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The IMPACT (Infection Management Plus Addiction Care Together) Pilot: A Case Series of Combined Contingency Management for Substance Use Disorders and Antibiotic Adherence in the Hospital Setting

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ABSTRACT

Objectives: Psychostimulant-related mortality is rising alongside increasing substance use-related hospitalizations, which are commonly complicated by patient-directed (or “against medical advice”) discharges. Contingency management (CM) is an underused evidence-based treatment for substance use disorders with proven efficacy to support medication adherence. Our objective was to describe feasibility and preliminary effectiveness of a novel CM intervention incentivizing both drug use reduction and antibiotic adherence in the hospital setting.

Methods: We conducted a pilot intervention of twice weekly CM for stimulant and/or opioid use disorder and antibiotic adherence conducted on inpatient wards and/or an embedded skilled nursing facility in an urban public hospital. Based on point-of-care urine drug test results and objective antibiotic adherence review, participants earned increasing opportunities to receive incentives. We measured feasibility via number of visits attempted and cost of gift cards dispensed. We evaluated effectiveness via antibiotic completion, discharge type, and participant perception of intervention effectiveness collected via structured survey.

Results: Of 13 participants enrolled, most had opioid use disorder (fentanyl in 10/13) and stimulant use disorder (methamphetamine in 7/13). Almost all were receiving treatment for osteomyelitis and/or endocarditis (12/13). Feasibility challenges included competing demands of acute care with variable range of completed visits per participant (1–12 visits). Despite this, antibiotic completion was high (92%, 12/13 participants) with only two patient-directed discharges. Participants described CM as very effective in aiding infection treatment but had greater variability in beliefs regarding CM facilitation of reduced drug use.

Conclusions: Providing CM in the hospital setting may represent an effective approach to improving health outcomes by increasing antibiotic adherence and addressing substance use.

Key words: substance use disorder, motivation, drug users, central nervous system stimulants, opioid-related disorders, endocarditis, osteomyelitis, medication adherence

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Successful treatment of serious infections among people who use drugs (PWUD) remains challenging given undertreated substance use disorders (SUD), stigma, competing life priorities, and more limited discharge options after hospitalization compared with non-PWUD.^{1–3} Contingency management (CM), a behavioral treatment anchored in operant conditioning that involves frequent assessment of objective behavior change with paired incentives, is an underused strategy that has proven efficacious in addressing SUD and separately infection treatment adherence. Numerous randomized trials have supported CM efficacy in treating methamphetamine use disorder, cocaine use disorder, and opioid use disorder, with additional studies demonstrating CM efficacy in HIV, hepatitis C, and tuberculosis treatment.^{4–10}

However, widespread implementation of CM, especially in hospital settings, has been limited.¹¹ Given the dearth of Food and Drug Administration–approved pharmacotherapeutic options for stimulant use disorders, the strong evidence for CM in stimulant use disorders, and the high rates of patient-directed discharges among patients with SUD and serious infections, it is imperative to adapt and pilot CM interventions in real-world settings. Recognizing the need to implement CM and scale up interventions to address both SUD and serious infections in PWUD, we enacted a pilot CM intervention in the hospital setting incentivizing both drug use reduction and antibiotic adherence (Infection Management Plus Addiction Care Together [IMPACT]). Our objective was to describe feasibility and preliminary effectiveness of this novel CM intervention.

METHODS

Between March 2022 and July 2022, we piloted IMPACT, an intervention involving twice weekly CM in an urban, public hospital. We included participants who were either admitted to the hospital or discharged to the skilled nursing facility physically attached to the hospital (where PWUD often complete complete antibiotic courses).

Infectious diseases, addiction consult teams, and primary teams referred participants to IMPACT. We enrolled adults 18 or older with stimulant and/or opioid use disorders interested in reducing or stopping drug use who had a planned hospitalization or skilled nursing facility stay ≥ 2 weeks for antimicrobial treatment. We excluded participants unable to participate in twice weekly urine drug testing.

