected using the kit. Meanwhile, an independent team of researchers from UERJ produced a qualitative and quantitative impact assessment of the e-health pilot on the patients and the community's healthcare staff.

Summary of Key Findings

1. Applying an e-health model of healthcare in an underprivileged urban community can bring significant cost savings to the public healthcare system.

Enabling health workers to reach patients who are difficult to access, the e-health model of primary care delivery makes it easier to monitor health indicators in underserved urban communities. According to the study, regular monitoring of basic health indicators among elderly patients as well as timely diagnosis of chronic diseases generally decreased the risk of hospitalization for patients with certain chronic conditions. In turn, avoiding hospitalization results in substantial savings for the public healthcare system. That

benefit is particularly pronounced in the case of elderly patients, whose recovery is slower, more complex and costlier than for the rest of the population and who therefore require lengthier hospital stays. The amount of cost savings due to avoided clinical events for specific types of chronic disease ranged between USD $4,000 (heart failure) and USD $200,000 (kidney dysfunction) per 100 elderly patients in the e-health program. Similarly, the cost savings due to avoided hospitalizations of patients with cardiovascular diseases was around USD $136,000 per 1000 patients in the e-health program. As a point of reference, the market price of the e-health backpack is USD $42,000.

2. E-health technology facilitates the job of healthcare professionals and improves the in-home medical checkup experience for patients.

E-health backpack equipment reduced the time needed to obtain medical results. With conventional medical testing procedures, results from blood samples can take up to 15 days, as opposed to three minutes with the e-health kit. Consequently, patients and healthcare professionals alike indicated high levels of satisfaction with the use of the backpack to conduct medical home visits.

3. An e-health model of healthcare accelerates the public health system's ability to overcome barriers to healthcare access in underprivileged communities.

The e-health pilot project helped bridge the social and digital gap between Santa Marta's residents and the city's public healthcare system. By bringing high-tech medical tools to Santa Marta – equipment conceived for an underserved community and adapted specifically to the needs of this community – the e-health pilot essentially leapfrogged the process of gradual, incremental improvements in Rio de Janeiro's healthcare services. Urban health services around the world can learn from this model to adapt their approach to healthcare delivery – from both a process and technological reform standpoint – in dense, low-income urban areas.

The full UERJ technical report and data analysis can be found at:

http://www.newcitiesfoundation.org/wp-content/uploads/PDF/Research/New-Cities-Foundation-E-Health-Final-Report-UERJ.pdf

Introduction

Low- and middle-income countries around the world are urbanizing rapidly. And urban lifestyles are changing in tandem: citizens of middle- and low-income countries are living longer, consuming more processed foods and exercising less often. As a result, the disease profile among urban populations in emerging countries is shifting from predominantly communicable diseases (malaria, tuberculosis, hepatitis and other such illnesses resulting from infection) to predominantly non-communicable diseases. (Non-communicable or chronic diseases are illnesses that are typically of long duration and are not passed from individual to individual.) There are four main types of chronic disease: cardiovascular, cancer, respiratory diseases, and diabetes[1]. These diseases are spreading at epidemic rates, affecting millions of people around the world. Among all but the poorest countries, disabilities and deaths due to chronic diseases exceed those attributed to communicable diseases.

Studies over the last two decades in low-income countries have shown persistent increases in the proportion of the population with high-risk symptoms of chronic diseases such as obesity[2]. Moreover, according to the World Health Organization, the number of deaths caused by non-communicable diseases is projected to increase by 15% globally over the next decade, with the greatest increases occurring in low- and middle-income countries where these deaths are expected to increase by more than 20%[3].

These diseases, which once affected primarily rich countries, are increasingly affecting poorer populations in emerging countries. As the population in cities has grown and as the health profile of increasingly urban populations has changed, access to healthcare and other public services has not always kept pace. This epidemiological transition is all the more critical in countries where people tend to lack access to basic services, let alone to healthcare facilities specializing in health monitoring and disease prevention. Existing health infrastructure in low- and middle-income countries was created primarily to deal with infectious diseases, and a very different kind of healthcare is required to cope with the lengthy duration of chronic diseases. The result: unprecedented strain on public healthcare systems in terms of skills, equipment and management.

In this context, how can a city with limited resources afford to remove the barriers to universal access to primary health services? Is it possible to ensure equal treatment between underprivileged and wealthier areas? Can e-health technology provide a solution that reduces costs while expanding primary care coverage?

The New Cities Foundation, a non-profit organization dedicated to building more just, creative, dynamic and sustainable cities around the world, sought to address these complex questions with a practical, solution-oriented approach. In partnership with the Secretariat of Health of the Municipality of Rio de Janeiro, GE Healthcare and the State University of Rio de Janeiro, the New Cities Foundation designed a pilot project and deployed a Task Force on E-

[1] World Health Organization (WHO), 2013. *Noncommunicable diseases. Fact sheet.* [online] Available at: http://www.who.int/mediacentre/factsheets/fs355/en/ [Accessed 25 April 2012]

[2] Nugent, R., 2008. Chronic Diseases in Developing Countries Health and Economic Burdens. *Annals of the New York Academy of Sciences*, 1136: 70–79 (2008). [online] Available at: http://www.cgdev.org/doc/expert%20pages/nugent/Nugent_Annals_article.pdf [Accessed 25 April 2012]

[3] WHO, 2012. *Prevention and control of NCDs: Guidelines for primary health care in low-resource settings.* [online] Available at: http://www.who.int/nmh/publications/en/ [Accessed 25 April 2012]

health in an underserved community in Rio de Janeiro. Additional support for the project was provided by Cisco. The objective: to test a replicable, cost-effective model that leverages technology to facilitate primary healthcare access for underserved populations while increasing the quality and efficiency of healthcare delivery. While the potential of mobile and e-health technology has been tested in isolated rural areas and extreme situations (e.g., war zones, exceptional weather conditions…), the New Cities Foundation Task Force on E-health is among the few such initiatives to leverage this type of health indicator measurement technology in an underserved, densely populated urban environment.

Why Brazil?

The increase in chronic diseases is particularly significant in Brazil. According to the Brazilian Ministry of Health, cardiovascular problems, such as heart attacks and strokes, are the leading cause of mortality among Brazilians. In 2007, roughly 72% of deaths in Brazil were attributed to non-communicable diseases such as respiratory conditions, diabetes, cancer, and cardiovascular disease[4].

Moreover, according to the World Bank, "[c]ompared to 1980, there has been an addition of some ten years of life of a child born in 2008" in Brazil. Further estimates show that by 2050, life expectancy for babies born in Brazil will reach 81, beating the life expectancy enjoyed by most of the world's developed countries[5]. In 2005, citizens over the age of 65 constituted 15% of Brazil's population; they are expected to make up about 55% of the total population in 2050, or roughly 120 million people[6]. Along with aging, the World Bank report found that cardiovascular diseases and cancer are among the leading causes of death in Brazil and that non-communicable diseases are very common causes of death for the country's older population[7].

