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Interactive Computer Simulation for Adolescent Screening, Brief Intervention, and Referral to Treatment (SBIRT) for Substance Use in an Undergraduate Nursing Program

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ABSTRACT

Purpose: Adolescent substance use has been identified as our nation's number one public health problem. Screening, brief intervention, and referral to treatment (SBIRT) is an evidence-based approach to identify and address adolescent substance use. Despite recommendations for universal implementation, adolescent SBIRT training has been notably absent from undergraduate nursing curricula. This project describes and evaluates the effectiveness of using an interactive computer simulation for adolescent SBIRT in an undergraduate nursing program.
Design and method: Undergraduate nursing students ($n = 144$) completed an adolescent SBIRT interactive computer simulation (*SBI with Adolescents,* Kognito). Self-perceived competence, confidence, and readiness to deliver adolescent SBIRT were measured via pre- and post-survey items. Student attitudes toward substance use and simulation-based learning were also studied. At the end of the simulation, students received an automatic assessment challenge score based on performance. We compared the pre- and post-SBIRT scores using the Wilcoxon signed rank test and the sign test for repeated measures using 2-tailed $\alpha = 0.05$.
Results: We saw significant ($p < .05$) improvement in overall student competence, confidence, and readiness to deliver SBIRT. Positive quantitative and qualitative feedback were also received regarding the simulation experience.
Conclusions: Adolescent SBIRT training was successfully integrated into an undergraduate nursing curriculum. There were significant improvements in self-reported competence, confidence, and readiness to deliver adolescent SBIRT.
Practical implication: This project provided further support for the potential benefits of an interactive computer-based simulation in an undergraduate nursing curriculum.

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Introduction

Adolescent substance use is a significant concern worldwide and is the most preventable and costly public health problem in the United States (Feinstein, Richter, & Foster, 2012). The American Academy of Pediatrics (AAP) and the National Institute on Alcohol Abuse and Alcoholism (NIAAA) recommend that clinicians screen all adolescents for substance use disorders, yet research indicates that very few clinicians, including nurses, follow these recommendations (Substance Abuse and Mental Health Services Administration [SAMHSA], 2017). Until recently, treatment for adolescent substance use has focused on a tertiary care

approach with those who have a disorder. Emphasis has now shifted to primary prevention and early intervention for adolescents. SAMHSA recommends the use of screening, brief intervention, and referral to treatment (SBIRT), an evidence-based approach for identifying and addressing substance use behaviors before more serious problems develop (SAMHSA, 2017). Despite these recommendations, adolescent SBIRT training has remained absent from most undergraduate nursing curricula.

Interactive computer simulation for adolescent SBIRT may be a practical, efficient, and cost-effective way to educate undergraduate nursing students. Nursing schools that have embedded SBIRT education into their programs have seen positive results, including increased self-efficacy and improved competence to address substance use disorders (Knopf-Amelung et al., 2017; Puskar et al., 2013). Previous work has shown the efficacy of computer simulation for adolescent SBIRT in an Advanced Practice Registered Nursing (APRN) program (Kuzma et al.,

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2018). The current project evaluated the effectiveness of an interactive computer simulation for adolescent SBIRT in the clinical education and training of undergraduate nursing students.

Background and significance

Adolescent substance use has been identified as our nation's number one public health problem (The National Center on Addiction and Substance Abuse at Columbia University [CASA], 2011). Substance use is a leading cause of accidental injury and death among adolescents (Mericle et al., 2015; Schulte & Hser, 2014). Identifying adolescents' substance use and intervening early can help to reduce or eliminate negative consequences (United States Department of Health and Human Services [USDHHS], 2016). SBIRT is broadly recommended to identify adolescents at risk for substance use and related disorders. Through a variety of techniques, including active listening and change talk, SBIRT guides clinicians to engage in open conversations with adolescents about their risky substance use behaviors.