For CM in our study, we used the prize method for reinforcement provision¹² (also known as the “fishbowl method,”) in which participants earned escalating draws from a fishbowl containing slips with variable monetary value.¹³ The opportunity to earn incentives increased for longer durations of drug-free urine and/or electronic medical record (EMR)–confirmed antibiotic adherence (Fig. 1). We defined high-fidelity CM in our study as involving (1) frequent sessions, (2)

incentive provided immediately following objective assessment of behavior (via use of point-of-care assessments), (3) incentives not given if behavior not demonstrated.¹¹

An addiction medicine and infectious diseases physician performed CM consisting of the following: (1) point-of-care urine testing for cocaine, methamphetamine, and/or nonprescribed opioids; (2) antimicrobial medication review in the EMR; (3) drawing from a fishbowl to earn prizes (with draws based on drug testing and antibiotic adherence results); and (4) motivational interviewing for 15 to 45 minutes. We detailed specific protocols and procedures with regard to CM operations (including visit schedule, incentive provision, etc.) in Appendix 1 (<http://links.lww.com/JAM/A457>) to facilitate efficient dissemination to interested groups. Contingency management continued until discharge, at which time the study physician offered participants connection to outpatient CM. At IMPACT enrollment, participants completed a structured survey in which they quantified the importance and confidence they had in completing infection treatment and reducing substance use (Likert scale 1–10 with 10 greatest possible importance/ confidence). At exit, participants evaluated the effectiveness of the intervention in supporting infection treatment and substance use reduction (Likert scale 1–10 with 10 greatest possible effectiveness), and we used the same structured survey instrument to record antibiotic adherence (defined as infection treatment completion as recorded in primary hospital team notes) and type of discharge (standard vs premature patient-directed discharge). At every CM session, we also recorded open-ended intervention feedback and participant reflections as field notes.

Data Analysis

We used the Consolidated Framework for Implementation Research (CFIR) 2.0 to develop our evaluation plan for the feasibility and effectiveness of IMPACT.¹⁴ We used this framework to organize IMPACT evaluation by CFIR domain (innovation, outer setting, inner setting, and characteristics of individuals), specifically incorporating assessment of the needs of the innovation recipients in considering effectiveness. We defined feasibility by the number of visits attempted and completed and cost of gift cards dispensed. We quantitatively evaluated effectiveness via antibiotic completion (binary outcome), discharge type (binary outcome), and participants' perception of intervention effectiveness (Likert scale as above). We included field notes pertinent to intervention feasibility and effectiveness, and organized field notes into CFIR 2.0 domains corresponding with themes.

Patient Consent Statement

Written consent was obtained to participate in this study, and the University of California, San Francisco, Institutional Review Board (21-33298) approved this study.

RESULTS/CASE PRESENTATIONS

Clinicians referred 15 participants to IMPACT, and 13 met inclusion criteria and consented to participate. The median age of participants was 39 (interquartile range [IQR], 35–67), almost half identified as cisgender women (n = 6/13), and the majority were experiencing homelessness (n = 10/13). Participants were receiving intravenous antibiotics for osteomyelitis (n = 7), endocarditis (n = 6), and tenosynovitis (n = 1). The majority of participants had both opioid use disorder (n = 10/13) and stimulant use disorder (n = 9/13). See Table 1 for additional participant characteristics.

At enrollment, most participants reported that infection treatment completion and drug use reduction were both very important (mean importance >8/10). However, infection treatment importance was ranked higher than drug use reduction, and participants were more confident in completing infection treatment (Table 1) than reducing substance use. No participant (n = 0/13) had prior knowledge of or participation in CM.

Feasibility

Date of IMPACT referral and remaining length of hospital or nursing facility stay dictated the duration of the CM intervention. Of the 13 IMPACT participants, the longest participation was 7 weeks (participant 1: 14 attempted twice weekly visits, 12 completed visits). The shortest participation was 1 visit (participant 2: 1 visit completed before discharge earlier than planned because of recommended oral antibiotic treatment). See Table 2 for additional feasibility measures, including attempted versus completed visits and the cost of gift cards earned. Visits were attempted but not completed because of urgent clinical concerns (e.g., shortness of breath receiving evaluation, off the floor for procedure, etc.) or other scheduled visits (e.g., physical therapy, consultant evaluation, etc.) Participants earned a median of \$110 in gift cards as part of this hospital-based CM intervention with an interquartile range of (\$30–\$210).

