RESEARCH

Digital strategies and behavior change techniques for preventing sexually transmitted infections: Protocol for an overview of systematic reviews

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ABSTRACT

INTRODUCTION Sexually transmitted infections (STIs) are a leading cause of premature mortality, with unsafe sex as a predominant risk factor. Changing risky sexual behaviors and adopting healthy habits is key to preventing STIs, including HIV, essential for public health. Technological advances in digital interventions have revealed significant opportunities, and systematic reviews have evaluated their effectiveness. These digital interventions, using technologies such as mobile phones, apps, and wearable devices, have shown great potential to reduce STIs, particularly among young people, who are a key population for their implementation.
OBJECTIVE This protocol aims to describe in advance a systematic review intended to gather, evaluate, and synthesize the available evidence on digital behavior change interventions for STI prevention. In particular, it seeks to identify the most effective behavior change techniques to guide the design of evidence-based interventions that contribute to reducing STIs.
METHODS This protocol outlines a review of systematic reviews. The methodological quality of the included reviews will be assessed using the AMSTAR-2 tool, following the PRISMA-P guidelines. Comprehensive searches will be conducted in Cochrane, PubMed, Epistemonikos, and PsycINFO. The inclusion criteria will focus on systematic reviews evaluating the effect of digital behavior change interventions for STI prevention, covering technologies such as mobile phones, apps, and websites. Data extraction will identify key components using the Behavior Change Techniques Taxonomy version 1 (BCTTv1). The protocol is registered in PROSPERO (CRD42023485887).

EXPECTED RESULTS This review is expected to provide theoretical insights into behavior change in STI prevention through digital interventions, identifying the most effective techniques. These findings will help design scalable, evidence-based interventions, aimed especially at youth, and guide policymakers in implementing more effective strategies to reduce STI transmission around the world.

KEYWORDS Behavioral change, behavioral design, sexually transmitted diseases, HIV, digital behavior change intervention (DBCI)

INTRODUCTION

Unsafe sex, along with behaviors such as physical inactivity, smoking, and alcohol consumption, is associated with over

half of premature deaths worldwide [1,2]. Unsafe sex—one of the main risk factors for morbidity and mortality in youth—is linked to sexually transmitted infections (STIs) [3], including human immunodeficiency virus (HIV) and cancer [4], related to persistent human papillomavirus (HPV) infection. Globally, HIV/AIDS is the fourth cause of death among people aged 15 to 49 [5] with over 1 million people contracting a sexually transmitted infection (such as syphilis, gonorrhea, chlamydia, among others) every day [6]; currently, nearly 39 million people worldwide are living with HIV [7], resulting in significant personal, social, and economic costs.

The most effective programs are evidence-based interventions, behavioral theories, and behavior change [8]. To reduce the risk of contracting and transmitting STIs or HIV, digital

behavior change interventions to promote safer sex or limit risky sexual practices can be designed from constantly updated or "live" theoretical frameworks and evidence. [9–11]

Digital behavior change interventions are defined as products or services that use technology to promote behavior change [12], they can support health behavior change [13] at both individual and collective levels by modifying the environment [14]. Digital behavior change interventions are more scalable and potentially cost-effective compared to traditional face-to-face interventions; they are also more adaptive, allowing for personalized delivery based on vulnerability, and passive screening, among others [15]. An example of this was seen during the COVID-19 pandemic, where digital interventions significantly changed healthcare delivery [16]. Digital behavior change interventions can be delivered via mobile phones, smartphone apps, wearable devices, or websites and can support behavior change by pursuing different outcomes such as increased physical activity [17,18], weight control [19], smoking cessation [20], and reducing alcohol consumption in pregnant women [21].

Behavior change interventions often contain multiple 'active ingredients' (i.e., the types of content that have the potential to enhance prevention and intervention design, in this case for STI/HIV) of behavior change techniques [22]. Although most health interventions do not describe the construction process to improve replication and practice [23], identifying specific behavior change techniques or combinations with the potential to be effective in increasing safe sex and reducing STIs/HIV represents a major challenge for health policies. Our team has not identified the 'active ingredients' necessary to design digital interventions and standardize their construction. We understand the 'active ingredients' in a medical intervention as the components of the intervention that determine the results, such that, if they are omitted, the intervention would be ineffective. [24].

