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# Application of Roy adaptation model on adherence to treatment in patients with heart failure

Aplicación del modelo de adaptación Roy sobre la adherencia al tratamiento en pacientes con insuficiencia cardíaca

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## ABSTRACT:

**Introduction:** Poor adherence to treatment in chronic illnesses is a global problem and its human, clinical and economic consequences is increasing around the world.

**Methods:** This study aims to construct of the conceptual- theoretical structure which to explains the interaction of environmental stimuli, the coping mechanisms and adaptation modes responses that influence the adherence to treatment in heart failure patient.

**Results:** We used the three steps of Fawcett's theoretical derivation method, we illustrate the links between the concepts of Roy adaptation model, the concepts and assumptions of the treatment adherence model in patient with heart failure.

**Conclusions:** It is expected that the results of this study, based on Roy adaptation model, describes adherence behaviors to treatment regimen in patients with heart failure and provide certain strategies and assessment criteria for facilitating adherence to treatment in those patients, and it also could have results for future studies, so that relations between variables are tested and nursing interventions to improve adherence to treatment will be developed and tested.

**KEYWORDS:** Treatment Adherence and Compliance, Heart failure, adaptation.

## RESUMEN:

**Introducción:** La mala adherencia al tratamiento en enfermedades crónicas es un problema global y sus consecuencias humanas, clínicas y económicas están aumentando en todo el mundo.

**Métodos:** Este estudio tiene como objetivo construir la estructura conceptual-teórica que explica la interacción de los estímulos ambientales, los mecanismos de afrontamiento y las respuestas de los modos de adaptación que influyen en la adherencia al tratamiento en pacientes con insuficiencia cardíaca.

**Resultados:** Utilizamos los tres pasos del método de derivación teórica de Fawcett, ilustramos los vínculos entre los conceptos del modelo de adaptación de Roy, los conceptos y supuestos del modelo de adherencia al tratamiento en pacientes con insuficiencia cardíaca.

**Conclusiones:** Se espera que los resultados de este estudio, basados en el modelo de adaptación de Roy, describan los comportamientos de adherencia al régimen de tratamiento en pacientes con insuficiencia cardíaca y proporcionen ciertas estrategias y criterios de evaluación para facilitar la adherencia al tratamiento en esos pacientes, y también podría tener resultados para estudios futuros, de modo que se desarrollen y prueben las relaciones entre las variables y las intervenciones de enfermería para mejorar la adherencia al tratamiento.

**PALABRAS CLAVE:** Cumplimiento y cumplimiento del tratamiento, insuficiencia cardíaca, adaptación.

## INTRODUCTION:

**Introduction:** Heart failure is a global pandemic, about 26 million people around the world are suffering from this disease<sup>1</sup>. HF is associated with periods of recurrence and worsening<sup>2</sup> that would increase costs for health care system considerably<sup>3</sup> and reduce patients' life quality<sup>4,5</sup>. Mortality, morbidity, rehospitalization and disease progression in these patients can be reduced by self-care behaviors or adherence to treatment<sup>6-11</sup>.

Adherence to treatment is defined as a range of medical behaviors and lifestyle recommendations, which is in accordance with agreed recommendations by health care providers<sup>12</sup>. Adherence to treatment is a multi-dimensional phenomenon that is determined by socioeconomic factors, health care systems related factors, patient related factors, condition rated factors and treatment related factors<sup>13</sup>. Although adherence to treatment is essential, non-adherence to medication and lifestyle recommendation is common in HF<sup>14-16</sup> and its human, clinical and economic consequences, as a chronic illness are increasing worldwide<sup>17</sup>.

There are several interventions to improve adherence to treatment in the HF, but even the majority of effective interventions will not result in a significant improvement in adherence and health consequences<sup>18</sup>. This is probably related to the complexity of the determinants of adherence<sup>19</sup> and lack of attention to theories that may explain adherence behaviors<sup>20</sup>. So that, identification of factors influencing adherence to treatment in patients with HF, based on theories, seems essential<sup>21</sup>.

