First Results of the Digital ECG Implementation in Belo Horizonte, Brazil

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Abstract

Cardiovascular problems are prevalent in the general population of the city of Belo Horizonte and they are the main cause of hospital admission and death. In 2007 and with the aim of improving the solving capacity of basic healthcare, speeding up the service and reducing the waiting time in the Cardiology Service at the Second level reference Units, the city of Belo Horizonte started TeleECG, with the implementation of digital ECGs at Primary Care Units. Electrocardiograms are easy, low risk, low cost and high diagnosis value exams. Already existing IT equipments at the units were used. These equipments had been purchased for the implementation of Patient Electronic Medical Records (SISREDE). Nurses and Nursing Technicians were trained on the execution of the exam as well as on the filing and sending of results to the Reports Central Unit located at Hospital das Clínicas (HC). Family Health Team physicians were trained to identify normal exams through a distance course in partnership with the School of Medicine of the UFMG. After a concept test carried out in 21 Primary Care Units, TeleECG was extended to 158 units, among basic units, health reference units and emergency units. At present 1.300 exams are done every month, of which an average of 650 exams are sent to the Reports Central Unit. After the success of this service in Primary Care, its implementation on Emergency Care Units was proposed. The main advantages shown by the TeleECG are as follows: 1) comfort for patients – it avoids trips to the specialized unit to do the exam: 2) time saved to do the exam and quick access to the result; 3) access to specialist (cardiologist) through the report issued in 15 minutes in emergency exams and in 48 hours in non-emergency exams; 4) qualification of referrals; 5) permanent training of Family Health Team physicians. Incorporating Information and Communication Technologies (ICTs) in the health area has enabled a qualified care, speeding up the decision making process with diagnosis support and it has also contributed to provide users with a more human care.

Key-Words: *Telemedicine; Information Technologies and Communication; Electrocardiography; Diagnosis Services; Telemetry; Primary Care.*

Resumen

Primeros resultados de la experiencia de implantación del Recurso de ECG Digital en Belo Horizonte, Brasil

En el municipio de Belo Horizonte hay una gran prevalencia de problemas cardiovasculares en la población general, siendo una de las principales causas de hospitalización y defunción. En 2007, con el objetivo de mejorar la resolutividad de la atención básica, agilizar la atención y disminuir el tiempo de espera para la atención en Cardiología en las Unidades de Referencia Secundarias, el municipio de Belo Horizonte puso en práctica el TeleECG, a través de la implantación de equipos de ECG digitales en las Unidades Básicas de Salud (UBS). El electrocardiograma (ECG) es una prueba sencilla de bajo riesgo, bajo coste y de gran valor diagnóstico. Se utilizaron equipos de informática ya existentes en las unidades adquiridos para implantar el Expediente Electrónico del Paciente (SISREDE). Los enfermeros y Técnicos de Enfermería fueron capacitados para ejecutar la prueba y archivar y enviar el trazado para la Central de Informes ubicada en el Hospital de las Clínicas (HC). Los médicos de los Equipos de Salud de la Família (ESF) recibieron capacitación para la identificación de las pruebas normales mediante un curso a distancia en alianza con la Facultad de Medicina de la UFMG. Después de un examen de conceptos realizado en 21 unidades básicas de salud (UBS), el TeleECG se amplió a 158 unidades, entre unidades básicas, unidades de referencia secundarias y unidades de

Resumen

urgencia, y actualmente se realizan aproximadamente 1.300 pruebas por mes, de las cuales 650 pruebas en promedio se envían a la central de Informes. Con el éxito de la implantación en la Atención Básica se propuso la implantación del TeleECG también en las unidades de urgencia. Las principales ventajas demostradas por el TeleECG son: 1) comodidad para el paciente - evita desplazamientos en la realización y acceso a los resultados; 3) acceso al especialista (cardiólogo) a través del informe emitido en hasta 15 minutos en casos identificados como urgentes y hasta 48 horas en pruebas no urgentes; 4) cualificación de las derivaciones; 5) capacitación permanente de los médicos de los equipos de la salud de la familia. La incorporación de las Tecnologías de la Información y Comunicación (TICs) en el área de la salud ha propiciado la cualificación de la atención, ha agilizado la toma de decisión a través del apoyo diagnóstico y también ha contribuido para la humanización de la atención brindada al usuario.

