Consumer Health Information Technology in the Prevention of Substance Abuse: A Scoping Review

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Abstract:

Background: Addiction is one of the most rapidly growing epidemics that have currently plagued nations around the world. In the US itself, it has cost the government more than $700 billion a year in terms of health care and other associated costs, and it is also associated with dire social, physical and mental consequences. Increasing efforts have been made to tackle this issue at different interventional levels from primary prevention to rehabilitation across the globe. With the rolling in of the digital age, an effort to leverage these consumer health information technologies to combat this rising epidemic has been underway.

Objective: While multiple efforts have been undertaken to examine the efficacy, effectiveness and feasibility of interventions using the CHIT, these efforts have been segmented at best. The current review aims at providing a holistic and overarching view of the breadth of research on primary prevention using CHIT that has been conducted over nearly past five decades. It also aims at providing an overview of the changing face of CHIT over this time period.

Methods: We conducted a scoping review using the Arksey and O’Malley’s modified methodological framework. We searched four electronic databases (PubMed, Cochrane, Scopus, Embase). We selected papers for inclusion based on our eligibility criteria. Papers that did not focus on primary prevention of substance abuse were eliminated.

Results: 42 papers met our inclusion criteria and were included in the review. The papers included spanned between years 1970–2018 of publication, and were not restricted by geography, age, race or sex. The review mapped studies using different CHIT platforms used for interventions from mass media in the 1970s to mobile and social media in 2018. Studies that were exclusively focused on alcohol prevention were excluded from this review. The studies included had diverse research designs, though majority were randomized control trials or review papers. Many of the RCTs used different behavioral theories such as family interactions, social cognitive theories, harm-minimization framework and so on.

Conclusions: The current review finds these CHIT platforms to be efficacious and cost effective in the real-world settings. It also shows a gradual shift in the types and use of CHIT platforms over the past few decades and maps out their progression. Additionally, the review detected the shift in consumer preferences and behaviors from face-to-face interactions to technology-based platforms over the years. However, the studies included in this review only focused on the aspect of primary prevention. Additional research on the effectiveness of these platforms for secondary prevention and for prevention among comorbid populations needs to be undertaken.

Key Words: Consumer Health Information Technology (CHIT); primary prevention; substance abuse; scoping review

Introduction

Addiction has been identified as the most neglected disease in the United States of America, with nearly 40 million Americans over the age of 12 years meeting the clinical criteria for addiction involving nicotine, alcohol or other drugs [1]. Additionally, it also estimated that nearly 80 million people in the country are ‘risky substance users’, meaning while they are not addicted, they use tobacco, alcohol and other drugs in ways that could be harmful and threaten public health and safety [1]. Addiction, thus, has been established as a growing epidemic, which in 2017, cost the American government in excess of $740 billion in costs related to crime, lost work and health care, and it is growing exponentially [2-6].

However, the burden of drug and alcohol use and abuse is not just limited to the United States. WHO estimates the global burden of disease worldwide related to drug and alcohol to be nearly 5.4% [3]. Drug use is associated with grave long-term and short-term health implications and is recognized as one of the avoidable causes of
mortality [7]. According to the National Institute on Drug Abuse, in the US, nearly 64,070 people died of drug overdose in 2016, and this number is rapidly increasing [8]. Given the dire medical, social and economic consequences associated with this ever-growing drug use, the governments and institutions around the world have been working tirelessly to develop treatments and strategies to combat this drug epidemic.

Consumer Health Information Technology (CHIT) experienced an exponential growth during the recent decades [9]. In addition to the traditional consumer-centered information technologies for health promotion such as educational audio and video materials, the rapid proliferation of new modalities taking advantage of the wide accessibility of health-related content via internet, smartphones and social media may present an opportunity for solutions to this drug epidemic [10]. Access to the Internet has been rapidly increasing in the US and around the world. By 2016, nearly 88% Americans were using the internet [11], 92% a cellphone and 76% social media [12]. Given the reach of these modalities, technologies such as the internet and mobile phones are viewed as a promising platform for affecting assessment, prevention, treatment and recovery of substance abuse disorders. The WHO in 2012 has launched an innovative portal on alcohol and health with a web-based self-help intervention tool in four pilot countries, which provides an overview of relevant information for policymakers and professionals [13].

In the past few decades, multiple research studies have been conducted on the use of CHIT in the prevention of substance abuse, but the reflective step of looking broadly across this vast research corpus is yet to be undertaken. A few studies have reviewed different aspects and implications of the use of CHIT in substance abuse, but a broad and overarching approach is lagging. In this article, we present a scoping review of the breadth of research over the past few decades, specifically the use of CHIT in the substance abuse prevention domain. The objective of this review is to describe the use of CHIT in the primary prevention of substance abuse over the last five decades and examine the changes and developments in the types of CHIT employed for this effort. Our goal is also to summarize these of preventive approaches and report lessons learned from these studies.

**Methods and Design**

After considering the multiple systematic approaches that are used for the review of published literature, we decided to undertake a scoping review of the published literature as the best method to map out the changing trends in the use of CHIT in the substance abuse prevention landscape over the past few decades. The scoping review methodology is more commonly known as mapping, a process of summarizing the range of evidence to convey the depth, and the breadth of the published literature in a particular field of interest. Unlike systematic reviews and meta-analysis, scoping reviews are neither limited by the type of study under consideration nor do they evaluate their quality. Yet, it enables the researcher to examine the extent, range and nature of research activity, determine whether a full systematic review would be of value, summarize and disseminate the research findings and identify gaps in the literature [14-17].

In designing our scoping review, we used Arksey and O’Malley’s pioneering framework and incorporated recent scoping review publications as well. Arksey and O’Malley’s scoping review framework outlines a five-stage approach which was further adapted and modified to some extent by others to develop a more feasible approach for reviewing such a vast body of literature [14, 15]. The five steps are each discussed below.

**Identifying the Research Questions**

The growing drug abuse epidemic in the United States underscores the need for exploring new approaches to prevention. The ubiquitous nature of CHIT in our day-to-day lives presents an opportunity to study its potential as a tool for substance abuse prevention. Our intent, thus, was to learn the extent of the present use of CHIT
platforms in the prevention of substance abuse; however, the scope of this review was only limited to primary prevention and not secondary prevention. Additionally, we also intended to explore how best to leverage CHIT platforms in the future among high-risk individuals for primary prevention. Our goal was to examine the extent, range & nature of the evidence, to identify gaps in the literature, and to summarize and disseminate this information to guide practice and policy. Following Levac et al.’s suggestion to enhance and advance Arksey and O’Malley’s framework, our team clarified and linked the purpose and the research question from the beginning of this study. In order to avoid leading with a “highly focused research question”, we asked a sufficiently broad question; what is the role and scope of CHIT in the primary prevention of substance abuse? [14, 15]. To further guide our review, we formulated four sub-questions.

1) What are the demographics related to substance abuse disorder studied
   - Locations – study site – US, UK, multi-country, etc.
   - Demographics of the study population and sample size of the study
   - Length of observation – long-term impact vs. short-term impact.

2) What is the type of intervention and the behavioral framework, if any, used?
   - Intervention – Primary Prevention
   - Behavioral Framework – Trans-theoretical Model, Motivational Interviewing, Brief Intervention, Acceptance and Commitment Therapy, Psychoeducation, etc.

3) What is the type of CHIT used?
   - CHIT – desktop, tablet, smartphone, internet, IVR, video/movies, VR / AR, radio
   - Social media – Baidu Tieba, Facebook (and its associated Facebook Messenger), Gab, Google+, Myspace, Instagram, LinkedIn, Pinterest, Tumblr, Twitter, Viber, VK, WeChat, Weibo, WhatsApp, Wikia, Snapchat, YouTube, etc.