This study aims to construct of the conceptual- theoretical structure which to explains the interaction of environmental stimuli, the coping mechanisms and adaptation mode responses that influence the adherence to treatment in HF patient. The present study is a part of a greater project named "Designing and testing of treatment adherence model based on Roy adaptation model (RAM) in patients with HF", which aims to determine the empirical validity of RAM as a conceptual model for explaining and predicting adherence to treatment in this group of patients, through mixed method study in Iran.

## MATERIALS AND METHODS:

We have reviewed literature on implications of RAM on adherence to treatment regimen, in patients with HF in English databases Medline, Web of Science, Scopus and Persian databases SID, Iranmedex, Magiran

between the years 2010-2017. The search was conducted on topics related to medical behaviors (medication adherence) and non-pharmalogical recommendations (lifestyle) in HF (**Table 1**).

TABLE 1.  
Search strategy

| Table 1. Search strategy                                                                                                                                                                                                                                                                                                                                                                                                        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Medline ("failure"[tiab] OR "heart failure"[tiab] OR "myocardial failure"[tiab] OR "CHF"[tiab] OR "HF"[tiab] OR "congestive heart"[tiab]) AND ("patient concordance"[tiab] OR "patient cooperation"[tiab] OR "patient adherence"[tiab] OR "patient compliance"[tiab] OR "treatment refusal"[tiab] OR "patient dropouts"[tiab] OR "self-care maintenance"[tiab])                                                                 |
| Scopus (TITLE-ABS("failure") OR TITLE-ABS("heart failure") OR TITLE-ABS("myocardial failure") OR TITLE-ABS("CHF") OR TITLE-ABS("HF") OR TITLE-ABS("congestive heart")) AND (TITLE-ABS("patient concordance") OR TITLE-ABS("patient cooperation") OR TITLE-ABS("patient adherence") OR TITLE-ABS("patient compliance") OR TITLE-ABS("treatment refusal") OR TITLE-ABS("patient dropouts") OR TITLE-ABS("self-care maintenance")) |
| ISI Web of Science (TS=("failure") OR TS=("heart failure") OR TS=("myocardial failure") OR TS=("CHF") OR TS=("HF") OR TS=("congestive heart")) AND (TS=("patient concordance") OR TS=("patient cooperation") OR TS=("patient adherence") OR TS=("patient compliance") OR TS=("treatment refusal") OR TS=("patient dropouts") OR TS=("self-care maintenance"))                                                                   |

The search results were reviewed by two researchers based on topics and repetitive articles were deleted while reviewing the topics. Then, abstracts of selected articles were retrieved and considering the inclusion and exclusion criteria, were investigated. In this analysis, studies concerned patients with HF who were 18 years old or older, and in terms of severity of illness in Class I-IV were classified as NYHA or patients with HFrEF, HFpEF, and HFmrEF. Also, studies that have examined one or more components of adherence to treatment and adherence to treatment is the main consequence of the study, results were reported quantitatively and qualitatively were investigated. Editorials, letters to the editor or summaries of conferences were considered as exclusion criteria and subsequently, the original articles were examined based on their relationship with the purpose of this analysis and related studies were selected. Manual search of related resources was also carried out and eventually, 76 studies were investigated (Figure 1).

