Published in final edited form as:

Drug Alcohol Depend. 2017 November 01; 180: 144–150. doi:10.1016/j.drugalcdep.2017.08.011.

Factors associated with an evidence-based measure of implementation for the Adolescent Community Reinforcement Approach

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Abstract

Background: An evidence-based measure of implementation (EBMI) is an implementation outcome measure shown to have predictive validity with one or more future-measured constructs of importance. The current study sought to identify correlates and predictors of an EBMI called procedure exposure. Garner et al. (2016) found procedure exposure to be an EBMI for the Adolescent Community Reinforcement Approach (A-CRA).

Methods: The dataset included 76 community-based substance use treatment organizations located across the United States. Organizational-level regression analyses, which were framed within the context of Chaudoir et al. (2013) framework for predicting implementation outcomes, were used to examine predictors of A-CRA procedure exposure

Results: The Washington Circle's treatment initiation performance measure ($B = 5.05$ [$SE = 1.60$], $p = 0.002$), as well as session exposure ($B = 0.18$ [$SE = 0.06$], $p = 0.003$), were significant predictors of A-CRA procedure exposure in the backward stepwise regression analysis (Adjusted R-square = 0.55). The Washington Circle's treatment engagement performance measure ($B = 7.93$ [$SE = 0.77$], $p < 0.001$), as well as time-to-proficiency ($B = -0.04$ [$SE = 0.02$], $p = 0.02$), each had significant bivariate relationships with A-CRA procedure exposure but were not retained in the final model.

Conclusions: Organizations implementing A-CRA are encouraged to make the following high priorities: (a) scheduling and completing a subsequent treatment session within 14 days of their index session (treatment initiation) and (b) providing a targeted number of treatment sessions to

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Contributors

The current study was conceptualized by BRG. Statistical analyses were conducted by MES, under the supervision of BRG and BH. BRG, SBH, MES, BH, and SHG were involved in developing and editing the manuscript and have given final approval of the submitted version.

Conflict of interest

All authors declare no conflicts of interest.

each client (session exposure). To the extent organizations do this, they may be more likely to achieve higher levels of A-CRA procedure exposure.

Keywords

Adolescent Community Reinforcement; Approach; A-CRA; Implementation; Washington Circle

1. Introduction

An evidence-based measure of implementation (EBMI) is an implementation outcome measure (e.g., acceptability, appropriateness, fidelity, penetration) shown to have predictive validity with one or more future-measured constructs of importance (e.g., key client outcome; Garner et al., 2016). Based on Lewis et al. (2015) systematic review, the majority of instruments measuring implementation outcomes have no information regarding their predictive validity. Given that implementation outcomes are critical to the advancement of implementation research (Proctor et al., 2011, 2009), the need to increase identification and use of EBMI is critical.

Toward addressing the need for greater identification and use of EBMI, Garner et al. (2016) sought to identify one or more EBMI for the Adolescent Community Reinforcement Approach (A-CRA; Godley et al., 2011). A-CRA is an evidence-based treatment for adolescent substance use that has been widely disseminated in the United States (Dennis et al., 2004; Garner et al., 2007, 2009; Godley et al., 2007). Using data collected as part of a large-scale federally funded initiative focused on the dissemination and implementation of A-CRA, Garner et al. (2016) identified A-CRA procedure exposure (a key dimension of fidelity; Dane and Schneider, 1998) as an organizational-level EBMI. As operationalized by Garner et al. (2016) A-CRA procedure exposure is an organizational-level measure representing an organization's average number of A-CRA sessions delivered to its respective adolescent clients. Garner et al. (2016) found A-CRA procedure exposure to have a significant relationship with adolescents' alcohol or other drug use at the 6-month follow-up, with treatment organizations having higher A-CRA procedure exposure also having greater decreases in adolescents' alcohol and other drug use.

Building upon this research and in alignment with recommendations by Proctor et al. (2011) that "once researchers have advanced consistent, valid, and efficient measures for implementation outcomes, the field will be equipped to conduct important research treating these constructs as dependent variables, in order to identify correlates or predictors of their attainment," the current study's primary objective was to identify correlates and predictors of A-CRA procedure exposure. By doing so, the current study also addresses what Nilsen (2015) identified as one of the three key overarching aims of implementation research: "understanding and/or explaining what influences implementation outcomes." Thus, study results will inform the key factors (beyond procedure exposure) to be targeted as part of future A-CRA implementation efforts, which continues to be an evidence-based treatment widely supported by government funding (Hunter et al., 2015). Additionally, study results will advance generalizable knowledge regarding the systematic uptake of evidence-based

innovations into routine practice (i.e., implementation research) by advancing understanding of what organizational-level factors may or may not successfully influence EBMT's.

1.1. Guiding framework

Chaudoir et al. (2013) developed a multilevel framework for predicting implementation outcomes. Using this five-level framework, which includes structural, organizational, provider, patient, and innovation levels, Chaudoir et al. (2013) conducted a systematic literature review focused on (a) identifying available measures for assessing these levels and (b) assessing the psychometric properties of these measures (e.g., criterion validity, predictive validity). Based on this systematic review, a total of 62 measures were identified, with the majority (37 measures; 60%) assessing the organizational level. Their review concluded that “a vast majority of measures” lacked strong psychometric properties (i.e., were either not examined/reported or not supported) and that there is “the need for continued development and refinement of psychometrically sound measures for use in implementation science settings.” This need for measurement improvement has been supported by other reviews of the literature (Emmons et al., 2012).

