Understanding pathways from implementation to sustainment: a longitudinal mixed methods analysis of promising practices implemented in the Veterans Health Administration

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Research Article

Keywords: Implementation Outcomes, Implementation, Sustainment Outcomes, Sustainability, Sustainment, Maintenance, Longitudinal, Survey, Sustainment Determinants, Consolidated Framework for Implementation Research (CFIR)

Posted Date: August 30th, 2023

DOI: https://doi.org/10.21203/rs.3.rs-3233018/v1

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Abstract

Background

The Veterans Health Administration (VHA) is the United States’ largest learning health system. The Diffusion of Excellence (DoE) program is a large-scale model of diffusion that identifies and diffuses evidence-informed practices across VHA. During the period of 2016–2021, 57 evidence-informed practices were implemented across VHA facilities. This setting provides a unique opportunity to understand determinants and pathways of sustainment. Our objective was to characterize longitudinal pathways of practices as they transition from initial implementation to long-term sustainment.

Methods

A longitudinal mixed-methods evaluation with semi-structured post-implementation interviews and annual sustainment surveys of 82 implementation leads of 57 DoE practices was completed. Primary outcomes (implementation, sustainment), and secondary outcomes (institutionalization, effectiveness, anticipated sustainment) at four time-points were collected. We performed descriptive statistics and directed content analysis using Hailemariam et al.’s factors influencing sustainment.

Results

After 5 years of implementation, of the 82 implementation leads, about one-third reported their practice was fully sustained compared to one-third who reported their practice was not fully sustained because it was in a “liminal stage” (neither sustained nor discontinued) or permanently discontinued. The remaining one-third of leads were missing 2021 sustainment outcomes. Over time, a higher percentage of leads (43%) reported inconsistent findings across primary outcomes compared to those who (29%) reported consistent findings across primary outcomes. Thirty-four percent of leads with sustained practices reported resilience since they overcame implementation and sustainment barriers. Leads of sustained practices were more likely to report positive secondary outcomes compared to those that did not sustain their practice. Key barriers to practice sustainment included: inadequate workforce, not able to maintain practice fidelity/integrity, critical incidents related to the COVID-19 pandemic, organizational leadership did not support sustainment of practice, and no ongoing support. Key facilitators to practice sustainment included: demonstrating practice effectiveness/benefit, sufficient organizational leadership, adequate workforce, and adaptation/alignment with local context.

Conclusions

We identified diverse pathways from implementation to sustainment, and our data underscore that initial implementation outcomes may not determine long-term sustainment. This longitudinal evaluation
contributes to understanding impacts of the DoE program, including return on investment, achieving learning health system goals, and insights into achieving high-quality healthcare in VHA.

**Key Words**

Implementation Outcomes, Implementation, Sustainment Outcomes, Sustainability, Sustainment, Maintenance, Longitudinal, Survey, Sustainment Determinants, Consolidated Framework for Implementation Research (CFIR)

**Contributions to the Literature**

- Contrary to literature, more leads reported inconsistent results across primary outcomes from initial implementation to long-term sustainment and initial success/failure did not always predict future success/failure.
- Future research should explore if leads with practices in a “liminal stage” of sustainment (neither sustained nor discontinued) benefit from additional support/intervention.
- Common barriers to long-term sustainment included: inadequate workforce, not able to maintain practice fidelity/integrity, critical incidents related to the COVID-19 pandemic, organizational leadership did not support sustainment of practice, and no ongoing support.
- Common facilitators to long-term sustainment included: demonstrating practice effectiveness/benefit, sufficient organizational leadership, adequate workforce, and adaptation/alignment with local context.

**Background**

It is well known that it takes years to implement evidence-informed practices (EIP) in real world settings [1]. However, understanding if EIPs are not only implemented, but sustained over a longer period is less frequently reported. Sustainment is defined as the extent to which an EIP is (or is not) in use after an initial implementation phase and is measured by assessing outcomes [2, 3]. Aarons et al. describe the need to study sustainment as “critical,” and “at least as important as the study of implementation,” given that over half of implemented innovations are not sustained over the long-term with fidelity [4]. Sustainment is important because otherwise “time and fiscal investments in implementation are wasted and public health impact is limited [5].”

Important facets for enhancing our knowledge about sustainment and developing more systematic and effective approaches to measuring sustainment include: 1) differentiating sustainment versus initial implementation and defining when it begins [6, 7]; 2) studying sustainment longitudinally [6–8]; 3) describing and critiquing frameworks employed [6], 4) studying use of sustainment strategies, fidelity checklists, and adaptations [6, 9]; 5) describing factors contributing to long-term sustainment success or failure; and 6) using pragmatic approaches to assessing sustainment [8, 10].
Though systematically studying EIP sustainment over the long-term is “critical,” it is complex and often difficult for researchers to attempt due to limited resources and fixed funding cycles [10], participant burden [11], and methodological challenges [10]. Given these challenges, EIP sustainment is reported less often [7, 8], there is no gold standard way for studying sustainment, and there is an increased need for implementation scientists to develop pragmatic ways to study the dynamic nature of long-term sustainment.[7] With the exception of the Provider Report of Sustainment Scale (PReSS) [12], few pragmatic sustainment measures exist, and even application of the PReSS in understanding sustainment across diverse EIPs and settings has not been evaluated.

As part of the Veterans Health Administration (VHA)’s learning health system goals, the Diffusion of Excellence (DoE) was created as a novel nationwide program to support broad EIP diffusion. Our team has evaluated implementation and sustainment of DoE EIPs since its inception [3, 13–19]. From 2016 to 2021, the DoE has supported implementation and diffusion of 57 diverse EIPs known as “Promising Practices” (hereafter: Practice) across 82 facilities in the VHA. Although implementation leads received approximately 6-9-months of facilitated implementation support for their Practice, their implementation and initial sustainment outcomes varied widely [15]. Previously [15], we found initial implementation status did not necessarily predict initial sustainment. For example, some implementations were initially unsuccessful in meeting 6-9-month milestones, but leads’ efforts continued and went on to full implementation and initial sustainment of their Practices. In contrast to published literature [9, 20], these results differ from long-standing ideas that initial implementation success predicts future sustainment success [15]. Most literature on sustainment actually focuses on sustainability (anticipated/predictions of future sustainment) [3] or on initial sustainment following successful initial implementation [21], leaving understandings of delayed implementers behind. Even less attention is paid to understanding longer-term sustainment outcomes [6, 8].