4) What are the major takeaways from the literature in terms of outcomes and is the intervention effectiveness evident within the literature?
   - Outcomes – change in knowledge, attitudes and behaviors
   - Effectiveness – intervention outcomes presented by the author(s) and their suggestions for future research

**Identifying Relevant Studies**
Arksey and O’Malley in their study had emphasized the need to be comprehensive while conducting a scoping review. [14] At this stage, our team deliberated and decided upon the various search terms, databases, search strategies and eligibility criteria. With the aid of a librarian, we searched electronic databases such as PubMed, Scopus, Embase and the Cochrane library. Various search terms and their combinations were used to identify relevant studies which discussed the use of CHIT in substance abuse prevention: “technology, internet, cell phone, multimedia, computer-assisted, telemedicine, social media, internet, web-based, etc. with prevention and control, preventive health services and substance-related disorders, substance abuse, substance misuse, drug addiction”
Eligibility Criteria
The following inclusion criteria were used to guide the search and will also be used for reviewing articles:

- Publication language – English
- Only limited to human subjects
- Time range – from 1809 - January 2018
- All age groups
- Review articles included – research studies, systematic reviews, meta-analysis, narrative reviews, observational studies, randomized control trials, qualitative studies, completed clinical trials, and dissertations and working papers.
- Reviews including but not limited to developed countries, given the growing drug abuse presence all around the world. Studies were included from the US, UK, Canada, Europe, Middle East, South America, South-East Asia, New Zealand, Australia, etc.
- Studies that address the role of CHIT in primary prevention –defined as strategies to prevent initiation of substance abuse.

Exclusion criteria:

- Journal articles that are not research studies or reviews (i.e., those besides the ones defined in the inclusion list), such as editorial reviews, commentaries, opinion articles, and book reviews.
- Research targeting secondary prevention strategies like treatment, maintenance, relapse and interventions
- Research studies that lacked the use of CHIT as a part of their interventions for primary prevention,

Results:

Study Selection
The literature search yielded 4393 articles. Following the search, the study selection was conducted in two parts. First, a single reviewer conducted a title screening process based on the inclusion and exclusion criterion. At this stage of screening any ambiguity with regard to the context of the study from review of the title, did not eliminate the study from being considered for the next step. After completion of this step 1606 articles were identified, then based on the eligibility criteria, two reviewers independently conducted abstract coding. Upon completion of abstract coding, the inclusion of the article for full text review was determined by corroboration from both the reviewers. The breadth of the literature we discovered on the use of CHIT in alcohol abuse prevention was so vast; we felt that a scoping review focused exclusively on alcohol abuse prevention would be more appropriate as a separate stand-alone study. Hence, for the purpose of this review, articles focusing solely on alcohol abuse prevention were excluded. However, if alcohol was included as one of the drugs of abuse in a prevention program of multiple substances, the study was retained in the review. We only included studies that focused solely on substance abuse prevention. Studies that looked at substance abuse prevention in conjunction with other morbidities such as prevention of HIV, or other areas of education such as undertaking risky sexual behaviors were excluded from this review.

Following abstract coding, 50 articles were included for a full text review. At the end of the full text review, 42 articles were found to meet the inclusion criteria and were included in the study. After the study selection, information relevant to each of the main review questions was extracted and analyzed (Fig 1). We developed a standardized table in order to assess the different forms of CHIT used and their impact on the prevention of substance use. We also used this table to identify the different underlying behavioral frameworks most commonly at play in these interventions.
Figure 1: PRISMA flow chart for literature search process
Locations
Most studies included in the review were conducted in the United States. Countries other than the US were Canada [18-20], Australia [19-24], Brazil [25], Netherlands [26], New Zealand [27], Norway [21, 28, 29], the United Kingdom [21, 30, 31], Germany [19], and Switzerland [32]. One systematic review included seven studies from the United States and one from Norway [29]. Another study reviewed trials that took place in Australia, Netherland, the United Kingdom, and the United States [21]. Another RCT was taken place in the US and Canada [18]. Six studies included in the review were conducted in Australia. Within the US, one randomized study recruited participants in West Virginia and Ohio [33]. Another randomized controlled trial (RCT) in the US chose participants in 19 states large Asian populations [34]. One study using Monitoring the Future survey data included nationally representative sample of students from 48 states [35]. Studies from other states in the United States recruited participants in California [36, 37], New York [38], New Jersey [38], Connecticut [38], Texas [39], Kansas [36], Michigan [40], Missouri [36], and South Carolina [41]. One study reported having participants mostly from rural communities in South Carolina [41]. Another study chose participants from schools in semi-rural community in Michigan [40].

Participants
We did not exclude any studies in the review based on demographic characteristics of participants. Therefore, study participants varied in ages, racial and ethnic background, and socioeconomic status. Thirteen studies assessed school or college-based intervention programs and thus participants were students, students with parents, or teachers [22, 25, 31, 35-37, 39, 40, 42-46]. One quasi-experimental study included participants enrolled in vocational schools [32]. Similarly, thirty studies included only young people, adolescents, or school-aged children from 11 to 24 years of age. However, some systematic reviews assessed studies across all ages, both children and adults [19, 47-50]. Some studies included only racial and ethnic minorities such as Asians [34], Hispanics [38], and African Americans [38]. While some studies did not specify racial background of participants, two studies reported having study subjects from various races including White, African American, Hispanic and Asian [37, 39]. One study in the UK having subjects from 7 schools included one school with predominantly Black students and the rest with mostly White students [31]. Another UK school-based study reported their participants were chosen to have a balance between both sexes, residence in rural and urban areas, and varying intellectual abilities [30]. Four studies specifically evaluated interventions on adolescent girls [34, 38, 51, 52]. Three of these studies involved mother-daughter prevention approach [34, 38, 44] thus assessed the impact of programs both on adolescent girls and their mothers. One study only selected participants from economically disadvantaged African American adolescents [53].

Sample Size
A range of study sample size was included in the review. One systematic review had a total of 52,746 individuals as participants from eight studies [28]. Other reviews included study sample sizes as small as 38 [19] to as large as 8352 [21]. Mother and daughter programs ranged from sample sizes of 206 to 916 girls and their mothers [34, 38, 51]. The nationally representative survey data included 337,918 cases [35]. Quasi-experimental studies also included both small (n=26) and large (n=2882) sample sizes [37, 53]. RCTs reported larger sample sizes in general ranging from 179 to 2332 participants [46].

Comparators
Of the 42 studies included in this review, table 1 shows the different CHIT platforms used by the studies included. 4 studies (Schuman et al., 1971; Milne et al., 1975; Pickens 1984 and Eiser et al. 1988) looked at the effects of films as a part of educational programs to promote discussion around the areas of substance use [27, 30, 31, 40]. The Schuman et.al 1971 study was a cross-sectional study conducted to evaluate the results of a field test conducted to emphasize on aspects such as motivations governing drug behaviors as opposed to drug facts [40]. The Milne et al. 1975 studies used a Pre-post study design [30], while the Eiser et al. 1988 study used a randomized control trial design to assess the effectiveness of films as a medium of drug education [31]. The
Pickens 1984 study was a literature review, which was also aimed at assessing the effectiveness of films in drug education as compared to other forms of media [27].

Ten studies looked at the use of different mass media interventions in general. Of these, 7 studies (Wallack 1980, Wallack 1981, Bandy et al. 1983, Flay et al. 1983, Flay et al. 1986, Brinn et al. 2010, and Carson et al. 2017) were literature reviews, which evaluated the use and effectiveness of mass media as a tool for substance abuse prevention [28, 29, 43, 48, 54-56]. The Barcus et al. 1975 and the Kinder 1975 studies examined the impact of mass media on attitudes associated with increased substance use [47, 57]. While the majority of studies evaluated the impact of mass media on multiple drug use, the Brinn et al. 2010 and the Carson et al. 2017 studies looked specifically into its role in smoking prevention [28, 29]. The Miller et al. 1981 study used a Cross-sectional survey design to compare effectiveness of media platforms such as TV, radio and newspaper in dissemination of substance abuse education [41]. Five studies looked specifically into the role of TV and radio as modes of interventions. Three of the studies (Feingold et al. 1977, Sussman et al. 1987 and Brannon et al. 1989) used a quasi-experimental design [36, 37, 42]. The Sussman study and the Brannon study used school based TV program format [36, 37] while Feingold 1977 and Terry-McElrath et al. 2011 used TV advertisements as their mode of intervention [35, 42]. The Johnson et al. 1989 study was the only one that reviewed the strategies and research efforts in the use of radio and TV [49].

