Original Paper

Online Rural Provider Training on Adverse Childhood Experiences: Evaluation of Knowledge Translation and Sustainability

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Abstract

Background: In the United States, 63.9% of adults report ≥1 adverse childhood experience (ACE), and 17.3% report ≥4. The presence and number of ACEs increases the odds of opioid misuse, overdose, and suicide. Rural children are more likely to experience ACEs. Despite ACEs' well-documented sequela, a large proportion of providers are unaware of their detrimental effects, creating a significant need for training. There is limited research on ACEs workforce training.

Objective: The objective of this study is to evaluate the implementation of an online ACEs training to cross-sector providers in 5 high-needs rural counties, assess knowledge to action, and the sustainability of that action.

Methods: The online training was launched through the university's Extension Canvas platform in May 2024. The training content included 5 modules. Recruitment occurred through networking, internet searches, and snowball recruitment. To receive credit for completion, participants were required to complete a pretraining survey, 6 discussion assignments, 5 quizzes, and a posttraining survey. This evaluation used a single group, pretest-posttest design with data collected at 3 time points (pretraining, posttraining, and follow-up approximately 9 months after the course opened). Wilcoxon signed-rank tests compared pre- and posttraining knowledge of ACEs and ACEs-related practice patterns. Conventional content analysis was applied to short answer, open-ended questions to identify patterns and initial codes, with the coding scheme then applied to individual responses.

Results: A total of 150 providers living and/or working in 5 rural Missouri counties requested training enrollment. Of those, 125/150 (83.3%) were enrolled and 114/150 (76%) accessed the training. Of those who accessed the training, 98/114 (86%) completed the pretraining survey and 55/114 (48.2%) completed the verifiable requirements of: (1) a pretraining survey; (2) 6 discussion assignments; (3) 5 quizzes, earning a score of >80% on each; and (4) a posttraining survey. A total of 40 posttraining survey responses were linked to the pretraining survey. In total, 11 participants completed the follow-up survey. Most participants intended to apply the training content to their personal life (36/40, 90%) and work or practice (35/40, 87.5%), and felt confident to implement the knowledge gained (37/40, 92.5%). ACEs knowledge increased significantly from pre (medians 3.0-4.0, IQRs 2.0-5.0) to post (medians 5.0, IQRs 5.0-5.0) training, *P* values <.001. Median practice pattern ratings were the same at posttraining and follow-up time points for all items.

Conclusions: Broad challenges in translating research into practice and policy underscore the continued importance of accessible, cross-sector ACEs workforce training, especially in rural areas. Given attrition, interpretation of findings is limited to participants who completed the training and associated assessments. Findings demonstrate the effectiveness, acceptability, knowledge to action, and sustainability of an ACEs training to a broad cross-sector of rural providers.

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KEYWORDS

adverse childhood experiences; training; trauma-informed care; rural; workforce

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Introduction

There is a significant need to train providers in the well-documented sequela of adverse childhood experiences (ACEs). Knowledge translation is defined as "a dynamic and iterative process that includes the synthesis, dissemination, exchange and ethically sound application of knowledge to improve health, provide more effective health services and products, and strengthen the health care system" [1]. The failure to translate research into practice and policy is a consistent finding from clinical and health services research [2]. In the United States, 63.9% of adults report ≥1 ACE, and 17.3% report ≥4 ACEs [3]. ACEs are defined as physical, emotional, or sexual abuse; physical or emotional neglect; having a household member with a serious mental illness, substance use disorder, or who is incarcerated; or witnessing intimate partner violence [4]. Cumulative ACEs exposure is associated with an increased risk of substance misuse [5,6], opioid misuse [7], overdose [8], and suicide [9].

The need to translate ACEs research into practice and policy is even greater in rural areas. Rural children are more likely than their urban peers to experience most ACEs [10]. US mortality rates have been rising, especially for adults in rural areas [11]. The largest contributors are "deaths of despair," that is, deaths from suicide and drug poisoning, including from opioids and alcohol [12]. Emergency department visit rates are also rising in rural areas, particularly for Medicaid beneficiaries and those without insurance [13]. Individuals with ≥4 ACEs are more likely to use the emergency department as their usual source of care, and are more likely to have public health insurance or be uninsured than those with no ACEs [14].

A large proportion of providers are unaware of the detrimental effects of ACEs [15,16]. Among primary care providers, many reported that they were not knowledgeable (19/72, 26.4%) or somewhat knowledgeable (39/72, 54.2%) about the effects of ACEs [16]. Moreover, despite nearly all (69/72, 95.8%) reporting that formal ACEs training would be beneficial, most (65/72, 90.3%) had not received such training. Another study found that just 19.5% (44/226) of physicians and resident physicians in a Midwest health care system had knowledge of the ACEs screening questionnaire and few (8/226, 3.5%) had used it in their practice [17]. Furthermore, cross-sector training opportunities are necessary to maximize population health impact. In a sample of students studying to become licensed public-school teachers, 70.7% (53/75) had heard of ACEs, but of those, only 43.4% (23/53) could provide an accurate definition [18]. More than three quarters of the sample reported that ACEs education was not part of their formal training, yet 89.3% (67/75) believed that ACE awareness would help them better support students. An online ACEs training format may be more accessible for busy professionals than in-person [15]. Finally, research on the sustainability of ACEs training is limited. In a systematic review evaluating the effects of trauma-informed staff trainings, 9 of the 14 studies that assessed knowledge, attitudes, or behaviors also assessed whether improvements were sustained 1 or more months after the training [19]. Of these, only 7 found sustained improvements, 3 of which were in trauma-informed behaviors.

The objectives of this study are to (1) report on the implementation and evaluation of an online ACEs training to a targeted cross-sector rural provider population; and (2) assess ACEs knowledge to action, and the sustainability of that action. This study follows "type 3 evidence," which shows how and under what conditions interventions were implemented and how they were received [20].

Methods

Study Design

This evaluation used a single group pretest-posttest design. Data were collected at the following three time points: (1) pretraining (after enrolling but before accessing the course content), (2) posttraining (immediately after completing the course), and (3) follow-up (launched approximately 9 months after the course opened).