To help address this need for measurement improvements, the primary aim of this study was to examine the relationship between A-CRA procedure exposure and key constructs (e.g., absorptive capacity, penetration, fidelity) posited to be important to the complex process of implementing evidence-based innovations within contemporary practice settings (Damschroder et al., 2009; Greenhalgh et al., 2004). Despite the fact that many (though not all) measures can be conceptualized, measured, and analyzed at a number of different levels and that the specific level(s) that is most appropriate is debatable (Garner et al., 2016), the current work focuses on the organizational level. The focus on the organizational level is consistent with the work of Klein and Sorra (1996), who viewed implementation as a collective group behavior (i.e., the pooled or aggregate level for a targeted group of individuals). Additionally, the focus on the organizational level is consistent with Chaudoir et al. (2013), who found the organizational level to be the level most commonly assessed (60%).

1.2. Hypothesized organizational-level influences

As noted above, our key dependent measure of interest was A-CRA procedure exposure, which Garner et al. (2016) found to be predictive of client outcomes (i.e., treatment organizations with higher levels of A-CRA procedure exposure had greater decreases in adolescent alcohol or other drug use at 6-month follow-up). Below, we operationally define the three key constructs (absorptive capacity, penetration, fidelity) examined as correlates or predictors of A-CRA procedure exposure, as well as the specific measures used to represent each construct. Additionally, the explicit hypotheses and support for each hypothesis is described below.

1.2.1. Absorptive capacity—Absorptive capacity is a multidimensional construct that represents an organization's ability to acquire, assimilate, transform, and exploit knowledge (Zahra and George, 2002). A key component of the assimilation dimension of absorptive capacity is speed of learning, with greater speed representing greater levels of assimilation/

absorptive capacity (Cohen and Levinthal, 1990; Zahra and George, 2002). Consistent with research that has posited absorptive capacity to influence implementation (Damschroder et al., 2009; Greenhalgh et al., 2004; Knudsen and Roman, 2004) we hypothesized there would be a significant positive relationship between absorptive capacity, measured via an organizations average staff time-to-proficiency and average staff ratings-to-proficiency (see Section 2.4 for descriptions), and A-CRA procedure exposure.

1.2.2. Penetration—Similar to the concept of reach (Glasgow et al., 1999), penetration has been defined as the integration of a practice within a service setting and its subsystems and can refer to either clients served or staff trained (Proctor et al., 2011). Consistent with research highlighting the importance of cumulative team experience (Elbardissi et al., 2013), organizations with greater staff penetration (i.e., the total number days that each organization employed staff that were certified to deliver A-CRA) were hypothesized to also exhibit higher levels of A-CRA procedure exposure. Additionally, organizations with greater client penetration (i.e., the organization's unduplicated number of adolescent clients receiving the A-CRA intervention) were hypothesized to exhibit higher levels of A-CRA procedure exposure, which is consistent with research finding absolute volume of patients to be associated with better outcomes (Mesman et al., 2015), and likely explained by the greater number of opportunities to become familiar with the delivery of different A-CRA procedures.

1.2.3. Fidelity—As detailed by Dane and Schneider (1998) fidelity is a multidimensional construct that is integral to the evaluation of any intervention and is operationalized as the degree to which specified procedures are implemented as planned. Participant responsiveness is an important dimension of fidelity and captures level of participation by participants. As part of the current study, participant responsiveness was represented using two organizational-level performance measures (treatment initiation, treatment engagement) developed by the Washington Circle Group (Garnick et al., 2002, 2009; McCorry et al., 2000). Treatment initiation is operationalized as the percentage of clients receiving a second treatment service within 14 days following their initial treatment service. Treatment engagement is operationalized as receiving two additional services within 30 days of treatment initiation. Using data from 73 Veterans Affairs facilities, Harris et al. (2007) found higher treatment initiation to be associated with greater decreases in client's drug use. Thus, we hypothesized that organizations with higher Washington Circle treatment initiation rates would have greater levels of A-CRA procedure exposure. Consistent with prior research that found patient-level measures of this treatment engagement measure to be predictive of client outcomes (Garnick et al., 2012), we hypothesized organizations with higher Washington Circle treatment engagement rates would also have a greater level of A-CRA procedure exposure.

Another key dimension of fidelity highlighted by Dane and Schneider (1998) was exposure, which in addition to being measured via procedures implemented (i.e., A-CRA procedure exposure) can be measured via sessions implemented. Consistent with our prior research (Garner et al., 2016), we hypothesized there would be a positive relationship between A-CRA session exposure and A-CRA procedure exposure, which is supported by prior

research that found a significant positive association between A-CRA session exposure and A-CRA procedure exposure ($r = 0.56$; Garner et al., 2016). Importantly, because our prior research was focused on client outcomes, only those treatment organizations with follow-up completion rates of 70% or greater ($n = 65$) were included to maximize the generalizability of our findings. Thus, the current study is important as it will examine the relationship between A-CRA session exposure and A-CRA procedure exposure with the full sample.

