Summer 8-2024

Neuroscience-based Harm Reduction Education for College Students in Portland, OR

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by

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An undergraduate honors thesis submitted in partial fulfillment of the

requirements for the degree of
Bachelor of Science

in
University Honors
and
Psychology

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Portland State University
2024

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Abstract

Harm reduction (HR) is a movement focused on reducing the harms of the opioid overdose crisis through education, advocacy, and community engagement. A key component of HR is naloxone, a medication which reverses opioid overdoses when administered. Due to increased fentanyl contamination, opioid overdose deaths have been on the rise among adolescents in the U.S and HR practices are crucially important at this point in time. In recent years, alternative curricula of HR education have included a neuroscience-based approach to the topic of substance use. While both traditional and alternative programs have had success increasing substance use literacy among adolescents, no studies to date have compared the efficacy of the two forms of HR education.

This thesis aims to compare the effectiveness of HR education with and without a neuroscience component through a survey of undergraduate students. 55 participants completed a survey assessing their knowledge, comfort, and interest in naloxone administration both before and after a video intervention. Participants were randomly assigned to a Control condition consisting of one video on naloxone administration, or a Neuroscience condition consisting of an additional video on the neurological mechanisms of naloxone. Participants completed a survey assessing their knowledge, comfort, and interest in naloxone administration both before and after a video intervention. Both conditions were effective at increasing participants' Knowledge and Comfort scores. The Neuroscience condition (M = 90%, SD = 7.9%) yielded significantly higher post-intervention knowledge scores than the Control condition (M = 83%, SD = 12.4%).

Key words: Harm reduction, naloxone, neuroscience education, substance use disorder

Introduction

Overdose History

The rate of opioid overdose deaths has steadily increased since the beginning of the first wave of the opioid overdose epidemic in the mid-1990, which was characterized by a 4-fold increase in deaths caused by prescription opioid overdoses. The second wave began as prescription opioid overdoses stabilized in 2010, and involved substantially increased mortality rates due to heroin overdose. The third wave began in 2013, when illicit fentanyl and other synthetic opioids became extremely common in the U.S substance supply. From 2013 to 2018, this third wave caused an 890% increase in mortality due to overdoses involving synthetic opioids (Jones et al., 2020). These mortality rates reached an all-time high in 2021. Of the 75,673 deaths due to opioid overdose that year, 88% involved synthetic opioids such as fentanyl (Centers for Disease Control and Prevention, 2023).

Fentanyl is a synthetic opioid, about 50 times more potent than heroin and 100 times more potent than morphine (Centers for Disease Control and Prevention, 2023). While fentanyl is used in medical settings, it can also be illegally made and added to other opioids. When this happens, these fentanyl-cut or fentanyl-laced substances make it more likely for unaware users to experience an opioid overdose. This is a prevalent health epidemic occurring throughout the U.S., and has taken a toll on Oregon. Almost 80% of the state's population resides in one of the twelve Oregon counties that have been classified as High Intensity Drug Trafficking Areas (HIDTA), where 3,455,653 fentanyl pills were seized in 2023 (Oregon-Idaho HIDTA, 2024). Unintentional opioid overdose deaths in the state have increased 5x since 2019, with a total of 1392 in 2023 (Oregon Health Authority, 2024).

Youth and young adults have been especially affected by the increased rates of fentanyl contamination. Despite steadily decreasing rates of substance use among adolescents in the U.S, they experienced the most significant increase in overdose deaths in 2020 (Friedman et al., 2022). This can be largely attributed to the concurrent rise of fentanyl availability across the nation. In 2021, 77% of adolescent overdose deaths involved fentanyl (Friedman et al., 2022). This pressing issue requires further attention in order to mitigate the increasing rates of opioid overdoses for youth populations.