Effectiveness

Related to infection treatment, 12 of 13 participants (92%) completed their antibiotic courses, and only 2 patients self-directed their discharge during the intervention (Table 3). Congruent with these high rates of antibiotic completion, most participants on surveys reported that CM was very effective in supporting infection treatment completion (median, 9/10; IQR, 8–10), also noting appreciation of CM in increasing social engagement, relief from boredom, and mitigating stigma.

Regarding drug use reduction, most participants (11/13, 85%) had urine testing without nonprescribed drugs during the intervention. Participant 7 had ongoing methamphetamine use and multiple life stressors including grief, intimate partner violence, and homelessness, leading to a self-directed discharge 2 days after IMPACT enrollment. Participant 11 had both cocaine use disorder and fentanyl use disorder, while this person successfully completed antibiotics and stopped using cocaine, and fentanyl use was ongoing. One participant crushed the oxycodone prescribed for pain and injected into a peripherally inserted central catheter. This was not captured by urine drug testing as oxycodone was prescribed. Patient-reported effectiveness is shown in Table 3; there was considerable heterogeneity in patient-reported effectiveness of hospital-based CM for drug use reduction (median, 6.5; IQR, 5–10).

At intervention exit, some participants felt that hospitalization for an infection was a “wake up call” without need for additional support to reduce drug use in the future. Two participants noted that the hospital setting was removed from the setting in which they were accustomed to using drugs, so this intervention was absent their typical triggers. Others appreciated the support to make change and feeling that IMPACT was instrumental in reducing future drug use. Ultimately, 5 of 13 were interested in receiving ongoing CM in the outpatient context. See Table 4 for select intervention field notes from participants describing their experience.

DISCUSSION

The efficacy of CM for reducing drug use in PWUD has been well supported by numerous randomized trials, and CM is currently considered the optimal treatment for stimulant use disorder.^{4,6-10,15-17} Despite this broad evidence base and increasing morbidity and mortality related to stimulants, CM implementation has been limited. As few as 10% of addiction providers use CM regularly,¹⁸ despite two-thirds having positive beliefs about CM.¹⁹ Frequently described CM barriers include (1) insufficient training and awareness, (2) resource intensiveness, and (3) staff reluctance to provide incentives.²⁰⁻²³ Although one study found that a common objection was CM's lack of effectiveness for multiple behaviors,¹⁹ incentivizing multiple behaviors has been described in HIV behavioral economic literature.^{24,25} The IMPACT is the first CM intervention, to our knowledge, that objectively assesses antibiotic completion and nonprescribed drug use to support infection treatment completion and reduced drug use, in addition to provision in the hospital setting.

The data supporting CM and other incentive-based interventions to encourage antimicrobial medication adherence are robust in HIV, hepatitis, and tuberculosis, suggesting that CM for antibiotic adherence should also be effective. Contingent incentives have been used to encourage HIV medication adherence to achieve viral suppression in multiple studies.²⁶⁻³⁰ In PWUD, incentive-based interventions have also improved rates of hepatitis B vaccination,^{31,32} supported hepatitis C treatment adherence,^{33,34} and most recently promoted COVID-19 testing.³⁵ These successes are consistent with our findings, in which more than 90% of participants with co-occurring SUD and serious infections completed their antibiotic course and only 2 of 13 self-directed their discharge. While there is no formal comparison group in this small pilot study, we note that in a previously published cohort study of a similar population not receiving CM, antibiotic completion for PWUD with serious bacterial infections was 69% and 25% self-directed their discharge.¹ Moreover, IMPACT participants described that this intervention was effective in encouraging antibiotic completion, citing satisfaction with the visits breaking up the long acute care stay, developing a trusting relationship, and the financial incentives.

Another novel aspect of IMPACT was use of CM in the hospital setting. To our knowledge, only one medical center in Canada has reported implementing CM for treatment of stimulant use disorders in the hospital. In this important case study, researchers incentivized cocaine abstinence in a patient with osteomyelitis to reduce cocaine use with the secondary benefit of completing antibiotics and surgery for hardware removal.³⁶ In IMPACT, we found key positive aspects of hospital CM. First, none of the participants had prior knowledge of CM. As many hospital-based addiction studies have demonstrated, hospitalization represents a reachable moment to provide a positive experience with SUD care that may facilitate future engagement.^{37,38} Second, many participants voiced appreciation that this intervention reduced the stigma they felt as a PWUD. Acute care settings are inhospitable to PWUD for multiple reasons, including stigma, insufficient withdrawal and pain treatment, and similarities to carceral settings.^{39,40} Having an addiction specialist trained in harm reduction may have promoted a more positive clinical environment (Table 4). Conversely, one challenge to hospital-based CM is reinforcing abstinence in an environment that is starkly different from the patient's postdischarge environment. Some participants described not having cravings to use stimulants while hospitalized because they were removed from their triggers, while others felt that the severity of illness they were experiencing was a "wake up call," such that they did not need additional support to abstain from drugs while hospitalized. These beliefs are reflected in