Adolescent substance use

Adolescence is a period in life during which fundamental psychosocial transitions occur, like moving away from home, completing education, engaging in romantic relationships, and transitioning to employment. As adolescents mature, they begin to feel a newfound sense of independence and start to take more risks, contributing to the high prevalence of adolescent substance use (Jiloha, 2017). Substance use can disrupt pivotal times of transition as the adolescent undergoes emotional and cognitive development (Degenhardt, Stockings, Patton, Hall, & Lynskey, 2016; Schulte & Hser, 2014). Research has indicated that brain development continues well into the late twenties (Wood et al., 2018), so substance use can alter the function and structure of the brain, as well as make the adolescent more prone to the development of a substance use disorder (National Institutes of Health [NIH], 2017).

The frequency of substance use in these developmental years is startlingly high. Research from CASA (2011) showed that 75.6% of high school students had used an addictive substance. Of these individuals, 19.4% were deemed to have a clinical substance use disorder. Furthermore, individuals who start using an addictive substance before the age of 15 are 6.5 times more likely to develop a substance use disorder compared to those who wait until they are at least 21 years old (Feinstein et al., 2012). Studies have also shown that up to 90% of individuals who meet the clinical criteria for a substance use disorder began using before the age of 18 (CASA, 2011).

Alcohol is the most commonly used substance among teenagers (SAMHSA, 2019). In 2016, nearly one in five adolescents reported alcohol use in the past month (USDHHS, 2018). Of adolescents aged 12 to 20, 7.4 million consumed alcohol in the past month, 4.5 million were considered binge drinkers, and 932,000 were classified as heavy drinkers (SAMHSA, 2018). Out of all age groups, adolescents have the lowest self-perceived risks from weekly binge drinking. For those aged 12 to 17 years old, only 43.6% saw any potential risks from binge drinking weekly, while 37.9% of 18 to 25 year olds considered such behavior to be risky. Binge drinking is defined as five or more drinks for a male and four or more drinks for a female on at least one day out of the month, while heavy drinking is binge drinking on five or more days during the month (NIH, n.d.).

In addition to the numerous negative consequences that adolescent substance use may cause, it is also a costly economic problem for the United States. The impact of alcohol misuse and alcohol use disorders is estimated to cost the United States $249 billion ($2.05 per drink) annually, while the impact of illicit drug use and related drug disorders is estimated to cost $193 billion annually (USDHHS, 2016). This $442 billion estimate is reflective of direct and indirect costs related to healthcare expenses ($120 billion), lost productivity, law enforcement,

and other criminal justice costs (USDHHS, 2016). Every dollar spent on addiction treatment can save up to $12 when factoring in healthcare costs, criminal infractions, and workplace productivity (NIH, 2018). This highlights the necessity of universal screening methods for adolescent substance use.

Motivational interviewing and SBIRT

Motivational interviewing (MI) is a feasible, evidence-based, patient-centered method of care that may be ideal for addressing adolescent substance use. During motivational interviewing, the clinician creates an open, goal-oriented, and non-coercive environment in which the patient feels a sense of empathy and comfort (Smedslund et al., 2011). In a systematic review of 185 studies on the use of brief interventions for adolescents, one-to-one MI techniques produced the strongest outcomes (Tanner-Smith & Lipsey, 2015).

As a result of MI's evidence-based efficacy, SAMHSA recommended its use to address adolescent substance use. MI is a foundational component of SBIRT, which is designed to identify adolescents with substance use behaviors, or those at risk, before more serious problems result (Mitchell, Gryczynski, O'Grady, & Schwartz, 2013). In the first step of SBIRT, standardized screening tools are used to identify risky substance use behaviors. Following screening, the clinician delivers a brief intervention. Using MI, the clinician engages in a conversation, discusses these risky behaviors, offers advice, and helps set goals. For patients who require additional care, a referral to specialized treatment is made. Universal implementation of SBIRT is recommended by the American College of Surgeons, The Joint Commission, the Veterans Health Administration, and the U.S. Preventive Services Task Force in order to help meet the Healthy People 2020 goals of reducing substance use (Puskar et al., 2013).