Harm Reduction

A major resource throughout the increasing dangers of the overdose epidemic has been harm reduction programs. The harm reduction movement emphasizes the minimization of the negative impacts that can stem from substance use, rather than the abstinence of substance use entirely. Organizations like the National Harm Reduction Coalition (NHRC) provide resources such as training guides, free naloxone access, and fentanyl testing strips (National Harm Reduction Coalition). Harm reduction methods, especially the distribution and training of naloxone, are crucial to decreasing the rates of opioid overdoses. These practices have been proven to be more effective than abstinence-based programs to reduce smoking in high school settings, and are more applicable to a wide range of audiences (Hamilton et al., 2005).

The harm reduction movement has its roots in Europe and North America, when both regions were experiencing the HIV epidemic of the 1980s. HIV was first observed in the U.S. in 1981, and its prevalence was severely underestimated. Accurate numbers were established when the HIV antibody test was developed in 1984, with 50% of people who use substances in New York City testing positive for HIV (Jarlais, 2017). Injection substance use in particular was a

primary risk factor for contracting HIV and was associated with over 20% of HIV cases in the U.S. in 1999 (Inciardi et al., 1999). The movement to end the HIV epidemic and the harm reduction movement are intersectional, and programs that were created to support those with HIV/AIDS often chose to concurrently support people who use substances. For example, the Doctor Peter Center in Vancouver, B.C. began as a medical center for people with HIV that eventually developed their own supervised consumption room in order to reduce risk of HIV transmission and other substance-related harms (Small et al., 2005). The harm reduction movement provided an alternative to the prohibitionist substance policies of the era, such as Ronald Reagan's "Just Say No" campaign that prioritized incarceration over treatment.

Harm reduction programs, including *OEND* (Opioid Overdose Education and Naloxone Distribution) are geared toward a layperson audience, with the goal to reduce & prevent overdoses through educational efforts & initiatives, especially with training & providing naloxone. Naloxone acts as a potent, rapid-action opioid antagonist that is a first-line treatment in opioid overdoses. It requires a relatively non-invasive nasal or injectable administration, and can be used to quickly reverse opioid overdoses. However, naloxone has a short half-life of about two hours and still requires emergent care (National Harm Reduction Coalition). Providing naloxone training & supplies to at-risk communities has real potential to save lives (Lipira 2021).

Within communities with established OEND programs, statistics have shown a decreasing relationship of opioid-related death rates in those communities following OEND integration (Kerensky, 2017). Additionally, a study conducted in Massachusetts evaluated the correlation between OEND programs and opioid overdose rates and found a relationship in

which higher rates of cumulative OEND enrollment in the community correlated with lowered rates of opioid overdoses (Walley et al., 2013).

Neuroscience-based Programs

Recent studies have also found that neuroscience-based harm reduction education may have more positive impacts than harm reduction education that is not neuroscience-based. Neuroscience-based harm reduction education is rooted in scientific explanations of mental health, how substance use impacts your brain, and how to minimize the potential harms of substance use. Neuroscience-based harm reduction education has been shown to decrease the stigma around substance use by providing scientific information about the link between mental health and substance use (Debenham et al., 2020).

When undergraduate students are exposed to explanations of psychological phenomena, they also tend to rate neuroscience-based explanations as better than those that do not include neuroscience (Weisberg et al., 2015). Neuroscience-based education on harm reduction could capture more interest and minimize the harms of future substance use, specifically for undergraduate and high school students.

The Illicit Project (TIP) successfully uses neuroscience principles to teach harm reduction in Australian high schools, resulting in significant increases in substance use literacy and decreases in binge drinking post-intervention (Debenham et al., 2022). TIP focuses on four topics: information on illicit substances and the brain, the development of resistance skills, statistical data to correct overestimated rates of substance use among peers, and providing harm reduction strategies for students (Debenham et al., 2020).

Youth Resources

Most studies previously conducted about the efficacy of harm reduction programs have worked with adults over the age of 25. This makes practical sense, as the groups most likely to die from an overdose are men aged 25-34 and women aged 45-54 (National Center for Drug Abuse Statistics). However, the mortality rate due to opioid overdose among adults aged 18-24 increased by 10% annually between 2000 and 2010 (Hedegaard, Chen, & Warner, 2015) and by 94% between 2019 and 2020 (Friedman et al., 2022). There is a dire need to provide resources for young adult populations in order to mitigate these numbers. What could the impacts be if people under the age of 25 received harm reduction education about naloxone?