the lower self-reported effectiveness of CM for reducing drug use as seen in Table 3 in some participants, suggesting that further study of optimal timing of CM as related to hospitalization may be helpful. On the other hand, others felt thankful for the positive reinforcement of sobriety and expressed that this achievement was empowering for the future. Further studies that incorporate patient perspectives over time and intervention cost will help improve CM in the acute care context.

Our pilot was subject to limitations. First, rigorous qualitative study of participants is needed to further refine long-term intervention implementation without the layer of social desirability bias potentially present in field notes. Prospective mixed methods evaluation is planned for the second wave of this intervention. In addition, regarding the intervention itself, it should be noted that CM is not a panacea for all patients with addiction, nor can it detect all nonprescribed drug use. Urine testing was limited to detection of recent, nonprescribed drug use, so our patient who had crushed a prescribed oxycodone pill was not flagged as having used nonprescribed drugs and was able to earn incentives accordingly that week. Although this was not a desired outcome and almost resulted in a patient-directed discharge, the participant completed hospitalization. Finally, while we reported participant earnings above, true program cost would also account for staff time, which was donated during this project. We plan to further evaluate implementation outcomes (including record of staff time) in subsequent waves of this intervention.

In summary, the IMPACT provided insight into potential strategies to support antibiotic adherence and drug use reduction in the hospital setting. Contingency management may be effective in patients with stimulant and/or opioid use disorders needing prolonged antibiotic treatment in hospital settings; we need larger hybrid effectiveness-implementation studies to understand both intervention feasibility and its role in supporting reduced drug use.

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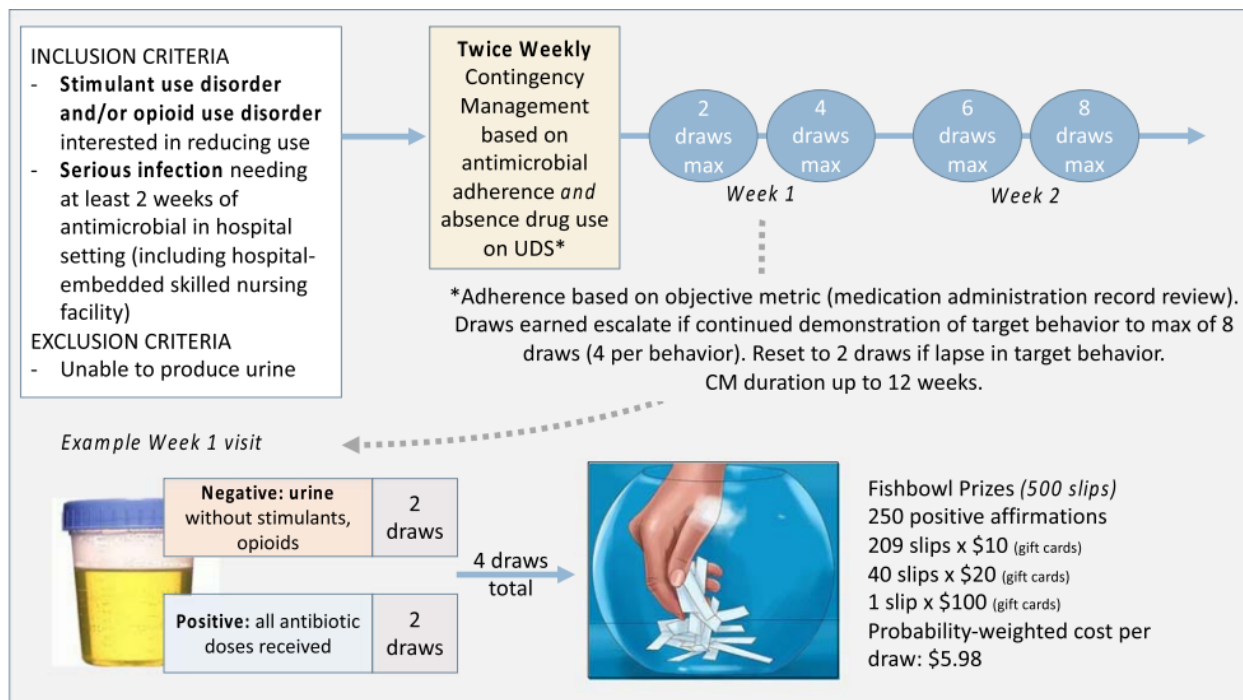


