

Is the Use of Information and Communication Technology Associated With Aspects of Women's Primary Health Care in Brazil?

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Abstract: The use of information and communication technology (ICT) is on the increase in the health systems, representing a means of improving the quality of health care. This study analyzed the ICT incorporation in primary care in Brazil and identified the different aspects that may be associated with better quality in the care provided, in relation to certain aspects of women's care. We noted an unevenness regarding ICT incorporation in Brazil. However, the findings indicate an association between ICT and certain aspects of the quality provided in women's health care, which reinforces the need for further studies on this type of evaluation. **Key words:** *information and communication technology, primary health care, quality of health care, women's health*

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IN RECENT YEARS, there has been a notable growth in the process of incorporating information and communication technology (ICT) in primary health care (PHC) in several countries. In 2015, a study on primary care carried out by the European Observatory on Public Health in 31 European Community countries demonstrated that computers are almost always available to general practitioners in health units in 21 countries, usually available in 7 countries, and only occasionally available in 3 countries (Kringos et al., 2015).

In the United States, between 2009 and 2011, the percentage of doctors with an electronic health record (EHR) grew from 22% to 35% (McGuire et al., 2013), while in Canada, 49% of doctors had EHR in their doctors' offices in primary care in 2010 (Price et al., 2013).

Given this increase, we sought to understand the relationship between incorporation of ICT and the quality of PHC. In 1997, a systematic review showed that the incorporation of ICT resulted in cost reductions and fewer unnecessary tests. However, consultation time was extended and the issuing of prescriptions also increased (Mitchell et al., 2001).

In 2009, another systematic review of the implementation of EHR in primary care in 7 countries concluded that (a) health information systems do not improve, and even undermine, the efficiency and quality of care or the safety of the patient; (b) the quality of the implementation process is as important as the quality of the system being executed; and (c) medical leaders can mitigate the above risks through training, introducing barcode systems, performing pilot projects, standardizing medical terminology, and having strong information technology management (Ludwick & Doucette, 2009).

Another systematic review, spanning the period from 1997 to 2010, concluded that there is little evidence in the literature of the impact of these technologies in relation to improvements in patients' results, as well as the lack of evidence on its cost-effectiveness. At the aggregate level, organizational issues are fundamental for implanting strategies that influence adoption (Black et al., 2011).

In 2013, a Canadian systematic review demonstrated that there was little evidence on specific benefits: EHRs were not precise enough to serve as base in clinical application; there was a lack of alignment between the EHR and the clinical work flow and the demonstrable value for the clinics was uncertain (Greiver et al., 2013).

Brazil has managed to make progress in relation to the incorporation of ICT in primary care, with the creation of the National Program for the Improvement of Access and Quality in Primary Health Care (PMAQ-AB), in 2011 (Pinto et al., 2012, 2014). By implementing continuous and progressive processes, PMAQ-AB aims to expand the capacity of the 3 spheres of government to provide services while ensuring a standard of quality that is comparable at national,

regional, and local levels (Brasil Ministério da Saúde, 2011). PMAQ-AB is beginning its third yearly cycle and continues to gather data relating to the ICT incorporation process.

Few studies have been carried out on the incorporation of ICT in PHC and on the quality of the service provided. In a study on the typology of the primary care units (PCUs), using data from the first PMAQ cycle from 2012, it was found that better-structured units incorporated more ICT. In the units with the worst structure (types 1 and 2), only 3.7% and 16.8% had online computers, respectively. In this study, it was noted that, in general, 51.2% of the units reported having a computer and 35.4% had Internet access (Giovannella et al., 2015).

Using data from the 2014 PMAQ, another study found that Internet connectivity in PCUs was available in 50.1% of units, with good quality—78.1% of the teams state that it was sufficient to perform their activities. However, the number of connected environments (reception, pharmacy, management, observation room, immunization room, procedure room) was still restricted. When we look at the ICT infrastructure, in primary care offices there is still a small incorporation of ICT: 86.2%, 80.6%, and 70.6% of dental, medical, and nursing offices, respectively, do not have a computer, and 78.3% of pharmacies situated in the PCU do not have one (Santos et al., 2016).