At the University of Southern California, in response to the opioid overdose related deaths of four students within just three weeks, a group of pharmacy students implemented an on-campus naloxone distribution and training program. Known as NaloxoneSC, the program offers both virtual and in-person naloxone education sessions as well as free, on-campus distribution and training of both naloxone and fentanyl testing strips. Between April 2021 and June 2022, over 300 students submitted requests for naloxone at USC and over 600 students have completed naloxone education since the program's inception. (Brown 2023) NaloxoneSC is entirely student volunteer run, and highlights the concern that university students hold for the opioid crisis. As demonstrated by these outcomes, implementing a similar program in a county with high overdose rates could mitigate the impacts that the opioid crisis has on college students and potentially prevent future overdoses.

The Baltimore Student Harm Reduction Coalition (BSHRC) is another student-run OEND program, and is the first of its kind in Maryland. The BSHRC provided naloxone and

naloxone training in multiple settings including support groups, local churches, and community health organizations. In a pre- and post-test study of the program, significant increases were found in participant knowledge, attitudes, and self efficacy regarding naloxone administration following the training. These results persisted at 8- and 12-month follow up surveys, with 3 successful overdose reversals reported (Lewis et al., 2016). Since their initiation in 2011, the BSHRC has expanded their services to a syringe exchange program, policy advocacy, and are currently developing a mail-order syringe program for those receiving hormone replacement therapy (HRT) in Maryland (Baltimore Harm Reduction Coalition, 2024).

Another effective school-based harm reduction program is the Drug Policy Administration's (DPA) Safety First: Real Drug Education for Teens curriculum. The curriculum was administered over the course of one semester by trained health teachers in a total of 24 freshmen health education classes in San Francisco, CA and New York, NY. The program was developed and studied in an effort to create a harm reduction program specifically aimed at teenagers, in response to recent research emphasizing the importance of contextually relevant substance use education content for younger demographics (Jenkins et al., 2017).

In a similar study to the one conducted at the BSHRC, results showed significant increases in student knowledge about harm reduction and substance use policies after the Safety First intervention. Students also demonstrated increased interest in harm reduction advocacy and decreased substance use from pre- to post-intervention. Additionally, results showed increased interest in harm reduction advocacy, including advocacy for less punitive substance use policies (Fischer, 2022). Safety First is an especially effective program as it not only increased student knowledge of harm reduction, but also decreased substance use and stigma around substance use.

Prevention and Promotion

Preventative programs, such as the ones aforementioned, are highly successful and have made a crucial difference in the overdose crisis. However, no studies to date have conducted a randomized, controlled study to compare the efficacy of different educational programs. The aim of this thesis is to examine whether neuroscience-based harm reduction education can promote interest, confidence, and knowledge in naloxone administration for college students more effectively than traditional education methods. In doing so, we can advocate for increased funding to the harm reduction program at Portland State University and additional local schools, as well as evaluate the potential implementation of a neuroscience-basis to said programs. Through compelling neuroscience-based education and awareness earlier in life, communities could attempt to get ahead of the overdose crisis.

Methods

Participants and Procedures

Eligible participants for this study were adults who were enrolled in any college course. Participants were recruited through fliers that were distributed via Portland State classes, emails, and posted publicly around the greater Portland metropolitan area. Participants included in data collection must also have fully completed survey data and measure scores within two standard deviations of the average for their condition. Additionally, included participants took a minimum of 400 seconds to complete the survey. Since Video A was 8m 36s long and Video N was 5m 36s long, the 400 second standard was designed to allow for participants who may have watched the video(s) at 2x speed.

Fliers contained a QR code that was linked to the survey, as well as a headline of either "Harm Reduction Study" or "Drug Education Study." The two headlines were intended to recruit a wider sample of participants, including those who may not be familiar with harm reduction.