2. Methods

2.1. Data source

The data used in this study were collected as part of a large-scale dissemination and implementation initiative funded between 2006 and 2012 by the Substance Abuse and Mental Health Services Administration's Center for Substance Abuse Treatment (SAMHSA/CSAT) that was focused on improving adolescent substance use treatment. The SAMHSA/CSAT initiative provided community-based substance use treatment organizations with funding to help their staff learn how to implement A-CRA (Godley et al., 2001) – an effective and cost-effective behavioral treatment for reducing adolescent substance use and substance-related problems (Dennis et al., 2004; Garner et al., 2007, 2009; Godley et al., 2007). Participating treatment organizations funded during the 2006–2012 time period each received approximately \$900,000 over a 3-year period and were able to have approximately five staff participate in comprehensive training, feedback, and supervision at no additional cost to the treatment organization. The training included several components (treatment manual, in-person training workshop, ongoing coaching and feedback), each of which have been shown to be effective for training clinicians (Miller et al., 2004; Sholomskas et al., 2005). A detailed description of the A-CRA dissemination and implementation initiative has been provided by Godley et al. (2011). Approval and oversight of this project was provided by the Institutional Review Boards of Chestnut Health Systems, as well as the RAND Corporation.

2.2. Sample

2.2.1. Organizations—A total of 76 substance use disorder treatment organizations, each of which received funding directly from SAMHSA/CSAT, were included as part of the current dataset. Treatment organizations were spread throughout 27 different states within the United States. On average, approximately 5 staff ($SD = 2.7$) were trained to deliver A-CRA. The median number of adolescents receiving A-CRA was 95 (mean = 118, $SD = 87$).

2.2.2. Staff—A total of 351 clinicians were trained. In terms of demographics, clinicians were primarily female (69%) and Caucasian (51%), with 20% Hispanic, 17% African American, and 7% mixed or other races. In terms of age, the average age of clinicians was 37 ($SD = 6.7$). In terms of education, the majority had a master's degree or higher (58%). The average number of years of substance use counseling experience was 5 ($SD = 2.9$).

2.2.3. Clients—Across the 76 treatment organizations were 8869 adolescents. The majority of adolescents were male (75%). The average age of adolescents was 16 years ($SD = 1.9$). With regard to race and ethnicity, 31% were Caucasian, 33% were Hispanic, 16%

were African American, and 20% were mixed/other. Current criminal justice involvement was reported by 69% of adolescents. Regarding baseline use of any alcohol or other drugs, 29 days ($SD = 31.9$) was the average number of days during the past 90-day period.

2.3. Procedures

During the SAMHSA/CSAT-funded initiative described above, staff from participating treatment organizations attended a 3.5-day A-CRA workshop training conducted by model developers. Based on Miller et al. (2004) evidence-based clinical intervention training protocol, each trainee received ongoing feedback and coaching based on review of audio-recorded treatment sessions and rated according to the A-CRA fidelity rating manual (Smith et al., 2007). The goal of this process was not only for ongoing fidelity assessment, but also for a clinician to attain certification via demonstrating proficiency in A-CRA delivery (Godley et al., 2016).

In addition to documenting the number of individuals trained from each participating treatment organization, our training and research team also documented the number of attempts (i.e., a session audio recording rated for A-CRA proficiency) each trainee required in order to demonstrate their ability to proficiently deliver A-CRA's core procedures, as well as the time (i.e., number of weeks between the initial training workshop and achievement of A-CRA proficiency). Detailed descriptions of the procedures related to the feedback and coaching process, as well as the requirements of demonstrating A-CRA proficiency have been described (Godley et al., 2011, 2016).

Finally, each of the individuals trained to deliver A-CRA was also trained to use a secure web-based program for recording key implementation-related data regarding each of their adolescent clients. Client information collected as part of this web-based program included: date of treatment admission, date of each A-CRA session, the specific A-CRA procedures delivered each session, the time (in min) spent on each A-CRA procedure, and treatment discharge date. As described in more detail by Hunter et al. (2013), the clinician reported data from the web-based program was cross-validated with clinical records and digital session recordings, with rates of agreement ranging from 89 to 100%. Below, we describe the current study's key dependent measure of interest, as well independent measures of interest. Given that implementation is a collective effort (Klein and Sorra, 1996), all measures were conceptualized as organizational measures (i.e., all data was aggregated to the organizational level of analysis).

2.4. Measures

2.4.1. Dependent measure—The organizational-level EBMI serving as the current study's dependent measure was A-CRA procedure exposure, which is a key dimension of fidelity (Dane and Schneider, 1998) and was operationally defined as the average number of A-CRA procedures each participating treatment organization delivered to their adolescent clients during the project. Given its significant inverse relationship with adolescent's alcohol or other drug use at 6-month follow-up, Garner et al. (2016) identified this measure as an EBMI for A-CRA. Across the 76 participating organizations, the average A-CRA procedure exposure was 9.24 ($SD = 2.05$). There are a total of 19 A-CRA procedures, which are: 1)

overview of A-CRA, 2) functional analysis of substance use behavior, 3) happiness scale, 4) treatment plan/goals of counseling, 5) functional analysis of prosocial behavior, 6) increasing prosocial activity, 7) communication skills, 8) problem solving skills, 9) drink/drug refusal, 10) systematic encouragement, 11) relapse prevention, 12) sobriety sampling, 13) caregiver's overview, 14) caregiver-adolescent relationship skills, 15) couple relationship skills, 16) job seeking skills, 17) anger management, 18) medication adherence and monitoring, 19) reviewing homework. As described in the latest A-CRA manual (Godley et al., 2016), the first six procedures listed above are recommended to be delivered in the first four sessions. In subsequent sessions, additional procedures are introduced as needed (e.g., Medication Monitoring and Adherence, Anger Management, Problem Solving).

