

Strategies used to implement Hospital at Home: a description of an approach to scaling a complex healthcare intervention

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Abstract

Background Advances have been made in recent years to characterize facilitators and barriers to implementation of complex health care intervention and to classify the implementation strategies available to address these determinants. We study the implementation of a Hospital at Home (HaH) intervention in a multi-hospital health system to understand the selection and use of implementation strategies in its launch, sustainment, and scaling. Methods We report on the implementation portion of an effectiveness-implementation study of the hybrid type 1 design. First, we retrospectively identified determinants of practice most relevant to the HaH intervention using the Integrated Checklist of Determinants (TICD) assisted by review of archived documents. We also identified implementation strategies using the listing created by the Expert Recommendations for Implementing Change (ERIC) that could potentially address each determinant. Second, we then identified which of the ERIC strategies were actually employed using a modified Delphi process to obtain consensus among HaH program leaders involved in the program implementation. Program leaders also rated the importance and effort expended on each strategy on 1-9 Likert scales. The most relevant implementation strategies identified through these steps were detailed with respect to actors, targets, dosing and justification, and associated with prospectively collected implementation outcomes. Results The majority of ERIC implementation strategies (57 of 73, 78%) were utilized; 7 strategies (10%) were not used. On the remaining 9 strategies (12%), program leaders did not reach consensus regarding utilization. For used strategies, mean importance was 6.87 and mean effort expended was 6.22. Implementation strategies rated most important by program leaders had a broad target of actions that included clinical staff, patients, leadership, external vendors, health plans, and government officials. The strategies varied in temporality and dosing. Over the course of the implementation, adoption, acceptance, and penetration increased over time, while measures of fidelity remained stable. Conclusions Considerable effort and multiple strategies were required to implement Hospital at Home. While potentially daunting, use of existing implementation frameworks can help focus limited efforts and resources by targeting strategies that address the key barriers and enablers to implementation of complex healthcare interventions.

Background

Advances have been made in understanding the strategies employed to implement complex health and social interventions. The variants and range of existing strategies, ranging from providing ongoing consultation to mandating change, have been categorized and defined^(1,2). To enhance understanding of the use and effectiveness of these strategies, methods have been proposed for specifying⁽³⁾ a strategy's actor, action, temporality, dose, expected target of an action, and justification, as well as the expected implementation outcomes that ultimately impact more distal service and patient or client outcomes⁽⁴⁾.

Other work has focused more proximally or upstream on identifying the determinants that either prevent or enable implementation as a precursor to identifying implementation strategies linked to the identified determinants. Flottorp and colleagues have categorized seven domains of practice and 57 specific determinants to used in designing implementation interventions⁽⁵⁾. Each domain (i.e. guideline or intervention factors, individual health professional factors, incentives and resources, etc.) consists of several determinants of practice which could be the focus of specific implementation strategies. In this way, implementation strategies can be selected and driven by the determinants of particular importance and concern.

To understand the selection and use of strategies used to implement a complex healthcare intervention, we studied the implementation of Hospital at Home (HaH) with 30-day post-acute care follow-up of patients in a seven-hospital system in New York City. For select patients with specific diagnoses (e.g., pneumonia) who would otherwise be admitted to a hospital bed, acute hospital-level services (e.g., intravenous antibiotics, fluids, oxygen, etc.) and daily clinician visits were provided at home along with durable medical equipment, phlebotomy, and home x-ray as needed. HaH has been shown to be safe, high quality, and cost effective in multiple studies, but it has been neither widely adopted in the United States nor able to achieve substantial scale⁽⁶⁻¹²⁾. We considered HaH a complex healthcare intervention to implement because successful implementation depended on addressing multiple implementation domains and constructs that included characteristics of the intervention, aspects of the inner practice setting, as well as external regulatory and payment concerns.⁽¹³⁾

Our implementation of HaH⁽¹⁴⁾ was an opportunity to better understand the barriers and facilitators to adoption and how implementation strategies were selected and used to bring about adoption of a complex intervention. In this paper, we report on data collected on the implementation process. We examine what strategies were used, their importance and effort, the determinants of practice they were intended to address, and the implementation outcomes they were intended to impact. First, we identify the

determinants of practice that prevent or enable the implementation of HaH. We then enumerate the strategies used by program leaders to implement the program and the principal determinant(s) they were intended to address. Further, for each strategy, we identified the phase (planning/implementation, sustainment, or scaling) during which each strategy was used, the relative importance and effort associated with each strategy, and we report on the implementation outcome it would most likely impact. For selected strategies, we examine how the same strategy will differ in its actors, actions, targets, and dosing depending on the stage of implementation. In so doing, we attempt to “connect the dots” from determinants to implementation strategy, to implementation outcomes to illustrate how theoretical frameworks from the implementation science literature can guide strategic and operational decision making in the setting of starting and sustaining a complex healthcare intervention.

Methods

We conducted an effectiveness-implementation study of the hybrid type 1 design ⁽¹⁵⁾. The effectiveness portion of the study has been previously reported (in support of one of the implementation strategies reported in this paper). Using a quasi-experimental design, patient outcomes for those receiving HaH were compared to those for patients meeting the same inclusionary and exclusionary criteria but admitted to a traditional hospital unit. HaH was associated with reduced 30-day hospital readmissions and emergency department revisits, as well as improved patient experience. ⁽¹⁴⁾ For the implementation portion of the hybrid design reported here, facilitators, barriers, and implementation strategies used were determined retrospectively from a combination of participant reports, qualitative interviews with key participants, and review of archived documents including proposals and quarterly progress and financial reports to the funder ⁽¹⁶⁾. Implementation outcomes were prospectively collected by quarter and analyzed in a time-series design.

First, we identified determinants of practice most relevant to the HaH intervention using of the Integrated Checklist of Determinants (TICD) ⁽⁵⁾. We also identified implementation strategies using the listing created by the Expert Recommendations for Implementing Change (ERIC) ¹⁻² that could potentially address each determinant. Second, we identified which of the ERIC strategies were actually employed using a modified Delphi process to obtain consensus among HaH program leaders involved in the implementation. The most relevant implementation strategies identified through these steps were detailed with respect to actors, targets, dosing and justification ⁽⁴⁾, and linked to specific implementation outcomes which are reported.

