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# Quality of mobile apps for syphilis prevention and control

## *Qualidade de aplicativos móveis sobre prevenção e controle da sífilis*

## *Calidad de las aplicaciones móviles de prevención y control de la sífilis*

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## Abstract

**Objective:** To evaluate the quality of mobile apps on syphilis prevention and control. **Methods:** A descriptive and evaluative study of mobile apps in virtual environments. The search was operationalized from January to February 2020, on Android and IOS platforms. The following guiding question was defined: "What is the quality of mobile apps on syphilis prevention and control available in virtual stores?" The keywords "Syphilis", "*Sífilis*" and "syphilis prevention" were used as a search strategy in the stores. The apps were evaluated by three authors, through the Mobile App Rating Scale, aimed at assessing the quality of mobile health apps. The data were presented in synoptic charts and tables. **Results:** Ten apps were included, all available free of charge for the Android operating system. The overall mean score of the apps was 2.8, not reaching the minimum acceptability score of 3.0. App engagement was evaluated with a mean of 2.2, functionality with 3.7, aesthetics with 2.8 and information contained in apps with a mean of 2.6. **Conclusion and implications for the practice:** It was evidenced that the quality of apps on syphilis should be improved. There is an urgent need to evaluate the effectiveness of these interventions for syphilis prevention and control.

**Keywords:** Education in Health; Sexually Transmitted Infections; Disease Prevention; Syphilis; Information Technology.

## Resumo

**Objetivo:** Avaliar a qualidade dos aplicativos móveis sobre prevenção e controle da sífilis. **Métodos:** Estudo descritivo e avaliativo dos aplicativos para dispositivos móveis em ambientes virtuais. A busca foi operacionalizada no período de janeiro a fevereiro de 2020, nas plataformas *Android* e *IOS*. Foi definida a questão norteadora: "Qual a qualidade dos aplicativos móveis sobre prevenção e controle da sífilis disponíveis em lojas virtuais?". As palavras-chaves "Sífilis", "*Syphilis"* e "prevenção da sífilis" foram utilizadas como estratégia de pesquisa nas lojas. Os aplicativos foram avaliados por três autores, por meio da *Mobile App Rating Scale*, voltada para avaliação da qualidade de aplicativos móveis em saúde. Os dados foram apresentados em quadros sinópticos e tabelas. **Resultados:** Dez aplicativos foram incluídos, todos disponíveis gratuitamente somente para o sistema operacional *Android*. A média geral dos aplicativos foi de 2,8, não atingindo a pontuação mínima de aceitabilidade de 3,0. O engajamento dos aplicativos foi avaliado com média 2,2, funcionalidade com 3,7, estética com 2,8 e as informações contidas nos aplicativos com média 2,6. **Conclusão e implicações para a prática:** Evidenciou-se que a qualidade dos aplicativos sobre sífilis deve ser melhorada. Urge a necessidade de avaliação da eficácia dessas intervenções para prevenção e controle da sífilis.

**Palavras-chave:** Educação em Saúde; Infecções Sexualmente Transmissíveis; Prevenção de Doenças; Sífilis; Tecnologias da Informação.

## Resumen

**Objetivo:** Evaluar la calidad de las aplicaciones móviles en materia de prevención y control de la sífilis. **Métodos:** Estudio descriptivo y evaluativo de aplicaciones móviles en ámbitos virtuales. La búsqueda se llevó a cabo de enero a febrero de 2020, en plataformas Android e IOS. Se definió la pregunta orientadora: "¿Qué calidad tienen las aplicaciones móviles sobre prevención y control de la sífilis, disponibles en las tiendas *online*?". Las palabras clave "Sífilis", " *Syphilis* " y "prevención de la sífilis" se utilizaron como estrategia de investigación en las tiendas. Las aplicaciones fueron evaluadas por tres autores a través de la Escala de Clasificación de Aplicaciones Móviles, destinada a evaluar la calidad de las aplicaciones móviles de salud. Los datos se presentaron en tablas y cuadros sinópticos. **Resultados:** Se incluyeron diez aplicaciones, todas disponibles de forma gratuita solo para el sistema operativo Android. El promedio general de las solicitudes fue de 2,8, sin alcanzar la puntuación mínima de aceptabilidad de 3,0. La participación en aplicaciones se evaluó con una media de 2,2, funcionalidad con 3,7, estética con 2,8 e información contenida en aplicaciones con una media de 2,6. **Conclusión e implicaciones para la práctica**: Se evidencia que debe mejorarse la calidad de las aplicaciones sobre la sífilis. Es urgente evaluar la eficacia de estas intervenciones para la prevención y el control de la sífilis.