In this case, digital behavior change interventions must contain 'ingredients' that incentivize change, promote safe sex practices and are transmitted through a more effective medium that involves users, encouraging them to take specific evidence-based measures, such as using condoms [25], learning about health risks, seeking support from partners and peer groups, and even redesigning the environment [26] to facilitate access to condoms and STIs screening tests [27], as well as reducing the number of sexual partners, sexual abstinence, mutual monogamy, vaccination, among others [28].

Study aim and research question

The main objective of this systematic review is to compile, evaluate and integrate the results of systematic reviews on digital interventions that seek to reduce or prevent sexually transmitted infections in the sexually active population through behavioral changes. Synthesizing the evidence on behavior change techniques has multiple purposes, including identifying the most effective strategies, designing evidence-based

interventions, and comparing review results to guide evidence-based decision making.

Characterizing the content of interventions is crucial to inform, replicate and synthesize evidence [29,3031]. To address the gap in the literature, this study aims to conduct an overview of systematic reviews to explore digital interventions for preventing sexually transmitted infections. Such an overview could offer valuable insights into the active ingredients needed to design an effective intervention.

Objective

This overview aims to synthesize the evidence on behavior change techniques using the behavior change techniques taxonomy, focusing on identifying the ´active ingredients´ of digital interventions applied to prevent sexually transmitted infections in the sexually active population. This review seeks to answer the following research question: What types of behavior change techniques are integrated into digital interventions, how are they implemented, and what impact do they have, according to the Behavior Change Techniques Taxonomy version 1 (BCTTv1), on improving the prevention of sexually transmitted infections/HIV in the sexually active population?

METHODS

This overview of reviews complies with the 'Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocols' (PRISMA-P) guidelines for reporting systematic reviews and meta-analyses [32] (see Supplementary Material 1). This protocol has been registered at PROSPERO with registration number CRD42023485887 (see Supplementary Material 2), and the completed version will be published in Open Science Framework (OSF) [33]. The final manuscript of this overview will be developed following the Preferred Reporting Items for Overview of Reviews (PRIOR) statement guidelines [34]. (see Supplementary Material 3).

An overview format was chosen for this study, as it allows for the synthesis and analysis of multiple systematic reviews on the same topic, in this case, digital interventions for preventing STIs/HIV. According to the Cochrane Handbook for Systematic Reviews of Interventions, specifically the chapter about overviews of reviews [35], overviews are suitable for providing a comprehensive understanding of existing evidence, addressing broader questions and summarizing interventions across diverse approaches and populations. This format aligns with our objective of identifying effective strategies in behavior change techniques, thereby supporting decision-making in public health.

Reviews included in this overview

We will conduct a systematic review of reviews (overview) [35] to synthesize the evidence on using theoretical frameworks or behavior change techniques, implemented through digital interventions, to prevent sexually transmitted infections/HIV.

The main objective is to identify these interventions 'active ingredients´ by extracting them according to the Behavior Change Techniques Taxonomy version 1, the Theoretical Domains Framework, or the Behavior Change Wheel. Understanding and analyzing these processes and techniques is fundamental for designing effective interventions and informed decision-making in healthcare. The synthesis of evidence on behavior change techniques can help identify the most effective interventions, improve the design of future evidence-based interventions for preventing STIs/HIV, and enable the comparison of findings between reviews, thus providing the necessary evidence for public health decision-makers.

Step-by-step mapping of systematic reviews

The following section summarizes the screening stage, which comprised several steps. These steps aim to determine if the material meets the inclusion criteria, which are described in more detail later.

Step 1: To verify that the reviews are digital intervention-focused.

Step 2: To ensure that they are aimed at preventing STIs/HIV.

Step 3: To confirm that they are systematic reviews

Eligibility criteria

Types of studies: We will include all systematic reviews that evaluate and describe the effect of behavior change techniques, their mechanisms of action or any behavioral model or framework that explains how digital intervention influences behavior change to reduce the risk or prevent the transmission of sexually transmitted infections, including HIV.

