

# Physician satisfaction with care to cardiovascular diseases in the municipalities of Minas Gerais: Cardiosatis-TEAM Scale\*

## *Satisfação de médicos com o cuidado às doenças cardiovasculares em municípios de Minas Gerais: Escala Cardiosatis-EQUIPE\**

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## **Abstract**

**Objective:** To evaluate psychometric validity and reliability properties of the CARDIOSATIS-Team scale and measure physician satisfaction before and after the implementation of the project. This scale was designed to evaluate physician satisfaction with the healthcare delivered for cardiovascular diseases in cities that participate in a telemedicine system. **Methods:** The scale was applied in 82 cities of Minas Gerais, before and after the implementation of a telecardiology system. The analysis of the psychometric properties of CARDIOSATIS-Team scale included: construct validity using factorial analysis; internal consistency reliability using Cronbach's Alpha; Pearson's correlation between items; Spearman's correlation between domains and global scale and; discriminant analysis. **Results:** The factor analysis of the principal components extracted two factors that explained 66.5% of the variance in satisfaction scores: healthcare delivery and diagnosis structure and satisfaction with the care delivered. Cronbach's Alfa for internal consistency reliability of the scale showed values of 0.92 for the global scale and up to 0.84 for factors. Inter-factor and inter-scale correlations were adequate, showing values of 0.59 to 0.89 and 0.73 to 0.85, respectively. The scale was able to distinguish the two moments of its application (before and after intervention), showing high satisfaction for most items measured afterwards ( $p < 0.05$ ). **Conclusions:** We can conclude based on the present study that the telemedicine system improved provider satisfaction and that the CARDIOSATIS-Team scale is a good tool to evaluate provider satisfaction with care delivered for CVD. Its appropriate characteristics in terms of validity and internal consistency reliability justify its utilization in other studies.

**Keywords:** CARDIOSATIS scales. Provider satisfaction. Cardiovascular diseases. Psychometric properties. Validity and reliability. Tele-health.

## Resumo

**Objetivos:** Avaliar as qualidades psicométricas de validade e confiabilidade da Escala CARDIOSATIS-Equipe, elaborada especificamente para avaliar a satisfação dos médicos com o atendimento pré-hospitalar às doenças cardiovasculares em municípios participantes de um projeto em Telessaúde e mensurar a satisfação dos médicos antes e depois da implantação do Projeto. **Método:** Aplicação do instrumento na linha de base e pós-implantação de um sistema de telecardiologia em 82 municípios de Minas Gerais. O estudo das qualidades psicométricas da escala incluiu: Validade de construto, por meio de análise fatorial; Análise de consistência interna pelo Alfa de Cronbach; Correlação de Pearson entre os itens; Correlação de Spearman entre os domínios e a escala Global; e Validade discriminante. **Resultados:** A análise fatorial por meio da extração de componentes principais indicou a distribuição dos itens da escala em dois fatores que explicaram 66,5% da variância dos escores de satisfação, identificados como Estrutura de atendimento e diagnóstico e Satisfação com o cuidado prestado. O coeficiente alfa de Cronbach mostrou valores elevados para a escala Global (0,92) e para os fatores (0,84). As correlações item-domínio e item-escala global também se mostraram adequadas, variando de 0,59 a 0,89 e de 0,73 a 0,85, respectivamente. A escala mostrou boa capacidade de discriminar os dois momentos da aplicação (antes e depois), mostrando um aumento significativo da satisfação dos médicos para a maioria dos itens avaliados pelo instrumento ( $p < 0,05$ ). **Conclusão:** pode-se concluir com este estudo que a introdução do sistema de telecardiologia melhorou a satisfação dos profissionais avaliados e que a Escala CARDIOSATIS-Equipe é um bom instrumento para se mensurar a satisfação dos profissionais com o atendimento às DCV. As boas características de validade e confiabilidade da escala colaboram para sua utilização em outros estudos.

**Palavras-chave:** Escala CARDIOSATIS. Satisfação. Doença cardiovascular. Qualidades Psicométricas. Validade e confiabilidade. telessaúde.

## Introduction

Today, one of the main objectives of the healthcare services is to produce a positive impact on population health indicators<sup>1</sup>. In this sense, new technologies have been implemented to achieve such a goal and decrease the gap in the access to healthcare services<sup>2</sup>.

One example of healthcare implementation is the telehealth systems, which have been largely diffused worldwide and more recently in Brazil. Telehealth can be understood as the transmission of medical information to specialised centres through telecommunication networks<sup>3,4</sup>. Advantages include better access to healthcare as well as improved communication and continued education for healthcare professionals, mainly those practising in remote areas<sup>5</sup>.