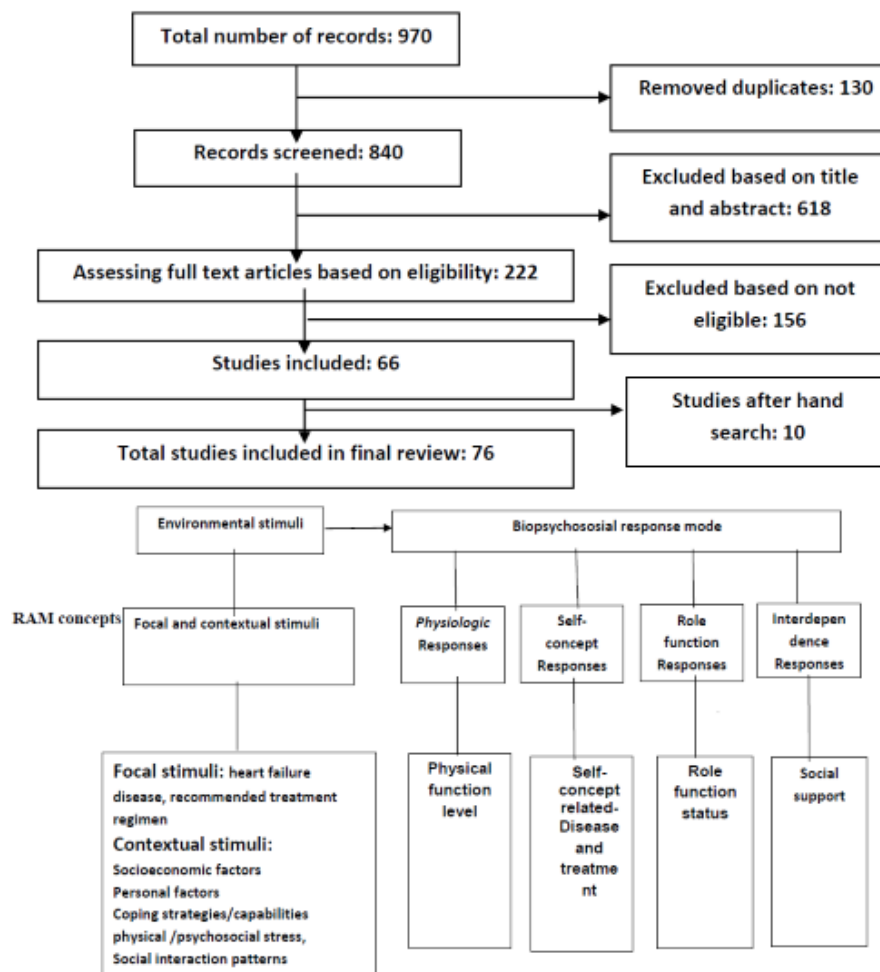


FIGURE 1.  
Conceptual- theoretical structure

In the next stage, full text of the qualified studies was reviewed and data analysis was conducted using directed qualitative content analysis method based on RAM. Directed qualitative content analysis contains three stages, preparation, organization and reporting. In preparation stage, text of each article, as a unit of analysis, was read several times by researcher, to become immersed in data. Then, in organization stage, researchers formed the unconstrained matrix of analysis based on the main concepts of RAM, thereby, new categories could be created. In each study, by reading the text line by line, important phrases were highlighted, to be differentiated with other parts. A code is assigned to each important paragraph or phrase. In the next stage, maintaining the coding and performing continuous comparison, obtained codes were sorted based on differences and similarities. After that, based on a conceptual and logical connection, the possibility of placing these categories in the main categories in the matrix or the formation of the new main categories is considered, so that the model of adherence to treatment in patients with HF was designed based on RAM.

## RESULTS:

Process of adherence to treatment in patients with HF: The person with HF as an adaptive system is constantly interacting with its changing environment and uses coping processes or defense mechanisms

which maintain adaptation in four modes physical status, disease/treatment-related self-concept, social support, role function status.

**Stimuli-** Three types of stimuli are given to person with HF. When the disease is diagnosed for the person, and he receives a prescription (initiate or continue medication), he must respond with a variety of behaviors such as receiving the correct medication or, in other words, adherence to the medication<sup>32,33</sup>. For person with HF, HF disease and recommended treatment regimen are considered as the focal stimuli related to adherence to treatment regimen according to RAM. Residual stimuli are internal and/or external environmental factors of human's system, whose effects are not obvious in the given position<sup>29</sup> and if identified, they will be placed on the focal and contextual stimuli category<sup>34</sup>. For this reason, the residual stimuli were not considered in this study.