Intervention type: We will include systematic reviews that evaluate digital and mobile health behavior change interventions focusing on changing unsafe sexual behaviors or preventing sexually transmitted infections/HIV. In other words, interventions conducted through a digital or mobile platform as a direct interface with participants.

Types of outcomes: We will not consider results as inclusion criteria during selection. We will include systematic reviews that evaluate short- or long-term behavior change regarding the following primary outcomes:

- Reduction of risky sexual behaviors, such as condom use (last sexual encounter, frequency, consistency), and increased use of STI tests.
- Prevention: HPV and Hepatitis A and B vaccination, and pre-exposure prophylaxis for HIV (PrEP).

As secondary outcomes, interaction reports on the methods of application of behavior change techniques will be analyzed, using standardized classifications whenever available, such as the taxonomy of behavior change techniques. Data extraction will identify TDF, COM-B behavior change system, associated BCW, and "active ingredients," using available standardized classifications, such as the behavior change techniques taxonomy (BCTTv1) developed by Michie and colleagues, to inform, replicate, and synthesize research evidence, as long as they are described in the findings of the reviews.

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Additionally, the following potential outcomes that may be obtained in data extraction will be included: Condom use (internal or external), frequency of unprotected sexual intercourse, number of sexual partners, STI/HIV testing (and if positive, this intervention would facilitate an STI test), acceptance of male medical circumcision, HIV counseling, vaccination against (HPV, HEP A and B), self-efficacy, knowledge related to STIs/HIV, attitudes towards condom use (and if positive, this intervention would facilitate condom use).

Any study that does not include a primary and/or secondary outcome will be excluded.

Search strategies

Electronic searches: We will perform an initial exploratory search, selecting articles according to specific criteria and extracting terms to refine the search strategy. We will discuss these terms with experts, create a boolean strategy, and iterate to include relevant omitted terms, refining the strategy accordingly. The search strategy was developed around the components of the research question, and before manuscript submission, a new search will be conducted to identify and update any additional potential studies.

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No language or publication status restrictions will be applied, and no filters will be used.

Our literature search will be conducted in the following databases: MEDLINE/PubMed; Cochrane Database of Systematic Reviews (CDSR); Epistemonikos; PsycINFO, chosen for their comprehensive coverage and effectiveness in identifying systematic reviews in health research [36].

The search strategy incorporates terms related to digital interventions, behavior change interventions, prevention and risk reduction of sexually transmitted infections, and systematic

reviews. Appendices 4 and 5 provide the detailed search strategy.

Other search sources

To ensure the identification of articles that may not have been detected by the search strategy or that are not available in the included databases, we will include the following sources of information:

- Manual review of references from included studies.
- Examination of systematic reviews that share at least one study in common with the included systematic reviews.

In addition to searching electronic databases, we will search the following sources of gray literature: Guideline Reducing sexually transmitted infections National Institute for Health and Care Excellence Publication date [37], Google Scholar, county health rankings and roadmaps [38], The Lancer Digital Health, and World Health Organization Library Information System (WHOLIS). The literature search will also be supplemented by contacting experts in the field and reviewing articles citing individual studies known to be relevant to the topic, including systematic reviews that are ongoing and not yet published or nearing completion on the PROSPERO platform [39].

Study selection

Studies identified through the search will be examined by title and abstract by two independent reviewers (GDA, DLA) according to predefined eligibility criteria. Then, all articles considered for inclusion will be fully assessed by two independent reviewers (GDA, DLA). Any disagreement in the study selection process will be resolved through consensus between the two reviewers. If necessary, a third reviewer (SSC) will be consulted for a final decision. Reasons for excluding studies examined at this stage will be recorded and reported in the PRISMA flow diagram. References of excluded studies will also be reported.

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Studies identified through the search will be examined by title and abstract by two independent reviewers (GDA, DLA) according to predefined eligibility criteria. Then, two independent reviewers will thoroughly assess all articles considered for inclusion (GDA, DLA). Any disagreement in the study selection process will be resolved through consensus between the two reviewers. A third reviewer (SSC) will be consulted for a final decision if necessary. The PRISMA flow diagram will record and

report the reasons for excluding studies examined at this stage. References of excluded studies will also be noted.

