Effect of Telehealth on Self-Care Behavior of Heart Failure Patients

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Abstract

Telehealth systems to monitor heart failure patients have become a very important tool in the last decade. However, little is known about the effect that such monitoring systems have on the self-care behavior of these patients. This study aims to investigate this effect, and to determine whether Telehealth helps improving patients compliance. Daily measurements of blood pressure, pulse, SpO2 and weight were collected from 108 patients suffering from heart failure. In addition, they were asked to fill in the European heart failure self-care behavior scale questionnaire before and after the monitoring period. Significant differences were found between the self-care behavior before and after the program. More specifically, the questions concerning weight and fluid intake per day, show a significant ($p \ll 0.05$) improvement in patients' compliance. These improvements were validated using the evolution of the physiological parameters. Patients whose blood pressure and weight tend to decrease, also appear to have significant changes in behavior.

1. Introduction

Heart failure (HF) is considered to be one of the most common diseases that affect the population worldwide. For example, in Europe more than 10% of the people older than 75 years suffer from HF [1]. This is why it is not a surprise that this disease has a strong impact on social and economical systems. Therefore, the use of solutions such as telehealth, that help to reduce costs and improve quality of life in HF patients is imminent.

Telehealth systems to monitor heart failure patients have become a very important tool in the last decade [2][3]. However, the implementation of such systems in a healthcare program is not yet feasible. Under these circumstances, the Recap (Regional Care Portals) project aims to develop state of the art tools to improve and promote these implementations [4]. Recap is the result of the cooperation between thirteen partners from the North West Europe region, which work together towards the application of innovative organizational, financial, legal and technological solutions to the field of telehealth in heart failure. The main goal of these solutions is to enhance the communication between patients and care givers, and to involve patients by educating them to self-manage their condition. By doing this, it is expected to have significant improvement in the diagnosis and therapy of HF patients in the long-term.

Several factors need to be taken into account during the implementation of telehealth programs in HF. One of them is the effect that such a program has on the self-care behavior of patients. It is well known that HF patients must be aware of the different symptoms of their disease, but more importantly, of the consequences that their behavior has on the evolution of their condition [5]. For example, patients need to follow a strict regimen of medication, seek assistance when different symptoms appear, exercise, reduce the amount of fluid intake per day, and monitor their weight on a daily basis. These requirements can be easily handled by a patient if the correct training is implemented, and if this is the case, an improvement in the heart failure outcome can be achieved. This study aims to investigate the effect of telehealth on self-care, and determine whether it helps improving patients compliance and adherence to the program. To do this, telehealth data was collected by one of the Recap partners, namely the North East London NHS Foundation Trust (NELFT). NELFT is in charge of recruiting patients into the telehealth program, and of following up their condition. Once a patient is included in the study, one Motiva telehealth platform [7], is deployed.

This platform contains educational material that encourages the patient to self-manage their disease, and more importantly, to adapt some behaviors that may lead to achieve a better quality of life. In addition, this platform offers an interactive interface connected to a television, which allows patients to feel more comfortable because of the use of a "well-known" technology.

2. Methodology

2.1. Data description

Daily measurements of blood pressure, pulse, SpO_2 and weight were collected from 108 heart failure (HF) patients, 30 females and 78 males, with mean age $70.4\text{yr}\pm12.4\text{yr}$. These patients were recruited for the telehealth study, by the North East London NHS Foundation Trust (NELFT) in the UK, and they were monitored during 42 days using the Motiva telehealth platform, offered by Philips. First, the patients were trained to measure 5 physiological parameters, twice a day, on a daily basis. After 42 days of regular monitoring, the equipment returned to NELFT and it was then allocated to a different patient. Finally, patients were asked to fill out the *European heart failure self-care behavior scale* (EHFScBS)[5] questionnaire before and after the monitoring period.

2.2. Inclusion criteria

- Age > 18 years
- Valid diagnosis of left ventricular systolic dysfunction (LVSD) supported by a positive ECG
- One of the following conditions *must* be satisfied:
  - Sudden increase in weight > 1.5kg in 24 hours
  - Systolic blood pressure < 90
  - Sudden increase in shortness of breath
  - Episodes of palpitation/tachycardia without collapse
  - Change of medication within 48 hours of discharge from acute
  - High Hospital Anxiety Depression Self Assessment (HADS) score

2.3. Exclusion criteria

If *any* of the following conditions applied, the patient was excluded from the study.