FIGURE 1. IMPACT contingency management procedures. We summarize pilot procedures of combined contingency management for substance use reduction and antibiotic adherence conducted in the hospital setting.

TABLE 1. Demographic and Baseline Characteristics of IMPACT Participants (n = 13)

Demographics

| | |
|--|-------------|
| Age, median (interquartile range) | 39 (35–67) |
| Female sex, n (%) | 6 (46%) |
| Unstably housed, n (%) | 10 (77%) |
| Clinical characteristics | |
| HIV, n (%) | 1/13 (8%) |
| Chronic hepatitis C, n (%) | 3/13 (23%) |
| Infection requiring hospitalization* | |
| Osteomyelitis, n (%) | 7/13 (54%) |
| Endocarditis, n (%) | 6/13 (46%) |
| Tenosynovitis, n (%) | 1/13 (8%) |
| Stimulant use disorder* | |
| Cocaine, n (%) | 3/13 (23%) |
| Methamphetamine, n (%) | 7/13 (54%) |
| Opioid use disorder* | |
| Fentanyl, n (%) | 10/13 (77%) |
| Heroin, n (%) | 3/13 (23%) |
| Patient characteristics at enrollment | |
| Importance of reducing or stopping drug use (mean of scale 1–10, standard deviation) | 8.8 (2.3) |
| Confidence in reducing or stopping drug use (mean of scale 1–10, standard deviation) | 8 (3.2) |
| Importance of completing infection treatment (mean of scale 1–10, standard deviation) | 9.5 (1.4) |
| Confidence in completing infection treatment (mean of scale 1–10, standard deviation) | 9 (1.8) |
| Prior knowledge of contingency management, n (%) | 0 (0%) |

*Not mutually exclusive.

TABLE 2. Contingency Management Feasibility Outcomes by Participant

| ID | CM Visits Attempted | CM Visits Completed | Total Monetary Value of Gift Cards Earned |
|-----------|----------------------------|----------------------------|--|
| 1 | 14 | 12 | \$460 |
| 2 | 1 | 1 | \$10 |
| 3 | 5 | 2 | \$20 |
| 4 | 3 | 3 | \$100 |
| 5 | 4 | 3 | \$70 |
| 6 | 6 | 5 | \$140 |
| 7 | 4 | 2 | \$10 |
| 8 | 6 | 4 | \$40 |
| 9 | 10 | 6 | \$180 |
| 10 | 8 | 7 | \$390 |
| 11 | 10 | 7 | \$240 |
| 12 | 12 | 7 | \$290 |
| 13 | 8 | 4 | \$110 |

CM indicates contingency management.

TABLE 3. Contingency Management Effectiveness Outcomes by Participant

| ID | Proportion of Urine Drug Tests Negative for Nonprescribed Drugs | Infection Treatment Complete? | Type of Discharge | Participant-Reported CM Effectiveness for Antibiotic Completion (1–10)* | Participant-Reported CM Effectiveness for Drug Use Reduction (1–10)* |
|-----------|--|--------------------------------------|--------------------------|--|---|
| 1 | 12/12 (100%) | Yes | Standard | 9 | 6 |
| 2 | 1/1 (100%) | Yes | Standard | No exit data | No exit data |
| 3 | 2/2 (100%) | Yes | Standard | No exit data | No exit data |
| 4 | 3/3 (100%) | Yes | Standard | 10 | 5 |
| 5 | 3/3 (100%) | Yes | Standard | 10 | 8 |
| 6 | 5/5 (100%) | Yes | Patient-directed | 10 | 3 |
| 7 | 0/2 (0%) | No | Patient-directed | No exit data | No exit data |
| 8 | 4/4 (100%) | Yes | Standard | 7 | 2 |
| 9 | 6/6 (100%) | Yes | Standard | 9 | 7 |
| 10 | 7/7 (100%) | Yes | Standard | 10 | 10 |
| 11 | 1/7 (14%) | Yes | Standard | 7 | 7 |
| 12 | 7/7 (100%) | Yes | Standard | 8 | 5 |
| 13 | 4/4 (100%) | Yes | Standard | 10 | 8 |

*1 indicating “no effect” and 10 indicating “extremely effective.”
CM indicates contingency management.