The use of telehealth has been increasing in the past decades. According to Whitten (2001)<sup>5</sup>, only four telehealth programs were in operation in the 1990s. Ten years later, this figure was significantly increased. In Brazil, telehealth was also effectively initiated in the 1990s, increasing in the 2000s<sup>6</sup>. The use of such systems in Brazil was so significant that in February 2010 the Ministry of Health regulated, under the governmental decree number 402, its use and expansion throughout the country<sup>7</sup>.

Allied to the increase in telehealth systems, there is a great interest in evaluating their quality, which is a key factor for their implementation and maintenance<sup>2</sup>. According to Bashshur (1995)<sup>8</sup>, the evaluation of telehealth systems involves aspects related to quality of equipment and information being transmitted, cost-effectiveness, satisfaction among users and professionals, and acceptance of the technology being used.

The professionals' satisfaction with telehealth deserves special attention as this factor involves an important dimension in the evaluation of the quality, besides being a good predictor of not only the actual use of such technology by professionals but also of the treatment adherence and correct use of the healthcare services by patients<sup>4,5</sup>.

In terms of telehealth, the physicians' satisfaction has been defined as a multidimensional factor, involving several aspects related to adequacy of the services to the individuals' expectancy and the professionals' satisfaction with the system itself<sup>2,4</sup>. This is an easy-to-use system that enables obtaining help from peers in critical situations, secure and reliable information, and precise diagnosis, besides being an opportunity of continued education<sup>2,10</sup>. Although some studies point to a good satisfaction with telehealth systems, the professionals' satisfaction tends to be lower than that by patients<sup>11</sup>. However, it is important to remind that such studies have been criticised for the lack of methodological rigour regarding both design and measurement instruments, since a few of them employed validated means to measure the results, which of course compromises the finding<sup>2,4,12</sup>.

Despite the importance of measuring the physicians' satisfaction with the healthcare services in general, not only in terms of telehealth, the existing literature is still restricted in comparison to the amount of studies on patients' satisfaction. The majority of studies on physicians' satisfaction are aimed at measuring the aspects related to their profession from the perspective of working conditions<sup>3,13</sup>, satisfaction with medical career<sup>14</sup> and mental health<sup>15,16</sup>. As strategies to measure the physicians' satisfaction, such studies rely upon focal groups, structured questionnaires, face-to-face interview and Likert-type scales.

With regard to scales themselves, no validated instrument was found in the literature, either national or international, specifically assessing the physicians' satisfaction with the structure of healthcare services available for treatment of cardiovascular diseases.

In view of the importance of knowing the physicians' satisfaction with the Minas Telecardiology Project<sup>17</sup>, and considering the lack of validated, replicable and reliable measurement instruments within the telehealth context, the CARDIOSATIS-Team scale was created in order to assess the

physicians' satisfaction with healthcare for cardiovascular diseases (CVD) available in the basic healthcare units where such a program was implemented. The present article is intended to validate the CARDIOSATIS-Team scale by analysing its measurement properties, including validity and reliability, and by measuring the physicians' satisfaction before and after implementation of the telecardiology project.

## Method

### The Minas Telecardiology Project

This is a quasi-experimental study involving the implementation of a telecardiology system in 82 low-population density cities situated far from specialised medical centres<sup>17</sup>. The project was implemented in June 2006 and lasted 30 months, with the objective of assessing the effectiveness of the telecardiology system for treatment of cardiovascular diseases. The study consisted of three evaluation steps: 1) establishment of a baseline; 2) implementation of the system and 3) evaluation of the effectiveness.

Each city received a computer with multimedia kit, printer and digital electrocardiograph. The participants were trained according to the task to be performed, including handling and maintenance of the electrocardiogram equipment (ECG); ECG sending operations; epidemiological data collection and access to teleconsultation system with participation of specialists. ECG data from each city were electronically sent to an on-call cardiologist at university hospitals taking part in the network. This professional issued a report, sent it back to the city of origin, besides discussing the case if necessary.

The project activities included on-call cardiology (issue of reports and discussion of clinical cases), virtual ECG acquisition, technical support to users of the system, on-line and off-line teleconsultation, teleconferences on cardiology and other specialties on the interest of the cities.

The physicians' satisfaction with the

structure of healthcare for cardiovascular diseases in the Minas Gerais cities, based on the CARDIOSATIS-Team scale, was one of the components for evaluation of the effectiveness of the Minas Telecardiology Project.