Patients, Settings, Core Components of HaH

Patients were enrolled in HaH starting in November 2014 for 33 months through August 2017. Patients were identified in the emergency departments of Mount Sinai Health System hospitals, or by referral from physicians in outpatient clinical practices or a home-based primary care practice. Inclusion criteria are described elsewhere ⁽¹⁴⁾. Core components of the intervention included enrollment of patients who required hospitalization; delivery of hospital-level services at home instead of the hospital; daily visitation from registered nurses to the home; daily visitation from a HaH clinician (physician or nurse practitioner); and 24/7 availability to patients and family members. We adapted the core components of previously-described HaH models with the addition of 30 days of postacute follow up at the end of the acute hospitalization episode in HaH ⁽¹⁷⁾.

Identifying Determinants of Practice

Determinants of practice specific to the implementation of HaH were retrospectively identified [by RZ and ALS] using the Integrated Checklist of Determinants (TICD) ⁽⁵⁾. Determinants were identified from driver diagrams originally formulated pre-implementation in 2014 as well as quarterly progress reports prepared for the funding agency over the course of implementation. Implementation strategies were identified that might address the specific determinants identified.

Implementation Strategies Actually Employed

Five program leaders were selected to participate based on longitudinal knowledge of HaH and familiarity with the implementation process. Participants all held leadership or advisory positions inside Mount Sinai's HaH and were involved in the earliest stages of planning through scaling HaH to new sites. Participants also had extensive prior experience with implementation of home-based medical care and HaH, including growth of the largest academic home-based primary care practice in the United States [LDC, ALS, AW] and the first implementation of HaH in the United States [BL].

To achieve consensus on use and importance of individual strategies. We used a modified Delphi process with two rounds. The first round surveyed program leaders regarding which implementation strategies were employed to deal with barriers to implementation. Participants were asked whether each of 73 implementation strategies previously defined by ERIC were used in the planning and provision of Mount Sinai's HaH program, and if so, during what phase of program enactment (planning/implementation, sustainment, scaling) each strategy was used. Implementation was defined as the period including all planning and six-months following launch of HaH. Sustainment was defined as the period after the initial six months of HaH enactment. Scaling involved all activities related to the enactment of HaH at new sites throughout the Mount Sinai Health System as well as broader dissemination.

For strategies identified as having been utilized, participants were also asked to evaluate how important each strategy was to further program goals, as well as how much effort was involved in utilizing each strategy using Likert scales. Participants were asked to consider rating importance between "1 - Not important to do, but there may be other reasons to do it" and "9 - So important that you should not bother if you cannot do this." Participants were similarly asked to consider rating effort along a scale between "1 - Discrete amount of effort by a few individuals within a defined time frame" and "9 - Open-ended collaboration amongst many individuals with an undefined time frame over at least months." Participants were also given the opportunity to include free text explanations of their votes regarding the use of each strategy.

The second round consisted of a structured discussion moderated by a non-voting member of the research team [RMZ] to reach consensus regarding the strategies. Prior to the discussion, participants were given anonymized survey responses, including used/not used votes, Likert ratings of importance and effort, as well as free text responses of each participant. Participants were also given instructions about the format of the moderated discussion. Strategies that reached consensus during the first round of the modified Delphi process, defined as all participants voting a strategy was "used" or "not used," were not included in the discussion. Strategies for which consensus was not reached after the first round were discussed individually. Program leaders were given the opportunity to speak in favor of or against inclusion of a strategy in the final round. Once discussion concluded, participants were asked to revote and were given the opportunity to revise importance and effort ratings following discussion.

Following the moderated discussion, individual strategies were determined either to have reached consensus or not using the same criteria as the first round (all participants voting a strategy was "used" or "not used"). For each strategy that all respondents determined were utilized, a mean score of importance and effort was calculated. For each strategy that was used, we noted the phase(s) of use that were indicated by at least a majority of raters.

Detailed Specification of Selected Strategies and Reporting of Implementation Outcomes

The most important implementation strategies identified through the analysis of determinants and consensus process were detailed with respect to actors, targets, dosing and justification⁽³⁾, and linked to specific implementation outcomes. We collected information on measures linked to these implementation outcomes. We collected information on the volume of patients by quarter to assess the implementation outcomes of adoption, appropriateness and feasibility of HaH. Similarly, to assess the implementation outcome of fidelity to operational protocols, we measured the percentage of patients who met Milliman Care Guidelines (MCG) for inpatient admission, and those who subsequently received daily provider home visits. We measured subject consent to be admitted into HaH as a measure of the implementation outcome of acceptability to patients. As measures of the implementation outcome of penetration, we considered the percentage of patients referred directly into HaH (as opposed to being enrolled from emergency departments) and the percentage of patients referred from a hospital other than the hospital where HaH was first implemented.

We present implementation outcome measures by quarter of HaH patient admission for the 295 receiving HaH during the study period. We used bivariate regression models to examine the relationship between each implementation outcome and the numerical

quarter of enrollment after an initial six-month implementation pilot phase. Linear regression was used to model patient volume. Logistic regression was used to model other outcomes. For the linear regression model, the coefficient is reported, and for the logistic regression models, odds ratios are reported. Models were estimated that included an independent variable for season; results were qualitatively similar, and we report the results for models without seasonal adjustment.

Results

Determinants of Practice and Associated Implementation Strategies

For each domain of practice, relevant determinants or barriers to implementing HaH were identified along with potential implementation strategies that might address the determinant. Barriers were identified from driver diagrams formulated prior to implementation with respect to feasibility, patient acceptance, referral processes, regulations, and payment. Table 1 outlines select determinants of practice for each domain of practice in TICD. Table 1 illustrates the complexity of the HaH implementation with relevant barriers identified for all domains of practice. Plausible implementation strategies were identified for each of these determinants.