Participants

Providers living and/or working in Missouri's rural Crawford, Dent, Phelps, St Francois, and Washington counties were eligible to enroll in the "Adversity to Action" ACEs online training. Counties are defined as rural (ie, nonmetro) based on the 2023 Rural-Urban Continuum Codes. According to the Missouri Department of Health and Senior Services (DHSS), these counties ranked worst in the state on all drug overdose mortality rates in 2021, behind only St Louis City, [21] and are among the top 23 counties most vulnerable to opioid overdoses [22]. Within the 5 target counties, providers from a diversity of professions and sectors were recruited, including health care, behavioral health, housing, law enforcement, daycares, child and family services, corrections, local public health agencies, schools, libraries, emergency medical services, social services, and nonprofit organizations. Conception of this work was informed by the life-course multilevel framework of factors involved in high and rising mortality [23] when considering cross-sector representation from community meso-level structures and how those structures intersect with individuals across the life-course.

Training Development

The Adversity to Action training was implemented through the University of Missouri (MU) Extension's online Canvas learning platform (Instructure) as an asynchronous training opportunity. Approximately 85% of Missourians have access to internet that meets broadband criteria [24]. While some rural communities remain constrained by limited broadband infrastructure, asynchronous, flexible online training offers an efficient modality for reaching a wide audience while reducing barriers of travel distance, transportation, and time constraints to attend scheduled, in-person events. Adversity to Action was tailored to the end user with actionable steps in mind. The Knowledge to Action process includes 7 phases [25]. The translation of these steps to this project is reported in Table 1 and the course outline is provided in Table 2. This training is modified and builds from a previously developed, implemented, and tested ACEs statewide training targeted to rural health care providers [26,27]. Modifications included explanation as to why these 5 counties were targeted; review for outdated links, references,

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clarity, or streamlining; expansion of content on positive childhood experiences and resilience; addition of tailored community resources; and the addition of deidentified impactful quotes from previous participants.

Table 1. "Knowledge to Action" steps and their translation to Adversity to Action study.

Knowledge to Action step [25]	Translation to Adversity to Action
Identify a problem that needs addressing	Strong body of evidence supports ACEs[a] association with adverse adult behaviors and health outcomes. Outcomes are often worse in rural areas. Providers are unaware of detrimental effects of ACEs. Knowledge to action is needed.
Identify, review, and select the knowledge or research relevant to the problem (eg, practice guidelines or research findings)	Training content included United States Preventive Services Taskforce recommendations and evidence grades associated with ACEs, among other research and literature.
Adapt the identified knowledge or research to the local context	Training designed in Canvas for dissemination through trusted Extension partner, with content tailored to Missouri including risk/needs and local resources available.
Assess barriers to using the knowledge	Online training was designed to be asynchronous to accommodate user needs and schedules. Continuing education was provided to incentivize users. Technical assistance was provided to support users in acclimating to the platform. Reminders were sent to encourage users who enrolled in the training to complete it.
Select, tailor, and implement interventions to promote the use of knowledge (ie, implement the change)	Content included: • Literature on benefits or perceived harms of screening, evidence for screening • Screening tools • Positive childhood experiences and how to identify and encourage them • Actionable steps for trauma informed organizations
Monitor knowledge use	Conducted via tracking spreadsheet for recruitment, eligibility, enrollments, completions, pre/post survey completion
Evaluate the outcomes of using the knowledge	Conducted via pre/post surveys
Sustain ongoing knowledge use	Conducted via follow-up survey

[a]ACE: adverse childhood experience.

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Table 2. Adversity to action course outline.

Module	Content
Module 0: Getting Started	• Welcome and Eligibility • Eligibility Quiz • Who Can Take This Training? • Funding • Why Is This Training Important? • Why Dent, Washington, Crawford, St. Francois, and Phelps Counties? • Drug Overdose Facts by County • About This Course • Demographic Survey • Meet the Instructor • Acknowledgments • Discussion
Module 1: What Are Adverse Childhood Experiences?	• Overview • Original Adverse Childhood Experiences • Expanded Adverse Childhood Experiences • Discussion • Quiz
Module 2: How Do Adverse Childhood Experiences Impact Health?	• Overview • The Impact of Adverse Childhood Experiences on the Developing Brain • The Impact of Adverse Childhood Experiences on Adult Health • The Impact of Adverse Childhood Experiences – Depression • The Impact of Adverse Childhood Experiences – Substance Use Disorders • The Impact of Adverse Childhood Experiences – Other Impacts • The Impact of Adverse Childhood Experiences – Increased Risk of Disease • The Impact of Adverse Childhood Experiences – Population Attributable Risk • Discussion • Quiz
Module 3: How Common are Adverse Childhood Experiences?	• Overview • How Common are Adverse Childhood Experiences in the United States? • How Common are Adverse Childhood Experiences in Missouri? • How Common are Adverse Childhood Experiences in Rural Areas? • How Are Missourians Doing with Wellness and Health Outcomes? • Discussion • Quiz
Module 4: How did the COVID-19 pandemic affect Adverse Childhood Experiences?	• Overview • What Was the Psychological Impact of the COVID-19 Pandemic? • How Did the COVID-19 Pandemic Affect Adverse Childhood Experiences? • Discussion • Quiz
Module 5: What Can We Do to Address Adverse Childhood Experiences?	• Overview • What are the Risk Factors for Adverse Childhood Experiences? • What Can Be Done at the Provider Level? • What Does the Evidence Say About Screening? • What are Positive Childhood Experiences (PCEs) and Protective Factors? • 10 Experiences Children Need to Promote Resilience • What Can Be Done at the Organizational Level? • What Can Be Done at the Community and Policy Level? • Discussion • Quiz
Module 6: Wrap Up	• Overview • Resources • Show-Me ECHO[a] • Course Evaluation • Wrap-up and Certificate • Final Thought

[a]ECHO: Extension for Community Healthcare Outcomes.

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Training Requirements for Certification

Participants were required to complete the following ("verifiable requirements"): (1) a pretraining survey; (2) 6 discussion assignments; (3) 5 quizzes, earning a score of >80% on each; and (4) a posttraining survey. Continuing education (CE) credit was available for physicians, licensed professional counselors, social workers, psychologists, and emergency medical service providers as an incentive for completing the course. Certificates of completion were also available.

