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SMARTPHONE'S SOFTWARE (APPS) WITH SCORES IN ACUTE CORONARY SYNDROMES: A SYSTEMATIZED REVIEW

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ABSTRACT

In the current world, cardiovascular diseases are the main causes of death, among which acute coronary syndromes stand out. In this scenario and with the current advancement in technology, there was the emergence of applications aimed at the use of prognostic scores in coronary syndromes. In such a way, a systematic review of smartphone software (applications) with scores in acute coronary syndromes was carried out. Through the search in the MEDLINE, LILLACS and SCielo databases, using the terms applications, app, acute coronary syndrome, myocardial ischemia and myocardial infarction, a search for anteriority was carried out on the World Intelectual Property Organization (WIPO), United States Patent and Trademark Office (USPTO) and Instituto Nacional de Propriedade Intelectual (INPI) websites using the cardiac score, coronary score and coronary score. 4 articles and 222 patents / registrations were found. The search was expanded through an active search of references and citations for each article previously found, with a total of 14 citations being listed while the thorough analysis of the records led to the exclusion of all. Through this systematic review, there was a scarcity of research on the subject despite its high importance both in health and economically.

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INTRODUCTION

Cardiovascular diseases are the main causes of death in world populations, mainly in the west, accounting for 16% of deaths in developed countries [Silveira, 2016]. In the United States of America, about 13.7 million people have coronary artery disease. In Brazil, according to the 2015 DATASUS census, there are 1,047,953 hospitalizations for such diseases with 95,522 deaths from acute myocardial infarction (Silveira *et al.*, 2016). leading journals to complete their grades. In addition, the published research work also provides a big weight-age to get admissions in reputed varsity. Now, here we enlist the proven steps to publish the research paper in a journal[1]. Coronary heart disease stands out, therefore, among heart diseases due to its heterogeneity and the possibility of unfavorable outcomes such as death and adverse cardiovascular events (Romano *et al.*, 2014). Science, as well as technology, has progressed over time, with the emergence of pagers, palmtops, smartphones and tablets (Boulos *et al.*, 2011; Ventola, 2014).

Such mobile devices caused a huge impact in several fields, including medicine, mainly tablets and smartphones, making it easier to access information at the point of care (Ventola, 2014; Aungst, 2013; Murfin, 2013). This fact only became possible due to the increasing availability, quantity and quality of software with applications (including medical) also called mobile applications or "apps" (Ventola, 2014). Several applications have been used by health professionals (Ventola, 2014) and their use in the medical field has grown (Bierbrier, Lo and Wu, 2014). There are already, in the context of acute coronary syndrome, several applications, from those to assist the treatment of chest pain, risk stratification, bularias with dosages, indications and contraindications of medications to those that assist in the interpretation of tests such as electrocardiograms, echocardiography, tomographies computerized coronary and cardiac catheterization and, finally, some with algorithms and guides that help in conducting the case. The present study seeks information on the development of applications involving coronary syndromes - especially those with prognostic scores. For that, the systematized review was used.

METHODOLOGY

This systematized review still has no protocol or registration. The analyzed studies followed the following inclusion criteria: addressing acute coronary syndromes, coronary risk scores, prognostic scores for coronary disease and applications formobile phones and computers as well as being in Portuguese, English and Spanish. Studies related to other non-coronary vascular or cardiac disorders, case reports, comments and opinions were not included. Staging articles, guidelines and technical documents that did not involve applications or software, institutional routines and description of the use of scores were excluded. Duplicate articles were also excluded. There was no source of funding. The risk of bias was assessed according to the criteria described by CHOI and PACK (Choi, 2005). A search was performed in the databases MEDLINE, LILACS, SCieLO and Google academic search sites, from January 2000 to November 2020.