**Palabras-clave:** Educación en Salud; Infecciones Sexualmente Transmitidas; Prevención de Enfermedades; Sífilis; Tecnología de la Información.

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## INTRODUCTION

The use of mobile devices has grown worldwide. By the end of 2019, 5.2 billion people had mobile services, representing 67% of the global population. It is estimated that this number will reach a total of 5.8 billion by 2025, representing 70% of the world population[1].

In this context, *mHealth*, defined as medical and public health practice supported by mobile devices such as cell phones[2], can be particularly useful in providing health interventions, as it allows actions at scale, covering broad geographic areas and delivering technologies in highly personalized ways, based on the users' preferences or characteristics[3].

In fact, *mHealth* is rapidly entering institutional health care environments and private spaces, surrounded by the promise to revolutionize health care, increasing patient self-management and empowerment, promoting efficiency and preventing disease, as well as accessibility to health throughout the world[4].

Digital communication channels such as apps provide broad coverage, allow messages to be targeted to specific groups or individuals, and offer the potential to improve delivery of information and support in the domains of sexual and reproductive health[5]. Thus, apps can provide prevention interventions for Sexually Transmitted Infections (STIs)[6], syphilis among them.

For syphilis, in 2016, the global estimate of prevalence in men and women was 0.5%, with regional values ranging from 0.1% to 1.6%, corresponding to 19.9 million cases. Regarding the global incidence of syphilis, the estimations are 1.7 cases per 1,000 women and 1.6 per 1,000 men, translating into 6.3 million cases in women and men aged between 15 and 49 years old in 2016[7].

In this sense, the global STI strategy sets the goal of reducing the incidence of syphilis by 90% and the incidence of congenital syphilis to <50 cases per 100,000 live births by 2030[8]. However, the indices and trends in the prevalence and rate of acquired and congenital syphilis suggest an increase in the number of cases[9,10].

Given this scenario, considering the growing use of mobile devices as promising health interventions and the rise in syphilis rates, the interest in the development of this study is justified, the results of which will allow knowing the quality of apps on syphilis prevention and control, verifying whether they are tools with the potential to promote positive results on care in syphilis prevention and control by the general population.

Therefore, the objective was to evaluate the quality of mobile apps on syphilis prevention and control.

## METHODS

A descriptive and evaluative study, operationalized through the search for apps for mobile devices in the main virtual environments, from January to February 2020. Two smartphones were used to search in two different operating systems: a Moto G5SPlus, for searching the *Play Store* (*Android, Google*) and an iPhone 8, for searches in the *Apple Store* (*iOS, Apple*).

The following guiding question was defined: "What is the quality of mobile apps on syphilis prevention and control available in virtual stores?" To answer this question, the keywords "Syphilis", "*Sífilis*" and "syphilis prevention" were used as a search strategy in the app stores.

Mobile apps that addressed syphilis prevention and control were included. The following were excluded: duplicate apps; those that were intended for professionals and health services; those in languages other than English, Portuguese and Spanish; those addressing other STIs; those about events; those that were only a means of dissemination or digital exposure for journals or periodicals; and apps that required specific or institutional login access.

Following the criteria of this study, the apps were evaluated using a validated instrument called *Mobile App Rating Scale* (MARS)[11]. This tool was chosen because it is a reliable, simple and objective multidimensional measure to test, classify and assess the quality of mobile health apps[11].