Contextual stimuli are all of the environmental stimuli that are not the focus of attention or energy, but help to manage the focal stimuli. For persons with HF, factors such as socio-economic factors, personal factors, physical/ psychological stress, abilities and coping strategies as the contextual stimuli are related to adherence to treatment.

Most of studies suggest the relationship between socio-economic factors such as income<sup>35-37</sup>, employment status<sup>38</sup>, education level<sup>35,39-46</sup>, and ethnicity/race<sup>45-50</sup>. In only one study was there no relationship between self-care and family income<sup>42</sup>. Most studies examining the association between race/ethnicity and adherence to treatment show that there are differences in adherence to treatment in racial and ethnic groups<sup>47-50</sup>. There is less adherence to treatment regimen in employed patients due to the problems in coordinating their daily life and job activities in accordance with their physical conditions and their illness<sup>38</sup>. From 7 studies, 5 studies<sup>35,39-42</sup> indicate a relationship between higher educational level and patient's better adherence with the treatment regimen.

Personal factors are factors such as age<sup>36,38,40,42,43,45,46,48,51-55</sup>, gender<sup>36,41,42,45,46,48,51,53,56-60</sup> and body mass index<sup>40,56,57</sup>. Age and gender are both positively and negatively associated with adherence to treatment. Considering that HF is more commonly associated with old age, therefore, several factors such as cognitive status, memory impairments, severity of disease, performance status, presence of comorbidity and multiple medications are considered in relation to old age, and potentially prevent effective decision making for patients with HF for self-care and adherence to treatment<sup>61</sup>. On the other hand, familial and occupational prohibition and excessive occupation in young people are factors associated with non-adherence with treatment at young age<sup>51</sup>.

Results about the relationship between gender and adherence to treatment are different, for instance, better adherence in women is related to their worries about maintaining their health<sup>53</sup>. On the other hand, women are more vulnerable to self-care behaviors due to having more experience of negative emotions associated with HF and weaker social and family support<sup>59</sup> and more perceived obstacles (such as lack of scale to control weight at home)<sup>41</sup>. Another reason for lower adherence to treatment regimen in women is associated with various etiologies of HF due to gender. HF in men often develops after myocardial infarction and leads to the patient and healthcare system focusing more attention to the disease. However, HF in women is often due to chronic and asymptomatic blood pressure<sup>51</sup>.

Abilities and coping strategies such as knowledge of illness<sup>48,53,54,62,63</sup>, motivation<sup>64</sup>, health literacy<sup>45,65-67</sup>, self-efficacy<sup>42,68-71</sup>, daily routine<sup>72-74</sup> and personality(type D)<sup>75-77</sup> are other contextual stimuli related to adherence to the treatment regimen. Health literacy and knowledge of illness are important factors of adherence to the treatment regimen, but some studies suggested that knowledge and health literacy cannot guarantee the adherence and the reason for this lack of relevance is the presence of other influential factors on adherence to the treatment regimen such as skill and motivation<sup>44,63,78</sup>. For example, some of the motivational factors regarding adherence to exercise, relate to social interactions acquired during exercise or

motivational factors related to disease conditions and treatment<sup>64</sup>. The results of systematic review confirm that self-efficacy is strongly associated with better self-care<sup>71</sup>. The suitability of the treatment regimen and instructions with daily routine and specific needs of each patient related to better adherence to treatment and self-care behaviors<sup>72,73</sup>.

Physical/psychological stress such as Duration of illness<sup>31,39,43,46,48,54,55,79</sup>, complexity of medical regimen such as poly-pharmacy and frequency of dosing<sup>45,53,55,74,80-82</sup>, forgetfulness<sup>41,74</sup>, comorbidities<sup>39,41,77,82-87</sup>, depression<sup>39,46,71,85,88</sup>, anxiety<sup>35,52,71,72</sup>, sleep disorders<sup>55,89</sup>, cognitive impairments<sup>48,56,71,86,90,91</sup>, rehospitalization and outpatient visits<sup>36,46,53,82</sup> are another contextual stimuli related to adherence to the treatment.