TABLE 4. Contingency Management Field Notes by CFIR Domain* and Theme

| CFIR Domain | Theme | Participant Comments |
|---------------|---|---|
| Outer setting | Stigma in the hospital | In prior hospitalizations, “I was [treated like I was] crazy, all the forms just said ‘meth psychosis,’ when I knew something was wrong. If someone who shoots dirty stuff into their blood says there is a problem with their blood, maybe you should at least give them a blood test!” |
| | Substance use triggers outside the hospital | “I know what to say to get the pill [full agonist opioids], but sometimes I just don’t want to deal with that [stigma].” <i>Doesn’t need support for drug cravings in the hospital, as home environment the issue:</i> “It’s that stepping off the bus and seeing your old haunts and feeling so pulled back into everything. ” |
| Inner setting | Value of relationships | “I wouldn’t be here without this [intervention]. I think that there is the urine, but then there is the conversation and the relationship we have, what I end up explaining in myself and my motivation.” “ I think there’s a lot of value in this—most doctors don’t actually listen to you or take the time to relate... Should I donate my last winning to the program? it should keep going.” “ If I really wanted to leave, I would have left regardless of the money. But I wanted to stay, I knew when I came back here [prior pt-directed discharge] that I needed to do this for my health. and honestly, it’s not just about me now—I’m doing this because I can’t leave [my partner] alone. Before her, I didn’t value my life as much.” Interested in intervention because, “The last two times I was in the hospital I left early because I thought I could bear it and muscle it out and be a man. I didn’t want to tell people I was struggling. But I really wanted to go use and thought I should be able to do better on my own. But I can’t do it alone. ” |
| | Relationships and incentives | “You know, more than anything in that bowl, the most important thing is that you were my friend... but those gift cards don’t hurt haha! I need those too!” |
| Individuals | Substance use motivation | <i>Highly motivated to stop using all substances, unclear if additive CM benefit:</i> “ This is a huge wake up call for me. I don’t just want to stop using heroin, I want to completely stop smoking, not drink a drop of alcohol. I can’t believe I abused my body for 15 years with grams of heroin and cocaine, almost getting shot, being in prison, and now from shooting up tramadol, I get this [endocarditis]. But I am almost excited to have this new lease because I know how productive I am when I’m sober. I’ve bought multiple houses and businesses, I’ve been raising my daughter right—I can do all that now, if I get out of here alive.” <i>Perceived CM benefit in stopping cocaine use (though ongoing fentanyl use):</i> “You might think that’s high [patient-reported CM effectiveness rating] as I’m obviously still using, but honestly, it was cocaine that was making me a different person and destroying my health. I’ve had weeks off now because of this [intervention] and [my partner] said that if I go back to it, she’s canceling our wedding date. I mean, it’s going to be different out there [after hospital discharge], but I’m going to try. The fentanyl is different—that’s been in my life for 12 years, and obviously we’re both still using it and we don’t want to be, but it’s less a problem.” |
| | Antibiotic adherence motivation | “I’ll be honest with you, it’s [antibiotic completion is] really important. And also I’ve messed up before. But I know I could die. I don’t want to die.” “I know I can die from this [infection]. I don’t want to.” |
| Innovation | | This intervention has been, “ the number one most positive force in this hospitalization, I don’t know if I could have done it.” “I got another week where I’m not outside, not injecting drugs, not getting this wound dirty, am getting good nutrition and getting well.” |

*The Consolidated Framework for Implementation Research 2.0 uses 5 domains to organize data that may influence implementation outcomes. We focused on the following domains for this analysis: innovation, outer setting, inner setting, and characteristics of individuals.

CM indicates contingency management.

Italicized comments are summative comments from the authors to aid in field note interpretation. Bolded comments are field note highlights as curated by authors.