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Original Article

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Feasibility of a cinematic-virtual reality training program about opioid use disorder for osteopathic medical students: a single-arm pre–post study

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Abstract

Context: Opioid use disorder (OUD) has a considerable morbidity and mortality in the United States. Healthcare providers are key points of contact for those with OUD; however, some providers may hold stigma toward OUD. Stigma toward OUD can lead to lower quality of care and more negative health outcomes. Thus, new trainings designed to reduce stigma toward OUD while increasing empathy are critical. We created a web-based cinematic virtual reality (cine-VR) training program on OUD for osteopathic medical students.

Objectives: The aim of this pilot study was to assess changes in stigma toward OUD and empathy before and after the online cine-VR training program on OUD.

Methods: We employed a single-arm, pre- and posttest pilot study to assess changes in stigma toward OUD and empathy. Osteopathic medical students from one large medical school in the Midwest with three campuses were invited to participate in the online cine-VR training. Participants completed two surveys before and after the cine-VR training. We performed paired t tests to examine changes in stigma toward OUD and empathy scores before and after the cine-VR OUD training program.

Results: A total of 48 participants completed the training. We observed a decrease in stigma toward OUD posttraining (t=4.402, p<0.001); this change had a Cohen's d of 0.64, indicating a medium effect. We also observed an increase in participants' empathy scores posttraining (t=−2.376, p=0.023), with a Cohen's d of 0.40 signifying a small effect.

Conclusions: Findings from this pilot study suggest that the online cine-VR training may reduce stigma toward OUD while increasing empathy. Future research employing a randomized controlled trial design with a larger, more diverse sample and a proper attention control condition is needed to confirm the effectiveness of the online cine-VR training. If confirmed, this cine-VR training may be an accessible approach to educating osteopathic medical students about OUD.

Keywords: empathy; medical education; opioid use disorder; stigma; virtual reality

Opioid use disorder (OUD) is defined as a pattern of opioid use that leads to clinical impairment [1]. In the United States, OUD is associated with high rates of morbidity and mortality [2]. From 2001 to 2016, opioid-related deaths increased by 345 % in the United States, signaling opioid-associated premature death as a major public health issue [2]. Most recently, drug overdose deaths rose 15 % between 2020 and 2021 [3]. The physical and psychosocial toll of the SARS-CoV-2 pandemic (COVID-19 pandemic) likely contributed to increased opioid use and related deaths [4]. From 2019 to 2022, opioid-related overdose deaths rose from 49,860 to 81,806 in the United States [5]. This rise in opioid overdoses has impacted the health profession. Healthcare providers have had to respond to the increase in overdoses and hospitalizations by offering

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different approaches to pain management, emphasizing opioid agonist treatment (OAT) [6], while coping with burnout, compassion fatigue, safety and security concerns, and stigma [7, 8].

People with OUD may not readily admit their condition to healthcare providers for fear of being labeled "drug seekers," [9] although they often display signs of dependence noticeable to providers. For this reason, healthcare providers are key points of contact for those with a substance use disorder (SUD). However, people with OUD experience more negative attitudes and bias from the healthcare system. A systematic review in 2013 by van Boekel et al. [10] examined 28 studies about providers' attitudes toward people with SUDs, and found that providers generally held a negative attitude toward people with SUDs. In this systematic review, evidence suggested that providers held a lower regard, less motivation, and feelings of dissatisfaction when working with people with substance abuse disorders, like OUD [10]. Thus, negative attitudes toward substance abuse disorders may act as a barrier to people in need of behavioral health [11]. Another study by Stone et al. [12] in 2021 found that primary care providers' stigma toward OUD decreased their likelihood of prescribing Food and Drug Administration (FDA)-approved medications (i.e., methadone, buprenorphine, and extended-release injectable naltrexone) as well as reduced their support for policies designed to increase access to these OUD medications. These findings support the development of targeted interventions aimed at reducing stigma toward SUDs, like OUD, and its treatment.