MARS contains 23 items in 3 sections: rating, app quality and satisfaction. In this study, satisfaction (subjective quality) was not assessed, as this section was not considered in the mean app quality score, due to its subjective nature[11]. Each MARS item uses a 5-point scale (1 – inadequate; 2 – poor; 3 – acceptable; 4 – good; 5 – excellent). The rating section is used for descriptive purposes only, containing variables such as name of app rated, operating system, app version and last update date. The app quality section has 19 items and classifies apps into four subscales: engagement, functionality, aesthetics, and information quality. MARS is scored by calculating the mean scores for the app quality subscales and the mean total score. There is a subjective quality section, containing 4 items that assess total user satisfaction, classified separately as individual items. MARS showed excellent internal performance, consistency ($\alpha = 0.92$) and inter-rater reliability (ICC = 0.85)[11]. In addition to these data, public ratings made available on the app download platforms, carried out by individual users, were also considered. This rating is based on the proportional number of evaluations, varying from one to five stars, depending on the current quality of the app.

Each app was used and evaluated by three authors of this study, aiming to ensure consistency and accuracy of the results of the measurement process. The score for each criterion was a mean of the scores. The data were stored in the Microsoft Office Excel software and presented in synoptic charts and tables.

## RESULTS

The searches carried out on the two operating systems identified 511 apps. Excluding 61 duplicate apps, there were 450 apps. However, 52 were in languages other than English, Portuguese and Spanish and 369 had other themes. Among the remaining 29 apps, 08 were excluded because they were intended for health professionals; 07 addressed other STIs; 02 needed a login to access and 2 were journal or scientific event apps. In the end, 10 apps were included. Figure 1 presents the app selection flowchart.