As a consequence of this projected increase in life expectancy and the accompanying rise in the prevalence of chronic diseases, greater strain is placed on health and social services. A significantly higher demand for health services comes from the elderly segment of the population. In 2006, while the proportion of older people in Brazil was about 10%, they accounted for 26% of hospital costs[8]. At the same time, the demands associated with the health needs of these senior citizens cannot be adequately met by Brazil's health infrastructure as long as the country's

---

[4] Schmidt et al., 2011. Chronic non-communicable diseases in Brazil: burden and current challenges. *The Lancet*, Volume 377, Issue 9781, 4–10 June 2011, Pages 1949–1961

[5] Gragnolati et al., 2011. *Growing Old in an Older Brazil. Implications of Population Ageing on Growth, Poverty, Public Finance, and Service Delivery*. The World Bank. [online] Available at: http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2011/09/09/000333037_20110909015302/Rendered/PDF/644410PUB00Gro00ID0188020BOX361537B.pdf [Accessed 25 April 2012]

[6] Instituto Brasileiro de Geografi a e Estatística (IBGE), 2008. Projeção da população do Brasil por sexo e idade 1980-2050. Revisão 2008. *Informação Demográfi ca e Socioeconômica*, número 24. [online] Available at: http://www.ibge.gov.br/home/estatistica/populacao/projecao_da_populacao/2008/projecao.pdf [Accessed 25 April 2012]

[7] Gragnolati et al., 2011.

[8] Gragnolati et al., 2011.

healthcare remains focused on infectious diseases[9]. This epidemiological shift requires a reorientation toward chronic care in Brazil's healthcare system.

Why Rio de Janeiro?

The City of Rio de Janeiro's current health challenges anticipate trends in other major emerging metropolises over the coming decades:

- **A rapidly-aging population**: Rio de Janeiro has a high proportion of elderly citizens when compared to the city's total population – the highest ratio in Brazil[10].
- **Changing dietary habits and more sedentary lives leading to an increase in chronic diseases**: Studies show that the problem of obesity, for example, is shifting toward the poor in Brazil and can no longer be considered a disease of the wealthy[11]. In Rio de Janeiro, studies found that chronic diseases are the primary cause of mortality among the elderly in poor neighborhoods[12].
- **Public healthcare services that are still adjusting** to the epidemiological transition from communicable to chronic diseases.
- **The rapid rise of real-estate prices** putting a damper on major infrastructure projects, such as new hospitals[13].
- **The prevalence of underprivileged urban areas** that have little or no access to healthcare. Rio de Janeiro has the largest *favela* population in Brazil. More than 22%, or 1.4 million, of the city's residents live in 763 *favelas*[14].

Faced with these challenges, the Municipality of Rio de Janeiro launched the *Saúde Presente* program in 2009 to expand health services to areas previously neglected by healthcare management. More than 30 clinics are already operating under this program. The aims and features of *Saúde Presente* include:

- Ensuring that all citizens have access to healthcare professionals who provide guidelines for disease prevention through early diagnosis.
- Improving maternal and child mortality indicators, and reducing hospital costs by decreasing hospitalizations, consultations and examinations.
- Integrated primary care health units: the gateway to these is the *Clinica da Familia*

[9] Gragnolati et al., 2011.

[10] Carneiro, A., 2005. Idosos: um perfil estatístico da terceira idade no Rio de Janeiro. *Coleção Estudos Cariocas*, Fevereiro - 2005. [online] Available at: http://portalgeo.rio.rj.gov.br/estudoscariocas/download/2360_Idosos%20-%20Um%20perfil%20estat%C3%ADstico%20da%20terceira%20idade%20no%20Rio%20de%20Janeiro.pdf [Accessed 25 April 2012]

[11] Monteiro, C. A. et al., 2007. Income-Specific Trends in Obesity in Brazil: 1975–2003. *American Journal of Public Health*, October 2007, Vol 97, No. 10. [online] Available at: http://ajph.aphapublications.org/doi/pdf/10.2105/AJPH.2006.099630 [Accessed 25 April 2012]

[12] Salomão, B., 2013. Causa da morte de idoso é ligada a local de moradia. *O Dia*, 13.04.2013. [online] Available at: http://odia.ig.com.br/portal/cienciaesaude/causa-da-morte-de-idoso-%C3%A9-ligada-a-local-de-moradia-1.571605 [Accessed 25 April 2012]

[13] Sainte Croix (de), S., 2010. Rio Prices May Double in 5 Years. *The Rio Times*, March 16, 2010. [online] Available at: http://riotimesonline.com/brazil-news/rio-real-estate/rio-prices-may-double-in-5-years/ [Accessed 25 April 2012]

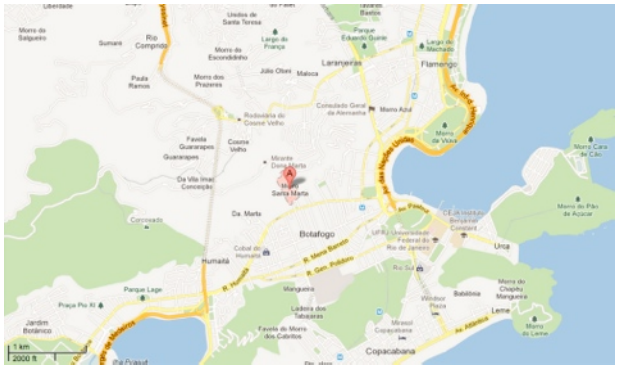
[14] Hurell, F., 2011. Rio Favela Population Largest in Brazil: Daily. *The Rio Times*, December 23, 2011. [online] Available at:http://riotimesonline.com/brazil-news/rio-politics/rios-favela-population-largest-in-brazil/ [Accessed 25 April 2012]14

(Family Clinic), where patients can obtain laboratory tests, x-rays, ultrasounds, consultations and other basic procedures.

- Access to a professional medical staff at the Family Clinics: physicians, nurses, nurse technicians, community health agents, dentists, dental assistants and health surveillance agents monitor patients with chronic diseases. Patients are referred to outpatient clinics and specialists as needed to reduce the onset of more serious illnesses that, if not properly treated, can result in severe clinical events (e.g., stroke, kidney failure, heart failure).

Why the Community of Santa Marta?