This study showed that in Brazil, the implementation of EHR is still quite limited, but that the telehealth resource utilization process has advanced in recent years, already reaching more than one-third of teams. On analyzing 3 dimensions of ICT—infrastructure, system implantation, and information use—it is in the latter one that we can see the most significant advances: more than 80% of the teams reported using information to monitor their activities (Santos et al., 2016).

In a 2016 Brazilian study, regarding the ICT incorporation process and results obtained by primary care teams (PCTs) in quality certification, it was noted that there was a positive association between the 2 dimensions, demonstrating the importance of ICT in improving care quality. This positive association

is present in all the analyzed dimensions: infrastructure, system implantation and information usage, the impact being most significant in the last dimension. However, studies, linking ICT incorporation and quality of care, are still at an early stage in Brazil (Santos et al., in press).

Despite the limits identified in several studies, current use of EHRs and ICT is widely recommended as a means for improving the quality, safety, and efficiency of health care. Its usage helps increase adherence to care based on guidelines, greater agility in assistance, more complete documentation, performance of examinations without duplication, and fewer medical errors. There is a need to carry out general and/or specific studies, covering the quality of care provided, and ICT incorporation.

This article aims to analyze the incorporation of ICT in primary care in Brazil and identify distinct aspects of ICT, which may be associated with better quality of specific aspects of the care provided to women, including the control of breast and cervical cancer, and pregnancy and postnatal care. These variables are used by the Ministry of Health in the certification of PCT participating in PMAQ (Brasil Ministério da Saúde, 2015).

METHODOLOGY

Study design

This is a cross-sectional quantitative study. We used data from the second PMAQ-AB external assessment, financed by the Ministry of Health and carried out between 2013 and 2014. We analyzed variables from modules I and II of the PMAQ-AB in relation to a universe of 29 757 PC teams. The variables were organized in categories to provide an overview of the incorporation of ICT in primary care provided by Brazilian public health system.

Selection of variables

To evaluate the quality of women's health care, we used variables from modules I and II from the second PMAQ cycle. These modules contain 68 variables concerning women's health care. Seventeen were selected, with 4

from module I and 13 from module II. They were selected on the basis of criteria used by the Ministry of Health in EAB (Basic Health-care Team) certification, which attributed a "weight" to each of the variables. For questions on Women's Health, weights between 0.0000 and 0.2143 were attributed. These variables were then arranged in decreasing order, with selection of those with "weight" equal to or greater than 0.1010 (Brasil Ministério da Saúde, 2015).

An index, called the IASM (Brazilian Portuguese acronym for aspects of Women's Primary Care Index), was created from the sum of each of the 17 values expressing the quality of women's care. The index was then dichotomized taking the value of "Adequate" (value 1), when the index was 13 and above, and "Inadequate" (value 0), when the index was 12 points or less. These variables were selected on the basis of the criteria employed by the Ministry of Health to assess the quality of aspects of women's primary care (Brasil Ministério da Saúde, 2015).

Variables from module I refer to the capacity of the PCU to provide rapid testing for syphilis, pregnancy, and human immunodeficiency virus (HIV) infection, besides the free supply of iron sulfate. In module II, variables refer to health promotion and education, focusing on cervical and breast cancer prevention, and family planning. Other variables were selected on the basis of pregnant women's care and the early diagnosis of complications during pregnancy, monitoring through the use of the Pregnant Card, and the capacity of the team to receive laboratory results in a timely manner. Furthermore, variables indicative of cervical cancer active search, final cytopathological examination, breast cancer, and prenatal care were selected. Finally, the selection was completed with childbirth care follow-up such as home visits by community agents, nurses, and doctors.

Independent variables referring to ICT incorporation were selected from modules I and II of the PMAQ-AB. The selection of independent variables included aspects of the following analytical ICT categories: infrastructure,

connectivity, information systems implementation, and use of information.

