

# Case Report

## Mobile Diagnostic Units for Rural Patients in Colombia

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### Abstract

**Background:** The literature on the use of mobile diagnostic units for the adult population is limited. This is a report for the first time in Colombia (Latin America) on the use of mobile diagnostic units for patients in rural areas and resolution of complex cases through telemedicine.

**Introduction:** Telemedicine is an alternative because it takes advantage of advances in telecommunications and technology for the provision of health services to patients in rural areas of a country.

**Materials and Methods:** A pilot program for mobile patient diagnosis was developed in three rural areas of central Colombia. The mobile unit was named Mobile dIagnostiC Unit (MICU). The unit includes a medical stretcher, dresser, washbasin, computer, videoconference equipment, satellite connectivity, and digital medical equipment: electrocardiogram, stethoscope, oximeter, and thermometer.

**Results:** The number of patients attended during the 3 days of activity was 108, ~36 each day. None of the patients (100%) was familiar with digital diagnostic tools and telemedicine. The entire population who attended (100%) was satisfied with the care, health education, and diagnosis received.

**Discussion:** Our case report shows that the use of MICUs with the support of telemedicine offers benefit to the rural population in the geographic zone chosen in Colombia.

**Conclusions:** With greater coverage and access for patients to health services via mobile telemedicine units, it is possible to increase the quality of care.

**Keywords:** telemedicine, extreme environments, cardiology/ cardiovascular disease, education

### Introduction

Colombia, a Latin American country, has a population of ~49 million people, of which 76% is located in municipal areas and the remaining 24% in rural areas. The country's demographic projection for the

year 2020 is 8.5% of the population over 65 years of age. In relation to mortality, the main cause of death in the general population corresponds to coronary heart diseases followed by neoplasia.<sup>1</sup>

According to the latest analysis of physicians in the country, Colombia has 1.5 doctors/1,000 inhabitants, less than the World Health Organization minimum recommendation of 2.3 physicians/1,000 inhabitants. Unfortunately, medical specialists tend to be located in major cities, because of better contracting and security conditions, affecting the efficiency in the provision of health services in rural areas or distant to large cities. In addition, the Colombian territory has a large area with 1.142 million square kilometers, being 40% mountainous, making it difficult to move patients to medical centers.<sup>2</sup>

Thus, telemedicine is an alternative because it takes advantage of advances in telecommunications and technology for the provision of health services to patients. According to data from the Colombian Ministry of Health for April 2016, the total telemedicine services enabled is 3,006. According to the characteristics of the territory, 56% of the services authorized correspond to rural areas, 24% to urban areas, and the remaining to scattered areas.<sup>3</sup>

However, there are barriers to progress in the development of telemedicine in the country: these are related to high implementation costs, lack of human talent with training in telemedicine, access to connectivity, resistance to change, disarticulation between the different participants, and the low demand for services. The objective of this case report is to evaluate the use of mobile diagnostic units for patients in three rural areas of Colombia, and the support of telemedicine in the resolution of complex cases.

### Materials and Methods

A pilot program for mobile patient diagnosis was developed in three rural areas of central Colombia: Bateas, Cumaca, and Tibacuy, on November 23, 24, and 25, 2016, respectively. The Mobile dIagnostiC Unit (MICU) was developed by AxURE Technologies (Bogota, Colombia). In its interior, the unit contains the following items: a desk, medical stretcher, and chairs; digital equipment for medical diagnosis: electrocardiogram, stethoscope, oximeter, and thermometer; and communications support material: a computer, videoconferencing equipment,



**Fig. 1.** MICU being transported to rural area. MICU, Mobile diagnostic Unit. Used with permission of the Municipality of Tibacuy, Colombia.

and satellite connectivity. The MICU is operated in its interior by a primary care physician (Figs. 1–4).