The Task Force on E-health conducted the pilot project in Santa Marta, a low-income hilltop settlement situated adjacent to an upper-middle class neighborhood called Botafogo in the heart of Rio de Janeiro. Historically, Rio's *favelas* comprised some of the most underprivileged urban communities in Brazil, lacking access to many basic public services such as sanitation, electricity, and healthcare. Today the community of Santa Marta, one of the city's steepest *favelas*, still has few roads and mobility is difficult. A slow, overcrowded cable car is the primary means of transportation. Most of Santa Marta's 8,000 residents use steep staircases to move around, and access to healthcare is challenging, particularly for the elderly. The public hospital that most residents attend is 6 kilometers from Santa Marta while the community's primary care clinic, the *Clinica da Familia*, is located at the very bottom of the hill.



Morro Santa Marta

The Santa Marta Community

Once a violent and dangerous neighborhood, Santa Marta today serves as an example of ongoing urban transformation in an underprivileged community. Upon the recommendation of the City of Rio de Janeiro, the Task Force selected Santa Marta as the project pilot site for two main reasons. First, it is the first community to benefit from Rio de Janeiro's municipal "pacification program" aimed at reducing high levels of violence and crime in

these neighborhoods[15]. Second, Santa Marta is one of the zones benefiting from the *Saúde Presente* healthcare program described above. Santa Marta's Family Clinic opened in 2009 to provide basic primary care to the community. Deprived of formal access to healthcare until relatively recently, many of Santa Marta's residents – the elderly in particular – suffer from chronic diseases. The clinic is currently staffed by a doctor, nurse, nurse technician, two oral health teams, and six community health agents who are residents of Santa Marta and are trained to bridge the social gap between the healthcare system and the community.

The Pilot Project: Scope and Aims

Responding to the context outlined above, the Task Force undertook to study the effects of bringing advanced healthcare technology to a long-ignored urban community facing serious demographic and epidemiological challenges. The Task Force empowered Santa Marta's Family Clinic with a portable e-health kit, supplied by GE Healthcare, which consists of a backpack containing nine medical tools designed to enable health workers to take essential health measurements, such as blood pressure and glucose levels, quickly and efficiently. The clinic staff regularly conducts in-home medical check-ups and consultations with patients who have difficulties accessing the clinic on their own, as mandated by the *Saúde Presente* program. During the pilot project, these health workers used the backpack for in-home monitoring and treatment. One of the backpack's key advantages is that it can be transported easily in the steep urban setting of Santa Marta, which lacks sufficient public transportation.

Through this pilot program in Santa Marta, the Task Force attempted to answer two main questions:

1. **Can e-health technology reduce the cost of healthcare in a previously underserved community?**
2. **Does e-health technology help overcome barriers to healthcare in this type of community?**

A unique aspect of this project is that it deploys high-tech where it can make the biggest impact. High-tech innovations tend to be designed primarily for populations that are economically well off. The Task Force on E-Health seeks to test the hypothesis that bottom-of-the-pyramid populations stand to derive greater benefits from innovation that allows them to bypass more basic forms of healthcare delivery. The e-health pilot accelerates the process of improving health services though the deployment of high-tech medical tools adapted to the needs of an underserved community. In doing so, the e-health pilot directly addresses the gap in access to public services between Santa Marta and the wealthier surrounding neighborhood.

[15] The program, which began in 2008, involved employing a surge of force to drive out drug traffickers followed by the permanent implantation of police units inside the favela and the subsequent establishment of public services such as healthcare and education. For more information, please see http://www.proarq.fau.ufrj.br/revista/public/docs/Proarq19_TourismSlums_CarvalhoSilva.pdf.

The New Cities Foundation Task Force on E-Health

Objectives

Beginning with this pilot project, the Task Force on E-health aims to highlight the project's global relevance in increasing access to healthcare among poor urban communities and to provide a model that can be replicated in any city. The ultimate objective is to present a scalable model that demonstrates the potential of e-health technology and policies to:

- Address current and future health challenges affecting major emerging cities
- Tackle the economic, social and physical barriers to healthcare for underserved communities
- Develop a new economic model of healthcare

Task Force Members: a Solid Cross-sector Ecosystem

The New Cities Foundation Task Force on E-health is composed of public and private partners – a unique ecosystem representing local authorities, private technology providers and academia. The New Cities Foundation acts as the initiator and coordinating body for the project and is also in charge of managing the implementation of the pilot.

The pilot was implemented in close partnership with the City of Rio de Janeiro, with the particular support of the Municipal Secretary of Health. The Municipality recommended the pilot site location and was also instrumental in providing the political support and legal framework needed to implement the project. GE, a leading global technology and infrastructure firm and Founding Member of the New Cities Foundation, provided the technology as well as strategic and financial support to set up the Task Force. The project was also supported by Cisco, an NCF Founding Member and a leading manufacturer of networking equipment. A prominent group of health economists at the Department of Clinical Medicine at the State University of Rio (UERJ) provided the independent research team that led the pilot's impact assessment.

Target Population

The Task Force specifically targeted elderly inhabitants of Santa Marta. Managing health for the elderly is one of the Municipality of Rio de Janeiro's priority programs[16]. Increased longevity, which is largely attributable to medical progress and better coverage of health services, brings with it a challenge for public policy with regard to the needs of senior citizens. The number of

[16] Universidade do Esado do Rio de Janeiro, 2013. E-health Pilot Final Report. Available at: http://www.newcitiesfoundation.org/wp-content/uploads/PDF/Research/New-Cities-Foundation-E-Health-Final-Report-UERJ.pdf

medical visits increases with age, as does the number of tests, medications, and lengthy hospitalizations. Recovery is slower and more complex, treatments become more prolonged and costly[17].

An aging population requires preventive health services that focus on quality of life, good nutrition, physical exercise and rehabilitation. Programs focused on home care, outpatient care and family health are also needed. With an elderly population proportionately greater than the national average[18], the City of Rio de Janeiro is particularly interested in measures to improve the effectiveness and efficiency of healthcare for the elderly, in line with Brazil's National Health Policy for the Elderly.

The pilot study was thus conducted with a sample of 100 patients over the age of 60 suffering from chronic diseases (e.g. diabetes, hypertension, heart disease) and/or mobility problems. The data collection process lasted seven months, beginning in August 2012 and concluding in March 2013.

The E-health Backpack

As part of the *Saúde Presente* initiative, and prior to the e-health pilot project, Family Clinic nurses performed home visits on a weekly basis, conducting check-ups on patients unable to travel down the hill to the clinic. The staff's on-site diagnosis capacity was limited to basic measurements such as body temperature and blood pressure. Medical samples such as blood tests had to be sent to a laboratory to be analyzed and patients would receive the results as much as two weeks later. With the e-health backpack, the clinic nurses had the ability to travel through the narrow streets of the community to perform in-home visits. The equipment in the backpack enabled them to detect an average of 20 different diseases such as hypertension and diabetes within minutes.