2.4.2. Independent measures—Using administration data collected as part of the project's technical assistance contract, seven organizational-level independent measures were created for the current study. Organized by the overarching construct represented, the operational definition for the current study's independent measure are described below, as are descriptive statistics for each independent measure. Correlations among independent measures are provided in Table 1.

Two measures were used to represent absorptive capacity (i.e., a multidimensional construct that represents an organization's ability to acquire, assimilate, transform, and exploit knowledge; Zahra and George, 2002). One measure was A-CRA time-to-proficiency, which represented an organization's average number of weeks between each staff attending the initial A-CRA training workshop and achieving A-CRA proficiency. The average time-to-proficiency was 33.5 weeks ($SD = 14.3$). A second measure was A-CRA ratings-to-proficiency, which represented an organization's average number of session recordings that needed to be rated per staff to achieve A-CRA proficiency. The average rating-to-proficiency was 21.2 weeks ($SD = 6.1$).

Two measures were used to represent penetration (i.e., the integration of a practice within a service setting and its subsystems and can refer to either clients served or staff trained; Proctor et al., 2011). A-CRA staff penetration was operationalized as the total number days that each organization employed staff that were certified to deliver A-CRA. The average level of A-CRA staff penetration was 2148 days ($SD = 2140$). A-CRA client penetration was operationalized as the organization's unduplicated number of adolescent clients receiving the A-CRA intervention. The average level of A-CRA client penetration was 118.1 clients ($SD = 87.3$).

Three measures were used to represent fidelity (i.e., the degree to which specified procedures are implemented as planned; Dane and Schneider, 1998). A-CRA session exposure, which was operationalized as the organization's average number of A-CRA sessions implemented across their unduplicated number of A-CRA clients, represented the exposure dimension of fidelity. The average level of A-CRA session exposure was 12 sessions ($SD = 4.4$). Representing the participant responsiveness dimension of fidelity were two performance measures developed by the Washington Circle Group (treatment initiation, treatment engagement; Garnick et al., 2002, 2009; McCorry et al., 2000). Treatment initiation represents the organization's percentage of clients who received a second treatment

service within 14 days following their initial treatment service. The average rate of achieving the Washington Circle's treatment initiation measure was 72% ($SD = 16\%$). Treatment engagement represents the organization's percentage of clients who received two additional sessions within 30 days of treatment initiation. The average rate of achieving the Washington Circle's treatment engagement measure was 54% ($SD = 21\%$).

2.5. Analytic plan

All organizational-level analyses were conducted using SAS/STAT version 13.1 (SAS Institute, 2012). Given that (a) the intercorrelations among independent variables was anticipated to be high and (b) the current research is one of the first to focus on identifying correlates and predictors of an EBMI, our analytic plan consisted of three analytic steps. The first was to generate a correlation table (see Table 1) among the independent variables, which enabled examination of the extent of multicollinearity among measures. As expected, multicollinearity was considerable, with 16 of the 36 (44.4%) correlations exceeding an absolute (positive or negative) correlation of 0.20. Thus, after confirmation of high degree of multicollinearity, we proceeded to a planned backward regression analysis (Cohen et al., 2003), which in addition to helping address issues of multicollinearity (Belsley et al., 2013), helps identify a more parsimonious model of independent measures. In addition to reporting the beta coefficient (B), standard error (SE), and p -value for the final model, we also report the adjusted R-square. Finally, given that bivariate relationships between the dependent measure and each independent measure are important for comparisons with other research (past and future), we report the results of the bivariate regression analyses.

3. Results

As Table 2 shows, treatment initiation rate ($B = 5.05$ [$SE = 1.60$], $p = 0.002$) and session exposure ($B = 0.18$ [$SE = 0.06$], $p = 0.003$) were the two measures identified as significant predictors of A-CRA procedure exposure in the final model of the backward stepwise regression analysis. The adjusted R-square of this model was 0.55, indicating that together these two measures explained 55% of the variance in A-CRA procedure exposure.

Table 2 also presents results of bivariate regression analyses between A-CRA procedure exposure and each of the seven independent measures examined. Overall, A-CRA procedure exposure was found to have a significant ($p < 0.05$) relationship with four of the seven independent measures (each in the hypothesized direction). More specifically, treatment initiation ($B = 8.93$ [$SE = 1.01$], $p < 0.001$), treatment engagement ($B = 7.39$ [$SE = 0.77$], $p < 0.001$), time-to-proficiency ($B = -0.04$ [$SE = 0.02$], $p = 0.02$), and session exposure ($B = 0.33$ [$SE = 0.04$], $p < 0.001$). Significant relationships were not found for ratings-to-proficiency, staff penetration, or client penetration.