- Unconfirmed diagnosis (without ECG)
- Clinically stable NYHA I to II classification (New York Heart Association)
- Nil Oedema
- Normotensive (120/80)
- Patient at end of life $\rightarrow$ NYHA $>$ II
- Insufficient cognitive understanding to complete questionnaires or to use the telehealth equipment

2.4. The European heart failure self-care behavior scale

This questionnaire consists of the following 12 items:

I1. I weigh myself every day
I2. If I get short of breath, I take it easy
I3. If my shortness of breath increases, I contact my doctor or nurse
I4. If my feet/legs become more swollen than usual, I contact my doctor or nurse
I5. If I gain 2 kg in 1 week, I contact my doctor or nurse
I6. I limit the amount of fluids I drink (not more than 1.52 l/day)
I7. I take a rest during the day
I8. If I experience increased fatigue, I contact my doctor or nurse
I9. I eat a low salt diet
I10. I take my medication as prescribed
I11. I get a flu shot every year
I12. I exercise regularly

Each item is scored using a scale ranging from "(1) *I completely agree*" to "(5) *I don't agree at all*". If less than 3 values are missing, they can be replaced by "(3) *Neither agree or disagree*", and a total score is calculated by adding up all items [5].

Two scores are calculated, one at the beginning and one at the end of the monitoring period. Therefore, it is possible to assess behavioral changes due to the telehealth program, and to evaluate the compliance of patients to the system.

In order to evaluate if the behavioral changes have an influence on the physiological parameters, the EHFScBS is compared against the evolution of each parameter, which is quantified by means of linear regression. Differences in the scores between increasing and decreasing trends are evaluated with a confidence interval of 95%, using the Kruskal-Wallis test.

3. Results

The first part of the analysis consisted of analyzing the total scores before and after the monitoring period. This was done in order to assess the general self-care behavioral changes that were the result of the telehealth program. The total scores of the 108 patients under investigation are indicated in Figure 1, and a significant difference ($p << 0.05$) was found between the EHFScBS scores before the patients were recruited and the scores after 42 days of monitoring. As mentioned before, this gives a general indication of the effect of the program on self-care. Hence, to assess more specific behavioral changes it was crucial to analyze the different items of the EHFScBS separately. This constitutes the second part of the analysis, and the

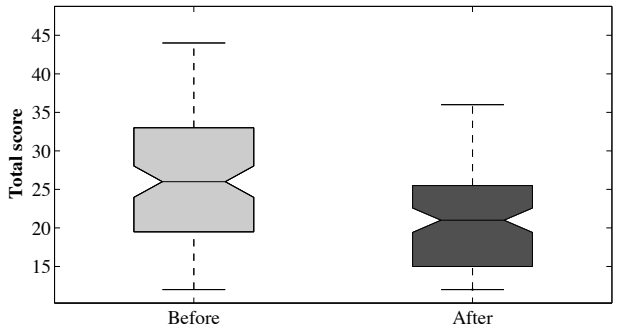


Figure 1. Total score of the European heart failure self-care behavior scale before and after the monitoring period. The lower the score, the better compliance of the patient to the system. A significant difference ($p < 0.05$) was found between both scores.

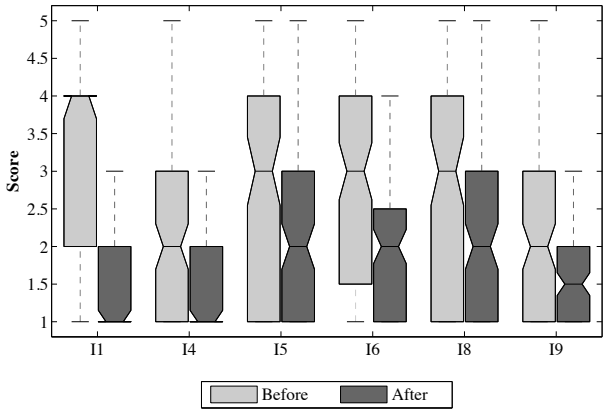


Figure 2. Score of the separate items with significant differences ($p < 0.05$). The item names correspond to those detailed in section 2.4

results are indicated in Figure 2. Only the items with significant differences are shown. It is interesting to note that I1 shows the more extreme change, followed by I6. These results are very important in HF monitoring, because I1 is related to daily weighing, and I6 gives an indication on how aware the patients are of the fact that they need to reduce the amount of fluid intake per day. Therefore, the remaining of this paper will focus on these two items.

When looking at I1, it was found that the score in 68.5% of the patients was improved. In 23.1%, the telehealth program did not seem to change the frequency with which they weighted themselves, and in only 8.3% of the cases a worsening was observed. Concerning I6, 58.3% of patients improved their behavior, 26.8% remained the same, and 14.8 displayed a worsening in the amount of fluid intake.