The aim of this evaluation was to extend existing sustainment knowledge by reporting sustainment outcomes and characterizing longitudinal patterns from initial implementation to sustainment of DoE’s diverse Practices. In addition, we describe lessons learned and offer future directions for evaluating longer-term sustainment.

Methods

Setting

The VHA DoE is one of few large-scale models of diffusion. The DoE seeks to identify, support, and disseminate EIPs across VHA, which is comprised of more than 1,200 facilities. DoE Practices are supported by evidence from research studies and/or administrative or clinical experience, and they address patient, employee, and/or facility needs. The DoE sponsors annual “Shark Tank” competitions, in which regional and facility leaders bid on the opportunity to implement a Practice, coupled with 6–9 months of external facilitation support. For additional detail on DoE, see previous publications [3, 15–19, 22, 23]. Over 2,000 practices were submitted for consideration between Shark Tank Cohorts 1–5. The DoE
designated 57 of these as Promising Practices and these were adopted at 82 facilities (some Practices were adopted by more than one facility). Two additional Practices were implemented outside of standard DoE processes; these are not included in this evaluation. As part of an ongoing DoE evaluation, we conducted interviews and administered surveys to implementation leads (hereafter: leads), responsible for implementing their Practice at a VHA facility, to elicit information about implementation and sustainment of EIPs in local settings (Additional File 1. Further DoE Description).

Per regulations outlined in Veterans Health Administration Program Guide 1200.21, the evaluation of DoE has been designated a non-research quality improvement activity.

Sample

Purposeful criterion sampling included 82 leads who were responsible for implementing a Promising Practice at their facility during Cohorts 1–5 [24].

Longitudinal Dataset

The dataset for Cohorts 1–5 spanned from 2016 to 2021 and included one semi-structured interview completed approximately 1–2 months after implementation (Cohorts 1–4) and up to three subsequent sustainment surveys administered in 2019, 2020, and 2021 (Cohorts 1–5). Depending on the timing of Cohorts, the 82 implementation leads completed up to 4 timepoints (see Table 1). Due to shifting evaluation priorities, Cohort 5 received the implementation outcome question via survey rather than semi-structured interview.

<table>
<thead>
<tr>
<th>Cohorts</th>
<th>Implementation Outcome Year*</th>
<th>Sustainment Outcome 2019</th>
<th>Sustainment Outcome 2020</th>
<th>Sustainment Outcome 2021</th>
<th>Total Timepoints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cohort 1</td>
<td>2016</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>4</td>
</tr>
<tr>
<td>Cohort 2</td>
<td>2017</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>4</td>
</tr>
<tr>
<td>Cohort 3</td>
<td>2018</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>4</td>
</tr>
<tr>
<td>Cohort 4</td>
<td>2019</td>
<td>N/A</td>
<td>Yes</td>
<td>Yes</td>
<td>3</td>
</tr>
<tr>
<td>Cohort 5</td>
<td>2020</td>
<td>N/A</td>
<td>N/A</td>
<td>Yes</td>
<td>2</td>
</tr>
</tbody>
</table>

*Implementation follow-up was only provided in sustainment surveys for leads who did not fully implement or were missing data
Recruitment

Implementation leads were invited via email to participate in a semi-structured interview and REDCap surveys (Additional File 2). To enhance recruitment, we completed three follow-ups via email or instant messaging. We asked participants who indicated they were no longer involved in their Practice to provide us with another contact. Leads were excluded from future surveys if they noted that their Practice was permanently discontinued or if they did not respond to three consecutive timepoints.

DOE Evaluation and Outcomes

Evaluation

Our primary evaluation question was: What are the longitudinal pathways from implementation to sustainment of DoE’s Promising Practices? See Table 2 for outcomes, questions, and response options.
Table 2
Interview/survey questions to assess outcomes and timepoints

<table>
<thead>
<tr>
<th>Primary Measure</th>
<th>Definition</th>
<th>Primary Outcome Measures</th>
<th>Timing of Data Collection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Practice Implementation</strong>&lt;sup&gt;1&lt;/sup&gt;</td>
<td>Extent to which Practice’s core components and activities were initially implemented</td>
<td>Question: Was this Practice implemented? Response: fully implemented, partially implemented, not implemented</td>
<td>2016, 2017, 2018, 2019, 2020</td>
</tr>
<tr>
<td><strong>Practice Sustainment</strong>&lt;sup&gt;2&lt;/sup&gt;</td>
<td>Extent to which Practice’s core components and activities were in use after initial implementation</td>
<td>Question: What is the current status of this Practice? Response: In use/In place, Partially in use/in place, Practice is temporarily not in use/in place, Practice has been discontinued permanently</td>
<td>2019, 2020, 2021</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Secondary Measure</th>
<th>Definition</th>
<th>Secondary Outcome Measure</th>
<th>Timing of Collection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Practice Institutionalization</strong>&lt;sup&gt;2&lt;/sup&gt;</td>
<td>Extent to which Practice’s core components and activities were part of routine care and work processes [41, 45]</td>
<td>Question: Is this Practice considered routine, usual Practice when it is place? (i.e., Practice is nearly always used or done when appropriate by all individuals involved) Response: yes, partially, no Please explain:</td>
<td>2021</td>
</tr>
<tr>
<td><strong>Practice Effectiveness</strong>&lt;sup&gt;2&lt;/sup&gt;</td>
<td>Extent to which Practice was demonstrating effectiveness</td>
<td>Question: Is the Practice demonstrating effectiveness when it is in use? Response: yes, partially, no Please explain:</td>
<td>2021</td>
</tr>
</tbody>
</table>

<sup>1</sup>Cohorts 1–4 were given the practice implementation measure via semi-structured interviews. Cohort 5 was given this item via survey.

<sup>2</sup>Measures were given via survey to Cohorts 1–5.