Recruitment and Enrollment

The training launched in May 2024. Participants, identified through networking and internet searches, were recruited via email and snowball recruitment. Recruitment emails provided a description of the training, the asynchronous online format, the eligibility requirements, and stated that the training and CE credit were offered free of charge. Interested individuals emailed study personnel to request enrollment. Individuals were sent instructions for creating a Canvas account, after which they were sent a link to access the training. After viewing a welcome page with a reminder of eligibility, participants were required to affirm they met eligibility requirements. Reminders were periodically sent to those enrolled to complete the training.

Assessment

Participants completed pre-, post-, and follow-up surveys in Qualtrics. Links to the pre- and post surveys were embedded within the online training. A link to the follow-up survey was embedded in an email sent in February 2025 to participants who completed the training. Reminder emails to complete the follow-up survey were sent weekly for 3 weeks following the initial email invitation, with a final reminder sent approximately 1 month later. In each survey, participants were asked to create a unique identifier using the last 4 digits of their phone number and the first 4 letters of their favorite pet's name (eg, 5012RUST), allowing linkage of responses over time. The pretraining survey captured demographics.

In the post survey, participants evaluated the course on a 5-point scale. Participants were also asked a series of open-ended questions. They described the training strengths, opportunities to improve, and how they intended to apply the content to their work or practice. The course evaluation questions were implemented in a previous study [26].

The pre- and postsurveys assessed participants' knowledge of ACEs and related practice patterns. ACEs knowledge was assessed using items developed by Onigu-Otite and Idicula [28] and used with permission. Participants rated their knowledge of 9 ACEs-related statements on a 5-point Likert scale. Practice patterns were assessed using 4 questions with a 5-point Likert scale, with an additional response option of *not applicable*.

The follow-up survey additionally asked sustainability of action questions qualitatively, that is, (1) how the training content was applied to work or practice, (2) changes to practice, workflow, or organization that resulted from the training, (3) challenges and facilitators to implementing the training content into practice, and (4) outcomes that occurred as a result of implementing training concepts into practice.

Data Analysis

Training engagement data were exported into Microsoft Excel. Descriptive statistics characterized engagement as the percentage of completed quiz and discussion posts, and average quiz scores.

Frequencies and percentages characterized the study sample and evaluation data. Wilcoxon signed-rank tests were used to compare pre- and posttraining knowledge of ACEs and ACEs-related practice patterns within the paired samples. Medians and IQRs were reported for posttraining and follow-up practice patterns to assess sustainability. Responses of *not applicable* on items assessing practice patterns were treated as missing, and analyses were performed using pairwise complete-case data. No pairwise missing data were observed among the items assessing ACEs knowledge. Statistical significance was reported at $P<.05$. Data were analyzed using R Statistical Software (version 4.4.1; R Core Team).

Short answer open-ended questions were exported into Microsoft Excel and analyzed qualitatively. The authors conducted a conventional qualitative content analysis of written responses to open-ended questions using an inductive, iterative, team-based consensus approach [29]. Consistent with conventional content analysis, codes were derived directly from the data rather than established a priori and were iteratively organized and refined. First, authors reviewed the data for familiarization and to identify predominant patterns. An initial coding scheme was created. The coding scheme was reviewed, discussed, and agreed upon by both authors. Then, the coding scheme was applied by one author (JMK) to individual participant responses, with authors discussing coding refinement where needed. Next, the other author (AED) independently coded participant responses, then this was reviewed by both authors (JMK and AED). Divergent coding was discussed until agreement was reached. Percentages described the proportion of responses assigned to each code within each question, with the denominator being the total number of responses to that question. Exemplary quotes were identified, and when necessary, lightly edited for readability while maintaining content.

Ethical Considerations

This study was approved by MU's Institutional Review Board (IRB 2120026) as a quality improvement project and does "not constitute human subjects research according to the Department of Health and Human Services regulatory definitions." As a program evaluation, consent was not obtained from participants apart from their consent to enroll in the program. Canvas is a web-based, cloud-based learning management system (LMS) designed to facilitate online, hybrid, and in-person learning by providing a central hub for course materials, communication, and assessment. It has a data classification level (DCL) of 3 (restricted) [30]. Data were kept confidential and shared between authors through a One Drive folder, also DCL3-restricted [31]. Datasets were deidentified prior to analysis.