The role of nurses in the delivery of SBIRT

In a position statement issued by the Emergency Nurses Association (ENA) and the International Nurses Society on Addictions (IntNSA), it was recommended that nurses in all specialties and settings be equipped to deliver SBIRT (Strobbe, Perhats, & Broyles, 2012). The ability of nurses to build rapport with patients allows for the discussion of sensitive topics like substance use and related disorders, making them uniquely qualified to screen adolescents. Nurses constitute the single largest group (four million) of health professionals in the United States (American Nurses Association, 2019) and have consistently been rated as the most trusted professionals (Gallup, 2018). Having a diverse body of nurses who practice at different levels in the healthcare field places them in an opportune position to deliver SBIRT. Another important asset is a nurse's opportunity and ability to advocate for healthy lifestyle choices and provide patient education (Puskar et al., 2013). For these reasons, it is critical that SBIRT education be implemented in undergraduate nursing curricula (Finnell et al., 2014).

In 2010, the inclusion of SBIRT education into nursing curricula was identified as the "next step" to increase the implementation and use of SBIRT in practice (Puskar et al., 2013). When students receive SBIRT education and training, there are clear increases in satisfaction, knowledge, confidence, self-efficacy, self-perceived competence toward addressing substance use, and improved attitudes about those with substance use disorders (Knopf-Amelung et al., 2017; Puskar et al., 2013). However, nearly a decade later, SBIRT still remains markedly absent from most nursing school curricula. A review of 27 baccalaureate nursing programs in the United States found minimal clinical instruction and didactic content about substance use, and only 37% of these programs provided content on how to counsel patients with substance use disorders (Knopf-Amelung et al., 2017).

Interactive computer simulation in undergraduate nursing curricula

In order for SBIRT to be taught in undergraduate institutions, additional educational resources are necessary. In 2016 alone, 64,067 qualified applicants were denied acceptance into undergraduate and graduate nursing programs due to faculty shortages, limitations in clinical sites, classroom space, and budget constraints (American Association of Colleges of Nursing, 2017). Simply put, the demand for nursing education greatly exceeds the supply of faculty, funds, and clinical experiences. Clinical simulation is one of the most practical methods for providing nursing education. One study found that up to 50% of traditional clinical time can be replaced by high-quality, high-fidelity simulation experiences without a change in clinical competency, knowledge assessments, or NCLEX pass rates (Hayden, Smiley, Alexander, Kardong-Edgren, & Jeffries, 2014).

Considering the personal nature of substance use and SBIRT, it is imperative that students have access to realistic experiences. Interactive simulations with virtual patients are a promising method for delivering clinical education. Students have the ability to repeat simulations at will, receive immediate feedback, and practice in real-life scenarios. Like other modalities of simulation, interactive computer simulations allow students to make mistakes and provide a self-directed method of education. Virtual patient paradigms also have the advantage of versatility, like the ability to alter patient gender, condition, and setting.

Another important aspect of virtual simulation is its case-based tenants. Case-based learning has been shown to be successful in promoting nursing autonomy, increasing the student's interest and motivation in simulations, and improving competency (Raurell-Torredà et al., 2015). A systematic review of nine randomized controlled studies in nursing education found that online learning resulted in equal or superior gains in overall knowledge, hands-on skill performance, and higher satisfaction when compared to the traditional classroom learning style (Knopf-Amelung et al., 2017).

With the constant advancement of technology, virtual patient simulations are becoming more low-cost, reproducible, and available on the market (Guise, Chambers, & Välimäki, 2011). As a result, clinical simulation may be one of the most practical methods of integrating SBIRT into nursing school curricula. By integrating a case-based, realistic, and cost-effective virtual simulation focused on SBIRT into nursing curricula, nursing schools can produce students who are capable of tackling the complex issues surrounding adolescent substance use.

Methods

The computer simulation, *SBI with Adolescents*, was provided by Kognito (http://www.kognito.com) as part of an ongoing collaboration. One hundred forty-four undergraduate nursing students completed the highly interactive computer simulation for adolescent SBIRT, using a virtual coach, and patients. Self-perceived *competence*, *confidence*, and *readiness to deliver* adolescent SBIRT were measured via ordinal Likert-style pre- and post-survey items, immediately before and after the simulation. Student attitudes toward substance use disorders and the SBIRT computer simulation were also assessed. At the end of the simulation, students received an automatic assessment challenge score based on simulation performance. Students were also able to provide qualitative feedback via free response.

