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ADVERSE SCHOOL OUTCOMES AND SEXUAL RISK BEHAVIORS AMONG HIGH SCHOOL STUDENTS WITH E-CIGARETTE AND MARIJUANA USE
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Purpose: The rapid emergence of youth-friendly nicotine-containing e-cigarettes and the increasing legality and accessibility of marijuana have led to high rates of adolescent use of these two substances. While several health risks of e-cigarette and marijuana use in youth have been described, little is known about how the use of these substances may be related to school performance and sexual behaviors in this population. We describe the associations between e-cigarette and marijuana use and adverse school outcomes and high-risk sexual behaviors in a large sample of high school students.

Methods: We used data from the two most recent waves (2015 and 2017) of the Youth Risk Behavior Survey, a nationally representative survey of high school students in the US. Our sample consisted of 30,389 students of which 26,821 (88.3%) had complete data on socio-demographic characteristics and exposure to e-cigarettes and marijuana. Participants were divided into four exposure groups for past 30-day use of e-cigarettes and marijuana: (1) no use, (2) e-cigarette-only use, (3) marijuana-only use and (4) dual use. We compared rates of e-cigarette and marijuana use for different demographic characteristics using chi-squared tests and performed multivariate logistic regressions exploring associations between e-cigarette and marijuana use and low school performance in the past year (grades that were mostly C's or lower) and high-risk sexual behaviors (3 or more sexual partners in the past 3 months and sex without a condom at last sexual encounter). Regression models were adjusted for survey year, grade, gender, race/ethnicity, sexual orientation and past-year use of alcohol and other substances. Complex sampling design was taken into account and results were weighted to reflect national estimates.

Results: Participants were primarily White (52.9%), Hispanic (22.1%) or non-Hispanic Black (13.2%) and 49.3% were female. E-cigarette-only use was reported in 7.7% of participants, marijuana-only use in 8.5%, and dual e-cigarette/marijuana use in 9.2%. Multivariable analyses revealed that youth with e-cigarette-only use had higher odds of reporting grades that were mostly C's or lower than youth with no use (adjusted odds ratio [AOR] 1.64, 95% confidence interval [CI] 1.43-1.87), which was also observed in youth with marijuana-only use (AOR 1.86, 95%CI 1.60-2.17) and dual use (1.98, 95%CI 1.67-2.35). Similarly, youth with e-cigarette-only use had higher odds than youth with no use of reporting 3 or more sexual partners (AOR 2.23, 95%CI 1.34-3.72), which was also observed in students with marijuana-only use (AOR 2.65, 95%CI 1.70-4.12) and dual use (AOR 3.52, 95%CI 2.19-5.68). However, increased odds of having sex without a condom were only seen in youth with marijuana-only use (AOR 1.41, 95%CI 1.16-1.71) and not in youth with e-cigarette-only use (AOR 0.96, 95%CI 0.77-1.19) or dual use (AOR 1.12, 95%CI 0.91-1.38).

Conclusions: We found increased odds of low school performance in all three use categories and increased yet contrasting sexual risk profiles between use groups. Considering the high prevalence of e-cigarette and marijuana use among adolescents, there is a need for effective screening and education strategies which could help mitigate adverse school outcomes and sexual risk behaviors seen in students exposed to these substances.
MANDATED PRESCRIPTION DRUG MONITORING PROGRAMS AND CHANGES IN ADOLESCENT INJECTION DRUG USE

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**Purpose:** Prescription opioid misuse among adolescents remains an ongoing public health problem and is a risk factor for injection drug use (IDU), but few studies have evaluated strategies for preventing adolescent initiation of IDU. To reduce the prescription opioid supply, almost all states have prescription drug monitoring programs (PDMPs). Many states mandate that clinicians use the PDMP before prescribing any controlled substances. The extent to which these ‘PDMP mandates’ might protect against substance use and IDU among adolescents is unknown. We sought to evaluate the relationship between state PDMP mandates and adolescent IDU.

**Methods:** We used biannual Youth Risk Behavioral Surveillance System (YRBSS) individual-level data representative of adolescents aged 17-18 years across 47 states from 1995 to 2017. Using a difference-in-differences design, we evaluated changes in the percent of adolescents reporting lifetime IDU before and after PDMP mandates in 18 states that implemented mandates prior to January 1, 2017, compared to changes in IDU over time in 29 states without PDMP mandates. We estimated linear regression models controlling for individual age, sex, race/ethnicity, state, year, and state-level poverty with standard errors clustered by state and standard YRBSS survey weights. Sensitivity analyses examined whether any potential changes in adolescent IDU might have begun to occur prior to PDMP mandates, as well as whether changes were sustained for at least two years beyond implementation. We used US Census Bureau data to estimate the number of adolescents who might have been prevented from initiating IDU if all states had implemented PDMP mandates.

