Use of A Community of Practice For The Implementation of Evidence-Based Practices For Heart Failure Within The United States Department of Veterans Affairs

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Research

Abstract

Communities of Practice (CoPs) are a promising approach to facilitate the implementation of evidence-based practices (EBPs) to improve care for chronic conditions like heart failure (HF). COPs involve a complex process of acquiring and converting both explicit and tacit knowledge into clinical activities.

Formation: In July 2006, a CoP called the Heart Failure Provider Network (HF Network) was established in the United States (US) Department of Veterans Affairs (VA) with the overarching goal of improving the quality of care for HF patients. The CoP has involved a total of 1,341 multidisciplinary and multilevel members at all 144 VA Health Care Systems (sites). Examples of CoP activities include discussions of interventions to decrease hospitalization rates and to empower patients and caregivers for self-management. Goals of the CoP include networking facilitation, information dissemination and exchange, collaboration and implementation of EBPs.

Assessment: We conceptualized the assessment (formative evaluation) of the HF Network in terms of its various activities (inputs) and proximal impacts (mediators) at the individual-level, and its distal and ultimate impacts (outcomes) at the site-level leading to an improved culture of implementation of new/improved EBPs at the system-wide level.

The HF Network membership grew steadily over the nine years. Most members were practicing clinicians (n = 891, 66.4%), followed by administrators (n = 342, 25.5%), researchers (n = 70, 5.2%), and others (n = 38, 2.8%). Participation was "active" for 70.9% versus "passive" for 29.4% of members. The distribution of active members (clinicians 64.7%, administrators 21.6%) was similar to the distribution of overall membership.

Survey respondents perceived the HF Network as useful in terms of its varied activities and resources relevant for patient care. Members, particularly those that consider themselves influential in improving quality of care, noted multiple benefits of membership. These included confirmation of one's own clinical practices, evidence-based changes to their practice and help in understanding facilitators and barriers in setting up or running HF clinics and other programs.

Background

Proactive management of knowledge is today seen as a key strategy to ensure the performance and success of organizations or systems. [1] In a 2020 systematic review conducted by Hill, Stephani, Sapple and Clegg [2] where continuous quality improvement appeared effective, collaboration and communication between health care professionals appeared important. A major challenge to integrating evidence into practice for conditions such as heart failure (HF) is that it involves a complex process of acquiring and converting both explicit and tacit knowledge into clinical activities. Explicit knowledge is codified information such as peer-reviewed articles, rules and guidelines, which can be readily shared through written documents and other communication channels. [3] Tacit knowledge, in contrast, requires intensive social interaction and exchange. Although both forms of knowledge are critical for effective

professional practice and health care delivery, most policy, practice and research activity to improve quality of care emphasizes explicit knowledge. Recent interest and expanded research activity examining Communities of Practice (CoPs) and related concepts are beginning to redress this imbalance, however.

The focus of this article is a CoP known as the "Heart Failure (HF) Provider Network" in the United States Department of Veterans Affairs (VA) Health Care System. Specifically, we describe the formation of this CoP, who participates, and how the CoP works including its various activities. The overarching goal of the HF Network CoP has been to improve the quality of care for HF patients in the VA Health Care System. The method to achieve this is by actively involving a significant number of members from different disciplines across all VA sites. As a CoP, the HF Network is designed to facilitate networking, information dissemination, and collaboration among members.

Communities of Practice (CoPs)

Communities of practice (CoPs) have been used in the health sector to support professional practice change. [4] They enable the diverse wealth of knowledge embedded in people, local conditions and special circumstances to flow from practice domain groups to program and service areas, and into the larger system where it can effect organizational change.[5] In 1991 Lave and Wenger [6] developed the concept of the CoP. They suggested that learning takes place in social relationships rather than through the simple acquisition of knowledge. These informal communications became the means for sharing information for improving practice and generating new knowledge and skills. In 1998, Wenger [7] proposed three CoP dimensions: mutual engagement (the interaction between individuals that leads to the creation of shared meaning), joint enterprise (the process in which people are engaged and work together towards a common goal), and a shared repertoire (the common resources and jargon that members use to negotiate meaning within the group). Later in 2002 Wenger, McDermott and Snyder refined the description of CoPs as 'groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis. [8] They identified three essential characteristics of CoPs: 1) the 'domain' creates common ground (i.e. the minimal competence that differentiates members from non-members), and outlines the boundaries that enable members to decide what is worth sharing and how to present their ideas; 2) the 'community' creates the social structure that facilitates learning through interactions and relationships with others; and, 3) the 'practice' is the specific knowledge that the community shares, develops, and maintains. Wenger *et al*. purported that a well-developed CoP group (i.e. when the three elements work well together) provides an environment that facilitates learning and knowledge development. [8]

Li has argued [9] that the literature is less clear on how to foster the three CoP elements, especially at the early stage. To improve their understanding about the use of the CoP concept, they conducted a research synthesis project to explore how the concept was operationalized in the business and health sectors. Findings showed that among shared characteristics of CoPs in business and health care, learning and sharing information through socialization appeared to be the central characteristic of the CoP groups. To varying degrees, all CoPs demonstrated four characteristics: social interaction among members

(interaction of individuals in formal or informal settings, in person or through use of communication technologies); knowledge sharing (process of sharing information that is relevant to the individuals involved); knowledge creation (process of developing new ways to perform duties, complete a task, or solve a problem); and identity building (process of acquiring a professional identity, or an identity of being an expert in the field).

Wenger and colleagues suggested that an ideal CoP group should include a leader(s)/champion(s), a facilitator(s), a core group of experts who regularly interact with the group, and a dedicated group of members with varying levels of expertise. [8] Their work suggested that organizations can engineer and cultivate CoPs to enhance their competitiveness. According to Bertone and colleagues [1] CoPs represent a potentially valuable tool for producing and sharing explicit knowledge, as well as tacit knowledge and implementation practices.

CoPs have been described as a type of informal learning organization are gaining popularity in the health sector. Some CoPs resemble an informal network, where the goal and structure of the group is loosely defined, and others are similar to support groups, where the main goal is to enhance self-efficacy. [9] One version of a CoP, known as a clinical community, is an emerging approach to quality improvement (QI) to which several largescale projects have attributed some success. [10]

Health Impact of CoPs

While there is evidence for improved process of care, there is limited evidence to show that CoPs affect health care outcomes. In their 2009 literature review from 1991–2005, Li and colleagues [11] found no studies to show improvements in health outcomes of CoPs in the health sector. In another comprehensive review of studies from 1990–2009, Ranmuthugala [12] noted that little is known about the organizational processes that lead to successful creation of knowledge-based structures such as CoPs.
Medical Education

In terms of its implications for medical education, Cruess and colleagues [13] stated that CoPs can serve as the foundational theory, and other theories can provide a theoretical basis for the multiple educational activities that take place within the community, thus helping create an integrated theoretical approach. CoPs can guide the development of interventions to make medical education more effective and can help both learners and educators better cope with medical education's complexity.

