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Development of Multidisciplinary Care Model With Participatory Action Research for Heart Failure Clinic in Bangkok, Thailand

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ORIGINAL STUDY

Development of Multidisciplinary Care Model With Participatory Action Research for Heart Failure Clinic in Bangkok, Thailand

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Abstract

Background: **Quality of care improvements is a challenge when resources are limited. In this participatory action research (PAR) study, we created a multidisciplinary care model (MCM) for heart failure clinic at a hospital in Bangkok, Thailand, and evaluated quality performance measures and clinical outcomes.**

Methods: **Using the PAR framework, this study included: 1) identification of problems and planning solutions with providers, 2) development of the MCM, 3) implementation of the MCM, 4) evaluation of quality process and outcome measures among heart failure patients at the follow-up conducted 6 months after implementation of the MCM, and 5) post-MCM survey.**

Results: **Information management of patient data, redundant work and communication, and ineffective workflow were the main problems identified. Providers suggested initiating a patient database, modifying the electronic health records, and developing an institutional map for heart failure care. Outcome measures were studied among 100 patients (mean age = 61.92 years, SD = 15.75; mean left ventricular ejection fraction = 31.15%, SD = 7.89). The mean guideline adherence indicator increased significantly ($p = 0.007$) from baseline (87.50 ± 22.14%) to follow-up (94.50 ± 15.54%). At follow-up, there was a significant reduction for risk of heart failure hospitalization (RR: 0.761, 95% CI: 0.652 to 0.889). Most study participants agreed that all MCM components could solve existing problems with heart failure care.**

Conclusion: **The PAR strategy used to develop the MCM for this heart failure clinic with limited resources was feasible and led to quality-of-care improvements.**

Keywords: Heart failure, Heart failure clinic, Multidisciplinary care, Participatory action research, Thailand

1. Introduction

Heart failure is a major public health problem worldwide. The estimated prevalence of heart failure in all ages was 1–2% among developed countries during 2009–2012. The prevalence of heart failure increased in elderly population aged 75 years or older [1,2]. There were 37.3 million patients living with heart failure globally in 2010 [2]. Current clinical practice guidelines have recommended standard medications for treatment of heart failure with reduced ejection fraction (HFrEF) to decrease hospitalization and mortality [3–6]. However, significant problems with clinical outcome still remain; and the directed medication therapy is suboptimal [7]. Patients with HFrEF are at high risk of experiencing adverse effects from prescribed medications; these effects are related to the aging of the heart failure patient population and the presence of multiple co-morbidities with polypharmacy. These factors are potential barriers to medication adherence and lifestyle modification, which impact on the clinical benefits of medications and patients' quality of life [8–10].

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Ideally, a multidisciplinary team of medical providers cares for patients with heart failure, thus supporting a high quality of care and cost-effectiveness. Several studies of multidisciplinary care from the heart failure clinic have demonstrated significant improvements in heart failure outcomes; however, there were no standardized components and interventions that were capable of being applied to all institutions [11−14]. A meta-analysis of the impact of multidisciplinary care in 3999 heart failure patients revealed a 32% reduction in risk of heart failure hospitalization (OR 0.68, 95%CI 0.53 to 0.88) [11]. However, maintaining and improving quality of care for heart failure patients is limited by circumstances including resource scarcity, increasing number of HFrEF patients, complexity in providing a continuum of care, redundancy of work in patient care tasks and documentation, and additional work from maintaining electronic health records [3−6]. These barriers could be overwhelming; they could lead to healthcare professional burnout and could influence patient safety outcomes including medication errors [15,16].

To improve multidisciplinary team care at a heart failure clinic, there needs to be close collaboration among healthcare members to develop a model that could optimally integrate institutional workflows and clinician preferences [17]. Participatory action research (PAR) supports social changes and solving problems with participants through cooperative methods [18]. There have been substantial PAR studies carried out in various healthcare settings for health promotion; but to our knowledge, there have been no previous PAR studies addressing care of heart failure patients [19−22]. This PAR study aimed to create a new multidisciplinary care model (MCM) for outpatients with chronic heart failure and to evaluate healthcare quality performance measures following implementation of the MCM.

2. Methodology

2.1. Study design and population

This PAR study was carried out for multidisciplinary patient care at a heart failure clinic (HFC) at a hospital in Bangkok, Thailand. Participants were healthcare professionals at both a HFC and non-HFC settings at a tertiary healthcare system. At the HFC, there were two cardiologists, three specialized nurses, and two clinical pharmacists, who provided multidisciplinary care for outpatients with heart failure. Our HFC clinic serves nearly 1200 patients (including repeated patients), or about 600 unique patients per year. The health data documentation system was partially digitalized using electronic health record and includes paper files for the HFC profile. Non-HFC clinicians were healthcare professionals in other departments who involved in the cooperative care of the heart failure patients.

Patients eligible to be included in this study included adults aged above 18 years old who were diagnosed with chronic heart failure with reduced ejection fraction. Reduced ejection fraction was defined as Left Ventricular Ejection Fraction (LVEF) less than 40% [4,5]. Patients who were missing from the treatment schedule for longer than 6 months were excluded from the study. All patients were monitored at the HFC in this study from June 2018 to May 2019.

2.2. Participatory action research (PAR) framework

The PAR framework utilized in this study included the following 5 steps [23]. Step 1) identification of problems in multidisciplinary care and planning of solutions among the HFC and non-HFC healthcare professional staffs participating in this study through meetings and surveys. Two survey questionnaires covered 2 domains of problems and suggestions. Responses included a 5-point Likert scale from strongly disagree (1) to strongly agree (5). Separate questionnaires were developed for the HFC staffs (39 items) and non-HFC staffs (36 items) because of differences in workflows and services as shown in the Table 2 and Supplement 1, 2 (https://shorturl.at/tG024). All survey questionnaires were validated for content by 3 experts. The reliability of the questionnaires was adequate: Cronbach's alpha was 0.901 for the HFC survey questionnaire and 0.939 for the non-HFC survey questionnaire. Step 2) development of the multidisciplinary care model (MCM). HFC healthcare members created the MCM based on the problems and suggestions identified during step 1. Step 3) implementation of the MCM. The MCM was tested and revised by the HFC members before implementation. Step 4) evaluation of quality performance measures. The objective outcome measurements were collected and analyzed for sharing knowledge and experience. Step 5) Opinion survey for reflection after the implementation of the MCM, and knowledge sharing among the healthcare providers. The PAR framework utilized in this study is described in the flowchart (see Fig. 1)