In the first category (ICT infrastructure), we used variables relating to computers, televisions, printers, and peripheral devices in working conditions. In the second category (connectivity), we used variables relating to Internet access, telephone and Smartphone availability, Internet access in medical and nursing offices, and sufficient bandwidth. These variables are present in module I. The third category (implementation and usage of the systems) from modules I and II included EHR implemented by the team and integration with other points of the health care network, the existence of telehealth and its resources in the unit, and the use of referral centers. The fourth category (usage of information) also came from module II: information made available by management and support for the teams in health situation analysis, as well as team execution of monitoring, indicator analysis, and women's health information registration related to prenatal care, and breast and cervical cancer care.

In the analysis of ICT incorporation, 4 ICT categories were created. Each category was assigned a value to represent the degree of technology incorporation by the PCT. Values were defined as "high" (presence of 80% of the variables), "average" (50%-80%), or "low" (<50%), allowing us to gauge the extent of ICT incorporation process.

Data analysis

Statistical analysis was performed in 2 phases: descriptive and inferential. First, we calculated the frequency of all ICT variables and those referring to women's health.

To verify associations between the incorporation of ICT and the quality of aspects of women's primary care, multiple logistic regression analysis was initially performed, with the IASM as the dependent variable. Throughout the analysis, the value of "inadequate" was used as a reference category. Models were analyzed in 2 stages. First, the association of the variables comprising the indexes of each category with the IASM was verified. This analysis sought to determine the degree of association of each component with the quality

of care index. Subsequently, the association of the IASM with the independent variables by each category's levels (low/medium/high) was verified.

Statistical analyses adopted a statistical significance level of 5% ($P \leq .05$) and a confidence interval of 95%, with calculation of the respective odds ratio (OR) to indicate the magnitude of the associations.

After logistic regression, calibration of the models created was evaluated using Hosmer and Lemeshow's goodness-of-fit test. In all cases, data were considered significant at a value of $P < .05$. This study was approved by the Research Ethics Committee of UFMG (number 1.275.911).

RESULTS

Analysis of the 29,757 PCTs assessed in the PMAQ-2nd cycle indicates that, in terms of ICT infrastructure, most of them have equipment and basic peripheral devices: 73.7% and 61% of the units have functioning computers and TVs, respectively; and 57.1% have a printer. As for peripheral devices, which are important in interactive processes, only 11.6% and 16.1% have a microphone and a webcam in working condition, respectively (Table 1).

The connectivity available to the PCTs, via the Internet and the provision of sufficient bandwidth to perform their activities, is at approximately 55% of the units. However, the number of medical or nursing offices with Internet-connected computers is roughly 1/5 of the units (18.7% and 21.8%, respectively) (Table 1).

Regarding the implantation of information systems, it was noted that only 13.9% of the PCTs have access to EHRs and 11.2% are integrated with other points of the care network. Thirty percent of the teams reported using telehealth resources, mainly for in-service training (32.7%) and education of professionals (21.4%). The referral of primary care users via the referral center is performed by 86.3% of the teams (Table 1).

It was noted that the use of process information by the basic health care team category demonstrates greater frequency (>60%) for most of its variables. Issues related to

Table 1. Distribution of Information and Communication Technology Variables According to Categories Brazil 2014

