

Cost-Effectiveness of Multidisciplinary Management Program and Exercise Training Program in Heart Failure



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Heart failure causes significant health and financial burdens for patients and society. Multidisciplinary management program (MMP) and exercise training program (ETP) have been reported as cost-effective in improving health outcomes, yet no study has compared the 2 programs. We constructed a Markov model to simulate life year (LY) gained and total costs in usual care (UC), MMP, and ETP. The probability of transitions between states and health-care costs were extracted from previous literature. We calculated the incremental cost-effectiveness ratio (ICER) over a 10-year horizon. Model robustness was assessed through 1-way and probabilistic sensitivity analyses. The expected LY for patients treated with UC, MMP, and ETP was 7.6, 8.2, and 8.4 years, respectively. From a societal perspective, the expected cost of MMP was \$20,695, slightly higher than the cost of UC (\$20,092). The cost of ETP was much higher (\$48,378) because of its high implementation expense and the wage loss it incurred. The ICER of MMP versus UC was \$976 per LY gained, and the ICER of ETP versus MMP was \$165,702 per LY gained. The results indicated that, under current cost-effectiveness threshold, MMP is cost-effective compared with UC, and ETP is not cost-effective compared with MMP. However, ETP is cost-effective compared with MMP from a healthcare payer's perspective. © 2017 Elsevier Inc. All rights reserved. (Am J Cardiol 2017;120:1338–1343)

Heart failure (HF), one of the major public health problems, affects more than 3 million patients in the United States.^{1,2} Despite the development of clinical and pathologic treatments, the prognosis remains poor, and patients with HF are still associated with high burdens of morbidity, mortality, and healthcare cost.³ Several behavioral interventions have been documented to improve health outcomes for patients with HF, including multidisciplinary management program (MMP) and exercise training program (ETP).^{4,5} Consisting of a multidisciplinary team (specialist nurse, pharmacist, dietician, or social worker),⁴ MMP generally involves health education, physiologic monitoring, diet promotion, and telecommunications.⁶ In contrast, ETP serves as a more advanced intervention program that integrates the basic elements in MMP with long-term, moderate exercise trainings.⁵ Several randomized controlled trials and systematic literature reviews have proven the safety and efficacy of MMP and ETP.^{5,7} Also, several studies have performed cost-effectiveness analysis on MMP and ETP.^{8,9} Yet results are inconsistent, and no study has examined the comparative cost-effectiveness of the 2 programs. Given the huge economic burden for HF management, we believe that understanding the cost-effectiveness of these

programs could help identify the preferable treatment option, especially for the current cost-contentious environment.

Methods

We developed a Markov model to simulate the long-term outcomes and costs in a hypothetical cohort of patients with HF in a 10-year horizon. We constructed 8 health states: 4 community-living states, 3 hospitalization states, and 1 death state (Figure 1). The living states and hospitalization states were classified by the number of previous hospitalizations as mortality increased with increasing number of hospitalization.¹⁰ All patients with HF started in the living state with no previous hospitalization, then moved through subsequent cycles, either living without any event, being hospitalized, or dead. We assumed that patients would have a maximum of 3 hospitalizations, and the risk of death became constant after 3 hospitalizations. We also assumed that hospitalization was a temporal state, in which patients would either be discharged from the hospital or die at the end of hospitalization. The cycle length in our model was 1 week, accounting for the observations that most patients with HF stayed in hospital for less than a week.¹¹

Clinical parameters were extracted from previous literature (Table 1).^{12–17} Our model allowed an increase in risks of rehospitalization and in-hospital death as the number of previous hospitalization increased. The relative risk (RR) of HF death also increases with the increasing number of previous hospitalization. The efficacy of MMP and ETP was characterized by the RR of hospitalization and outpatient death. We also assumed that for each intervention, the RR of hospitalization and death would apply only to living states. Once patients were hospitalized, the in-hospital risk of death would