### Sample Subjects

Physicians working in the healthcare services of cities having the telecardiology system took part in the study. The inclusion criteria were the following: being credentialed in the Regional Medical Council (RMC); providing healthcare where the system is operating and; having access to the project technology. This technology encompassed training and use of telehealth equipment, including ECG sending operations, on-call cardiology, teleconsultation and teleconferences.

The physicians could respond to the CARDIOSATIS-team scale at four different moments: 1) before project implementation (n = 152); 2) at the hiring of a new professional during the project (n = 52); 3) at the dismissal of the professional during the project; and 4) at the final of the project (n = 140). With regard to the measurement properties of the scale, only responses regarding moment 1 (before project implementation) were considered, thus totalising 152 physicians. For analysis of the impact of the project on the physicians' satisfaction, only the responses regarding the moment 4 (after project implementation) were taken into account, thus totalising 140 professionals.

According to Hair et al. (2005)<sup>19</sup>, the ideal sample size for a factor analysis should not be lesser than 100. In general, the minimum number of observations should be at least 5 times greater than the number of instrument items, whereas the optimum size would be that with a proportion of 10 subjects for each item. The present study has followed the authors' recommendations, that is, a ratio of 10:1. Within this context, a total of 150 subjects would be needed for conducting a factor analysis by using a 15-item instrument.

### Measurement Instrument

The creation of CARDIOSATIS-Team scale, specifically developed for evaluation of the physicians' satisfaction with emergency cardiovascular treatment, was based on international standards<sup>20</sup> and its detailed description can be found in Cardoso et al. (2008)<sup>18</sup>. This is a self-applicable scale using 15 items and 3 open questions on general satisfaction, satisfaction with medical facilities and diagnosis, promptness and precision of the diagnosis, capacity of resolutivity, professional qualification, and security and support during healthcare.

Each item consists of a 5-point Likert-type scale in which values 4 and 5 indicate higher levels of satisfaction, value 3 means that the professional is moderately satisfied, and values 1 and 2 indicate dissatisfaction with the item being evaluated. The open questions include information on healthcare access and interest in professional qualification.

### Data Collection

Two cross-sectional studies were conducted with application of the CARDIOSATIS-Team scale, one before and other after the project implementation, respectively, in June 2006 and October 2008, totalising 30 months of operation of the telehealth system in the cities.

All physicians who worked in healthcare services linked to the Minas Project Telecardiology were invited to take part in the study. After signing an informed consent form, each physician received the questionnaire and responded it individually. A previously trained team supervised the application of the instrument.

### Data Analysis

Initially, it was performed a descriptive analysis of the data from the responders. With regard to the measurement properties of the scale, a correlation analysis was firstly conducted between its 15 items and global

scale, followed by an analysis of internal consistency by using the Cronbach's alpha. Those items whose item-total correlations were lower than 0.40 were excluded from the study of scale validation.

After removing those items with low total-item correlations, the study of scale's validity proceeded by obtaining the following: 1) construct validity by means of exploratory factor analysis; 2) data adequacy for factor analysis by means of KMO index (Kaiser-Meyer-Olkin)<sup>21</sup>; 3) correlation between items by means of Pearson's and Spearman's correlation coefficients; and 4) discriminant validity by using scores of satisfaction *per* cities and professionals (RMC number) before and after implementation of the project.

With regard to the scale's reliability, analyses of the internal consistency were conducted by using the Cronbach's alpha coefficient and finding the correlation between items, domains and global scale.

For analysis of the discriminant validity, data were paired according to either city ( $n = 81$ ) or professional ( $n = 80$ ) at two experimental moments. Wilcoxon's test was employed to assess the median values of the physician's satisfaction *per* city, whereas the marginal homogeneity test was used to evaluate such a satisfaction *per* item. These statistical tests were chosen due to the non-normality of the data. In addition, the marginal homogeneity test was used depending on the ordinal characteristic of the data on physician's satisfaction regarding several items of the scale<sup>22</sup>. Two types of information were then obtained: 1) the physicians' satisfaction *per* city and 2) the physician's personal satisfaction at the two experimental moments.

Data were evaluated by using the SPSS software, version 11.5, and all analyses had statistical significance set at  $p\text{-value} \leq 0.05$ .

All the ethical principles contained in the Declaration of Helsinki were observed, and the research project was approved by the Institutional Review Board/ Research Ethics Committee of the Federal University in Minas Gerais, file number 0507/06. The

telehealth system is registered in the State of Minas Gerais regional medical council. This study has no conflict of interests to report.

## Results

### 1 – The Physicians' Profile

A total of 152 physicians responded the questionnaire at baseline and 140 after the project implementation. The mean time to answer the questionnaire was 12 minutes (median = 9 minutes).