Interventions designed to reduce stigma and improve empathy have been attempted and successful to a certain degree [13–15]. A 2021 study by Mort et al. [16] utilized a two-arm, parallel design to randomize osteopathic medical students to a modified contact-based education panel or a didactic lecture to reduce stigma. The modified contact-based education panel exposed second-year osteopathic medical students to providers who treated people with OUD and one person in recovery from OUD, whereas the didactic lecture included instruction on different types of opioid and nonopioid treatments for acute pain [16]. Findings showed that both the modified contact-based education panel and the didactic lecture reduced stigma toward OUD, with no statistical differences between the two educational methods [16]. Interestingly, this study also found that lower levels of stigma toward OUD were associated with medical students' intention to prescribe opioid agonist therapy (OAT) after graduation.

However, negative attitudes can be persistent and new approaches to changing healthcare providers' and trainees' stigma toward SUDs are needed. One promising approach is virtual reality (VR). VR can help learners build knowledge of abstract ideas based on simulations of real-life-experiences. VR has been shown to significantly decrease stigma scores toward mental illness [17] and address negative attitudes towards type 2 diabetes [18]. Current uses of VR in medical education mainly consists of surgical simulations and anatomy education [19]. Utilizing VR to address stigma toward substance abuse disorders is limited, with one prior study by Christofi et al. [20] in 2020 examining stigma and empathy with computer-generated VR and drug use (i.e., cocaine). Further, there remains a gap in knowledge regarding the use of VR in medical education, specifically osteopathic medical education [19].

Cinematic-VR (cine-VR) may be one approach to addressing abstract concepts like stigma toward OUD and empathy. Cine-VR utilizes 360-degree video to film live images captured through a camera. It differs from traditional VR in that it utilizes actors and scripts to tell the story, whereas traditional VR utilizes computer-generated worlds and characters. Cine-VR is a more immersive experience that allows the viewer to see and hear the virtual world as if they are in the virtual environment. For the purposes of this study, we created a cine-VR training program focused on OUD to give osteopathic medical students access to real life-like medical encounters without risk or harm to them or the patient. Further, the cine-VR OUD training program offered medical students a glimpse into the life of a patient and their environment.

We conducted a pilot study with an online interactive OUD cine-VR training program with osteopathic medical students. The purpose of the cine-VR training program was to determine its feasibility as well as to assess changes in stigma toward OUD and empathy.

Methods

The study design was a single-arm, pretest posttest pilot trial to assess changes in stigma toward OUD and empathy after participating in an online interactive cine-VR training program. We employed a pilot study design to evaluate the feasibility of our methods and procedures to determine if a larger-scale randomized controlled study was viable. Pilot studies are essential for determining feasibility, identifying problems with the research protocol, assessing the study design, and calculating sample size [21].

Ethics approval

Ethics approval for the study was obtained from the Ohio University Office of Research Compliance Institutional Review Board (Institutional Review Board # 22-X-18). In complying with federal, state, and local laws and regulations for human subjects, we ensured that our research met the requirements

set forth in the regulations on public welfare in Part 46 of Title 45 of the Code of Federal Regulations (45 CFR 46); the principles are set forth in "The Belmont Report," and the Helsinki Declaration of 1975. Informed consent was obtained from all participants and all participants consented to be included in the study.

Cine-VR episode content

The cine-VR episodes were designed to educate medical students about OUD, social determinants of health, and implicit bias. In the "Using Virtual Reality to Visualize the Opioid Crisis" cine-VR training program, participants watched 12 cine-VR episodes, ranging in length from 2 to 5 min. The main character, Destiny, is a 23-year-old woman from Appalachian Ohio who is pregnant and battling opioid addiction. Destiny lives in the same town where she grew up. Her mother and siblings live in an abusive home where Destiny refuses to stay. Instead, she lives with her abusive and unsupportive boyfriend who also has OUD. Destiny reaches out for help to her grandmother, but her grandmother stigmatizes her because of her OUD and threatens to take her unborn baby away. Despite Destiny's struggles, we learn about the strengths she finds in her desire to be a good mother, as well as the resiliency one person can have if providers invest the time to connect with her. In the cine-VR episodes, participants observe Destiny interacting with physicians, nurses, social workers, family, employers, and the community.