Heart Failure (HF) Provider Network

In July 2006, VA's Chronic Heart Failure (CHF) Quality Enhancement Research Initiative (QUERI) established a CoP consisting of VA members to improve the quality of care provided to HF patients throughout the VA Health Care System. This multidisciplinary CoP is called the **Heart Failure (HF) Provider Network.**
HF Network Goals

The overarching goal for the HF Network is facilitate knowledge exchange of EBPs and strategies for improving quality of care for HF patients. The specific Network goals are:

1)Share evidence-based HF programs.
2)Understand and help resolve barriers and facilitators to implementation.
3)Establish collaborations/networking.
4)Disseminate findings and implement quality improvement projects.
5)Provide opportunities to identify/involve opinion leaders and/or local champions.

Creation of HF Network

The HF Network involves HF members at all VA sites (sites) interested in improving HF care. It was rolled out at the national level and initiated with a single email to all known Chiefs of Medicine and Chiefs of Cardiology at the VA sites. They were asked to forward the invitation to all interested VA staff. Those expressing interest are sent an e-mail invitation describing the HF Network, including its purpose, opportunities to present, and next scheduled meeting. Membership grew based on peer/provider recommendations, VA newsletters and VA websites. Existing members may discontinue their membership at any time.

Activities of the HF Network

For our purpose, we chose to map Li's four characteristics of CoP groups [11] work to the four categories of the HF Network activities: shared ways of engaging, resources, research/QI activities and relationships.

Table 1
Mapping of Li's Characteristics of CoP Groups to HF Network Activities

HF Network Activities	Li's Characteristics of CoP Groups			
	Social interaction	Knowledge-sharing	Knowledge-creation	Identity-building
Shared Ways of Engaging				
Bi-monthly web-based meetings with conference calls	X	X	X	X
Annual in-person meeting	X	X	X	X
Surveys – e-mail text and web-based links				
Email exchange	X	X	X	
Non-mandated forum of VA SharePoint site to exchange ideas	X	X	X	
Revise CHF QUERI Strategic Plan		X		
Networking	X			X
Resources				
HF Programs		X	X	
HF Provider Toolkit		X	X	
HF Tools		X	X	
Patient and caregiver education materials		X	X	
Funds for projects		X	X	
Research/QI Activities				
Expand research activities	X	X	X	X
Expand QI initiatives	X	X	X	X
Recruit sites to conduct research and/or QI initiatives	X	X	X	X
Formative evaluation of HF Network	X	X		X
Relationships				
Collaborations	X	X	X	X
HF experts	X	X	X	X
New local opinion leaders and champions	X	X		X

HF Network Activities	Li's Characteristics of CoP Groups			
	Social interaction	Knowledge-sharing	Knowledge-creation	Identity-building
Development of sub-specialty networks	X	X	X	X

We have used the HF Network to disseminate results of randomized trials (e.g., clinical reminders for beta-blocker use) and to facilitate the implementation of the national quality improvement (QI) initiatives such as the Hospital To Home (VA H2H) initiative to reduce readmissions for Veterans with heart failure. [14] In collaboration with the members we also developed an online HF Provider Toolkit for better management by members. [15]

We have tracked four specific activities to determine members' "active" participation in the HF Network. The first, and most attended, is the bi-monthly web-based meetings with conference calls. During the web-based meetings the moderators share announcements and updates which are typically followed by two presentations made by members of the HF Network, guests (both VA and non-VA). The second is an annual in-person meeting. The third tracked activity is a periodic online survey to HF Network members. These surveys have queried sites on the presence of local QI projects and members' views on VA goals related to the care of Veterans with heart failure. The fourth tracked activity is soliciting members of the HF Network to apply for funding for implementation projects from the VA's QUERI Program funding as well as CHF QUERI's core funds.

Assessment of the HF Network

Our evaluation of the HF Network can be considered a formative evaluation. Stetler [16] defined formative evaluation as "a rigorous assessment process designed to identify potential and actual influences on the progress and effectiveness of implementation effort. Formative evaluation enables researchers to explicitly study the complexity of implementation."

Conceptual Frameworks for the Evaluation of CoPs

McKellar [17] reviewed evaluation frameworks for CoPs. It was found that strong claims about generalizability could not be made with limited applications of the frameworks. Richard developed a conceptual model to evaluate an initiative based on a CoP strategy. This model was based on theories of work-group effectiveness and organizational learning and can be adapted by evaluators who are increasingly called upon to illuminate decision-making about CoPs. [18] This model took its strength from two improvements over the traditional input-process-output models. First it used the term "mediation" to explain the transformation of its inputs into outcomes. Further, due to the feedback loops, it depicted that outcomes will have an impact on organizational learning and practices that will necessarily affect individual and group characteristics.

Conceptual Framework for the Evaluation of the HF Network as a CoP

Based on McKellar's approach [17] we have conceptualized the formative evaluation of the HF Network. Figure 1 highlights the HF Network's conceptual framework for the evaluation in terms of its various activities (inputs), proximal impacts (mediators) at the individual-level, and its distal and ultimate impacts (outcomes) on implementation of new/improved EBPs at the sites and system-wide level.

Methods

Formation of the HF Network

Member-Level

Membership

Member roles were categorized as: leadership (VA Central Office (VACO) / Veterans Integrated Service Network (VISN) or regions), sites/departmental), practicing clinicians (physicians, nurse practitioners, physician assistants, nurses, pharmacists and psychologists), quality improvement and administrative staff (quality management and administrators), researchers and others.

"Active" Participation

We have defined "Active" versus "Passive participation. To qualify as an "Active" participant, the member should have participated at least one of the four HF Network's activities: (1) attended and/or presented during the bi-monthly web-based meeting, (2) attended the annual in-person meeting, (3) sent request for slides, or (4) completed surveys. All remaining members were "Passive" participants.

Assessment of the HF Network

Survey

Six years after initiation, we conducted an evaluation to assess the strengths and weaknesses of the HF Network using a cross-sectional web-based survey of members (n=878). This survey asked respondents questions about the participation in the activities, how helpful were these various activities of the HF Network, how beneficial was participation in the network, did participation influence in improving care of patients, if applicable reasons for not participating. The survey response rate was 24.9%.

Phone Interviews

We used stratified purposeful sampling (n=18) to identify key participants to conduct semi-structured phone interviews. All participants were members of the HF Network and were practicing clinicians (physicians n=10 and nurses n=7) or VACO/VISN leadership (n=1). Each participant belonged to a separate sites and participated at varying levels in the HF Network (None/Low=4, Moderate=9 and High=5). All interviews were audio-recorded and then transcribed.

Site-Level

Setting/Sites

We identified a total of 124 participating VA sites with HF Network members over the nine years. We grouped sites by member participation (over years 1-4) into three levels: "None/Low" (members at these sites participated in no or single activity; n=47), "Moderate" (members at these sites participated in 2-3 activities; n=36) and "High" (members at these sites participated in 4 or more activities; n=41).