Palabras-clave: *Telemedicina; Tecnologías de Información y Comunicación; Electrocardiografía; Servicios de Diagnóstico; Electrocardiografía Ambulatorial; Telemetría; Atención Primaria de Salud.*

Resumo

Primeiros resultados da experiência da implantação do recurso de ECG Digital em Belo Horizonte, Brasil

O município de Belo Horizonte possui um cenário em que os problemas cardiovasculares são prevalentes na população geral e são as principais causas de internação e óbito. Em 2007, com o objetivo de melhorar a resolutividade da atenção básica, agilizar o atendimento e diminuir o tempo de espera para o atendimento em Cardiologia nas Unidades de Referência Secundária, o município de Belo Horizonte deu início ao TeleECG, por meio da implantação de equipamentos de ECG digital nas Unidades Básicas de Saúde (UBS). O eletrocardiograma (ECG) é um exame simples, de baixo risco, baixo custo e de grande valor diagnóstico. Foram utilizados os equipamentos de informática já existentes nas unidades adquiridos para implantação do Prontuário Eletrônico do Paciente (SISREDE). Enfermeiros e Técnicos de Enfermagem foram capacitados na execução do exame, arquivamento e envio dos traçados para a Central de Laudos localizada no Hospital das Clínicas (HC). Os médicos das Equipes de Saúde da Família (ESF) foram capacitados para identificação dos exames normais, através de um curso à distância em parceria com a Faculdade de Medicina da UFMG. Após prova de conceito realizada em 21 Unidades Básicas de Saúde (UBS), o TeleECG foi expandido para 158 unidades, entre unidades básicas, URSs e UPAs, sendo atualmente realizados cerca de 1.300 exames ao mês, dos quais mais de 650 exames em média são enviados à Central de Laudos. Com o sucesso da implantação na Atenção Básica foi proposta a implantação do TeleECG também nas Unidades de Pronto Atendimento (UPA). As principais vantagens demonstradas pelo TeleECG são: 1) comodidade para o paciente – evita deslocamento até uma unidade especializada para realizar o exame: 2) rapidez na realização e acesso ao resultado; 3) acesso ao especialista (cardiologista) através do laudo emitido em até 15 minutos em casos identificados como de urgência e até 48 horas em exames não urgentes; 4) qualificação dos encaminhamentos; 5) capacitação permanente dos médicos das ESF. A incorporação de Tecnologias de Informação e Comunicação (TICs) na área de saúde tem propiciado a qualificação do atendimento, agilizado a tomada de decisão por meio de apoio diagnóstico e também contribuído para a humanização da atenção prestada ao usuário.

Palavras-chave: *Telemedicina; Tecnologias de Informação e Comunicação; Eletrocardiografia; Serviços de Diagnóstico; Telemetria; Atenção Primária à Saúde.*

INTRODUCTION

During the last two decades, Information and Communication Technologies (ICTs) had been increasingly used in healthcare in the city of Belo Horizonte, Minas Gerais State, Brazil. The City Health Department has a decentralized and hierarchized structure with 147 Health Centers that provide Primary Care services and when necessary, they refer patients to specialists in four Second Level Reference Units, 9 Medical Specialties Centers, eight Emergency Units, 33 Hospitals, one of them its own institution and another 32 hospitals that participate in a general agreement. The city network of health has also 06 descentralized labs, 09 district pharmacies, among other services. Health units are regionalized and are distributed into nine health districts: Barreiro, Center-South, East, Northeast, Northwest, North, West, Pampulha and Venda Nova. The Northeastern region is the most populated one, with 15% of the population, whereas the area of Pampulha concentrates less inhabitants in the city (6.5%). Heterogeneity can be noticed in the demographic distribution among administrative regions, ranging from 3,082 inhabitants/km2 (Pampulha) and 8,987 inhabitants/km^2 (Eastern region). (Figure 1).