Post 2009 there was a notable surge in the number of computer and internet based interventions and a subsequent decrease in the number of mass media based interventions. There were in total 18 studies that used web-based and internet based programs for interventions while 5 studies used the desktop enabled software or CD-ROM based programs for interventions. Thirteen of these studies used a randomized trial design and were aimed at evaluating the effectiveness of computer based substance abuse prevention programs. The Hansen et al., Newton et al. 2014, 2016(2), Christoff Ade et al. 2015, and Andrews et al. 2011, 2014 studies evaluated the comparative effectiveness of computer delivered prevention or screening programs with those termed as usual or traditional models of delivery [22-25, 45, 46, 58]. Four studies performed by Schinke et al. compared the effectiveness of a mother-daughter based program to a control group involving no intervention [34, 38, 44, 51]. Two studies by Schwinn et al. tested the effect of an internet based gender specific drug prevention program among girls with intervention compared to no intervention [18, 52]. Two studies used the Quasi-experimental Pre-Post study design, the Klisch et al. 2013 study compared the effectiveness between two different web-based interactive programs [39] and the Moncher et al. 1989 assessed the efficacy of the computer delivered prevention programs [53]. Five of the remaining studies were systematic reviews aimed at expanding the base of research and synthesizing the effectiveness of computer and web-based prevention programs.

The review by Carson et al. 2017 and the randomized trial Schwinn et al. 2017 specifically included the effectiveness of social media as a component of the prevention programs [29, 52]. While, a quasi-experimental (pre-post assessment) study by Haug et al. 2017, and two systematic reviews by Jiang et al. 2017 and Kazemi et al. 2017 evaluated and critiqued the effectiveness of mobile based prevention programs [32, 50, 59].

Table 1: Technology used as intervention

<table>
<thead>
<tr>
<th>Technology</th>
<th>Number of Studies</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Computer</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>CD ROM</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>Film</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Internet</td>
<td>18</td>
<td>31</td>
</tr>
<tr>
<td>Mass Media</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Mobile</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Radio</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>TV</td>
<td>11</td>
<td>19</td>
</tr>
</tbody>
</table>
Length of Observation
Seventeen studies out of the 42 studies reviewed here were in the form of systematic reviews spanning over the past 60 years. Of the remaining 27 studies, 8 studies had a short-term follow up period of one month or less (Schuman et al., Milne et al. 1975, Feingold et al. 1977, Eiser et al. 1988, Moncher et al. 1989, Andrews et al. 2011, Deitz et al. 2011, Klisch et al. 2013) [30, 31, 33, 39, 40, 42, 53, 58]. Most of these studies used a cross sectional pre-post assessment format. The long term follow up periods for most of the remaining studies ranged between 6 months (Schwinn et al. 2010, Champion et al. 2016, and Haug et al. 2017) to 1 year (Sussman et al. 1987, Schinke et al. 2009, Fang et al. 2010, Newton et al. 2014, Newton et al. 2016, and Schwinn et al. 2017) [18, 22, 24, 32, 37, 34, 51, 52]. Two studies, Schinke et al. 2009 which evaluated computer delivered program in preventing abuse among adolescent girls and Andrews et al. in 2014 which assessed the long term efficacy of a tobacco prevention program had a follow up period of 2 years [44, 46]. The study by Christoff Ade et al. in 2015, which compared the efficacy of 3 different interventions including a computer delivered one, followed its participants for 3 months [25]. The longest study period in this review was 10 years (Terry-McElrath et al., 2011); it evaluated the impact of anti-drug ad exposure and campaign-specific exposure on the attitudes, beliefs and behaviors among youths from 1995-2006 [35].

Outcomes and Results
Of the 4 studies that looked at films as the mode of intervention delivery, the Schuman et al. 1971 study found no significant difference in the identification of drug clues by geographical or socio-economic differences [40]. It also found a large gap in perceptions about drugs among faculty and students [40]. The Milne et al. 1975 study found no significant difference in knowledge and attitudes towards drug use. Instead, results showed that students who believed drug use had social advantages also held onto the concept that the dangers of drug abuse were over exaggerated, a finding that thereby emphasizes the need for drug education [30]. The review study conducted by Pickens et al. 1984 did not find film interventions superior to non-film approaches and found that the short-term impact of film interventions did not last in long term follow up studies [27]. However, the Eiser et al. 1988 study showed that an entertaining drug prevention film might be more effective in leading students to reject dangerous substances. In contrast, the students who viewed the educational film regarded both illegal and legal drugs to be similarly dangerous and addictive [31].

Studies which used mass media, radio and TV as modes of intervention found that neither of these platforms as standalone were adequate to bring about a change in the overall attitudes and behaviors of people who engage in substance use. The Barcus et al. study in 1975, Wallack et al. 1980, Wallack et al. 1981, and Flay et al. 1983, all found that mass-media alone is not sufficient to affect behavioral changes and that it needs to be supplemented by school or community based prevention programs [54-57, 48, 28, 29, 47]. Additionally, the literature reviews conducted on the use of mass media by Kinder in 1975, Bandy et al. in 1983, Brinn et al. 2010, Carson et al. 2017 and a study by Sussman et al. in 1987 found either inconclusive or conflicting end results pertaining to the use of mass media in disseminating drug-related information and bringing about attitude changes [28, 29, 37, 47, 48]. Some studies (e.g. Feingold et al., 1977) also found a boomerang effect of the use of TV and radio, where anti-drug messages were found to potentially lead to drug use [42]. Another exploratory study by Miller et al. 1981 evaluated the comparative effectiveness among different mass media platforms like TV, radio and newspaper and found that it depended on the demographics of the target audience: the results varied by race, sex and geographical area [41]. Only, the Brannon et al. study (1989) which specifically looked at the effectiveness of TV as a delivery format found it to have higher classroom participation rates, greater satisfaction and higher perceived effectiveness for a combined TV and classroom program, thus concluding it to be a viable option for wider implementation [36].

Post 2009 there was a notable increase in the number of studies that used computer and web-based interventions for substance use prevention. Four studies conducted by Schinke et al. between 2009 to 2011 used mother-daughter dyads from different races to study the effectiveness of computer-delivered interventions based on the family interaction theory [34, 38, 44, 51]. All studies found significant reductions in risk factors, drug use and an increase in the protective factors. Some studies also showed improvements in the quality of mother-daughter
relationships. Two studies conducted by Schwinn et al. in 2010 and 2017 used gender specific interventions for girls using internet and social media platforms. These studies found reduced 30- day alcohol, marijuana, poly drug and total substance use at 6 month and 1 year follow-up [18, 52]. The 2017 study also found material changes in the cognition and skills that are empirically linked to drug use risks [52]. Two studies by Andrew et al. in 2011 and 2014 which analyzed the short and long term efficacy of “Click city tobacco intervention” found that the intervention had the potential to significantly postpone or prevent the initiation of cigarette use and regular smoking among students. However, while in the short term the intervention showed moderate effectiveness at changing intentions to use smokeless tobacco in the future, the effect did not persist in the long term [46, 58]. Another study, (Deitz et al., 2011) which evaluated the effect of the Smart Rx web program found that it significantly increased participants’ knowledge of proper prescription drug use, and improved their self-efficacy in ability to manage and adhere to appropriate treatments [33].