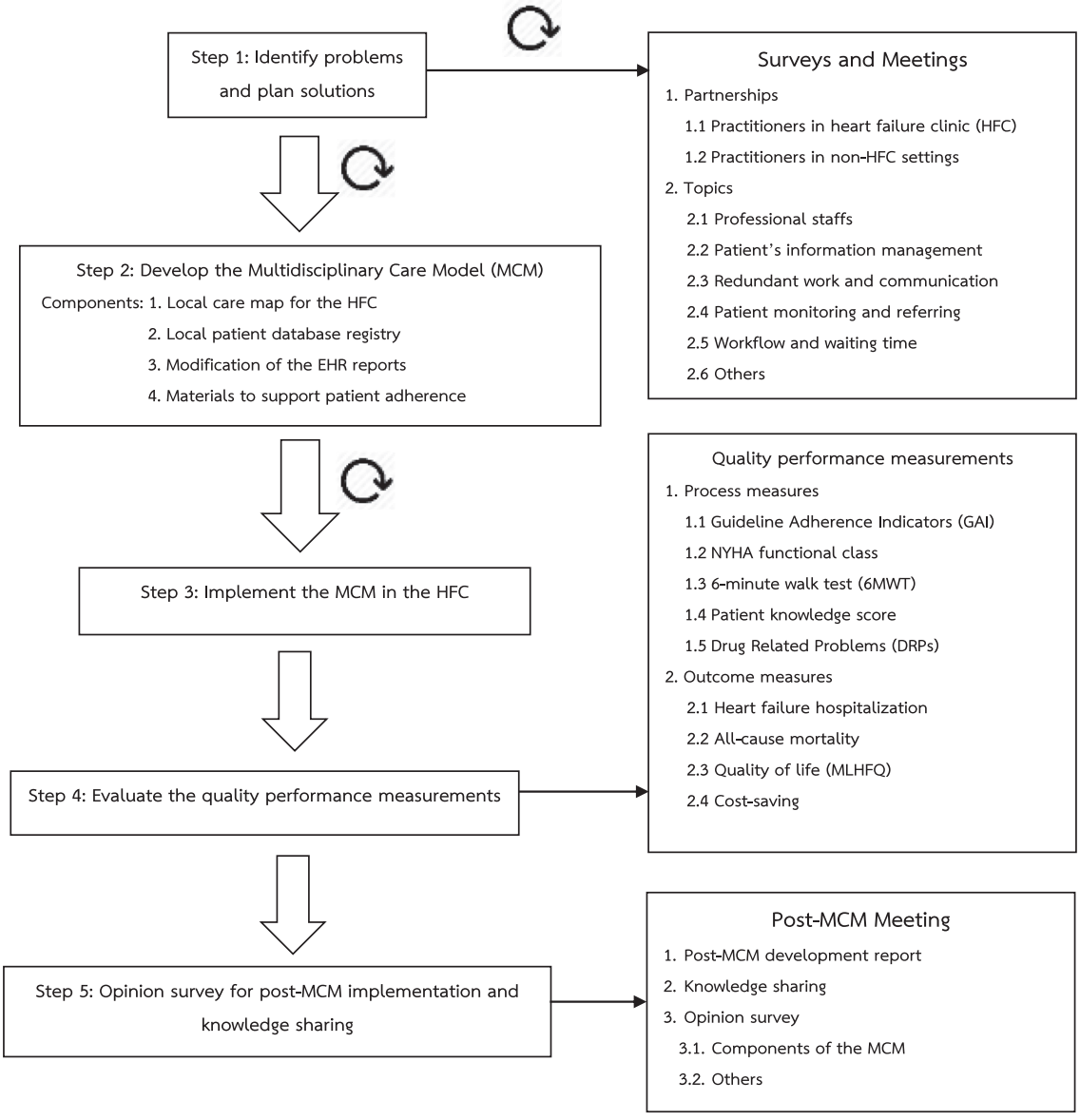
2.3. Quality performance measures

All quality measures considered by the HFC health professional staffs focused on accountability, validity, reliability, feasibility of data collection, and

association to heart failure outcomes. The quality performance measures were divided into 2 categories: process measures and outcome measures according to the clinical practice guidelines [3–6] with additional measures [24–26].

2.3.1. Process measures

1) Guideline Adherence Indicator (GAI) is a percentage of guideline-directed medications treatment that are prescribed for HFrEF management. The GAI percent was calculated by a total prescription number of guideline-directed medications divided by a total number of guideline-directed medications that should be prescribed without contraindications as summarized in the Table 1 [3–6]. The percentage of GAI was classified into 4 levels: low (0–39%); moderate (40–59%); high (60–99%); complete (100%) [24,27]. The GAI of each heart failure medication class was calculated to present a proportion of patients were prescribed a selected medication class without contraindications. The GAI calculation was performed by pharmacists



EHR: electronic health record, MLHFQ: the Minnesota Living with Heart Failure Questionnaire, NYHA: New York Heart Association

Fig. 1. Participatory Action Research framework for MCM for heart failure patients.

Table 1. Guideline-directed medications therapy for all HFrEF (class I recommendation) at the HFC,2018−2019 [4−6]

Medications	Eligible patients	Contraindications
Beta blockers (BBs): bisoprolol, carvedilol, metoprolol succinate, nebivolol	All stable HFrEF patients with LVSD	- Symptomatic hypotension with heart rate (HR) less than 50 beats per minute or systolic blood pressure (SBP) less than 80 mmHg - ADHF (acute decompensated heart failure) - Severe asthma or chronic obstructive pulmonary disease (COPD) - Heart blocks (second-degree AV block or tri-fascicular block)
Angiotensin converting enzyme inhibitors (ACEIs) or Angiotensin receptor blockers (ARBs) or Angiotensin receptor neprilysin inhibitor (ARNI: sacubitril/valsartan)	All stable HFrEF patients with LVSD	- Hyperkalemia (serum potassium higher than 5.5 mEq/L) - Acute kidney injury or severe renal insufficiency without dialysis [glomerular filtration rate (eGFR) less than 20 mL per minute per 1.73 m^2] - SBP less than 80 mmHg - Bilateral renal artery stenosis/Pregnancy/Shock/History of angioedema from ACEIs or ARBs
Mineralocorticoid antagonists (MRAs): spironolactone	All HFrEF patients with NYHA functional class II to IV and already given a BBs combined with a ACEIs/ARBs/ARNI	- Hyperkalemia (serum potassium higher than 5.5 mEq/L) - Creatinine clearance less than 30 mL/min - Serum creatinine higher than 2.5 mg/dL - Painful gynecomastia

HFrEF: heart failure with reduced ejection fraction, LVSD: left ventricular systolic dysfunction, AV: *atrioventricular*.

