# Technologies for the Investigation of CAD – Association between Scientific Publications and Clinical Use

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## Abstract

**Background: Although some evidence suggests an association between a technology exposure in the literature and its dissemination in clinical practice, few studies have evaluated such association.**

**Objective: To analyze whether the pattern of scientific publication on two competitive technologies used in the assessment of coronary artery disease (CAD) reflects what occurs in clinical practice.**

**Methods: The number of scientific articles published annually in the medical literature (global scientific interest in technology) on two technologies used in the assessment of CAD was evaluated: electron beam computed tomography (EBCT) and multidetector computed tomography (MDCT). The number of countries that annually publish scientific articles about these technologies (geographic interest in the technology) was also analyzed.**

**Results: The EBCT showed a peak of "global scientific interest" in 2001, with 127 published articles. After this peak, the "global scientific interest" decreased by around 50% in 2008. In opposition, the "global scientific interest" for MDCT progressively increased up to 2007, with 454 articles published in that year. The "geographic scientific interest" by EBCT showed a peak in 2002, with 14 countries publishing about this technology. After this peak, the "geographic scientific interest" decreased by almost 25% up to 2008, with 11 countries publishing about this technology. In opposition, the "geographic scientific interest" by MDCT progressively increased up to 2008, with 37 countries publishing articles about it.**

**Conclusion: The medical scientific literature is compatible with the substitution of EBCT by MDCT in the assessment of CAD. (Arq Bras Cardiol 2010; 94(3):379-382)**

**Key words: Coronary disease; equipment and supplies technology; scientific and technical publications.**

## Introduction

The images of the heart generated by computed tomography had as the great initial impulse the use of equipment that had the electron beam computed tomography (EBCT)[1] technology, which has as the main characteristic a high temporal resolution (<100 ms). The EBCT allows the noninvasive estimation of the calcium deposits along the coronary arteries[2], and when this deposition is biologically associated with the atherosclerotic disease[3], this technique can be used in the investigation of coronary artery disease (CAD).

With the introduction of the multidetector computed tomography (MDCT) at the end of the 90s[4], the usefulness of the EBCT in the noninvasive assessment of CAD started to be surpassed. Thus, the heart images using the MDCT started to substitute those acquired through the EBCT[5], which rapidly became an obsolete technology.

The signs of this obsolescence can be inferred from the fact that Imatron® (the only company that manufactures EBCT) has sold only 150 devices, whereas General Electric®, which bought Imatron® in 2001, interrupted the production of EBCT a few years later[6]. Another sign of the obsolescence of the EBCT originates from the trajectory of the technology in Brazil. The only service that acquired the EBCT in Brazil was Hospital Israelita Albert Einstein, in 1998[7], with the posterior deactivation of this technology around four years later – part of the clinical experience of Hospital Israelita Albert Einstein with EBCT was published in December 2003 in the Brazilian Archives of Cardiology[8].

In opposition to the EBCT, the MDCT has been progressively more used in clinical practice. In a recent report presented by the diagnostic imaging market assessment company IMV®[9], it was observed that the use of 64-channel computed tomography equipment by Cardiology services has increased two-fold in the last two years.

There is evidence that the exposure of a technology in scientific literature is associated with the dissemination of this technology in clinical practice. Hillman[10] suggests that the sigmoid curve of technological dissemination in clinical practice is preceded by another sigmoid curve representative of the dissemination of the information that impels the commercial interest for the technology. According to Greer[11], there are four main ways to acquire interest for a technological innovation in

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the medical area. The most traditional and conventional way is through the presentation of information on the technological innovation in a Congress and through its publication in scientific journals, with the latter being considered the most reliable sources of information, as they are peer-reviewed.

In spite of this evidence, there have been few studies that effectively associated the trajectory of medical technologies in clinical practice with their exposure in scientific literature. Therefore, the objective of the present study is to analyze whether the pattern of the scientific publication on two competitive technologies used in the assessment of CAD reflects what occurs in clinical practice.

## Methods

The database chosen for the search of articles related to the two technologies (EBCT and MDCT) was PubMed – a database of the U. S. National Library of Medicine – which allows bibliographic searches in more than 17 million references in the health area published in approximately 5,200 scientific journals, in the United States as well as in more than 70 countries, since 1949. PubMed is maintained by the Medical Literature Analysis and Retrieval System Online (Medline®) and is available on the internet at http://www.ncbi.nlm.nih.gov/PubMed/. The program Reference Manager11® was used to carry out the search in PubMed.