Items	Number of PCTs ^a That Provided	
	Actions	% PCTs ^a
Infrastructure		
Computers in working condition	21 924	73.7
Stabilizers in working condition	18 906	63.5
TVs in working condition	18 160	61.0
Printers in working condition	16 984	57.1
Stereos in working condition	12 425	41.8
Web cameras in working condition	4 802	16.1
Computer microphones in working condition	3 455	11.6
Connectivity		
Doctors' offices with Internet-connected computers	5 570	18.7
Access to smartphones	391	1.3
Information systems implementation		
Referral center	25 684	86.3
Telehealth: in-service training	9 736	32.7
Telehealth available	8 920	30.0
Use of Telehealth	6 379	21.4
Electronic medical record	4 132	13.9
Telehealth: Forming second opinion	3 984	13.4
Electronic medical record integrated with the care network	3 336	11.2
0800 telehealth	2 854	9.6
Use of e-SUS files	1 601	5.4
e-SUS data transmission	75	0.3
Information usage		
Supply the prenatal information system	28 276	95.0
Record of the person in charge of monitoring the pregnant women	28 166	94.7
Record of the pregnant women's up-to-date vaccination	28 141	94.6
Record of all pregnant women	27 795	93.4
Monitoring and analysis of health indicators	26 350	88.6
Team planning according to the risk of the pregnant woman	24 334	81.8
Record of cytopathological testing of the pregnant woman	23 079	77.6
Record of women eligible for cytological examination	22 144	74.4
Risk stratification protocols for prenatal care	21 753	73.1
Risk stratification protocols for cervical cancer	20 255	68.1
Record of dental appointment for pregnant women	19 292	64.8
Risk stratification protocols for breast cancer	19 205	64.5
Record of higher-risk pregnant women referred to other care centers	16 785	56.4
Record of women eligible for mammography	15 960	53.6
Record of higher-risk women with abnormal mammography referred to other care centers	14 027	47.1

Abbreviation: OR, odds ratio adjusted.

^aTotal of PCTs = 29 757.

pregnancy and prenatal monitoring affect nearly 100% of teams. However, regarding issues on the registration of women eligible for mammography, in the referral of higher-risk users to other points of the care network, in the event of abnormal cytopathology or mammography examinations, the percentage of positive responses is lower (53.6%, 56.4%, and 47.1%, respectively). It is worth highlighting that the monitoring and analysis of health information and indicators are carried out by 88.6% of the teams (Table 1).

Aspects of women's health care were analyzed on the basis of variables from primary care applied to prenatal and postnatal care, breast cancer, and cervical cancer. In terms of prenatal and postnatal care, the PCTs carry out many of the established activities such as

active research (82.8%), the use of Pregnant Card in the monitoring of pregnant women (97.8%), and receipt of pregnant women's examinations in a timely manner (96.6%). However, other recommended actions demonstrate lower percentages: the use of protocols to enroll pregnant women into the system for early diagnosis of complications during pregnancy (54.4%), and appointments at specially assigned times on any day of the week to ensure postnatal monitoring up to 10 days after childbirth (45.7%). Rapid testing for syphilis, pregnancy, and HIV is at 31.8%, 34.1%, and 33.4%, respectively. Educational activities and health initiatives regarding family planning are carried out by 72.0% of the PCTs (Table 2).

In the prevention and monitoring of breast and cervical cancer, we observed that the

Table 2. Distribution of Breast, Cervical Cancer, Prenatal and Postnatal Care Variables, Brazil, 2014

	Number of PCTs ^a That Provided Actions	% PCTs ^a
Breast and cervical cancer		
Cytological examination of the cervix in the unit	27 066	91.0
Educational activities: Cervical cancer and breast cancer	23 322	78.4
Active search: Cervical cancer	22 707	76.3
Active search: Late cytopathology	22 224	74.7
Active search: Breast cancer	19 779	66.5
Prenatal and postnatal care		
Use the Pregnant Card to monitor pregnant women	29 103	97.8
Laboratory results of pregnant women in time for any interventions	28 743	96.6
ACS visit to check on the women 10 days after delivery	24 714	83.1
Active search: Prenatal	24 648	82.8
Educational activities: Family planning	21 428	72.0
Visit of other team members 10 d after delivery	21 372	71.8
Iron sulfate available in the unit	19 539	65.7
Early diagnosis of pregnant women and complications in pregnancy	16 198	54.4
Appointment at special hours any day 10 d after delivery	13 611	45.7
Rapid pregnancy test	10 145	34.1
Rapid HIV test	9 931	33.4
Rapid syphilis test	9 456	31.8
Total IASM adequate	8 088	27.2
Total IASM inadequate	21 669	72.8

Abbreviations: ACS, Community Health Agent; HIV, human immunodeficiency virus; IASM, Women's Primary Care Index; PCT, primary care team.