Multiple studies identified in this review had used school based programs for the delivery of online interventions, three of these conducted by Newton et al. between 2013-2016 in Australia used the Climate Schools format for prevention of use for drugs like Cannabis, Alcohol, Ecstasy and New Psychoactive Substances (NPS) [22-24]. These studies not only found evidence that internet-based preventive interventions significantly decreased substance use, but also demonstrated that they could concurrently reduce associated risk factors in adolescents. However, the intervention did not significantly change binge drinking and cannabis, ecstasy and NPS use in the short term; the effects of these interventions were only apparent after 12 months, thereby showing a time-delayed effect which could be attributed to the time required by the students to experience and implement the strategies learned [24]. The Hansen et al. study in 2009 that evaluated the efficacy of online components to facilitate program implementation concluded that school-based prevention programs could benefit from adding web-based components to improve ease of implementation and enthusiasm of teachers [45]. The Klisch et al. 2013 study which used interactive game sessions in 11th and 12th graders found the intervention to be effective in promoting healthier attitudes towards non-medical use of prescription drugs [39]. Similarly, the Haug study in 2017 which used a mobile based intervention found that it improved study participation, retention and improved effectiveness with a statistically significant increase in the life skills and self-management skills, and reduction in the number at risk for alcohol use [32]. However, a study conducted by Christoff-Ade et al. in 2015 could not find conclusive evidence of effectiveness of computer-based intervention among college students for reducing substance use [25].

Four systematic reviews conducted by Champion et al. 2013 & 2016, Wood et al. 2014 and Hopson et al. 2015 on the use of computer and internet based programs found them to be potentially efficacious methods of delivering drug prevention programs. The Champion et al. reviews found greatest effects in relation to drug and alcohol related knowledge with persisting effectiveness at 6 and 12 month follow ups [21, 26]. The Wood et al. review on the other hand emphasized the need for further research to better understand the value of human contact in health interventions and to determine the optimal levels of professional input [19], while the Hopson et al. 2015 review identified these modes as cost-effective options for reaching more individuals but on the whole reported mixed findings in terms of the effectiveness over traditional methods [20]. Two reviews conducted by Jiang et al. in 2017 and Kazemi et al. in 2017 reviewed the use of telephone and mobile technology in substance use prevention and found that while it was a promising means to address substance use, the studies included in the reviews for the most part showed either inconclusive or mixed results in terms of the efficiency and efficacy [50, 59].

A summary of all the articles has been provided in table 2.

Table 2: Summary of articles by study design, CHIT used, and outcomes
<table>
<thead>
<tr>
<th>Title</th>
<th>Authors</th>
<th>Publication year</th>
<th>Study Design/Methodology (Study design used, N, Behavioral frameworks used if any, intervention if any)</th>
<th>CHIT used</th>
<th>Comments (Outcomes, conclusions, results, summary in brief)</th>
</tr>
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<tbody>
<tr>
<td>Drug perception and the student-teacher gap. Reactions of 428 students and 72 teachers to an experimental trigger film on drugs [40]</td>
<td>Schuman, S. H.</td>
<td>1971</td>
<td>Cross-sectional survey data from open-ended questionnaire post film viewing, N - 428 students and 72 teachers, Field test of a film for teenagers emphasizing motivations of drug behavior rather than drug facts, chi-square</td>
<td>Film</td>
<td>The study found a large gap in drug perception by correcting identifying drug clues between faculty (12.5%) and students (32%). There was no significant difference in identification of drug clues by geographical or socioeconomic difference among schools. In order for drug educations to be effective, drug counselors and teachers need to understand subtle clues of drug use in ordinary, everyday context of students.</td>
</tr>
<tr>
<td>Drugs and the mass media [57]</td>
<td>Barcus, F. E.; Jankowski, S. M.</td>
<td>1975</td>
<td>Review of literature and strategies in place to understand the role of different mass media platforms and messages in the field of drug use and abuse</td>
<td>Mass media, non-specific</td>
<td>Mass media antidrug messages have been largely ineffective in changing behavior. One of the reasons is the media messages have not been tailored to reach specific segments of population by drug use status or age. The authors concluded the mass media alone is not sufficient to change behavioral changes. The media may serve as a source of information but decision to change behaviors is influenced by many other factors.</td>
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<tr>
<td>Attitudes toward alcohol and drug abuse. II. Experimenta l data, mass media research, and methodologi cal consideratio ns [47]</td>
<td>Kinder, B. N.</td>
<td>1975</td>
<td>Literature review of 14 studies, concerning relationship of demographic and personality variables to drug and alcohol-related attitudes.</td>
<td>Mass media (newspaper, magazine, radio and television</td>
<td>There are conflicting results about he effects of mass media on disseminating drug-related information Drug users tend to rely on friends and their own experience as a source of drug information rather than media. In contrast, non-users are more likely to obtain drug information from mass media. However, no previous study results had demonstrated if the mass media are effective in changing an attitude toward drug use. Rather some professionals in the field believed fear-arousing tactics used by the mass media produced an undesirable effect of inducing young people to experiment with drugs. Overall, the mass media was shown to be ineffective in changing values and attitude that require strong commitment.</td>
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<tr>
<td>The critical assessment of the T.V. film &quot;The Drug Takers&quot; [30]</td>
<td>Milne, H. B.; Butt, T. W.</td>
<td>1975</td>
<td>Cross-sectional Survey before and after film viewing; Pre-test and post-test; N- 270 children (13-16 years of age), intervention - 20 minute film, material illustrated clinical facts and demonstrated relationships between the young drug abuser, society and the law, and in particular the young person's problems created by drug abuse; t-test</td>
<td>T.V, Film</td>
<td>No immediate change in knowledge and attitude was observed after viewing the film compared with before film viewing. The results suggested those who considered drug use is associated with social advantages also thought the dangers of drug use is exaggerated. Therefore, the authors suggested to explore advantages of being a non-drug user and presumed advantages of drug use as viewed by young people</td>
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<tr>
<td>Study Title</td>
<td>Author(s)</td>
<td>Year</td>
<td>Study Details</td>
<td>Media Type</td>
<td>Conclusion</td>
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<td>Anti-drug abuse commercials [42]</td>
<td>Feingold, P. C.; Knapp, M. L.</td>
<td>1977</td>
<td>Survey after film viewing; junior and sophomore students in 10 classes; data collected in 6 sessions over 3 weeks from 60 students; T-test, ANOVA, correlation matrix, and principle components factor analysis</td>
<td>TV and radio</td>
<td>The message with explicit conclusion was shown to be more effective. However, there was no difference between monologue vs. dialogue or serious vs. minimal harm format. Contrary to the intention of the anti-drug message, many students changed their attitude toward drugs from negative to less negative. Due to the boomerang effect, the authors concluded anti-drug messages might lead adolescents to use drugs.</td>
</tr>
<tr>
<td>Mass media and drinking, smoking, and drug taking [56]</td>
<td>Wallack, L. M.</td>
<td>1980</td>
<td>Mass media, non-specific</td>
<td></td>
<td>Though mass media campaign against smoking had little impact on changing behaviors of individual smokers, it did change the social structure in which smoking took place. Such that the pressure against smoking was far greater than for smoking. Anti-drinking and anti-drug did not bring about similar changes in social structure against abuse of these substances. The author advocated the use of monopolism (presence of no opposing views), canalization (directing existing views or behaviors in a similar but different direction), and supplementation (interpersonal contact in addition to mass media) for mass media campaign to be successful.</td>
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<tr>
<td>Comparison of media for substance abuse education in rural communities [41]</td>
<td>Miller, M. C., 3rd; Cantor, A. B.; Larisey, L.; Murphy, E.</td>
<td>1981</td>
<td>Cross-sectional survey after educational programs were offered, n=50; TV programs presented Saturday and Monday morning, and radio programs presented Sunday and Monday morning on 2 different stations; chi-square used</td>
<td>TV, radio, newspaper</td>
<td>The study examined which mode of media is more effective in disseminating substance use education program to various age, racial groups, geographical areas, and income levels. The authors found radio to be not as effective as newspaper and TV. The study concluded in order for mass media campaign to be effective the program has to understand characteristics of target audience.</td>
</tr>
<tr>
<td>Mass media campaigns: the odds against finding behavior change [55]</td>
<td>Wallack, L. M.</td>
<td>1981</td>
<td>Review the history, commonalities, assumptions, and effects of planned large-scale campaigns to communicate information to the general population to encourage moderation or abstinence in the use of alcohol, drugs, or tobacco. The concept of experimental design is critiqued regarding the appropriateness of such a model for evaluation of mass media campaigns.</td>
<td>Mass media, non-specific</td>
<td>Overall, mass media campaign has been shown to be ineffective to change behavior in consumption of substances. Some studies reported campaign against the use of drug and alcohol may have resulted in increased use of substances due to sensational effects of media messages. In general, the effectiveness of media is limited to increasing knowledge and reinforcing existing behavior. The author suggested the use of monopolization, canalization, and supplementation as conditions of media campaign success.</td>
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<tr>
<td>Recent literature on drug abuse prevention and mass media: Focusing on youth, parents, women and the elderly [48]</td>
<td>Bandy, P.; President, P. A.</td>
<td>1983</td>
<td>Reviews the recent literature on mass media campaigns and communication approaches promoting drug abuse prevention aimed at four target audiences: youth, parents, women, and the elderly.</td>
<td>Mass media, non-specific</td>
<td>Of the four audiences, the youth target group has been studied the most in terms of drug abuse messages, credibility of sources, drug patterns, and so on. Parents play a dual role, as targets and as intermediaries. Although mass media efforts to reach parents have been minimal, this target group has a strong motivation for both receiving messages and for acting on them. Women have received attention primarily through the message of appropriate drug use. However, studies focused primarily on the channel as opposed to other elements of communication. The elderly are also targets of campaign messages.</td>
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on appropriate drug use. These efforts feature multiple media platforms, which frequently involve an intermediary interpreter. The importance of audience analysis, of segmenting audiences into subgroups, and of designing customized presentations has been cited as critical across all target populations.