Depression has potential effects on patients' perceptions of their behavior<sup>92</sup>. Although most studies suggest the relationship between depression and adherence to treatment, results of systematic reviews show inconsistent evidence in this regard, and this inconsistency of results may be due to the differences in methodology and also differences in methods of measuring depression and adherence<sup>85</sup>. Anxiety affects people's willingness and ability to engage in self-care, mild to moderate anxiety can activate individual in the face of threatening events on an adaptive path. In this level, anxiety is a compensatory process, but severe or long lasting anxiety prevents endeavors to adapt<sup>29</sup>. Although several studies have investigated the relationship between anxiety and adherence to treatment regimen, nature of anxiety and type of self-care consequences must determine whether anxiety should be considered as a facilitating or preventative factor of self-care<sup>71</sup>.

Sleep disorder is associated with increase in sleepiness during the day, which leads to reduction in learning, motivation and decision making for self-care performance<sup>93</sup>. Cognitive impairment is related to reduction in patients' adherence to treatment, through reduced attention and poor performance<sup>86</sup>.

Several studies have investigated the relationship between adherence to treatment and comorbidity, the greater number of comorbidities related to non-adherence is due to the feeling of deterioration, in addition to the fact that the illness also increases the chance of forgetfulness<sup>94</sup> and on the other hand, apart from multiple comorbidities, it is difficult to differentiate heart failure symptoms from other comorbid illnesses, and this may lead to inability to integrate self-care guidelines for any comorbid illness and eventually less action will be taken when symptoms occur<sup>83</sup>. Nonetheless, there are different evidences in this regard; researchers concluded that the number of comorbidities does not cause the difference, but rather it is the type of disease which causes the difference<sup>46</sup>.

In the literature related to heart failure, different results were found in the relationship between the severity of illness and adherence to treatment. For example, the severity of illness is related to lower adherence to self-care behaviors and the possible reason for this relationship is the physical disability associated with the severity of illness, so that, the severity of illness may limit the patient's ability to perform daily life activities and subsequently to disregard the treatment regimen<sup>95</sup>. On the other hand, severity of illness has positive relationship with adherence to treatment. In justifying their findings, the researchers stated that the severity of illness could be a factor in provoking patients to follow the regimen and self-care care behaviors to prevent disease progression<sup>39</sup>. The result systematic review and meta-analysis shows of that history of hospitalization is related to higher levels of adherence, while, there is an inconsistency of evidence between outpatient visits and adherence to treatment<sup>46</sup>. Results of systematic analysis suggest the harmful effects of mild cognitive impairments on self-care, however, it is not possible to combine and compare the findings, due to the limited body of evidence and the lack of compatibility in the tools used<sup>91</sup>.

## DISCUSSION:

**Behavioral Responses**—Behavioral responses are internal or external actions and reactions in specific circumstances that show how an individual is adapting to stimuli. Behavioral responses reflect the ability of coping mechanisms to adapt to changing environments and also acts as feedback and additional input to the system. Behavioral responses can be adaptive or ineffective, can be measurable or subjectively reported. Adaptive responses promote the integrity of the human system in terms of adaptation goals such as survival, growth, reproduction, and mastery. For person with HF, adherence to treatment is defined as an adaptive behavior which expresses the perception of people about the cost-benefit of receiving treatment<sup>33</sup>. Adherence to treatment reflects the general answer of adaptive system to environmental stimuli and is reflected in four modes of bio-psycho-socio response (physical status, disease/treatment-related self-concept, role function status and social support) with three integrated adaptation levels (100% adherence) compensatory (relative/partial adherence or adherence with help) and compromised (non-adherence).