^aTotal of PCTs = 29 797.

PCT performed most of the recommended actions: 91% perform cytopathology pelvic examinations in the unit; 76.3% and 66.5%, respectively, carry out active searches in cases of cervical and breast cancer; and 74.7% of teams implement active searches in late cytopathology examinations. Educational activities and health promotion initiatives on cervical and breast cancer are offered by 78.4% of the teams (Table 2).

In relation to the index created—IASM, based on the sum of the variables described earlier, we find that only 27.2% ($n = 8088$) of the teams achieved a score of “adequate”; that is, they performed 80% or more of the selected activities (Table 2).

In analysis of the association of the ICT categories and the IASM quality of care measure, we noted a statistically significant association between ICT infrastructure resources and the quality of care provided, particularly concerning printer availability (OR = 1.70), TV (OR = 1.39), and computer (OR = 1.30) (Table 3).

The association between connectivity and the IASM is observed in the cases where there is Internet in medical offices (OR = 1.60) and access to smartphones (OR = 1.64) (Table 3).

Regarding system implantation, there is a statistically significant association in relation to the existence of EHRs and the quality of care (OR = 3.05). The presence of telehealth is associated with quality of care (OR = 1.28) and its use is applied only in the case of forming a second opinion (OR = 1.41) and use of telehealth (OR = 1.50). The use of the telehealth 0800 telephone line is associated with quality of care (OR = 1.34), as well as the use of records from e-SUS (1.29). Referral of primary health care users via the referral center is also associated with the quality of care (OR = 1.42) (Table 3).

Concerning the use of information, all analyzed variables presented statistically significant association with the IASM, with the exception of activities related to the registration of higher-risk pregnant women. In this case, it is possible that this variable is a confounding factor, considering that the teams' planned activity according to pregnant women and risk is strongly associated with the quality of care

(OR = 1.84) and may already contain information on this risk (Table 3).

The assessment of ICT categories points to a low-degree incorporation for infrastructure (47.1% of low-degree incorporation), connectivity (81.0%), and system implantation (90.9%). With regard to the information usage, the degree of ICT incorporation is about evenly distributed between medium-degree incorporation (42.7%) and high-degree incorporation (38.4%) (Table 4).

On analyzing associations between the degrees of incorporation of ICT categories that may be contributing to better women's care, it is noted that in all ICT categories there was a statistically significant association between infrastructure, connectivity, information usage and systems, and the quality of care provided. There is a strong association between information usage and the IASM (OR = 3.78 and OR = 12.31 for medium and high degrees of ICT, respectively).

Besides this, for the other categories, the high degree of ICT incorporation increases the chances of better women's health care quality: connectivity (OR = 1.22), infrastructure (OR = 2.03), and implementation of information systems (OR = 4.36) (Table 4).

DISCUSSION

The results of the study indicate a relative unevenness regarding the incorporation of ICT in Brazil, despite the implementation of projects aimed at stepping up the process of ICT incorporation in public PCUs. In Brazil, the National Broadband Plan (the result of a partnership between the Ministry of Health and the Ministry of Communications) is ongoing, with the aim of installing high-speed Internet in 12 000 PCUs, as well as the PCUs Retraining Program by the Ministry of Health, which has invested in the provision of computers and Internet, and in the implantation of EHR (Brasil Ministério da Saúde, n.d.-a, n.d.-b). In particular, the proposal to implement the e-SUS project has become a significant initiative that has also driven the incorporation of ICT in Brazil's primary care. The e-SUS project substitutes the former

Table 3. Association Between Categories Relating to Information and Communication Technology and the IASM, Brazil, 2014^a