<table>
<thead>
<tr>
<th>The role of mass media in preventing adolescent substance abuse [54]</th>
<th>Flay, B. R.; Sobel, J. L.</th>
<th>1983</th>
<th>Review literature and discuss the pervasiveness of media influence, review past attempts to utilize mass media for drug education and use of classroom programming to be leveraged for solving the problem of adolescent drug abuse.</th>
<th>Mass media, non-specific</th>
<th>Most media prevention programs have failed. One reason may be it never reached the targeted audience. In addition, advertisement may influence behavioral changes if audiences are exposed to it three or more times. With drug prevention program, studies did not ensure the audience has watched the program multiple times. The messages themselves also have been either informational or fear arousing neither of which has been effective in changing behaviors. Effective mass media program should be able to gain the attention of audience and function as a supplement of other programs such as school-based curriculum or community organization intervention</th>
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<tr>
<td>The use of films in drug education--a review [27]</td>
<td>Pickens, K. A.</td>
<td>1984</td>
<td>Literature Review of 7 studies; no quality assessment done</td>
<td>Film</td>
<td>The studies also reported film is not as effective as other types of media in bringing on changes in knowledge, attitude, and behavior. Thus, authors concluded an intervention via film was not superior to non-film approaches. The short-term impact of film intervention did not last in long-term follow up in some studies. Measuring long-term effects would need to be assessed as well.</td>
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<tr>
<td>Mass media linkages with school-based programs for drug abuse prevention [43]</td>
<td>Flay, B. R.</td>
<td>1986</td>
<td>Literature review includes 3 major articles that provide insightful analyses of conditions under which the mass media can induce desired behavior change</td>
<td>Non-specific</td>
<td>The study discussed critical components for successful media drug prevention program including overcoming apathy of audience and promoting discussion thru interpersonal communication. The authors emphasized importance of monopolization and canalization to improve effectiveness of media drug education. The intervention strategies using the media intervention should attempt to increase awareness of problems associated with substance abuse and to maintain positive attitude toward remaining drug-free. Furthermore, mass media is effective when it is used in conjunction with other types of intervention such as school-based programs to reinforce knowledge and skills learned in school and community programs.</td>
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<tr>
<td>Viewing and evaluation of a televised drug education program by students previously of concurrently exposed to</td>
<td>Sussman, S.; Flay, B. R.; Sobel, J. L.; Rauch, J. M.; Hansen, W. B.; Johnson,</td>
<td>1987</td>
<td>Quasi-experimental study design, N - 2882 students (8th graders), survey after viewing TV program; intervention - PSA during prime-time viewing hours, 4 days of 5-min segments during early evening news hour discussing family, health consequences and other difficulties related to drug abuse, encouraging</td>
<td>TV program</td>
<td>Those who received concurrent drug prevention program at school during the period the show aired were more likely to watch the show than the other two groups. The show seemed to have more positive impact when it was viewed with parents on learning, interest, and helpfulness. Being involved in previous school drug program did not affect the viewing of TV drug education program. As the frequency of viewing increased, students assessed the TV</td>
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<tr>
<td>School-based substance abuse prevention programming [37]</td>
<td>C. A</td>
<td>Family involvement to prevent or stop drug abuse, and a half-hour interactive information program called 'The Drug Abuse Test'.</td>
<td>Program more favorably. The authors concluded positive involvement of parents might improve the impact of mass media drug program.</td>
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<td>Reactions to drug education: a comparison of two videos produced for schools [31]</td>
<td>Eiser, C.; Eiser, J. R.; Pritchard, M.</td>
<td>Randomized control study design with post assessment questionnaire after film, N - 518 students (14 yo); social skills approach used; Intervention - 3 groups assessed, 2 films were reviewed, 'thinking twice' and 'minder'; control group viewed the minder film after the completion of questionnaires. Pre-test the first group was shown a video that was an entertaining story about how some teenagers became involved with drugs. The second group was shown a video that was more didactic and informational. The third group saw no video.</td>
<td>Video Three groups of students were compared for effectiveness of drug education videos: an entertaining educational video about drug use, informational video, and no video viewing. The students who watched didactic video had increased knowledge about drug use whereas those who viewed entertaining video had more negative attitude toward drug use after viewing the video.</td>
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<td>Reaching Hispanics with messages to prevent alcohol and other drug abuse [49]</td>
<td>Johnson, E. M.; Delgado, J. L.</td>
<td>Review of strategies and developing research efforts concentrated in media use, non-broadcast points of access, preferences for and appropriateness of spoke person, and development of messages for selected target audience</td>
<td>Radio, TV Based on previously published data, authors concluded there is a particular need for more research on communication programs to reach three groups of Hispanics: children and adolescents, women of childbearing age, and heavy-drinking men. Authors suggested due to the diversity of these groups of people, the contents of program must be developed in recognition of this diversity. Not much is known about attitude, social norms, values, and resistance behaviors toward alcohol and drug use in this population; understanding these factors would provide a solid base for program development. For each group of audience, a message that promotes positive changes in behaviors should capitalize on the value of familyism, a strong psychological factor among Hispanics.</td>
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<td>Microcomputer-based approaches for preventing drug and alcohol abuse among adolescents from ethnic-racial minority backgrounds [53]</td>
<td>Moncher, M. S.; Parms, C. A.; Orlandi, M. A.; Schinke, S. P.; Miller, S. O.; Palleja, J.; Schinke, M. B.</td>
<td>Quasi-experimental Posttest study, N 26 11-14 years old black children from economically disadvantaged homes; Social cognition theory used; Intervention - demonstration program, 15 mins interaction with the software and brief description of learning task and basic keyboard use was presented. Questionnaire items measured contextual and interactional variables appropriate to the microcomputer task and software. Contextual variables measured in the battery included the amount of material retained, or learned,</td>
<td>Computer Large percentage of participants (42%) did not have any objections to the use of computer to receive information. However, majority (69%) preferred to receive drug information or counseling delivered by human rather than computer</td>
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by subjects upon completion of computer interaction. These variables covered subjects’ feelings about using computers respective to such factors as intimidation, mastery, enjoyment, and involvement.