Modified Delphi Process to Identify Strategies Actually Deployed

After the initial round of surveying program leaders, 24 of 73 (33%) of all ERIC implementation strategies had reached consensus. 18 as “Used” and 6 as “Not Used.” The remaining 49 strategies (67%) did not reach consensus after the first round. These 49 strategies were discussed in a structured format and subsequently re-scored by program participants in the second round of the modified Delphi process. Following a moderated discussion and re-scoring by study participants, 64 of 73 strategies (88%) reached consensus (Table 2). The vast majority of ERIC implementation strategies (57 of 73, 78%) were “Used.” Another 7 strategies (10%) were “Not Used.” The remaining 9 strategies (12%) did not reach consensus at the end of the Delphi process.

Among strategies that reached consensus by participants as having been used mean importance was 6.87 and mean effort was 6.22 (Table 2). Notably, no strategies were rated in the lower range of importance ratings (1-3), and 23 had mean ratings of relatively high importance (greater than 7). Informing local opinion leaders (mean rating of 3.2) and conducting educational outreach visits (mean rating of 3.8) were rated as involving relatively less effort; however, the remaining strategies were rated as having moderate or high effort (ratings greater than 4). This table also indicates the number of times each strategy was selected by program leaders as having been used during each phase of HaH (implementation, sustainment, and scaling). Almost all strategies were used in initial implementation and sustainment. Strategies in the financial cluster tended to be more heavily identified as having been used in sustainment and scaling efforts.

Specification of Selected Strategies and Implementation Outcomes

The relevant actors, actions, targets, temporality, dose, targeted outcome, and justification were specified for selected strategies. Table 3 presents these specifications for strategies linked and organized by important determinants. Almost all the strategies involved program leadership (e.g., medical director, program manager and supervisors) as actors. However, several strategies notably involved actors outside core program staff such as legal counsel and contracting officer, highlighting the importance of being able to engage actors outside the core program staff who may have broader organizational responsibilities. Implementation strategies had a broad target of actions that included clinical staff, patients, leadership, external vendors, health plans, and government officials. The strategies varied in

temporality and dosing illustrating the dynamic, continuing and significant effort that needs to be devoted to implementation activities.

Table 4 provides two examples of strategies used across all phases and illustrates how, the specifics of an implementation strategy may vary across stage. For instance, the creation of new clinical teams may involve different actors in the planning/implementation

phase than during program scaling. Similarly, the target of the action and justification for developing new clinical teams may vary by phase.

Implementation Outcomes

295 patients received HaH services in lieu of an inpatient hospital admission. A median of 33 patients (range 11-44) received services each quarter during the study period. Patient volume increased by quarter ($\beta = 3.15$, SE 0.99, $p = 0.013$), indicating improved adoption, appropriateness and feasibility of HaH (see Figure 1). Patient acceptance of HaH increased over time (1.22, OR 1.13-1.32, $p < 0.0001$) indicating improved acceptability of HaH over the course of implementation (see fFig. 2). All but one patient (not graphed) met Milliman Care Guidelines (MCG) for inpatient admission as an indication of fidelity to the original evidence-based practice; however, there was a non-significant trend (OR 0.87, 0.76-1.00, $p=0.056$) of cases not having a daily home visit over time (see Fig. 3). The odds (OR 1.16, 1.04-1.29, $p=0.008$) of referrals coming directly into HaH from home or office practice (as opposed to being enrolled from emergency departments) increased over time as did the odds (1.26, OR 1.14-1.40, $p < 0.0001$) (see Fig. 4) of patients being referred from a hospital other than the hospital where HaH was initially implemented (see Fig. 5). These last two measures indicate growing penetration, adoption, and acceptability of HaH.

Discussion

The findings from this study indicate that determinants that would pose barriers or enablers to an intervention can be linked to specific implementation strategies. Additionally, implementation of a complex intervention such as HaH involved use of these strategies and many more, all of which were rated to be of moderate or great importance and most of which were perceived by program leaders to involve moderate or greater effort. Use of these strategies were associated with achieving improved implementation outcomes.

The considerable effort involved in implementing many strategies simultaneously could seem daunting and might dissuade many potential program adopters. Most strategies were employed from the initial planning phase through efforts to scale. As a result, opportunities would be limited to significantly stagger the introduction of many of these strategies over time. Further, several of these strategies differed in significant ways when used in different implementation phases. The relevant targets and actors changed at each phase along with the indicated actions and their dose. Thus, the actual number of strategies employed could be even larger when one considers variations in how a strategy may be executed.

Our findings illustrate a possible approach to this daunting process by focusing initially and targeting implementation strategies addressing the most important barriers and enablers to implementation of the specific intervention similar to what Powell has described⁽¹⁸⁾. Starting with a review of the relevant determinants as others have proposed⁽⁵⁾, determinants may be prioritized using pilot data and key informant interviews to estimate their situational relevance and likely impact on implementation (TICD Worksheet 3). Implementation strategies could then be selected aided by compilations from the literature (ERIC) based on their likely impact and feasibility (TICD Worksheet 4). Our report indicates that, specific to the context of what is being implemented, selected strategies may be identified as being particularly important and that the effort involved in their use may be estimated. Expected implementation outcomes may be tracked, and that information may be used to further select strategies to target as the implementation proceeds. These considerations may be used in selecting strategies to initially target and to deploy as the intervention proceeds.

Although selected strategies can be targeted, our report indicates that many more than a few targeted strategies may need to be used for complex interventions involving determinants across many domains of practice. In these cases, the selection of implementation strategies may need to consider that many of these discrete strategies are actually closely related conceptually⁽²⁾, as well as in the actors and efforts involved in their use. For example, a number of strategies related to training and education (conducting ongoing training, making training dynamic, using train-the-trainer methods are all discrete strategies) may share actors and targets of the action. Efforts to use these strategies may be coordinated to share staff and materials. Additionally, some of these discrete implementation strategies are actually overarching strategic approaches and could encompass a number of other strategies. For example, adaptability is an overarching strategic approach that could include adaptability in other specific strategies such as conducting educational meetings or in auditing and providing feedback. An otherwise daunting implementation plan can be made

less forbidding by careful targeting, staging the use of strategies within related clusters of strategies, and by recognizing overarching strategic approaches in the overall plan.