**Defense Mechanism**—As mentioned, individuals as an adaptive system are constantly interacting with the environment, which uses intrinsic and acquired mechanisms – subsystem regulator and cognator- to adapt to the environment. The regulator subsystem consists of neuro-chemical and endocrine components that receive stimuli from the internal and external environment and transmitted to the nervous system, and physical responses are seen by the nurse through the activity of the autonomic nervous system, the endocrine and perceptual process. The perceptual process remains in short-term memory; the physical responses can be given as additional stimuli to the system<sup>96</sup>. The cognator subsystem is composed of four psychosocial pathways such as information/perceptual processing, learning, judgment, and emotion. The two subsystems are internal processes Which are not directly observed, but their actions are reflect within the mode of adaptation<sup>30</sup>. The relationship between two subsystems is through perception and four modes of adaptation, and also the relationship between these subsystems will be different with the adaptive modes, so that the regulator subsystem is often associated with physiological mode and the cognator subsystem with all four modes<sup>96</sup>. Four adaptive modes are also interrelated. Relationships between the four modes of adaptation occur when the stimuli have more than one mode, when the disruptive behavior occurs in more than one mode becomes the stimulus for another modes<sup>28</sup>.

When the person with HF is given stimulus (for example, medication is prescribed), the regulator subsystem is activated and its response in physical status can be effective (improvement of symptoms associated with the disease) or ineffective (worse symptoms associated with the disease). The behavioral response observed is stored through the perception in short-term memory for the next reaction, and as stimulus, feedback is given to the system, then the cognator subsystem is activated and the stimuli respond in two ways: threat or challenge<sup>97</sup>.

When a person with HF recognizes a prescribed regimen (focal stimuli) as a threat to self-concept (for example, drug-related side effects, sodium-restricted diet tasteless or exercise-induced tiredness), then anxiety occurs and use emotional responses such as redefining the situation, avoidance, denial or devaluation of situation. These emotion-centered strategies are considered as ineffective responses, and it prevents using problem-centered strategies (for example, seeking treatment and adherence to a regimen) to respond appropriately to the stimulus<sup>97</sup>. So, though self-concept is preserved, non-adherence occurs<sup>98</sup>.

When the treatment regimen is understood as a challenge, problem-centered strategies such as redefining the situation, finding alternative solutions, weighting solutions based on the advantages and disadvantages, choosing the right solution, and ultimately action are used<sup>97</sup>. Therefore, if person understand that the medication helps to improve shortness of breath, or a low salt diet can reduce the amount of edema (adaptive responses in physiological mode), in that case because the benefits of the recommended regimen (i.e. improving dyspnea following diuretic use) more weight than its disadvantages (i.e. the frequency of urine

during the night due to diuretic use), In this way, person try to reduce the disadvantages of treatment regimen by using alternative strategies (i.e. the change hours of diuretic use in the early hours of the day to prevent sleep disorders caused by frequent urination Overnight), in which case people will integrate the treatment regimen into their lives and adhere to the treatment regimen.

It should be noted that the relationship between the threat and the challenge in different situations can be changed, although the threat and the challenge can occur simultaneously, but in each situation one will dominate the other, i.e. the existence of a supportive environment and availability more resources make the situations and stimuli perceived as challenges<sup>99</sup>.

**Adaptive Modes** - The function of subsystems is the achievement of integrated adaptation levels. For persons with HF, adherence to treatment is an integrated adaptation level. Adaptation levels imitate people's behavior and we observe behavior in four adaptive modes: Physical status, disease/treatment-related self-concept, role function status and social support.

For persons with HF, Common symptoms associated with HF and severity of illness is ineffective responses to basic physiological activity. In some studies, severity of illness is related to reduced adherence to treatment<sup>47-100</sup> and in some studies, it is associated with increased adherence to treatment<sup>39,48</sup>.

Self-concept is a set of individual's feelings and beliefs which is formed from his inner perception and understanding of other people's reactions. Perceived emotions of illness and treatment can affect individual's self-concept and ultimately his behavior<sup>98</sup>. So, factors such as spirituality<sup>101-103</sup>, perception and belief<sup>7,38,41,46,71,73,104-106</sup> as dimensions of treatment-related self-concept play an important role in self-care performance. Belief is necessary to change the behavior<sup>45</sup>. Individual perception and belief is related to self-care, but the direction and power of relationship is based on the type of belief and self-care behavior that is evaluated<sup>71</sup>. Believing in benefits and disadvantages of treatment, necessity of treatment, individual control, chronic disease and lifelong treatment regimen, are factors associated with adherence to treatment<sup>73,107</sup>. The inner spirituality in praying and saying prayers appears in guiding actions and outer spirituality is described by religious affiliation and helps to understand self-care<sup>101-103</sup>.