<sup>3</sup>Sustainability is an anticipated outcome [2]
<table>
<thead>
<tr>
<th>Primary Measure</th>
<th>Definition</th>
<th>Primary Outcome Measures</th>
<th>Timing of Data Collection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sustainability</strong>&lt;sup&gt;2,3&lt;/sup&gt;</td>
<td>Likelihood Practice’s core components and activities will be in use in the future</td>
<td>Question: What is the likelihood this Practice will be sustained in the future:</td>
<td>2021</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Response: very unlikely, unlikely, neither likely/unlikely, likely, very likely</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Please explain what will make sustainment harder:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Please explain what will make sustainment easier:</td>
<td></td>
</tr>
<tr>
<td>&lt;sup&gt;1&lt;/sup&gt;Cohorts 1–4 were given the practice implementation measure via semi-structured interviews. Cohort 5 was given this item via survey.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;sup&gt;2&lt;/sup&gt;Measures were given via survey to Cohorts 1–5.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;sup&gt;3&lt;/sup&gt;Sustainability is an anticipated outcome [2]</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[Table 2.]

Primary implementation outcome

Implementation outcomes (Table 2) were based on facility implementation leads’ responses to qualitative and quantitative data obtained from in-depth interviews and sustainment surveys. Implementation outcomes were classified into the following: fully implemented, partially implemented, not implemented, or missing.

Primary and secondary sustainment outcomes

Sustainment outcomes (Table 2) involved 4 multiple-choice survey questions, which were based on published literature [26–28]; we assessed current Practice sustainment, sustainability (anticipated outcome), institutionalization, and effectiveness. Open-ended text boxes were provided after each question, so participants could contextualize their responses (i.e., provide a rationale for their current/anticipated outcome and explain barriers/facilitators to sustainment).

We included 9 Likert Scale determinant questions with follow-up text boxes to understand factors influencing sustainment (e.g., practice priority) [26–28]. However, these data were excluded due to both the low number and inadequate responses to text boxes, which made it unclear which ratings represented relevant barriers and/or facilitators.

Based on prior evaluation phases [15], we updated the 2021 survey to include a *temporarily not sustained* response option. The *temporarily not sustained* category aimed to capture a more nuanced...
understanding of sustainment, which included Practices that would usually be in place but were currently paused due to, e.g., the COVID-19 pandemic, loss of staff.

Analysis

Outcome data obtained from 2016–2021 were compiled into a Microsoft Excel matrix to facilitate within and across facility analysis and comparison of each lead’s Practice pathway from implementation to sustainment (e.g., implementation, implementation follow-up if not initially successful, sustainment 2019, sustainment 2020, sustainment 2021). We used Microsoft Excel to calculate descriptive statistics, response rate, summarize outcomes, and organize longitudinal pathways. We then categorized implementation to sustainment outcome pathways into consistent patterns (i.e., Practice status remained the same over time), inconsistent patterns (i.e., Practice status changed or had missing data over time), or missing patterns (i.e., Practice data was missing).

We performed directed content analysis of optional open-ended text boxes containing brief responses (approximately 1–2 sentences) [29] using Hailemariam et al.’s [6] systematic review, which is organized by Wiltsey-Stirman et al.’s influences on sustainability framework [9]. These factors are noted in italics in the results. New sustainment factors were created as needed using the updated Consolidated Framework for Implementation Research (e.g., critical incidents) [30] and other sustainment literature (e.g., sustained attention to topic/priority) [27]. Exemplary quotes are provided in Tables 3–4.
Table 3
Factors that facilitate sustainment

<table>
<thead>
<tr>
<th>Hailemariam et al.’s Facilitating Factors</th>
<th>Wiltsey Stirman et al.’s Framework</th>
<th>Fully Sustained</th>
<th>Not fully sustained</th>
<th>Example quotation</th>
</tr>
</thead>
<tbody>
<tr>
<td>EIP effectiveness or benefit</td>
<td>Innovation characteristics</td>
<td>10</td>
<td>1</td>
<td>“The [EIP] has been successful and continues to guide our practice”</td>
</tr>
<tr>
<td>Organizational leadership</td>
<td>Context</td>
<td>8</td>
<td>1</td>
<td>“We have support from leadership and the department”</td>
</tr>
<tr>
<td>Workforce</td>
<td>Capacity</td>
<td>6</td>
<td>0</td>
<td>“The primary team is doing well to manage the process with little oversight and facilitator involvement”</td>
</tr>
<tr>
<td>Adaptation/Alignment</td>
<td>Processes &amp; interactions</td>
<td>5</td>
<td>0</td>
<td>“[EIP] was adapted to accommodate more telehealth and fewer face to face encounters during COVID 19”</td>
</tr>
<tr>
<td>Ongoing support</td>
<td>Processes &amp; interactions</td>
<td>4</td>
<td>1</td>
<td>“Our facility offers strong support for the [EIP] which has allowed us to expand beyond our own facility”</td>
</tr>
<tr>
<td>EIP fit</td>
<td>Innovation characteristics</td>
<td>2</td>
<td>1</td>
<td>“It also fits within the mission of [top VHA initiative]”</td>
</tr>
<tr>
<td>Critical incidents*</td>
<td>Outer Setting*</td>
<td>2</td>
<td>0</td>
<td>“Virtual technology helped keep practice ongoing during COVID”</td>
</tr>
<tr>
<td>Ability to maintain EIP fidelity/integrity</td>
<td>Innovation characteristics</td>
<td>1</td>
<td>1</td>
<td>“[EIP] is used on a daily basis”</td>
</tr>
<tr>
<td>Integration of rules &amp; policies</td>
<td>Processes &amp; interactions</td>
<td>1</td>
<td>0</td>
<td>“[EIP] made an expectation for all nurses and providers”</td>
</tr>
<tr>
<td>Resources</td>
<td>Capacity</td>
<td>1</td>
<td>0</td>
<td>“Equipment is not an issue”</td>
</tr>
<tr>
<td>Community stakeholder support/involvement</td>
<td>Capacity</td>
<td>1</td>
<td>1</td>
<td>“I met with stakeholders outside the VA in an effort to get equipment and support for our Veterans in these areas”</td>
</tr>
<tr>
<td>Internal/external EIP champions</td>
<td>Capacity</td>
<td>0</td>
<td>4</td>
<td>“Unit champion ensures practice is continued”</td>
</tr>
<tr>
<td>Training &amp; education</td>
<td>Processes &amp; interactions</td>
<td>0</td>
<td>1</td>
<td>“Previous work with [EIP staff] trainings have facilitated the early success of the pilot program”</td>
</tr>
<tr>
<td>Hailemariam et al.'s Facilitating Factors</td>
<td>Wiltsey Stirman et al.'s Framework</td>
<td>Fully Sustained</td>
<td>Not fully sustained</td>
<td>Example quotation</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>-----------------------------------</td>
<td>----------------</td>
<td>---------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Sustained attention to topic/priority*</td>
<td>N/A*</td>
<td>0</td>
<td>2</td>
<td>“We still use some of the [EIP elements] we set in place during the process”</td>
</tr>
<tr>
<td>Total**</td>
<td></td>
<td>41</td>
<td>13</td>
<td></td>
</tr>
</tbody>
</table>

