Exploring Open Educational Resources (OER): OER Awareness and Perceptions within STEM Fields

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Article

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Abstract: Open Educational Resources (OER), educational materials permit unrestricted use and adaption, have proven beneficial for cost savings and curriculum flexibility. However, OER are not frequently used in college courses. An OER initiative was designed to understand the factors contribute to increasing access to STEM course materials. This study employed a survey to investigate faculty awareness and usage of OER and explore support needed to increase the use of OER in STEM. Results indicated that one-sixth of the respondents were unaware of OER, and 53% had never used OER. The motivating factors for OER usage included cost-free licenses, day-one availability to students, and increased access. The support strategies for new OER creation included OER workshops, grants, and recognition for OER authoring. In conclusion, the current study fills a gap in the existing literature by documenting motivating factors for faculty to integrate OER into STEM for the first time.

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1. Introduction

Making the study of STEM (science, technology, engineering, and mathematics) fields more affordable, inclusive, and equitable is critical for meeting the contemporary challenges in the 21st century. Open Educational Resources (OER) -- teaching and learning materials that reside in the public domain or have a Creative Commons (cc) license that permits free use and adaption by others -- have the potential to broaden STEM education [1].

The term OER was originated by the United Nations Educational, Scientific and Cultural Organization (UNESCO) in 2002 and was followed by the creation of the cc license by Stanford University in 2003, which enabled the free distribution of OER materials [2]. Further development defined the 5 Rs, which are the permissions openly granted to users of OER, including retain (e.g., the ability for users to retain copies of resources), reuse (e.g., the ability to use resources for multiple purposes), revise (e.g., the ability to modify or translate resources), remix (e.g., the ability to blend or combine two resources), and redistribute (e.g., the ability for users to share resources freely) [2]. For educational materials, licenses can be categorized into three types, including copyright, public domain, and creative commons (cc). Of these, a cc license permits the usage and reuse of educational materials freely, with some rights reserved only [3].

Figure 1 summarizes OER and its key benefits to students, its license type, and its impacts on STEM education. Research studies indicate that the use of OER in higher education is commonly associated with increased access, cost savings for students and colleges, flexible evolving content, and day-one readiness in a classroom setting (Figure.1).

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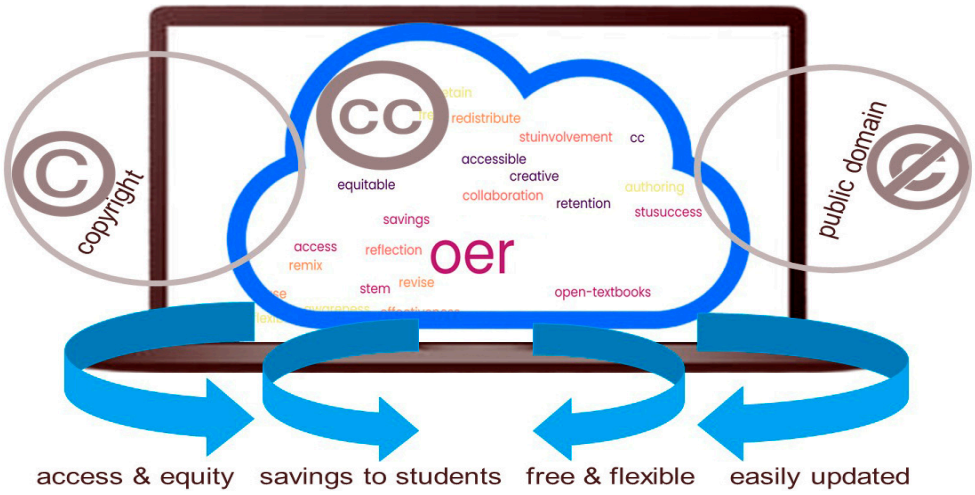

Figure 1. A summary of characteristics of Open Educational Resources (OER). License type, benefits, and impacts of OER. Abbreviations: C, copyright; cc, creative commons; and public domain, no license.