Results

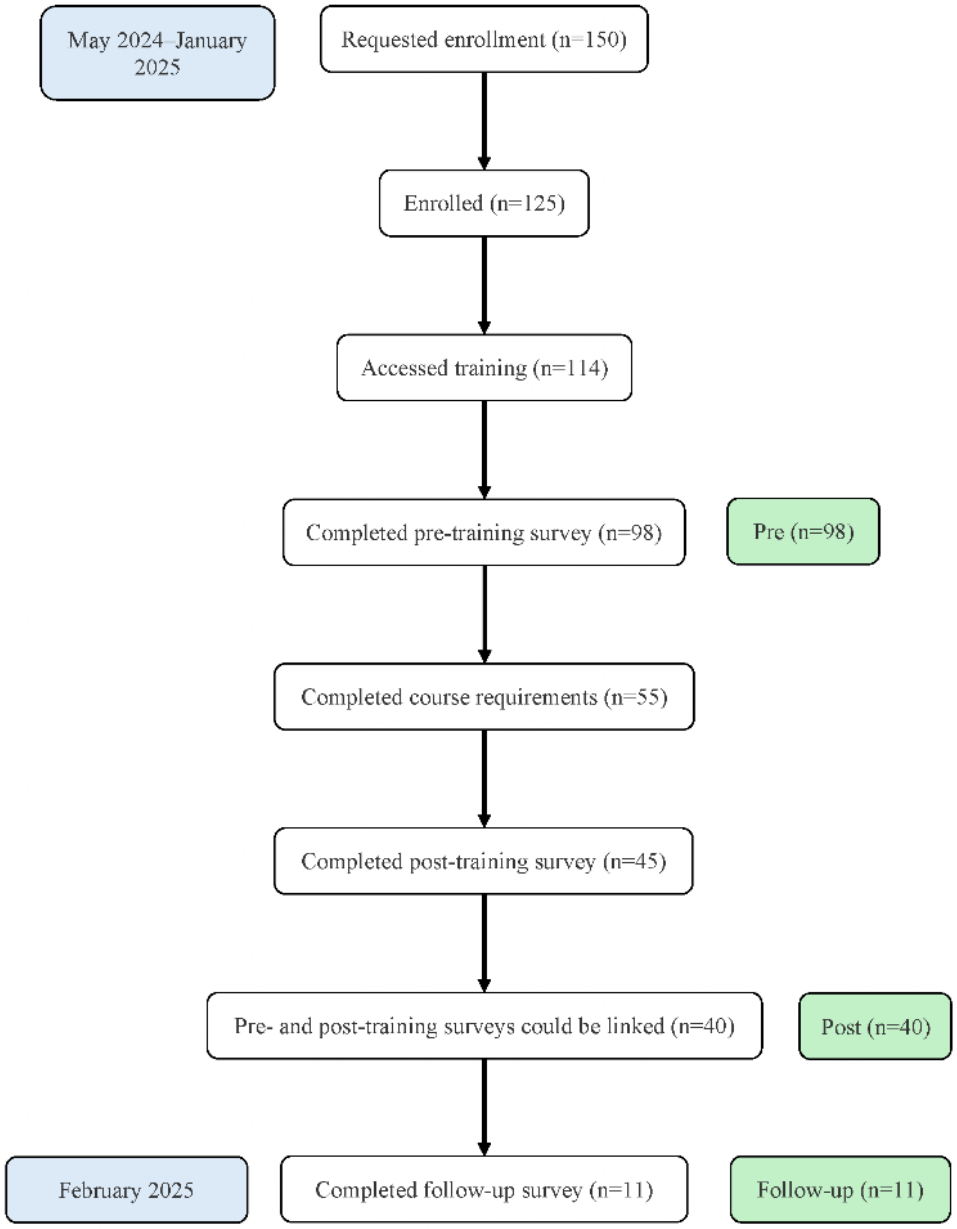
Enrollment and Completion

From May 2024 to January 2025, 150 individuals requested enrollment in the ACEs training. Of those, 125/150 (83.3%)

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were enrolled and 114/150 (76%) accessed the training (see Figure 1). Of those who accessed the training, 98/114 (86%) completed the pretraining survey and 55/114 (48.2%) completed the verifiable requirements. A total of 40 posttraining survey responses could be linked to the pretraining survey using the unique identifier, from among 45 who completed the posttraining survey. In total, 11 participants completed the follow-up survey with a linkable identifier an average of 5.8 (SD 2.5; range 0.7-8.2) months after completing the posttraining survey.

Figure 1. Adversity to Action Participant Flow Diagram.



Participant Characteristics

Characteristics of the participants who completed the pre- (n=98) and postsurveys (n=40) are presented in Table 3. Most participants who completed the pretraining survey were women (84/98, 85.7%), White (90/98, 91.8%), and non-Hispanic (91/98, 92.9%). Participants' ages varied but were largely within the age groups of 35 to 44 years (34/98, 34.7%) and 45 to 64 years (38/98, 38.8%). Most participants reported having a bachelor's (35/98, 35.7%) or master's degree (31/98, 31.6%). The majority reported growing up in a rural area (77/98, 78.6%). All participants either lived or worked in the 5 target counties or held a statewide position. Overall, 67.3% (66/98) reporting living in 1 of the 5 target counties of Phelps (24/98, 24.5%), St Francois (21/98, 21.4%), Washington (10/98, 10.2%), Dent (9/98, 9.2%), and Crawford (2/98, 2%). All participants either lived in the eligible counties, or worked in them directly or through a statewide position. Many participants served more than one of the target counties (37/98, 37.8%) or held a statewide position (9/98, 9.2%), while others worked in Phelps (19/98, 19.4%), St Francois (16/98, 16.3%), Dent (11/98, 11.2%), Washington (4/98, 4.1%), and Crawford (1/98, 1%) counties. Moreover, 1 (1%) participant did not respond; however, this participant lived in one of the target counties. The most commonly reported employment settings were child advocacy centers (16/98, 16.3%) and schools (16/98, 16.3%). Common

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professions included behavioral health (14/98, 14.3%), K-12 teacher or administrator (14/98, 14.3%), and social work (10/98, 10.2%). Participant characteristics were similar at the pre- and post–time points.

All or most participants who completed the follow-up survey (n=11; data not included in table) were women (11/11, 100%), White (10/11, 90.9%), non-Hispanic (11/11, 100%), aged 35 to 64 years (10/11, 90.9%), and had a bachelor's (4/11, 36.4%) or master's (5/11, 45.5%) degree. Their professions included behavioral health (2/11, 18.2%), social work (2/11, 18.2%), K-12 teacher or administrator (1/11, 9.1%), director or leadership (1/11, 9.1%), nurse (1/11, 9.1%), and other roles (4/11, 36.4%).

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Table 3. Characteristics of training participants who completed the pre- and posttraining surveys.

Variable	Pretraining (n=98), n (%)	Posttraining (n=40), n (%)
Personal attributes		
Gender		
Women	84 (85.7)	35 (87.5)
Men	12 (12.2)	5 (12.5)
Age group (years)		
18-24	3 (3.1)	2 (5.0)
25-34	21 (21.4)	7 (17.5)
35-44	34 (34.7)	13 (32.5)
45-64	38 (38.8)	17 (42.5)
65-84	1 (1.0)	1 (2.5)
Race		
White	90 (91.8)	37 (92.5)
Black or African American	4 (4.1)	3 (7.5)
Native Hawaiian or Pacific Islander	1 (1.0)	0 (0.0)
Ethnicity		
Hispanic or Latino	2 (2.0)	0 (0.0)
Non-Hispanic or Latino	91 (92.9)	38 (95.0)
Grew up in a rural area		
Yes	77 (78.6)	29 (72.5)
No	21 (21.4)	11 (27.5)
Education level		
Regular high-school diploma or GED	4 (4.1)	0 (0.0)
Some college	13 (13.3)	2 (5.0)
Associate degree	8 (8.2)	3 (7.5)
Bachelor’s degree	35 (35.7)	16 (40.0)
Master’s degree	31 (31.6)	16 (40.0)
Professional, medical, or doctorate degree	7 (7.1)	3 (7.5)
Employment attributes		
Employment setting		
Child advocacy center	16 (16.3)	9 (22.5)
School or school district	16 (16.3)	6 (15.0)
Government	11 (11.2)	3 (7.5)
Community-based organization	10 (10.2)	4 (10.0)
Local public health agency	9 (9.2)	1 (2.5)
Federally qualified health center or look-alike	8 (8.2)	4 (10.0)
Daycare	5 (5.1)	3 (7.5)
Criminal justice	3 (3.1)	1 (2.5)
Rural health clinic	3 (3.1)	2 (5.0)
University extension	2 (2.0)	2 (5.0)
Fire department	2 (2.0)	0 (0.0)
Area health education center	1 (1.0)	0 (0.0)
Critical access hospital	1 (1.0)	1 (2.5)