This study included one initial survey (*Survey 1)* and one follow-up survey (*Survey 2*). In order to evaluate the long-term effects of the intervention, Survey 2 was completed four weeks after completion of Survey 1. Prior to both surveys, participants were presented with a consent form and a brief overview of the study.

Initial Survey

In Survey 1, participants received one of two conditions. A control group was presented with a video demonstrating how to identify an opioid overdose and administer naloxone (*Video A*). Video A was 8m 36s long, and sourced from the National Harm Reduction Coalition. An experimental group was presented with Video A, as well as an additional video explaining the neurological mechanisms of naloxone (*Video N*). Video N was 5m 36s long, sourced from the National Library of Medicine, and contains information about how both opioids and naloxone affect the nervous system. Both conditions received the same survey questions.

Prior to the intervention videos, participants were asked questions in four domains: Demographics, Knowledge, Comfort, and Interest. The 4-item Demographics section asks about college enrollment status, age, and whether the participant knows someone who has been diagnosed with Substance Use Disorder. The 8-item Knowledge section is adapted from the Opioid Overdose Knowledge Scale (OOKS) (Williams, Strang, and Marsden, 2013) and consists of questions about what actions to take in the event of an opioid overdose. The 3-item Comfort section asks participants about their self confidence in their ability to identify and reverse an

opioid overdose. The 2-item Interest section asks whether a participant has attempted to access naloxone through an organization before, and if they would be interested in a free naloxone distribution program.

Participants were then presented with the intervention (*Video A* or *Video A and N*). After watching the video(s), participants were asked to repeat the same Knowledge, Comfort, and Interest measurements along with a few additional questions. All participants were asked about any barriers they may perceive in their current access to naloxone, and asked whether they were aware of and interested in the on-campus PSU Harm Reduction Program. Participants were provided with the information of local naloxone distributors, including Portland State's Harm Reduction Program, and encouraged to contact them. To conclude Survey 1, participants were thanked for their time and asked to enter their email address in order to receive Survey 2.

Follow-up Survey

Four weeks after the completion of Survey 1, participants were contacted via email with a link to access Survey 2. After signing a consent form, participants were asked about whether they had accessed or administered naloxone in the past four weeks, as well as any barriers they may have faced in doing so. Additionally, participants completed four items from the Knowledge section in Survey 1 to check for knowledge retention.

Results

Participant Demographics

The first survey collected a total of 90 responses. 33 of these responses were excluded from analysis because they were incomplete, 2 responses were excluded due to having results that were more than two standard deviations from the mean for their condition, and 9 participants were excluded for taking less than the minimum of 400 seconds to complete the survey. 28.07% of participants were aware of PSU's Harm Reduction Program, but only 10.57% had previously participated in it. 60.34% of participants reported knowing someone diagnosed with Substance Use Disorder (SUD) and 17.5% of participants had previously attempted to access naloxone through an organization..

Original Sample

The following results are from the original dataset, prior to controlling for the time taken to complete the survey. Of the 55 original responses, 26 had been assigned to the Neuroscience condition (Videos A and N), and 29 were assigned the Control condition (Only Video A). In the Control condition, there was a significant increase in the Knowledge score from pre-intervention (M = 69%, SD = 17.6%) to post-intervention (M = 83%, SD = 12.5%);t(28) = -3.949, p = <.001. In the Neuroscience condition, there was also a significant difference in the Knowledge measure from pre-intervention (M = 74%, SD = 14.3%) to post-intervention (M = 87%, SD = 9.2%);t(25) = -5.172, p = <.001.

In the Control condition, there was an increase in the average Comfort measure score from pre-intervention (M = 48%, SD = 28.5%) to post-intervention (M = 76%, SD = 18.8%);

t(28) = -6.392, *p* = <.001. However, among participants aged 25+ in the Control condition, there was only a significant difference in the Comfort measure from pre-intervention (M = 51%, SD = 31.9%) to post-intervention (M = 78%, SD = 16%); t(9) = -3.727, *p* = .008, with no significant difference in the Knowledge or Interest measures. In the Neuroscience condition, there was a significant difference in the Comfort measure from pre-intervention (M = 58%, SD = 21.5%) to post-intervention (M = 79%, SD = 15.1%); t(25) = -5.754, *p* = <.001 (Figure 1).