Our report has several limitations. First, the identification of determinants and strategies was performed retrospectively; however, the determinants relied heavily on driver diagrams formulated before implementation initiated, and the implementation strategies were documented in quarterly progress reports over the course of the implementation. Second, use of specific strategies and ratings of importance and effort were based on report of program leaders, but we were able to achieve consensus on these ratings with multiple raters. Third, it was beyond the scope of this analysis to examine the association between specific strategies and implementation outcomes. Indeed, such an analysis would be difficult to perform for this type of implementation. The need to employ multiple strategies simultaneously that might be associated with a given implementation outcome would make such an analysis difficult to design.

Conclusions

Implementation of complex interventions targeting multiple determinants of practice may involve using a large array of implementation strategies, and the effort involved in planning and executing these strategies may dissuade potential adopters. Our work suggests that strategies may be identified and prioritized for the most important determinants, and that formulating an implementation plan around clusters of related strategies and overarching strategic approaches may be useful for conceptualizing and prioritizing implementation resources. These efforts can lead to implementation outcomes that can be tracked and that are important to achieving improved patient outcomes expected from these complex interventions.

Abbreviations

HaH: Hospital at Home

TICD: Integrated Checklist of Determinants

ERIC: Expert Recommendations for Implementing Change

MCG: Milliman Care Guidelines

Declarations

Declarations

Ethics approval for this study was granted by the Icahn School of Medicine at Mount Sinai's Program for the Protection of Human Subjects (PPHS). All panelists involved provided written, informed consent under protocol IRB-14-00944. PPHS approved a waiver of informed consent under IRB-17-02565 for the retrospective analysis of patient data presented, as patients were no longer being followed for clinical purposes. These data were collected for grant reporting, quality assurance, and internal program monitoring purposes.

Consent For Publication: Not applicable

Availability of Data and Material: The datasets generated and analyzed during the current study are not publicly available as they were measured for internal quality improvement purposes but may be available from the corresponding author on reasonable request.

Competing Interests: ALS, AF, LVD, BM, SL, and EC are full time employees of the Icahn School of Medicine, which in turn has an ownership interest in a joint venture with Contessa Health, a venture that manages acute care services provided to patients in their homes through prospective bundled payment arrangements. ALS, AF, LVD, BM, SL, and EC have no personal financial interest in the joint venture. Authors RZ, MG, and BL have no competing interests.

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Author Contributions: ALS and RMZ conceived and designed the study. RMZ and ALS drafted the manuscript. ADF, LVD, MG, BM, and BL provided critical revision of the manuscript for important intellectual content. ADF, SL, and EC provided statistical analysis. ALS, LVD, and BL obtained funding. BM, SL, and EC provided administrative, technical and material support. ALS and ADF provided supervision. All authors read and approved the final manuscript, each author has participated sufficiently in the work to take public responsibility for appropriate portions of the content and agreed to be accountable for all aspects of the work.

References

1. Powell BJ, Waltz TJ, Chinman MJ, Damschroder LJ, Smith JL, Matthieu MM, Proctor EK, Kirchner JE. A refined compilation of implementation strategies: results from the Expert Recommendations for Implementing Change (ERIC) project. *Implement Sci.* 2015 Feb 12;10:21. doi: 10.1186/s13012-015-0209-1.(1)
2. Waltz TJ, Powell BJ, Matthieu MM, Damschroder LJ, Chinman MJ, Smith JL, Proctor EK, Kirchner JE. Use of concept mapping to characterize relationships among implementation strategies and assess their feasibility and importance: results from the Expert Recommendations for Implementing Change (ERIC) study. *Implement Sci.* 2015; 10: 109. doi: 10.1186/s13012-015-0295-0
3. Proctor EK, Powell BJ, McMillen JC. Implementation strategies: recommendations for specifying and reporting. *Implement Sci.* 2013 Dec 1;8:139. doi: 10.1186/1748-5908-8-139.
4. Proctor E1, Silmere H, Raghavan R, Hovmand P, Aarons G, Bunger A, Griffey R, Hensley M. Outcomes for implementation research: conceptual distinctions, measurement challenges, and research agenda. *Adm Policy Ment Health.* 2011 Mar;38(2):65-76. doi: 10.1007/s10488-010-0319-7.
5. Flottorp SA, Oxman AD, Krause J, Musila NR, Wensing M, Godycki-Cwirko M, Baker R, Eccles MP. A checklist for identifying determinants of practice: a systematic review and synthesis of frameworks and taxonomies of factors that prevent or enable improvements in healthcare professional practice. *Implement Sci.* 2013 Mar 23;8:35. doi: 10.1186/1748-5908-8-35.
6. Leff B, Burton L, Mader SL, Naughton B, Burl J, Inouye SK, et al. Hospital at home: Feasibility and outcomes of a program to provide hospital-level care at home for acutely ill older patients. *Ann Intern Med.* 2005; 143:11.
7. Stessman J, Ginsberg G, Hammerman-Rozenberg R, Friedman R, Ronen D, Israeli A, et al. Decreased hospital utilization by older adults attributable to a home hospitalization program. *J Am Geriatr Soc.* 1996; 44:5.
8. Caplan GA, Ward JA, Brennan NJ, Coconis J, Board N, Brown A. Hospital in the Home: A Randomised Control Trial. *Medical Journal of Australia.* 1999; 170:4.
9. Cryer L, Shannon SB, Van Amsterdam M, Leff B. Costs for "hospital at home" patients were 19 percent lower, with equal or better outcomes compared to similar inpatients. *Health Aff.* 2012; 31:6.
10. Wilson A, Parker H, Wynn A, Jagger C, Spiers N, Jones J, et al. Randomised controlled trial of effectiveness of Leicester hospital at home scheme compared with hospital care. *BMJ.* 1999; 319:1542.
11. Harris R, Ashton T, Broad J, Connolly G, Richmond D. The effectiveness, acceptability and costs of a hospital-at-home service compared with acute hospital care: A randomized controlled trial. *Journal of Health Services Research and Policy.* 2005; 10:3.
12. Summerfelt WT, Sulo S, Robinson A, Chess D, Catanzano K. Scalable hospital at home with virtual physician visits: Pilot study. *Am J Manag Care.* 2015; 21:10.