*Not present in Hailemariam et al.'s factors. **Totals are based on 66% (39/59) of leads who provided brief, open-ended text box responses in the 2021 survey. Some responders had provided more than one type of barrier.
<table>
<thead>
<tr>
<th>Hailemariam et al.'s Hindering Factors</th>
<th>Wiltsey Stirman et al.’s Framework</th>
<th>Fully Sustained</th>
<th>Not fully sustained</th>
<th>Example quotation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workforce</td>
<td>Capacity</td>
<td>3</td>
<td>9</td>
<td>“Staffing is the largest hurdle as to why buy in is not 100%”</td>
</tr>
<tr>
<td>Not able to maintain EIP fidelity/integrity</td>
<td>Innovation characteristics</td>
<td>0</td>
<td>3</td>
<td>“Many of the tenants from the [EIP] have stopped”</td>
</tr>
<tr>
<td>Critical incidents*</td>
<td>Outer Setting*</td>
<td>1</td>
<td>3</td>
<td>“Shortage of nursing staff during pandemic”</td>
</tr>
<tr>
<td>Organizational leadership did not support the sustainment of EIP</td>
<td>Context</td>
<td>0</td>
<td>2</td>
<td>“Lack of leadership buy-in to support”</td>
</tr>
<tr>
<td>No ongoing support</td>
<td>Processes &amp; interactions</td>
<td>1</td>
<td>2</td>
<td>“The practice has partial support and buy in”</td>
</tr>
<tr>
<td>Lack of trained personnel to continue EIP</td>
<td>Capacity</td>
<td>0</td>
<td>2</td>
<td>“Champion left position”</td>
</tr>
<tr>
<td>EIP effectiveness or benefit not observed</td>
<td>Innovation characteristics</td>
<td>0</td>
<td>2</td>
<td>“Many [staff] don't find the [EIP] to be effective”</td>
</tr>
<tr>
<td>Unable to navigate competing demands</td>
<td>Processes &amp; interactions</td>
<td>0</td>
<td>1</td>
<td>“Other priorities in the program”</td>
</tr>
<tr>
<td>System/policy change</td>
<td>Context</td>
<td>0</td>
<td>1</td>
<td>“Our facility is including in [new] Initiative process”</td>
</tr>
<tr>
<td>Poor collaboration/partnership</td>
<td>Processes &amp; interactions</td>
<td>0</td>
<td>1</td>
<td>“Disconnect between [clinic] and [other] service.”</td>
</tr>
<tr>
<td>Other</td>
<td>Lack of adequate service users</td>
<td>0</td>
<td>1</td>
<td>“[Event] in use, however due to the low census, no qualifying Veterans at this time.”</td>
</tr>
<tr>
<td>No/limited funding</td>
<td>Capacity</td>
<td>0</td>
<td>1</td>
<td>“Funding [barrier]”</td>
</tr>
<tr>
<td>No ability to modify/did not modify EIP</td>
<td>Innovation characteristics</td>
<td>0</td>
<td>1</td>
<td>“Transitioning practice to a different format”</td>
</tr>
<tr>
<td>Internal/external champion did not support the sustainment of EIP</td>
<td>Capacity</td>
<td>0</td>
<td>2</td>
<td>“The [champion] is a problem who falls under our [leadership].”</td>
</tr>
<tr>
<td>Community stakeholders do not support the sustainment of the EIP</td>
<td>Capacity</td>
<td>1</td>
<td>1</td>
<td>“Buy in from some community providers has been challenging”</td>
</tr>
<tr>
<td>Hailemariam et al.’s Hindering Factors</td>
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<td>--------------------------------------</td>
<td>----------------------------------</td>
<td>----------------</td>
<td>-------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Total**</td>
<td>6</td>
<td>32</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Not present in Hailemariam et al.’s factors. **Totals are based on 66% (39/59) of leads who provided brief, open-ended text box responses in the 2021 survey. Some responders had provided more than one type of barrier.

Results

Eighty-two implementation leads, who were members of DoE Cohorts 1–5, collectively implemented 57 different Promising Practices (25 clinical interventions, 23 process improvements, 9 staff-oriented interventions). Of the 57 practices, 53% had a virtual component. See Practice Descriptions in Additional File 1.

As of 2021 (timepoints ranged from 1–5 years after a 6-9-month initial implementation period), about one-third of leads reported their Practice was fully sustained, one-third reported their Practice was not fully sustained, and one-third did not respond. One lead was missing outcomes for all time-points. Twenty-nine percent (24/82) of leads reported consistent outcomes from initial implementation to sustainment, 43% (35/82) of leads reported inconsistent outcomes from implementation to sustainment, and pathways for 28% (23/82) of leads were unknown because they did not respond to the 2021 survey. Tables 3–4 list facilitators and barriers to sustainment for the 66% of leads who responded to optional open-ended text boxes. Additional File 3 provides more details, showing sustainment outcomes separately by Practice type. Figure 1 visually displays all longitudinal pathways, showing shifts in Practice implementation/sustainment status over time.

[Figure 1]

Longitudinal Pathways for Practices that were Fully Sustained in 2021

Thirty-five percent (29/82) of leads reported their Practice was fully sustained in 2021, which was an average of 2.3 years (range: 1–5 years) after implementation. Of these 29 leads, 76% reported full implementation at their 6-9-month milestone; the remaining leads completed their implementation milestone later. Further, of these 29 who reported their practice was fully sustained, 79% (23/29) reported full sustainment at initial follow-up. The six leads who did not initially sustain their practice went on to sustain their Practice by 2021.