Outcome Measures

The quality indicator outcomes were 30-day mortality after admission, death at 1-year after readmission, and all-cause admission after 30 days. We also examined guideline recommended process of care measures in those with depressed left ventricular ejection fraction (LVEF) <40%: use of beta blockers, use of angiotensin converting enzyme (ACE) inhibitors and use of aldosterone antagonist. These data were obtained through linkages with quality data from chart reviews (medications and LVEF) and administrative data (mortality and hospitalization).

Statistical Analysis

Member-Level - Survey

The HF Network database was created using Microsoft Access and we tracked member role, membership period, years of membership and participation in activities. Categorical responses were compared using chi-square tests. Survey data has been analyzed using the IBM SPSS Statistics Version 21. [19]

Member-Level - Phone Interviews

Data was then analyzed by the qualitative research team where de-identified verbatim interview transcripts were entered into Atlas.ti, [20] a qualitative data management program for coding by a trained analyst. Interviews were analyzed by 2 qualitative researchers familiar with the topic using an emergent, thematic approach based on the tenets of grounded theory. [21,22] A codebook was developed iteratively using feedback from members of the coding and research team until consensus on the codebook is reached. Core categories were identified, defined and operationalized to examine congruent, divergent and conflicting themes. Intercoder reliability was with the goal of achieving a kappa statistic of 0.65 and above or what Landis and Koch [21] describe as a "substantial" level of agreement.

Site-Level Analysis

All analyses for site-level data were conducted using STATA 11.0. [23] A p-value of <0.05 was considered statistically significant.

Results

Following the format described in the Methods section, below we have first focused on the formation of the HF Network at the member-level. Based on the study database, we have provided description of all

members, sustainability in membership over the nine years, member roles and their participation in the HF Network. Next, based on the quantitative data obtained through surveys and qualitative data obtained through phone interviews, we have provided results focused on the assessment of the HF Network both at the individual (member) level and site level.

Formation of the HF Network

Member-Level

Description of All Members (July 2006 – June 2015)

As seen in Table 2 over the nine years the HF Network had a total of 1,341 members from 143 VA sites. Among them as of June 2015, there were 930 current members, 145 past members who opted out for reasons like change in work role, work overload, etc., and 266 members who left the VA.

Table 2
Characteristics of All HF Network Members

Member Role	Membership Status (July 2006 – June 2015)			
	Current member N (%)	Past member: (opted out) N (%)	Past member: (left VA) N (%)	Total N (%)
Administration				
Site/Departmental leaders	159 (11.9%)	27 (2.0%)	24 (1.8%)	210 (15.7%)
VACO/VISN leaders	43 (3.2%)	11 (0.8%)	12 (0.9%)	66 (4.9%)
Other administrators	28 (2.1%)	3 (0.2%)	5 (0.4%)	36 (2.7%)
Quality management staff	23 (1.7%)	3 (0.2%)	4 (0.3%)	30 (2.2%)
Practicing Clinicians				
Physicians	255 (19.0%)	43 (3.2%)	110 (8.2%)	408 (30.4%)
Nurses	178 (13.3%)	33 (2.5%)	56 (4.2%)	267 (19.9%)
Nurse Practitioners	95 (7.1%)	6 (0.4%)	20 (1.5%)	121 (9.0%)
Pharmacists	52 (3.9%)	5 (0.4%)	13 (1.0%)	70 (5.2%)
Physician Assts.	11 (0.8%)	3 (0.2%)	3 (0.2%)	17 (1.3%)
Psychologists	6 (0.4%)	1 (0.1%)	1 (0.1%)	8 (0.6%)
Researchers	57 (4.3%)	3 (0.2%)	10 (0.7%)	70 (5.2%)
Others	23 (1.7%)	7 (0.5%)	8 (0.6%)	38 (2.8%)
TOTAL	930 (69.4%)	145 (10.8%)	266 (19.8%)	1341 (100.0%)

Sustainability of Membership over Nine Years

As seen in Fig. 2 membership in the HF Network was highly sustainable. Membership increased steadily particularly in Year 1 (n = 210), Year 5 (n = 911) and Year 9 (n = 1341). Highest number of new members joined the HF Network in Year 6 (n = 224) followed by Year 1 (n = 210). Over the years some members also left the HF Network with highest leaving in Year 2 (n = 90) followed by Year 1 (n = 34), and some members left the VA with highest in Year 3 (n = 68) and least in Year 9 (n = 3).

Member Roles

Figure 3 shows the distribution of member roles as highest for Practicing Clinicians (n = 891, 66.4%), followed by Administration (n = 342, 25.5%), Researchers (n = 70, 5.2%), and Others (n = 38, 2.8%). Among the Practicing Clinicians highest membership in the HF Network was for physicians (n = 408, 30.4%) followed by nurses (n = 267, 19.9%).

"Active" Participation

Figure 4 shows that among the members there were "Active" participants (n = 947, 70.6%, range 1–23 activities) as well as "Passive" participants (n = 394, 29.4%, range 0–0 activities).

Focusing solely on the above active members Fig. 5 shows they participated in HF Network's activities at low (1 activity), moderate (range 2–3 activities) and high (range 4 or more activities) levels. As seen Practicing Clinicians participated most in activities (total n = 1518, 64.7%) and among them highest participation was seen by physicians (total n = 668, 44.0%) followed by nurses (total n = 466, 30.6%). The second highest level of participation was observed for Administration (n = 507, 21.6%) and among them compared to VACO/VISN leadership, higher participation was seen by the Site/Departmental leaders (n = 406, 80.0%). The remaining two categories participated to a much lesser extent.

Assessment of the HF Network
Survey Findings

The survey was e-mailed to 878 members who had been a member of the HF Network for at least six months. Table 3 provides description of roles of all respondents. Despite the small response rate, the roles of the respondents were consistently representative of the roles of the total HF Network members. Highest representation was observed for the Practicing Clinicians (respondents n = 144, 65.6% versus all n = 891, 66.4%) followed by Administration (respondents n = 54, 24.7% versus all n = 276, 20.6%), then Researchers (n = 17, 7.8% versus n = 70, 5.2%), and Others (n = 4, 1.8% versus n = 8, 0.6%). The survey response rate was 24.9% (n = 219).