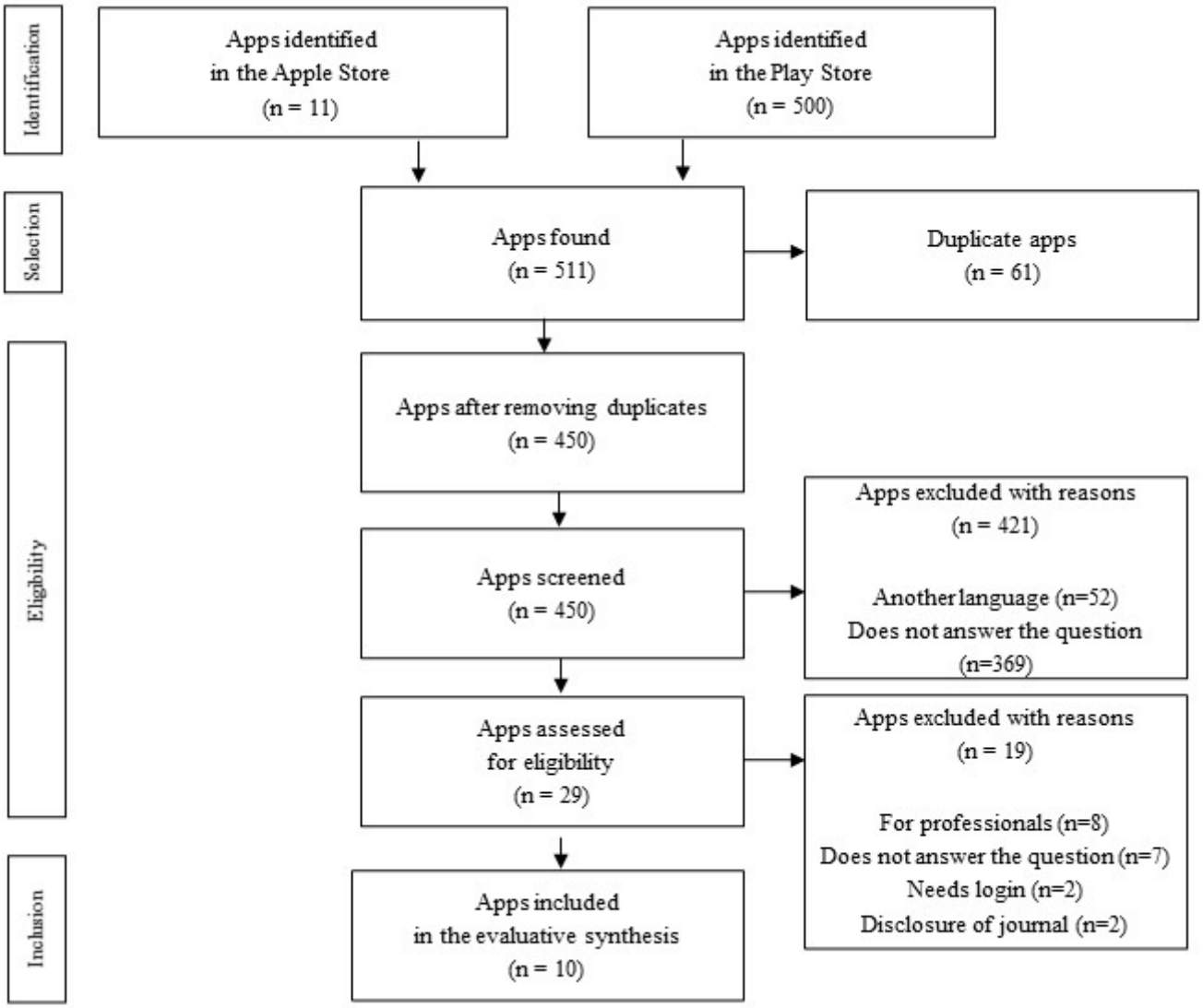


**Figure 1.** Identification flowchart corresponding to the app selection process.
Source: Research data.

All the apps included were available free of charge for Android OS, but none for the *IOS* platform. The data on the characterization of these apps are presented in Chart 1.

English was the main language of the apps. Most had free rating. Table 1 presents the subscale and overall scores of apps rated with MARS. It was not possible to classify item 19, which provides a measure of the evidence base for the apps since, in the results of this study, the apps found did not include this item. However, this did not change calculation of the mean score.

The "*Sexually Transmitted Diseases and Infections*" app had the highest mean total MARS score (mean of 3.4). The next highest scores were obtained by "*Sexo Seguro*" (3.3) and "*Sexually Transmitted Diseases Free*" (3.2). "*Syphilis: Cure And Tips*" obtained the lowest score (2.3). The mean of all the apps was 2.8, not reaching the minimum acceptability score of 3.0.

In the engagement section, it was assessed whether the apps were fun, interesting, customizable, interactive and well-targeted for the audience. It was verified that the apps did not use all the strategies to increase entertainment and interest, for example, through gamification (2.4); did not allow any customization, providing no space for user settings or preferences (1.3); had non-interactive characteristics or lack of response to user interaction, not sending alerts, messages, reminders or feedback (1.8); they had acceptable content, but not aimed at the target audience (3.0). In this section, the apps were rated with a mean of 2.2.

In the functionality section, navigation, flow logic, design and whether the apps were easy to learn were evaluated. The apps

**Chart 1.** Characterization of the apps included.

| App* | Developer | Language | Downloads | Grade/ No. of assessments | Updated on | Classification |
|---|---|---|---|---|---|---|
| 1. *How to Treat Syphilis* | NonitaDev | English | >1,000 | 0/0 | 06/25/2018 | Free |
| 2. *Sexually Transmitted Diseases Free* | Medical 360 | English | >50 | 0/0 | 08/21/2019 | Free |
| 3. *Sexually Transmitted Diseases and Infections* | Sonal Hadiya | 15 languages | >1,000 | 0/0 | 04/1/2019 | Free |
| 4. *Syphilis and Treatment* | Fumo | English | >1 | 0/0 | 01/19/2020 | 14 |
| 5. *Sexo Seguro* | Eworld Tech | Portuguese | >500 | 0/0 | 06/21/2019 | Free |
| 6. *Syphilis Info* | Programming Is Fun | English | >100 | 0/0 | 11/05/2019 | 12 |
| 7. *Sexually transmitted diseases* | JACOAPPS | English | >1,000 | 4.4/7 | 01/03/2020 | Free |
| 8. *Sexually Transmitted Diseases* | Education_free | English | >1,000 | 4.7/7 | 10/14/2018 | Free |
| 9. *Syphilis: Cure And Tips* | Biemultimedia | English | >100 | 0/0 | 01/09/2020 | Free |
| 10. *STDs Sexually Transmitted Diseases* | Dr_Apps | English | >500 | 0/0 | 10/16/2018 | Free |