Traveling with the backpack through the community

The Santa Marta community

[17] IBGE, 2010. Síntese de indicadores sociais. Uma análise das condições de vida da população brasileira 2010. *Informação Demográfi ca e Socioeconômica*, número 27. [online] Available at: http://www.ibge.gov.br/home/estatistica/populacao/condicaodevida/indicadoresminimos/sinteseindicsociais2010/SIS_2010.pdf [Accessed 25 April 2012]
See also Schramm, JMA et al. Transição epidemiológica e o estudo de carga de doença no Brasil. *Ciênc. saúde coletiva*, Rio de Janeiro, 9(4)2004. [online] Available at: http://www.scielo.br/scielo.php?pid=S1413-81232004000400011&script=sci_abstract&tlng=pt [Accessed 10 September 2012]

[18] Vieira, S., 2010. Rio de Janeiro é capital brasileira com mais idosos. *R7*, 13/10/2010. [online] Available at: http://noticias.r7.com/rio-de-janeiro/noticias/rio-de-janeiro-tem-maior-proporcao-de-idosos-do-brasil-20101013.html [Accessed 25 April 2012]

The market price of the e-health kit is Brazilian Reals $85,000 (or USD $42,000) and contains the equipment detailed below.

Due to various technical and logistical factors, the health workers were able to use only the basic health indicator measurement tools in the backpack. The V-scan, for example, was not deployed during home visits as it required a specialist trained to interpret ultrasound images. As a result, during this phase of the pilot study, the backpack served the purpose of a mobile health – or m-health – kit rather than an e-health kit with full wireless connectivity and data transmission capabilities. The aim of using the backpack was to augment the quality of primary care provided by health workers when attending patients at home.

Importantly, the pilot project focuses largely on the process of integrating the backpack into the Family Clinic's daily routine. This process includes training the clinic staff and familiarizing them with the equipment as well as measuring the capacity of the equipment to improve access to primary healthcare for underserved populations.

	V-Scan, a pocket-sized ultrasound device for obstetric, abdominal and heart tests
	Tuffsat pulse oxymeter to measure blood oxygenation and heart rate
	Electrocardiogram
	Accutrend blood monitor for glucose, cholesterol and triglycerides
	Tape-measure to measure waist circumference
	Scale to assess bioimpedance, weight, fat and hydration
	Stethoscope to auscultate heart and lungs
	Blood pressure monitor
	Thermometer

Backpack Deployment and Project Implementation

The New Cities Foundation coordinated a collaborative and transparent process among Task Force members and local actors. Due to the high sensitivity of personal medical data management, the Task Force followed strict procedures to ensure full confidentiality and guarantee the deontology of the research. For example, with respect to the health data, the Municipality granted to authorized UERJ researchers exclusive access to Santa Marta patients' medical files.

All three teams at the clinic were involved in the project. Each team was comprised of a doctor, a nurse, a technical nurse and six community health agents.

Training and Outreach

A team composed of 11 health professionals (four doctors, one nurse manager, three nurses, and three nurse technicians) was trained prior to the start of data collection. The first training session involved teaching the professionals how to use the equipment in the backpack. For example, all of them were trained to perform an electrocardiogram to measure a patient's heart electrical activity.

E-health equipment training session, Santa Marta Family Clinic, July 2012

Later, the doctors were trained to use the V-Scan, a state-of-the-art pocket-sized ultrasound machine. The backpack was used mainly by professionals who make home visits. Although the nurse manager and doctors did not use the backpack, they were involved in interpreting the data collected using the backpack equipment. The Family Clinic's community agents spread the word about the project, helping reach the most vulnerable and isolated patients in Santa Marta. Lastly, beyond training, the pilot project initiated the process by which the backpack would become integrated in the Family Clinic's regular schedule. This entailed making the backpack part of the clinic staff's weekly home visits, rotating its use by the various professionals to ensure deployment across the broadest spectrum of patients.

Community health agents went door-to-door to inform Santa Marta residents about the e-health pilot project

Data Collection

One half of the patient data was collected over two separate cycles of home visits, one at the beginning and the end of the pilot study. The second half was gathered during a data collection event in the community as part of an awareness and prevention campaign. The patients identified during this event were visited once more at their homes with the backpack.

Over the 30-week data collection period, 200 visits were made with the backpack, reaching an average of 6.6 visits per week. The backpack was also used for patients who did not meet the study's inclusion criteria, among them pregnant women, patients under 60, and patients with disabilities. The idea was to diversify the data pool and test the backpack among a variety of patients. In the end, though, these patients' records were excluded from the final analysis. For patients included in the study, the research team collected the following information:

Table 1: Patient Clinical Data

Patient name:	Gender:
Age:	Height:
Weight:	Temperature:
Glucose:	Triglycerides:
Cholesterol:	Pulse:
Saturation:	Blood Pressure:
Waist Circumference:	

Setting up the pilot study in the heart of Santa Marta community

On Thursday morning, October 18, 2012, the *Clinica da Familia*'s medical team gathered at a strategic thoroughfare, atop the hill at the third cable car station, in order to reach Santa Marta's most isolated patients.

Within a few minutes, their blood pressure, glucose and cholesterol level were measured free of charge by healthcare professionals from their local clinic. Some of these residents had never been to the clinic; others discovered they had high blood pressure. All benefited from the advice of volunteer nutrition students while Professor Eduardo, the clinic's sports trainer, encouraged everyone to be more active and take part in the various outdoor activities he organizes weekly throughout the community.

As a result of this event, NCF was able to test a **new way for the e-health kit to break physical barriers and bridge the social gap** between low-income populations and their local public health services.

Research Methodology

The New Cities Foundation commissioned UERJ researchers specializing in health economics to design the methodological framework and indicators to assess the impact of the pilot. The Foundation identified three strategic questions to guide the research:

1. Is e-health cost-effective from the public healthcare perspective?
2. Does the pilot improve access to healthcare services for underserved populations?
3. What is the end-user experience?