Family Health Strategy started in 2002 in the city of Belo Horizonte, with the implementation of 485 Family Health Teams. Throughout the years new teams had joined and today the city has 535 Family Health Teams, of which 237 work with Oral Health, 58 Teams work with Mental Health and 48 units of Family Health Support centers. Family Health Teams welcome users at Primary Care Units, meeting the spontaneous demand for services, as well as programmed actions by life cycles, such as pre-natal, early childhood care, teenagers, adults and the eldery through assistance protocols.[1]

In February 2002, the implementation of the Management System in Health Network – SISREDE, Electronic

Medical Record of the Patient, and the computerization of the Health City Network made possible the access to clinical records and exams results of patients in other complexity levels. Thus, information is available to help make clinical decisions in a fast and qualified manner. This technological structure enabled the implementation of the *BHTelessaúde system (BHTelehealth)*, which started in 2003 with the aim of promoting the integration of Primary Care professionals with specialists, connecting the Health Centers to the Second Level Reference Units among them and to the Federal University of Minas Gerais (UFMG). The goal was to improve the quality of the service provided by the City Health Department through permanent education and assistance support given to the professionals of the Family Health Program. The feasibility of this telehealth network was possible due to a deep integration between the city health network of Belo Horizonte and the Federal University of Minas Gerais, implemented through the funding coming from the @lis project of the European Community and the Ministry of Health.[2]

BHTelessaúde incorporated telehealth resources in primary care involving professionals linked to the City Health Department and lecturers of the Federal University of Minas Gerais. This resulted in the most comprehensive and systematic telehealth program in the country and an important model in the process of formulating and implementing the National Telehealth Program. The national program is applied to Primary Care through the set up of nine Telehealth Centers located in nine Brazilian states. Each Telehealth Center is connected to 100 spots (900 in total) installed in Basic Health Units, around these states, including approximately 2.700 Family Health teams and benefitting around 11 million inhabitants.[2]

The implementation of telehealth resources allowed Basic Health Units professionals from the municipality, especially those linked to the Family Health Program, to have access and interaction with specialists from the Federal University of Minas Gerais, from the Medical Specialties Center and from the Dentistry Specialties Center for the assistance support and continuous education. *BHTelessaúde* is nowadays made of the following modules: videoconferences, Tele-consultation, Tele-urgency Distance Learning, Excellence and Innovation Lab in Telehealth and TeleECG. The City Health Department has always tried to increase and improve the different services provided. This paper has the goal of reporting the experience of implementing the TeleECG service at the city health network and its first results.

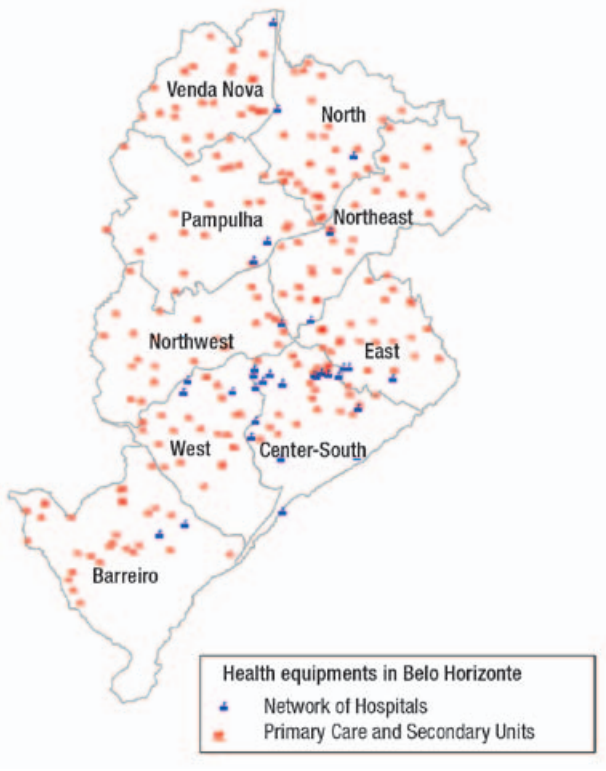

Figure 01: Healthcare units in the city of Belo Horizonte by Health District – March 2011.