**Results:** Among 331,025 students, 51.7% identified as male, 62.1% as non-Hispanic white, 17.4% as non-Hispanic black, 14.6% as Hispanic, and 5.9% as another race or ethnicity. Among all adolescents, 3.5% (95% confidence interval [CI], 2.8 to 4.2%) reported IDU prior to PDMP mandates. Baseline trends in IDU did not differ in states that did and did not mandate PDMPs (point estimate, <0.001; 95% CI, -0.001 to 0.002). PDMP mandates were associated with a 1.5 percentage point (95% CI, 0.6 to 2.4 percentage-points) reduction in adolescent IDU, a relative reduction of 42.9% (95% CI, 17.1 to 68.6%). Sensitivity analyses were consistent with the main results. Declines in IDU did not precede PDMP mandate implementation (point estimate, 0.005; 95% CI, -0.04 to 0.013). The effect of PDMP mandates persisted at least two years beyond implementation, with an associated 1.5 percentage point reduction (95% CI, 0.5 to 2.5 percentage points) in IDU, indicating the effect of the laws persisted over time. Using US Census Bureau data on the population of 17-18 year-olds in 2017, this reduction translates into 128,195 (95% CI, 51,098 to 204,992) fewer adolescents initiating IDU if all states had implemented PDMP mandates.

**Conclusions:** PDMP mandates were associated with a reduction in adolescent IDU, providing empirical evidence that PDMP mandates may prevent adolescents from initiating IDU. Policymakers might consider PDMP mandates as a potential strategy for preventing adolescent IDU.

USING A SYSTEM SCIENCE APPROACH TO UNDERSTAND HOW DYNAMIC SOCIAL COMPLEXITIES INFLUENCE ADOLESCENT AND YOUNG ADULT MARIJUANA USE

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Purpose: Social influences, including peers, are a critical contributor to marijuana use among adolescents; however, little is known about how other members of an adolescent’s social network, in particular romantic partners, affect marijuana use. The continued rise in adolescent marijuana use and the limited effectiveness of interventions to prevent adolescent marijuana use may be due to the failure to recognize the complexity of peer relationships, including developmental shifts in the prominence of peers vs. romantic partners, changes within romantic relationships, and the interconnected relationship between peers and romantic partners. We used group model building, a rigorous system science approach, to understand from youth how dynamic social complexities influence uptake, continuation and escalation of marijuana use.

Methods: Two groups of marijuana exposed youth (current users, former users, never users whose close friends/partners used), aged 15-20, were recruited from an adolescent clinic, emergency department and the community to participate in four, 2-hour workshops, held at a community location. Through structured activities (i.e. variable elicitation, behavior over time graphs), participants generated a qualitative system dynamics model in the form of a causal loop diagram (visualization tool that explains system behavior by making explicit the system structure through connected variables and feedback loops) representing critical features of the complex and dynamic social system impacting marijuana use for youth in their community.

Results: Youth (N=20) were 95% African American, 35% male, mean age 18 yrs. All participants in group 2 were retained for all four workshops, one participant in group 1 missed the 4th workshop. Participants produced a causal loop diagram, consisting of nine interconnected feedback loops. Three were balancing and six were reinforcing (virtuous and/or vicious cycles) reflecting how interpersonal interactions contribute to a high prevalence of both marijuana use and unhealthy relationship patterns at the community level. The model illustrates how marijuana is used to cope with both life and relationship stressors as well as to facilitate positive interactions with both partners and non-romantic peers. While adolescents identified how communication and supportive behaviors in romantic relationships could be protective against substance use, issues with trust and vulnerability dominate such that when conflicts arise, they increasingly resort to cycles of negative behaviors within their relationship adding to increasing relationship stress and ultimately more marijuana use. Together these impact the composition of the partner pool. Both groups independently generated the same system diagram.
**Conclusions:** The youths’ system model identified feedback loops in the peer system that may perpetuate disparities in health and social consequences. The model made explicit the connections between multilevel factors, which together maintain a high prevalence of adolescent marijuana use in their community. Rather than influence initiation as hypothesized, romantic relationships impact continuation and escalation of marijuana use. Understanding how these factors, including individual emotions, interpersonal behaviors, community context, and partner availability function as a system provides important information for designing more impactful and synergistic interventions. Findings suggest that supporting healthier relationships has the potential to make a significant impact on adolescent marijuana use making it possible to transform risk to wellness.