Item ^b	OR	P ^c	95% CI	
			Lower	Upper
Infrastructure				
Computers in working condition	1.30	.00	1.17	1.46
Stabilizers in working condition	0.91	.04	0.84	0.99
TVs in working condition	1.39	.00	1.31	1.48
Printers in working condition	1.70	.00	1.58	1.83
Stereos in working condition	1.27	.00	1.19	1.35
Web cameras in working condition	1.13	.00	1.04	1.23
Computer microphones in working condition	1.23	.00	1.12	1.34
Connectivity				
Doctors' offices with internet connected computers	1.60	.00	1.48	1.73
Access to smartphones	1.64	.00	1.33	2.01
Information systems implementation				
Referral center	1.42	.00	1.31	1.54
Telehealth: In-service training	0.70	.00	0.63	0.78
Telehealth available	1.28	.00	1.19	1.37
Use of Telehealth	1.50	.00	1.36	1.65
Electronic medical record	3.05	.00	2.64	3.52
Telehealth: Forming second opinion	1.41	.00	1.28	1.55
Electronic medical record integrated with the care network	0.69	.00	0.59	0.81
0800 telehealth	1.34	.00	1.22	1.48
Use of e-SUS files	1.29	.00	1.15	1.44
e-SUS data transmission	0.46	.00	0.28	0.76
Information usage				
Supply the prenatal information system	1.64	.00	1.37	1.96
Record of the person in charge of monitoring the pregnant women	1.31	.01	1.08	1.58
Record of the pregnant women's up-to-date vaccination	1.29	.02	1.05	1.58
Record of all pregnant women	1.35	.00	1.12	1.61
Monitoring and analysis of health indicators	1.80	.00	1.60	2.04
Team planning according to the risk of the pregnant woman	1.84	.00	1.65	2.06
Record of cytopathological testing of the pregnant woman	1.82	.00	1.67	1.99
Record of women eligible for cytological examination	1.20	.00	1.09	1.32
Risk stratification protocols for prenatal care	1.34	.00	1.19	1.50
Risk stratification protocols for cervical cancer	1.25	.00	1.07	1.44
Record of dental appointment for pregnant women	1.67	.00	1.56	1.79
Risk stratification protocols for breast cancer	1.43	.00	1.26	1.63
Record of higher-risk pregnant women referred to other care centers	1.15	.00	1.05	1.27
Record of women eligible for mammography	1.64	.00	1.53	1.77
Record of higher-risk women with abnormal mammography referred to other care centers	1.57	.00	1.44	1.71

Abbreviations: CI, confidence interval; OR, odds ratio adjusted; PCT, primary care team.

^aDependent variable: reference category: inadequate; independent variables: reference category: low level.

^bTotal of PCTs = 29757.

^c $P < .05$.

Table 4. Association Between Indexes of Information and Communication Technology and IASM, Brazil, 2014^a

Category	Degree	n	%	P	OR*	CI (95%)	
						Lower	Upper
Infrastructure	Low	14 013	47.1	...	1.00
	Medium	11 935	40.1	.00	1.79	1.68	1.90
	High	3 809	12.8	.00	2.03	1.85	2.23
Connectivity	Low	24 116	81.0	...	1.00
	Medium	3 463	11.6	.00	1.21	1.11	1.31
	High	2 178	7.3	.00	1.22	1.10	1.36
Information systems implementation	Low	27 033	90.9	...	1.00
	Medium	2 578	8.7	.00	1.94	1.78	2.12
	High	146	0.5	.01	4.36	3.08	6.18
Information usage	Low	5 647	19.0	...	1.00
	Medium	12 691	42.7	.00	3.78	3.35	4.27
	High	11 419	38.4	.00	12.31	10.92	13.88

Abbreviations: CI, confidence interval; OR, odds ratio adjusted.

^aDependent variable: reference category: inadequate; independent variables: reference category: low level.

primary health care information system that did not have the individualized registration of attended patients. The new system registers activities carried out in primary health care, individual consultations, and even more advanced options, such as electronic medical records (Brasil Ministério da Saúde, 2014).