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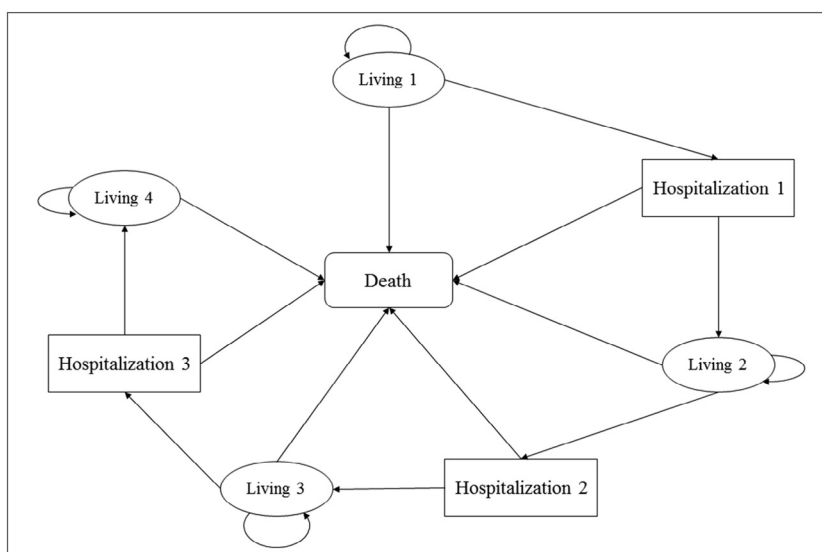


Figure 1. Markov model diagram. Patient transition across Markov states where cycle length is 1 week. We assumed a maximum of 3 hospitalizations.

Table 1
Estimates of health outcomes and costs

Parameters	Estimate	Range	References
<i>Basic clinical parameters</i>			
Control: usual care			
Hospitalization rate with no prior hospitalization (monthly)	0.004	0.002–0.006	12
Mortality rate with no prior hospitalization (monthly)	0.003	0.002–0.005	12
In-hospital risk of death with no prior hospitalization (per stay)	0.0186	0.009–0.028	12
Relative risk of re-hospitalization with 1 prior hospitalization vs. no prior hospitalization	7	3.5–10.5	12
Relative risk of re-hospitalization with 2 prior hospitalizations vs. no prior hospitalization	14.5	7.3–21.7	12
Relative risk of death with 1 prior hospitalization vs. no prior hospitalization	5.8	5.51–6.09	13,14
Relative risk of death with 2 prior hospitalizations vs. 1 prior hospitalization	1.22	1.14–1.30	14
Relative risk of death with 3 prior hospitalizations vs. 1 prior hospitalization	1.33	1.20–1.47	14
Intervention: multidisciplinary management program			
Relative risk of hospitalization: multidisciplinary management program vs. usual care	0.74	0.63–0.87	15
Relative risk of out-of-hospital death: multidisciplinary management program vs. usual care	0.75	0.59–0.96	15
Intervention: exercise training program			
Relative risk of hospitalization: exercise training program vs. usual care	0.61	0.46–0.80	16
Relative risk of out-of-hospital death: exercise training program vs. usual care	0.71	0.37–1.02	17
<i>Healthcare expenditures</i>			
Outpatient heart failure care cost (annually)	\$2,063	\$1,032–3,095	15,18
Hospitalization cost per stay	\$11,512	\$5,756–17,268	15,18,19
Multidisciplinary management program implementation cost (one-time expense)	\$910	—	18
Exercise training program implementation cost (one-time expense)	\$2,922	—	19
Exercise training program induced wage loss (annually)	\$3,569	\$1,785–5,354	19
Discount rate	3%	0–5%	Assumption

The implementation costs for multidisciplinary management programs and exercise training programs are fixed costs. Ranges are not applicable. All costs were converted into 2015 US dollars.

be the same and independent of their intervention. The RRs of rehospitalization and death with increasing number of previous hospitalizations were the same as that of patients in usual care (UC).

To calculate the cost of each treatment, we extracted expenditure data from previous cost-effectiveness analyses.^{18,19} We selected carvedilol treatment as our UC as it has been a common clinical practice for patients with HF.²⁰ The cost for

annual outpatient HF care was identical for patients across all 3 programs. The cost of hospitalization was \$11,512 per stay.¹² The costs of implementation of MMP and ETP were 1-time expenses incurred at the start of the follow-up. Wage loss was induced in ETP patients as they needed to attend long-term training sessions and consequently lose working hours. No wage loss was induced in MMP as patients were not required to participate in trainings, and most interventions

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