Source: Research data.
***The rated versions of the apps may not be available in the stores at the time of publication as they may have been superseded by newer versions.**

worked fine in general, but some had technical issues, such as slowness (3.5); were easy to learn to use or had clear instructions (4.0); had appropriate and easy-to-use navigation (movement between screens) (3.8); and had coherent and intuitive interactions across all components and screens (3.5). The overall functionality of the apps was rated with a mean of 3.7.

In the aesthetics section, graphic design, overall visual appeal, color scheme and stylistic consistency were evaluated. The apps had satisfactory layouts, but with some problems, such as the size of buttons, icons or menu (3.0), moderate graphics quality and consistent visual design (3.0). However, they had little visual appeal or misuse of colors, making them visually unattractive (2.4). The apps' aesthetics was rated with a mean of 2.8.

In the information section, the quality of texts and references was assessed, whether they were from a credible source. The apps were considered imprecise in relation to their description in the store, as they contain little information about the components and functions described (2.6). With regard to measurable and achievable goals and targets, specified in the store or within the app itself, some goals are listed, but the apps have little chance of achieving them (2.9). Regarding quality of the information, the apps have appropriate content (3.0) and, in relation to quantity, the information is adequate and comprehensive, although not concise (3.1). Visual information, presented through graphics and images, was adequate, but imprecise, confusing or incorrect (3.0). In addition to that, in some apps there is no visual information: they only contain text. With regard to credibility, when identified, the sources specified in the store or within the apps were considered questionable (1.7). The information contained in the apps was evaluated with a mean of 2.6.

## DISCUSSION

Apps are increasingly being incorporated as supporting strategies for the teaching and learning process. However, few apps on syphilis were found in this study. This reinforces a

**Table 1.** Assessment scores as per MARS.

| App* | Engagement | Functionality | Aesthetics | Information† | General |
|---|---|---|---|---|---|
| 1. *How to Treat Syphilis* | 2.3 | 4.3 | 3.1 | 2.4‡ | 3.0 |
| 2. *Sexually Transmitted Diseases Free* | 2.3 | 4.0 | 3.2 | 3.2 | 3.2 |
| 3. *Sexually Transmitted Diseases and Infections* | 2.7 | 3.8 | 3.8 | 3.1§ | 3.4 |
| 4. *Syphilis and Treatment* | 2.3 | 3.6 | 2.7 | 2.8 | 2.8 |
| 5. *Sexo Seguro* | 2.4 | 3.9 | 3.6 | 3.3 | 3.3 |
| 6. *Syphilis Info* | 2.5 | 3.3 | 3.0 | 2.7‡ | 2.9 |
| 7. *Sexually transmitted diseases* | 1.9 | 3.7 | 2.0 | 2.4‡ | 2.5 |
| 8. *Sexually Transmitted Diseases* | 1.9 | 3.4 | 2.4 | 2.3‡ | 2.5 |
| 9. *Syphilis: Cure And Tips* | 1.7 | 3.3 | 2.1 | 2.3 | 2.3 |
| 10. *STDs Sexually Transmitted Diseases* | 1.9 | 3.4 | 2.3 | 2.0‡§ | 2.4 |

Source: Research data.
*The rated versions of the apps may not be available in the stores at the time of publication as they may have been superseded by newer versions.
†The information quality score excluded item 19 from MARS.
‡The information quality score excluded item 14 from MARS, as the description and app did not list objectives or goals to be achieved.
§The information quality score excluded item 17 from MARS because there was no visual information within the app (for example, it contains only audio or text).

gap in the tools that can be used to prevent this condition. It is emphasized that the insertion of these technologies in learning emerges as another possibility of instruction[12], providing self-care, as they have relevant information to turn individuals into the main protagonist of their own health and disease context.