Table 3
Characteristics of Members: Responded to Survey and All Members

Member Role	Survey Respondents (Members) N (%)	All HF Network Members N (%)
Administration		
VACO/VISN leaders	12 (5.5%)	66 (4.9%)
Site/Departmental leaders	35 (16.0%)	210 (15.7%)
Quality management staff	6 (2.7%)	30 (2.2%)
Administrators	1 (0.5%)	36 (2.7%)
Practicing clinicians		
Physicians	50 (22.8%)	408 (30.4%)
Nurse Practitioners	43 (19.6%)	121 (9.0%)
Physician Assistants	4 (1.8%)	17 (1.3%)
Nurses	32 (14.6%)	267 (19.9%)
Pharmacists	15 (6.8%)	70 (5.2%)
Psychologists	0 (0.0%)	8 (0.6%)
Researchers	17 (7.8%)	70 (5.2%)
Others	4 (1.8%)	8 (0.6%)
Total (%)	219 (100%)	1341 (100%)
Involvement with QI projects/programs at own site		
Type of QI role		
Formal role	34 (23.1%)	
Informal role	35 (23.8%)	
Both formal and informal roles	78 (53.1%)	
Member QI role specific to:		
HF related QI projects	74 (50.3%)	
Non-HF related QI projects	14 (9.5%)	
All types of QI projects	58 (39.5%)	
Total (%)	147 (67.7%)	

Also, shown in Table 3 is that 67.7% of the respondents were involved with QI projects/programs at their own site. Among them 53.1% respondents reported being involved in both formal and informal roles, and the remaining respondents were involved either in formal (23.1%) or informal (23.8%) roles in the projects. Further, 50.3% of the respondents were involved with HF-related projects while 39.5% of them were involved with all types of QI projects (HF and non-HF related).

Respondents were also asked if the five goals of the HF Network were of particular interest to them, and if they perceived these goals being achieved by the HF Network at least to a moderate extent.

Table 4
HF Network Goals as Perceived by Members

Goals	Goals of particular interest to members N (%)	Goals achieved by HF Network at least to a moderate extent N (%)
Share evidence-based HF programs and updates in HF care	219 (95.4%)	219 (97.3%)
Understand the context in providing HF care (e.g., site, culture, leadership style, HF program)	219 (85.8%)	219 (90.6%)
Learn about barriers and facilitators to improve HF care	219 (92.2%)	219 (91.2%)
Establish collaboration and/or network among members of the HF Network	219 (88.6%)	219 (90.0%)
Provide opportunities to identify/involve local champions at sites	219 (73.5%)	219 (82.4%)

Table 4 shows that majority of the respondents expressed significant interest in four out the five goals (range 85.8% – 95.4%), and most of them reported that all goals have been achieved at least to a moderate extent (range 82.4% – 97.3%).

Respondents were also asked overall, if they considered their participation in the HF Network to be beneficial; and how influential they were in making changes in the quality of care of heart failure patients at their site. Figure 6 shows that almost all the respondents (97%) perceived their participation in the HF Network as beneficial. These respondents perceived themselves as highly influential in 19.6%, somewhat influential in 55.6%, and not influential in 24.8% in making changes in the quality of care of HF patients at own site. Similarly, most respondents perceived their participation in the HF Network as somewhat beneficial (51.6%) or very beneficial (42.9%). Interestingly, those respondents who considered themselves influential in making changes in the quality of care of HF patients at their site also found their participation more beneficial than those who perceived themselves as not influential.

Phone Interview Findings

A total of 18 semi-structured interview were conducted with physicians (n = 10), nurses (n = 7) and VACO/VISN leaders (n = 1). Qualitative analysis from the semi-structured interviews shows that these participants perceived the goals of the HF Network as sharing information (n = 11), improving care for HF patients (n = 10) and providing information based on EBPs (n = 5). They participated in the HF Network to stay informed (n = 10), maintain/enhance their knowledge (n = 8) and collaborate with other members (n = 5). HF Network activities helpful to these participants were discussions about setting up HF programs (n = 11), discussions focusing on QI projects (n = 4) and collaborations with the HF Network (n = 6). They considered the HF Network as "...is a good tool for networking" and "meeting potential collaborators to share information about current research".

Most the participants said they had no concerns related to the HF Network (n = 11) and they had referred other members to join the HF Network (n = 11). Many of them perceived themselves as having influence in making changes at their own site (n = 13).

At the site-level, the barriers to success of the HF Network were reported as limited time (n = 8) and lack of resources (n = 4), and facilitators for the success of the HF Network were commitment and support (n = 4).

Site-Level
Participation Levels

Among those who responded to the survey (n = 219), Table 5 shows the comparison of the site characteristics based on the categorization of member-level participation in the activities of the HF Network from Year 1 through Year 4. Analysis of variance showed that these members belonged to 124 sites and they participated at three levels: None/Low (n = 47; 0–5 activities), Moderate (n = 36; 6–10 activities) and High (n = 41; 11 ≥ activities). These differences were significant at p > .001 level.

Table 5
Characteristics of Sites Based on Site Participation Level

Site Characteristics	Site-Level Participation by Members			
	None/Low (N = 39) N (%)	Moderate (N = 61) N (%)	High (N = 119) N (%)	P value
Tertiary care site	13 (5.9%)	38 (17.4%)	78 (35.6%)	.002**
Bed size				
1−99 beds	10 (4.8%)	5 (2.4%)	13 (6.3%)	.01**
100−199 beds	7 (3.4%)	18 (8.7%)	17 (8.2%)	
200 or more beds	19 (9.2%)	36 (17.4%)	82 (39.6%)	
Member COTH (Council of Teaching Hospitals)	14 (6.7%)	32 (15.2%)	62 (29.5%)	.250
Has ACGME (Accredited Graduate Medical Education) Program	28 (13.3%)	53 (25.2%)	110 (52.4%)	.005**
Has a Cardiac Cath Lab	36 (16.4%)	58 (26.5%)	119 (54.3%)	.01**
Has on-site cardiologist services	35 (16.0%)	61 (27.9%)	117 (53.4%)	.005**
Has a HF clinic	20 (9.1%)	50 (22.8%)	87 (39.7%)	.004**
Use of pharmacist	27 (12.3%)	45 (20.5%)	84 (38.4%)	.860
Standardized home-monitoring	29 (13.2%)	55 (25.1%)	98 (44.7%)	.110
*P value significant at .05 level; **P value significant at .01 level				

Quality Indicators

Categorizing member-level participation in the activities of the HF Network from Year 1 through Year 4, using one-way ANOVA Table 6 shows comparison of means for the 3 levels of site-level participation by the members (n = 219). As evident, these groups of sites differed significantly with each other (p value < = 0.001). Between these 3 groups of sites the level of member participation didn't significantly impact 30-day mortality after admission ($p > 0.199$). But both death at 1-year after readmission ($p > .045$) and all-

cause admission after 30 days (p > 0.003) were found to be significantly different with groups of sites where members who were participating highly had higher readmission rates.

We also compared level of member participation in these 3 groups of sites for the following processes of care. Higher participating sites were significantly better in the use beta blockers (p < 0.01) and ACE inhibitors (p < 0.001) but not regarding the use of aldosterone antagonist (p < 0.436). While trends analysis for all these three processes of care were not significant for beta blocker (p > 0.881) and ACE inhibitor (p > 0.501) and only borderline for aldosterone antagonist (p > 0.087), these trends were indicative of care in the right direction.