2) The New York Heart Association (NYHA) functional class provides severity of HF symptoms as classified in class I to IV according to the referenced clinical practice guidelines [3,5,6]. A nurse assessed patients for their NYHA functional class during the screening process before they were seen by a cardiologist.
3) 6-minute walk test (6MWT) is the distance in meters that patient was able to walk without assistances in 6 minutes [3]. This distance was also assessed by a nurse in the screening process.
4) Patient's knowledge about living with heart failure was assessed by a questionnaire in Thai language. The questionnaire was validated for content by 3 professional experts. Its reliability was adequate (Cronbach's alpha = 0.761). The questionnaire comprised of 12 items to assess 4 domains which included common symptoms of heart failure, medication treatment in heart failure, lifestyle modification and self-monitoring, and assessing the worsening symptoms and when to seek for medical attention as shown in the Supplement 3, 4 (https://shorturl.at/tG024). The knowledge questionnaire was self-evaluated at before and immediately after the patient received health education. Patients watched a digital multimedia presentation and received counseling with the heart failure team.
5) Drug Related Problems (DRPs) were problems associated with medication therapy and were not limited to treatment of heart failure. The DRPs were classified based on the recommendations of the American Society of Health-System Pharmacists (ASHP) and the Pharmaceutical Care Network Europe (PCNE) [24−26]. The DRPs were identified and corrected by pharmacists with collaboration of cardiologists and nurses.

using a summarized data of the prescriptions and laboratory results from patient database registry with additional clinical data from electronic health records in selected cases.

2.3.2. *Outcome measures*

1) Percentage of patients with heart failure hospitalization [3,5] was the proportion of patients who admitted in the hospital with diagnosis of heart failure, acute heart failure, or acute decompensated heart failure as documented in the electronic health records.
2) Percentage of all-cause mortality [3,5], was a proportion of deaths from any causes documented in the electronic health records.
3) Quality of life (QOL) was assessed by the Minnesota Living with Heart Failure Questionnaire (MLHFQ) in Thai language [28,29]. This questionnaire consisted of 21 items with a score ranging from 0 to 104 (the higher score indicated worsening QOL), the Supplement 5, 6 (https://shorturl.at/tG024).
4) Cost-savings were calculated by a difference of total costs in heart failure hospitalizations between the baseline and after the MCM implementation. The costs were collected from documents containing the cost summary reports for admissions from all types of the healthcare insurance.

2.4. *Opinion survey for post-MCM and knowledge sharing*

We did an evaluation following the development and implementation of the MCM. We conducted a

Table 2. Demographic data from healthcare professionals at HFC and non-HFC settings and their ratings (1 = strongly disagree to 5 = strongly agree) of problems and suggestions for multidisciplinary care at HFC

	HPs in HFC N = 8	HPs in Non-HFC N = 35
Respondent demographics		
1. Age (years)		
- 20-30	2 (25.00)	11 (31.43)
- 31-40	4 (50.00)	10 (28.86)
- 41-50	1 (12.50)	8 (22.86)
- 51-60	1 (12.50)	6 (17.14)
2. Female	6 (75.00)	34 (97.14)
3. Type of Professionals		
- Nurses	3 (37.50)	34 (97.14)
- Physicians	1 (12.50)	0
- Pharmacists	2 (25.00)	1 (2.86)
- Others	2 (25.00)	0
Problems - score (mean ± SD)		
1. Professional staff shortages (cardiologist, nurses, pharmacists, other healthcare professionals)	3.94 ± 0.44	3.15 ± 0.34
2. Patient information management (documentation, retrieving, archiving, organization, and reporting)	3.80 ± 0.23	3.59 ± 0.07
3. Redundant work and communication (patient interviews, recommendation, documentation)	3.46 ± 0.52	3.54 ± 0.21
4. Patient monitoring and transition of care	3.46 ± 0.52	2.87 ± 0.11
5. Workflow and waiting time	2.87 ± 0.37	2.99 ± 0.19
6. Overall problems with HF patients' care	2.38 ± 2.07	3.22 ± 0.58
Suggestions - score (mean ± SD)		
1. Development of a specialized patient database for HFC (management of the patient information records)	4.30 ± 0.10	3.69 ± 0.11
2. Modification in the hospital electronic medical record system (a popup notification with HFC patient status, tracking of the last department visit in the appointment patient list)	4.32 ± 0.09	3.56 ± 0.22
3. Development of an institutional map for heart failure care	4.13 ± 0.83	3.64 ± 0.95
4. Other suggestions		N/A
- Development of digital multimedia technology for patient education		
- Development of materials for patient counseling on medications		

HPs: healthcare professionals, HFC: heart failure clinic, N/A: not available.

post-MCM meeting with an opinion survey to assess whether each MCM component solved the problems of multidisciplinary care at the HFC. We also gathered other opinions for improvement and ideas about developing the MCM for different patient populations. The survey was designed by using a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). It had good reliability (Cronbach's alpha = 0.891). The questionnaire included of a total of 6 items for the MCM components and other opinions (Supplement 7 (https://shorturl.at/tG024)).

2.5. Statistical analysis

Descriptive statistics were calculated for surveys and baseline characteristics. The proportions (and percentages) were reported for categorical variables. The mean ± standard deviation was presented for continuous data with normal distribution (including survey scores, age, LVEF, and GAI percent). The median with interquartile range (IQR) of 25th to 75th percentiles were reported for non-normal distributed continuous data (including 6MWT and patient's knowledge score). The quality performance analyses were performed to determine effects of the MCM at 6-months follow-up compared to baseline. We compared categorical variables including GAI levels, NYHA functional class, and heart failure hospitalizations using the McNemar's test. The paired t-test was used for the GAI percent, which was a continuous variable with a normal distribution. The Wilcoxon signed rank test was used for the patient's knowledge score and MLHFQ score, which were continuous variables with a non-normal distribution. A two-sided alpha value was prespecified as 2.5% to determine statistical significance. Relative risk (RR) was calculated with a 95% confidence interval (CI) to determine an association of the MCM implementation with risk of heart failure hospitalization. Sample size was calculated by using a continuity correction that assumed 20% dropout and

power of 80%. We calculated a total sample of 99 patients was needed to detect an estimated difference from 46% to 24% in the rate of heart failure hospitalization between baseline and 6-months follow-up after the MCM implementation [12]. All statistical analyses were performed by using the SPSS software (IBM SPSS statistics 22, IBM Corp.)

2.6. Ethical issues

Our study was granted by the Health System Research Institute (HSRI), Thailand. There was no any involvements in conducting this research by the HSRI. This study protocol was approved by the Bangkok Metropolitan Administration Human Research Ethic Committee (BMAHRC) under approval code E006h/61.

3. Results

3.1. Identification of problems and planning solutions

A total of 44 healthcare professionals, 8 staffs who worked in the heart failure clinic (HFC) and 35 staffs worked in other departments or non-HFC settings, participated in this study. All practitioners were concerned mainly with the problems of health professional staff shortages, information management of patient's healthcare data, redundant work and communication, workflow, and waiting time. The HFC's staff realized that one reason that patients missed their scheduled was problems with patient monitoring and referring between departments. Feasible suggestions were discussed and scored including development of a disease-specific patient database, modification of the electronic health records, and institutional map for care management of heart failure patients with reduced ejection fraction.