Cragwall's [4] OER study of the Introduction to American Government course at Pellissippi State Community College in Tennessee indicates that some disciplines may benefit from OER without sacrificing the quality of content. Bahamon's [5] study of a C Programming course at the University of North Carolina indicates that OER not only helped address high textbook costs but also had positive student outcomes. Johnson et al.'s [6] pilot study of the Intro Programming class at Georgia's Gwinnett College indicates that OER accomplished its mission by providing both low-cost course materials and students' self-confidence results as good as or better than commercial textbooks.

Even though their fast growth among several universities and community colleges has been documented, there is limited evidence regarding OER usage in higher education. Therefore, an OER in STEM initiative was developed to increase knowledge about OER and enhance teaching and student learning at the university. As a result, the OER initiative at the university has focused on four activities, including an OER curation website at FAMU (https://cst.famu.edu/departments-and-centers/OER.php), a Twitter handle for OER in STEM fields (https://twitter.com/OERonSTEMcenter), an STEM faculty development workshop at FAMU, and an online STEM faculty survey on OER awareness at the university. As part of the initiative, the FAMU OER workshop provided information for faculty to locate, adopt, combine, and create OER content to provide important learning tools and educational experiences for undergraduate courses in STEM. The workshop organizer (G.H.), an OER textbook author of "From Growing to Biology: Plants 1e" [7], helped workshop attendees learn how to find and use OER resources at FAMU. Furthermore, the OER workshop was also presented to the faculty at the University of Tokyo, Japan, as a Fulbright lecture [8].

Since using zero-cost OER enables students to have free access to open course materials, universities can benefit from their full potential as well. There are various types of OER materials, including open textbooks, online tutorials, learning modules, videos, and open courseware. OER can be created and built on OER platforms such as university libraries (e.g., Florida State University Libraries), commons (e.g., OER Commons), or OER self-publishing companies (e.g., Presbooks, LibreTexts). Furthermore, OER can be produced and published in various formats, including online (e.g., Html, pdf, epubs, plugins) and through learning management systems (e.g., Moodle), as well as in print on demand (e.g., hard copy materials).

High textbook prices are increasing the challenges for access to textbooks. According to a study at Washington State University, students from culturally diverse backgrounds and first-generation college students were more likely to drop a course if textbook prices were high cost [9]. About 64% of college students nationwide skip textbook purchases or take fewer courses because of the cost of textbooks, and this trend worsened during the pandemic [10]. Griffiths et al.'s [11] study of 11 U.S.

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community colleges indicates that students who took OER courses made greater progress toward a degree than those who took non-OER courses. Marsh et al.'s [12] study of Intro Biology at a two-year community college indicates that OER helped reduce equity gaps in STEM fields. As a result, several OER platforms have started, including MERLOT (Multimedia Education Resource for Learning and Online Teaching), OpenStax (at Rice University), OER Commons, and Open Textbook Library (at the University of Minnesota), to provide no-cost access and cc licensed textbooks.

Studies at the University of Pikeville in Kentucky have found that 62% of students from courses using OER showed greater engagement, and 65% of students showed better academic performance compared to non-OER courses [13]. Furthermore, another study at Brigham Young University has found significant differences in course completions and class achievements favoring OER usage group students [14]. Another study of OER at the University of Georgia showed that OERs not only increased savings but also improved grades and decreased D/ F/ Withdraw (W) grades for students receiving Pell Grants, part-time students, and underserved students [15]. A study in state universities in Nigeria has found that faculty had a favorable perception of OER and suggested encouraging undergraduate students to utilize OER textbooks [16].

Previous research initiated at Florida A&M University (FAMU) indicates that adaptive, innovative instructional strategies play a significant role in increasing student interest in STEM education and improving student success [17–19]. In an earlier study, a flipped teaching method coupled with an active learning curriculum and education technology were implemented at FAMU. More specifically, increased student learning gains were reported in flipped General Biology course sections compared to traditionally taught sections [20]. Similarly, an undergraduate STEM study focused on first-year Scientist Life Skills (ISC1058) courses at FAMU. Students who were enrolled in the ISC1058 course improved their growth mindset scores and second- semester grade point averages (GPA) [21].

Many university campuses in Florida are currently focused on textbook affordability. At FAMU, a new OER on STEM initiative (OER on STEM Center, 2022) was initiated to understand what factors encourage STEM faculty to adopt and use OER. The study shows that increased awareness and future use of OER by faculty are essential.