The majority of the physicians included in the study of the scale's validity ( $n = 152$ ) had a mean age of 40 years old (median = 38.5 years), with the length of post-graduation ranging from 2 months to 47 years (mean of 14 years), whereas 28% were newly graduated (less than 4 years). As for the speciality, 51.4% were general practitioners and 48.6% were specialists, mostly gynaecologists/obstetricians (15.1%), paediatricians (7.5%), general surgeons (7.5%), cardiologists (6.2%), and others (12.3%).

More than a half of the professionals worked at primary health care services (64.6%), such as basic healthcare units (BHUs) and family health care programs, whereas 35.4% worked in secondary or tertiary health care services at mixed healthcare units (MHUs), such as outpatient clinics and hospitals.

A high percentage of physicians reported that their cities offered no qualification resources regarding cardiovascular diseases (95%), but 67% of these professionals sought some qualification in this area by themselves. A total of 56% of the physicians have already asked to be released from their work in order to attend some type of qualification course on cardiovascular diseases, with the majority (82%) being released..

### 2 – Measurement Properties of the CARDIOSATIS-Team Scale

#### 2.1. Correlation Analysis

The 15 items of the scale showed item-total correlations ranging from 0.29 to 0.78

(Table 1). The items having the best correlations with total indicator were “Technology Available for Diagnosis” and “Resolutivity”, both with correlations of 0.78. One can observe that items “Too Much Responsibility”, “Professional Background”, “Course Availability” and “Specific Training” (items 11, 12, 14 and 15, respectively) had the lowest item-total correlations, all below 0.40.

The Cronbach's alpha showed that if one of these four items were excluded, there would be a positive impact on the scale in terms of satisfaction, increasing the alpha value of global scale to 0.90. In this way, factor analysis was conducted after removing these four items, for they were poorly correlated with satisfaction, and analysis of the measurement properties of the scale proceeded accordingly.

## 2.2. Construct Validity

Factor analysis indicated the distribution of 11 items regarding two domains, which accounted for 66.5% of the variance with percentages of 56.8% for the first do-

main and 9.7% for the second one. Table 2 lists the saturation coefficients for each item as well as their distribution within the respective factors. The values of these saturation coefficients ranged from 0.59 to 0.82.

Data adequacy for performing factor analysis was confirmed by means of KMO coefficient (Kaiser-Meyer-Olkin), whose value was 0.92.

With regard to Spearman's correlations between factors and global scale, it was observed that higher correlations were found between each factor and global scale (0.89 and 0.92, respectively) compared to the correlation between two factors (0.68) (Table 3). This result indicates the presence of a relationship common to the factors that is related to the global scale for evaluation of physicians' satisfaction with pre-hospital treatment of cardiovascular diseases in the small cities.

The dimensional structure of the CARDIOSATIS-Team scale was distributed as follows: Domain 1, satisfaction with healthcare provided (items 1-3, 8 and 13) and

**Table 1** – Results of item-total correlations and Cronbach's Alpha analysis for the CARDIOSATIS-Team scale, (n = 152)

**Tabella 1** – Resultado da análise de correlações item-total e Alfa de Cronbach para a escala CARDIOSATIS-Equipe, (n = 152)

Items	Corrected item-total correlations	Multiple squared correlations	Cronbach's alpha, if item excluded <sup>b</sup>
1- Satisfaction with healthcare provided	0.65	0.54	0.88
2- City's structure for diagnosis	0.71	0.68	0.88
3- Structure for treating cardiovascular diseases	0.71	0.69	0.88
4- Medical facilities for diagnosis of cardiovascular diseases	0.64	0.58	0.88
5- Quality of equipment and materials	0.70	0.63	0.88
6- Technology available for diagnosis	0.78	0.75	0.88
7- Prompt diagnosis	0.66	0.49	0.88
8- Precise diagnosis	0.65	0.53	0.88
9- Adequacy of service	0.62	0.56	0.89
10- Resolutivity	0.78	0.67	0.88
11- Too much responsibility	<b>0.36<sup>a</sup></b>	0.20	0.90
12- Professional background	<b>0.33<sup>a</sup></b>	0.28	0.90
13- Technical support	0.48	0.32	0.89
14- Course availability	<b>0.36<sup>a</sup></b>	0.32	0.90
15- Specific training	<b>0.29<sup>a</sup></b>	0.39	0.90

<sup>a</sup> Items removed from scale because they reached item-total correlation values below 0.40 / <sup>a</sup> Itens retirados da escala por terem obtido valores de correlação item-total inferiores a 0,40