The study selection process will be conducted using the CollaboratronTM software [40], a screening tool developed by the Epistemonikos Foundation within the SK (Sustainable Knowledge) platform. The results of the electronic search will be incorporated based on inclusion criteria. Complete reports will be obtained for all titles that appear to meet the inclusion criteria or require further analysis to decide on their inclusion.

At each search stage, we will record the reasons for excluding reviews and describe the study selection process in a PRISMA flow diagram adapted for this project.

Additional articles meeting the inclusion criteria but not found in the initial search because they do not mention "digital behavior change interventions for the prevention of sexually transmitted infections/HIV" in the title or abstract will be searched in the reference lists of included articles.

Data extraction and management

Using standardized forms, two reviewers will independently extract data from each included SR [41]. Any disagreements will be resolved through discussion, and if necessary, a third researcher will be consulted. Reliability between reviewers will be assessed based on two coding categories (inclusion versus exclusion) after the full-text selection phase using kappa statistics adjusted for prevalence and bias (PABAK), which controls for probability agreement. The following cutoff points will be used: 0.40–0.59 indicates fair agreement, 0.60–0.74 indicates good agreement, and >0.75 indicates high agreement.

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The following characteristics of the included SRs will be reported: a) Author, b) Publication date, c) Objective of the systematic review, d) Number of studies included, e) Year of the most recent study, f) Location (country or geographic location of the included studies), g) Number of included studies, h) Included designs, i) Number of randomized controlled trials (RCTs), j) Type of population (adolescents, young adults, adults, men who have sex with other men, sexual diversity groups (LGBTIQ+), etc.), k) Types of digital interventions (delivered technology, type of digital content, and other descriptions), l) Behavioral outcomes, m) Cognitive outcomes (prevention mediators), n) Biological outcomes, o) Implementation outcomes (APEASE, i.e., Acceptability, Feasibility, Effectiveness, Affordability, Side Effects, Equity), p) Assessment of the

quality of evidence of the included studies, r) Eligibility criteria of the included systematic review, s) Study funding source, and t) Conflicts of interest disclosed by the researchers (see Supplementary Material 6).

Additionally, we will include information on the explicit theoretical framework of behavior change, a description of the framework or theory as reported by the authors, Behavior Change Techniques Taxonomy version 1 (BCTTv1), Theoretical Domains Framework, and/or mapping according to the Behavior Change Wheel (intervention functions according to the behavior change wheel), a bias risk tool, and evidence certainty (GRADE). Once the data extraction process is complete, the results will be reported and synthesized using standardized classifications following the Coding Manual (OSF). Taxonomy coding will be performed whenever available, following the Behavior Change Techniques Taxonomy version 1 to inform, replicate, and synthesize research evidence [22].

Risk of bias assessment

Two authors will independently assess the risk of bias of eachsystematic review using the risk of bias tool in systematic reviews (AMSTAR-2). [42] This tool helps identify potential biases, including selection, reporting, information, publication, interpretation, biases, and critical and non-critical weaknesses. The decision to use AMSTAR-2 is further supported by its ability to evaluate key methodological elements, such as the clarity of eligibility criteria, the comprehensiveness of the search strategy and the rigour of data collection. This standardized tool, combined with independent evaluations and consensus, will improve control over possible biases in the systematic reviews. The risk of bias of the primary studies included in the reviews will not be evaluated.

Data synthesis

The results of the included systematic reviews will be presented in a narrative format. A table will summarize the characteristics of each systematic review and their results according to the type of behavior change technique (´active ingredients´) of the Behavior Change Techniques Taxonomy version 1 considered in designing digital interventions to prevent sexually transmitted infections/HIV

Overlapping

To avoid duplicating primary studies' data, we will assess whether the systematic reviews contain overlapping primary studies, developing an evidence matrix before presenting the data. If no overlap is detected, we will include all relevant systematic reviews without concern for data duplication of primary study results. In the event of there being an overlap of primary studies between the reviews included, we will follow these steps: 1. Include the Cochrane systematic review (if available), the most recent, the highest quality, the 'most relevant' or the 'most comprehensive' (to avoid duplication of results data) and present the data in a separate results table.