Cine-VR episode format

The cine-VR training contains two six-episode story arcs. The first cine-VR story arc focuses on Destiny's relationship with her obstetrical nurse, and the second series focuses on the relationship with her social worker. In the first story arc, the first episode depicts a suboptimal clinical interaction between Destiny and her obstetrical nurse, with her nurse blaming her for delaying her first prenatal visit until she was 6 months along and for utilizing opioids while pregnant. This is followed by three cine-VR simulations that open narrative windows into her daily life, her world, and her struggles. The fifth and sixth episodes of each series are "guided simulations," or pre-recorded cine-VR face-to-face conversations, with Destiny's provider and Destiny herself. These high-stakes conversations give participants a chance to practice difficult conversations without the pressures of being watched or failing. Participants are encouraged to speak predetermined dialogue to the character and listen for responses. For the first series, the "guided simulation" includes a conversation between the participant and the obstetrical nurse. The participant assumes the role of a colleague and points out how blame and stigma negatively impact care and follow-up. The second "guided simulation" gives the participant an opportunity to recreate the initial visit to correct the "errors" from the first clinical interaction. This six-video pattern repeated with a social worker focusing on OAT for OUD and identifying a support system.

Cine-VR training program curricular content

To complete the cine-VR OUD training program, we developed curricular content to be taught synchronously with the cine-VR episodes. The curriculum included 12 brief modules or reflections that reinforced the key takeaways from each cine-VR episode. Cine-VR episodes 1–4 and 7–10 focused on social determinants of health and implicit bias (i.e., stigma toward OUD), whereas episodes 5–6 and 11–12 emphasized clinical pearls to improve patient-physician communication and build trust. The key takeaways from each cine-VR episode focused on the following content: (1) bias toward OUD; (2) lack of transportation; (3) job insecurity; (4) childhood trauma; (5) interprofessional communication; (6) motivational interviewing (Part 1); (7) connecting patients with community resources; (8) housing insecurity; (9) living below the federal poverty level; (10) lack of supportive relationships; (11) identifying strengths in Destiny's life; and (12) motivational interviewing (Part 2). Integrity of the content was ensured via written materials, a peer-review process of all materials, and user testing of the website.

Online cine-VR website

The cine-VR training program is on a website hosted on the university domain. The cine-VR episodes were viewed in two-dimensional videos utilizing a computer, laptop, or smart device. Participants could move their cursor or smart device in any direction to see the 360-degree video. This created an active viewing experience with the participant choosing what they want to focus their attention on, which in turn increased immersion as well as engagement in the cine-VR. For example, observant participants may have noticed subtle details, such as Destiny's boyfriend's heroin on the kitchen counter or the cigarette butts left in dirty dishes. In turn, participants may have felt a sense of accomplishment as they noticed subtle details planted by the filmmaking team, which in turn may have heightened their viewing experience.

Pilot study recruitment

Osteopathic medical students were recruited from a large medical school in the Midwest with three campuses. An

electronic, anonymous survey was distributed to all osteopathic medical students enrolled at a medical school in the Midwest with three campuses during the summer of the 2021–2022 academic year. The email invitation was sent by the study investigator (DR) through school-maintained class listservs. All osteopathic medical students enrolled during the 2021–2022 academic year were eligible to participate in the study; there were no exclusion criteria. The study opened on June 6, 2022, and closed on July 18, 2022. Participation in the study was completely voluntary.

Power analysis

We did not conduct an *a priori* power analysis for this pilot study. We followed the recommendation by Lancaster et al. [22] to recruit a sample size of 30 participants. When we recruited a minimum of 30 matched pairs, we closed recruitment for the pilot study.

Theoretical frameworks

For the cine-VR training program, we applied three learning frameworks. First, we applied Vygotsky's [23] "scaffolding theory" to our cine-VR education. Scaffolding is a technique in which new information is introduced gradually with sufficient structure and support to assist the learner. As the learner progresses throughout the cine-VR training, the learner/participant will become more independent and the level of support will taper [23]. This allows the participant to acclimate to the new material at their own pace. Second, we created the cine-VR training program based on the core elements of Adult Learning Theory [24]. Specifically, we facilitated self-directed learning by allowing osteopathic medical students to take the initiative to enroll in the cine-VR training. Additionally, the online cine-VR training program was task-oriented allowing the participant to exercise problem-solving skills to solve unanswered questions posed in each cine-VR episode and reflection. Third, the foundation for our cine-VR rested on the theory of Recursive Reminding, or why "errors enhance learning." [25] Learning about errors facilitates retrieval of the original episodic event in which both the mistake and correct answer were embedded. According to this theory, the learner should able to remember the context of the error as well as the surrounding context where the correction was applied. We intentionally filmed scenes with negative clinical interactions and situations (episodes 1–4 and 7–10) to provide "correct answers" in the guided simulations (episodes 5–6 and 11–12) so that the participant can integrate the information into memory and improve future clinical practice.