<sup>b</sup> Cronbach's Alpha for the Global scale (15 items) = 0.90 / <sup>b</sup> Alfa de Cronbach para a escala Global (15 itens) = 0,90

<sup>c</sup> Item-item correlations varying between 0.08 and 0.735 / <sup>c</sup> Correlações item-item variando entre 0,08 e 0,735

**Table 2** – Results of factorial analysis and factorial loads for items of the CARDIOSATIS-TEAM scale, KMO index <sup>a</sup> and communalities<sup>b</sup> (n = 152)

**Tabela 2** – Resultados da análise fatorial e cargas fatoriais dos itens da escala CARDIOSATIS-EQUIPE, índice KMO<sup>a</sup> e cumunalidades<sup>b</sup> (n = 152)

Domains	Domain 1 <sup>c</sup>	Domain 2 <sup>c</sup>
<b>1- Satisfaction with healthcare provided</b>		
1- Satisfaction with healthcare provided	0.78	
2- City's structure for diagnosis	0.59	
3- Structure for treating cardiovascular diseases	0.65	
8- Precise diagnosis	0.59	
13- Technical support	0.82	
<b>2- Structure for Healthcare and Diagnosis</b>		
4- Medical facilities for diagnosis of cardiovascular diseases		0.80
5- Quality of equipment and materials		0.81
6- Technology available for diagnosis		0.82
7- Prompt diagnosis		0.60
9- Adequacy of service		0.78
10- Resolutivity		0.71

<sup>a</sup> KMO (Kaiser-Meyer-Olkin) = 0,92

<sup>b</sup> Communalities varying between 0.53 and 0.81 / <sup>b</sup> Cumunalidades variando entre 0,53 a 0,81

<sup>c</sup> Values below 0.50 were suppressed / <sup>c</sup> Foram suprimidos valores inferiores a 0,50

Domain 2, structure for healthcare and diagnosis (items 4-7, 9, 10).

### 2.3. Internal Consistency

The results regarding internal consistency of the items of each domain and global scale, calculated by using Cronbach's alpha, are listed in Table 3.

Domain 1 – Satisfaction with the healthcare provided: This domain consists of five items aimed at assessing the physicians' satisfaction with the healthcare for patients with cardiovascular complaints. The internal consistency of this domain was also high (alpha = 0.84) and item-global scale correlations ranged from 0.59 to 0.77. The item "Satisfaction with Healthcare Provided" had the best correlation with the other items of this domain, that is, 0.83.

Domain 2 – Structure for healthcare and diagnosis: This domain has six questions on the structure of equipment and diagnosis available for treatment of cardiovascular diseases in the healthcare services. One can observe that the internal consistency for this domain was high (alpha = 0.90). Item-global scale correlations ranged from 0.64 to 0.80.

Item 6 (Technology Available for Diagnosis) and item 5 (Quality of Equipment and Materials) had the best correlations with the other items of this domain, with correlations of 0.85 and 0.84, respectively.

Global scale – The internal consistency of the global scale, including the 11 items, was also high (alpha = 0.92) and the item-global scale correlations ranged from 0.59 to 0.80. All correlations were statistically significant (p < 0.01).

### 2.4. Discriminant Validity

Table 4 lists the results regarding the physicians' satisfaction *per city* before and after implementation of the project. The median values for satisfaction showed statistically significant differences in all items, domains and global scale. In the pre-implementation phase, the physicians' satisfaction ranged from 2.0 to 3.0, thus suggesting dissatisfaction with the treatment for cardiovascular diseases. On the other hand, physicians were found to be satisfied after the project implementation, according to the scale items that ranged from 3.0 to

**Table 3** – Cronbach's Alpha Coefficients for domains and for the Global scale, and correlations for items with domain and with the Global scale: CARDIOSATIS-TEAM (n = 152).

**Tabela 3** – Coeficientes Alfa de Cronbach para os domínios e para a escala Global e correlações dos itens com o domínio e com a escala Global: CARDIOSATIS-EQUIPE (n = 152).