On June 20, 2009, the search for scientific articles published on the two technologies (EBCT and MDCT) was carried out. The search strategies used were the following:

- Technology: MDCT.
- Strategy: [(multidetector computed tomography) OR (MDCT) OR (multidetector CT) OR (multidetector computerized tomography) OR (MSCT) OR (multislice spiral computed tomography) OR (multislice CT) OR (multislice computed tomography) OR (multislice computerized tomography) OR (multi-slice computed tomography) OR (multi-slice computerized tomography)] AND (coronary).
- Technology: EBCT.
- Strategy: [(electron beam computed tomography) OR (electron beam tomography) OR (electron beam computerized tomography) OR (electron beam CT) OR (imatron)] AND (coronary).

The articles obtained through the search were subsequently separated by year of publication and country that published the article, obtained from the address for correspondence available at PubMed. Some articles that did not have the address for correspondence were later excluded from the analysis.

Therefore, it was possible to obtain the number of articles published annually on the two technologies ("global scientific interest" in the technology) and the number of countries that published on the technologies at each year ("geographic scientific interest" in the technology).

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## Results

The searches carried out in PubMed resulted in 1,122 articles (1,052 with corresponding address) published on EBCT and 1,983 (1,806 with corresponding address) on MDCT until 2008. The first article on EBCT obtained through this search strategy had been published in 1992 and the first article on MDCT, in 1999, which shows that the EBCT, as a heart assessment technique, preceded by seven years the technique by MDCT.

Charts 1 and 2 present the number of annual publications on the two technologies and the countries that published articles about them annually.

The charts show that the EBCT presented a peak of "global scientific interest" in 2001 (127 published articles), two years after the appearance of the MDCT in scientific literature (1999) and, as the interest for the latter increased, the interest for the EBCT gradually decreased until 2008, with the publication of only 60 articles. On the other hand, the "global scientific interest" in the MDCT progressively increased since its introduction in literature in 1999, with 454 articles published in 2007.

Regarding the "geographic scientific interest", the EBCT had a peak in 2002, with 14 countries publishing articles on this technology. After this peak, the "geographic scientific interest" also decreased until 2008, with 11 countries publishing articles on this technology. In opposition, the "geographic scientific interest" in the MDCT progressively increased until 2008, with 37 countries publishing articles on this technology.

## Discussion

In the last decades there has been a significant increase in the development of new technologies in the health area and, consequently, an increasing use of these technologies in clinical practice[12]. In this context, the use of technologies in the area of imaging diagnosis has expanded, presenting a growth rate of approximately 10% a year in the United States[13].

Regarding specifically CAD, it is natural that the interest for the development of new diagnostic methods for the detection and follow-up of this pathology is high, as the prevalence of the disease is quite elevated, in addition to the fact that this is the main cause of mortality in some population groups[14]. Therefore, new diagnostic methods are often developed with the purpose of detecting CAD, from the simple electrocardiogram (ECG) to, more recently, the positron-emission tomography (PET), magnetic resonance imaging (MRI) and the multiple-detector computed tomography (MDCT) itself[15].

However, while some technologies disseminate at a significant velocity, being capable of modifying the paradigms concerning the attention to certain diseases, the developed technologies do not always have a relevant clinical role and some of them simply do not have significant clinical applicability and thus rapidly pass from the phase of dissemination to the phase of obsolescence.

It is evident, therefore, that the issue "technological dissemination" is currently very important and that the adequate use of technology in healthcare constitutes a challenge for modern societies. Nonetheless, to evaluate the patterns of technology dissemination is not an easy task due to the scarcity of data in this area and the little availability of these data in several countries.

The association between the production of knowledge and the use of technology has been described. Bruce J. Hillman[10], as mentioned before, suggests that the curve of technological dissemination is preceded by a similar curve, representing the dissemination of knowledge on the technology itself. In a recent analysis, presented at the Congress of the Society of Nuclear Medicine, in Toronto[16], an association between the number of scientific articles published on a group of technologies used in Nuclear Medicine and the use of these technologies in clinical practice was observed. In 2005 for instance, a Pearson's correlation coefficient of 0.99 ($p < 0.01$) was observed between the number of scientific publications and the clinical use of technologies.

In order to deepen the evidence of this association between production of knowledge and use of technology, the present study analyzed the pattern of exposure in the scientific literature of two technologies used in the assessment of coronary artery disease (EBCT and MDCT) and the existing data suggested that the EBCT became obsolescent because the manufacturers stopped its production[6]. The literature findings on these technologies were compatible with the substitution of EBCT by MDCT in clinical practice, considering that the number of articles published on EBCT ("global scientific interest" in the technology) as well as the number of countries that annually publish on the subject ("geographic scientific interest" in the technology) started to decrease a few years after the appearance of MDCT in the scientific literature.