The computer simulation (Fig. 1) was led by a virtual coach named Amanda. With Amanda's guidance, students practiced delivering SBIRT to two patients, each in a different clinical environment. Following completion of the two practice scenarios, students faced a final scenario, independent of Amanda. Within the simulation, students had a variety of pre-written responses to choose from to address and communicate with the patient. Following the completion of the final independent simulation, students were given a challenge assessment score. A passing assessment challenge score (≥75) was required for full course credit. This score was based on the student's ability to choose options

Fig. 1. SBI with adolescents (Kognito). The interactive computer simulation guided undergraduate nursing students through a series of different scenarios regarding adolescent substance use.

that aligned with the sequential components of SBIRT: engagement, building rapport, eliciting pros and cons, providing feedback to the adolescent, assessing the readiness to engage, negotiating a plan for action, summarizing and thanking, and motivational style. Students received a certificate upon completion of the simulation. Students subsequently participated in a face-to-face simulation, also based on adolescent SBIRT, in groups of approximately eight students with a clinical faculty member, which was not part of this evaluation. The computer and face-to-face simulations were integrated into the required junior-level clinical course in psychiatric nursing at the University of Michigan School of Nursing.

Stata (v 15.1) software was used for all statistical analyses, using alpha = 0.05 criteria to determine statistical significance (StataCorp, 2017). We compared pre- versus post-SBIRT scores using the Wilcoxon signed rank test (Wilcoxon, 1945) and the sign test (Snedecor & Cochran, 1989) for repeated-measures to compare pre- vs. post-training scores. Similar comparisons were then conducted on individual questions for descriptive purposes. Given the higher risk of Type I errors, *p*-values for these comparisons were adjusted using the Bonferroni multiple comparison adjustments (Bonferroni, 1936).

While 144 students completed the intervention, not all of them completed their pre- and post-surveys in full. To increase the quality of the data analyzed, students who completed <80% of the items within a sub-scale (ex. competence) were not evaluated for that sub-scale. Responses for individual items were summed to create sub-scale scores for students who completed all items within the scale. Sub-scale totals utilized the mean of the answered items within the sub-scale as replacement(s) for the one or more (but never >20%) of the skipped sub-scale items. The number of students who provided enough data varied from section to section and can be reviewed in Table 1 in the "overall scores" items.

To further evaluate the validity of the scale used in this study, Cronbach's alpha scores were generated from pre-survey data. The scores for competence (0.95), confidence (0.93), and readiness to deliver adolescent SBIRT (0.95), all strongly suggested the validity of the scales used.

Results

Quantitative measures

Of the original 144 students enrolled in the simulation, 135 identified as female (93.75%) and nine identified as male (6.25%). The sample identified as predominantly White (116 participants), while the remainder of the sample identified as Asian (13), Hispanic (six), Black/African American (three), two or more (three), or did not indicate an

Table 1
Change in pre- and post-survey competence, confidence, and readiness to deliver SBIRT.

Selected Survey Items	# + change (% + change)	Adjusted p-values
Competence	116/121 (95.87%)	p < .001
Asking adolescents about their alcohol and drug use	70/120 (58.33%)	p < .001
Assessing adolescent's readiness to change regarding their alcohol and drug use behavior	98/121 (80.99%)	p < .001
Discussing/advising adolescents to reduce or halt their drinking and drug use behavior	88/120 (73.33%)	p < .001
Helping adolescents identify benefits of cutting back or stopping use of alcohol and drugs	61/121 (50.41%)	p < .001
Helping adolescents identify challenges/barriers in cutting back or stopping use of alcohol and drugs	64/121 (52.89%)	p < .001
Helping adolescents develop a personal plan for cutting back or stopping alcohol; or drug use	93/121 (76.86%)	p < .001
Arranging follow-up to help adolescents cut down or stop using alcohol or drugs	92/119 (77.31%)	p < .001
Confidence	100/122 (81.97%)	p < .001
Using information gathered about the adolescent's substance use to provide feedback	87/122 (71.31%)	p < .001
Helping an adolescent to agree to cut back or accept referral	95/122 (77.87%)	p < .001
Intervening with adolescents who misuse prescription medication	90/120 (75%)	p < .001
Expressing empathy and reflecting an adolescent's emotions during a brief intervention for substance use	80/122 (65.57%)	p < .001
Readiness	97/120 (80.83%)	p < .001
To screen all adolescents for alcohol use	90/121 (74.38%)	p < .001
To provide brief interventions for adolescents who screen positively for alcohol use	91/122 (74.59%)	p < .001
To screen all adolescents for illicit drug use or prescription drug misuse	87/122 (71.31%)	p < .001
To provide brief interventions for adolescents who screen positively for illicit drug use or prescription drug use	89/121 (73.55%)	p < .001