To answer these questions, the research team measured the following:

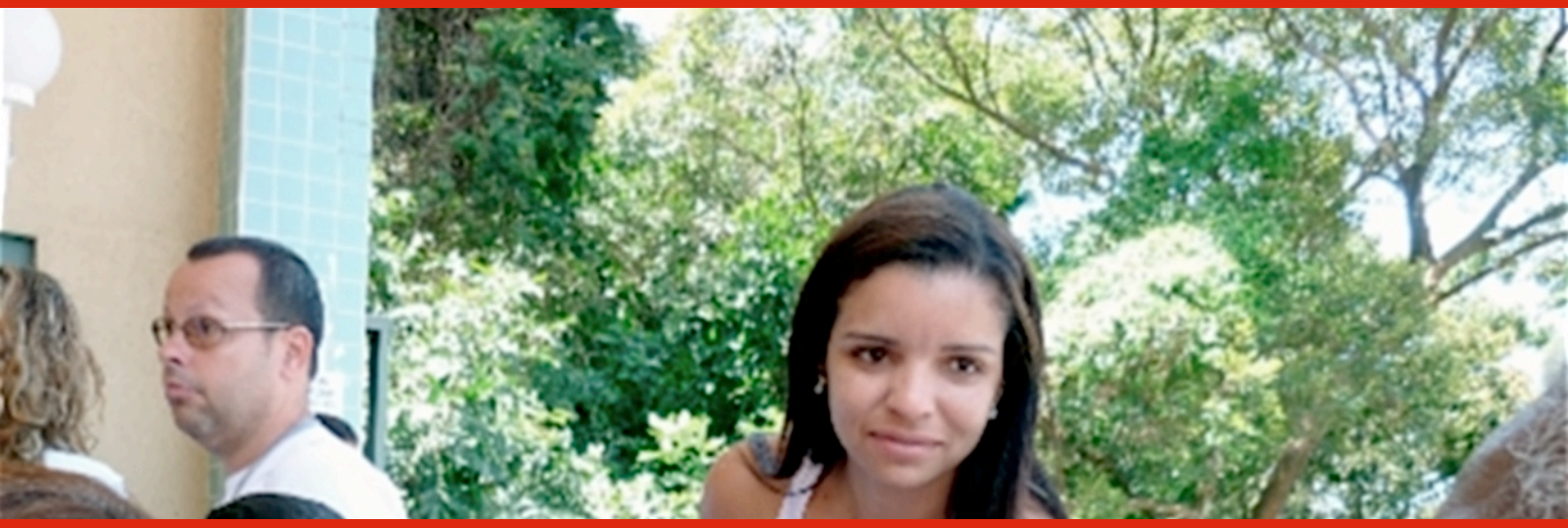
Economic Benefits: UERJ assessed the economic benefits to the healthcare system based on the number of avoided hospitalizations or avoided clinical outcomes. If patients' conditions can be prevented from advancing to a stage where they need extensive clinical treatment or hospitalization, this saves costs for the public health system. Accordingly, the researchers carried out a broad revision of recent literature about the cost of illness in the Brazilian health system to estimate the economic benefit of avoided diseases and medical procedures for the e-health patient group (see detailed questionnaire on cost of treatment in Appendix I).

Clinical Impact: The clinical outcome was calculated to derive the cost savings analysis mentioned above. The goal was to compare the clinical outcomes of patients in the e-health pilot with those of a control group of individuals who did not participate in the pilot, to measure the difference in healthcare costs associated with the two groups' clinical outcomes. To comply with ethical research standards, the research team compared clinical data of the target population following the introduction of the pilot with clinical data of a historical control group[19], rather than comparing the same population before and after the pilot program[20]. The researchers designed indicators (see Appendix II) and questionnaires to collect a comprehensive set of data on the target population.

End-user satisfaction: The research team evaluated both patients' and clinic staff's satisfaction with the use of the backpack by using survey questionnaires (see Appendices III and IV).

[19] A historical control group refers to a group of patients whose disease or health conditions are considered to be the same as or similar to the study group, but who were studied during a period of time prior to that of the study group or whose health data is available through records.

[20] Comparing with a historical control group entails certain methodological limitations due to the different socio-economic characteristics of the two populations. However, the large magnitude of effect in outcomes such as stroke and heart failure mitigates this methodological bias. According to the Grading of Recommendations Assessment, Development and Evaluation (GRADE) system for grading evidence, a large magnitude of effect is a factor that may increase the quality of evidence based on observational study. In addition, GRADE identified the choice of hard clinical endpoints (such as blood pressure) as opposed to surrogate markers as a factor that contributes to making the results more robust. In other words, the researchers' assessment of the pilot project was based directly on the occurrence of actual medical outcomes within the target population. A clinical endpoint is the incidence of a particular disease or medical abnormality that forms one of the target results of the clinical assessment. A surrogate marker (or endpoint) measures the impact of a specific treatment that might correlate with a true clinical endpoint, but where the relationship is not necessarily guaranteed.



Results and Key Findings

The following results are based on the technical impact evaluation report submitted by the UERJ research team at the conclusion of the patient data collection and analysis period (to read the full technical report, please see here).

Economic Impact

A main area of study was avoided hospitalizations, a key source of cost savings to the public healthcare system. The results in Santa Marta indicate that Rio de Janeiro's recently instituted system of early diagnosis and prevention through the *Saúde Presente* program has had a significant positive impact on citizens' health and, consequently, on the incidence of hospitalizations or other serious clinical events. The research team found that the Family Clinic's weekly in-home visits were enhanced through the integration of the e-health backpack. Improved patient monitoring and timely disease diagnosis and treatment contributed to the reduction or avoidance of chronic disease conditions requiring expensive treatment or hospitalization, delivering major cost savings to the public healthcare system.

Based on the costing of avoided clinical events and hospitalizations, the research team produced an estimate of cost savings by type of medical event and an estimate of general avoided hospitalization for patients with cardiovascular conditions. These are summarized in Table 2 below. The costing methodology of this research does not take into account the wider socio-economic benefits for patients, their families and society at large. If indirect benefits such as costs saved for patients (e.g., transportation costs, or wages foregone due to illness and treatment) were calculated, the actual aggregated benefits of e-healthcare are potentially much higher.

For full calculations on costs of disease treatment, breakdown by specific disease type, and prevalence of diseases among patients, please see the UERJ technical report.

Table 2: Cost savings resulting from avoided medical events

Medical event avoided in e-health patient	**Associated cost savings**
Strokes (per 100 patients per year)	Brazilian Reals $65,454.36 (USD $ 32,521)
Heart failures (per 100 patients per year)	Brazilian Reals $8,055.00 (USD $ 4,002)
Kidney dysfunction (per 100 patients per year)	Brazilian Reals $403,628.40 (USD $ 200,541)
Hospitalizations due to cardiovascular conditions (per 1000 patients per year)	Brazilian Reals $273,750.00 (USD $ 135,876)

Due to aging and the dietary factors discussed earlier, the number of patients requiring renal replacement therapy, such as dialysis or kidney transplants, is expected to grow steadily in Brazil in coming years. Since renal replacement therapy is publicly funded in Brazil, the growing proportion of cases requiring kidney treatment equates to a corresponding increase in costs for the public healthcare system. However, the early detection of chronic diseases through weekly visits and regular monitoring means that patients can be treated before they advance to end-stage renal failure. Given the high cost of these treatments, the e-health pilot demonstrates the opportunity for significant cost savings in Brazil: over USD $200,000 per 100 patients per year.