<b>Domains and global scale</b>	<b>Cronbach's alpha coefficients</b>	<b>Item-domain correlations<sup>a</sup></b>	<b>Item-global scale correlations<sup>a</sup></b>
<b>1- Satisfaction with healthcare provided</b>	0.84	---	---
1- Satisfaction with healthcare provided		0.83	0.77
2- City's structure for diagnosis		0.79	0.77
3- Structure for treating cardiovascular diseases		0.80	0.76
8- Precise diagnosis		0.74	0.72
13- Technical support		0.73	0.59
<b>2- Structure for Healthcare and Diagnosis</b>	0.90	---	
4- Medical facilities for diagnosis of cardiovascular diseases		0.79	0.70
5- Quality of equipment and materials		0.84	0.74
6- Technology available for diagnosis		0.85	0.80
7- Prompt diagnosis		0.73	0.70
9- Adequacy of service		0.75	0.64
10- Resolutivity		0.77	0.77
<b>Global scale (11 items)</b>	0.92	----	----

<sup>a</sup> Spearman's Correlation significant at the 0.01 level / <sup>a</sup> Correlação de Spearman significante ao nível de 0,01

<sup>b</sup> Item-item correlations varying between 0.26 and 0.73 / <sup>b</sup> Correlações item-item variando entre 0,26 a 0,73

4.0. The same result was observed for global scale (3.3) and both domains (3.4 and 3.2, respectively). Satisfaction was found to be high in relation to the baseline study as well, thus suggesting an improvement in the physicians' satisfaction *per city*.

The comparison of satisfaction *per professional* (RMC) before and after project implementation is listed in Table 5. One can observe that the majority of the physicians were dissatisfied with the healthcare structure for treatment of cardiovascular diseases at the baseline (values 1.0 and 2.0) for all items evaluated. The item "Quality of Equipment" was the only one to be considered moderately satisfactory by the physicians (3.0). After implementation of the project, however, it was observed an improvement in the satisfaction with the other items, ranging from 3.0 to 4.0 (moderately satisfied and satisfied, respectively). Only items "Quality of Equipment" and "Resolutivity" remained unchanged (3.0 and 2.0, respectively).

The scale's capacity in discriminating correctly the both application moments

was observed for global scale and all items and domains ( $p \leq 0.01$ ), either in relation to cities or professionals individually.

## Discussion

In the present study, the CARDIOSATIS-Team scale has demonstrated adequate psychometric properties in terms of construct validity, internal consistency and discriminant validity to measure the physicians' satisfaction with the treatment of cardiovascular diseases, thus demonstrating a positive impact of the implementation of the telehealth system on the satisfaction of the users.

The process of validation followed international and national criteria for instrument development<sup>20,23,24</sup>. Initially, the individual contribution of each item to the indicator was analysed through internal consistency and data adequacy for performing a factor analysis. Such a procedure is of extreme importance for the development of an instrument to measure the healthcare conditions, since it allows the adequacy

**Table 4** – Results of the discriminant validation test of the CARDIOSATIS-Team scale, using the municipality as unit of analysis –Minas Telecardio Project.

**Tabela 4** – Resultados do teste de validação discriminante da escala CARDIOSATIS-Equipe utilizando o município como unidade de análise – Projeto Minas Telecardio.

Domains - Items	Satisfaction per cities (n=81)		p <sup>a</sup>
	Median before	Median after	
<b>1- Satisfaction with healthcare provided</b>	<b>2.6</b>	<b>3.4</b>	<b>p≤0.01</b>
1- Satisfaction with healthcare provided	3.0	4.0	
2- City's structure for diagnosis	2.0	3.7	
3- Structure for treating cardiovascular diseases	2.0	3.3	
8- Precise diagnosis	2.7	3.5	
13- Technical support	2.2	3.0	
<b>2- Structure for Healthcare and Diagnosis</b>	<b>2.4</b>	<b>3.2</b>	<b>p≤0.01</b>
4- Medical facilities for diagnosis of cardiovascular diseases	2.3	3.0	
5- Quality of equipment and materials	3.0	3.3	
6- Technology available for diagnosis	2.0	3.3	
7- Prompt diagnosis	2.0	3.3	
9- Adequacy of service	2.3	3.0	
10- Resolutivity	2.0	3.0	
<b>Global scale (11 items)</b>	<b>2.4</b>	<b>3.3</b>	<b>p≤0.01</b>

<sup>a</sup> Wilcoxon Test for paired data, p≤0.01, for factors, global scale and for all items / <sup>a</sup> Teste de Wilcoxon para dados pareados, p≤0,01, para os fatores, escala global e para todos os itens /

<sup>b</sup> Global Scale, comprised by the median of the 11 items of the scale / <sup>b</sup> Escala Global, composta pela mediana dos 11 itens da escala

between theoretical and statistical models to be evaluated<sup>24</sup>.

In the present study, the indicator used to assess data adequacy for factor analysis (KMO coefficient) showed a perfect adequacy<sup>19,21,25</sup>.