Note. # + change and % + change are representations of improvement for each question post survey. Factor analysis confirmed the cohesion of each survey item toward its category (competence, confidence, readiness to deliver). P-values adjusted using Bonferroni Correction.

ethnicity (three). Our percentage of male nursing students and minority nursing students were 6.25% and 19.44%, respectively. Both of these measures are below the national data published by the National League for Nursing (NLN) for men (13%) enrolled in BSN programs (National League for Nursing [NLN], 2018b) and minority (32.4%) nursing students in BSN programs (National League for Nursing, 2018a). When the course started, the age distribution included eight people who were 19 years old, 58 were 20 years old, 48 were 21 years old, 25 were 22 years old, four were 23 years old, and one was 25 years old.

Of 144 students who completed the computer simulation, 134 (93%) students achieved the recommended passing assessment challenge score on a first attempt, with a mean score of 86.44 out of 100. Data reported students' first attempts at the computer simulation, along with their first pre- and post-survey responses. For educational purposes, the ten remaining students who did not pass on the first attempt were given an opportunity to enhance scores on subsequent attempts. Among post-survey respondents, 89.3% were satisfied with the overall quality of this education, with 93.4% of students satisfied with the quality of the simulation between the practitioner and adolescent. Prior to simulation, many (93.5%) students had already realized the importance of providers who could assess substance use. There was a widely held belief that negative approaches to treating substance use were ineffective (91.67% of students). Prior to the simulation, four of the 133 respondents (3%) agreed that individuals suffering from substance use

disorders were "weak willed," and four out of 120 respondents (3.3%) agreed that treating alcohol dependent patients were "unpleasant to work with." The post-survey revealed that four of 114 respondents (3.5%) still agreed that individuals suffering from substance use disorders were "weak willed," while only two of the 108 respondents (1.9%) agreed that these individuals were "unpleasant to work with."

Of the 144 students, 125 completed both the pre- and post-surveys. As shown in Table 1 and Fig. 2, pre- and post-survey analysis revealed significant (p < .001) increases in self-perceived competence, confidence, and readiness scale-scores to deliver adolescent SBIRT. Table 1 shows the percent of participants who displayed positive changes between pre- and post-survey in items representing competence, confidence, and readiness to deliver adolescent SBIRT. Students displayed a significantly increased desire to work with individuals who drink alcohol (p = .0012), viewing this opportunity as "rewarding" (p = .0013). The students also reported an increased understanding of the causes of drinking problems (p < .001). Students demonstrated effective use of the nine sequential components of adolescent SBIRT (Table 2).

Qualitative measures

Students were provided an opportunity to provide written feedback about their simulation experiences. In these sections, students praised the realistic, structured, and interactive aspects of the simulation. One student noted:

I liked how the conversation, especially on the adolescent's end, was very realistic and similar to things I would have said when I was that age. I also liked how easy to use it was and how the generated responses always seemed to convey the emotions and things I wanted to be said by the practitioner.

Another student wrote, "The simulation was very similar to situations I may encounter in real practice. The outline was very organized so I had a direction on how to intervene when adolescents could be the most motivated." These comments were among many that reflected students' positive thoughts regarding this style of education.