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Variable	Pretraining (n=98), n (%)	Posttraining (n=40), n (%)
Other	11 (11.2)	4 (10.0)
Profession		
Behavioral health specialist	14 (14.3)	5 (12.5)
K-12 Education: teacher or administrator	14 (14.3)	6 (15.0)
Social worker	10 (10.2)	4 (10.0)
Director or leadership	8 (8.2)	3 (7.5)
Prevention specialist	5 (5.1)	2 (5.0)
Nurse or nurse practitioner	5 (5.1)	2 (5.0)
Forensic interviewer	4 (4.1)	2 (5.0)
Advocate	2 (2.0)	2 (5.0)
Law enforcement	2 (2.0)	1 (2.5)
Emergency medical services	2 (2.0)	1 (2.5)
Community outreach coordinator	2 (2.0)	1 (2.5)
Public health practitioner	1 (1.0)	1 (2.5)
Other	29 (29.6)	10 (25.0)

Participant Engagement

Among the 98 participants who completed the pretraining survey, the following completed each quiz and discussion post, respectively, for each of the following modules: (1) module 1: 88/98 (89.8%) and 73/98 (74.5%), (2) module 2: 81/98 (82.7%) and 66/98 (67.3%), (3) module 3: 70/98 (71.4%) and 60/98 (61.2%), (4) module 4: 68/98 (69.4%) and 57/98 (58.2%), and (5) module 5: 67/98 (68.4%) and 57/98 (58.2%). Average quiz scores for each module were 93.5% (SD 9.1%) for module 1, 89.5% (SD 16.3%) for module 2, 87.7% (SD 16.4%) for module 3, 97.2% (SD 6.0%) for module 4, and 95.6% (SD 10.8%) for module 5.

Training Evaluation

The posttraining evaluation results are presented in Table 4. Most participants agreed or strongly agreed that the learning objectives were clear (35/40, 87.5%), the length was appropriate (36/40, 90%), the videos were informative (36/40, 90%), the quizzes provided a helpful self-assessment (34/40, 85%), the discussions were valuable (29/40, 72.5%), the resources were helpful (36/40, 90%), and the content was culturally sensitive (35/40, 87.5%), tailored to the community (35/40, 87.5%), and relevant to their work, life, or practice (36/40, 90%). Most agreed or strongly agreed that they intended to apply the content to their life (36/40, 90%) and work or practice (35/40, 87.5%), and felt confident to implement the knowledge gained (37/40, 92.5%). Most participants rated the training as excellent or very good (37/40, 92.5%) and agreed or strongly agreed that they would recommend it to others (39/40, 97.5%).

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Table 4. Results of Adversity to Action posttraining evaluation survey questions.

Statement and response options	Posttraining (n=40), n (%)
The learning objectives are clear	
Strongly agree or agree	35 (87.5)
Neutral or not sure	2 (5.0)
Strongly disagree or disagree	3 (7.5)
The length is appropriate	
Strongly agree or agree	36 (90.0)
Neutral or not sure	1 (2.5)
Strongly disagree or disagree	3 (7.5)
The videos are informative	
Strongly agree or agree	36 (90.0)
Neutral or not sure	1 (2.5)
Strongly disagree or disagree	3 (7.5)
The resources are/were helpful	
Strongly agree or agree	36 (90.0)
Neutral or not sure	1 (2.5)
Strongly disagree or disagree	3 (7.5)
The quizzes provided a helpful self-assessment	
Strongly agree or agree	34 (85.0)
Neutral or not sure	2 (5.0)
Strongly disagree or disagree	4 (10.0)
The discussions are valuable	
Strongly agree or agree	29 (72.5)
Neutral or not sure	7 (17.5)
Strongly disagree or disagree	4 (10.0)
The content is culturally sensitive	
Strongly agree or agree	35 (87.5)
Neutral or not sure	2 (5.0)
Strongly disagree or disagree	3 (7.5)
The content is tailored to the community	
Strongly agree or agree	35 (87.5)
Neutral or not sure	2 (5.0)
Strongly disagree or disagree	3 (7.5)
The content is relevant to my work, life, or practice	
Strongly agree or agree	36 (90.0)
Neutral or not sure	1 (2.5)
Strongly disagree or disagree	3 (7.5)
I intend to apply the course content to my personal life	
Strongly agree or agree	36 (90.0)
Neutral or not sure	1 (2.5)
Strongly disagree or disagree	3 (7.5)
I intend to apply the course content to my work or practice	
Strongly agree or agree	35 (87.5)

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Statement and response options	Posttraining (n=40), n (%)
Neutral or not sure	2 (5.0)
Strongly disagree or disagree	3 (7.5)
I feel confident to implement the knowledge I gained	
Strongly agree or agree	37 (92.5)
Neutral or not sure	0 (0.0)
Strongly disagree or disagree	3 (7.5)
I would recommend this course to others	
Strongly agree or agree	39 (97.5)
Neutral or not sure	1 (2.5)
Strongly disagree or disagree	0 (0.0)
Please rate the course overall	
Excellent or very good	37 (92.5)
Good	3 (7.5)
Fair or poor	0 (0.0)

Training strengths largely centered around training features (22/29, 75.9%) and awareness (5/29, 17.2%). Examples of training feature responses included:

> *I appreciated the length of the videos. I enjoyed the different formats- videos, reading, and charts.* [ID 11, K-12 education: teacher or administrator]