EXPECTED RESULTS

This article addresses the issue of sexually transmitted infections (STIs) and HIV, which represent a significant portion of premature deaths worldwide, especially among youth. The importance of digital behavior change interventions (DBCI) for the prevention and reduction of these diseases is highlighted, given their potential to reach a wide audience effectively and at scale. These interventions, which can be delivered through various digital platforms such as mobile applications, wearable devices, and websites, offer the opportunity to implement evidence-based strategies and behavioral theories in real-time, adapting to individual and contextual needs.

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The main objective of this study is to conduct a systematic review of reviews to identify the active ingredients of digital behavior change interventions used to prevent STIs/HIV, specifically focusing on behavior change techniques according to the Behavior Change Techniques Taxonomy version 1. Synthesizing this evidence has the potential to inform the design of future interventions and provide a solid foundation for decision-making in public health policies.

Relevant systematic reviews addressing the efficacy of digital behavior change interventions in STI/HIV prevention and describing the behavior change techniques used are expected to be selected by applying specific eligibility criteria. Data extraction and synthesis will be conducted rigorously, following the guidelines established in the review protocol and using validated tools to assess the risk of bias.

The results of this study are expected to contribute significantly to the field of public health, providing crucial information on the most effective digital behavior change interventions and key factors for their successful implementation. Policymakers, healthcare professionals, and intervention designers could utilize these findings to develop more effective strategies in STI/HIV prevention and sexual health promotion among the population.

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Estrategias digitales y técnicas de cambio de comportamiento para la prevención de infecciones de transmisión sexual: protocolo para una revisión de revisiones sistemáticas

RESUMEN

INTRODUCCIÓN Las infecciones de transmisión sexual (ITS) son una de las principales causas de mortalidad prematura, con el sexo inseguro como un factor de riesgo predominante. Cambiar comportamientos sexuales de riesgo y adoptarlos como hábitos saludables es clave para mejorar la prevención de ITS, incluido el VIH, lo que resulta fundamental para la salud pública. Los avances tecnológicos en intervenciones digitales han revelado importantes oportunidades, y las revisiones sistemáticas han evaluado su efectividad. Estas intervenciones digitales, que utilizan tecnologías como teléfonos móviles, aplicaciones y dispositivos portátiles, han mostrado un gran potencial para reducir la transmisión de ITS, particularmente entre los jóvenes, quienes constituyen una población clave para su implementación.

OBJETIVO Este protocolo tiene como objetivo describir de forma anticipada una revisión de revisiones sistemáticas destinada a reunir, evaluar y sintetizar la evidencia disponible sobre las intervenciones digitales de cambio de comportamiento para la prevención de ITS. En particular, busca identificar las técnicas de cambio de comportamiento más efectivas, con el fin de orientar el diseño de intervenciones basadas en evidencia que contribuyan a reducir la transmisión de ITS.

MÉTODOS Este protocolo detalla una revisión de revisiones sistemáticas. La calidad metodológica de las revisiones incluidas será evaluada con la herramienta AMSTAR-2, siguiendo las directrices PRISMA-P. Se realizarán búsquedas exhaustivas en las bases de datos Cochrane, PubMed, Epistemonikos y PsycINFO. Se incluirán revisiones que evalúen el efecto de intervenciones digitales de cambio de comportamiento para prevenir ITS, abarcando tecnologías como teléfonos móviles, aplicaciones y sitios web. Los datos extraídos identificarán componentes clave mediante la Taxonomía de Técnicas de Cambio de Comportamiento (BCTTv1). Este protocolo está registrado en PROSPERO (CRD42023485887).

RESULTADOS ESPERADOS Se espera que esta revisión aporte conocimientos teóricos sobre el cambio de comportamiento en la prevención de ITS mediante intervenciones digitales, identificando las técnicas más efectivas. Estos hallazgos servirán para diseñar intervenciones escalables y basadas en evidencia, especialmente dirigidas a los jóvenes, y guiarán a los responsables de políticas en la implementación de estrategias más efectivas para reducir la transmisión de ITS a nivel global.