4. Discussion

Building upon research supporting A-CRA procedure exposure as an organizational-level EBMI (Garner et al., 2016), the current study examined the influence of several organizational-level factors on this measure. Overall, of the seven organizational-level measures examined, four were found to have significant relationships with A-CRA

procedure exposure. Specifically, organization's treatment initiation rate, treatment engagement rate, and average session exposure level were all highly significant ($p < 0.0001$), with time-to-proficiency also significant, but not as highly as the other three ($p < 0.05$). Likely a result of their high intercorrelation with other measures, time-to-proficiency and treatment engagement were not retained as significant predictors of the final model where only treatment initiation and session exposure were retained. Additionally, several "promising" organizational-level measures (e.g., staff penetration, client penetration) were not found to be related to A-CRA procedure exposure. Given the dearth of research that has examined the influences of implementation outcomes (Chaudoir et al., 2013), the current study advances knowledge regarding the factors that may be associated with the implementation of evidence-based practices, as well as the factors that may not be associated with the implementation of evidence-based practices. Based on our current findings, a key implication for treatment organizations implementing A-CRA is to make the following high priorities: (a) scheduling and completing a subsequent treatment session within 14 days of their index session (treatment initiation) and (b) providing a targeted number of treatment sessions (7+ sessions) to each client (session exposure; Garner et al., 2012). To the extent that organizations are able to do this, they may be more likely to achieve higher levels of A-CRA procedure exposure, which has been shown to be associated with greater decreases in adolescent substance use (Garner et al., 2016). As such, research focused on addressing client-level and/or program-level barriers that impede greater achievement of treatment initiation and session exposure is warranted.

We did not find evidence suggesting that ratings-to-proficiency, staff penetration, or client penetration significantly influenced A-CRA procedure exposure. As such, we do not make explicit recommendations regarding the extent to which organizations implementing A-CRA should or should not place emphasis on these other organizational-level measures. Future examinations of the extent to which these and other organizational-level measures influence implementation outcomes for A-CRA and other evidence-based practices remain warranted.

4.1. Strengths and limitations

Given that sample size matters, a major strength of the current study is its relatively large number of treatment organizations, which enabled measurement and analysis at the organizational-level. However, beyond this challenging, yet fundamentally important study aspect, the study also includes several other fundamentally important study strengths. Particularly noteworthy is the study's high level of standardization (i.e., each of the participating treatment organization receiving standardized levels of funding, training, and ongoing feedback and coaching to learn to implement the same evidence-based treatment), which minimizes the extent to which variation between treatment organizations may be due to these factors.

There are also several notable limitations. First, the current study was limited to examining organizational-level influences of one single evidence-based practice, which can be a strength, yet is simultaneously a limitation in that findings may (or may not) generalize to other evidence-based practices. Second, the organizational-level measures examined as part of the current study far from represent the wide array of organizational-level measures that

have been proposed to be important influences on implementing evidence-based practices (Aarons et al., 2011; Damschroder et al., 2009; Proctor et al., 2011). Notably, however, the A-CRA dissemination and implementation initiative began in 2006, a time when the breadth of implementation-related constructs was more modest (Fixsen et al., 2011; Greenhalgh et al., 2004; Simpson, 2002); however, each of the organizational-level measures examined as part of this study remain viable candidates for testing given research examining the relationship between these constructs and other important constructs (EMBI, client outcomes) remains limited (Chaudoir et al., 2013; Lewis et al., 2015). Indeed, a major conclusion of Lewis et al. (2015) recent systematic review, which focused on instruments measuring implementation outcomes, was that the majority of instruments had no information regarding predictive validity. Finally, a third limitation of the current study was that structural-level measures were not assessed, which Chaudoir et al. (2013) concluded as part of their systematic review “are among the least likely to be assessed because their measurement poses unique methodological challenges for researchers.”

4.2. Future research

Fig. 1 illustrates the three pillars of implementation research established as part of our team’s recent program of implementation research, which we believe is helpful in supporting our future implementation research regarding the implementation of A-CRA within routine practice. Because implementation is multilevel (Chaudoir et al., 2013), the level at which implementation is operationalized is one of these three pillars. Our *implementation-level pillar* is operationalized at the organizational-level, which is consistent with the work of Klein and Sorra (1996). Secondly, because all EBMI are implementation outcomes but not all implementation outcomes are EBMI (Garner et al., 2016), the establishment of EBMI is another one of these three pillars. Our *EBMI pillar* includes

A-CRA procedure exposure, which is an organizational-level EBMI empirically shown to be predictive of greater decreases in adolescent’s alcohol and other drug use (Garner et al., 2016). Finally, EBMI-related factors is one of these pillars, which is important because EBMI-related factors represent the potential mechanisms of change through which implementation strategies may improve EBMI and in turn key client outcomes. Our *EBMI-related factors pillar* includes the factors identified as part of the current research.

The three hypothesized pillars of the proposed implementation research framework provide a foundation for research focused on testing implementation strategies to further improve A-CRA implementation. For example, as shown in Fig. 1, pay-for-performance (i.e., providing financial incentives for the achievement of predefined criteria) is a discrete implementation strategy empirically shown to improve individual-level implementation of A-CRA (Garner et al., 2012). However, even when using pay-for-performance methods, significant room for implementation improvement remains. Thus, future research is needed to identify additional or different implementation strategies that can optimize effective and cost-effective implementation. One promising implementation strategy we believe warrants future research attention is external facilitation (see Fig. 1; Garner et al., 2012; Kauth et al., 2010; Parchman et al., 2013; Stetler et al., 2006).