13. Damschroder LJ, Aron DC, Keith RE, Kirsh SR, Alexander JA, Lowery JC. Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. *Implementation Science* 2009; 4:50
14. Federman AD, Soones T, DeCherrie LV, Leff B, Siu AL. Association of a Bundled Hospital-at-Home and 30-Day Postacute Transitional Care Program with Clinical Outcomes and Patient Experiences. *JAMA Internal Medicine*. 2018 Aug 1;178(8):1033-1040. doi: 10.1001/jamainternmed.2018.2562.
15. Curran G, Bauer MS, Stetler CB, Mittman BS. Effectiveness-implementation hybrid designs of clinical effectiveness and implementation research to enhance public health impact. *Med Care* 2012; 50:217-26.
16. Brody AA, Arbaje AI, DeCherrie, LV, Federman AD, Leff B, Siu AL. Starting up a Hospital at Home program: facilitators and barriers to implementation. *J Am Geriatr Soc*. 2019 Feb 08;67(3):588-595. doi: 10.1111/jgs.15782.
17. Siu AL, Zimbroff RM, Federman AD, DeCherrie LV, Garrido M, Morano B, Lubetsky S, Catalan E, Leff B. The effect of adapting Hospital at Home to facilitate implementation and sustainment on program drift or voltage drop. *BMC Health Serv Res*. 2019 Apr 29;19(1):264. doi: 10.1186/s12913-019-4063-8.
18. Powell BJ, Beidas RS, Lewis CC, Aarons GA, McMillen JC, Proctor EK, Mandell DS. Methods to Improve the Selection and Tailoring of Implementation Strategies. *J Behav Health Serv Res*. 2017 Apr;44(2):177-194. doi: 10.1007/s11414-015-9475
19. Institute of Medicine (US) Committee on the Health Professions Education Summit; Greiner AC, Knebel E, editors. *Health Professions Education: A Bridge to Quality*. Washington (DC): National Academies Press (US); 2003. Chapter 3, The Core Competencies Needed for Health Care Professionals. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK221519/>
20. Hibbard JH, J Stockard, ER Mahoney, and M Tusler. Development of the Patient Activation Measure (PAM): Conceptualizing and Measuring Activation in Patients and Consumers. *Health Serv Res* 2004 Aug 39(4 Pt 1): 1005-26)
21. Massy WF. *Reengineering the University: How to be Mission Centered, Market Smart, and Margin Conscious*, Johns Hopkins University Press, 2016.
22. Aarons GA, Sklar M, Mustanski B, Benbow N, Brown CH. "Scaling-out" evidence-based interventions to new populations or new health care delivery systems. *Implement Sci* 2017; 12:11
23. Chambers DA, Glasgow RE, Stange KC. The dynamic sustainability framework: Addressing the paradox of sustainment amid ongoing change. *Implement Sci*. 2013; 8:117.
24. Beriwck DM. Developing and testing changes in delivery of care. *Ann Intern Med* 1998;128:651-56.

Tables

Table 1. Important Determinants of Hospital at Home (HaH) Adoption, by Domain of Practice, Linked to Implementation Strategy Cluster and Specific Strategy *

Domain of Practice	Determinants Specific to HaH	Implementation Strategy Cluster	Targeted Implementation Strategy
Guideline or Intervention Factors	Feasibility	Use evaluative and iterative strategies	Assess for readiness and identify barriers and facilitators
	Accessibility of the intervention	Utilize financial strategies	Place innovation on fee for service lists/formularies
Individual Health Professional Factors	Skills needed to adhere	Provide interactive assistance	Provide clinical supervision
	Capacity to plan change	Develop stakeholder interrelationships	Use an implementation advisor
Patient Factors	Patient needs	Engage consumers	Intervene with patients to enhance uptake/adherence
Professional Interactions	Referral processes	Adapt and tailor to context	Tailor strategies
Incentives and Resources Factors	Availability of necessary resources	Develop stakeholder interrelationships	Obtain formal commitments
	Financial Incentives and disincentives	Utilize financial strategies	Alter incentive/allowance structures
Capacity for Organizational Change	Quality assurance and patient safety systems	Use evaluative and iterative strategies	Develop and implement tools for quality monitoring
	Regulations, rules, and policies	Adapt and tailor to context	Promote adaptability
Social/Political/Legal Factors	Monitoring and feedback	Use evaluative and iterative strategies	Conduct cyclical small tests of change
	Payer or funder policies	Utilize financial strategies	Use other payment schemes
	Contracts	Utilize financial strategies	Use capitated payments

*Domains of practice and relevant determinants identified using the Integrated Checklist of Determinants (TICD).⁽⁵⁾ Implementation strategies used were organized by clusters described by Waltz et al⁽²⁾