Initially, factor analysis and analysis of internal consistency were performed, including all the 15 items of the scale. The results indicated the distribution of items into three domains, explaining 62% of the variance. Nevertheless, the model was found to be poorly adjusted because of the low values for factor loadings and Cronbach's alpha. In view of this, it was decided to build a new model by assessing judiciously the adequacy between each item and the statistical model. The correlation between the items and their contribution to the scale (Table 1) showed that the scale was poorly adjusted (alpha values ranging from 0.58 to 0.90). Another important observation was that the items "Too Much Responsibility", "Professional Background", "Course Availability" and "Specific Training" had item-

total correlations below 0.40. According to McHornwy et al. (1994)<sup>26</sup>, only those items having item-total correlation greater than 0.40 should be included, otherwise their exclusion from the scale is recommended.

As a result, factor analysis was applied to the 11 items indicated by the statistical model. Thus, the CARDIOSATIS-Team scale was divided into two domains: 1) satisfaction with healthcare provided and 2) satisfaction with the structure for healthcare and diagnosis, accounting for 66.5% of the data variance. It is interesting to note that the scale was conceived by keeping in mind six dimensions, namely: 1) general satisfaction, 2) satisfaction with physical and diagnostic structure, 3) promptness and precision of the diagnoses, 4) resolutivity, 5) professional competence, and 6) security and reliability in the healthcare, all grouped into two dimensions in this study<sup>18</sup>. Although the statistical model had not confirmed the 6-dimension theoretical model at first<sup>24</sup>, the analyses corroborated the multidimensional character of the satisfaction construct<sup>2</sup>.

**Table 5** – Comparison of physician satisfaction, paired by Medical Council Number, with the CARDIOSATIS-Team scale before and after the implementation of the Minas Telecardio project.

**Tabela 5** – Comparação da satisfação dos médicos, pareados por CRM, para a escala CARDIOSATIS-Equipe antes e após a implantação do projeto Minas Telecardio.

Domains – scale's items		Percentage of satisfaction (n=80) <sup>a</sup>				
		1	2	3	4	5
<b>1 Satisfaction with healthcare provided</b>						
1- Satisfaction with healthcare provided	Before	6.3	42.5	10.0	41.3	0
	After	3.8	16.3	2.5	71.3	6.3
2- City's structure for diagnosis	Before	6.3	60.0	5.0	26.3	2.5
	After	0	30.0	3.8	65.0	1.3
3- Structure for treating CVDsb	Before	11.3	58.8	5.0	21.3	3.8
	After	2.5	35.0	8.8	52.5	1.3
8- Precise diagnosis	Before	5.1	53.2	11.4	30.4	0
	After	0	20.3	11.4	64.6	3.8
13- Technical support	Before	29.5	21.8	16.7	17.9	14.1
	After	7.7	25.6	23.1	23.1	20.5
<b>2 Structure for Healthcare and Diagnosis</b>						
4- Medical facilities for diagnosis of CVDsb	Before	17.7	35.4	25.3	16.5	5.1
	After	6.3	30.4	17.7	40.5	5.1
5- Quality of equipment and materials	Before	7.5	35.0	40.0	17.5	0
	After	1.3	6.3	47.5	42.5	2.5
6- Technology available for diagnosis	Before	10.1	62.0	11.4	16.5	0
	After	2.5	34.2	10.1	45.6	7.6
7- Prompt diagnosis	Before	11.3	58.8	10.0	20.0	0
	After	1.3	38.8	8.8	50.0	1.3
9- Adequacy of service	Before	11.4	45.6	32.9	10.1	0
	After	5.1	29.1	45.6	19.0	1.3
10- Resolutivity	Before	12.8	64.1	6.4	15.4	1.3
	After	1.3	43.6	12.8	41.0	1.3

<sup>a</sup> Values varying between 1 and 5, in which, 1: very dissatisfied; 2: dissatisfied; 3: more or less satisfied; 4: satisfied and 5: very satisfied. The higher the value, the higher the satisfaction / <sup>a</sup> Valores variando entre 1 e 5, sendo, 1: muito insatisfeito; 2: insatisfeito; 3: mais ou menos satisfeito; 4: satisfeito e 5: muito satisfeito. Quanto maior o valor, maior a satisfação

<sup>b</sup> p Value attained using the Marginal Homogeneity Test (all significant - p value  $\leq 0.01$ ) / <sup>b</sup> Valor p obtido por meio do Teste de Homogeneidade Marginal (todos significantes valor- p  $\leq 0,01$ )

The final statistical model proposed for development of the instrument had good correlation between domains and global scales, since all exhibited significant correlation coefficients between themselves. In fact, this outcome is expected for scale validity and indicates that domains are linked to a common construct, which in this study, refers to the physicians' satisfaction with emergency treatment of cardiovascular diseases in the basic healthcare services<sup>27</sup>.