Facilitators of sustainment included demonstration of Practice *effectiveness/benefit*, sufficient *organizational leadership*, appropriate *workforce*, and Practice *adaptation/alignment*. Leads also described potential barriers to future sustainment, including *workforce* turnover, challenges with *critical incidents* related to the COVID-19 pandemic, and concerns about *ongoing support*; they also listed potential facilitators for future sustainment that included having appropriate *workforce* and sufficient
organizational leadership and ongoing support. See Tables 3–4 for all factors influencing sustainment. Sustained Practices included more clinical interventions (45%, 13) and process improvements (45%, 13) compared to staff interventions (10%, 3) and were almost evenly split between the presence (48%, 14) or absence (52%, 15) of a virtual component. Figure 2 displays longitudinal pathways for leads that fully sustained their practice.

[Figure 2]

[Table 3]

Consistent Pathways

Among the 29 leads who reported their Practice was sustained in 2021, 66% (19/29) consistently sustained; meaning that they had sustained at all timepoints after fully implementing. All leads anticipated that their Practice would continue to be sustained into the future and 89% (17/19) reported their Practice was institutionalized and effective. See Fig. 3 for a consistently successful pathway showing outcomes with qualitative explanations.

[Figure 3]

Inconsistent Pathways

Among the 34% percent (10/29) of leads with an inconsistent pathway to sustainment in 2021, the majority experienced initial challenges with implementation (n = 6) compared to challenges with implementation and sustainment (n = 1) or were missing data (n = 3) in 2020. Leads with inconsistent pathways to sustainment needed more calendar time than the 6-9-month facilitation period to overcome implementation barriers, which were often related to insufficient workforce and available resources. One lead also reported a temporary pause in sustainment due to critical incidents related to the COVID-19 pandemic that were resolved when pandemic restrictions at their facility were loosened.

Once achieving sustainment, these leads emphasized that facilitators to sustainment were sufficient workforce and organizational leadership. All but two leads anticipated future sustainment. One lead anticipated future sustainment as “unlikely” without explanation and one did not respond to the question (see Fig. 2). Most (8/10) leads described their Practice as institutionalized and effective in 2021. Two leads described partial institutionalization because of no/limited funding or lack of adequate number of service users (i.e., insufficient Veteran enrollment in a voluntary program). Two leads reported their Practice was partially effective: one of whom cited no/limited funding as an issue. Figure 4 provides an example pathway showing outcomes and qualitative explanations.

[Figure 4]

Longitudinal Pathways for Practices that were Not Fully Sustained in 2021
Thirty-seven percent (30/82) of leads reported that their Practice was not fully sustained because they were in a liminal stage (neither sustained nor discontinued) or permanently discontinued as of 2021, which was an average of 2.1 years (range: 1–5 years) after implementation. Only 43% (13/30) of these leads reported full implementation at their 6-9-month milestone with five additional leads completing implementation later. Only 23% (7/30) of leads reported full sustainment at initial follow-up.

Barriers to sustainment included: insufficient workforce (losing or not being able to hire staff), not being able to maintain EIP fidelity/integrity, critical incidents related to the COVID-19 pandemic, organizational leadership did not support sustainment of EIP, no ongoing support, lack of trained personnel to continue the EIP, and/or EIP effectiveness/benefit was not observed. Despite not being fully sustained, these leads also described facilitators to sustainment. The most frequently reported facilitators to sustainment were internal/external EIP champions and sustained/attention to topic/priority, which were not mentioned by leads with sustained practices. See Tables 3–4 for all factors influencing sustainment. Practices that were not fully sustained had a similar percent of clinical interventions (50%, 15), process improvements (43%, 13), and staff-oriented interventions (7%, 2) as those that were sustained but had fewer Practices with virtual components (37%, 11). The following sections describe results for leads who reported unsustained Practices, which is organized by status (liminal sustainment or discontinued permanently) and pathway (consistent or inconsistent). Figure 5 displays longitudinal pathways for leads that did not fully sustain their practice.

Liminal Sustainment

Eighteen percent (15/82) of leads reported that their practices were not fully sustained because they were in a liminal stage of sustainment (6 partially sustained, 9 temporarily paused) since they were neither sustained nor discontinued in 2021. The major barriers associated with practices that were in a liminal stage of sustainment included insufficient workforce, no ongoing support, lack of trained personnel, and critical incidents related to the COVID-19 pandemic. Though fewer facilitators were mentioned compared to barriers, the top facilitator to sustainment was internal/external EIP champions.

Despite their liminal status, almost half (7/15) of these leads were optimistic about sustaining their Practice in the future. However, the remaining leads did not expect to sustain their practice (5) or were uncertain about future sustainment (3). Most of these leads reported their Practice was not fully institutionalized (8 no, 4 partial) nor effective (3 no, 8 partial).

Permanently Discontinued

Eighteen percent (15/82) of leads reported that their Practices were not fully sustained because they were permanently discontinued. Common barriers associated with Practices that were discontinued included two of the same as those in a liminal stage (workforce and critical incidents). However, not able to maintain EIP fidelity/integrity (top barrier), organizational leadership did not support sustainment of the
EIP, and system policy change were cited as other important reasons for Practice discontinuation. Despite Practices being discontinued, two leads cited sustained attention to topic/priority as a facilitator.

Among leads who provided responses to secondary outcomes (6/15), half reported their Practice was not fully institutionalized (2 no, 1 partial). Unexpectedly, the remaining leads with discontinued Practices (3) reported their practice was institutionalized due to some aspect of the Practice becoming routinized. Regarding effectiveness, more leads reported their Practice was not fully effective (3 no, 1 partial). However, those who reported their discontinued Practice had demonstrated effectiveness (2), cited they were tracking an aspect of Practice effectiveness.

[Table 4]

Consistent Pathways

Only 17% (5/30) of leads reported consistently less successful implementation and sustainment outcomes over time. Two leads reported their Practice being partially implemented and sustained through 2021. Despite these leads’ consistent liminal status, responses to secondary outcomes of institutionalization, effectiveness, and anticipated sustainment were different from each other. One lead reported partial institutionalization and effectiveness and anticipated full sustainment in the future, but it was dependent on having sufficient workforce in place. The other lead reported that the Practice was effective but was not institutionalized and would not be sustained in the future due to insufficient workforce.

The other 3/5 leads who were consistently less successful did not implement their Practice by the end of the 6-9-month facilitation period and then reported their Practice was permanently discontinued. Only 1/3 leads responded to the institutionalization and effectiveness outcome questions and responded that their Practice was not institutionalized nor effective. These leads experienced insurmountable barriers with implementation and never reached the sustainment phase because of critical incidents related to the COVID-19 pandemic or no/limited funding. Figure 6 provides an example pathway showing outcomes and qualitative explanations.