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**NOVEL SCHOOL-BASED SBIRT INITIATIVE IMPROVES YOUTH CONNECTION WITH ADULTS AT SCHOOL**

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**Purpose:** Schools increasingly see the connection between student health and academic achievement and can be a critical partner in improving systems of support to promote youth well-being. Screening, Brief Intervention, and Referral (SBIRT) is a promising approach to addressing adolescent risk factors, yet little is known about the use of SBIRT in schools and its impact on youth protective factors, such as connection with adults at school. Middle schools in King County, WA implemented an innovative SBIRT model this year. While traditional SBIRT focuses on substance use, this school-based approach comprehensively addresses broader risk factors and connection with a continuum of supports based on individual need. We compared youth connection with adults at school before and after participating in school-based SBIRT and assessed youth satisfaction to better understand how school-based SBIRT can improve systems of support for middle school youth.

**Methods:** Sixty-five students ages 11-14 from 10 middle schools participating in school-based SBIRT completed an electronic screening tool at baseline and a follow-up survey after program participation. We used a pre-post survey design to assess change in connection with adults at school from baseline to follow-up. Youth connection with adults at school was assessed using a 4-item scale adapted from the Student Resilience Survey. Responses from each item were summed to generate an overall school connection score. We conducted two sided paired t-tests to determine whether youth connection with adults at school was higher after participating in school-based SBIRT. Chi squared tests were used to determine if youth were significantly more likely to respond “Yes” to each of the 4 scale items at follow-up. Youth satisfaction was measured at follow-up using a 5-item scale adapted from a patient-centered care framework that asked youth to describe the proficiency of the person conducting Brief Intervention in key areas including explaining the purpose of meeting, making youth feel comfortable, listening to their story, understanding their needs, and talking about their goals. Responses were summarized by item.

**Results:** Mean youth-reported school connection scores were significantly higher after participation in school-based SBIRT than at baseline (5.8/8 vs. 6.8/8, p<0.001). At follow-up significantly more youth responded that there was an adult who cares about them (52.3% vs. 64.6%, p<0.001), tells them when
they do a good job (52.3% vs. 70.8%, p<0.001), listens to them (50.8% vs. 67.7%, p<0.05), and believes they will be a success (63.1% vs. 81.5%, p<0.001) at school. Youth reported high satisfaction with those who conducted Brief Intervention, with 90% ranking the interventionist as “good”, “very good” or “excellent” in all 5 satisfaction items.

**Conclusions:** Our results indicate that middle school youth were satisfied with the school-based SBIRT model and participation in the program resulted in increased youth connection with adults at school. These findings help improve our understanding of the impact of school-based SBIRT on youth protective factors and systems of support.

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**MEDICATIONS FOR ALCOHOL USE DISORDER AMONG MEDICAID-ENROLLED YOUTH, 2011-2016**

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**Purpose:** Alcohol use disorder (AUD) is commonly an adolescent-onset condition, and intervening early with effective treatment may avert lifelong addiction. Naltrexone, acamprosate, and disulfiram are US Food and Drug Administration-approved for treating AUD in adults over age 18, and the Substance Abuse and Mental Health Services Administration recommends considering medications for adolescents under age 18. We aimed to determine the proportion of Medicaid-enrolled adolescents and young adults (“youth”) with AUD who receive AUD medication.

**Methods:** We analyzed all inpatient, emergency department, outpatient, and pharmacy claims of 4,064,195 Medicaid-enrolled youth using Truven MarketScan data from 16 states between January 2011 and December 2016. We included youth aged 13-22 years with ≥6 months continuous enrollment who received a diagnosis of AUD. Diagnosis was based on claims with previously validated International Classification of Diseases, Ninth Revision [ICD-9] and ICD-10 diagnostic codes for AUD. We identified the proportion of youth dispensed AUD medication (i.e., naltrexone, acamprosate, or disulfiram) and/or receiving behavioral health services within 3 months of first AUD diagnosis, excluding those youth who received medication before their first diagnosis and those lacking enrollment information prior to first diagnosis. Using multivariable logistic regression, we identified differences in the receipt of AUD medication according to sociodemographic characteristics, psychiatric comorbidity, other substances used, and location of diagnosis. The study was not considered human subjects research by the Boston University School of Medicine Institutional Review Board due to use of entirely de-identified data.