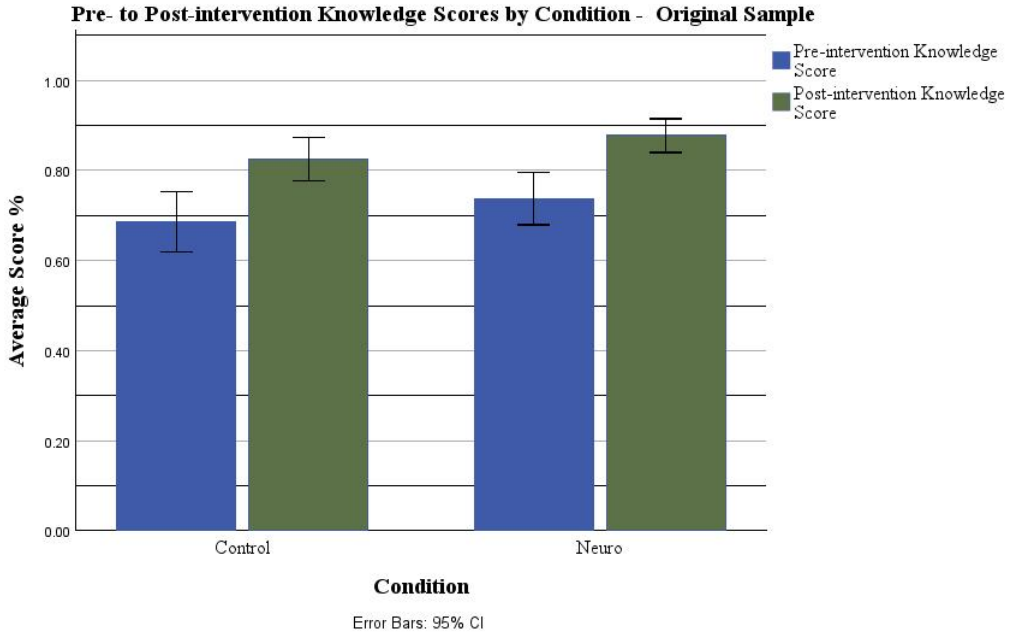

Figure 1. Pre- to Post-intervention Knowledge Scores of the Original Sample.

12 participants reported perceived barriers in their access to naloxone. The most common barrier was a lack of information, as participants were unsure of where to go to get naloxone or how to administer naloxone if needed. The second most common barrier was cost. Participants also reported being unsure of how often naloxone would be needed, and believed you require a prescription to access it.

This Knowledge, Comfort, and Interest data from the original sample was deemed unreliable because a significant number of participants took less than the minimum time to complete the survey, and these participants may not have watched the intervention video(s). The data was rerun after excluding these participants, and those results are shown below.

Survey 1

Knowledge

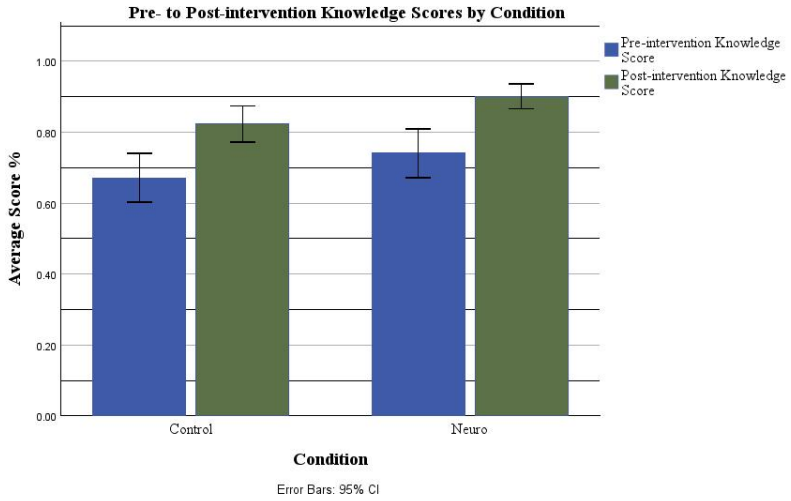

Figure 2. Average Pre- to Post-intervention Knowledge Scores by Condition.