Measures

To assess the feasibility of the cine-VR OUD training program, we measured recruitment, retention, length of time required to recruit, rate of completion of the cine-VR training program, and feasibility of the data-collection measures. Additionally, participants provided sociodemographic factors (age, gender, race, ethnicity, year in school) and completed the following measures:

Adapted Opening Minds Survey for Health Professional Students [26, 27]: A 20-item scale that measures stigma toward OUD. The 20 items are answered on a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). Total scores were summed for a composite stigma score (minimum=20, maximum=100). The scale demonstrates good internal consistency (Cronbach's alpha=0.85).

Jefferson Scale of Empathy Healthcare Provider Students Version [28]: A 20-item scale that measures empathy. The 20 items are answered on a seven-point Likert scale, ranging from 1 (strongly disagree) to 7 (strongly agree). 10 questions are worded positively, and 10 questions are worded negatively. Scores are summed for a composite score (minimum=20, maximum=140). The scale demonstrates good internal consistency (Cronbach's α=0.85).

Data collection

Participants completed the demographic questions, Adapted Opening Minds Survey for Health Professional Students, and the Jefferson Scale of Empathy via the online questionnaire service Qualtrics (Qualtrics, Provo, UT). All participants provided online informed consent. Completion of the measures took approximately 10–15 min. For completing the study, participants received a $25 gift card as compensation. To receive the gift card, participants clicked on a separate Qualtrics link that was not connected to their survey responses. This step was necessary to ensure that their survey data was not linked to their identity. However, given the anonymous nature of the study, it was possible that participants received compensation without completing all of the pre-and postmeasures. Participants with questions about the study were directed to email or call the principal investigator (EAB).

Statistical analysis

Initial analysis examined distribution and other descriptive data to ensure that the data met the assumptions of statistical tests. We assessed participants' demographic factors

Table 1: Demographic characteristics of participants (n=48).

Variable	n (%)
Age (mean±standard deviation)	24.5±2.1
Gender	
Woman	38 (79.2)
Man	10 (20.8)
Nonbinary	0 (0)
Transgender	0 (0)
Genderqueer	0 (0)
An identity not listed	0 (0)
Race	
Asian/Pacific Islander	9 (18.8)
Black/African American	2 (4.2)
Middle Eastern	2 (4.2)
Multiracial	1 (2.1)
White	34 (70.8)
Ethnicity	
Hispanic/Latino	1 (2.1)
Year in program	
OMS I	5 (10.4)
OMS II	21 (43.8)
OMS III	15 (31.3)
OMS IV	7 (14.6)

OMS, Opening Minds Stigma Scale.

utilizing descriptive statistics and presented them as means and standard deviations or sample size and percentages. Next, we assessed skewness and kurtosis to determine which statistical test to utilize to analyze the pre-post data. The values for skewness and kurtosis were between −2 and +2, which is considered acceptable for a normal distribution [29]. Then, we performed paired sample t tests to examine changes in stigma toward OUD and empathy before and after the cine-VR OUD training program. In addition, we calculated effect sizes utilizing Cohen's *d*, with a small effect=0.2, medium effect=0.5, and a large effect=0.8. We defined statistical significance as a p value less than 0.05 and conducted analyses in SPSS statistical software version 29.0 (SPSS Inc., Chicago, IL).

Results

Feasibility

All osteopathic medical students at the Midwestern medical school were invited to participate. We successfully recruited 48 participants in less than 6 weeks. All 48 participants completed the online cine-VR OUD training program for 100 % retention. No technological difficulties were reported with the website or cine-VR episodes. The self-reported completion time ranged from 90 to 120 min. Lastly, we received no negative feedback about the cine-VR OUD training program.