3.2. Development of the MCM

The problems and suggested plans from step 1 were applied in designing the MCM to address institutional workflow, culture, and compatibility. The MCM components included the following:

3.2.1. Institutional map for heart failure care

An institutional map for heart failure care was created and approved by the HFC members for HFrEF management. It included information on treatment availability, workflow, professional roles of healthcare providers, monitoring processes, clinical outcomes, and key performance indicators, which adhered to the standard, evidence-based clinical practice guidelines [3−6]. The local heart failure care map was also planned to reduce the redundancy in workflow by supporting and guiding each health professional's individual role. The content covered 4 domains in heart failure assessment and diagnosis, pharmacological treatment and devices, patient education, and monitoring for clinical outcomes.

3.2.2. Local patient database registry for the HFC

An extra heart failure dataset was needed to perform specific tasks related to this study. The dataset was developed by IT programmers with input from the users' points of view, which included HFC and non-HFC participants. This additional platform was operated in parallel with a pre-existing hospital electronic health record in order to facilitate documentation, retrieving, archiving, and reporting essential patients' information. Moreover, this is the source of clinical outcome data for this study.

3.2.3. Modification of the report in electronic health record for patient status of the HFC

A popup notification for the healthcare personnel regarding HFC patient status was created to inform the non-HFC clinicians to refer or schedule an appointment back to the HFC after hospital admission. Another modification on the electronic health record was made for patients who were missing their appointments at the HFC due to being scheduled at non-HFC locations or being admitted in the hospital. The modification reported the current location of department visit for patients that were on the HFC patient list; it also notified HFC nurses to be aware and cooperate with other departments. These modifications intended to prevent patients from missing their scheduled visits at the HFC or losing opportunities for care coordination with the HFC.

3.2.4. Materials to support patient adherence

Other suggestions from the surveys were to develop materials for supporting patient education and medication adherence. The materials were created to encourage patient education through a booklet, a logbook, and digital multimedia with simple animations that illustrated general content for heart failure patients. This content included the common signs and symptoms of heart failure, medications, lifestyle modifications, self-care, documenting and self-monitoring (diet, blood pressure with pulse rate, weight, and worsening symptoms), and when to seek a medical attention. Patients and caregivers watched the digital multimedia during

their waiting time at the HFC. They received individual counseling with the healthcare team. They were also provided with a QR code of the digital multimedia for self-study at home. Another material was a modification on labelling of the heart failure medications when prescribing ACEIs/ARBs/BBs/MRAs. We added an indication for heart failure in the computerized prescribing system, which aimed to prevent patient confusion with other indications, especially hypertension. Finally, a chart of medication samples was designed to help discussion about medication adherence during the patient counseling.

3.3. Implementation of the MCM and evaluation of the quality performance measurements

After the MCM was pre-tested and revised by the HFC professional members, a consensus decision was made. Then the implementation of the MCM was gradually applied to the routine practice. The institutional map for heart failure care was first utilized to revise the HFC workflow and plan for quality measurements, then other materials were applied. After the patient database registry was successfully implemented, manual data collection and filing gradually decreased. Instead, the relevant patient information was systemically extracted via a newly developed platform. This platform created a recorded dataset. It was feasible to generate the data evaluation and report for process and outcomes measures in regular practice, as planned. Patients were monitored during implementation of the MCM for 6 months with assessments of the quality performance measures.

3.3.1. Baseline characteristics

A total of 203 patients were screened with the inclusion criteria. There were 77 patients excluded from the study due to incomplete documentation. 26 patients were excluded due to missing the HFC scheduled appointments for longer than 6 months. Finally, a total of one hundred patients included in this study. Of the total study patients, 58% were males with a mean age of 61.92 years (SD = 15.75). The participants' mean LVEF was 31.15% (SD = 7.89). Ischemic cardiomyopathy was a major leading cause of HFrEF (70%). Baseline characteristics of the study population are summarized in the Table 3.

Table 3. Heart failure patient characteristics

Characteristics	Patients (N = 100)
Male–number (%)	58 (58.00)
Age (years) – mean ± SD	61.92 ± 15.75
Comorbidities–number (%)	
Type 2 diabetes mellitus	64 (64.00)
Hypertension	60 (60.00)
Coronary artery diseases	58 (58.00)
Atrial fibrillation	20 (20.00)
Prior strokes	4 (4.00)
Chronic kidney diseases	
Stage 3a (GFR 45–59 ml/min/1.73 m^2)	6 (6.00)
Stage 3b (GFR 30–44 ml/min/1.73 m^2)	4 (4.00)
Stage 4 (GFR 15–29 ml/min/1.73 m^2)	2 (2.00)
Hemodialysis	1 (1.00)
Others	16 (16.00)
LVEF (%)– mean ± SD	31.15 ± 7.89
Smoking	8 (8.0)
Causes of cardiomyopathy (CMP)	
Ischemic CMP	70 (70.00)
Idiopathic CMP	18 (18.00)
Valvular heart disease (VHD)	6 (6.00)
Alcoholic CMP	1 (1.00)
Others	3 (3.00)

GFR: glomerular filtration rate, LVEF: left ventricular ejection fraction.

3.3.2. Quality performance measures

1) **Process measures:**

Heart failure medications prescribed according to the referenced guidelines were calculated as the GAI percent (Table 4). The mean GAI percent increased significantly compared to the baseline (87.50 ± 22.14% vs. 94.50 ± 15.54%, p = 0.007). The proportion of patients with complete GAI (100%) increased significantly compared to the baseline (72% vs. 88%, p = 0.010). The heart failure medication class GAI percent was calculated as the proportion of patients who were prescribed a heart failure medication without contraindications. We found that spironolactone was the only heart failure medication that we studied whose GAI percent increased significantly from the baseline (79.70% vs. 97.30%, p = 0.039).

The proportion of patients with NYHA functional class I after the MCM implementation increased significantly (25% vs. 53% respectively, p < 0.001); while the number of patients with NYHA class III decreased significantly compared to the baseline (25% vs. 3.0%, p < 0.001). Patients' performance in walking distance improved; the median 6MWT increased significantly from the baseline (240 m vs. 300.00 m, p < 0.001). In addition, the median score for patient knowledge increased significantly from the baseline (75.00% vs. 100%, p < 0.001, Table 4).