| The television, school, and family project [36] | Brannon, B. R.; Dent, C. W.; Flay, B. R.; Smith, G.; Sussman, S.; Pentz, M. A.; Johnson, C. A.; Hansen, W. B. | 1989 | Posttest study, n=28, ANOVA | TV | TV format of intervention has a higher participation rates than classroom delivery format (p<0.001). Participants in TV format had a greater satisfaction with the program (p<0.03), but perceived program effectiveness was higher in combination of TV program and classroom program (p <0.001) than TV program alone. The authors concluded TV delivery format can be useful in wide implementation of program and enhancing effectiveness of classroom-based program.

| Computer-delivered, parent-involvement intervention to prevent substance use among adolescent girls [44] | Schinke, S. P.; Fang, L.; Cole, K. C. | 2009 | Randomized control trial, N-916 girls age 11-13 years and their mothers, family interaction theory used; Intervention - web-based 0 9 sessions of 45 mins each and 1 annual booster session of 45 mins, Each session was delivered through voice-over narration, skills demonstrations by animated characters, and interactive exercises for mothers and daughters to complete jointly. Program exercises taught mothers and daughters the value of listening to each other, spending time together, understanding one another’s personality, negotiating mutually agreeable decisions to problems, doing personal favors for one another, and giving each other praise and compliments | Internet, CD-ROM | The intervention group had lower relevant risk factors, higher protective factors, and less 30-day alcohol use (p<0.006), marijuana (p<0.016), illicit prescription drug use (p<0.03) and inhalants (p<0.03). Similar finding was seen among mothers in the intervention groups, there was less weekly use of alcohol (p<0.0001), Mothers who received the prevention program had better outcomes than control-arm mothers on variables associated with lower substance use risks for their adolescent daughters. |
| Using online components to facilitate program implementation: impact of technological enhancement to all stars on ease and quality of program delivery [45] | Hansen, W. B.; Bishop, D. C.; Bryant, K. S. | 2009 | Randomized field trial, 23 schools and 2 community groups, ANOVA, Chi-square | Web-based and CD ROM | Most teachers (83%) who used technology format of program preferred it to the standard format. However, more teachers using technology version made changes to activities in the program, though not statistically significant (p=0.18). Majority of students (>75%) agreed or strongly agreed online activities made an important contribution to the drug prevention program. The authors concluded school-based prevention program could benefit from adding web-based components to improve ease of implementation and enthusiasm of teachers |

| Preventing substance use among adolescent girls: 1-year outcomes of a computerized, mother-daughter program [51] | Schinke, S. P.; Fang, L.; Cole, K. C. | 2009 | Randomized control trial with N=591 mother-daughter pairs conducted; Family interaction theory was used for the intervention | Internet | The program showed positive effects on adolescent girls and their mothers one year after program delivery. Intervention-arm girls relative to control-arm girls improved on variables associated with lower risks for substance use, variables that can protect adolescents against future substance use, current use of alcohol, marijuana, and prescription drugs, and intentions to use tobacco, alcohol, and drugs in the future. Intervention-arm mothers uniformly benefited from the program across all of their measured outcome variables. Over time, girls in both arms increased their cigarette, alcohol, and marijuana use and their intentions to smoke, drink, and use illicit drugs in the future. However, the increases in cigarette, alcohol, and marijuana use for intervention-arm girls were more modest than those for control-arm girls. There was also less prescription use among intervention-group girls |