Despite these initiatives, it is worth mentioning the limited dissemination of ICT resources, for example (only 13.9% of teams use EHRs and only 11.2% are linked to the national network). These data serve to illustrate Brazil's challenges in relation to ICT incorporation, in comparison with international experiences.

Difficulties in computerizing medical care are well-documented, but some countries have achieved significant progress in this regard. In 2015, in Finland, 75% of PCUs had electronic records (World Health Organization, 2016). In Canada, 49% of primary care doctors reported using an EHR, in 2010 (Greiver et al., 2013). In 2011, in the United States (Black et al., 2011), usage of an HER was observed in 35% of outpatient care medical offices.

Some aspects connected to the ICT incorporation process are noteworthy. For

instance, there is the low effective penetration of the national telehealth program, established in Brazil since 2007, given that its resources are used by only 30% of PCTs. In Latin America, there are very few countries that have a structured national telehealth project with Brazil, along with Mexico, standing out (Organización Panamericana de la Salud, 2016). Another aspect refers to the use of the referral center in referring patients to other points in the health care network, which is significant in that it contributes to the establishment of collaborative networking, as well as the PCUs reporting the use of information for the planning and monitoring of actions.

The current program of women's care, in which there is continuous monitoring, was based on a continuous process of information usage. The program established minimum quantitative criteria for obstetric care, aimed at indirectly improving the quality of care (Brasil Ministério da Saúde, 2002). This aspect of the implemented program provides interesting opportunities in the search for a correlation between ICT incorporation and the quality of care. The women's health care program establishes well-defined quality criteria, particularly aspects addressed in this

article. This program has been monitored over time through official information systems.

In this context, our study showed a strong correlation between the use of information and the quality of women's healthcare care provided. Among the 4 categories analyzed (infrastructure, connectivity, system implementation, and the use of information), it was the last one that stood out. The category regarding information usage could contribute greatly to an improvement in the quality of health care—more so than the others.

The Women's Health Care Program was a pioneering initiative in Brazil's public health, in establishing a minimum protocol of actions to be implemented during the follow-up of pregnancies. The information system established by the program was the management tool that enabled the monitoring of program compliance, achievement of goals, and the direct follow-up of mother and child health statistics within the national context. Through the proposed process indicators, the monitoring of results is another important management tool, capable of generating program and strategy actions, based on the profile of the target population (Andreucci & Cecatti, 2011). Despite this effort, the created index (IASM) shows that only 27.2% of the teams demonstrated a level deemed adequate from the perspective of the women's health care provided, based on the variables related to the generation and use of information.

In the analysis of the association between the quality of certain aspects of women's care provided and the ICT incorporation process,

in the 4 categories analyzed, a strong association was noted. Teams that have a medium or high degree of ICT incorporation are more likely to provide better women's care, this being a progressive gradient. The information usage category demonstrates the most notable association, more so than the others. In other studies on ICT incorporation, the dimension related to information usage is also the one most consolidated in Brazil (Giovanela et al., 2015; Price et al., 2013).

It should be noted that this analysis focused on aspects of ICT that were assessed by the PMAQ-AB. Therefore, it is possible that there are information and/or selection bias problems in the study. The creation of an index to assess some aspects of quality of women's health care may also result in bias in the association analysis.

Despite these limitations, this study allowed us to identify relevant issues in the provision of ICT in terms of structure, connectivity, information systems implementation, and information usage. Although the relationship between ICT incorporation and the quality of primary health care is not yet well established in the literature (Black et al., 2011; Ludwick & Doucette, 2009; Mitchell et al., 2001; Scochi, 1994; Tanaka, 1995; Vasconcellos et al., 2008), this study's findings indicate a positive association between all the analyzed categories and the quality of certain aspects of women's primary health care. As such, we reiterate the need for further assessments of the policies implemented in the area, with the aim of improving access and quality in Brazil's primary health care.

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