Once the items with the highest change after the monitoring period were found, the third part of the analysis took place. This time, the evolution of the physiological parameters was taken into account, and the main focus was on the relation between the changes in daily weighing and fluid intake with increasing and decreasing trends in the parameters. For example, a comparison between the EHFScBS items at the beginning and at the end was done for patients with decreasing weight during the monitoring period (50 patients). Figure 3 presents the scores that correspond to patients with decreasing trends in diastolic blood pressure (80), systolic blood pressure (69), and weight (50). No significant differences were found for decreasing trends in pulse and SpO_2 (62). Furthermore, the scores did not differ when studying increasing trends in any of the parameters.

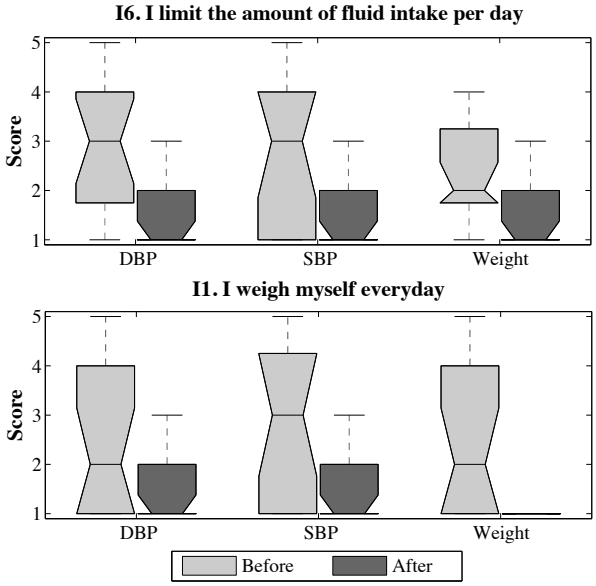


Figure 3. Scores of items I1 and I6 before and after the monitoring period, for patients with decreasing trends in diastolic blood pressure (DBP), systolic blood pressure (SBP) and weight.

4. Discussion

The results of this study show a general improvement in self-awareness, self-management and assistance-seeking after the telehealth program. After only 42 days of telemonitoring, the patients were more aware of the importance of self-managing their condition. When looking into the different items of the European heart failure self-care behavior scale, it was possible to observe that factors like daily weighing and fluid intake were of significant importance for the patients during the monitoring period. This is supported by the fact that more than 50% of the patients displayed an improved behavior, which may be related to a better understanding of their condition, and a better adherence to the system. This, of course, in the long term can

help improving the heart failure outcome.

This study also showed that behavioral changes appear to have implications in the evolution of the physiological parameters. It is presumed that weight changes are more controlled, provided that patients reduce the fluid intake, and weigh themselves everyday. Therefore, heart failure decompensations are expected to be reduced thanks to the use of telehealth medicine, where patients may feel more in control of their condition. Furthermore, subjects with decreasing trends in blood pressure and weight, appear to cope better with their condition.

An important point that must be considered, is the fact that the telehealth platform used in this study provides educational material that encourages patients to follow up on their condition. Moreover, it allows them to understand the importance of making the correct decisions and follow the right strategies in order to improve their quality of life. For this reason, the self-care scale can be also seen as an evaluation of the effect due to education provided by such a system. Another important point worth to mention is the user interface of the telehealth system. As mentioned in the introduction, the Motiva platform is seen as a different television channel, which helps patients to interact with the system using a "well-known" interface. However, the question now is: "would the self-care behavior display the same improvement when a different interface is used?" To be able to answer this question, different datasets, collected with other telehealth equipments, need to be analyzed.

5. Conclusions

The main goal of the present study was to assess the effect of telehealth on the self-care behavior of patients suffering from heart failure. It was shown that significant improvements were achieved by involving the patient into the monitoring and management of their condition. These improvements in self-care behavior appeared to have a positive impact on the evolution of the physiological parameters, which on its turn might help reducing the load in the healthcare system due to fewer hospitalizations. It is important to remember that the monitoring period in this study consisted of 42 days, where no hospitalization occurred. Therefore, to be able to conclude that a reduction in hospitalizations can result from behavioral changes, a longer monitoring period needs to be analyzed.

A crucial point in this study was the use of the European heart failure self-care behavior scale. This questionnaire is a reliable and valid scale to quantify self-care behavior in heart failure patients. However, it is necessary to keep in mind that this questionnaire is self-assessed, which can fail to describe behavioral changes accurately. The reason for this is the social pressure that such a questionnaire can have on the patients at the moment of filling in the questions. Under these circumstances, it is important to use other measurements, like quality of life questionnaires, or the assessment of self-care behavior from the point of view of a third person.

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