Although the creation and dissemination of OER continues, there are few data on its awareness and usage. The main objectives of the current study were: (1) to learn about STEM faculty experiences and opinions related to OER; and (2) to improve faculty awareness of how to adopt, modify, remix, and create OER in STEM fields in the future.

2. Materials and Methods

2.1. Population and Site

The current study explored university STEM faculty awareness, perceptions, and experiences of OER materials generally. The target population for this study was full- or part-time STEM faculty members of the university (FAMU). Florida A & M University (FAMU), part of the State University System of Florida, serves over 9,000 students and employs approximately 70 faculty in STEM fields. The study site presents a unique opportunity since there is limited literature on OERS in HBCUs. FAMU has been recognized as being the highest-ranked public HBCU, number 92nd-ranked national public university, and number 13th in social mobility [22]. FAMU is devoted to student success at all levels, including undergraduate, graduate, and professional education, through innovative teaching, research, service, and scholarship. Furthermore, FAMU's strategic priority number one is to elevate student success outcomes, including retention and graduation [23].

2.2. Faculty Survey Design

An electronic survey was designed to assess faculty's thoughts, experiences, and knowledge toward OER via using Qualtrics software (Qualtrics, Provo, UT, USA). The survey included multiple-choice, multiple answers, and free-response questions and was administered to university (FAMU) faculty. Survey questions asked participants about current academic rank, teaching area, OER awareness, OER usage, motivation factors to use OER, as well as support strategies needed to create

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an OER. The survey, with an informed consent statement, was distributed to faculty via email. The survey was anonymous, and themes and frequency of answers were identified and presented in the results section. The survey was administered through Qualtrics online, and participation was voluntary. This research was approved by the Institutional Review Board (IRB) at Florida A&M University.

2.3. Data Collection and Analysis

The current study was undertaken during the Spring 2022 semester following approval from the university's Institutional Review Board. Data were collected and organized according to the online survey's question framework.

3. Results

3.1. Survey Participants and Rank

This study included a total of 42 participants from faculty across the campus. As shown in Figure 2A, participants represented professors (31%), associate professors (26%), assistant professors (20%), and instructors (23%). Participants also indicated which STEM discipline(s) they were affiliated with at the university (FAMU).

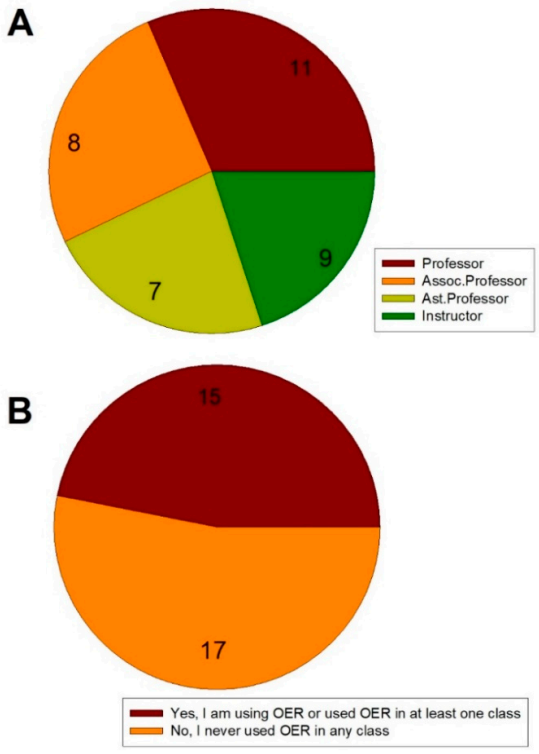

Figure 2. (A) Faculty academic ranks of survey participants. (B) Faculty responder usage of Open Educational Resources (OER).

3.2. OER Awareness and Adoption

As shown in Figure 2B, results indicated that 53% of the participants were unaware of OER. Figure 3A shows that, of OER-using faculty, about 25% selected OpenStax as their OER textbook source.

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Participants who had never used OER indicated the following reasons: I cannot find OER for my course (30%), the instructor does not pick the textbook (30%), and the effort needed to adopt OER (10%) (Figure 3B).