In the search performed, it was found that all the apps identified about syphilis were only available for Android and free of charge. In fact, the development of apps for Android is simpler due to the deeper access to the operating system and because high levels of customization are possible, corroborating for this operating system to occupy 87% of the market[13]. Furthermore, cost also appears to be a significant concern for non-users and users alike, as most people do not want to pay for apps and stop using them when they discover that payment is required[14].

One of the factors that can hinder access to apps on syphilis is the language in which the apps are available. Most of the apps found were in the English language. In some cases, use of this language can limit access to information and lead to misinterpretations by non-native speakers, becoming an obstacle for people who do not have the necessary schooling level for reading and understanding[15]. In this sense, the development of apps on syphilis in the Portuguese language is configured as a digital inclusion strategy for lay people, and may be a way of democratizing access to knowledge in a broad and accessible way, generating positive impacts on the health-disease process.

It was verified that apps on syphilis did not have all the features to draw the users' attention. In a study conducted among users who downloaded health apps and no longer use them, a percentage of 40.5% revealed that discontinuity was due to loss of interest in the app[14]. From this perspective, it would be appropriate to involve the apps' end users (whether health professionals or patients) in the process of designing them during the initial stages, in order to identify their real needs and characteristics[16]. In this way, apps about syphilis, based on the user's insertion context, may have the ability to be more interesting.

Getting users to engage with an *mHealth* app is fundamental to the apps' success and to the interventions focused on changing health behaviors. Incorporating more customizable features into mobile health apps, targeting key subgroups, can help make them easier to be used for a longer period of time and, as a result, drive better health outcomes[17]. In addition to that, the effectiveness of digital interventions is mediated by factors associated with user involvement in interventions and determinants of the change in terms of health behaviors[12]. Nevertheless, in this study, it was detected that the personalization and gamification characteristics were fragile, which can make the user lose interest in apps on syphilis.

In order to enhance this engagement, gamification can be an effective means of targeting motivational components, and games can be effective in sparking interest in individuals and increasing the apps' popularity[18]. It is conclusive that interactive games increase the players' motivation to improve health behaviors and self-care, in a variety of scenarios and clinical populations, with the possibility of drawing and maintaining attention, being a key component for an effective behavioral change[19].

For the development of an app, it is indispensable that it has some characteristics: availability of relevant, reliable and current information; understandable language; visually appealing images and information layouts; easy handling; interactive and with practical features[20]. These characteristics diverge from the result found in the evaluations made, as it was verified that the apps had low interactivity and few resources.

Another important component is functionality, since slowness was verified in apps on syphilis. Therefore, apps need to be available for access on mobile devices that are compatible with the features, in order to ensure equitable access between the different groups of people who can enjoy these mobile devices and their benefits[21].

It is noted that the app abandonment rate is usually higher when a user has a bad experience[14]. Therefore, all developers should carefully test apps on syphilis before placing them in the hands of the customer or user. When testing mobile apps, aspects such as functionality, ease of use, compatibility, performance and safety should be considered, as well as consistency and stability when interrupted by other apps, the network itself, or the same device[11].

Unlike the findings of this study, for apps to be effectively incorporated into daily life, it is necessary that they are visually attractive, interactive and that the health information made available is presented to the user in a coherent and understandable way[22].

Apps must be dynamic and have consistent information to efficiently and effectively empower the users. Therefore, there is a need for studies that analyze and reflect on the reliability of the information available in apps on syphilis.