Table 6
Average Site Quality Indicators Based on Site-Level Participation by Members

Site Characteristics During Year2 - Year7	Site-Level Participation by Members			
	None/Low	Moderate	High	P value*
	Mean (SD)	Mean (SD)	Mean (SD)	
	N = 47 (37.9%)	N = 36 (29.0%)	N = 41 (33.1%)	
ACE inhibitor	0.963 (.057)	0.963 (.047)	0.979 (.021)	.198
Beta-blocker use*	0.940 (.067)	0.946 (.047)	0.952 (0.044)	.565
Use of aldosterone antagonist*	0.230 (.146)	0.254 (.122)	0.275 (.124)	.301
Death 30-days after readmission*	0.680 (.028)	0.073 (.031)	0.062 (.023)	.225
Death at 1-year after readmission*	0.297 (.068)	0.285 (.051)	0.278 (.040)	.245
30-day all cause readmission following discharge with principal diagnosis of HF**	0.165 (.041)	0.177 (.038)	0.191 (.024)	.005**
*Trends analysis				
*P value significant at .05 level; **P value significant at .01 level				

Impact of the Formative Evaluation on CoP

Based on the results of the formative evaluation several changes to the HF Network were made. First, given the rich mix of clinicians and non-clinicians attending each meeting, we now include two presentations for each call with one focusing on a research project and the other on a QI initiative. Second, given the importance that members placed on the role of champions we sought local champions to serve as "internal" facilitators at each site. We could identify such champions at 65% of the sites.

Third, given many responses indicating that the HF Network can be helpful "...to keep as updated as possible with the standards for treating the HF patients", we developed a web-based Heart Failure Toolkit for the members of the HF Network as well as other VA providers. [14] This toolkit focuses on several key areas in the management of heart failure with downloadable documents.

Discussion

The purpose of this study was to describe the formation of a CoP (HF Network) to determine who is participating, and how they view the impact of the Network. The main observation is that members, particularly those that consider themselves influential in improving quality of care, have noted multiple benefits of participating in the Network.

The major strength of the NF Network lies in its multi-disciplinary and multi-level membership. Over two-thirds of these participants have been actively participating in the HF Network's activities. Their participation helped them validate own current practice in taking care of patients, encouraged evidence-based changes in practice and helped solve implementation-related problems. Given the extremely high web traffic reported by VA's Center for Information Dissemination and Education Resources (CIDER), anecdotal evidence and reported barriers for active participation like limited time and lack of resources, we are confident that most of the remaining members, too, have been "passively" participating by viewing/downloading resources and networking/collaborating with other members.

There is strong evidence of the sustainability of this network over the nine years as over those nine years membership steadily increased six-fold. Then as typical in any organization, there was also attrition as some members left the HF Network while some other members left the VA itself.

The wide variety of resources in terms of activities of the HF Network was perceived as helpful by the members of the HF Network. Our findings also show sharing of HF as a concern involving identity-building and networking (social interactions) with deepening of knowledge and expertise through interactions and helping each other both by actively and passively participating on an ongoing-basis. Strong influences of their participation are evident in terms of self-reported validating own current practice in taking care of HF patients, evidence-based changes in their own practice and help in understanding facilitators and barriers in setting up or running HF clinic/program. This observation was shared in a review of literature where CoPs were seen as promoted in the healthcare sector as a means of generating and sharing knowledge and improving organizational performance. [12]

This study noted an interesting association between member-reported self-influence in making changes in the quality of care of HF patients at own site and benefit of own participation in the HF Network. Those members who considered themselves influential in making changes in the quality of care of HF patients at their site also found their participation very beneficial. This finding has an important impact as we expect that influential members who are finding their participation beneficial would be among those who reported that their participation in the HF Network helped solve an implementation-related problem at own site, helped influence leadership/administration at own site to improve HF care and helped influence other

members/staff to improve HF care. These strong findings substantiate the two complementary theoretical approaches being used to guide the implementation of interventions through the HF Network. Based on Rogers Diffusion of Innovation theory [24] we have used local opinion leaders in shepherding the implementation efforts. Also based on the PARIHS framework's [25] "facilitation" element we've also used a "blended" facilitation approach to implement HF-related EBPs at the local, regional and/or national levels.

On a similar note the qualitative findings also support both these theoretical frameworks. The role of champions as stated by Rogers [24] found strong empirical support here. A nurse said a facilitator for the success of the HF Network is "I think having a champion. I think multi-departmental buy in, and I think you also need top administration to support it. Those three things". Another nurse said, "I have no problem with taking that hour because the chief of cardiology is one of the major supporters of the CHF thing…"

The main strength of the CoP theory is that it is able to provide a basis for the development and delivery of theory informed implementation interventions as well as their evaluations, which is especially important in the current situation when theory is not sufficiently utilized in the field of implementation research. [26] Utilizing Rogers Diffusion of Innovation theory [24] and the PARIHS framework, [25] the HF Network has been used both as a mechanism to implement interventions (research and QI projects) and as a vehicle to get funding for implementation-focused research and QI projects.

An important aspect is to assess the value of the HF Network as a CoP to the participating and non-participating members and key stakeholders including VACO leadership. The success of this organically grown HF Network with careful management and rigorous evaluation encourages the growth of similar CoPs through the development of social networks with the VA health care system for other conditions. In this VA context CoPs focusing on issues relating to returning Veterans and sexual trauma would need to expand the key stakeholders by including the patients and caregivers. CoPs are interesting structures to facilitate intra- and inter-disciplinary collaborations necessary to accelerate the implementation of the Chronic Disease Model and best practices recommendations. [27] Our effort facilitates the establishment and effectiveness of similar networks within VA and contributes new insights and evidence regarding the operation and impacts of communities of practice (and similar social network strategies) in improving healthcare quality and outcomes and facilitating implementation of EBPs and innovations in healthcare delivery.

We developed the CoP for heart failure care as a social network. This was based on the rationale that social networks are an important source of tacit knowledge, and thus there is growing interest in the use of networks to facilitate knowledge exchange in health-care settings. Their structures provide opportunities and incentives to their members along with a high degree of connectedness which enhances imitation of behaviors and related social processes, resulting in more homogenous practice patterns. [28] As noted by Mittman and colleagues, healthcare professionals work within peer groups who often share common values, assumptions and beliefs, and professional practices can be strongly

influenced by these factors. [29] There is strong evidence that physicians obtain information and related guidance (e.g., professional norms, values, attitudes) from other physicians who they consider to be peers and to possess expertise in the knowledge area. [30]

In a study [31] it was found that structure and operation of social networks were central to implementation of EBPs. Further, social networks influence the implementation process through two mechanisms, development and operation of successful collaborations and acquisition of information and support related to EBPs. Within the US's VA, Parchman [32] and colleagues examined the properties of a network created by 'co-care' of patients within one region. They found that the network was complex, consisting of highly connected provider nodes that serve as 'hubs' within the network, and demonstrating some 'scale-free' properties.