For our assessment, 48 participants (48/1,011, 5 % response rate) provided informed consent to participate in the pilot study (Table 1). The mean age of participants was 24.5±2.1 years. Thirty-eight participants (79.2 %) self-identified as women, and 10 self-identified as men (20.8 %); no other genders were self-reported. Participants self-identified their race as follows: 9 (18.8 %) Asian or Pacific Islander, 2 (4.2 %) Black or African American, 2 (42 %) Middle Eastern, and 34 White (70.8 %); also, one participant (2.1 %) self-identified as Hispanic/Latino. Participants from all4 years of medical school were represented, with the most from the second year (n=21, 43.8 %).

Stigma towards OUD findings

Baseline OUD stigma scores ranged from 39.0 to 67.0, with a mean and standard deviation of 52.7±7.9. Post-cine-VR training OUD stigma scores ranged from 12.0 to 64.0, with a mean and standard deviation of 42.0±16.2. Comparison of mean OUD stigma scores showed positive changes in total stigma (mean change=10.8, t=4.402, p≤0.001, Table 2). This change had a Cohen's d of 0.64, indicating a medium effect. This finding suggests that the cine-VR OUD training may reduce participants' stigma toward OUD.

Empathy findings

Baseline empathy scores ranged from 60.0 to 123.0, with a mean and standard deviation of 88.7±14.6. Post-cine VR

Table 2: Mean changes in opioid use disorder (OUD) stigma and empathy before and after an online OUD virtual reality (VR) training (n=48).

	Presurvey	Postsurvey	Mean change	*t* value	p-Value	Cohen's *d*
OUD stigma scores (n=48)	52.7±7.9	42.0±16.2	10.8	4.402	<0.001	0.64
Empathy scores (n=36)	88.7±14.6	93.8±16.0	5.1	−2.376	0.023	0.40

training empathy scores ranged from 72.0 to 126.0, with a mean and standard deviation of 93.8±16.0. Note, only 36 of the 48 participants provided complete empathy data for the analysis. Paired t tests revealed improvements in participants' empathy scores (mean change=−5.1, t=−2.376, p=0.023, Table 2), with a Cohen's d of 0.40 signifying a small effect. This finding suggests that the cine-VR OUD training may increase empathy.

Discussion

In this pilot study, we examined the feasibility of a cine-VR OUD training program. In addition, we assessed changes in osteopathic medical students' stigma toward OUD and empathy before and after participating in the online OUD cine-VR training program. Overall, we showed that the cine-VR OUD training program was feasible, with 100 % retention and no reports of technological difficulties. Post-VR training, we observed improvements in both stigma toward OUD and empathy. These improvements suggest that the online cine-VR training program decreased stigma toward OUD while simultaneously increasing empathy. Importantly, this pilot study did not include a control condition or a measure for long-term follow-up to determine the sustained impact of the cine-VR training program on stigma and empathy. To confirm the effectiveness of our online OUD cine-VR training program, future research should employ a randomized controlled study design with a larger, more heterogenous sample of osteopathic medical students.

Few evidence-based interventions exist that address stigma toward OUD in medical students. A study, by Moses et al. [30] in 2022, found that an opioid overdose prevention and response training program with 34 medical students increased their knowledge about opioid overdose, actions to be taken during overdose, and naloxone use as well as improved their perceived comfort and ability to respond to an OUD overdose. Posttraining changes in stigma toward OUD were observed in three of 11 scale items, such that students were less likely to agree that "Patients with SUDs are particularly difficult for me to work with" and "There is little I can due to help patients with SUDs," and more likely to agree to "I can usually find something that helps patients with SUDs feel better." When compared to a control group of 67 students who received a standard OUD curriculum, scores for knowledge and attitudes toward OUD increased in both groups, with the intervention arm showing greater improvements [30]. Additionally, improvements in medical students' knowledge about opioid overdose and actions to be taken during overdose persisted at 6-month follow-up; stigma was not assessed at 6-month follow-up due to minimal changes post-training [30]. A similar study by Berland et al. [31] in 2017 piloted an opioid overdose prevention training with 73 first-year medical students and documented improvements in knowledge about and preparedness to respond to opioid overdoses. No changes were observed in attitudes toward patients with substance abuse disorder [31]. Finally, a 2022 study by Bascou et al. [32] also found that an opioid overdose prevention program improved knowledge about OUD, increased confidence in utilizing naloxone and treating an overdose, and reduced stigma toward OUD among medical students. Thus, implementing opioid overdose prevention training in osteopathic medical schools could be part of the solution to destigmatizing the workforce. Further, combining our cine-VR training program with opioid overdose prevention training may augment the effect on stigma toward OUD.