The activity was focused on the adult population with cardiovascular problems, because it is a nontransmissible pathology with the highest prevalence in Colombia.<sup>4</sup> The cases of difficult cardiovascular diagnosis that were captured by the physician at the unit were reprogrammed for a teleconsultation with a cardiologist located in his house in a capital city during the last day of the program. The project was supported by the Mayor of Tibacuy (Cundinamarca, Colombia), the geographic area where the case report was developed. The cost



**Fig. 2.** MICU located in one of the rural areas with its satellite support. Used with permission of the Municipality of Tibacuy, Colombia.

of adapting the mobile unit was 1,000 U.S. dollars (USD) on a unit that was already used as a mobile office, and was adapted to become a mobile medical unit. The operational cost of the unit was 200 USD per day, which includes the fees of four people involved in the project: communications engineer, primary care physician, nurse, and unit driver. The other associated costs were for the communication service determined by the Internet broadband channel used during the 3-day working activity.

The equipment used inside to support the medical diagnosis was provided on loan by the primary care physician who was part of the pilot test activity. Total cost for the 3-day activity

was 1,600 USD. The information from the patients evaluated in the mobile unit was stored and analyzed in a format specifically designed for this study, using Microsoft Excel<sup>®</sup> 2010 (Microsoft, Redmond, WA) which included demographic and clinical variables. As for user satisfaction, a specific quality-of-life instrument was not used, but rather two questions evaluating the service and the quality of care provided.

## Results

The number of patients attended during the 3 days of activity was 108, ~ 36 each day. The average age was 63.5 years and women accounted for 62% of the population. Patients reported moving from their places of residence to reach the MICU in an average of 3 h. The unit was located in the center of each of the three areas chosen. Of the patients treated, 90% were linked to a health maintenance organization (HMO) called CONVIDA. Patients had several chronic conditions (Table 1), with arterial hypertension being the most frequent, that is, 74% of the population. Two of the patients with coronary heart disease presented an elevation of the ST segment on the electrocardiogram, and clinical symptomatology of angina pectoris, and were referred to a hospital of intermediate level located in a major city.



**Fig. 3.** Clinical care between physician and patient inside the unit. Written consent obtained from the patient.

None of the patients (100%) were familiar with digital diagnostic tools and telemedicine. Four patients were scheduled for a second evaluation with the objective of being consulted with a physician specialized in cardiology through telemedicine. Each of them signed an informed consent and the postevaluation cardiologist through telemedicine corroborated the diagnosis, who requested further examinations to be performed in the hospital. In the evaluation of patient satisfaction at the end of the project, this was rated as excellent in 98% of the cases.



**Fig. 4.** Complex case resolution through telemedicine. Written consent obtained from the participants.

**Discussion**

This case report shows that the use of MICUs with the support of telemedicine offers a benefit in accessibility to health services in a rural population of a geographic zone in Colombia with mobility difficulties because of the highly mountainous routes and of armed conflict in the country. This is why, for isolated geographical areas, without the availability of health centers, mobile diagnostic units supported by telemedicine play a very important role in the provision of health services.

This first pilot test, which had not been carried out in the country previously, was considered as a case report, whereby 108 patients from three rural areas in Colombia were treated, with difficulty in access to their health center. In the consultation of four patients, referred to the specialist cardiologist, feedback was received from a new management in the pharmacotherapy of the patients and necessary diagnostic tests that must be performed in a more complex hospital center.

The system of MICUs and telemedicine has advantages such as (1) access to diagnostics immediately supported by diagnostic digital resources and supported with connectivity for resolution of difficult cases through telemedicine, (2) better quality of care, because primary care physicians in MICUs can have effective and rapid communication with different

CHRONIC CONDITION	NO. (%)
Atrial fibrillation	9 (8.3)
Coronary heart disease	11 (10.2)
Heart failure	12 (11.1)
Arterial hypertension	76 (70.4)

medical specialists, (3) effectiveness in the referral of patients from the MICUs to more complex hospitals, and (4) economic benefits, because with a good orientation by medical specialists through the telemedicine system, they can be treated in real time in the MICUs and greater universal coverage.

As a developing country, Colombia is today immersed in a serious problem that encompasses many factors, in terms of quality of medical care. Latin American governments are continually working to increase health coverage, but they do not have strategies that transcend their political periods, where the quality of health care is the common denominator and with better benefits in terms of access to health.

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### Disclosure Statement

No competing financial interests exist.

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