4.3. Implications

The current study provides empirical support for several organizational-level factors as important influences of an EBMI for A-CRA, which is one of the most broadly disseminated and implemented EBPs for adolescent substance use treatment (Godley et al., 2011; Hunter et al., 2014, 2015). Because increasing attention has focused on identifying valid performance measures for substance use treatment organizations (Garnick et al., 2009; McLellan et al., 2007), the current finding has important implications for the field of substance use treatment. More specifically, the current findings provide additional support for two Washington Circle performance measures (treatment initiation and treatment engagement) and two additional performance measures (session exposure, time-to-proficiency).

In addition to the implications the current study has for the field of substance use treatment, the current findings have implications for the broader field of implementation science. Namely, study findings add to the current paucity of research that has empirically examined constructs of hypothesized importance (e.g., absorptive capacity, penetration, fidelity). This is important given implementation science researchers have noted as part of their reviews that “increasing the capacity of researchers to both conceptualize and measure constructs hypothesized to affect implementation outcomes is a critical way to advance the field of implementation science” (Chaudoir et al., 2013) and that “building in opportunities to evaluate the impact of factors on the success of an implementation is perhaps one of the most critical understudied areas in implementation science” (Martinez et al., 2014). Our hope is that the current research may stimulate additional research directed toward the identification of factors associated with EBIMs. If not, the continued absence of such information may increase the risk of identifying implementation strategies that effectively improve implementation outcomes will little to no established relationship with the most important outcome: client outcome.

Acknowledgement

Role of funding source

This work was supported by the National Institute on Alcohol Abuse and Alcoholism (NIAAA; R01-AA021217) and the Substance Abuse and Mental Health Services Administration’s Center for Substance Abuse Treatment (SAMHSA/CSAT; contract no. 270-07-0191). The content is solely the responsibility of the authors and does not necessarily represent the official views of the government.

References

- Aarons GA, Hurlburt M, Horwitz SM, 2011 Advancing a conceptual model of evidence-based practice implementation in public service sectors. *Adm. Policy Ment. Health* 38, 4–23. 10.1007/s10488-010-0327-7. [PubMed: 21197565]
- Belsley DA, Kuh E, Welsch RE, 2013. *Regression Diagnostics: Identifying Influential Data and Sources of Collinearity*. John Wiley and Sons, Inc., New York, NY.
- Chaudoir SR, Dugan AG, Barr CH, 2013 Measuring factors affecting implementation of health innovations: a systematic review of structural, organizational, provider, patient, and innovation level measures. *Implement Sci* 8 (22). 10.1186/1748-5908-8-22.
- Cohen J, Cohen P, West SG, Aiken LS, 2003 *Applied Multiple Regression/correlation Analysis in the Behavioral Sciences*, 3rd ed Routledge Mahwah, NJ.

- Cohen WM, Levinthal DA, 1990 Absorptive capacity: a new perspective on learning and innovation. *Adm. Sci. Q* 35, 128–152.
- Damschroder LJ, Aron DC, Keith RE, Kirsh SR, Alexander JA, Lowery JC, 2009 Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. *Implement. Sci* 4, 50 10.1186/1748-5908-4-50. [PubMed: 19664226]
- Dane AV, Schneider BH, 1998 Program integrity in primary and early secondary prevention: are implementation effects out of control? *Clin. Psychol. Rev* 18, 23–45. [PubMed: 9455622]
- Dennis M, Godley SH, Diamond G, Tims FM, Babor T, Donaldson J, Liddle H, Titus JC, Kaminer Y, Webb C, Hamilton N, Funk R, 2004 The Cannabis Youth Treatment (CYT) Study: main findings from two randomized trials. *J. Subst. Abuse Treat* 27, 197–213. 10.1016/j.jsat.2003.09.005. [PubMed: 15501373]
- Elbardissi AW, Duclos A, Rawn JD, Orgill DP, Carty MJ, 2013 Cumulative team experience matters more than individual surgeon experience in cardiac surgery. *J. Thorac. Cardiovasc. Surg* 145, 328–333. 10.1016/j.jtcvs.2012.09.022. [PubMed: 23083794]
- Emmons KM, Weiner B, Fernandez ME, Tu SP, 2012 Systems antecedents for dissemination and implementation: a review and analysis of measures. *Health Educ. Behav* 39, 87–105. 10.1177/1090198111409748. [PubMed: 21724933]
- Fixsen D, Scott V, Blase K, Naoom S, Wagar L, 2011 When evidence is not enough: the challenge of implementing fall prevention strategies. *J. Safety Res* 42, 419–422. 10.1016/j.jsr.2011.10.002. [PubMed: 22152258]
- Garner BR, Godley MD, Funk RR, Dennis ML, Godley SH, 2007 The impact of continuing care adherence on environmental risks, substance use, and substance-related problems following adolescent residential treatment. *Psychol. Addict. Behav* 21, 488–497. 10.1037/0893-164x.21.4.488. [PubMed: 18072831]
- Garner BR, Godley SH, Dennis ML, Hunter BD, Bair CM, Godley MD, 2012 Using pay for performance to improve treatment implementation for adolescent substance use disorders: results from a cluster randomized trial. *Arch. Pediatr. Adolesc. Med* 166, 938–944. 10.1001/archpediatrics.2012.802. [PubMed: 22893231]
- Garner BR, Godley SH, Funk RR, Dennis ML, Smith JE, Godley MD, 2009 Exposure to adolescent community reinforcement approach treatment procedures as a mediator of the relationship between adolescent substance abuse treatment retention and outcome. *J. Subst. Abuse Treat* 36, 252–264. 10.1016/j.jsat.2008.06.007. [PubMed: 18715742]
- Garner BR, Hunter SB, Funk RR, Griffin BA, Godley SH, 2016 Toward evidence-based measures of implementation: examining the relationship between implementation outcomes and client outcomes. *J. Subst. Abuse Treat* 67, 15–21. 10.1016/j.jsat.2016.04.006. [PubMed: 27296657]
- Garnick DW, Lee MT, Chalk M, Gastfriend D, Horgan CM, McCorry F, McLellan AT, Merrick EL, 2002 Establishing the feasibility of performance measures for alcohol and other drugs. *J. Subst. Abuse Treat* 23, 375–385. [PubMed: 12495800]
- Garnick DW, Lee MT, Horgan CM, Acevedo A, Washington Circle Public Sector, W., 2009 Adapting Washington Circle performance measures for public sector substance abuse treatment systems. *J. Subst. Abuse Treat* 36, 265–277. 10.1016/j.jsat.2008.06.008. [PubMed: 18722075]
- Garnick DW, Lee MT, O'Brien PL, Panas L, Ritter GA, Acevedo A, Garner BR, Funk RR, Godley MD, 2012 The Washington Circle engagement performance measures' association with adolescent treatment outcomes. *Drug Alcohol Depend* 124, 250–258. 10.1016/j.drugalcdep.2012.01.011. [PubMed: 22364777]
- Glasgow RE, Vogt TM, Boles SM, 1999 Evaluating the public health impact of health promotion interventions: the RE-AIM framework. *Am. J. Pub. Health* 89, 1322–1327. [PubMed: 10474547]
- Godley MD, Godley SH, Dennis ML, Funk RR, Passetti LL, 2007 The effect of assertive continuing care on continuing care linkage, adherence and abstinence following residential treatment for adolescents with substance use disorders. *Addiction* 102, 81–93. 10.1111/j.1360-0443.2006.01648.x. [PubMed: 17207126]