A total of 401 drug related problems (DRPs) were identified in 94 patients (94.00%). The highest percentage of DRPs was the medication dosage too low (44.89%), which mainly was found in dosage titration of the heart failure medications (22.44%). Patient non-adherence was 18.45%; non-adherence included self-

Table 4. Comparisons of process measures between baseline and 6 months after MCM implementation

Process measures	Baseline	MCM	p-value
GAI percent (%)	(N = 100)	(N = 100)	
Mean ± SD	87.50 ± 22.14	94.50 ± 15.54	0.007*
GAI level − number (%)			
Low (0−39%)	7 (1.00)	2 (2.00)	0.125†
Moderate (40−59%)	3 (3.00)	5 (5.00)	0.727†
High (60−99%)	18 (18.00)	5 (5.00)	0.007†
Complete (100%)	72 (72.00)	88 (88.00)	0.010†
Medication class GAI − Number (%)			
ACEIs/ARBs/ARNI	74 (81.30)	68 (90.70)	0.549†
Beta-blockers	96 (96.00)	98 (98.00)	0.625†
Spironolactone	63 (79.70)	71 (97.30)	0.039†
NYHA functional class − number (%)			
I	25 (25.00)	53 (53.00)	<0.001†
II	50 (50.00)	44 (44.00)	0.543†
III	25 (25.00)	3 (3.00)	<0.001†
6MWT (meter)	(N = 97)	(N = 97)	
Median (IQR)	240.00 (180.00−300.00)	300.00 (240.00−345.00)	<0.001**
Unable to walk − number (%)	3 (3.00)	3 (3.00)	N/A
Patient's knowledge score (%)			
median (IQR)	75.00 (66.67−83.33)	100.00 (100.00−100.00)	<0.001**

MCM: Multidisciplinary Care Model, GAI: Guideline Adherence Indicator, ACEI: Angiotensin converting enzyme inhibitors, ARB: Angiotensin receptor blockers, ARNI: Angiotensin receptor neprilysin inhibitor, NYHA: New York Heart Association, 6MWT: 6-minute walk test, IQR: interquartile range, *Paired t-test, **Wilcoxon signed ranks test, †McNemar test, N/A: not available.

care problems such as having an uncontrolled diet for the heart failure management or co-morbidities (5.24%), not taking prescribed medications (3.49%), and incorrect drug administrations (2.99%). 6.48% of patients had adverse drug events, which included symptomatic hypotension or bradycardia (4.49%), hyperkalemia (3.74%), and acute kidney injury (2.00%). All DRPs were successfully managed and monitored by the collaboration of cardiologists, nurses, and clinical pharmacists to correct the prescriptions and provide patient counseling.

2) Outcome measures:

Six months after the MCM implementation, the rate of heart failure hospitalization decreased significantly from the baseline (33.00% vs. 12.00%, p = 0.001). The implementation of the MCM was associated with a 23.9% reduction in risk of heart failure hospitalization compared to the baseline (RR 0.761, 95% CI 0.652 to 0.889). All-cause mortality was reported in 5 cases (5.00%). A significant number of patients had an improved mean MLHFQ score compared to the baseline (13.00 vs. 10.07, p < 0.001). The total costs of heart failure hospitalization decreased by 73.6% compared to baseline, Table 5.

3.4. Opinion survey for post-MCM and knowledge sharing

A total of forty-five healthcare providers from the HFC and non-HFC settings participated in the MCM development and implementation. In the opinion survey, they responded that all of the MCM components decreased the pre-existing problems with patient care at the HFC. All mean scores were higher than 4.00 for a 5-point Likert scale, with slightly higher scores from the HFC members than non-HFC practitioners (Table 6). Respondents also felt that the development process of the MCM could be applied to different multidisciplinary care services in other departments. The hospital electronic health record system required more improvement for effective use. In particular, the patient database registry should be synchronized with the electronic health record system for use in a real time manner. Finally, the materials and digital multimedia were good for patient education; however, they needed more development for use in other patient populations.

Knowledge sharing was the conclusion of the process to develop the MCM with extensive suggestions and input from healthcare providers. The process began with participants collecting problems and possible plans in meetings and surveys, which brought out practical solutions. Development of an institution map for heart failure care was key; it provided the main plan to guide the role and responsibilities for each professional member with key performance indicators. Preparation of the dataset for patient database registry needed to be concise and relevant to the outcome measures. The MCM components that needed technical staffs and application developers were challenging to develop

Table 5. Outcome measures after MCM implementation at 6-months follow-up

Outcome measures	Baseline (N = 100	MCM (N = 100)	p-value
HF hospitalization−number (%)	33 (33.00)	12 (12.00)	0.001*
RRR (%)		63.64	N/A
RR (95%CI)		0.761 (0.652−0.889)	N/A
All-cause mortality−number (%)	N/A	5 (5.00)	N/A
Quality of life (MLHFQ score)	(N = 97)	(N = 89)	
median (IQR)	13.00 (5.00, 24.50)	10.07 (2.00, 10.50)	<0.001**
HF hospitalization costs			
Thai Baht	1,108,561.08	292,662.55	N/A
US Dollars	36,714.43	9692.69	N/A
Cost-savings			
Cost-savings from HF hospitalization − difference (%)		73.60	

HF: heart failure, MCM: multidisciplinary care model, RRR: relative risk reduction, RR: relative risk, CI: confidence interval, MLHEQ: Minnesota Living with Heart Failure Questionnaire, IQR: interquartile range, N/A: not available, *McNemar test, ** Wilcoxon signed ranks test.

Table 6. Demographic data for healthcare professionals 6 months after implementation of the MCM and their ratings (1 = strongly disagree to 5 = strongly agree) of MCM components in addressing problems with HF patient care

	HPs in HFC N = 7	HPs in Non-HFC settings N = 38
Respondent demographics - number (%)		
1. Age (years)		
20-30	1 (14.29)	2 (5.26)
31-40	3 (42.86)	13 (34.21)
41-50	3 (42.86)	14 (36.84)
51-60	0	9 (23.68)
2. Female	6 (85.71)	38 (100.00)
3. Professionals		
Nurses	2 (28.57)	36 (94.74)
Physicians	2 (28.57)	0
Pharmacists	1 (14.29)	2 (5.26)
Technical nurses	1 (14.29)	0
Clerks	1 (14.29)	0
Please rate on how each of the MCM component resolved the pre-existing problems of the HF patients care		
1. Institution map for heart failure care	4.71 ± 0.49	4.42 ± 0.55
2. Modifications in the hospital electronic medical record system	4.57 ± 0.79	4.37 ± 0.67
3. Patient database registry for the HFC	4.43 ± 1.13	4.50 ± 0.56
4. Digital multimedia technology for patient education	4.71 ± 0.49	4.45 ± 0.60
5. Materials for patient counseling on medications	4.71 ± 0.49	4.63 ± 0.54
Other opinions - number (%)	**N = 17**	
1. Development process of the MCM	8 (47.06)	
A good example that can be applied in other multidisciplinary care services included outpatient clinics and hospitalized patients		
2. Patient information system included patient database registry and electronic health record system	6 (35.29)	
Need for data synchronization between the patient database registry and electronic health record system in a real time manner		
Electronic health record should be modified for documentation that supported the current multidisciplinary care		
The MCM has facilitated communication between the HFC and other relevant departments through the electronic health record		
Usual communication still required for confirmation of the cooperation between departments, especially for the hospitalized patients with ward staffs		
3. Materials and digital multimedia for patient education	3 (17.65)	
Need for more developments for other patient populations including patients using inhalers		
An incredibly good medication sample chart for drug counseling		

HPs: healthcare professionals, HFC: heart failure clinic.

because of communication barriers due to different perspectives. To overcome these obstacles, participants suggested that technical staff communicate with lay language and illustrate their database plans with a simple dataset structure. Finally, continual follow up throughout the development and progression of the MCM implementation and ongoing problem-solving were the keys to the success of this project.