Similarly, the e-health pilot also reveals a decreased severity of cardiovascular illness for patients in the target population who are hospitalized for heart disease. Again, thanks to timely diagnosis and treatment through consistent surveillance of relevant health indicators, there was a significant reduction in the risk of hospitalization when comparing patients in the e-health project to the historical control group data. From the health policymaker's perspective, this translates to an estimated reduction of 360 hospitalizations per 1000 patients in the e-health project, which in turn equates to a cost savings of approximately R$ 273,750 (USD $ 135,876) for every 1000 patients per year.

Clinical Impact

The UERJ team observed a significantly lower prevalence of certain clinical conditions among patients in the Santa Marta pilot project compared to historical control groups, in particular for strokes, heart failure and kidney dysfunction.

While these results are significant, a word of caution is necessary. Due to the relatively short period of data collection during the pilot study and the long lifespan of chronic diseases, it is unwise to attribute the improved clinical outcomes shown here solely to the e-health project. Nor is it wise to dissociate the impact of the e-health pilot from the overall success of Rio de Janeiro's *Saúde Presente* program. However, the improved clinical outcomes are noteworthy in terms of what they indicate about the potentially positive health implications of implementing e-health programs in urban areas where health access is lacking.

A summary is shown in Table 3 below.

Table 3: Comparison of disease prevalence between e-health patients and historical control group

Prevalence (%) of stroke in hypertension patients	
% outcomes in the historical control	14.8%
% outcomes in the e-health pilot	0.82%
Prevalence (%) of heart failure in patients with type II diabetes and hypertension	
% outcomes in the historical control	17.1%
% outcomes in the e-health pilot	6.36%
Annual percentage of type II diabetes patients undergoing hemodialysis	
% outcomes in the historical control	28%
% outcomes in the e-health pilot	2.71%

Social Impact

The majority of patients and health workers in Santa Marta were enthusiastic in adopting the e-health backpack. In particular, patients and health workers directly benefited from the reduction in the time necessary to receive the results of medical tests. Obtaining faster test results also leads to a shorter gap between initial consultation and follow-up appointments. The impact of this improved access to healthcare via the e-health backpack was measured via satisfaction surveys conducted with the patients in the study and with the clinic staff who used the backpack.

Patient Satisfaction

See Appendix III for full questionnaire.

Chart 1 below measures patient satisfaction with the home visits in general, while Chart 2 shows patient satisfaction with the e-health kit specifically.

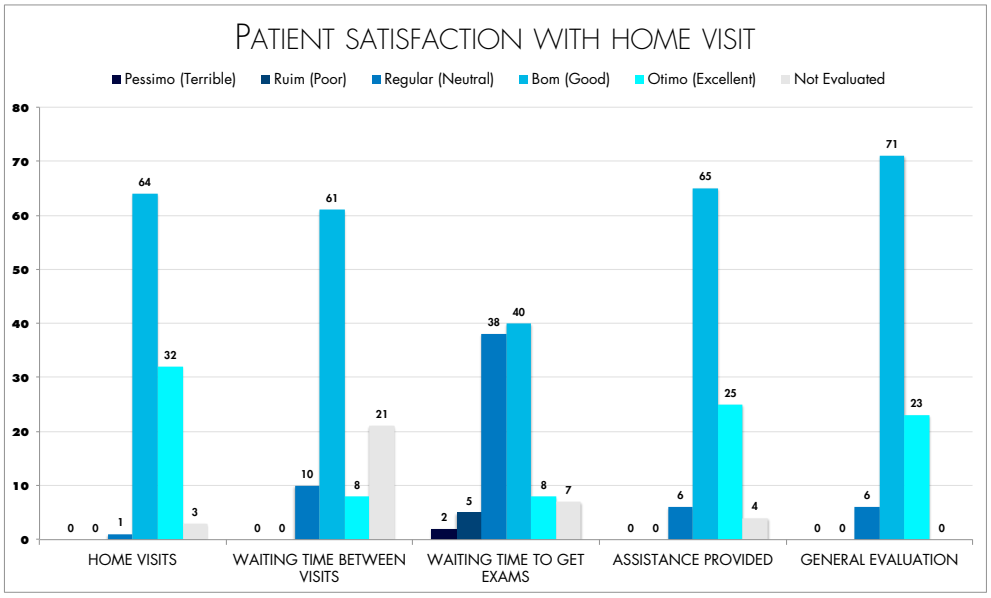


Chart 1

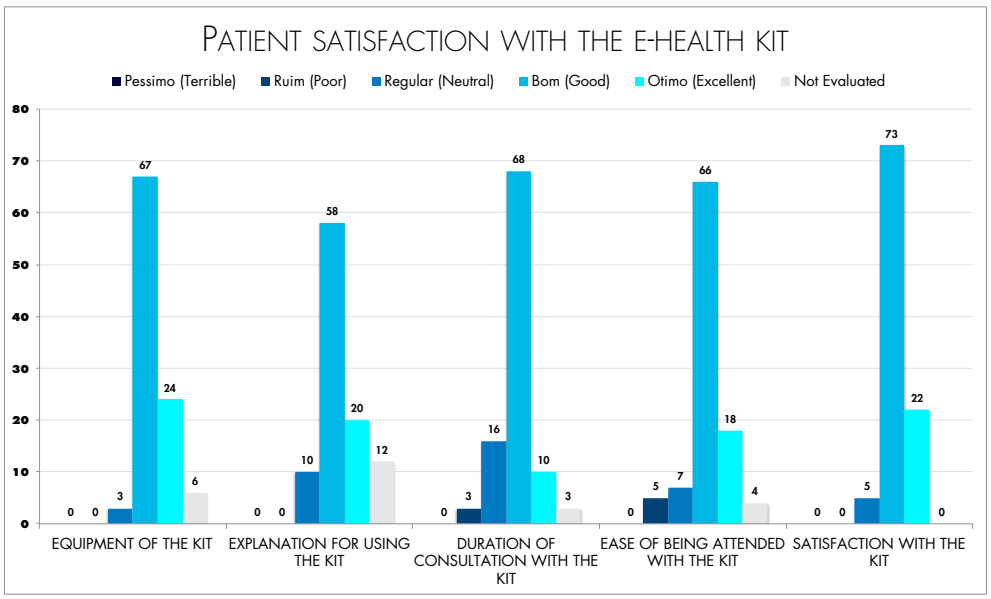


Chart 2

Both charts depict the percentage of patients who provided their impressions of the home visits and the e-health kit.

The vast majority of patients were quite satisfied with both the home visits and the e-health kit. Seventy percent of patients considered the home visits to be "good" while 73% rated the e-health kit as "good". The lowest level of satisfaction with home visits recorded in Chart 1 (i.e. "waiting time to get exam") related to the general delays in obtaining test results following an in-home exam. By providing medical results in three minutes, the e-health kit addressed the main shortcoming of the existing home visit care system.