- Godley SH, Garner BR, Smith JE, Meyers RJ, Godley MD, 2011 A large-scale dissemination and implementation model for evidence-based treatment and continuing care. *Clin. Psychol. (New York)* 18, 67–83. 10.1111/j.1468-2850.2011.01236.x. [PubMed: 21547241]
- Godley SH, Meyers RJ, Smith JE, Godley MD, Titus JC, Karvinen T, Dent G, Passetti LL, Kelberg P, 2001 The adolescent community reinforcement approach (DHHS publication No. SMA 01–3489) Cannabis Youth Treatment Series, vol. 4 Center for Substance Abuse Treatment, Substance Abuse and Mental Health Services Administration, Rockville, MD.
- Godley SH, Smith JE, Meyers RJ, Godley MD, 2016 The Adolescent Reinforcement Approach: A Clinical Guide for Treating Substance Use Disorders. Chestnut Health Systems, Normal, IL.
- Greenhalgh T, Robert G, Macfarlane F, Bate P, Kyriakidou O, 2004 Diffusion of innovations in service organizations: systematic review and recommendations. *Milbank Q* 82, 581–629. 10.1111/j.0887-378X.2004.00325.x. [PubMed: 15595944]
- Harris AH, Humphreys K, Finney JW, 2007 Veterans affairs facility performance on Washington Circle indicators and casemix-adjusted effectiveness. *J. Subst. Abuse Treat* 33, 333–339. 10.1016/j.jsat.2006.12.015. [PubMed: 17400416]
- Hunter SB, Ayer L, Han B, Garner BR, Godley SH, 2014 Examining the sustainment of the adolescent-community reinforcement approach in community addiction treatment settings: protocol for a longitudinal mixed method study. *Implement. Sci* 9, 104 10.1186/s13012-014-0104-1. [PubMed: 25116509]
- Hunter BD, Godley SH, Hesson-McInnis MS, Roozen HG, 2013 Longitudinal change mechanisms for substance use and illegal activity for adolescents in treatment. *Psychol. Addict. Behav* 507–515. [PubMed: 24128291]
- Hunter SB, Han B, Slaughter ME, Godley SH, Garner BR, 2015 Associations between implementation characteristics and evidence-based practice sustainment: a study of the adolescent community reinforcement approach. *Implement. Sci* 10, 173 10.1186/s13012-015-0364-4. [PubMed: 26701601]
- Kauth MR, Sullivan G, Blevins D, Cully JA, Landes RD, Said Q, Teasdale TA, 2010 Employing external facilitation to implement cognitive behavioral therapy in VA clinics: a pilot study. *Implement. Sci* 5, 75 10.1186/1748-5908-5-75. [PubMed: 20942951]
- Klein KJ, Sorra JS, 1996 The challenge of innovation implementation. *Acad. Manage. Rev* 21, 1055–1080. 10.2307/259164.
- Knudsen HK, Roman PM, 2004 Modeling the use of innovations in private treatment organizations: the role of absorptive capacity. *J. Subst. Abuse Treat* 26, 51–59.
- Lewis CC, Fischer S, Weiner BJ, Stanick C, Kim M, Martinez RG, 2015 Outcomes for implementation science: an enhanced systematic review of instruments using evidence-based rating criteria. *Implement. Sci* 10, 155 10.1186/s13012-015-0342-x. [PubMed: 26537706]
- Martinez RG, Lewis CC, Weiner BJ, 2014 Instrumentation issues in implementation science. *Implement. Sci* 9, 118 10.1186/s13012-014-0118-8. [PubMed: 25185799]
- McCorry F, Garnick DW, Bartlett J, Cotter F, Chalk M, 2000 Developing performance measures for alcohol and other drug services in managed care plans. *J. Qual. Improv* 26, 633–643.
- Mesman R, Westert GP, Berden BJ, Faber MJ, 2015 Why do high-volume hospitals achieve better outcomes? A systematic review about intermediate factors in volume-outcome relationships. *Health Policy* 119, 1055–1067. 10.1016/j.healthpol.2015.04.005. [PubMed: 25958187]
- Miller WR, Yahne CE, Moyers TB, Martinez J, Pirritano M, 2004 A randomized trial of methods to help clinicians learn motivational interviewing. *J. Consult. Clin. Psychol* 72, 1050–1062. 10.1037/0022-006x.72.6.1050. [PubMed: 15612851]
- Nilsen P, 2015 Making sense of implementation theories, models and frameworks. *Implement. Sci* 10, 53 10.1186/s13012-015-0242-0. [PubMed: 25895742]
- Parchman ML, Noel PH, Culler SD, Lanham HJ, Leykum LK, Romero RL, Palmer RF, 2013 A randomized trial of practice facilitation to improve the delivery of chronic illness care in primary care: initial and sustained effects. *Implement. Sci* 8, 93 10.1186/1748-5908-8-93. [PubMed: 23965255]
- Proctor E, Silmere H, Raghavan R, Hovmand P, Aarons G, Bunger A, Griffey R, Hensley M, 2011 Outcomes for implementation research: conceptual distinctions, measurement challenges, and