The descriptors (DeCS / MeSH) selected, in Portuguese and English, were: Applications, app, acute coronary syndrome, myocardial ischemia and myocardial infarction. The initial search strategy was: Applications OR app) AND (acute coronary syndrome OR myocardial ischemia OR myocardial infarction). Also included were the research, some relevant articles and guidelines, contained in citations of articles researched or that were included in references or bibliographies of previously identified texts. A previous search was also carried out from January 2000 to November 2020, in the databases: World Intellectual Property Organization (WIPO), United States Patent and Trademark Office (USPTO) and the National Institute of Intellectual Property (INPI). The following keywords are used: Cardiac score (cardiac score) and coronary score (coronary score / coronary score). In this search for records and patents, the following analysis criteria were used: Exclusion of applications or software records that do not involve coronary syndrome. Failure to include records of prostheses, orthoses or other materials involving coronary syndrome not related to software. Inclusion of software registrations and / or patents involving acute coronary syndrome.

RESULTS

4 articles were found in the textual search or desk search, in the MEDLINE, LILACS, SCieLO databases. Two of these articles were not directly related to the topic. The search was expanded through an active search for references and citations for each previously found article, making a total of 14 citations. As for patents and registrations, 222 abstracts were found on the data sites of the World Intellectual Property Organization (WIPO), United States Patent and Trademark Office (USPTO) and the National Institute of Intellectual Property (INPI), however in a thorough analysis of such records it was observed that they met the exclusion criteria or although they did not completely close the inclusion criteria (Figure 1).

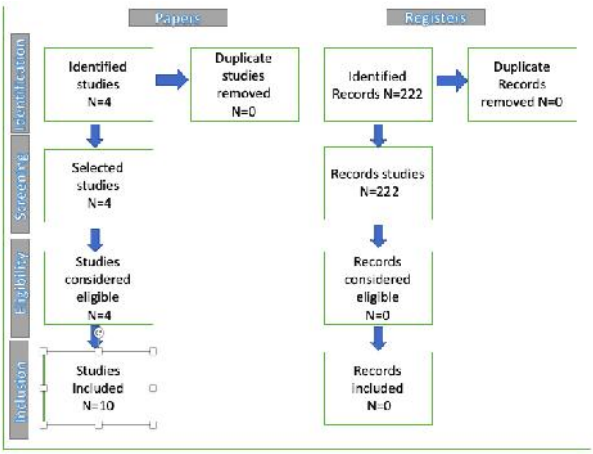

Figure 1. Analysis flow chart of articles and records N = Total number of articles or registers encounters per stage

DISCUSSION

There are numerous guidelines from the main cardiology societies discussing acute myocardial infarction, their diagnostic criteria, classification and treatment, the main ones being the American College of Cardiology and Amercian Heart Association, the European Society of Cardiology (ESC) and the Brazilian Society of Cardiology (SBC) and the diagnostic and treatment criteria are beyond the scope of this text although some points will be addressed for a better understanding of the context. Acute coronary syndrome has been referred to as a useful term involving a spectrum of conditions compatible with ischemia and (or) acute myocardial infarction, which are usually caused by an abrupt reduction in coronary blood flow. The key point of division or subclassification is the elevation of the ST segment or the appearance of new left branch block on the electrocardiogram (ECG). The latter is an immediate indication for coronary angiography to determine the need for reperfusion therapy (usually via angioplasty) in order to recanalize the completely occluded vessel (Amsterdam *et al.*, 2014).

In updating the guidelines of the Brazilian Society of Cardiology (SBC) on unstable angina and acute myocardial infarction without ST-segment elevation, the second edition of which was in 2007, analyzed unstable myocardial syndromes without supra ST-segment elevation ot non elevated ST acute coronary syndromes (NSTACS) and recommend: 1 - All patients must be evaluated and classified as high, intermediate or low probability of presenting NSTACS (Recommendation class I and level of evidence B); 2 - All patients with NSTACS should be stratified and classified at high, intermediate or low risk of developing major cardiac events. Classification by more than one method is recommended, and the worst-case scenario must be taken into account in decisions regarding conduct (Recommendation class I and level of evidence B); 3- All patients with NSTACS should be stratified into classified at high, intermediate or lowrisk of developing bleeding (Recommendation class I and level of evidence B) (Nicolau *et al.*, 2014). In the absence of ST-segment elevation (Except patients with posterior wall infarction), NSTACS can also be subdivided based on cardiac necrosis biomarkers (Ex. Troponin). If such biomarkers are elevated and the clinical context is appropriate, the patient is considered as an acute myocardial infarction without ST segment elevation or non ST elevated myocardial infarction (NSTEMI); Otherwise, it will be considered unstable angina (UA) (Amsterdam *et al.*, 2014). Therefore, the need for risk stratification in a quantitative way to determine strategies for outpatient or hospital treatment, providing greater cost adequacy due to greater therapeutic efficacy, is extremely necessary (Amsterdam *et al.*, 2014).