[Figure 6]

Inconsistent Pathways

Eighty-three percent (25/30) of leads whose practices did not fully sustain in 2021 reported inconsistent outcomes over time, which meant their outcomes did not align over time and/or they were missing at least one outcome prior to 2021. There were two main types of inconsistent pathways leading to unsuccessful sustainment. The first type consisted of leads who successfully implemented their Practice, but experienced challenges with sustainment. Early on, thirteen leads reported full implementation at the end of the 6–9-month facilitation period and another five reported full implementation with additional time when responding to the follow-up survey. Although 72% (18/25) of these leads were successful at
by 2021, nine downgraded to a liminal stage of sustainment (4 partially sustained, 5 temporarily not sustained) and 9 reported being discontinued permanently.

The second type consisted of leads (7/25) who experienced some challenges early on with implementation (3 not implemented, 2 partially implemented) or were missing implementation outcomes (2). These leads’ status fluctuated up and down over time and by 2021, they all downgraded to being temporarily not sustained (4) or permanently discontinued (3). Figure 7 provides an example pathway showing outcomes and qualitative explanations.

[Figure 7]

Missing Data in 2021

Missing data resulted from leads being lost-to-follow-up because they did not respond to implementation or sustainment survey assessments. Forty-one percent of leads had at least one missing time point across all years of data collection with an average of 1.8 missing time points overall. Only one lead was missing responses for all time-points. Among leads with two missing timepoints in a row, only 2/5 responded to subsequent surveys. Leads from Cohorts 1 (53%) and 3 (43%) had more missing data than those from other Cohorts (Cohort 2 = 24%, Cohort 4 = 19%, Cohort 5 = 17%).

In 2021, 28% of leads (23/82) had missing data. Leads with missing 2021 sustainment outcomes had more process improvement Practices (39%, 9) compared to staff interventions (35%, 8) and clinical interventions (26%, 6), which differed from practices that were sustained or not fully sustained. These leads also had fewer practices with virtual components (30%), which was like those that were not fully sustained.

After the 6-9-month facilitation period, only 17% (4/23) of leads had missing implementation outcomes data. However, 3/4 leads responded at follow-up. One of three leads reported their practice was implemented and sustained before being lost-to-follow-up. Whereas the other two other leads reported at follow-up that their Practice was not implemented nor sustained before being lost-to-follow-up in subsequent years.

For all the other leads (19/23), once they failed to respond to a survey, they were consistently non-responsive. Of the 23 leads lost-to-follow-up in 2021, only two (9%) were lost-to follow-up two years earlier in 2019. However, by 2020, an additional 12 leads (52%) were lost to follow-up, and the remainder (9/23; 39%) had their first missing data in 2021.

Sixteen leads with data missing in 2021 (16/23; 70%) were initially reported as fully implemented by the time of the second implementation assessment. Although these leads were lost-to-follow-up in 2021, most (69%,11/16) reported full implementation or sustainment as their last known status. The remaining leads reported a downgraded status of being temporarily (2/17), partially (1/17), or not (2/17) sustained before being lost-to-follow-up in subsequent assessments.
Discussion

Longitudinal pathways are often non-linear

Our evaluation includes implementation and sustainment outcomes from 81 leads (at different VHA facilities) at over 4 timepoints, spanning 1–5 years after an initial 6-9-month implementation milestone (excluding 1 lead with missing data across all assessment points). It has long been thought that initial implementation success predicts future success [31–33]. However, in this evaluation, we found a higher proportion (43%) of leads had non-linear (inconsistent) longitudinal pathways as their Practices transitioned from implementation to long-term sustainment compared to 29% who had linear (consistent) implementation and sustainment pathways [15].

Among the 29 leads reporting that their Practice was sustained in 2021, two-thirds consistently reported sustainment for prior timepoints. This finding is affirmed by published literature emphasizing that initial success leads to future success [21, 34]. Leads with Practices that were consistently successful over time often led to EIPS that were highly institutionalized. However, in contrast to published literature, we also found that one-third of these leads reported delayed implementation, but eventually fully implemented and sustained their Practice.

Sustainment benchmarks are not well established

Published literature highlights that measuring sustainment is challenging, contributing to few studies reporting long-term sustainment outcomes over time.[6] There are no well-established sustainment benchmarks, so it is difficult for researchers/evaluators to determine how their sustainment rates compare with others.[9] Wiltsey-Stirman et al. describe in their systematic review that partially sustained EIPs were reported more often than sustained, even if initial implementation was successful.[9] Conversely, leads in this evaluation reported relatively high sustainment rates (35%) compared to those in a “liminal sustainment stage” (18% were partially sustained/temporarily paused). Wiltsey-Stirman et al. also state “virtually no studies reveal the nature of the changes made, the reasons for the changes, or the process by which adaptations or decisions to discontinue elements of the program or intervention were made.”[9] Building on Wiltsey-Stirman et al.’s systematic review, Hailemariam et al.’s systematic review identified 26 facilitating and 23 hindering factors impacting sustainment, which were then mapped onto 4 major thematic areas of the influences on sustainment framework (innovation characteristics, context, capacity, processes and interactions) [6, 9].

To enhance knowledge about influences on sustainment outcomes, we mapped leads’ open-ended descriptions of barriers and facilitators onto Hailemariam et al.’s factors (Tables 3–4) [6, 21]. We extend Hailemariam et al.’s work by linking barriers and facilitators to actual sustainment outcomes. The top 3 facilitators to sustainment that leads mentioned included EIP effectiveness/benefit (innovation characteristics); organizational leadership (context), and workforce (capacity), which differed somewhat from Hailemariam et al.’s top 3 identified in their systematic review (adaptation (processes and interaction), funding (capacity), organizational leadership (context)).
The top three barriers to sustainment identified by leads in this evaluation were *workforce* (capacity), *not able to maintain EIP fidelity/integrity* (innovation characteristics), and *critical incidents* due to the COVID-19 pandemic (outer setting), which we added based on the updated CFIR [30]. Conversely, Hailemariam et al.’s most frequent barriers to sustainment were *no/limited funding* (capacity), *lack of resources* (capacity), and being *unable to navigate competing demands* (processes and interaction). We identified an additional facilitator referred to as *sustained attention to topic/priority*, which occurred when elements of Practice were integrated into workflow despite Practice discontinuation. Of note, *sustained attention to topic/priority* is not included in Hailemariam et al.’s systematic review, but is referenced in other sustainment literature.[27] Given our evaluation was conducted within a single healthcare system and during the COVID-19 pandemic, it is not surprising that our top barriers and facilitators differ from Hailemariam et al.’s systematic review. Since leads experienced challenges 2 years (on average) after implementation, understanding the timing and factors that contribute to successful and unsuccessful sustainment can provide DoE with specific strategies and opportunities to intervene to improve its program.