The verbal feedback received from patients about their experience with the e-health pilot is more telling. "Now [the Family Clinic nurse] does blood exams and measures blood pressure at home," said Francisco, the son and caregiver of an 87-year-old patient in the program who can no longer walk. "This facilitates our life a lot. We don't have to go down the hill all the way to the clinic with her."

Clinic Staff Satisfaction

See Appendix IV for full questionnaire.

The chart below measures the satisfaction of the six clinic staff who used the backpack during their in-home patient visits. Categories included the backpack's ease of use, satisfaction with the duration of the consultation, and the quality of the equipment in the backpack. As the chart shows, health workers on the whole were satisfied with the use of the backpack when conducting in-home patient consultations.

"On average there's a 15-day delay to get blood exam results," explained Caroline Marques, head of the Family Clinic in Santa Marta. "Now we have them in 180 seconds." Dr. Pedro Hakme, a doctor at the clinic, pointed out that the e-health kit "allows us to take immediate decisions, without patients going to a laboratory or a hospital where the delay in getting results is important."

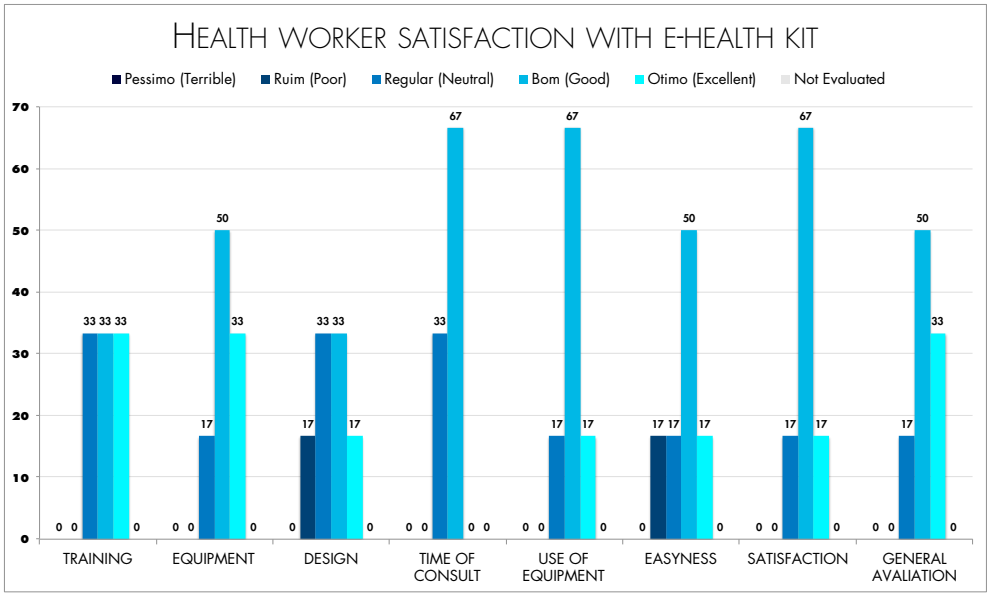


Chart 3

The backpack has become a source of pride in the community, pointing to the eroding of social and digital barriers in Santa Marta. For example, according to Suzanne Nascimento, a community health agent who assisted with the implementation of the pilot, "These mobile tools make it a lot easier for everyone involved. It is much more comfortable for patients with mobility issues to get their exams done at home, just as it will make things much easier for their relatives who sometimes have to quit their jobs to take care of them."

The human aspect of the pilot also deserves to be highlighted. Empowered with the e-health backpack, Santa Marta's residents and the Family Clinic's staff consistently reported feeling proud that this pilot was conducted in their community as opposed to a more affluent part of the city. That such an innovative project was initiated in Santa Marta created a marked sense of ownership among patients and health workers alike. The community notably felt that the public health system was paying renewed attention to a previously underserved, some might say forgotten, segment of the city's population. While the anecdotal observation described here would merit further exploration, the New Cities Foundation concludes that this sense of empowerment should also be seen as a significantly positive outcome of the pilot.

Challenges

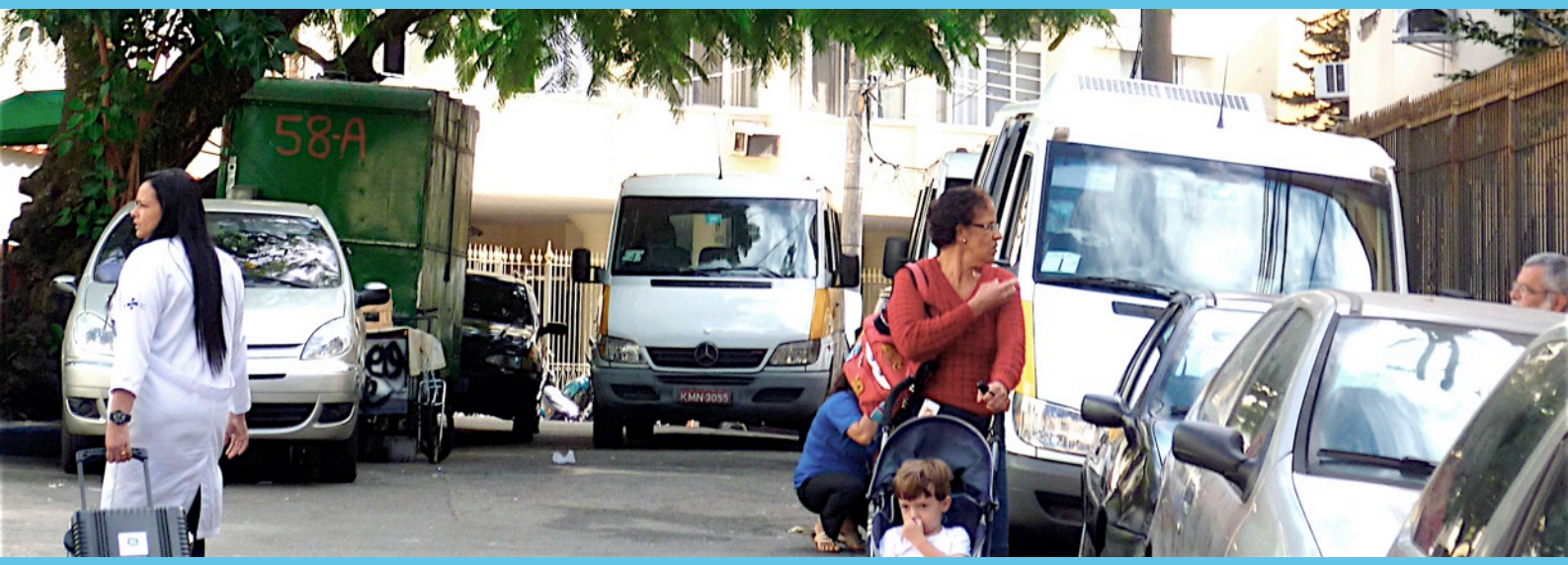
Given that this kind of urban e-health project has not been tested before, the Task Force encountered a few challenges during project implementation that are worth highlighting here:

- **Delays**: The authorization process for the release of sensitive medical data led to substantial unforeseen delays in the pilot implementation and research. Additionally, completion of the e-health kit required more time than initially planned, delaying the training and delivery of the backpack to the clinic. Consequently, data collection did not begin until four months after the original start date of the project.
- **Technical**: Family Clinic staff, who are primary care providers, were unable to use the V-scan ultrasound machine during home visits. While the V-scan is relatively simple to operate, it requires the presence of a medical specialist to interpret the images. Such specialists are not typically part of the medical team at primary healthcare facilities such as the Family Clinic.
- **Process**: Integrating the backpack into the clinic's routine proved somewhat difficult. Because use of the backpack was not yet an established part of the clinic's processes on a day-to-day basis, it took some ramp-up time to adjust the staff's routines. Staff, for example, were occupied with attending to patients and had little available time to devote to the pilot.
- **Data collection**: Due to the initial difficulties in integrating the kit in the clinic's routine, the pace of data collection was slow at the early stage.

The New Cities Foundation played a key role in overcoming these challenges. Nurses and health workers at the clinic were shown how the backpack, rather than representing an additional

workload, could help them deliver healthcare more efficiently. The nurses' schedules were aligned to integrate the use of the backpack in their routines. Ultimately, these nurses used the kit regularly every week, demonstrating the importance of focusing on the process change aspect of technology integration. While doctors prioritized in-clinic patients, the nurses and nurse technicians became the most active users of the backpack. Finally, to speed up the data collection process, the New Cities Foundation organized a data collection event in the community, gathering comprehensive data on 50% of the sample population in one day.

Conclusions and Recommendations



"This experiment we ran in Santa Marta was a great success. The results were of much satisfaction, be it for users, be it for health professionals working with this technology in the primary level of attention and we expect to be able to expand to other areas of the city, bringing this innovative tool within the context of primary attention to the care of elderly people in Rio de Janeiro, making it one of the ways to overcome the challenges ahead for our city."

Dr. Hans Dohmann, Municipal Health Secretary of Rio de Janeiro

As healthcare costs increase globally, public leaders face a key challenge. They must assess which health interventions will result in a cost-effective means of increasing the quality and reach of healthcare. The findings of the New Cities Foundation Task Force on E-health are therefore particularly timely and relevant. Even in the case of deploying only the basic health monitoring equipment from the backpack, the e-health pilot study points to the potentially significant positive impact on chronic disease prevention and management in poor urban communities across the world.

The research evaluated whether the initial investment in the e-health kit and better management of diseases at the primary care level would result in a decrease in costs associated with the need for hospital admission or clinical procedures. Results of the study indicate that by adopting an e-health strategy in the public health system, morbidity can be reduced for patients suffering from chronic diseases, demonstrating clinical benefits to patients and economic savings to health care managers in the system at large. Additionally, the e-health kit directly benefits both patient and healthcare professional by dramatically increasing the speed of diagnosis.

Despite certain methodological limitations of the study[21], the research demonstrates the substantial impacts of e-health technology when integrated into a comprehensive policy for primary healthcare coverage and disease prevention. The economic savings linked to avoided medical events and hospitalizations, for example, offsets the initial $85,000 Brazilian Reals or USD $42,000 cost of the equipment, making the solution cost-effective for the public healthcare system. The integration of the backpack into the Family Clinic's routine demonstrated clear process improvements. The healthcare benefits and the cost savings indicated by the results of the e-health pilot study reveal that this kind of model is well worth the investment in a city like Rio de Janeiro across all their Family Clinics.

The results of the e-health pilot study in Santa Marta suggest that high-tech innovations in primary healthcare can be applied in emerging cities and underprivileged urban communities around the world, thereby leapfrogging the standard, often barebones healthcare available to the urban poor. The potential of the e-health pilot project is further magnified when considering the possible effect on people in urban areas who have even less access to healthcare than the residents of Santa Marta. In communities where primary healthcare clinics have not yet been set up, a portable solution like the e-health backpack would be especially useful. The addition of more sophisticated technological capabilities in the backpack, such as wireless connectivity, digital patient data record-keeping and data transmission

[21] Using a historical control group to compare to the treatment group limits the ability to identify direct causality.

capabilities, could further amplify the impact of this e-healthcare model in neglected urban communities. The economic, health and social benefits of replicating the e-health pilot in these communities is expected to be even higher, underscoring the point that public healthcare managers must prioritize bottom-of-the-pyramid urban populations for investments made in e-health.

The key lesson that the Task Force has learned from the work being done in Santa Marta is that high-tech solutions can – and should – be used where there is great need. Rather than wait for innovation and progress to trickle down to underserved communities, city leaders should begin looking where it is needed most, and deploy the best technology available.

Beyond the Pilot

The Task Force on E-health clearly lays the foundation for an expanded pilot project in Santa Marta and other locations. In the future, the Task Force should broaden the scope of the project in the following ways:

1. **From m-health to e-health:** While the pilot phase focused on integrating use of the e-health kit in the Santa Marta Family Clinic's standard operating procedures, a significant opportunity remains to be explored in utilizing the full technological capacity of the backpack. Technological upgrades to the kit could radically change patient health data management as well as the clinic's ability to triage patients and better manage resources. An important next step will be to deploy a wireless tablet device in the backpack that collects, stores and analyzes patient data, and to measure the impact of a full suite of e-health tools.

2. **Expand the type and location of patients in the e-health program:** To explore the ability of the e-health model of care among the non-elderly as well as the effect of e-health technology in communities as yet unexposed to public health services, it will be important to increase the number of patients in the program and to measure the impact of the backpack's use in communities with fewer health services than Santa Marta.

3. **Extend the analysis of measurements taken:** To conduct a more thorough and in-depth analysis of the e-health model's social, economic and environmental impacts, the research should include indicators such as costs saved for patients, carbon emissions reduced due to avoided travel through in-home patient care, and economic productivity gains through improved health. It is recommended that a specialized social scientist, such as an urban sociologist and/or a health anthropologist, take part in the research.

The potential of this e-health pilot project to dramatically change the way primary care is delivered in underserved urban communities is enormous. It is now a question of identifying how this potential can be fully realized.

NEW CITIES FOUNDATION

www.newcitiesfoundation.org

contact@newcitiesfoundation.org