> *I liked the way the course was set up with very clear objectives and flow in the information/connection to the sources for the information.* [ID 14, other/library clerk]

Examples of awareness responses included:

> *I was not aware of the difference in rural and urban communities with ACEs. I was aware of the issue of not enough resources in both communities and lack of education and awareness and feel like it needs to be addressed.* [ID 10, advocate]

> *An "a-ha" moment was the correlation between ACEs and physical health. I knew stress was a known health factor, but for whatever reason, I did not include childhood trauma.* [ID 20, other/treatment court administrator]

Participant feedback on opportunities to improve the training largely included course features (10/17, 58.8%). Examples included:

> *Mobile navigation. I completed [the training] from my phone. Not ideal.* [ID 19, K-12 education: teacher or administrator]

> *The hardest thing I found was getting to the module you were working on when you had to stop and start back another day.* [ID 24, director or leadership]

Examples of content feedback (5/17, 29.4%) included:

> *I had originally thought this was meant for specific communities in our area. As I navigated through the information it was clear it was more a class. So, it was not what I had expected.* [ID 2, forensic interviewer]

> *Personally, I would have liked to see more information about how places such as libraries could help support our community. There was a lot of information for how places like health care settings and schools could support the community but not as much for community places like libraries.* [ID 14, other/library clerk]

Finally, 2 participants (2/17, 11.8%) recommended including posttraining handouts to use, such as the list of resources provided, or pamphlets or educational materials to disseminate.

Knowledge and Translation to Action

Self-reported ACEs knowledge increased significantly across all items from pre- (medians 3.0-4.0, IQRs 2.0-5.0) to post-training (medians 5.0, IQRs 5.0-5.0; P<.001; Table 5). The frequency at which participants engaged in ACEs-related best practices also increased significantly from pre-to-post training for all items (P values<.05). Practice pattern engagement varied across items, both before and after completing the training. For example, participants recommended resources (pretraining median 4.0, IQR 3.0-5.0 vs posttraining median 5.0, IQR 4.0-5.0) much more frequently than they screened for ACEs (pretraining median 1.0, IQR 1.0-2.0 vs posttraining median 2.0, IQR 1.0-4.0).

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Table 5. Results of the Wilcoxon signed-rank tests comparing pre- and posttraining knowledge and practice patterns[a].

Item	n	Pretraining, median (IQR)	Posttraining, median (IQR)	Z	*P* value[b]	Effect size (r)
Knowledge						
I can define ACEs[c]	40	3.0 (3.0-4.0)	5.0 (5.0-5.0)	–5.2	<.001	0.82
I know what an ACE score is	40	3.0 (2.0-4.0)	5.0 (5.0-5.0)	–5.2	<.001	0.81
I can identify 3 or more household dysfunctions classified as ACEs	40	3.0 (2.0-4.0)	5.0 (5.0-5.0)	–5.3	<.001	0.83
I recognize the link between ACEs and adult mental health problems	40	4.0 (2.8-5.0)	5.0 (5.0-5.0)	–4.4	<.001	0.70
I recognize the link between ACEs and chronic medical problems	40	4.0 (2.8-4.3)	5.0 (5.0-5.0)	–4.6	<.001	0.73
I appreciate that neurotoxic stress can change brain functioning	40	4.0 (3.0-5.0)	5.0 (5.0-5.0)	–4.7	<.001	0.74
I understand how high ACE scores are linked to a shorter life span	40	3.5 (2.0-5.0)	5.0 (5.0-5.0)	–4.6	<.001	0.72
I can describe resilience	40	4.0 (3.0-5.0)	5.0 (5.0-5.0)	–4.3	<.001	0.68
I recognize that ACEs can be prevented and treated	40	4.0 (3.0-5.0)	5.0 (5.0-5.0)	–4.6	<.001	0.72
Practice patterns						
Do you screen patients or clients for ACEs?	25	1.0 (1.0-2.0)	2.0 (1.0-4.0)	–2.2	.03	0.44
Do you discuss ACEs with patients or clients?	31	2.0 (1.0-3.5)	4.0 (2.5-4.0)	–3.6	<.001	0.65
Do you discuss positive childhood experiences (PCEs) with patients or clients?	34	2.5 (1.3-3.0)	3.5 (3.0-4.0)	–3.2	.001	0.55
Do you recommend resources to patients or clients?	29	4.0 (3.0-5.0)	5.0 (4.0-5.0)	–2.16	.03	0.40

[a]Knowledge items were rated on a scale from 1="no or low knowledge" to 5="high knowledge." Practice patterns items were rated on a scale from 1="never" to 5="always." Responses of *not applicable* on items assessing practice patterns were excluded, and analyses were performed using pairwise complete-case data.

[b]Significant at $P<.05$.

[c]ACE: adverse childhood experiences.

Most (16/28, 57.1%) participants intended to apply the training content to their work or practice through action or intervention, followed by awareness (7/28, 25%), education (3/28, 10.7%), and screening (2/28, 7.1%). Examples of intervention-based responses included:

> *I intend to use the information to move my organization into a trauma-informed business.* [ID 7, director or leadership/program director]
>
> *As a middle school teacher, a refresher in what kids "bring" to school and how it can negatively impact their mood, drive, and attention is always helpful. I can take these things into consideration and adjust my responses, adjust assignments, and offer to listen.* [ID 11, K-12 education: teacher or administrator]
>
> *I intend to apply these in my everyday life working with adults with substance use because I know that they have been affected by ACEs and once they can heal they can recover.* [ID 37, behavioral health specialist]
>
> *I plan on having more resources available for the patrons of the library and plan to have more positive groups/clubs in the library to provide more support to members of our community.* [ID 14, other/library clerk]

Examples of awareness responses included:

> *As a teacher, being aware of ACE scores and how they impact student well-being and learning. I feel the information that I learned will help promote a more healthy learning environment.* [ID 5, K-12 education: teacher or administrator]
>
> *I work with children who have experienced some form of abuse and neglect. The information in this course will help me understand how to better serve these children.* [ID 4, forensic interviewer]

Finally, participants were asked what they think should be done to help individuals in these counties address ACEs. Half (12/24, 50%) requested more education. Examples included:

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> *More training and knowledge to help these individuals. While I may not be able to directly help, I can be the eyes and ears in the classroom to spot out ACEs and then pass on the information.* [ID 3, K-12 education: teacher or administrator]
>
> *I think education is vital. Unfortunately, public service does not pay well and funding for mental health was cut years ago. More people are needed in public service and until there are more boots on the ground and more professionals are educated this issue will continue to flourish.* [ID 20, other/treatment court administrator]
>
> *I believe everyone who works with people needs Trauma Informed Care.* [ID 34, behavioral health specialist]
>
> *More education, to teachers, law enforcement and social workers* [ID 36, social worker]

The second most common request was more mental health resources (8/24, 33.3%):

> *Development and expansion of mental health programs. Missouri should revisit licensure requirements for therapists. Many states offer licensure paths through experience for persons with Masters in a like field.* [ID 12, behavioral health specialist]
>
> *The biggest help would be more access to mental health services. There's not enough access to services for the amount of individuals that need support.* [ID 14, other/library clerk]
>
> *Availability of resources for those living with substance abuse, mental illness, or co-occurring disorders due to the impact of ACEs.* [ID 40, law enforcement]

Other recommendations for the community included resources for family wellness and parenting education, stigma reduction (including at pharmacies), more screening and preparedness with resources or support, and housing resources.

Sustainability of Action

Among those who completed the follow-up survey, median practice pattern ratings were the same at the posttraining and follow-up time point for all the following items: (1) screening patients or clients for ACEs (n=6, medians 3.5, post IQR 1.5-4.8, follow-up IQR 3.0-4.8), (2) discussing ACEs with patients or clients (n=7, medians 4.0, post IQR 3.5-4.5, follow-up IQR 2.5-5.0), (3) discussing positive childhood experiences with patients or clients (n=7, medians 4.0, post IQR 3.0-4.5, follow-up IQR 3.0-4.5); and recommending resources to patients or clients (n=7, medians 5.0, post IQR 5.0-5.0, follow-up IQR 5.0-5.0). Spearman correlations were conducted to examine whether the time that had elapsed between the post and follow-up assessments was associated with changes in practice patterns. Results indicated no significant associations (P>.05).

Most (7/11, 63.6%) participants reported applying the training content to work or practice by implementing trauma-informed care (TIC) approaches, followed by implementing ACEs screening (3/11, 27.3%). TIC examples included:

> *I work with very young children. I'm able to explain to both the parents and children how important it is to rewire the brain in order to keep the child in the healthiest state possible.* [ID 18, behavioral health specialist]
>
> *ACEs will be considered when planning or implementing a program and reflecting on successes/challenges.* [ID 27, other/university extension]
>
> *I'm able to use the things I learn in these courses when working with certified peer specialist and clients with substance use issues.* [ID 29, nurse]

Descriptions of changes to practice, workflow, or organizations included improved awareness in interactions with students, monitoring ACEs with patients, educating parents or caregivers, and adding an ACEs questionnaire and education to practice. Challenges resulting from implementing concepts into practice included getting local public health agencies to prioritize ACEs and wellness, working with clients with co-occurring ACEs and ADHD, and wishing handouts were provided. Facilitators included improved ACEs awareness that enhanced their work, and the data, videos, tools, and resources provided.

Reported outcomes resulting from the training included being able to educate staff and clients on ACEs, implement prevention strategies, and assist more children due to expanded awareness of subtle indicators. Finally, participants' recommendations for what should be done to help individuals in these counties address ACEs included more virtual platforms to increase access to care, resources for individuals and families, mental health staff resources and education, pamphlets at primary care physician offices, funding for interventions, access to mental health professionals, and mandatory TIC training in schools and businesses.

Discussion

Training Implementation

This study is unique in its evaluation of the implementation and sustainability of an ACEs training to cross-sector rural providers, including, but not limited to health providers. This adds to the literature in several ways. First, most ACEs training literature is not specific to rural contexts, and additionally focuses on health care providers [15,16]. Second, findings support the ability to effectively reach resource-limited rural providers through online platforms. All participants either lived in the eligible counties, or worked in them directly or through a statewide position. Third, findings support the ability to engage broad cross-sectors of rural providers, with all sectors who were targeted in recruitment represented in enrollment. This suggests ACEs are deemed broadly relevant to diverse professions, including behavioral health specialists, K-12 educators or administrators, social workers, prevention specialists, nurses, law enforcement, emergency medical services, and community outreach coordinators. While findings support broad participation from health providers (ie, behavioral health,

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nursing, and emergency medical services), noticeably missing were medical providers. Unfortunately, the incentive of continuing education credit and the asynchronous training format was not enough to entice participation. Our previous study that tested statewide ACEs training specifically targeted rural health care providers [26], and similarly had few medical providers participate. To engage medical providers, future trainings might be offered in-person at job sites following an endorsement of the training from trusted sources. Although, given a limited rural workforce and the challenge of assembling a critical mass of providers in person, the efficiency of this option may be prohibitive.

Participant demographics robustly represented age groups most active in their professions (ie, 25-64 y), and as expected in a rural setting, most participants were White and non-Hispanic. That the majority of participants were women is consistent with our previous study [26] and women in general being more likely to participate in surveys than men [32].

Training Acceptability and Satisfaction

Findings demonstrate the training was well-received by participants in the final sample. Most participants reported the resources were helpful, the content was culturally sensitive, and relevant to their work, life, or practice. In fact, participants requested additional educational opportunities to address the public health burden in these counties, that is, "More education, to teachers, law enforcement and social workers" and "I believe everyone who works with people needs Trauma Informed Care." Findings demonstrate high satisfaction levels with the training. Participant-reported satisfaction with the training is consistent with our previous statewide study that targeted health and health care providers [26], that is, 92.5% (37/40) of the participants from this study rated the training as excellent or very good compared with 92.9% (39/42) of previous participants, and 97.5% (39/40) of current participants would recommend it to others compared with 100% (42/42) of previous participants. Regarding training features, that participants scored the value of discussion posts lowest (72.5% agreement) compared with other course features is consistent with the engagement results, with participants being more likely to engage with quizzes than discussion posts. One interpretation is that discussion posts require more active engagement and may therefore be viewed less favorably. This is consistent with findings from our previous work [26]. Finally, participants offered helpful suggestions for future trainings, including handouts with resources, pamphlets, or educational materials to download or disseminate.