Post-intervention Knowledge and Comfort scores were high in both conditions, with the Neuroscience condition (M = 90%, SD = 7.9%) averaging higher post-intervention than the Control (M = 83%, SD = 12.4%); t(44) = -2.410, p = .020 (Figure 2). In the Control condition, there was a increase in the Knowledge measure from pre-intervention (M = 67%, SD = 16.2%) to post-intervention (M = 83%, SD = 12.4%); t(23) = -3.742, p = .001. In the Neuroscience condition, there was also a significant increase in the Knowledge measure from pre-intervention (M = 74%, SD = 15.5%) to post-intervention (M = 90%, SD = 7.9%); t(21) = -5.343, p = <.001.

In the Control condition, post-intervention scores on the knowledge measure varied between people aged 18-25 (M = 87%, SD = 9.4%) and 25+ (M = 73%, SD = 13.3%); t(22) = 2.903, *p* = .008 (Figure 3). On average, people over the age of 25 had higher post-intervention scores on the Knowledge measure when assigned to the Neuroscience condition (M = 88%, SD = 9.6%) over the Control condition (M = 73%, SD = 13.3%); t(14) = -2.652, *p* = .019. There was no significant difference between conditions in the post-intervention Knowledge score among people who are under the age of 25.

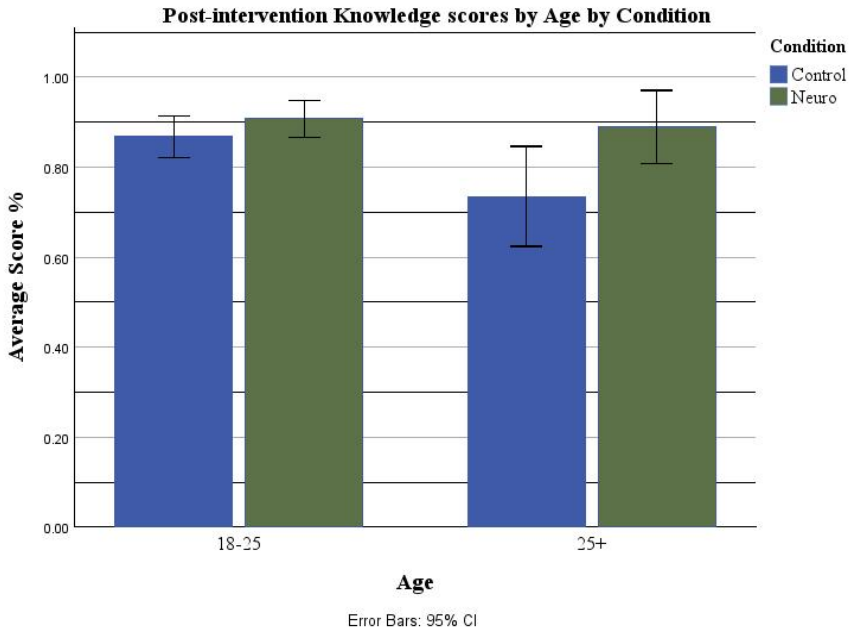

Figure 3. Average Post-intervention Knowledge Scores by Age by Condition.

People who scored above the median pre-intervention Knowledge score of 65% also achieved higher post-intervention Knowledge scores when assigned to the Neuroscience condition (M = 92%, SD = 7.8%)than the Control condition (M = 92%, SD = 12.7%); t(24) = -2.232, *p* = .035. Participants who scored below 65% showed no significant difference in post-

intervention Knowledge scores depending on the assigned condition. Participants over the age of 25 who also know someone with SUD achieve the highest pre-intervention Knowledge scores (M = 82%, SD = 14.4%).