research agenda. *Adm. Policy Ment. Health* 38, 65–76. 10.1007/s10488-010-0319-7. [PubMed: 20957426]

Proctor EK, Landsverk J, Aarons G, Chambers D, Glisson C, Mittman B, 2009 Implementation research in mental health services: an emerging science with conceptual, methodological, and training challenges. *Adm. Policy Ment. Health* 36, 24–34. 10.1007/s10488-008-0197-4. [PubMed: 19104929]

SAS Institute, Inc, 2012 SAS/STAT 12.1 User's Guide. SAS Institute, Inc, Cary, NC.

Sholomskas DE, Syracuse-Siewert G, Rounsaville BJ, Ball SA, Nuro KF, Carroll KM, 2005 We don't train in vain: a dissemination trial of three strategies of training clinicians in cognitive-behavioral therapy. *J. Consult. Clin. Psychol* 73, 106–115. 10.1037/0022-006X.73.1.106. [PubMed: 15709837]

Simpson DD, 2002 A conceptual framework for transferring research to practice. *J. Subst. Abuse Treat* 22, 171–182. [PubMed: 12072162]

Smith JE, Lundy SL, Gianini L, 2007 Community Reinforcement Approach (CRA) and Adolescent Community Reinforcement Approach (A-CRA) Coding Manual. University of New Mexico, Albuquerque, NM.

Stetler CB, Legro MW, Rycroft-Malone J, Bowman C, Curran G, Guihan M, Hagedorn H, Pineros S, Wallace CM, 2006 Role of external facilitation in implementation of research findings: a qualitative evaluation of facilitation experiences in the Veterans Health Administration. *Implement. Sci* 1, 23 10.1186/1748-5908-1-23. [PubMed: 17049080]

Zahra SA, George G, 2002 Absorptive capacity a review, reconceptualization, and extension. *Acad. Manage. Rev* 27, 185–203.

Fig. 1.

The three precursory pillars of implementation research that support our future implementation research.

Table 1

Correlations among independent measures.

Construct							
Measure name	1.	2.	3.	4.	5.	6.	7.
Absorptive Capacity							
1. Time-to-proficiency ^a	1.00						
2. Ratings-to-proficiency ^b	0.21	1.00					
Penetration							
3. Staff penetration ^c	0.16	-0.11	1.00				
4. Client penetration ^b	0.14	-0.04	0.76	1.00			
Fidelity							
5. Treatment initiation ^d	-0.26	0.20	0.18	0.25	1.00		
6. Treatment engagement ^d	-0.28	0.12	0.18	0.29	0.92	1.00	
7. Session exposure ^b	-0.18	0.22	0.20	0.26	0.80	0.83	1.00

Note: Bold indicates $p < 0.05$.^a Measured in weeks.^b Measured as raw number.^c Measured in days.^d Measured as a proportion.

Table 2

Backward stepwise regression and bivariate regression results predicting A-CRA procedure exposure.

Construct Measure	Backward Stepwise Regression			Bivariate Regressions		
	<i>B</i>	<i>SE</i>	<i>p</i>	<i>B</i>	<i>SE</i>	<i>p</i>
Absorptive Capacity						
Time-to-proficiency				-0.040	0.016	0.017
Ratings-to-proficiency				0.054	0.039	0.17
Penetration						
Staff penetration				0.00014	0.00011	0.22
Client penetration				0.0034	0.0027	0.21
Fidelity						
Treatment initiation	5.05	1.60	0.002	8.9	1.01	< 0.0001
Treatment engagement				7.4	0.77	< 0.0001
Session exposure	0.18	0.06	0.003	0.33	0.038	< 0.0001
Adjusted R-square = 0.55						

Note: Bold indicates $p < 0.05$.