One particular challenge with implementation, despite strong initial interest with 150 individuals requesting enrollment, was participant attrition with 36.7% (55/150) of those requesting enrollment completing the course requirements. Course implementation metrics from comparable literature are infrequently reported in detail. One study of a free online, self-directed course for health care workers in remote and resource-constrained settings about caring for patients with COVID-19 reported 7101 (23%) participants completed their course from among 30,859 who enrolled and 5184 (16.8%) completed the postcourse survey [33]; our study reports 44% (55 who completed course requirements) and 36% (45 who completed the posttraining survey from among 125 who enrolled).

While 92.5% (37/40) of the final sample rated the training as excellent or very good, and 97.5% (39/40) agreed they would recommend it to others, we do not have feedback from participants who did not complete the course to better assess reasons for attrition. Therefore, we speculate that attrition was related to time constraints and course features, given 58.8% (10/17) of participant feedback included opportunities to improve course features, such as their computer blocking emails from the course, mobile navigation, and continuing where one left off. This is supported by attrition flow, with 76% (114/150) retention between requesting enrollment and accessing the training, but only 48.2% (55/114) retention between accessing the training and completing the course requirements. Future training implementation might include technology support for course settings and navigation.

Knowledge Assessment, Knowledge to Action, and Sustainability

Findings from the final sample demonstrate that the training was effective at increasing ACEs knowledge from pre to post, with all knowledge items increasing significantly. Additionally, findings demonstrate effectiveness in translating research into practice. Participants were significantly more likely to report applying the training content to action through education, screening, and resource recommendations post training. Participants' intention for action or intervention is consistent with their request for handouts with resources, pamphlets or educational materials to facilitate their practice. Qualitative responses demonstrated the diversity of contexts and settings in which this work is relevant.

Our findings are consistent with previous literature, although the literature is limited by its focus on health care and clinical contexts. One ACEs training study for rural, school-based health clinicians reported pre-post increases in knowledge and confidence in supporting children [34]. Another ACEs training study for clinic staff serving rural farmworker communities reported an increase in confidence in participants' ability to provide ACEs education and screenings, that the training was easy to understand, and agreed that ACEs education and screening was acceptable during routine doctor visits [35].

As far as barriers reported by participants, a common response to asking what is needed in these counties to help individuals was more mental health programs. The federal government designates much of rural Missouri as a primary care health professional shortage area in medical, dental, and mental health [24]. Even with adequate provider resources, rural Missourians have more barriers than urban counterparts for accessing health services including distance to a health care provider, lower rates of insurance coverage, and limited availability of public transportation for residents who do not own a vehicle or who are unable to drive [24]. Health care providers increasingly use telehealth technologies to reach rural individuals [24].

This study adds to an extremely limited literature on sustainability of ACEs training. With an average span of 5.8 (SD 2.5) months after training completion, findings

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demonstrated consistency between immediate posttraining survey responses and follow-up on all practice pattern items, suggesting the training was successful in long-term behavior change. Qualitative responses illustrated how participants have integrated the training content into their workflow in a variety of settings.

As next steps to address the evidence-practice and policy gap, future research would include "T2" translational research (the translation of new clinical knowledge into improved health) [2]. Specifically, research is needed to demonstrate whether comprehensive ACEs screening improves outcomes for children [36]. The implications of mitigating the intergenerational transmission of ACEs are profound. A 10% reduction in the US prevalence of ACEs equates to an annual savings of 3 million disability-adjusted life years or US $105 billion [37]. However, future efforts are limited by available resources. Participants in our study recognize that more mental health resources are needed in rural areas, including funding for interventions and TIC training. Translating research into policy is crucial.

Limitations

This study is a pretest-posttest design and not a gold-standard randomized controlled trial. Therefore, it is possible that knowledge and practice pattern improvements resulted in part from confounding factors. Additionally, attrition may have introduced selection bias, as participants who completed the training and subsequent assessments may have been more engaged with ACEs-related content or more comfortable with technology than those who did not complete the training, potentially limiting generalizability of findings. The follow-up findings in particular should be considered exploratory due to the modest sample size (n=11).

Conclusion

This is the first study to train a broad cross-sector of rural providers on ACEs. Using a knowledge translation lens, we implemented an ACEs workforce training for rural providers; its cross-sector nature expands the representation of roles across the community, an indicator of external validity [38]. Findings also contribute to a limited literature on sustainability, with follow-up assessment occurring an average of 5.8 months after training. Among participants who completed both posttraining and follow-up assessments, median practice pattern ratings were the same at both time points, suggesting that changes in practice may be sustained over time among those who completed the assessments. Among participants who completed the training and assessments, findings support the acceptability of cross-sector rural provider ACEs training and provide preliminary evidence of knowledge translation into practice, and potential for sustainability. Attrition from initial interest through training and assessment completion limits the generalizability of these findings to the broader group of providers who initially expressed interest. Nevertheless, the broad challenges of translating research into practice and policy underscore the continued importance of accessible, cross-sector ACEs workforce training, particularly in rural areas.

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Data Availability

The datasets generated or analyzed during this study are available from the corresponding author on reasonable request.

Generative AI Use

The authors declare that generative AI was not used in the preparation of this manuscript.

Authors' Contributions

Conceptualization: JMK
Data curation: AED (lead), JMK (supporting)
Formal analysis: AED (lead quantitative) JMK (supporting), JMK (lead qualitative), AED (supporting)
Funding acquisition: JMK
Investigation: AED, JMK
Methodology: JMK
Project administration: JMK (lead), AED (supporting)
Resources: JMK
Supervision: JMK

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Validation: AED, JMK
Visualization: AED, JMK
Writing – original draft: JMK (lead), AED (supporting)
Writing – review & editing: JMK, AED

Conflicts of Interest

None declared.

Multimedia Appendix 1

Adversity to Action survey instruments.
[DOCX File , 40 KB-Multimedia Appendix 1]

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Abbreviations

ACE: adverse childhood experience
CE: continuing education
DCL: data classification level
DHSS: Department of Health and Senior Services
LMS: learning management system
MU: University of Missouri

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PCE: positive childhood experience
TIC: trauma-informed care

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