Comfort

In the Control condition, there was a significant increase in the Comfort measure from pre-intervention (M = 42%, SD = 24.5%) to post-intervention (M = 75%, SD = 17.9%); t(23) = -7.264, p = <.001. There was also a significant increase in the Comfort measure from pre-intervention (M = 57%, SD = 20.7%) to post-intervention (M = 82%, SD = 10.9%); t(21) = -6.624, p = <.001 found in the Neuroscience condition. However, when we examine people aged 25+ in the Control condition, we find that they exclusively have significant increases in the Comfort measure pre-intervention (M = 38%, SD = 21%) to post-intervention (M = 72%, SD = 12.5%); t(7) = -4.690, p = <.001. People aged 25+ assigned to the Control condition did not have any significant differences in their Knowledge or Interest scores from pre- to post-intervention. Additionally, people over the age of 25 have higher post-intervention scores on the Comfort measure when assigned to the Neuroscience condition (M = 88%, SD = 09.9%) rather than the Control condition (M = 72%, SD = 12.5%); t(14) = -2.797, p = .014.

Interest

There were no significant changes in the Interest measure from pre- to post-intervention for any population. There were also no significant differences between the pre- or post-intervention Interest scores between any populations. However, it's important to note that both pre- and post-intervention Interest scores were very high. In the Control condition, pre-intervention scores averaged at 79% (SD = 41.4%) and post-intervention scores averaged at 91%

(SD = 28.2%). In the Neuroscience condition, pre-intervention scores averaged at 77% (SD = 42.8%) and post-intervention scores averaged at 86% (SD = 35.1%).

Survey 2

Participant Retention

16 participants completed the follow-up survey, resulting in a 28% retention rate from the initial survey. Of these participants, 7 were aged 18 - 25 and 8 were aged 25+. 7 participants had been assigned to the Control condition, and 8 participants had been assigned to the Neuroscience condition.

Knowledge Retention

The average score on the Knowledge Retention measure for Survey 2 was 80%. There were no significant differences found between the post-intervention Knowledge score from the initial survey and the Knowledge Retention measure from Survey 2. There were also no significant differences found on the Knowledge Retention scores between conditions or age groups.

Access

No participants had administered or attempted to access naloxone since the initial survey. 60% cited there being no barriers that prevented them from attempting to access naloxone during the 4-week period. Two participants reported that they had no need to, since they already had their own supply. Two participants reported that they were either traveling or in rural areas with limited access to naloxone.

Discussion

Both the Control and the Neuroscience conditions were highly effective at increasing the Knowledge scores from pre- to post-intervention. The highest post-intervention Knowledge score was 100% in both categories, with an average score of 90% in the Neuroscience condition and 83% in the Control condition. While the Neuroscience condition yielded significantly higher results than the Control, the Control condition still demonstrated adequacy in increasing scores from pre- to post-intervention.

More detailed results demonstrate that a neuroscience-based harm reduction curriculum can be more effective for some groups than others, with two major predictors being age and proximity to SUD. People over the age of 25 had significantly higher scores on both Knowledge and Comfort when assigned to the Neuroscience condition. When assigned to the Control condition, people over the age of 25 exclusively demonstrated significant score increases in the Comfort measure, and not in Knowledge or Interest. The reasoning behind this is unclear, but may be explained by the fact that there are more harm reduction programs tailored towards adults, and adults are more likely to have accessed harm reduction services (Kimmel et al., 2021). As such, they may already be aware of the content in Video A and find the content in Video N more intellectually stimulating, resulting in higher Knowledge scores. Note that the condition had no effect on the Knowledge or Comfort scores of people under the age of 25.