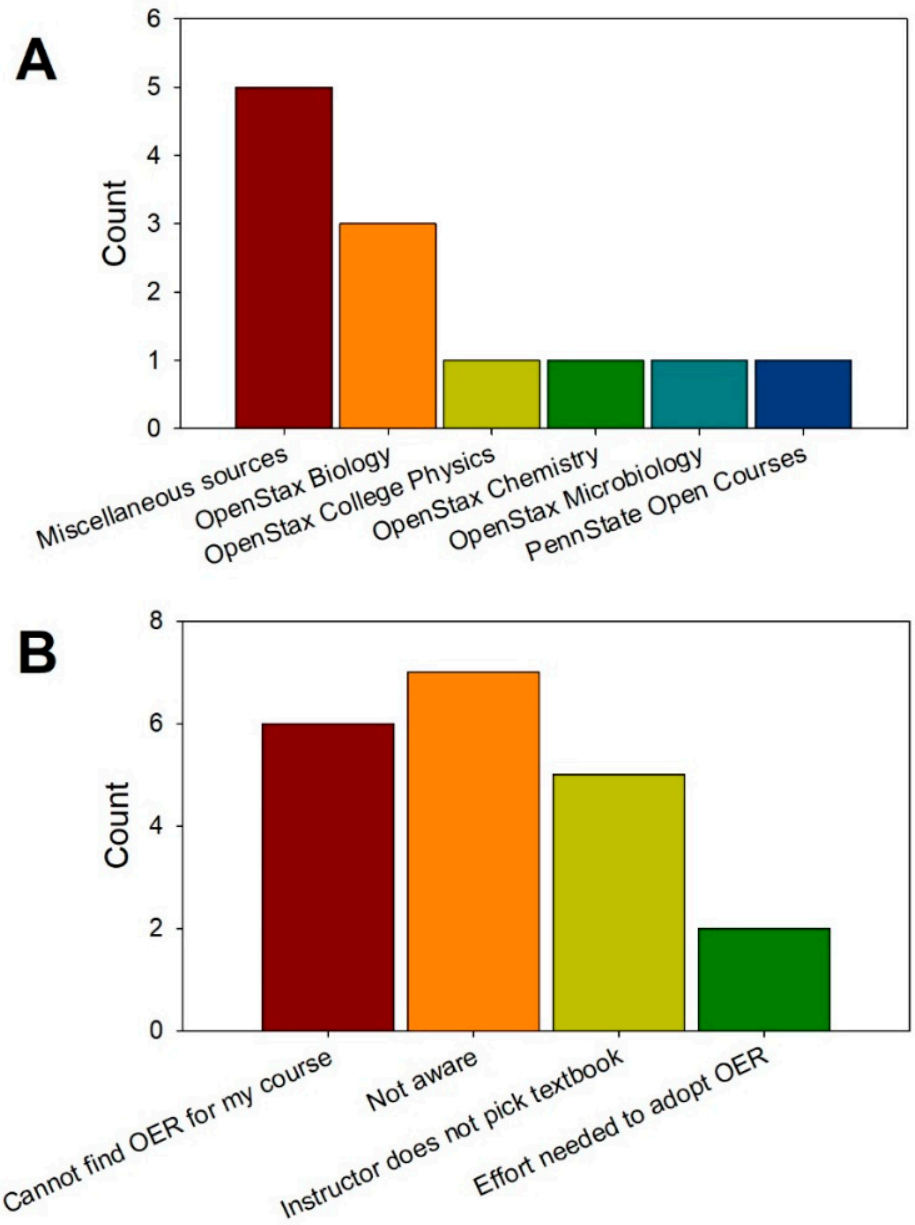

Figure 3. Response count for (A) Specific Open Educational Resources (OER) used by faculty participants. (B) Reasons for not using Open Educational Resources (OER).

3.3. Factors that Motivate OER Adoption

Results from all respondents indicated primary motivations for OER use, especially after learning about OER in the university STEM workshop. 42% of respondents indicated that a major motivation would be the free cost to students, 36% of the participants indicated the day-one availability of course materials in the classroom setting, 22% of the participants indicated the promotion of increased access and equity, and 13% of the participants indicated that the current textbook was not meeting their needs (Figure 4A).