4. Discussion

A multidisciplinary team is essential for coordinating care for patients to reach their goals of receiving the guideline-directed medical therapy. A system of care is also important to improve patient outcomes and support communication among healthcare professionals. The MCM was developed to improve the multidisciplinary care. We integrated concepts of PAR into the development of the MCM to address resource limitations with an increasing number of patients and workload. This study proved the feasibility of MCM development that consisted of participants who came from various departments other than host clinic (heart failure clinic) to voluntarily share and contribute. The willingness for participation, sharing experiences, brainstorming for solutions, and cooperation to develop and deploy the MCM were the major keys to success. These factors made the PAR-based model different from a conventional MCM model. This studied MCM led to favorable clinical outcomes i.e., heart failure hospitalization risk reduction, improvement of GAI percent, NYHA functional class, and quality of life. To our knowledge, this is the first study that applied PAR in the development of a MCM for caring for a chronic heart failure population.

Previous evidence of PAR was mostly conducted in a community level; these studies mainly focused on the common diseases with a lesser degree of disease complexity such as hypertension and diabetes mellites. In addition, models on disease preventive measures such as cancer screenings (colorectal and cervical cancers) and vaccination program have been reported [20−22,30,31]. There has been limited evidence of PAR-based MCMs that apply to complicated disease subtypes. For example, two ongoing PAR-based MCM randomized controlled trials are currently focused on antibiotic stewardship and an advanced care plan program [32,33].

A PAR study is designed to encourage participation through a cycle of planning − action − observation − reflection with the objectives of social change and knowledge building [23]. In our study, the PAR cycle started with identification of problems and planning for solutions − development of the MCM components − implementation the MCM − evaluation of the quality performance measures − reflection and knowledge sharing. The participation step allowed healthcare members to share and reflect their experiences by collecting any possible suggestions. This activity was also recommended to prevent the healthcare provider burnout [34]. Moreover, the participation level in our study was considered as high level because we initiated and carried out the PAR without outside facilitators [23].

The suggested plans were designed directly to solve the local problems in regular practice under available resources. For instance, we developed the institutional map for heart failure care as the main plan of the MCM. We agreed to decrease our manual data collection from electronic health records because the functions were limited to serve patient information management in the documentation, retrieval, and communication. The barrier of the electronic health record was also reported in several studies; these studies reported that the electronic health record system was insufficient to improve adherence according to the evidence-based practice guidelines for HFrEF management. The studies also identified the potential to increase unnecessary workload in documentation with task redundancy [35−37]. However, the electronic health record is a big data management system that is actually has a high potential to support patient care quality and efficiency for disease management. However, the data systems need to be designed well and used effectively. Therefore, we applied the newly developed patients' HFC dataset for data collection of the performance and outcome measures. This dataset proved the significant benefits of improving the quality of patient tracing and care.

We adjusted the workflow based on the local heart failure care map for each professional's role to increase communication among healthcare professionals for coordinating the patient care between departments. We designed materials to assist patient education based on common non-adherence problems in our HFC. These materials included a booklet with a logbook of self-monitoring, digital multimedia, medication labelling for heart failure treatment, and the medication sample chart.

After the MCM implementation for 6 months, the results showed improvements in quality performance measures in both process and outcome measures: GAI percent, NYHA functional class, 6MWT, patient knowledge scores, heart failure hospitalization rate, MLHFQ, and cost savings. The

results were supported by the IMPROVE-HF study (Improving Evidence-Based Care for Heart Failure in Outpatient Cardiology Practices). In this study, a HFrEF registry in outpatients cardiology practices showed improvements in 5 out of 7 guideline quality measures including medication management (beta-blocker and MRA), cardiac resynchronization therapy and heart failure education [38].

After the MCM implementation, we found that the heart failure hospitalization rate was significantly lower than the baseline (33%, vs. 12%, $p = 0.001$) with a relative risk of 0.761 (95% CI 0.652 to 0.889). The results were supported by previous studies. For example, a meta-analysis of 3999 patients in HFCs, revealed that the risk of heart failure hospitalization reduced significantly by 32% (OR 0.68, 95%CI 0.53 to 0.88) [11]. A randomized controlled study of a HFC in Thailand showed that the rate of rehospitalization in the HFC group was significantly lower than the usual care group (46% in the usual care group vs. 24% in the HFC group, $p = 0.04$) [12].

There has also been substantial evidence that GAI percent and NYHA functional class were associated with clinical outcomes in heart failure [24,27,38,39]. One example is a longitudinal cohort of the HELUMA, a heart failure registry in Germany from 1994 to 2007 with 3292 outpatients at cardiology clinics. In this study, increasing GAI percentage was independently associated with a reduction in all-cause mortality (HR = 0.92, 95%CI: 0.88 to 0.97, $p = 0.001$). Patients with NYHA functional class of III/IV (higher severity of HF symptoms) compared to the NYHA functional class of I/II (lower severity of HF symptoms) was independently associated with an increase in all-cause mortality (HR 1.67, 95% CI: 1.13 to 2.47, $p = 0.01$) [27]. Therefore, we applied the GAI percent and NYHA functional class as performance indicators for the MCM. In our study, the number of patients that received complete GAI (100%) increased significantly from the baseline (72% vs. 88% respectively, $p = 0.010$). The number of patients with NYHA functional class III decreased significantly from the baseline (25.0%, vs. 3.0% respectively, $p < 0.001$), which could predict a decrease in all-cause mortality.

We found that patients' knowledge score increased significantly after the MCM implementation. The implementation included individual counseling with the HFC team and supporting educational materials. Our result was supported by a randomized controlled study in heart failure patients that aimed to evaluate the educational intervention by multidisciplinary team. That study showed that patients in the intervention group had significantly higher knowledge scores immediately after the intervention ($p = 0.02$), and sustained higher scores over the 1-year follow-up ($p = 0.05$) [13]. The incidence of adverse drug reactions (11.48%) in our study was lower than a report in the previous study (77%). Our lower incidence is likely due to the fact that we had faster follow-up in our study, and there could be some unrecorded data [10]. The MLHFQ score among our study participants improved significantly. This result was supported by several previous HFC studies, which showed that patients had better quality of life scores after the interventions implemented by the multidisciplinary team [12,40–42]. After the implementation of the MCM in our study, the costs of heart failure hospitalizations declined by 73.60%, which was greater than a previous study (36.5%). This difference may be due to the fact that the previous study had a higher risk population with more elderly patients. These patients were more likely to develop worsening symptoms, and be hospitalized with acute decompensated heart failure [42].