Analysis of internal consistency demonstrated good characteristics for domains and global scale, with alpha values greater than 0.84. These values were found to be even greater than the ideal range sug-

gested by Vallerand (1989)<sup>20</sup> for assessment of the reliability of a scale (0.70 to 0.85).

The scale also had a good discrimination power between both experimental moments, that is, before and after the project intervention. In fact, the satisfaction found at the baseline was significantly different from that found after the project implementation ( $p \leq 0.01$ ), either in terms of cities or professionals individually (Tables 4 and 5). Therefore, besides confirming the discriminant validity of the CARDIOSATIS-Team scale, these results demonstrated higher levels of satisfaction among the subjects following implementation of the telehealth system. In fact, these results are corroborated

ted by the majority of studies that show a significant increase in the satisfaction levels after implementation of new healthcare technologies<sup>14,28,29</sup>.

With regard to the physicians' satisfaction (RMC) obtained at baseline, one can observe that the majority of subjects were satisfied with the items evaluated. Items such as "Resolutivity", "Technology Available for Diagnosis", "Structure for Diagnosis", "Structure for Treatment of Cardiovascular Diseases", and "Prompt Diagnosis" were those presenting the higher level of dissatisfaction among these professionals. These results can be explained by the fact that the telecardiology system was implemented, in the majority of the cases (64.6%), in basic healthcare units (64.6%) lacking technological equipment and resources required for the treatment of cardiovascular diseases<sup>13,30</sup>. Even when such resources are available, they are often not used because of the lack of specialised professionals or trained staff<sup>3</sup>.

In this sense, implementation of the telecardiology system has made the professionals to feel more satisfied with the structure available for handling cardiovascular diseases, which was demonstrated by the higher levels of satisfaction regarding all items of the scale, except for "Resolutivity", whose score remained unchanged even after the project implementation. A possible explanation might be the fact that the telecardiology system was able to improve several diagnosis-related items as equipment, training and second opinion were then available, although the complex reference structure existing in the public healthcare system was little changed, if any. As a result, even improving promptness and precision of the diagnosis of cardiovascular diseases, the resolutivity was not always reached because the healthcare service has difficulty in referring the patient to a specialised centre<sup>13</sup>.

Another interesting aspect from the individual analysis of the physicians' satisfaction has to do with the "Technical Support", since this item changed little even after the project implementation. There is a possible

explanation that might be related to the professionals' resistance in using the telehealth system and its several components, such as teleconsultation for a second opinion, which not only plays an educational but also a clinical role, thus widening the scope of the system beyond the technical issues<sup>28</sup>.

Paradoxically, despite the literature pointing to problems with equipment and data transmission (technical problems related to Internet) – important issues to be considered for using the teleconsultation<sup>2,3,4,10,11,28</sup>, the subjects of this study reported no difficulty in handling the equipment<sup>31</sup>.

According to Hu (2003)<sup>4</sup>, the quality of both equipment and information affects the use of the system by the users, thus having a negative impact on their satisfaction and even impeding them from using the system. In addition, the physicians' dissatisfaction with the healthcare structure in cities located far from specialised centres can contribute to a turnover among them<sup>3</sup>. On the other hand, satisfaction with and consequent use of the telehealth systems can bring many benefits to both patient and physician. Among these benefits, one can cite second opinion and diagnostic improvement without the need to move from one place to another, reduction of unnecessary referrals, and prompt diagnosis and treatment<sup>2,4</sup>. Other factors frequently associated with the use of teleconsultation include some knowledge about Internet, previous use of this type of technology and perception on the potential benefit to the patient<sup>28,29</sup>.

With regard to the limitations of the present study, one can cite the impossibility to isolate the participating cities for evaluation of the impact of such an intervention locally because the study was quasi-experimental. In addition, other factors may have interfered with the physicians' satisfaction, such as professional recognition, wage change, and better work conditions, all factors not directly measured in the present study.

Despite such limitations, one can conclude that implementation of the telehe-

alth system has improved the physicians' satisfaction and the CARDIOSATIS-Team scale was found to be a good instrument to measure this satisfaction with the treatment of cardiovascular diseases. The good validity and reliability of the scale reinforce its possible use in other studies as auxiliary instrument for evaluation of the quality in the healthcare provided/received as well as in qualification programs. In addition, comparative studies assessing pre- and post-implementation of technologies and

defining healthcare priorities, mainly those regarding cardiovascular diseases, can be conducted.

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