People who reported knowing someone with SUD also had higher Knowledge scores when assigned to the Neuroscience condition ($M = 91\%$, $SD = 6.9\%$) instead of the Control condition ($M = 82\%$, $SD = 11.8\%$). This may be due to previous exposure to harm reduction education as well. 15.4% of participants who know someone with SUD had previously attempted

to access naloxone, in comparison to 5% of participants who do not know someone with SUD. Participants who have previous knowledge of harm reduction principles may benefit from more comprehensive education, such as an explanation of how naloxone and other substances chemically work in the brain. This idea is further supported by the fact that participants with a high pre-intervention Knowledge score of 65% or above score significantly better post-intervention when assigned to the Neuroscience condition rather than the Control condition regardless of age or proximity to SUD. Additionally, people over the age of 25 who also know someone with SUD have the highest pre-intervention Knowledge scores.

At the 4-week follow up, no participants had attempted to access or administer naloxone. However, it's important to note that 90% of participants post-intervention reported being interested in participating in a free naloxone distribution and training program. Due to this study's small sample size and limited time period of 4 weeks between Surveys 1 and 2, it is reasonable to assume that increased time before follow-up may influence how many participants seek out naloxone. Participants also reported multiple barriers to accessing naloxone, including living in rural areas, cost, and misinformation. Despite the lack of naloxone, participants in both conditions demonstrated high knowledge retention and had little difference in their Knowledge scores at the 4-week follow up.

Limitations and Future Directions

This study has several limitations. The first limitation is brief length of the intervention. Conversely, many harm reduction programs consist of long-term, in person instruction with the opportunity for participants to ask questions and to gain more information than is possible with a short survey. Additionally, this survey focused only on naloxone. Harm reduction education

frequently encompasses many other factors such as syringe exchange programs, substance testing strips, and other safer use practices. This study also focuses on one university in Portland, Oregon and has a relatively small sample size of 46 participants. As such, this study may not be representative of the general U.S. population.

Another limitation of this study is the time it took participants to complete the survey. Video A was 8m 30s and Video N was 5m 36s, but many participants took less than 5 minutes to complete the entire survey. To address this, we analyzed the data both with and without participants who took less than 400 seconds to complete the survey. The revised data has less statistical power due to the reduced sample size, but may have clearer insights on the efficacy of harm reduction education. The effects of the intervention videos are difficult to determine, as we must assume many participants didn't fully finish the video regardless of the time taken to complete the survey.

Further studies are needed to determine the best practices for harm reduction education for varying populations. Going forward, longitudinal studies including follow-up surveys at one year would be beneficial to evaluate knowledge retention and interest in harm reduction. Future research should also use a method that involves providing participants with naloxone in order to increase accessibility, as well as educate participants on additional facets of harm reduction e.g., syringe exchanges and fentanyl testing strips. It may also be beneficial to ask participants if they have previously administered naloxone or have a supply in their possession prior to the intervention. I would also urge future researchers to expand their Interest measures to specifically include volunteering for, working for, or attending a harm reduction service of any kind.

Conclusion

This study aimed to compare the effects of traditional and neuroscience-based harm reduction education on the knowledge, comfort, and interest of college students. Our results showed that both forms of education were effective at increasing the knowledge and comfort scores of all participants under the age of 25. Participants who are over the age of 25 or know someone diagnosed with SUD had the most significant increase in knowledge and/or comfort scores when assigned to the Neuroscience condition. Neuroscience-based harm reduction education is a useful resource that can provide potentially lifesaving information, especially for people who already have a foundational knowledge of harm reduction. However, any harm reduction intervention is effective at improving participants' knowledge and comfort in naloxone administration.

Acknowledgements

There are many people to thank for their support and encouragement throughout this project. To my advisor Dr. Rebecca Cantone, thank you for taking a chance on a cold email from an undergraduate student. Your guidance has been invaluable over this past year, and has inspired me to continue the path to a career in research.

To my advisor Dr. Eric Mankoswki, thank you for taking the time to help me through IRB submissions, data analysis, and every other aspect of the project. Your class on Community Psychology helped spur the idea for this study, and your continued support allowed me to see it through to the end.

To my friends and loved ones who have cheered me on over this past year, I cannot overstate my appreciation for you all. I would not have been able to complete this project without your encouragement.

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