5. Limitations

There were some limitations of this study. First, although this study was conducted prospectively, randomization was not performed. The participants from non-heart failure sections were enrolled voluntarily. This may result in selection bias. Second, despite regular reminders, cooperation from participants was not perfectly achieved. A few survey questionnaires were not returned, and full engagement on every project activity was not been accomplished. Third, the post-MCM had different content than the baseline survey; the baseline survey asked respondents to identify problems with heart failure care, while the post-MCM survey asked about the components of the MCM that solved the problems. Thus, the scores from the baseline and post-MCM survey could not be compared. However, we conducted an opinion survey instead; most of the participants agreed that every MCM component could resolve the pre-existing problems. During the post-MCM meeting, participants discussed the lessons learnt, to solicit feedback, and to identify the remaining problems for the future improvement. Fourth,the new updated standard practice guidelines for management of heart failure were launched during the study period. Recommendations regarding standard heart failure medications and a monitoring parameter had been updated; these changes affected some monitoring quality measure parameters. Lastly, because our study had a small number of participants and was conducted at a

single center, its generalizability and applicability to other settings may be limited.

6. Conclusions

This study proved that the PAR strategy for developing a MCM for a heart failure clinic in a hospital with limited human and other supporting resources was feasible. Consequently, this model effectively led to quality-of-care improvements in terms of both process and clinical outcomes. The key components to success included: 1) using team decisions to direct problem-solving plans, 2) the cooperative attitude from participants, especially who were non-HFC staff, and 3) team contributions and information technology-assisted measures that were integrated into the main hospital's electronic health record system. Further study in a larger study population with a randomization design is warranted. In addition, future studies of this type among the different types of clinics or to address other diseases should be considered.

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Conflict of Interest

None.

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References

[1] Mosterd A, Hoes AW. Clinical epidemiology of heart failure. Heart 2007;93(9):1137−46. https://doi.org/10.1136/hrt.2003.025270.

[2] Ziaeian B, Fonarow GC. Epidemiology and aetiology of heart failure. Nat Rev Cardiol 2016;13(6):368−78. https://doi.org/10.1038/nrcardio.2016.25.

[3] Yancy CW, Jessup M, Bozkurt B, Butler J, Casey Jr DE, Drazner MH, et al. 2013 ACCF/AHA guideline for the management of heart failure: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. J Am Coll Cardiol 2013;62(16):e147−239. https://doi.org/10.1016/j.jacc.2013.05.019.

[4] Yancy CW, Jessup M, Bozkurt B, Butler J, Casey Jr DE, Colvin MM, et al. 2017 ACC/AHA/HFSA Focused Update of the 2013 ACCF/AHA Guideline for the Management of Heart Failure: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines and the Heart Failure Society of America. J Am Coll Cardiol 2017;70(6):776−803. https://doi.org/10.1016/j.jacc.2017.04.025.

[5] Ponikowski P, Voors AA, Anker SD, Bueno H, Cleland JG, Coats AJ, et al. 2016 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure: The Task Force for the diagnosis and treatment of acute and chronic heart failure of the European Society of Cardiology (ESC). Developed with the special contribution of the Heart Failure Association (HFA) of the ESC. Eur J Heart Fail 2016;18(8):891−975. https://doi.org/10.1002/ejhf.592.

[6] Buakhamsri A, Chirakarnjanakorn S, Sanguanwong S, Porapakkham P, Kanjanavanich R. Heart Failure Council of Thailand (HFCT) 2019 heart failure guideline: Pharmacologic treatment of chronic heart failure − Part I. J Med Assoc Thai 2019;102(2):240−4.

[7] Dunlay SM, Roger VL. Understanding the epidemic of heart failure: past, present, and future. Curr Heart Fail Rep 2014;11(4):404−15. https://doi.org/10.1007/s11897-014-0220-x.

[8] Smith CE, Piamjariyakul U, Wick JA, Spertus JA, Russell C, Dalton KM, et al. Multidisciplinary group clinic appointments: the Self-Management and Care of Heart Failure (SMAC-HF) trial. Circ Heart Fail 2014;7(6):888−94. https://doi.org/10.1161/circheartfailure.113.001246.

[9] Gastelurrutia P, Benrimoj SI, Espejo J, Tuneu L, Mangues MA, Bayes-Genis A. Negative clinical outcomes associated with drug-related problems in heart failure (HF) outpatients: impact of a pharmacist in a multidisciplinary HF clinic. J Card Fail 2011;17(3):217−23. https://doi.org/10.1016/j.cardfail.2010.10.009.

[10] Dempsey JT, Matta LS, Carter DM, Stevens CA, Stevenson LW, Desai AS, et al. Assessment of Drug Therapy-Related Issues in an Outpatient Heart Failure Population and the Potential Impact of Pharmacist-Driven Intervention. J Pharm Pract 2017;30(3):318−23. https://doi.org/10.1177/0897190016641491.

[11] Gandhi S, Mosleh W, Sharma UC, Demers C, Farkouh ME, Schwalm JD. Multidisciplinary Heart Failure Clinics Are Associated With Lower Heart Failure Hospitalization and Mortality: Systematic Review and Meta-analysis. Can J Cardiol 2017;33(10):1237−44. https://doi.org/10.1016/j.cjca.2017.05.011.

[12] Kanoksilp A, Hengrussamee K, Wuthiwaropas P. A comparison of one-year outcome in adult patients with heart failure in two medical setting: heart failure clinic and daily physician practice. J Med Assoc Thai 2009;92(4):466−70.

[13] Gwadry-Sridhar FH, Arnold JM, Zhang Y, Brown JE, Marchiori G, Guyatt G. Pilot study to determine the impact of a multidisciplinary educational intervention in patients hospitalized with heart failure. Am Heart J 2005;150(5):982. https://doi.org/10.1016/j.ahj.2005.08.016.

[14] Strömberg A, Mårtensson J, Fridlund B, Levin LA, Karlsson JE, Dahlström U. Nurse-led heart failure clinics improve survival and self-care behaviour in patients with heart failure: results from a prospective, randomised trial. Eur Heart J 2003;24(11):1014−23. https://doi.org/10.1016/s0195-668x(03)00112-x.

[15] Hall LH, Johnson J, Watt I, Tsipa A, O'Connor DB. Healthcare Staff Wellbeing, Burnout, and Patient Safety: A Systematic Review. PLoS One 2016;11(7):e0159015. https://doi.org/10.1371/journal.pone.0159015.

[16] Shanafelt TD, Balch CM, Bechamps G, Russell T, Dyrbye L, Satele D, et al. Burnout and medical errors among American surgeons. Ann Surg 2010;251(6):995−1000. https://doi.org/10.1097/SLA.0b013e3181bfdab3.