The quantitative assessment of ischemic risk using scores is superior to isolated clinical assessment. The great challenge for these patients is the integration of the clinical presentation with ECG information, troponin values and imaging tests to adopt a standardized and effective strategy. The initial risk assessment in the acute setting will guide the selection of the place of care (intensive care units, intermediate or common), type of therapy and the need or not to perform angiography as well as the best time for its execution (Roffi *et al*., 2016). The importance of biomarkers must be emphasized: Troponin I and T, components of the contractile apparatus of myocardial cells. The first is practically not detected in non-cardiac tissues while the second can be expressed in skeletal muscles. Other markers of myocardial necrosis such as CKMB are less sensitive and specific. Myocardial injury or injury is said to occur when blood levels of troponin exceed the upper limit of the 99th percentile reference. Such injury may be acute or chronic depending on whether the increase is newly detected with a dynamic pattern of rising or falling levels of the biomarker (Thygesen *et al*., 2016). A systematic review was carried out on the impact of portable mobile technology on medical-hospital practice and patient care. Research was carried out based on the principles of Cochrane reviews and the Critical Appraisal Checklist for Systematic Reviews of Health Informations Evaluations (CASP) through the use of multiple search strategies (due

to problems with inadequate indexing and to broaden the search spectrum). The MeSh terms used were "computers, handheld" complemented with keywords identified as synonyms. Being added the articles identified as relevant present in the references of those previously researched. A total of 2292 articles were initially found, 456 were duplicated, 1347 were excluded after analyzing the title and another 269 were excluded after analyzing the summary. 172 non-quantitative studies were excluded and 6 systematic reviews and 22 researched references were included. Another 63 articles were excluded for not correlating with medicine or medical practice or for having insufficient information. A total of 13 studies were identified and met the inclusion criteria (published from January 200 to December 2007, experimental, evaluative or observational studies). Qualitative design studies, beta testing exercises, proof-of-concept research, product description, usability studies, research on patent opinions, medical use standards and ease of use were excluded. The works were categorized in 3 themes according to Bates and Gawande: Fast response, prevention of errors in medications and data management and accessibility. Although there is still a shortage of data on this topic, the study suggests that there are benefits in the use of mobile technology in the medical field attributed to greater mobility, ease of communication between professionals as well as the portability of a large scope of information and updates. Such benefits were greater where time and quick response were crucial factors such as in pre-hospital care and in emergency rooms (Prgomet *et al.*, 2009). The growing use of applications in the medical field has been described. Among the main uses of these software, are the help in the diagnosis, prognosis and treatment of some diseases. Such Apps can also provide assistance in the disease stage or promote quick access to decision-making algorithms. An increase in clinical score systems has also been reported, which include calculators such as the degree and stage of liver disease (Ex. MELD), risk of pulmonary thromboembolism (Ex. Well's score) or infarction assessment score (Ex. TIMI). These authors ultimately suggested that most free handheld calculators are accurate and can be used in clinical practice (Bierbrier *et al.*, 2014). In a literature review, the appearance of mobile computerized devices was initially reported with personal digital assistants (Palmtops), followed by smart phones (smartphones) and compact portable computers (tablets). Since medicine is one of the disciplines deeply affected by the availability of such devices that are "driven" by an increasing amount of software and applications (apps). Such applications include features such as information at the time of handling, ease of communication with other health care professionals, obtaining information (research and literature review, medication leaflets and updates), assistance in patient management (resources, guidelines, guides, calculators and other clinical decision tools), monitoring of patient education and medical training (Ventola, 2014).