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3.4. Strategies Needed for New OER Creation by Faculty

Results regarding support strategies that would contribute to increasing new OER creation showed the following requests by the faculty: 42% of the participants indicated that OER workshops would be effective in motivating them to create OER, 36% of the participants indicated that OER grants would be motivational, and 22% of the participants indicated recognition for OER authoring (Figure 4B).

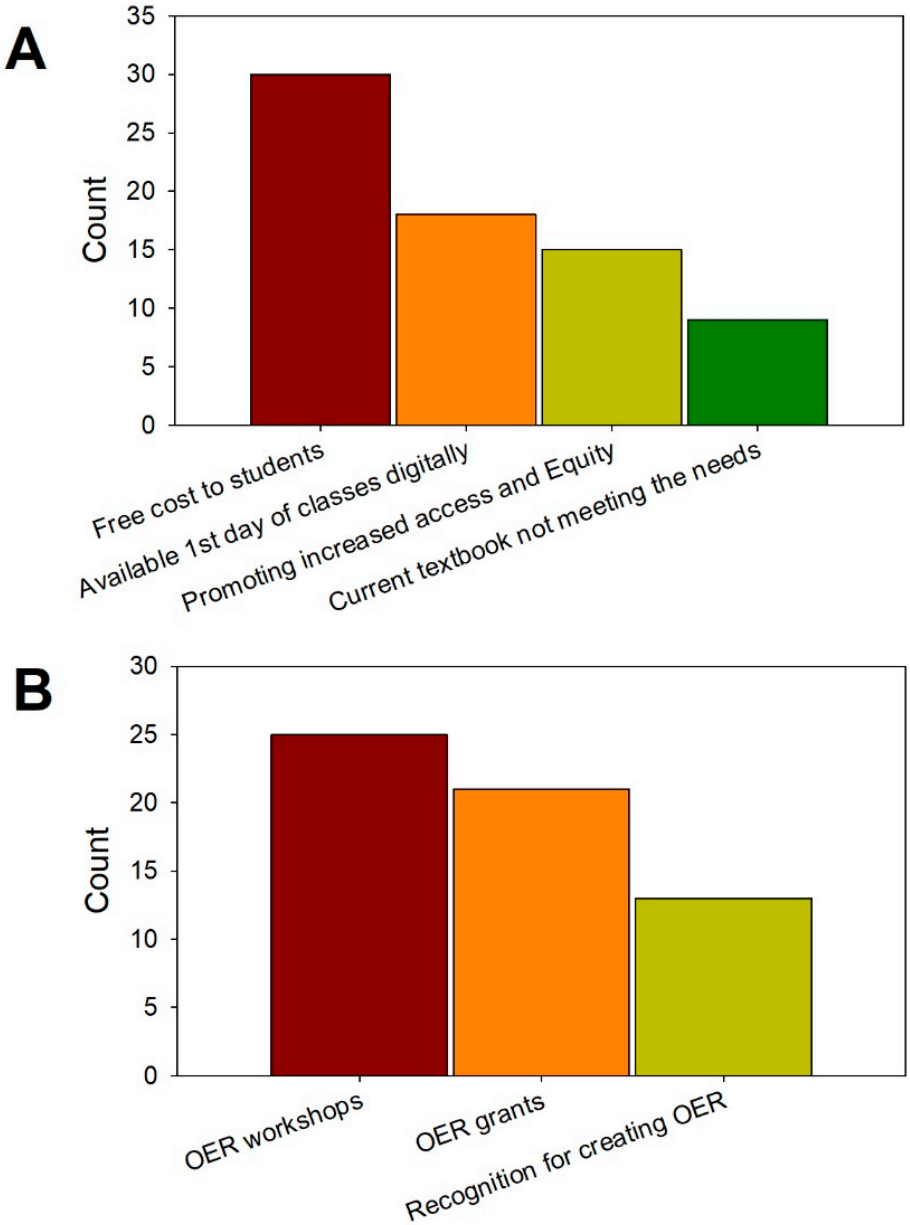

Figure 4. Response count for (A) Motivating factors for faculty Open Educational Resources (OER) creation. (B) Support strategies to increase new Open Educational Resources (OER) creation by faculty.