An integrative review on the use of information technologies in health education showed that more research studies are essential to investigate and analyze the effectiveness of Information and Communication Technologies (ICTs) and this encompasses the quality of information being provided to the users[22].

In this study, most of the apps did not obtain satisfactory grades in the information section, which could compromise the quality of the material made available. App validation studies are important, since it is from them that methodical stages are initiated, following certain flows with scientific criteria, to make an ICT validated by professionals who are experts in the subject matter, in order to provide development and availability of a reliable product for the users[23].

Mobile apps, including those that address syphilis, need to incorporate guidelines that guide behaviors, clinical actions and other evidence-based practices since, when confronted with conventional interventions, they are suitable strategies for intervention and education in health for people due to their cost-effectiveness, scalability and high reaching power[20].

For health-related apps in app virtual stores, no evaluation studies of these technologies are found. What is publicly available has not been rated and what has been rated is not publicly available[6]. Given possible explanations for this event, it is imperative to document the exploitation of smartphones in a way that is easily accessible to the scientific community[24], supporting and fostering research studies and mobile technology interventions on syphilis.

Mobile apps to improve health are proliferating but, before health care providers or organizations can recommend an app, strategies are needed to assess them. It is interesting that, before the information and communication technology tools are distributed, they go through a critical, evaluative and improvement process[25]. When the apps are validated and effective, they are configured as a favorable strategy for dealing with public health problems, for encouraging healthy habits and educating people, as they assertively guide the best attitude to be implemented and which health care service should be sought[20].

It is imperative to thoroughly test and evaluate promising new approaches, adapting research methods to the needs of these new platforms and interventions, to ensure that people at risk have access to the best information and training content available[26]. However, more research studies on these technology approaches with rigorous research designs are indispensable to assess their efficacy and cost-effectiveness in promoting preventive behaviors[27]. Furthermore, it is necessary to be innovative in designing and evaluating future public health interventions to reduce the STI rates, including the use of digital telephone technology[28].

In this study, apps aimed at preventing syphilis were addressed. However, it is observed that there is a largely unexplored market for apps that improve the interactions of mobile device users with the health system, especially with regard to sexual health care. There is significant interest among users in communicating with health care professionals and using apps to search for health care-related services. The potential of this app usage is enormous[14]. In this context, public health programs need to be evidence-based and tested to ensure that the resources selected are effective and adaptable to the general population[29].

## CONCLUSION AND IMPLICATIONS FOR THE PRACTICE

This study provided an assessment of the quality of mobile apps existing in the main operating systems on syphilis prevention and control for the lay population. According to the *Mobile App Rating Scale* (MARS), the mean of all the apps was 2.8, not reaching the minimum acceptability score of 3.0. Few apps achieved an acceptable mean score, indicating that the quality of apps on syphilis should be improved. In addition to that, no evidence on the effectiveness of these interventions was identified. It is worth noting that only two apps were available in Portuguese, which shows a gap in the development of apps on syphilis in Portuguese-speaking countries.

The use of mobile apps is a reality and requires strategies to make them efficient and effective in the fight against syphilis. Thus, there is an urgent need to develop apps that are interactive, fun, customizable, well oriented to the audience, easy to manipulate, with adequate visual aspects, good use of colors, making them visually attractive and well-described in the store or within the apps themselves. In order to improve engagement between the user and the app, gamification can be a strategy to be adopted.

It is noteworthy, however, that the research presented some limitations regarding the instrument used to evaluate the apps, since it was only available in the English version and has not been validated for use in Brazil. In addition to that, we found a limited number of apps in virtual stores and no evaluation of their effectiveness. Some items could not be evaluated as not enough

data was found about the apps. This may have indirectly contributed to the fact that no app reached the minimum acceptability score in the assessment.

Therefore, it is essential that new information technologies are developed, validated and implemented in different health contexts involving sexual and reproductive health and, above all, in the prevention of sexually transmitted infections such as syphilis. New research studies with more descriptors are suggested, in addition to the development of mobile apps in the Portuguese language and studies that validate these technologies on syphilis.

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