Lessons learned from evaluating longitudinal sustainment

In the following sections, we describe lessons learned that will enhance our ongoing understanding of DoE’s diverse Practices as they transition from initial implementation to longer-term sustainment. We also provide recommendations to improve sustainment reporting and measurement using pragmatic measures to help enhance the field of implementation science.

Maximizing open-ended text boxes

We purposefully administered a pragmatic sustainment survey (i.e., easy to understand, quick to complete, non-specific to practices) since it was more feasible in a real-world setting when comparing diverse EIPs.[3, 35] As part of our survey, we included open-ended text boxes to offer leads opportunities to explain and contextualize their sustainment outcomes. In our evaluation, new insight on factors influencing sustainment depended on responses to open-ended text boxes in the survey. Closed ended-survey items can be limiting because they rely on a priori assumptions and in our case, did not generate the level of contextual information needed to discern all the reasons or types of sustainment/discontinuation. For example, through participant responses to open-ended text boxes, we learned that a Practice that is temporarily sustained because of a short-term barrier, (e.g., the COVID-19 pandemic lockdowns, temporary hiring freeze, etc.), is different than a facility with a Practice that is partially sustained, (e.g., only some of the Practice components are in use or it is only being used some of the time). As a result, open-ended text boxes in our survey allowed us to reclassify response options, which also led to creating a new response option (temporary hold outcome) in our survey to better reflect leads’ experiences and improve validity of responses. Overall, we found that a high proportion of leads responded to open-ended text boxes and qualitative data collected in the survey was invaluable to contextualizing outcomes, understanding salience of determinants, and describing changes in outcomes
at a facility [36]. Learning about sustainment experiences in a lead’s own words allows for insight into their thought process interpreting questions, as well as a rationale behind their response.

In future surveys, we aim to leverage responses to open-ended text boxes (e.g., making some mandatory, highlighting their importance). This is especially important for Practices that were discontinued but participants revealed that elements were integrated into other aspects of workflow and processes. These leads reported that while the Practice was not sustained, there was institutionalization and/or effectiveness. As described in the literature as “sustained change”, completing implementation had an impact on the health topic/priority even though it was no longer sustained, demonstrating some lasting effects/benefits even when Practice is no longer in use.[27] This result also illustrates that relying on sustainment rates alone may lead to missed opportunities in understanding important nuances of sustainment contexts and the full continuum of sustainment (i.e., in some cases (negative outcomes) it may be important to measure impacts in other ways).

Minimizing Missing Data

In our longitudinal evaluation, missing data hindered our ability to fully understand outcomes and describe each longitudinal pathway. One might think that participants are less likely to respond if they are not sustaining. However, we found that most (69%) leads reported that they had implemented and sustained their Practice at their last known status. Thus, a missing timepoint may not mean that the Practice is discontinued. In our evaluation, we found that less than half of leads (40%) responded after two consecutive missing time points. As a result, we will consider leads lost-to-follow-up (removed from the sample) after three consecutive years of missing data. Sometimes, a change in the primary point of contact can result in missing data. To reduce missing data and to track changes in staffing, we include a line in the recruitment email about providing contact information for current leads.

When following-up with participants longitudinally over a longer time-period, engagement may decrease because of insufficient rapport [37]. Obtaining participant input is challenging throughout longitudinal studies. However, it is important to develop ways to engage participants over the long-term to help minimize missing data. Teague’s systematic review and meta-analysis suggest reducing participant burden overall rather than incorporating a larger number of strategies to improve retention [38]. As we move forward with our evaluation, we aim to incorporate new strategies that will not burden respondents, such as using instant messaging instead of email follow-ups since it helps to improve recruitment rates [25], extending recruitment periods or changing the recruitment season, offering incentives if employees complete surveys outside of work hours, and eliciting feedback from participants about how to increase response rates. Our literature search for “sustainment” and “missing data” resulted in zero articles. Therefore, strategies for reducing missing data and analyzing missing data is an important area for future development in the sustainment literature.

Strengthening survey questions
Moving forward, we aim to improve our survey in important ways. We will do more robust testing using cognitive interviews to ensure questions and responses resonate with participants [39, 40]. For example, our question about measuring effectiveness was originally “what indication do you use to determine its effectiveness”, but upon reviewing participant responses, we realized that while we want to know the measure they use, we also want to understand their perception of effectiveness and how it was determined (i.e., actual data or self-reported based on experience/feedback).

Additionally, we included Likert Scale determinant questions with open-ended text boxes that were informed by the literature [26, 27, 41, 42]. However, we will discontinue these questions because the response quality was poor, and we were unable to determine the salience of determinants. Lower quality responses affirm literature reporting on increased question complexity (content and intensity) and cognitive burden for respondents for Likert Scale questions [43]. We had better quality responses to multiple choice questions (i.e., outcome questions) and the barrier and facilitator open-ended text boxes. Building off literature on alternatives to Likert Scale questions [43] and the pragmatic PReSS sustainment scale mentioned earlier [12], we will use simplified language and replace Likert Scale determinant questions with an open-ended barrier and facilitator text box. In addition, we will add phrase completion [43] questions that focus on not only the “what” Practice components are sustained, but also on the “who” has sustained, “when” the Practice is sustained, and “where” the Practice is sustained. These questions will provide a pragmatic yet nuanced understanding of sustainment, especially when Practices are in a liminal phase of sustainment. Given the changing nature of sustainment, we will continue including the question about sustainability (anticipated outcome) for all participants unless they indicate that their practice is permanently discontinued.