<p>| Mass media interventions for preventing smoking in young people [28] | Brinn, M. P.; Carson, K. V.; Esterman, A. J.; Chang, A. B.; Smith, B. J. | 2010 | Systematic Review of 10 articles; Information relating to the characteristics and the content of media interventions, participants, outcomes, methods of the study and risk of bias was abstracted by two independent reviewers. Studies were combined using qualitative narrative synthesis. Most studies used the Social learning theory | Mass media (radio - TV) | Three out of seven studies demonstrated statistically and clinically significant reductions for smoking uptake in young people. Common features to these successful campaigns included multiple channels for media delivery (e.g. newspapers, television, radio, posters, etc.), combined school and media components (through school posters and/or school based curriculum), and repeated exposure to campaign messages consecutively delivered for the same cohort of students over a minimum period of three years. The other successful campaigns used provocative messages to cause effective personal reactions. However three of the remaining four studies, which did not produce any statistical benefit, also used the social influences approach. Two of the four unsuccessful studies had short campaign durations (two weeks for one study, and four weeks for another) and as such were less intense than the successful campaigns. The lack of a structured curriculum component to support these messages, such as those in the combined school based studies, likely accounts for the eventual failure in |
| Preventing substance use among early Asian-American adolescent girls: initial evaluation of a web-based, mother-daughter program [34] | Fang, L.; Schinke, S. P.; Cole, K. C. | 2010 | Randomized control trial with N -108 Asian-American mother-daughter pairs conducted; Family interaction theory was used for the intervention; intervention - 9 session web-based substance use prevention program | Internet | At posttest, relative to control-arm girls, intervention-arm girls showed less depressed mood; reported improved self-efficacy and refusal skills; had higher levels of mother-daughter closeness, mother-daughter communication, and maternal monitoring; and reported more family rules against substance use. Intervention-arm girls also reported fewer instances of alcohol, marijuana, and illicit prescription drug use, and expressed lower intentions to use substances in the future. |
| Preventing drug abuse among adolescent girls: outcome data from an internet-based intervention [18] | Schwinn, T. M.; Schinke, S. P.; Noia, J. | 2010 | Randomized control trial; N-236 girls; Based on Social Learning Theory; Pre-Post design used; intervention - 12-session, internet based gender-specific drug prevention program | Internet | Adolescent girls who participated in the online intervention reported decreased 30-day alcohol, marijuana, poly drug, and total substance use at 6-month follow-up. Past-month cigarette use did not differ between groups. Posttest measures were completed immediately after intervention delivery. The trajectory of decreased substance use between posttest and follow-up for intervention-arm girls and increased use among control-arm girls suggests that girls may require time and real-life opportunities to apply acquired skills. |
| Short-term efficacy of Click City(R): Tobacco: changing etiological mechanisms related to the onset of tobacco use [58] | Andrews, J.A; Gordon, J. S.; Hampson, S. E.; Christiansen, S. M.; Gunn, B.; Slovic, P; Severson, H. H. | 2011 | Randomized Control trial; N - 2322; Multiple theories - Cognitive and risk perception theories; Intervention - 8 sessions in 5th grade and 2 booster sessions in 6th grade delivered over Intranet on school computers; Pre-post assessment | Intranet and Desktops | Results show that Click City®: Tobacco had the potential to postpone or prevent initiation of cigarette use. In addition, findings suggest that the program is efficacious at reducing all etiological risk factors associated with cigarette use, significantly lowering the risk of initiation. The program was particularly effective at decreasing intentions and willingness for those students who were particularly at risk, further adding to the efficacy of the program. It was only moderately effective at changing intentions to use smokeless tobacco in the future. |
| Preventing prescription drug misuse: field test of the SmartRx Web program [33] | Deitz, D. K.; Cook, R. F.; Hendrickson, A. | 2011 | Randomized control study; N-362; Social Cognitive theory was used; Intervention - web-based - using multimedia platforms like videos, graphics and interactive segments | Web-based (internet - includes video content) | Compared with the wait-list control group, users of the Web-based program significantly increased their knowledge of proper prescription drug use and had greater self-efficacy in their ability to manage and adhere to appropriate pharmaceutical treatment compared with the control group. In addition, the significant effects of the program on CAGE scores indicate that the Web-based SmartRx program resulted in a reduction of symptoms commonly associated with drug misuse problems. |</p>
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<tr>
<th><strong>Preventing substance use among Black and Hispanic adolescent girls: results from a computer-delivered, mother-daughter intervention approach</strong> [38]</th>
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<tr>
<td>Schinke, S. P.; Fang, L.; Cole, K. C.; Cohen Cutler, S.</td>
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<tr>
<th><strong>Potential exposure to anti-drug advertising and drug-related attitudes, beliefs, and behaviors among United States youth, 1995-2006</strong> [35]</th>
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<td>Terry-McElrath, Y. M.; Emery, S.; Szczypka, G.; Johnston, L. D.</td>
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<tr>
<th><strong>A systematic review of school-based alcohol and other drug prevention programs facilitated by computers or the internet</strong> [21]</th>
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<tr>
<td>Champi on, K. E.; Newton, N. C.; Barrett, E. L.; Teesson, M.</td>
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<td>Study Title</td>
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<td>The impact of science education games on prescription drug abuse attitudes among teens: a case study [39]</td>
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<td>Long-term efficacy of click city: tobacco: a school-based tobacco prevention program [46]</td>
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<tr>
<td>Universal Internet-based prevention for alcohol and cannabis use reduces truancy, psychological distress and moral disengagement: a cluster randomized controlled trial [22]</td>
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<tr>
<td>Computer-based programs for the prevention and management of illicit recreational drug use: a systematic review [19]</td>
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<td>Reducing substance involvement in college students: a three-arm parallel-group randomized controlled trial of a computer-based intervention [25]</td>
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<td>A detailed analysis showed that, for alcohol, the computer-based intervention reduced specific scores compared with the control group and the two formats reduced the scores for each question at follow-up. For marijuana, a small positive effect was observed at follow-up in the interview and control groups, suggesting low effectiveness. For tobacco and other drugs, despite the decrease in specific involvement scores in the three groups at follow-up, inconsistency was observed within groups in the scores for each question, and no significant difference was observed compared with the control group.</td>
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<td>The effectiveness of electronic approaches to substance abuse prevention for adolescents [20]</td>
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<td>Results show that computer- and Web-based approaches provide a cost-effective option for reaching more individuals, including those who have limited access to service providers. The present review also demonstrates that many computer- and web-based interventions have solid research support. Although most of the studies included in this review demonstrated positive effects of electronic interventions, some evaluations indicate that computer- and Web-based prevention have limited or no effects relative to interventions delivered using traditional methods.</td>
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<tr>
<td>A cross-validation trial of an Internet-based prevention program for alcohol and cannabis: Preliminary results from a cluster randomized controlled trial [23]</td>
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<td>Results indicate that the program was effective in increasing alcohol and cannabis knowledge, and there was some evidence that the intervention reduced students’ intentions to use alcohol and delayed the use of any alcohol (including even a sip or taste). However, the module did not have an impact on binge drinking, cannabis use in the past 6 months or intentions to use cannabis. The program showed significant positive effect on the intention to use alcohol and no significant effect on the intention to use cannabis. There were no significant intervention effects for binge drinking and cannabis use at post-intervention, which is consistent with the results from the original trial of the Climate Schools course.</td>
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<td>Effectiveness of a universal internet-based</td>
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<td>Students in the control group were more than 10 times as likely to use NPS and more than three times as likely to intend on using synthetic cannabis at the 12-month follow-up. Students in the control group also</td>
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<td>Prevention program for ecstasy and new psychoactive substances: a cluster randomized controlled trial [24]</td>
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<tr>
<td>Prevention of alcohol and other drug use and related harm in the digital age: what does the evidence tell us? [26]</td>
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<tr>
<td>Mass media interventions for preventing smoking in young people [29]</td>
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<tr>
<td>A Mobile Phone-Based Life Skills Training Program for Substance Use Prevention Among Adolescents: Pre-Post Study on the Acceptance and Potential Effectiveness</td>
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In order for the online interventions to advance toward widespread dissemination, further replication and longer-term trials are needed to better understand the effectiveness of interventions and to examine effects at both a symptom and disorder level. Attempts to increase impact are also required, which could be achieved by targeting additional agents of change, such as parents, or addressing additional behavioral risk factors alongside alcohol and other drugs. Despite these issues, there is clear evidence that online prevention for alcohol and other drugs can be effective.
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<th>s of the Program, Ready4life [32]</th>
<th><strong>Detected by interactive features such as quiz questions, message- and picture-contests, and integration of a friendly competition with prizes in which program users collected credits with each interaction.</strong></th>
<th>reduced by a quarter from baseline assessment to follow-up, whereas no significant changes were obtained in the prevalence of tobacco and cannabis use.</th>
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<tr>
<td><strong>Beyond face-to-face individual counseling: A systematic review on alternative modes of motivational interviewing in substance abuse treatment and prevention [50]</strong></td>
<td><strong>Jiang, S.; Wu, L.; Gao, X.</strong> 2017 Systematic Review of 25 articles; Randomized clinical trials (RCTs) that evaluated the effectiveness of alternative modes of MI (other than face-to-face individual counseling) in preventing and treating substance abuse were included. Eligible studies were rated on methodological quality and their findings were qualitatively synthesized using the CONSORT 2010 guidelines</td>
<td><strong>Telephone, internet communications, mobiles (SMS)</strong> Beyond face-to-face counseling, telephone was the most frequently used medium for delivering MI (11 studies), followed by Internet communication (4 studies) and short message service (SMS) (2 studies). Mail was incorporated as a supplement in one of the studies for telephone MI. The effectiveness of telephone MI in treating substance abuse was supported by all of the published RCTs included. Collectively, the studies reviewed indicate that telephone MI is a promising mode of intervention in treating and preventing substance abuse. The effectiveness of other alternative modes (SMS-based MI, Internet-based MI and group MI) remains inconclusive given the controversial findings and a limited number of studies. By synthesizing the currently available evidence, this systematic review suggested that telephone MI might be considered as an alternative to face-to-face MI for treating and preventing substance abuse.</td>
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<td><strong>A Systematic Review of the mHealth Interventions to Prevent Alcohol and Substance Abuse [59]</strong></td>
<td><strong>Kazemi, D. M.; Borsari, B.; Levine, M. J.; Li, S.; Lambers on, K. A.; Matta, L. A.</strong> 2017 Systematic Review of 12 articles; Mobile intervention for substance use literature from 2005-2015 was searched and included. Studies were excluded if they used computer web-based interventions exclusively for screening. Data on study design, sample, intervention, results and outcomes was collected.</td>
<td><strong>Mobile</strong> Although various primary outcomes were studied, most of these papers found at least partial positives results. Although mHealth interventions can reach a large number of individuals and promote self-regulation, there is a need for larger sample sizes and longitudinal studies in future investigations of mHealth interventions for substance use, as larger sample sizes would help increase generalizability, and longitudinal studies would help researchers understand the long-term effects of the interventions. The current review supports the mounting evidence that mHealth technology is a promising means to address substance use and warrants further development and study. Given the familiarity and comfort that young adults have with mobile phones and their willingness to adopt new trends, there is an exciting opportunity to use mHealth interventions to reduce substance use either by themselves or through enhancing traditional intervention techniques by increasing access to real-life contexts within one’s natural environments.</td>
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An Online Drug Abuse Prevention Program for Adolescent Girls: Posttest and 1-Year Outcomes [52]

| Schwinn, T. M.; Schinke, S. P.; Hopkins, J.; Keller, B.; Liu, X. | 2017 | Randomized control trial design; N = 788 13-14 year old girls; Social learning theory used; intervention - Real teen - Online program, comprised of two components: the homepage and the intervention sessions. The homepage for the program was accessible at any time, included feeds from the latest entertainment sites, online polls, horoscopes, beauty tips, and a quote of the day. The nine intervention sessions (15-20 mins each) focused on goal setting, decision-making, puberty, body image, coping, drug knowledge, refusal skills (two sessions), and a review. | Internet and social media | The intervention program tested in this study produced material changes not only in girls’ drug use behavior, but also in cognitions and skills that are empirically linked to reduced drug use risks. These include higher self-esteem, positive goal setting, increased media literacy, and drug refusal self-efficacy. As expected of any successful drug abuse prevention program, the intervention positively impacted girls’ drug use behavior, including their cigarette use and binge drinking. That the positive impacts of the intervention were also seen in rates of peer drug use suggests that the program had a beneficial effect on girls’ friendship networks. Continued positive outcomes at 1-year follow-up serve to underscore the social-emotional learning that apparently resulted in girls’ participation in the intervention. |