In RAM, role is considered as a set of expectations of people from each other<sup>28</sup>. If an individual experiences problem in his roles, this problem affects his ability to manage and improve health, also, change in health can influence an individual's role function status<sup>29</sup>. Patients with HF usually suffer from social isolation resulted from lifestyle changes, medication regimen, physical limitations associated with shortness of breath and fatigue<sup>108</sup>. Also, due to the moderate to severe problems these patients face in doing daily activities, the ability to perform self-care is usually reduced<sup>109,110</sup>. Interdependence mode relates to the ability to give and receive love, respect and worthiness. In this mode, some relations such as significant others and support system are considered. For persons with HF, social support was used as the representative of interdependent mode, hence, patients' understanding about the provided support is considered as a consistent and effective response in this regard. There is a considerable amount of evidence which suggests the beneficial effects of social support on adherence to treatment regimen and self-care behaviors in HF<sup>11,42,48,63,106</sup>.

Social support contributes to successful management of chronic disease; nevertheless, the mechanism of its effect has long remained unanswered, maybe because of the mediating effect of self-care confidence. In other words, social support improves self-care confidence/self-efficacy in patients, which will improve patient's ability to perform self-care<sup>69,111</sup>. In some studies, the results also indicate a lack of relationship between overall social support and its dimensions with adherence to treatment in patients with HF. Maybe the reason for this lack of relationship is measurement of social support and existence of other factors affecting adherence. For example, evidence about the impact of marital status and living arrangement as a structural dimension of social support on adherence to treatment regimen in people with HF has different results<sup>45</sup>. Researchers in justifying their findings, stated that living with a spouse or other family members does not

guarantee adherence behavior, but presence of a family member who has a dietary restriction of sodium can be a strong source of support for the patient's adherence to regimen <sup>112</sup>.

Assumptions of the model of Adherence to treatment in patients with heart failure: Human health is a function of internal stimuli and the adaptation of levels. Adherence to treatment is conceptualized as an important aspect of the adaptation of levels, reflecting the overall response of the adaptation system to environmental stimuli. Environmental stimuli are processed through regulator and cognator subsystems. These subsystems are internal processes which are not directly observed, but their actions are reflect within the mode of adaptation. Response modes are interrelated, so that the adaptive or ineffective response in each mode may make changes in several adaptive modes that these changes indicate the level of adherence to treatment. In other words, adherence to treatment as a type of adaptation to chronic disease, is the outcome of observed change in the physical status, disease/treatment-related self-concept, role function status and social support which allows patients to feel well-being.

## CONCLUSION:

RAM, focusing on the adaptability of people with different environmental stimuli, is one of the most effective models in caring for patients with chronic diseases and an effective guide for nurses in caring for patients with HF. By using this conceptual model, nurses will be able to play an important role to improve the adaptation and integration of patients, through environmental management. Since medication adherence and other lifestyle recommendations in heart failure is a complex and challenging phenomenon for the patient and the treatment team, therefore, the results of this study, based on the RAM, described the behaviors of adherence to treatment regimen in patients with HF and can provide criteria to facilitate adherence to treatment in HF. It can also have implications for future researches, so that, the relationships between variables are tested and nursing interventions are developed and tested to improve adherence to treatment.

## Abbreviations:

|                     |                                           |
|---------------------|-------------------------------------------|
| EF                  | Ejection Fraction                         |
| HF                  | heart failure                             |
| HFmrEF              | HF with mid-range ejection fraction       |
| HFpEF               | HF with preserved ejection fraction       |
| HFrfEF              | HF with reduced ejection fraction         |
| NYHA Classification | New York Heart Association Classification |

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