In Canada, Conklin [33] focused on understanding the processes mobilized through various CoPs that are working to improve the health in the Senior Health Research Transfer Network (SHRTN) in Ontario. They found that the CoP functioned as an incubator that brought together best practices, research, experiences, a reflective learning cycle, and passionate champions. Also, in Canada Norman and Huerta [34] examined building foundations for a CoP using evaluation and social network methodologies. A well-designed evaluation protocol has been reported by Conklin [35] using the PARIHS framework [24] with a shift of focus towards frontline practices where it is hoped to be implemented. In a previous study Conklin and Stolee's [32] evaluation model efforts showed that SHRTN and the CoP provide a supportive context but continued active facilitation of knowledge exchange is necessary at the point of care. In 2005, Poissant [27] reported that emergent CoPs with Canada's Montreal Stroke Network were successful in developing and implementing critical inputs, such as referral tools that accelerated patients' transition between acute care to rehab. A later study [36] demonstrated that to support the development of the CoPs, to assist with specific initiatives, and to promote the growth of the network, knowledge brokers who support the CoPs take on a complex and demanding role. Moreover, their role is contextual. Supporting the development of a new CoP differs from supporting the efforts of a well-established CoP.

This study has several potential limitations. A major limitation was that we were unable to link the survey responses to the respondent's role, type of member and site name. Therefore, this data had to be analyzed at the general level instead of allowing a comparison of responses particularly based on the respondent's role and type of site. It would have been interesting to see how member perceptions vary based on their roles and academic as well as site characteristics.

Conclusions

We established the HF Network as a CoP for VA members to facilitate networking, information dissemination and exchange, and collaboration among VA HF members to improve HF care for Veterans. Several hundred multidisciplinary members and administrators from throughout the VA continue to join and participate as members of the HF Network. Strong evidence in varied forms supports the contention that these members perceive the HF Network as useful in terms of its varied activities and resources

relevant for patient care. Members, particularly those that consider themselves influential in improving quality of care, have noted multiple benefits of membership. Such CoPs have strong potential for increasing medical knowledge of providers, spreading best practices across health systems and improving outcome for patients.

Abbreviations

CoPs: Communities of practice; PARiHS: Promoting Action on Research Implementation in Health Services; EBP: Evidence-based practice, HF: Heart failure; HF Network: Heart Failure Provider Network; QI: Quality improvement; VA: United States Department of Veterans Affairs; VACO: Veteran Affairs Central Office; VISN: Veterans Integrated Service Network; CIDER: Center for Information Dissemination and Education Resources.

Declarations

- **Availability of data and material:** This study has two types of datasets and neither of them are publicly available. First dataset generated for the study contains sensitive personal health information (first and last names, e-mail addresses, location, and roles) and participation of the VA employees in the HF Network. Second dataset was generated based on VA's highly sensitive and protected administrative datasets which contains site characteristics and site quality indicators.

- **Ethics approval and consent to participate:** Not applicable as this is a quality improvement study which does not require ethics approval and consent to participate.

- **Competing interests:** The authors declare that they have no competing interests.

- **Consent for publication:** Not applicable.

- **Authors' contributions:** AS, PH and BM conceptualized the study. AS and PH developed the study's design and methods. AS, PH and PG carried out the data collection. AS, PH and LS conducted the analysis. AS drafted the draft manuscript. All authors were involved in data interpretation and manuscript preparation and approved the final manuscript.

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- **Additional files:** None

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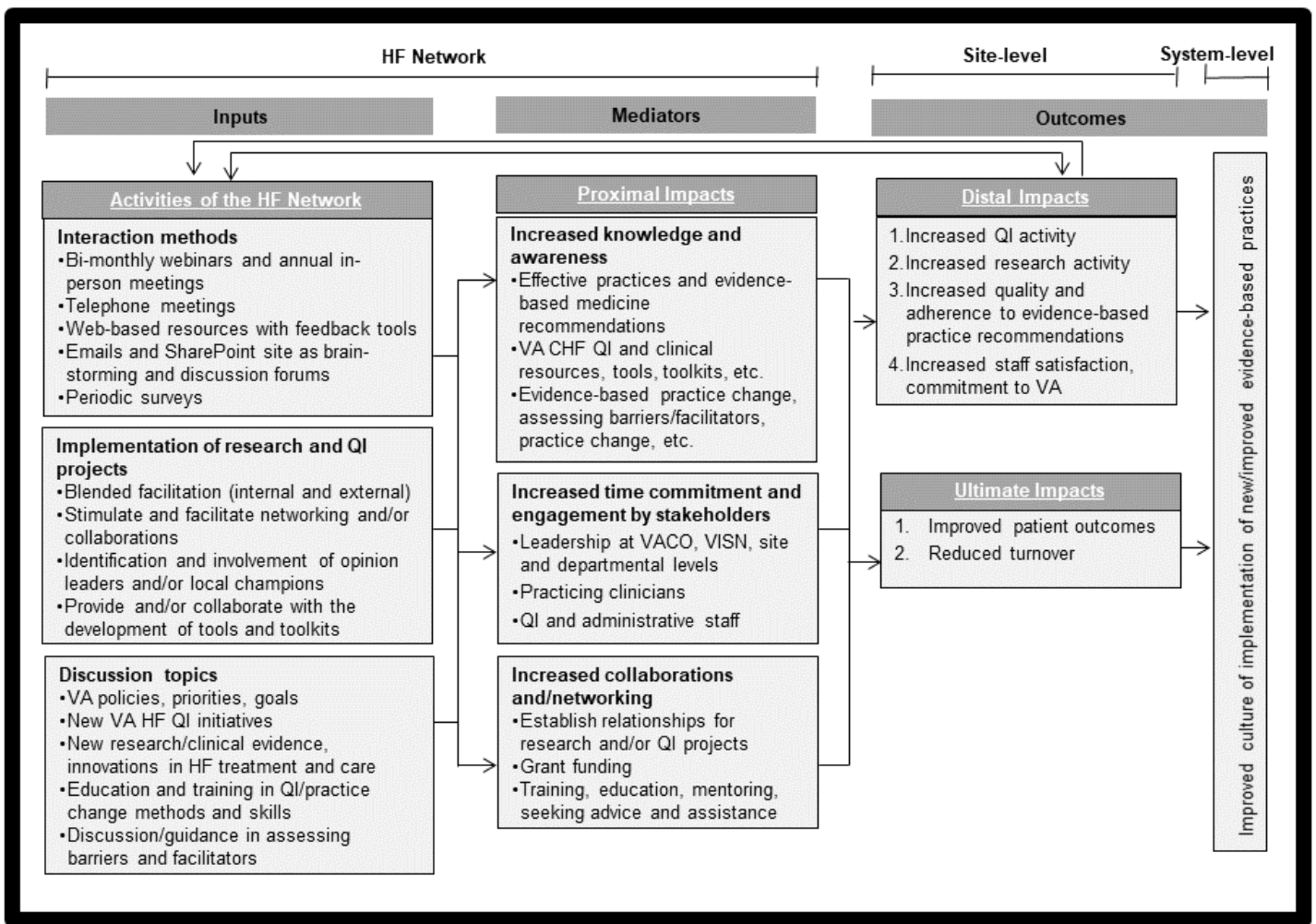
Figures