IMPLEMENTATION OF TELEECG IN BELO HORIZONTE

The city of Belo Horizonte has a population of 2.375.344 inhabitants, representing around 45% of the residents in the Metropolitan Region of Belo Horizonte estimated in 5.110.588 inhabitants.[3] Cardiovascular diseases are prevalent among the general population of the city and they are among the main causes of hospitalization and death in the municipality. In 2008, cardiovascular diseases represented 25.6% of all deaths in BH residents and 18.5% of all hospitalizations due to strokes in the population over 40 years old of the National Health System in Belo Horizonte. Of all Hospital Admission Authorizations paid by the National Health System, 19.9% were due to diseases of the circulatory system. The waiting time for adult cardiology consultations in 2008 was over 60 days for 63.6% of patients. Belo Horizonte is the main city of micro and macro regions in the health area, meaning that the city receives patients from other neighbouring municipalities for secondary and tertiary care. Over the last years there had been an increase of demand for cardiology services.

TeleECG, one of *BHTelessaúde* modules started in 2007 with the goal of improving the resolution capability of primary care with electrocardiograms done at Health Centers. The choice for this type of exam was due to the fact that ECGs are simple, low risk, low cost and high diagnosis value exams. TeleECG offers diagnosis support to speed up and prioritize hospitalization cases as well as reducing the waiting time for Cardiology at Second Level reference Units, or in public and/or private hospitals.

The TeleECG program took digital electrocardiographs to all Health Centers of the city. The program also trained nurses, nursing assistants and technicians in handling the equipment and in carrying on the exams, as well as in sending the file generated to the Report Central Unit located at the *Hospital das Clínicas* (HC) when necessary. The *Hospital das Clínicas* of the Federal University of Minas Gerais is a component of the outpatient and hospital healthcare network of the National Health System in Belo Horizonte. It has a Cardiology Central Service that through the Minas Telecardio Program offers cardiology reference services to 608 municipalities in the state of Minas Gerais.

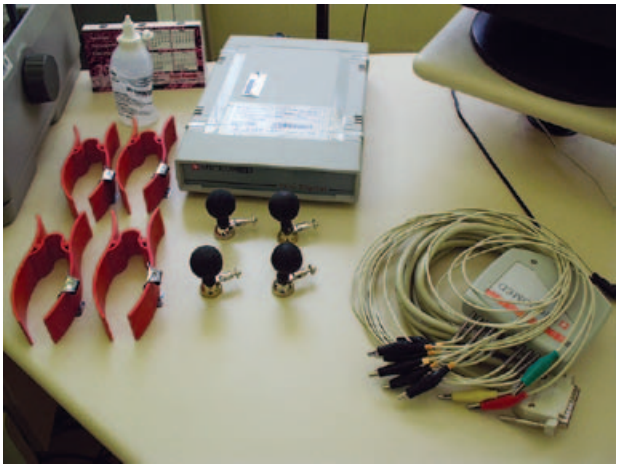

Figure 02: Digital Electrocardiography.

Digital electrocardiogram equipments were bought for the implementation of TeleECG . The Information Technology equipments used (microcomputers and printers) already existed at the units since they were bought for the SISREDE implementation. The equipment enables to do computerized electrocardiograms, patient monitoring, registry and filing of exams and reports. The Health Centers started having the backup of the Distance Report Central Unit at the *Hospital das Clínicas* that sends the report back within 48 hours and within 15 minutes for urgent cases. It is also possible to discuss reports using the online teleconsultation system via internet.

The Family Health Team is responsible for the comprehensive management of informations on its patients in a standardized, quick and qualified manner. The solution chosen for the ECG project was WinCardio®, that is made of a digital electocardiograph machine through a serial port and a compatible software with Windows platform.