There was also some constructive feedback. One student focused on what was missing by stating, "I think that maybe the student would benefit from being able to type in questions or responses, so that they can learn better. The prompts are helpful, but maybe not the best assessment of learning." While results were overwhelmingly positive, some students also expressed dissatisfaction with the length of the simulation (2 h).
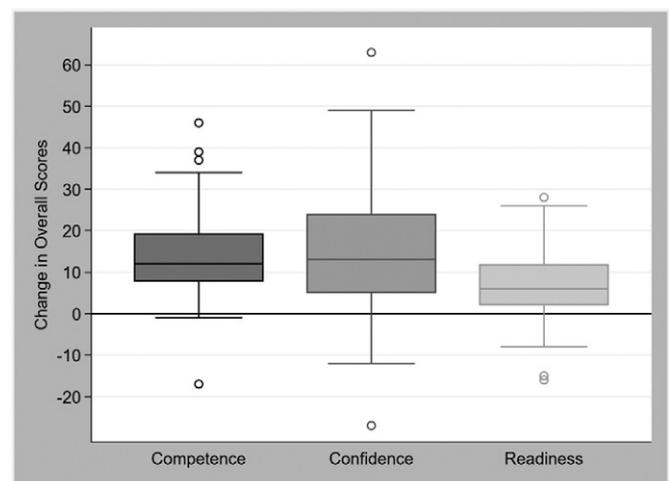

Fig. 2. Changes in competence, confidence, and readiness to deliver SBIRT scores post-survey. Individual scores were generated by summing the values for each survey item in each category. N = 121, 122, 120 respectively.

Table 2
Performance measures.

Item	Median (IQR)	Mean (SD)	95.0% lower CI for mean	95.0% upper CI For mean
Assessment Challenge Score	88 (10)	86.40 (8.33)	85.04	87.78
Engagement	3 (1)	2.49 (0.542)	2.40	2.58
Build Rapport	14 (4)	13.89 (2.14)	13.54	14.24
Elicit Pros and Cons	19 (6)	18.03 (3.05)	17.53	18.54
Provide Feedback	17 (0)	16.46 (1.53)	16.21	16.71
Assess Readiness	16 (1)	16.26 (0.861)	16.12	16.41
Negotiate and Action Plan	16 (4)	14.85 (3.09)	14.34	15.36
Summarize and Thank	9 (0)	8.90 (0.850)	8.76	9.04
Motivational Style	4 (1)	3.70 (0.932)	3.55	3.85

Note. IQR = interquartile range; CI = confidence interval; SD = standard deviation.
IQR: 50% of responses lie within this range.

Discussion

Undergraduate nursing students displayed significant increases in self-perceived competence, confidence, and readiness to deliver adolescent SBIRT. The implementation of this project was well-received both by students and faculty. Given the research supporting simulation-based learning in nursing curricula, as well as the positive results from our study, nursing educators should continue adapting to the shift of simulation-based learning in nursing curricula. By making simulation-based adolescent SBIRT training a required aspect of the undergraduate nursing curriculum, all students were required to have a strong understanding of SBIRT. This is critical given that many currently practicing nurses may not have been exposed to this modality prior to their entrance into the workforce. Now, the next generation of nurses may have greater competence and confidence in delivering this important clinical intervention.

Although the computer simulation yielded positive results, certain limitations existed. Our experience was limited to an undergraduate program at one university-based school of nursing, so findings may not be widely generalizable. Also, there may or may not be a correlation between assessment challenge scores and self-perceived competence, confidence, and readiness to deliver, but we did not specifically analyze this aspect. Finally, access to various computer simulation products may include associated financial costs.

Conclusion

Adolescent substance use is a major public health problem, and undergraduate nursing students are in an ideal position to receive education about the delivery of adolescent SBIRT. Nursing students demonstrated significant improvements in self-perceived competence, confidence, and readiness to deliver SBIRT. Students responded with predominantly positive feedback regarding the clinical simulation experience. In summary, an interactive computer simulation for adolescent SBIRT was successfully integrated into an undergraduate nursing school curriculum.

CRediT authorship contribution statement

Katie A. Burmester: Writing - original draft, Writing - review & editing, Visualization, Investigation, Validation. **Jai P. Ahluwalia:** Data curation, Software, Visualization, Formal analysis, Writing - original draft, Writing - review & editing, Validation. **Robert J. Ploutz-Snyder:** Data curation, Formal analysis, Methodology, Supervision, Writing - review & editing, Visualization, Software, Investigation, Validation. **Stephen Strobbe:** Conceptualization, Methodology, Validation, Visualization, Investigation, Supervision, Project administration, Writing - review & editing.

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Declarations of competing interest

None.

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