**Discussion**

The current review included studies spanning across the globe, with the target population for these studies ranging across varying age groups, race/ethnicity and gender, and having differing study designs and sample sizes. The time period for the literature search ranged from 1809-January 2018, the search only captured studies going as back as the early 1950s. This could be attributed to the fact that the review only included studies that had digitalized records enlisted on the databases searched. However, it can be said with fair amount of certainty that this review manages to capture majority of the trends in the use of CHIT. The boom in the use of media and CHIT platforms was seen to have occurred post the second world war, thereby reaffirming the validity of the literature search timeline [60].

This review explored multiple CHIT platforms such as TV, radio, films, mass media, computer, CD-ROM, internet, social media and mobile. It was observed that From 1971 to 1989, film, TV, radio and mass media were the most commonly used modes of intervention [27, 30, 31, 36, 37, 40-43, 47-49, 53-57], while post 2009, there was a greater emphasis on the use of computers and internet based interventions [18-26, 28, 33-35, 38, 39, 44-46, 51, 58]. Additionally, recent years show a growing emphasis towards exploring the role of social media and mobile-based interventions to expand the reach of these prevention programs [29, 32, 50, 52, 59].

CHIT based interventions have been shown to overcome challenges imposed by in-person delivered intervention strategies such as the need for trained personnel to prepare and deliver intervention programs [32]. Also, studies that examined the impact of ehealth and mhealth interventions found them to be efficacious and cost-effective, with computer-based interventions being more cost-effective than other preventive measures that are labor-intensive and costly such as Life Skills Training Program [61]. In our study, the use of media and technology to prevent substance abuse was also found to have several advantages as a prevention strategy. Technology-based interventions can facilitate rapid dissemination of information and improving knowledge about substance use [34, 53, 55, 57]. They can also reduce intervention variability that may occur with person intervention method [43], improving integrity of intervention measures. In addition, intervention recipients, especially non-abusers who are ideally candidates for primary prevention, are more likely to depend on the media to gain information and knowledge about substance abuse [45].
Studies based on the family interaction theory and aimed at improving relationship quality among mother daughter duos and studies that were gender-based were found to be effective in reducing the substance use in both the long and short term [34, 38, 44, 51, 52]. Multiple studies included in the review used school based programs for delivery of online interventions, of these the Climate school studies conducted in Australia not only found evidence that internet-based preventive interventions significantly decreased substance use, but also demonstrated that they can concurrently reduce associated risk factors in adolescents [21-24, 26]. However, the intervention did not show significant impact in the short-term use of substances; the effects of these interventions were only apparent after 12 months, there by showing a time-delayed effect, which could be attributed to the time required by the students to experience and implement strategies learnt [21, 23, 24]. Other studies that explored the effectiveness of school based programs using online or mobile-based interventions also found similar results. The studies that focused on the use of social media and mhealth platforms suggested the growth of research and literature in this domain [29, 32, 50, 52, 59].

However, in the present study we also found that technology-based interventions are not a panacea in the prevention of substance abuse. Despite the great amount of resources poured into development and implementation of media- and technology-based interventions, in general earlier and recent studies demonstrated moderate effectiveness of these strategies in changing attitude and ultimately behavior of recipients of interventions [22, 45, 52-56]. Even in cases where people may gain greater and more accurate knowledge in substance abuse and negative consequences ensuing from the use, studies failed to show the actual changes in terms of decreasing or terminating the use or abuse of substance due to these interventions [45, 53, 54]. For example, studies that explored the role of film, TV, radio and mass media did not find any conclusive evidence to support the standalone effectiveness of these platforms. Most of the studies concluded that these platforms should be used in conjunction with other prevention initiatives [30, 36, 37, 40, 42, 43, 54-57].

This review shows a gradual shift in the types and use of CHIT platforms over the past few decades. It has slowly moved from mass media based interventions towards web-based intervention, and following the current trends is heading towards a greater emphasis on telehealth and mhealth based interventions. We live in an age in which most people frequently use technology and social media, and are acutely aware of the current opioid misuse and substance abuse predicament facing the US in general and the world at large [13, 62]. In this social context, technology could be useful to reach the general population as well as specific, at-risk population and potentially be used to develop more tailored and effective prevention. In particular, since adolescents are frequent and avid users of various types of latest technology, computers and smartphones among other technology could potentially be powerful tools in the primary prevention of substance abuse [32]. Thus, we are quite confident that future research would be focused more on leveraging the use of current CHIT platforms such as mobiles and social media to enhance the outreach of substance abuse prevention programs.

Limitations
This study has multiple strengths and is unique in its approach to map the changing trends in the use of CHIT for substance abuse prevention. It covers a long time period and spans across the globe. By design, it did not capture technological interventions for alcohol prevention, as a stand-alone review on the prevention of alcohol abuse would be more appropriate. It is also seen that there was a gap in the literature between 1990-2008, no studies during this period were included, this could be attributed to the stringent eligibility criteria for this review. For study limitations, the review solely focuses on primary prevention and hence fails to capture the use of CHIT in secondary prevention and its role in treatment of substance use. The focus of the study on primary prevention of substance abuse necessitated the exclusion of a large number of studies, however there is an opportunity to follow on with subsequent studies to fill this gap. For example, by
design, the study did not capture the effects and correlation between substance use and co-morbidities such as HIV and risky health behaviors, and the use of CHIT to either treat or prevent either of the repercussions of these correlations. It did not include studies conducted in special populations such as cancer patients and patients with HIV, AIDS or other STD's. This review also did not include a large number of studies that explored the use of mobile and social media platforms as vehicles of intervention delivery as opposed to providing prevention programs. This could again be attributed to the stringent eligibility criteria.

**Conclusion**

The current review shows a gradual shift in the types and use of CHIT platforms over the past few decades for substance abuse prevention. It captures the progression from mass media-based interventions towards web-based intervention and the current trends that head towards a greater emphasis on telehealth- and mhealth-based interventions, while emphasizing the need for further development and study of these interventions. It also highlights the gradual shift in consumer and participant behavior, wherein preferences have slowly moved from face-to-face interactions towards more web-based and technology based platforms given the anonymity and the vast outreach that these platforms offer. Studies included in this review found these technologies to be effective and cost-effective in real world settings and contexts. Taking into account the familiarity and ease of use of these CHIT platforms among adults and youth alike, we now have an opportunity to further leverage these platforms for substance use prevention.

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**Authors Contribution**

FS, AP and JF conceived the project and contributed to the design of the scoping review. AP and LP contributed to the execution and analysis of the scoping review. FS and JF contributed significant intellectual content presented in this report as expert members on the team. All authors were involved in writing the paper. All authors read and approved the final manuscript.

**Conflict of Interest**

The authors declare that there are no conflicts of interest.

**Abbreviations**

CHIT: Consumer Health Information Technology
Reference


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