Qualitative responses were crucial in understanding a lead’s Practice status, as well as the salience of barriers and facilitators. To improve qualitative response rates and quality, we will include language explaining the importance of specific open-ended questions, increase the size of text boxes, and note that responses are not limited by the size of the text box. [44] Further, we will reduce the overall survey length and require (i.e., make the question not skippable) a set number of questions deemed most relevant for this evaluation, which include a primary sustainment outcome, sustainability outcome, and “please explain” qualitative questions providing insight on contextual factors that help or hinder sustainment.

Limitations

This evaluation has several limitations. First, we compared sustainment outcomes longitudinally for diverse Practices, which is simultaneously a strength and limitation. It is a strength because we report on diverse Practices across a large, integrated health care system, thus, prompting us to use a pragmatic approach that can be applied across different types of Practices. However, comparing sustainment outcomes of diverse Practices limited our ability to use more specific sustainment measures or look more closely at intra-group variation within a single Practice. Second, missing data is an ongoing challenge in understanding longitudinal patterns of DoE’s Practices’ sustainment over-time. Moving forward, we aim to incorporate new techniques described above for minimizing missing data. Third, these diverse
Practices also represent several cohorts, each beginning in a different year resulting in varying numbers of data collection timepoints. Leads with Practices in the earliest cohorts had lower response rates in 2021, which might be due to survey fatigue, staff/point of contact turnover, changes in facility priority, and/or reduced engagement with DoE. Fourth, the barriers and facilitators in Tables 3–4 are only based on the open-ended text responses in the 2021 survey. Given the challenges, changes, and complexities of longitudinal datasets, e.g., missing data and changes in point of contacts, it was not feasible to compare barriers and facilitators from previous years.

**Conclusions**

We enhance existing literature with our longitudinal analyses of multiple implementation and sustainment-related outcomes plus lessons learned from the large-scale DoE program in VHA to disseminate EIPs. The relatively high rates of Practices with long-term sustainment provide important evidence to support that VHA's DoE is achieving its goal as a model for large learning health systems. We also highlight the importance of understanding the dynamic, longitudinal pathways that Practices often undergo from implementation to longer-term sustainment. We offer novel suggestions and lessons learned from our evaluation to inform the field of implementation science and to strengthen future efforts in understanding longitudinal sustainment of EIPs.

**Abbreviations**

Consolidated Framework for Implementation Research: CFIR

Diffusion of Excellence: DoE

Evidence-informed practice: EIP

Veterans Health Administration: VHA

**Declarations**

**Ethics approval and consent to participate**

Per regulations outlined in VHA Program Guide 1200.21, this evaluation has been designated a non-research quality improvement activity.

**Consent for publication**

Not applicable.

**Availability of data and materials**
The datasets generated and/or analyzed during the current evaluation are not available due to participant privacy but may be available from the corresponding author on reasonable request.

**Competing interests**

The authors declare that they have no competing interests.

**Funding**

This evaluation was funded by the Veterans Health Administration (VHA) Quality Enhancement Research Initiative (QUERI) [PEC-17-002] with additional funding subsequently provided by the VHA Office of Rural Health through the Diffusion of Excellence (DoE).

**Authors' contributions**

All authors were engaged in the national evaluation of the Diffusion of Excellence (DoE). BH leads the DoE and collaborates with the evaluation team. GJ, LD, SC, AG, HK, AN, and GF designed and supervised the overall evaluation. MA, BW, and KDL provided project management support and MB and JL provided statistical analysis. AN, MOW, CR, and LD led data collection, analysis, and manuscript writing for this aspect of the evaluation. All authors were involved in the critical revision of the manuscript for intellectual content. All authors read and approved the final manuscript.

**Acknowledgements**

The opinions expressed in this article are those of the authors and do not represent the views of the Veterans Health Administration (VHA) or the United States Government. The authors would like to thank Ms. Elizabeth Orvek, MS, MBA for help programming the survey and Mr. Rich Evans, MS for statistical analysis and figure design. In addition, the authors want to express their sincere gratitude to the VHA employees who participated in this evaluation and shared their experiences with us.

**References**


37. Full Text n.d.


Figures

**Figure 1**

Pathways for all facilities

*Implementation follow-up was only provided for facilities that did not fully implement their practice or were missing data.

**Cohort 4 practices only have sustainment outcomes for 2020 and 2021. Cohort 5 practices only have sustainment outcomes for 2021. For the purposes of the figure visual, their statuses were carried over from earlier timepoints.*
Figure 2

Pathways for facilities that fully sustained by 2021

*Implementation follow-up was only provided for facilities that did not fully implement their practice or were missing data.

**Cohort 4 practices only have sustainment outcomes for 2020 and 2021. Cohort 5 practices only have sustainment outcomes for 2021. For the purposes of the figure visual, their statuses were carried over from earlier timepoints.
Figure 3

Facility with a consistent pathway to full sustainment: example outcomes and qualitative explanations

*3_IF06 (Clinical Intervention)

Figure 4

Facility with an inconsistent pathway to full sustainment: example outcomes and qualitative explanations

*1_IF04 (Process Improvement)
**Figure 5**

Pathways for facilities that did not fully sustain by 2021

*Implementation follow-up was only provided for facilities that did not fully implement their practice or were missing data.

**Cohort 4 practices only have sustainment outcomes for 2020 and 2021. Cohort 5 practices only have sustainment outcomes for 2021. For the purposes of the figure visual, their statuses were carried over from earlier timepoints.

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<th>Type of Outcome</th>
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<th>2021</th>
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<td>Completed</td>
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<tr>
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<td>Partly</td>
<td>Note: they hoped to complete implementation in the future</td>
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*5_IF04 (Clinical Intervention)

**2021 survey did not have a separate question for implementation follow-up and sustainment

**Figure 6**

Facility with a consistent pathways to not fully sustained: example outcomes and qualitative explanations
Figure 7

Facility with an inconsistent pathway to not fully sustained: example outcomes and qualitative explanations

<table>
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<tr>
<th>Facility</th>
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</tr>
</tbody>
</table>

Figure 8

Pathways for facilities with missing data in 2021
*Implementation follow-up was only provided for facilities that did not fully implement their practice or were missing data.

**Cohort 4 practices only have sustainment outcomes for 2020 and 2021. Cohort 5 practices only have sustainment outcomes for 2021. For the purposes of the figure visual, their statuses were carried over from earlier timepoints.

**Supplementary Files**

This is a list of supplementary files associated with this preprint. Click to download.

- FinalDoEAdditionalFiles13.2023.8.3.docx