The Digital ECG equipment is directly plugged into the physician's office computer, where all the exams data is stored. This data can be accessed by all the offices through a centralized database per unit. The ECG kit includes a digital device, a set of clamps, a set of suction bulbs, serial logical cable, power cable and the patient cable for the 6 basic derivations (V1 to V6, besides the DI, DII, DIII, aVR, aVL and aVF). This facilitates and speeds up the exam because with only one click all derivations are available in the computer and with just another click the exam can be printed for the patient. Wincardio needs few hardware resources and it operates with SGDB Firebird 2.0, with just a few *plugins* Flash and Java previously installed in the computer. It is made of an electrocardiograph in 12 simultaneous derivations, a compatible software with Windows 95 or higher and digital filters used to remove muscle tremors, baseline variations and influences of the feed network of 60 Hz, bringing minimum distortion of signals, ensuring higher quality for the trace. This equipment enables to carry out computerized electrocardiograms as well as monitoring, recording and filing. The ECG exam can be exported into a file of approximately 100 kbytes, providing more speed to send and answer the report.[4]

Figure 03: Nurse at a Health Center carries out an electrocardiogram exam and sends the report to the specialist in real time.

Nursing professionals were trained on how to do the exams and to send the trace to the Report Central Unit by the technical team of the Office for Information Technology in health of the Belo Horizonte Health Department (GTIS-SMSA) and the Assistance Management – GEAS. A distance training course on exam results reading was available for physicians through a partnership between the City Health Department and the School of Medicine of the Federal University of Minas Gerais. This training course had 30 hours/classes divided into four face to face classes and eight distance classes. It was delivered in 5 groups during November 2007 and February 2008. Modern technological resources such as 3D images, animations and videos were used making the learning process more pleasant.

The course was made available at the Federal University of Minas Gerais course platform. In order to have access to the classes and exercises, physicians needed to register to have a login and a password. Distance classes were mainly seen from the work place via intranet at a time previously agreed upon with the managers and the reservation made in the physician's schedule. Microcomputers of the Health Units were configured to make possible the access optimization to intranet classes. Due to the several systems being used, physicians were recommended not to access simultaneously the course and to avoid times where data traffic was more intense. Internet access from any place was also offered according to the physicians' choice. Face-to-face classes were delivered in the evenings at the School of Medicine of the Federal University of Minas Gerais.

RESULTS, DISCUSSIONS AND FUTURE PERSPECTIVES

Health Centers

The project was initially implemented in 21 Health Centers including nine health districts and after an assesment made by the Family Health Teams and users the decision was made to extend it to all the Health Units. The main advantages of TeleECG at Health Centers were comfort and fast service for patients who do not need to wait or travel to specialized units, since the exam can be scheduled in the same unit with the possibility of doing it immediately if necessary. A study done with healthcare professionals of the West Health District showed that the patients who used digital ECG exams more frequently were patients with high blood pressure, diabetes, congestive heart failure and surgical risk; differential diagnosis for syncope, tachycardia and murmur. Online report has helped in the diagnosis and treatment, in patient classification enabling to priotize referrals. The report result had arrived in due time for the treatment[3]. After a period of testing and evaluation at pilot-units, TeleECG was widely applied during 2009. TeleECG is now implemented and operational in 158 health units(primary care and secondary units). More than 1.300 exams are currently done per month, and an average of 650 exams are sent for reports.

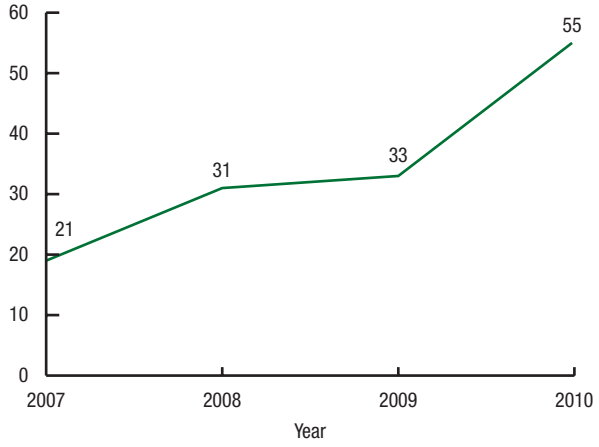

Figure 03: Extension of TeleECG implementation in the city, 2007 to 2010.