Table 2. Summary of Implementation Strategies used, Organized by Cluster with Mean Importance and Effort Ratings and Phase of Use *					
	Importance	Effort	Implementation	Sustainment	Scaling
<u>Use evaluative and iterative strategies</u>					
Develop and implement tools for quality monitoring	8.4	5.8	**	**	*
Develop and organize quality monitoring systems	8.4	7.2	**	**	
Conduct local need assessment	8.2	8	***	**	
Assess for readiness and identify barriers & facilitators	8	6.8	***	*	*
Purposefully reexamine the implementation	8	8.4	***	***	
Conduct cyclical small tests of change	7.8	6.4	***	**	
Audit and provide feedback	7	6.2	**	***	**
Stage implementation scale up	6.8	7.2	***	***	
Develop a formal implementation blueprint	6.6	7.2	**	*	*
Obtain and use patients/consumers & family feedback	5.4	5.2	***	***	
<u>Provide interactive assistance</u>					
Provide clinical supervision	7	5.2	**	*	*
Provide local technical assistance	5.2	5.6	*		
<u>Adapt and tailor to context</u>					
Tailor strategies	8.2	8.2	***	**	*
Promote adaptability	7	6.6	**	**	*
Use data warehousing techniques	7	7	***	***	***
Use data experts	6.2	6.2	*	*	
<u>Develop stakeholder interrelationships</u>					
Organize clinician implementation team meetings	8.2	7	***	**	
Build a coalition	8.2	7.8	***		
Obtain formal commitments	8.2	8.4	***	**	**
Identify and prepare champions	7.4	4.2	***	*	
Visit other sites	7.4	5.4	***		
Recruit, designate, and train for leadership	7.2	4.8	**	**	
Involve executive boards	7	4.2	***	*	**
Model and simulate change	6.8	6.2	***		
Conduct local consensus discussions	6.6	5.2	***	*	
Use advisory boards and workgroups	6.4	4.4	***	**	**
Develop academic partnerships	6.2	5.6	***		
Inform local opinion leaders	5.6	3.2	**	*	*
Use an implementation advisor	5	5.2	***		
<u>Train and educate stakeholders</u>					
Conduct ongoing training	6.8	5.4	***	**	*
Use train-the-trainer strategies	6.6	4.4	**	***	**
Conduct educational meetings	6.2	5.8	***	***	*
Develop educational materials	6	5.5	***	**	
Conduct educational outreach visits	6	3.8	***	**	
Shadow other experts	6	5	**		
Work with educational institutions	5.4	6	*	***	*
Create a learning collaborative	4.75	5		**	***
Provide ongoing consultation	4.6	4.2	**	**	**
<u>Support clinicians</u>					
Create new clinical teams	8.4	7.8	***	**	*
Develop resource sharing agreements	8	7.8	***	**	*
Revise professional roles	7.6	8	**	**	**
Remind clinicians	5	4.8	**	**	*
<u>Engage consumers</u>					
Intervene with patients to enhance uptake & adherence	6.4	5.2	**	**	*
Use mass media	4.8	4.8	***	***	*
<u>Utilize financial strategies</u>					
Use other payment schemes	8.8	8.8	*	***	**
Fund and contract for the clinical innovation	8.6	8.8	**	**	**
Make billing easier	8.2	8.2	*	**	***
Use capitated payments	8.2	7.8	*	***	***

Place innovation on fee for service lists/formularies	7.6	8.6	**	***	***
Alter incentive/allowance structures	6.8	7		**	**
Alter patient/consumer fees	6.2	4.8	**	*	
<i>Change infrastructure</i>					
Change service sites	8.2	8.6	**	***	**
Change record systems	7.2	6.6	*	***	*
Start a dissemination organization	7	8.4		**	**
Mandate change	6.2	5.6	**	*	
Create or change credentialing and/or licensure standards	6	5.4			**
Change accreditation or membership requirements	5	4		*	**

* Raters reached consensus that the following strategies were not used: centralizing technical assistance, developing an implementation glossary, making training dynamic, preparing patients/consumers to be active participants, developing incentive, changing physical structure and equipment, and changing liability laws. No consensus was reached on the following strategies: facilitation, identifying early adopters, capturing and sharing local knowledge, promoting network weaving, distributing educational material, facilitating relay of clinical data to providers, involving patients/consumers and family members, increasing demand, and accessing new funding. Implementation strategies used were organized by clusters described by Waltz et al ⁽²⁾

For phase of use, one asterisk denotes designation of that phase by a simple majority of raters, two asterisks denote designation by 4 of 5 raters, and three asterisks denote agreement from all 5 raters.

Table 3. Specification of Selected Implementation Strategies *							
	Implementation Strategy						
	Assess for readiness and identify barriers and facilitators	Provide clinical supervision	Intervene with patients to enhance participation	Tailor strategies	Obtain formal commitments	Promote adaptability	Use other payment schemes
Determinant To Be Addressed (Domain of Practice)	Feasibility (Guideline/ Intervention)	Skills needed to adhere (Individual Health Professional)	Patient needs (Patient)	Referral processes (Professional)	Availability of necessary resources (Incentives and Resources)	Regulations, rules, & policies (Capacity for Organizational Change)	Payer or funder policies (Social/ Political/ Legal)
Actor(s)	Director, Manager, Staff	Director, RN and SW supervisors and experienced clinicians	Nurses, social workers, and care coordinators	Director and Manager	Director, Manager, Contracting Officer, and legal	Director, Manager, Legal counsel	Director, Manager, and finance, billing, and legal staff
Action(s)	Evaluate interest, feasibility, demand, resources, and barriers for HaH	Train on protocol; observing and shadowing experienced staff	In-person and telephone reminders about follow-up appointments	Expand diagnoses and services, tailor inclusion criteria, customize EHR and processes	Contract with vendors, and commitments with other departments to collaborate	Adapt procedures for existing regulations, rules, and policies	Negotiate payment contracts with health plans and government payers
Target(s) of the action	System and department leaders; intervention acceptability, appropriateness, and feasibility	MD, RN, and SW staff; fidelity to protocols, patient safety, optimal clinical outcomes	Patients, family, and caregivers; understanding of intervention, consent, and adherence	Referral sources, partners; volume of referrals and patients served.	Vendors and other department heads; access to and provision of services in the home	System leaders, stakeholders, and vendors; implementation of service in compliant manner	Health plans and government payers; delivering HaH services to covered members
Temporality	6-12 months prior to launch	3 months prior to launch, with addition of staff, then periodically	During service initiation, home, phone and video interactions	Frequent cycles to test tailored strategies during all phases	0-3 months prior to launch, as needed thereafter	0-6 months prior to launch, as needed thereafter	6-12 months prior to launch and continuing afterwards
Dose	20-100 hours prior to program launch, with 5-10 hours re-evaluation quarterly	40 hours initially per staff trained with periodic retraining	15-30 minute for initial discussion, and 5 minutes for later interactions	Intensively with each site start-up; 1 hour weekly review meetings	10-20 hours per negotiation; 2-5 hours per contract for review by each party	10-80 hours negotiation/ discussion with counsel and involved parties	Varies by plan; 100-200 hours per contract
Implementation outcomes(s) affected	Adoption and feasibility assessed by volume of patients served	Fidelity assessed by cases meeting hospitalization criteria and cases having daily home visits	Acceptability and adoption by patients assessed by consent rate	Acceptability, adoption, and penetration assessed by volume and number from new sites	Acceptability, appropriateness, costs, and feasibility assessed by volume	Acceptability, adoption, appropriateness, and sustainability assessed by volume	Sustainability and penetration assessed by number of payers engaged and volume
Justification	Matching intervention components to aspects of the inner setting of the CFIR ⁽¹³⁾	Importance of professional competencies in practice ⁽¹⁹⁾	Theory of activated and informed consumers ⁽²⁰⁾	Matching intervention components with inner setting of the CFIR ⁽¹³⁾	Matching intervention components to the aspects of the inner setting of the CFIR ⁽¹³⁾	Adapting intervention from the CFIR ⁽¹³⁾	Importance of margin in sustaining a healthcare program ⁽²¹⁾