Another literature review was carried out with discussion of several applications that use smartphones in cardiology. They were divided according to their functionality into: Arrhythmia detectors, vital signs monitoring, echocardiography, physical examination, medication management, prevention, public health and research. Systems such as the AliveCor ECG device capture, through electrodes, the heart rate for screening atrial fibrillation while devices for the detection of ischemia are being developed. Airstrip has developed a systems platform that integrates waves, image and laboratory tests for monitoring via smartphones. In heart failure, telemetry and tele-monitoring are already performed to guide interventions reducing mortality and readmission. The MUSIC study (MUlti Sensor monitoring In Cardiac heart failure) demonstrated that multi-sensor devices have a sensitivity of 65% and specificity of 90% to predict rehospitalization. In echocardiography, applications use devices similar to a probe connected to the smartphone with images comparable to traditional devices, being more cost effective and with information stored in the cloud. Digital stethoscopes record and share sounds through applications with improved diagnostic accuracy, case discussion and virtual consultations. Applications with names, dosages, interactions and side effects of drugs are already common and can even increase patient compliance. There are apps that encourage weight loss (through dietary recommendations and calorie calculations / day), the habit of doing physical activity and discourage you from smoking again. Apps calculate blood glucose and blood pressure or assist in cardiac rehabilitation. Some, such as the one developed by the AHA for cardiopulmonary resuscitation training, have increased the teams' effectiveness and results in the face of cardiovascular arrest. There are also those such as Apple's ResearchKit, Azumio App, iHealth, QuardioArm, AliveCor that assist in the collection of data for research (Nguyen and Silva, 2016). However, in the present study, we did not find any software or application in the research of the WIPO, USPTO and INPI databases that met the specifications of involving coronary syndrome and containing prognostic scores for coronary syndrome. A mobile application for teaching and interpreting ECG was developed and validated using the JAVA language with the participation of a multiprofessional team composed of two professors from the medical course and one from computing, a systems analyst, a programmer and a graphic design. As it is a self-learning process application, the adapted codesign methodology was used, which has five phases: Scope, shared understanding, brainstorming, refinement and implementation. Software development kits (SDK) were used for specific Android and Apple devices using the IDE (Integrated Developement Enviroment), Android Studio, Google's Android tools with APIs (Application Programming Interface) and the OpenCV library (Open-Source Computer Vision). For validation analysis, the System Usability Scale (SUS) questionnaires and a questionnaire were used to assess the suitability of software for use in medical education previously translated to Brazil. 109 students had free access to the app for 6 weeks and then answered the SUS questionnaire. The questionnaires had good reliability by Cronbach's alpha (value 0.74) and the application showed excellent acceptance (score 85.3 on the SUS scale). In addition, 15 teachers evaluated the application using the second questionnaire, most of whom agreed with its suitability for use in medical education. The finished product was considered to be of good usability and suitable for educational purposes, being registered with the National Institute of Intellectual Property (Lima *et al.*, 2019). In this document, the systematized review was chosen as a methodology due to the fact that despite the precepts and elements of the systematic review it does not follow all its standards and has greater flexibility for a search both in the literature and in the database of developed software (records). A relatively low number of articles were found on the subject as the preview literature review (Albuquerque *et al.*, 2020) as well as no record with the necessary specifications although the first screening found 222 units. This fact raises the hypothesis that applications and software in coronary syndrome with scores are being developed without proper registration and without research either pre or post development. Thus, the possibility of evaluating such apps is lost as far as technological characteristics, usability as well as market acceptance.

CONCLUSION

Through this systematized review, it was observed that the literature on the topic software for smartphones / applications in acute coronary syndrome is still poorly developed. This fact draws attention due to the clinical importance of coronary disease and because it encompasses a potentially relevant market in which there is the emergence of software that probably has not been registered. Nevertheless, further studies on the subject are needed to confirm these findings and assist in the development of future software in cardiology and coronary syndromes.

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