HF Network — Inputs, Mediators; Site-level, System-level — Outcomes

HF Network

Inputs	Mediators

Site-level **System-level**

Outcomes

Activities of the HF Network

Interaction methods
- Bi-monthly webinars and annual in-person meetings
- Telephone meetings
- Web-based resources with feedback tools
- Emails and SharePoint site as brainstorming and discussion forums
- Periodic surveys

Implementation of research and QI projects
- Blended facilitation (internal and external)
- Stimulate and facilitate networking and/or collaborations
- Identification and involvement of opinion leaders and/or local champions
- Provide and/or collaborate with the development of tools and toolkits

Discussion topics
- VA policies, priorities, goals
- New VA HF QI initiatives
- New research/clinical evidence, innovations in HF treatment and care
- Education and training in QI/practice change methods and skills
- Discussion/guidance in assessing barriers and facilitators

Proximal Impacts

Increased knowledge and awareness
- Effective practices and evidence-based medicine recommendations
- VA CHF QI and clinical resources, tools, toolkits, etc.
- Evidence-based practice change, assessing barriers/facilitators, practice change, etc.

Increased time commitment and engagement by stakeholders
- Leadership at VACO, VISN, site and departmental levels
- Practicing clinicians
- QI and administrative staff

Increased collaborations and/networking
- Establish relationships for research and/or QI projects
- Grant funding
- Training, education, mentoring, seeking advice and assistance

Distal Impacts

1. Increased QI activity
2. Increased research activity
3. Increased quality and adherence to evidence-based practice recommendations
4. Increased staff satisfaction, commitment to VA

Ultimate Impacts

1. Improved patient outcomes
2. Reduced turnover

Improved culture of implementation of new/improved evidence-based practices
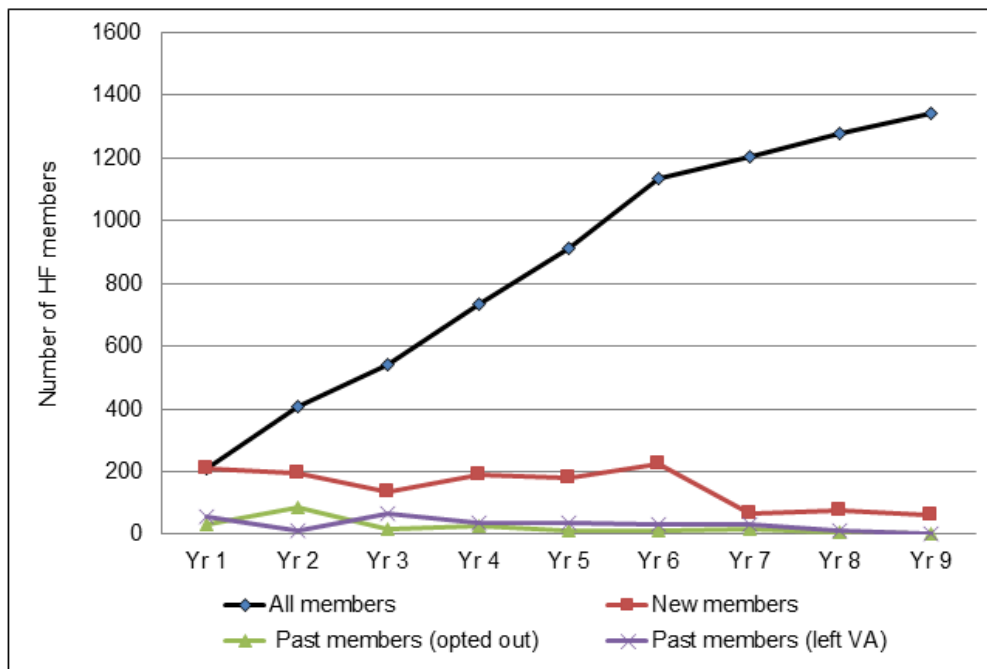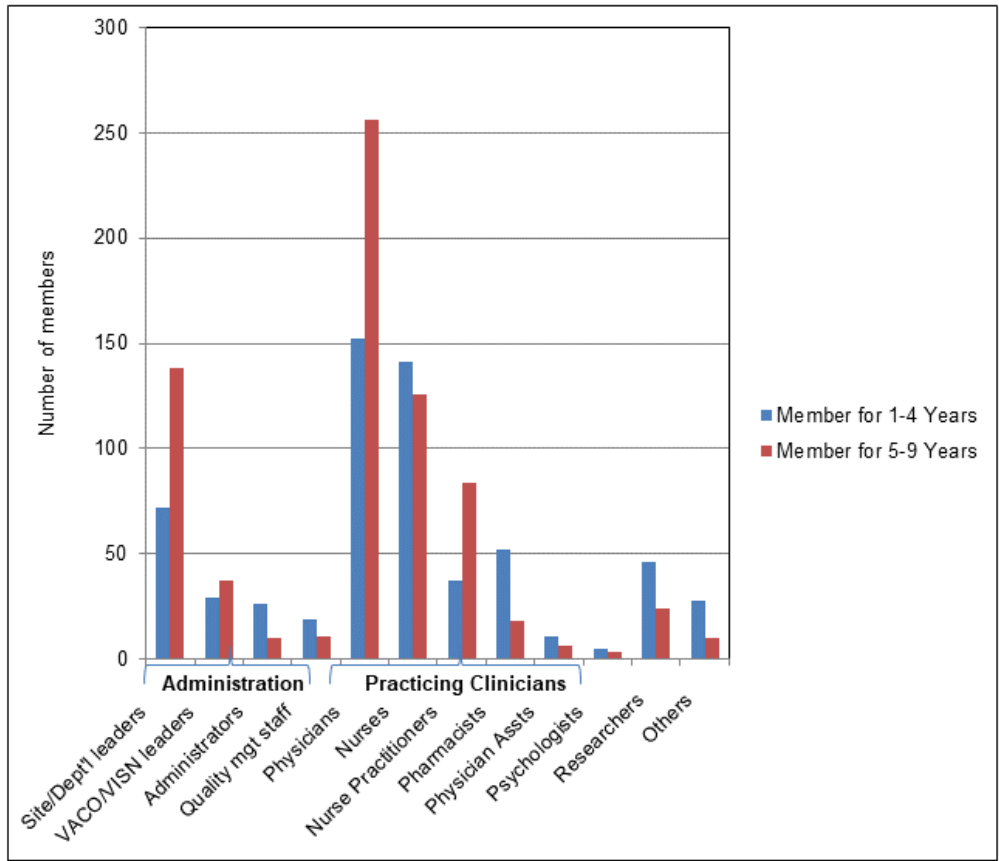
Figure 1