The reasons for this substitution must be diverse. While the performance of these technologies in the assessment of the calcium scores is quite comparable[17], in the case of the coronary angiotomography, which provides coronary stenosis and lumen assessment, there is no technological equality. Although the EBCT can also perform the angiotomography with contrast, allowing the visualization of the coronary lumen, the image quality is degraded due to the limitations in slice thickness[18]. Moreover, this limitation in slice thickness also makes the EBCT inferior to the MDCT in the assessment of other non-cardiac structures[18]. Thus, the EBCT is practically exclusive for the assessment of calcium score, a characteristic particularly problematic in Services that do not present many cardiac assessments.

Regardless of the causes that led to the substitution of EBCT by MDCT, the results herein presented corroborate the hypothesis made by other authors[10,11] that the scientific production on a certain technology is associated to the use of this technology in clinical practice, thus reinforcing the idea that the analysis of scientific literature can act as the indicator for the use of a certain technology in clinical practice. The observation of this association is quite interesting, as measuring the use of a technology in clinical practice is a hard task, due to the little availability of data on such use. On the contrary, the assessment of the exposure of the technology in the scientific literature can be carried out easily, through databases that are broadly available on the internet (PubMed, Lilacs and Embase, ISI, among others).

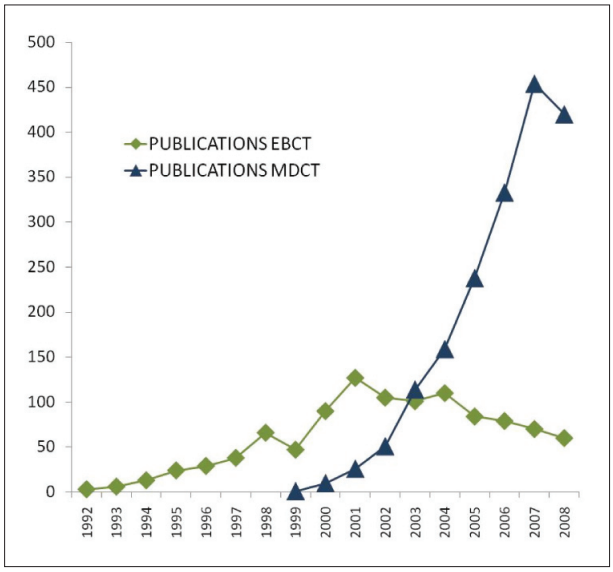


*Chart 1 – Number of scientific articles annually published on EBCT and MDCT.*

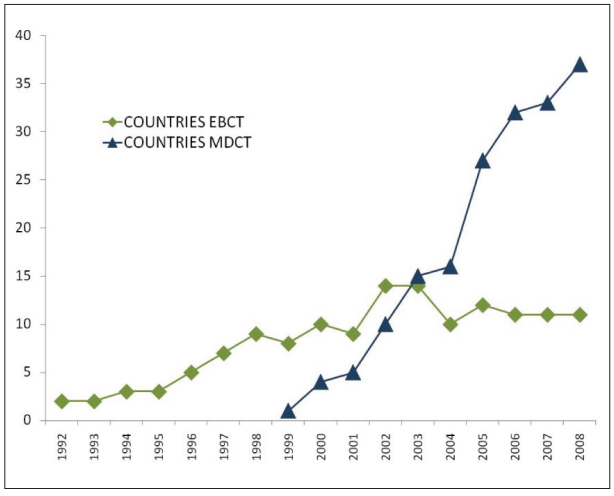


*Chart 2 – Number of countries that publish scientific articles annually on EBCT and MDCT.*

Considering that the assessment of the technological dissemination in clinical practice is quite important due to the increasing costs involved in this practice, simple methods that allow estimating the behavior of the dissemination of different technologies can be useful to direct the investments to be made by healthcare providers and, therefore, prevent investments in technologies about to become obsolete. Additionally, they can also be useful to help the system payers

(health insurance managers and providers) in the assessment of which medical technologies have the potential to represent significant increases in costs of medical attention in the short and medium term.

## Conclusions

The exposure of the medical technologies in the scientific literature seems to act as an estimate of the pattern of dissemination of these technologies in clinical practice and, in the present study, it is compatible with the substitution of EBCT by MDCT in the assessment of coronary artery disease.

**Potential Conflict of Interest**

No potential conflict of interest relevant to this article was reported.

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**Study Association**

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