**Results:** Among 10,426 youth diagnosed with AUD, 57.0% (n=5,945) were male, 61.2% (n=6,385) were non-Hispanic white, and median age (interquartile range) was 19 (18-21) years at diagnosis. Overall, 37.4% (n=3,896) of youth with AUD received any treatment within 3 months of diagnosis (i.e., AUD
medication and/or behavioral health services). Only 4.3% (n=168) were dispensed an AUD medication. Of those receiving medication, 86.3% received naltrexone, 8.9% received acamprosate, and 4.8% received disulfiram. Among those receiving any treatment, odds of AUD medication receipt were significantly lower among younger youth (age 13-15: adjusted odds ratio [AOR], 0.24; 95% confidence interval [CI], 0.11-0.52; age 16-17: AOR, 0.36; 95% CI, 0.22-0.60) compared with adults ≥21 years, and among non-Hispanic black youth (AOR, 0.42; 95% CI, 0.23-0.77) compared with non-Hispanic white youth. Odds of AUD medication receipt were higher among females (AOR, 1.63; 95% CI, 1.13-2.34) compared with males, and among individuals with another co-occurring substance use disorder (AOR, 2.89; 95 CI, 1.95-4.27). However, odds of AUD medication receipt were lower among youth who used cannabis (AOR, 0.60; 95% CI, 0.42-0.85) compared with youth who did not.

Conclusions: Among Medicaid-enrolled youth with AUD, only 1 in 3 received any treatment, and medications were only dispensed to 1 in 45 adolescents with AUD, suggesting that pharmacotherapy may be underutilized for this age group. It is especially imperative that clinicians and policymakers work to address even lower AUD medication receipt for black youth and for those who use cannabis.


18.

TRAINING IN ADOLESCENT SUBSTANCE USE AND OPIOID MISUSE IN US PEDIATRIC RESIDENCY PROGRAMS: A NATIONAL SURVEY

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Purpose: Nine of every 10 people with addiction first used substances before age 18, and opioid overdose deaths among adolescents have risen nearly threefold since 1999. However, recent data on training in substance use and opioid misuse in pediatric residency programs are lacking. We sought to describe the educational landscape of training on substance use and opioid misuse in US pediatric residency programs.

Methods: An electronic survey was distributed to pediatric associate program directors (APDs) from all 201 US pediatric residency programs through the Association of Pediatric Program Directors listserv. The survey assessed (1) whether programs are providing formal training in substance use and opioid misuse; (2) the content and format of training; and (3) interest in a shared curriculum. Surveys were completed by one APD from each program, or if the APD preferred, by a chief resident or rotation director with better knowledge of the educational content offered. Descriptive statistics were used to summarize results. Data collection is ongoing; here we report preliminary data from respondents to date (n=91; 45.3% of all pediatric residency programs). The study was approved by the Boston University School of Medicine Institutional Review Board.

Results: Among programs surveyed, 77 (84.6%) reported having a curriculum on adolescent substance use. Topics covered included screening (94.8%), brief interventions (77.9%), and treatment (50.6%).
Overall, 74 (81.3%) programs reported teaching about adolescent opioid misuse. Among these 74 programs, topics covered included: epidemiology of opioid misuse and related harms (72.9%), screening for opioid misuse (72.5%), use of medications such as buprenorphine or naltrexone to treat opioid use disorder (29.7%), emergence of high-potency opioids including fentanyl (25.7%), and how to prescribe the overdose reversal agent naloxone (21.6%). Among all residency programs, 23 (25.3%) reported that the buprenorphine waiver course was available to pediatric residents in their health system while 49 (53.9%) were unsure if the course was available. Twelve (11.4%) programs had ≥1 resident who had completed buprenorphine waiver training. Overall, 71.8% of APDs reported that their residents cared for adolescents with opioid use disorder “sometimes” or “frequently”, and 96.7% believed training about opioid misuse was “important” or “very important”. However, only 11.0% rated their overall education on opioid misuse as “good” or “very good.” Barriers to providing education about adolescent opioid misuse included insufficient faculty expertise (67.0%), curricular time (57.1%), curricular content (48.4%), and resident time (45.1%). All (100.0%) respondents reported interest in a shared, web-based curriculum on adolescent opioid misuse and related topics.

Conclusions: Although most US pediatric residency programs provide some teaching about adolescent substance use—most commonly focused on screening and brief intervention—gaps in training remain, particularly with respect to opioid misuse, treating opioid use disorder, and preventing overdose. There is broad interest in a shared curriculum to address educational gaps. Given the onset of substance use disorders during adolescence and rising youth morbidity and mortality related to opioid misuse, addressing gaps in training for pediatricians should be a priority.