4. Discussion

The COVID-19 pandemic has significantly disrupted many aspects of daily life, especially education globally, by forcing over one billion students out of school (Hacisalihoglu, 2020). Consequently, mandatory online learning increased the demand for digital educational content and

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OER's popularity. In response to this demand, universities and libraries started initiatives to create digital content and repositories for OER to increase access and make textbooks fully available online.

Expansion of STEM OER is critically important, not only for textbook affordability but also to increase the accessibility of learning materials, to enhance learning experiences, and to give faculty greater freedom in their teaching materials or supplements (Figure. 1). As a result, OER initiatives have been growing on many university campuses. However, there are numerous barriers to wider OER adoption, including the need to review and verify OER quality, the effective utilization of OER, the need for assessment tools, and the need for instructional design resources for learning management system (LMS) readiness. Hence, further studies in OER areas could be considered for addressing these barriers at the campus level and beyond.

In this study, we describe the current OER status at a medium-sized state university in Florida to better understand STEM faculty perceptions and awareness of OER availability and usage. This survey of educators was possible due to a CASL leadership project on broadening STEM participation in higher education.

Previous research indicates that if OER were used in a course, significantly fewer students dropped a course while student performance and grades were higher, compared to a course that used commercial textbooks [24]. This research was consistent with another OER impact study at Brigham Young University that showed that no-cost OER in General Chemistry did not adversely affect student grades, and student grades were equal or better when compared to commercial textbooks sections [25]. Although no post-OER usage benefits were investigated in the current study, we speculate that the OER option will likely benefit our STEM students, which is consistent with previous studies.

The current study highlighted several findings about HBCU STEM faculty experiences with OER as well as how to improve faculty awareness and future adoption, adaption, and creation of OER on STEM.

First, our results showed that 47% of FAMU faculty had some OER awareness, while 35% were completely unaware (Figure 2B). This is consistent with previous studies, which have shown that while over the past 20 years, OERs have grown worldwide, less than 50% of college faculty are aware of OERs [26]. Secondly, our results revealed that faculty overwhelmingly needed support such as OER workshops and OER grants (Figure 4B).

5. Conclusions

This project is related to the leadership of broadening participation by fostering an initiative that empowers individuals from all backgrounds to have increased access to textbooks. Effective leadership in broadening participation entails creating opportunities to actively support the full spectrum of STEM participation among all participants.

The use of OER materials has been emerging and growing fast, especially since the COVID-19 pandemic. OER can make STEM learning more accessible with their cost-free and flexible licensing. Because OER materials often help all students obtain textbooks on day one of a course, OER can help them achieve their full academic potential. This study of the importance of faculty awareness and motivation to use and create OER should serve as a springboard for further study of OER adoption, adaption, creation, and usage, especially in STEM fields. Further studies could also evaluate OER perception and use in non-STEM fields. These results are also limited because they were collected at a single HBCU (FAMU). Therefore, they do not capture or represent the perception and awareness of OER at all higher education institutions.

Thus, we propose the following recommendations for universities interested in increasing use of OER and increasing future usage of OER within the STEM fields:

1. Holding workshops to improve faculty awareness, consideration, use, and advocacy of OER
2. Encouraging faculty-faculty collaborations in OER development, adoption, modification, remixing, and creation
3. Developing faculty grant initiatives to promote and support OER usage and faculty OER authorship

4. Increasing OER discoverability so that they could be more easily located by faculty and students; and
5. Providing faculty with resources and time to locate OER in their disciplines

The findings provide a foundation for future studies on OER at HBCUs and beyond. Based on the findings presented in this study, we recommend that universities create institutional initiatives to foster OER production as well as adoption across the STEM fields. OER has enormous potential to improve STEM student success as well as STEM equity and participation for the future.

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Institutional Review Board Statement: The current study was undertaken following approval from the university's Institutional Review Board. Data were collected and organized according to the online survey's question framework.

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Conflicts of Interest: The authors declare no conflicts of interest.

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