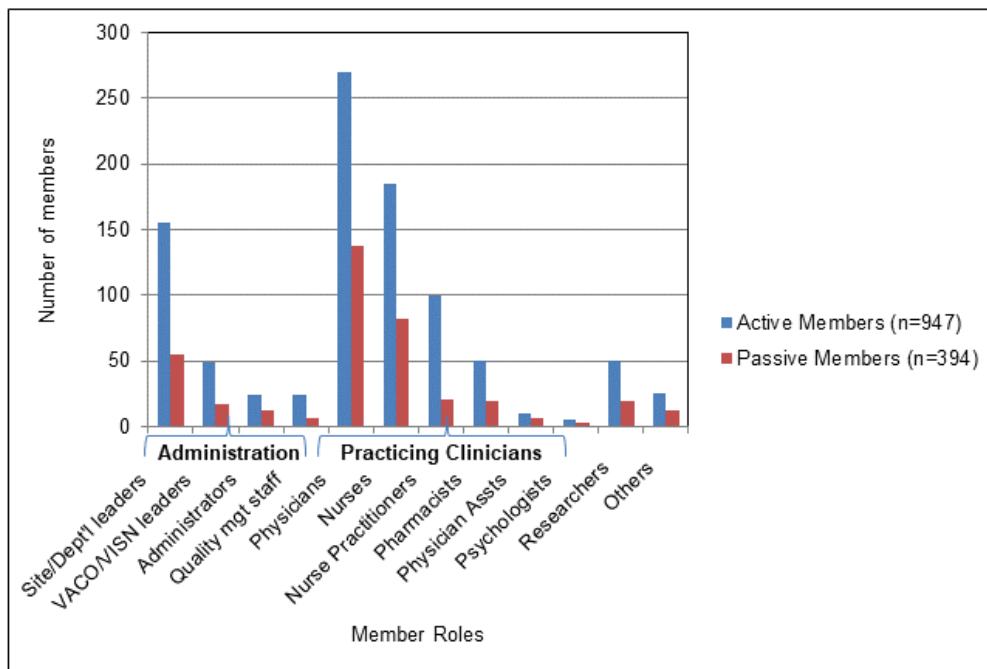Conceptual framework for the evaluation of the HF Network as CoP

Figure 2

Sustainability of HF Network membership per year shown for all, new, past (opted out) and past (left VA) members
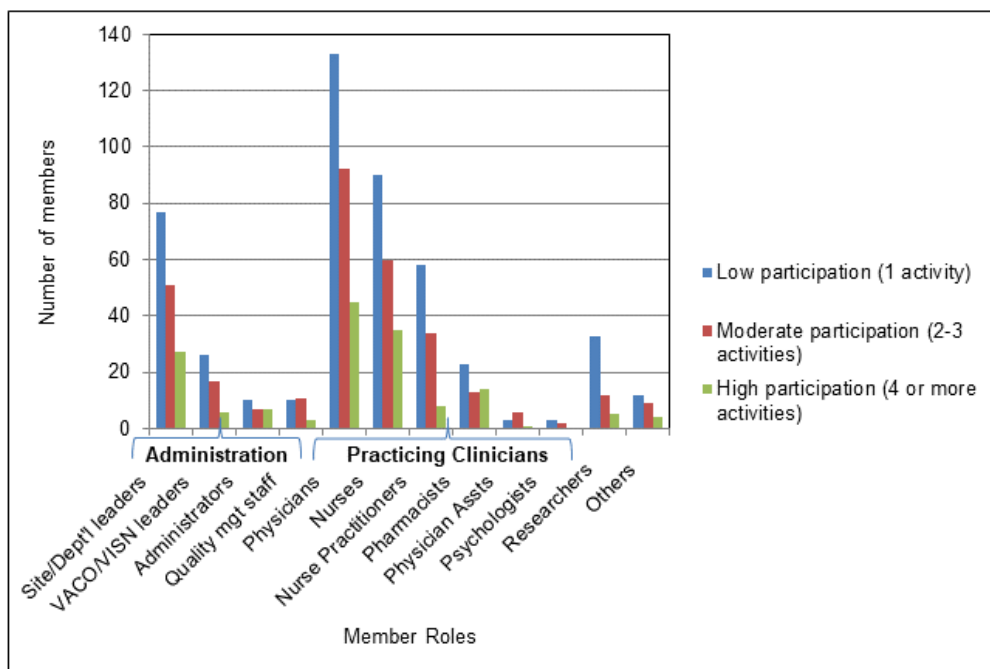
Figure 3
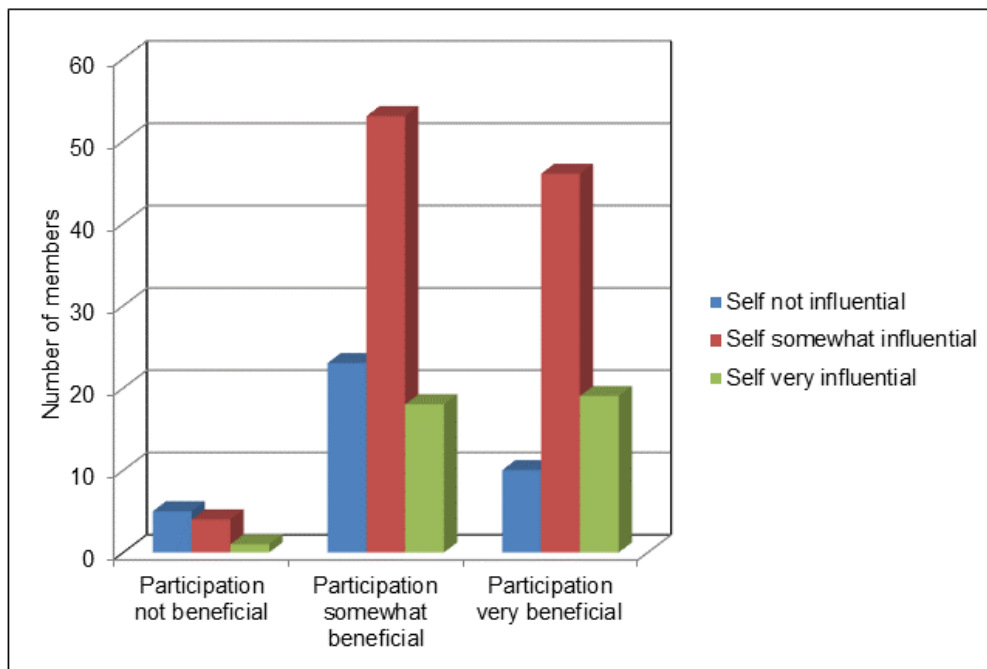
Member role and years of membership in HF Network

Figure 4

Member role and active versus passive members of the HF Network

Figure 5

Member role and level of active participation in the HF Network

Figure 6

Benefit of participation for self-reported influential members