* One implementation strategy was selected for an impactful determinant within each of the seven domains of practice

Table 4. Illustration of How an Implementation Strategy Specification Varies by Implementation Phase			
Create New Clinical Teams	Phase		
	Planning/Implementation	Sustainment	Scaling
Actor(s)	Medical Director, RN and SW supervisors	Medical Director, RN and SW supervisors, Operations Director, system leaders	Medical Director, RN and SW supervisors, Operations Director, and leadership and stakeholders at many sites
Action(s)	Organize provision of acute services in the home and test in PDSA cycles	Operate a cost effective clinical service using dedicated, as well as existing healthcare staff	Adapt operation of a cost effective clinical service using dedicated as well as existing healthcare staff in other locations
Target(s) of the action	Dedicated interdisciplinary team; development, testing, and refinement of intervention protocols; safe and effective service delivery	Interdisciplinary team of dedicated and non-dedicated existing staff in other roles; safe and effective service delivery with expanded hours of operation	Interdisciplinary team of dedicated as well as non-dedicated existing staff in other roles; safe and effective service delivery with expanded hours of operation In many locations
Temporality	6 months prior to program launch	Quarterly after HaH launch	6-12 months in advance of expansion to new site or geography
Dose	20-40 hours prior to program launch, with 5-10 hours re-evaluation quarterly	5-10 hours per quarter	10-15 hours per week before expansion and in early phase of expansion
Implementation outcomes(s) affected	Adoption, acceptability, appropriateness, and fidelity	Adoption, acceptability, feasibility, costs, and sustainability	Penetration, costs, and sustainability catchment area expansion, increased volume
Justification	Matching intervention components to aspects of the inner and outer setting from the Consolidated Framework for Implementation Research ⁽¹³⁾	Expanded hours of service initiation to include greater night and weekend hours to meet payer expectations; most consistent with Type I Scale-out (population fixed; different delivery system) ⁽²¹⁾	Dynamic Sustainability Framework posits that intervention success depends on intervention fit with the practice setting and the larger ecological system over time ⁽²³⁾ ; scaling effort approaches Type III Scale-out (different population; different delivery system) ⁽²²⁾

Tailor Strategies	Phase		
	Planning/Implementation	Sustainment	Scaling
Actor(s)	Medical Director, RN and SW supervisors	Medical Director, RN and SW supervisors, Operations Director, system leaders	Medical Director, RN and SW supervisors, Operations Director, and leaders and stakeholders at many sites
Action(s)	Expand inclusionary diagnoses, adapt exclusion criteria to reflect current medical science	Continue to expand inclusionary diagnoses, addition of related services, addition of telehealth and community paramedicine services, customization of EHR modules	Tailor recruitment processes at each site given differences in geography, population, and admitting processes; addition of new related services
Target(s) of the action	HaH team and referral sources; improved adoption, acceptability, appropriateness of patients enrolled	HaH team, referral sources and partners; improved feasibility and efficiency of service delivery	HaH team, referral sources and partners; enhanced efficiency and penetration of services
Temporality	1-3 months prior to program launch	Quarterly review of targeted diagnoses; addition of new services as they are developed and become available	Engage new sites 3-6 months prior to launching new site
Dose	50 hours each to discuss safety of and to develop protocols for identifying and treating new diagnoses in home	50 hours each to develop protocols for new services in the home	50-200 hours based on existing processes for screening/enrolling eligible patients, as well as admitting practices, at each site
Implementation outcomes(s) affected	Adoption, acceptability, appropriateness, and fidelity	Adoption, acceptability, feasibility, costs, and sustainability	Penetration, costs, and sustainability catchment area expansion, increased volume
Justification	Prior HaH trials treated only a handful of diagnoses and had very strict inclusion criteria limited; implementation methods consistent with Plan-Do-Study-Act cycle approach to improving care ⁽²⁴⁾	Expanded hours of service initiation to include greater night and weekend hours meet payer expectations; effort most consistent with Type I Scale-out (population fixed; different delivery system) ⁽²²⁾	Dynamic Sustainability Framework posits that intervention success depends on intervention fit with the practice setting and the larger ecological system over time ⁽²³⁾ ; scaling effort approaches Type III Scale-out (different population; different delivery system) ⁽²²⁾