Finally, training that emphasizes treating the whole person and providing empathy-driven care is a pillar of osteopathic medicine. Integrating the osteopathic tenets into OUD-related training increases physician empathy and improves patient satisfaction [33]. Cine-VR inherently captures all aspects of a patient and not just the physical symptoms of a condition. In our cine-VR OUD training program, osteopathic medical students not only saw that but also felt as if they were a part of a patient's life outside the clinic. For example, students experienced Destiny's abusive relationship, financial struggles, stigma from healthcare providers, and barriers to abstinence from opioids in the cine-VR simulations. Experiencing the content viscerally from another's point of view, may partially explain the observed increase in empathy [34]. A study by Schutte and Silinovic [35] in 2017 [35] compared the delivery of educational content via VR to a didactic presentation in a sample of 24 undergraduate students to examine changes in empathy. Participants in the VR arm reported higher levels of empathy postintervention compared to the control condition [35]. Moreover, this study showed that increased engagement via VR mediated the relationship to higher empathy levels [35]. Thus, empathy may be a key construct moving forward in reducing stigma toward OUD. Future research needs to examine the potential mediating role of empathy in our cine-VR and its effects on stigma toward OUD.

Limitations

Limitations of this study include the small and homogenous sample, selection bias, nonresponse bias, subject bias, and lack of a control group. Although a final sample of 48 participants was small, it was sufficient to pilot the online cine-VR training program. Also, it is important to note that we had

complete empathy scores for only 36 of the 48 participants, which introduces nonresponse bias. Data from one osteopathic medical school limits the generalizability of the findings to all osteopathic medical students; however, the findings suggest that the methods and procedures of the pilot study can be replicated for a larger educational trial. A future trial should include a more diverse sample of osteopathic medical students from multiple colleges of osteopathic medicine. Next, our findings may be susceptible to selection bias, because individuals who volunteered to participate may have been more willing or motivated to participate in this online VR training program about OUD. In addition, the responses may be susceptible to social desirability bias given that the participants may have felt undue pressure to provide positive responses on the training session. A similar susceptibility to subject bias may be ascribed to the use of new technology encouraging people to provide positive feedback. Finally, this pilot study presents findings from a 2 h cine-VR training program on OUD. We did not include a control condition as a comparison group. To determine the effectiveness of the cine-VR OUD training program, future research necessitates a randomized-control design to compare the effectiveness of the OUD VR-training arm vs. an attention control arm to assess changes in osteopathic medical students' stigma toward OUD and empathy.

Conclusions

We created an online cine-VR training program focused on addressing OUD and associated biases. Findings from our pilot study suggest that this cine-VR training may reduce stigma toward OUD and increase empathy among osteopathic medical students. More research is needed to compare the cine-VR training to a proper control condition to confirm the effectiveness of the training. If confirmed, this cine-VR may provide a novel and accessible way to enhance the application of osteopathic principles in medical education about OUD.

Research ethics: The study was approved by the Ohio University Office of Research Compliance (Institutional Review Board #22-X-18).

Informed consent: All participants provided electronic informed consent. Informed consent was completed prior to participation in the study.

Author contributions: All authors provided substantial contributions to conception and design, acquisition of data, and analysis and interpretation of data; all authors drafted the article or revised it critically for important intellectual content; all authors gave final approval of the version of the article to be published; and all authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Competing interests: None reported.

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Data availability: All data are available upon request to the corresponding author.

Disclaimer: Dr. Beverly, who is a Section Editor for the *Journal of Osteopathic Medicine*, was involved neither in the peer review of this manuscript nor the decision to publish it.

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