FUTURE PERSPECTIVES OF TELEECG – EMERGENCY UNITS

Each district has an Emergency Unit in its territory, that with a differentiated scope will be incorporated into the project. The decision to incorporate the Emergency Units was due to the good results reached at the Health Centers. Due to the peculiar features of those units, it was necessary to give mobility to the equipment. Thus, wheeled carts were used to bring the electrocardiograph to the patient. This provides more comfort to patients because they do not have to get out of bed and it also speeds up the exam because it prioritizes patients' wellbeing. The sending system has also a differential point, every exam sent requesting a report, it is sent to the Coronary Care Unit of the *Hospital das Clínicas* due to the likelihood of being urgency or emergency cases. Exams sent can also be discussed online among the Emergency Unit professionals and the Coronary Care Unit specialists who assess the need of transfering the patient into a hospital.

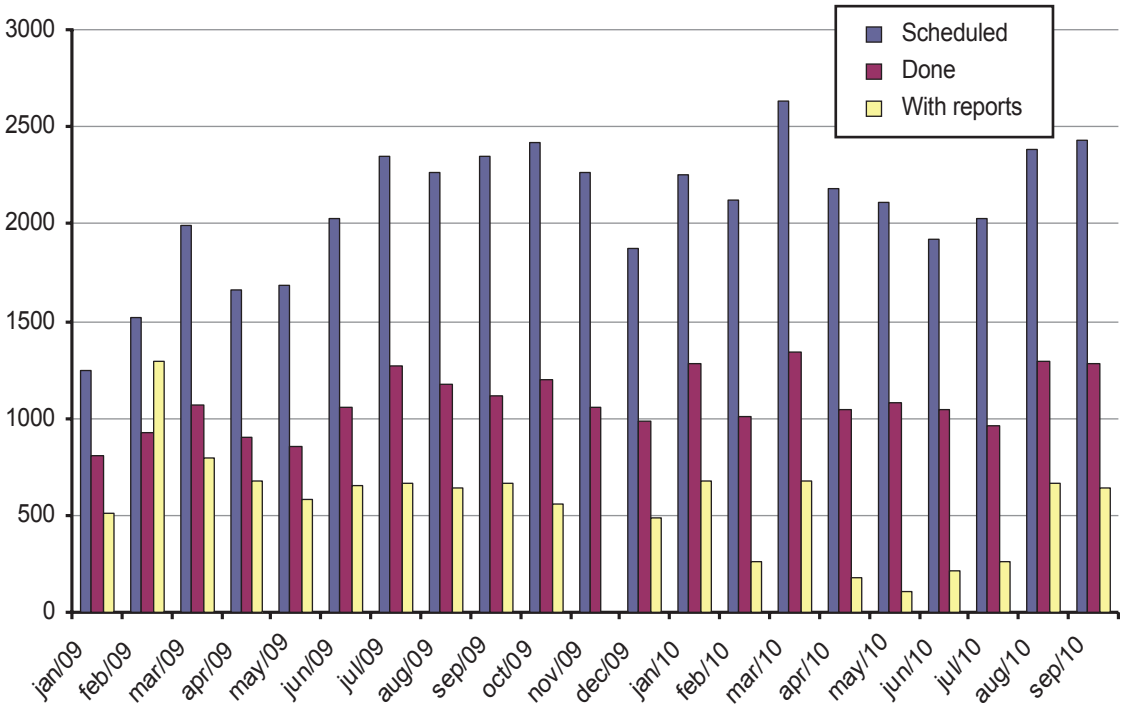

Figure 05: Distribution of scheduled ECG done with reports between 2009 and 2010.

CONCLUDING REMARKS

The use of Information Technology in healthcare has provided a more qualified and humanized care, as well as speed in assistance decision making. In Belo Horizonte, TeleECG showed it is an extremely important tool to support diagnosis and clinical decision in the care coordination of users by Family Health Teams, providing the user with a better quality service. It is important to notice that since the pilot project was implemented in 2007, its extension process has been based on the evaluation and demands from the professionals of Family Health Teams involved in direct assistance to users in the National Health Sytem in Belo Horizonte.

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