Figures

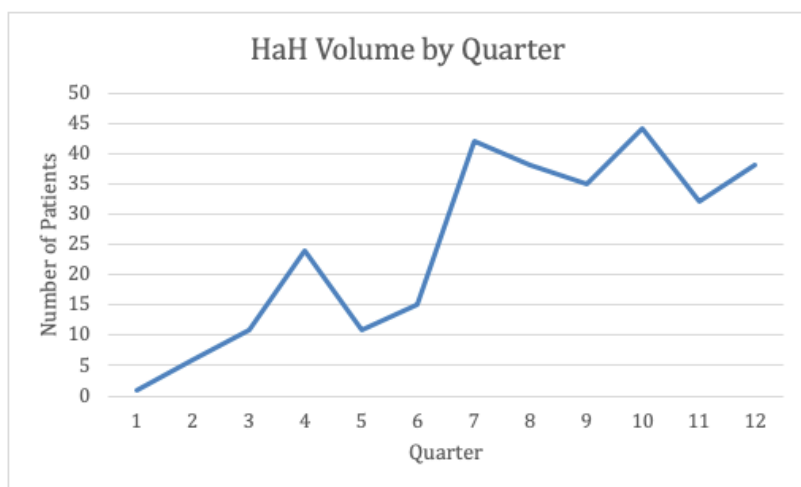


Figure 1

HaH Volume by Quarter

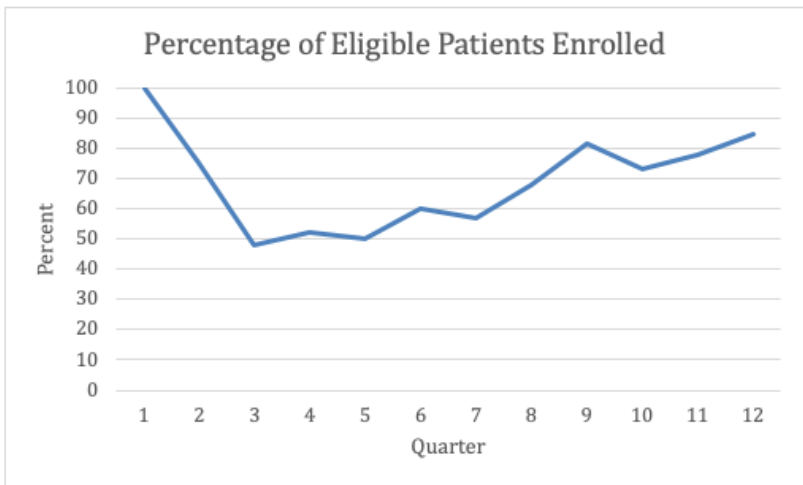


Figure 2

Percentage of Eligible Patients Enrolled

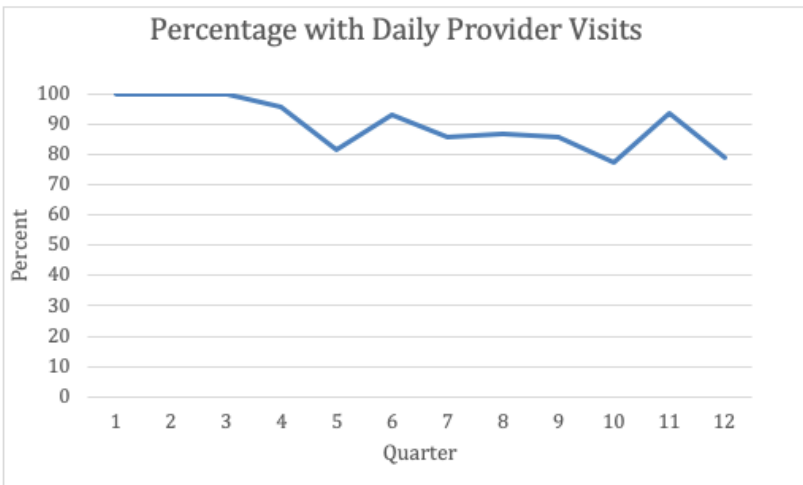


Figure 3

Percentage with Daily Provider Visits

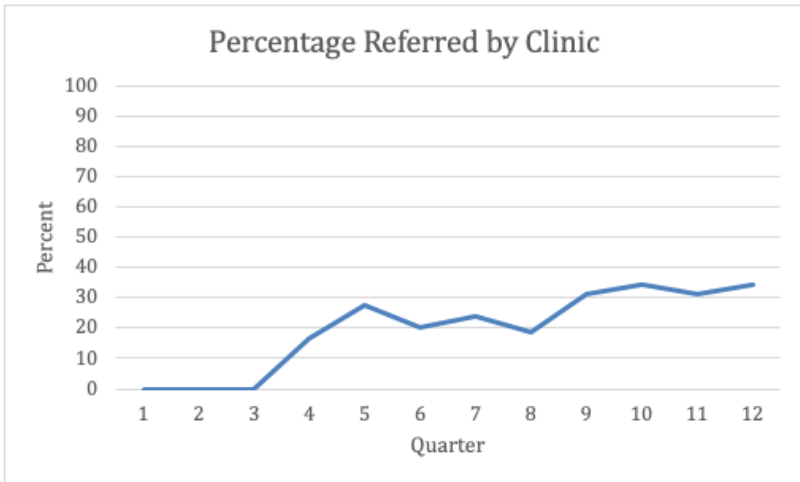


Figure 4

Percentage Referred by Clinic

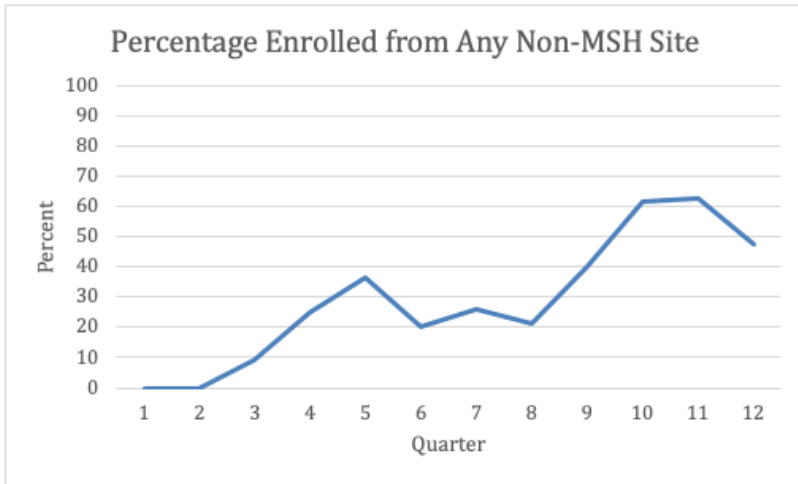


Figure 5

Percentage Enrolled from Non-MSH Site