[17] Kao DP, Trinkley KE, Lin CT. Heart Failure Management Innovation Enabled by Electronic Health Records. JACC

Heart Fail 2020;8(3):223−33. https://doi.org/10.1016/j.jchf.2019.09.008.
[18] Hutchinson A, Lovell A. Participatory action research: moving beyond the mental health 'service user' identity. J Psychiatr Ment Health Nurs 2013;20(7):641−9. https://doi.org/10.1111/jpm.12001.
[19] Kidd S, Kenny A, McKinstry C. Exploring the meaning of recovery-oriented care: an action-research study. Int J Ment Health Nurs 2015;24(1):38−48. https://doi.org/10.1111/inm.12095.
[20] Smith S, Johnson L, Wesley D, Turner KB, McCray G, Sheats J, et al. Translation to practice of an intervention to promote colorectal cancer screening among African Americans. Clin Transl Sci 2012;5(5):412−5. https://doi.org/10.1111/j.1752-8062.2012.00439.x.
[21] Levinson KL, Abuelo C, Chyung E, Salmeron J, Belinson SE, Sologuren CV, et al. The Peru cervical cancer prevention study (PERCAPS): community-based participatory research in Manchay, Peru. Int J Gynecol Cancer 2013;23(1):141−7. https://doi.org/10.1097/IGC.0b013e318275b007.
[22] Austin SA, Claiborne N. Faith wellness collaboration: a community-based approach to address type II diabetes disparities in an African-American community. Soc Work Health Care 2011;50(5):360−75. https://doi.org/10.1080/00981389.2011.567128.
[23] Cordeiro L, Soares CB. Action research in the healthcare field: a scoping review. JBI Database System Rev Implement Rep 2018;16(4):1003−47. https://doi.org/10.11124/jbisrir-2016-003200.
[24] Komajda M, Lapuerta P, Hermans N, Gonzalez-Juanatey JR, van Veldhuisen DJ, Erdmann E, et al. Adherence to guidelines is a predictor of outcome in chronic heart failure: the MAHLER survey. Eur Heart J 2005;26(16):1653−9. https://doi.org/10.1093/eurheartj/ehi251.
[25] American Society of Health-System Pharmacists. ASHP statement on pharmaceutical care. Am J Hosp Pharm 1993;50:1720−3.
[26] Pharmaceutical Care Network Europe [PCNE]. Classification for drug related problems V 9 [cited 2020 December 5]. Available from: http://www.pcne.org/working-groups/2/drug-related-problem-classification.
[27] Frankenstein L, Remppis A, Fluegel A, Doesch A, Katus HA, Senges J, et al. The association between long-term longitudinal trends in guideline adherence and mortality in relation to age and sex. Eur J Heart Fail 2010;12(6):574−80. https://doi.org/10.1093/eurjhf/hfq047.
[28] Morgan K, McGee H, Shelley E. Quality of life assessment in heart failure interventions: a 10-year (1996-2005) review. Eur J Cardiovasc Prev Rehabil 2007;14(5):589−607. https://doi.org/10.1097/HJR.0b013e32828622c3.
[29] Tangsatitkiat W, Sakthong P. The content improvements of the Thai version of the Minnesota living with heart failure questionnaire using cognitive interview. Thai Pharm Health Sci J 2009;4(2):227−35.
[30] Tapp H, White L, Steuerwald M, Dulin M. Use of community-based participatory research in primary care to improve healthcare outcomes and disparities in care. J Comp Eff Res 2013;2(4):405−19. https://doi.org/10.2217/cer.13.45.
[31] Chimberengwa PT, Naidoo M. Using community-based participatory research in improving the management of hypertension in communities: A scoping review. S Afr Fam Pract 2004;62(1):e1−14. https://doi.org/10.4102/safp.v62i1.5039. 2020.
[32] Hartman EAR, Groen WG, Heltveit-Olsen SR, Lindbaek M, Hoye S, Sundvall PD, et al. Multifaceted antibiotic stewardship intervention using a participatory-action-research approach to improve antibiotic prescribing for urinary tract infections in frail elderly (ImpresU): study protocol for a European qualitative study followed by a pragmatic cluster randomised controlled trial. BMJ Open 2021;11(10):e052552. https://doi.org/10.1136/bmjopen-2021-052552.
[33] Gilissen J, Pivodic L, Wendrich-van Dael A, Gastmans C, Vander Stichele R, Engels Y, et al. Implementing the theory-based advance care planning ACP+ programme for nursing homes: study protocol for a cluster randomised controlled trial and process evaluation. BMC Palliat Care 2020;19(1):5. https://doi.org/10.1186/s12904-019-0505-7.
[34] Bridgeman PJ, Bridgeman MB, Barone J. Burnout syndrome among healthcare professionals. Am J Health Syst Pharm 2018;75(3):147−52. https://doi.org/10.2146/ajhp170460.
[35] Selvaraj S, Fonarow GC, Sheng S, Matsouaka RA, DeVore AD, Heidenreich PA, et al. Association of Electronic Health Record Use With Quality of Care and Outcomes in Heart Failure: An Analysis of Get With The Guidelines-Heart Failure. J Am Heart Assoc 2018;7(7):e008158. https://doi.org/10.1161/jaha.117.008158.
[36] Walsh MN, Yancy CW, Albert NM, Curtis AB, Stough WG, Gheorghiade M, et al. Electronic health records and quality of care for heart failure. Am Heart J 2010;159(4):635−642.e1. https://doi.org/10.1016/j.ahj.2010.01.006.
[37] Rule A, Bedrick S, Chiang MF, Hribar MR. Length and Redundancy of Outpatient Progress Notes Across a Decade at an Academic Medical Center. JAMA Netw Open 2021;4(7):e2115334. https://doi.org/10.1001/jamanetworkopen.2021.15334.
[38] Fonarow GC, Albert NM, Curtis AB, Stough WG, Gheorghiade M, Heywood JT, et al. Improving evidence-based care for heart failure in outpatient cardiology practices: primary results of the Registry to Improve the Use of Evidence-Based Heart Failure Therapies in the Outpatient Setting (IMPROVE HF). Circulation 2010;122(6):585−96. https://doi.org/10.1161/circulationaha.109.934471.
[39] Komajda M, Cowie MR, Tavazzi L, Ponikowski P, Anker SD, Filippatos GS. Physicians' guideline adherence is associated with better prognosis in outpatients with heart failure with reduced ejection fraction: the QUALIFY international registry. Eur J Heart Fail 2017;19(11):1414−23. https://doi.org/10.1002/ejhf.887.
[40] Kasper EK, Gerstenblith G, Hefter G, Van Anden E, Brinker JA, Thiemann DR, et al. A randomized trial of the efficacy of multidisciplinary care in heart failure outpatients at high risk of hospital readmission. J Am Coll Cardiol 2002;39(3):471−80. https://doi.org/10.1016/s0735-1097(01)01761-2.
[41] de la Porte PW, Lok DJ, van Veldhuisen DJ, van Wijngaarden J, Cornel JH, Zuithoff NP, et al. Added value of a physician-and-nurse-directed heart failure clinic: results from the Deventer-Alkmaar heart failure study. Heart 2007;93(7):819−25. https://doi.org/10.1136/hrt.2006.095810.
[42] Del Sindaco D, Pulignano G, Minardi G, Apostoli A, Guerrieri L, Rotoloni M, et al. Two-year outcome of a prospective, controlled study of a disease management programme for elderly patients with heart failure. J Cardiovasc Med 2007;8(5):324−9. https://doi.org/10.2459/JCM.0b013e32801164cb.