Interactive education on CD-ROM—a new tool in the education of heart failure patients

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Abstract

The study aimed to develop and evaluate whether a computer-based program for patients with heart failure was user-friendly, could be operated by elderly patients and gave sufficient information about heart failure. The program was developed by a multidisciplinary group and designed with large, clear illustrations and buttons. A total of 42 patients aged 51–92 years tested the program and completed afterwards a questionnaire. Three heart failure nurses evaluated how the patients used the program and their attitudes towards the computer. All patients could use the program, despite the fact that only six had used a computer before. The patients were satisfied with the computer-based information and appreciated that the program was interactive, flexible and contained a self-test. They thought it was a better way of receiving information than reading a booklet or watching a video about heart failure. The nurses reported that the patients were positive towards the computer and seemed to understand the information and that the patient education was less time-consuming, when the patients could seek knowledge on their own. © 2002 Elsevier Science Ireland Ltd. All rights reserved.

1. Introduction

Chronic heart failure is a major health problem, especially among the elderly. Around 10% of the population in the western world over 80 years of age is affected [1]. Despite improvements in survival due to treatment with ACE-inhibitors [2] and β-adrenoreceptor antagonists [3] the prognosis remains poor. The 1-year survival has been estimated at 80–90% in mild to moderate heart failure [4] and 50–60% in severe heart failure [2]. The pharmacological treatment for patients with heart failure is often life-long and complex, with a multitude of medications. Changes in lifestyle and symptom monitoring are important complements to the pharmacological regime. Studies have shown that compliance with dietary restrictions and medications among patients with heart failure was low [5–7] and that non-compliance was a major cause of hospitalisations [8–10]. Patient education has become an important component in heart failure management in order to teach the patient self-care, [11,12] increase compliance, self-efficacy [13], quality of life and reduce health care costs [14,15]. The education should be repeated and individually adjusted to the person's previous knowledge, learning needs and abilities. In the education of patients with heart failure, written and verbal information is most commonly used, and sometimes video-tapes for additional education [16]. Computer-based programs have mainly been used in the education of patients with diabetes. The use of computer-based tools in the education of elderly patients, is relatively new and not very common [17]. Liedholm et al. [18] developed the only interactive program for heart failure patients that, to our knowledge, has been described in the literature. This program [18] was evaluated in combination with systematic nurse and pharmacist-led education and compared with conventional information regarding knowledge about heart failure [19]. Knowledge about heart failure was increased compared to traditional education and high age was not a hinder for using the new technique. However, it is difficult to evaluate the isolated effect of the interactive program since it was part of an extensive educational programme [19]. The program by Liedholm et al. [18] was developed as a Kodak photo-CD portfolio for displaying on a TV monitor. The

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program did not include animations or sound. A recent format used in a standard PC is the CD-ROM. The purpose of this study was therefore to develop and evaluate a new CD-ROM-based multimedia program including animations, photos and voice-overs, for the education of patients with heart failure. The evaluation aimed at determining if the program was user-friendly, could be operated by elderly patients and gave sufficient information about heart failure.

2. Materials and methods

2.1. Design and setting

The design was split into two parts: one development part during which the program was created by a multidisciplinary group and one evaluating where the program was tested by heart failure patients and its use was evaluated by heart failure nurses. The setting was medical wards and heart failure clinics in three hospitals in Sweden, two university hospitals and one county hospital. Permission for the study was obtained from the Regional Ethics Committees for Human Research at the Universities of Gothenburg, Linköping, and Stockholm, Sweden.

2.2. Development of the program

A multidisciplinary group consisting of a cardiologist, a heart failure nurse and a pharmacist in co-operation with a multimedia company developed the computer program. First, an expert panel consisting of a pharmacist, a cardiologist, a heart failure nurse, a physician specialising in internal medicine and a GP independently wrote an individual description about what knowledge they thought a patient with congestive heart failure needed. Frequent questions about heart failure were collected from patients and health care professionals working with heart failure patients. The separate descriptions and the questions were then synthesised and the result was used as the basic content in the computer program. The basic content was also compared with current guidelines on heart failure education [20,21] in order to be consistent with them. A group of heart failure patients and heart failure nurses tested a beta-version of the program. After this test the content of the program was modified, some of the topics were added, excluded or clarified. The final program constituted of eight modules, seven modules covering educational topics of heart failure and one module with a self-test (Table 1), and each of the educational modules had 4–7 subheadings, see Fig. 1. After completing the education the patient could perform a self-test with 15 multiple-choice questions with answers given in the program. If the answer was correct a green lamp flashed together with a positive sound effect, if incorrect a red lamp flashed together with a negative sound effect. The result from the self-test was shown graphically with two columns filled with boxes indicating the number of correct (green box) and incorrect (red box) answers.

The CD-ROM program was produced using standard authoring tools such as Macromedia Director in order to enable playback on a PC with Windows 95 or NT as well as on a Macintosh with Mac OS 7.5 x. It required at least a PowerPC 80 MHz or Pentium 90 MHz processor, 16 MB of RAM and a hard drive with 3 MB available. In order to achieve high quality colour photographs and a non-cluttered user interface, the display used 16-bit colour at 800 pixels × 600 pixels resolution. The user control could be with a mouse or touch screen and the program was available in Swedish, English, German, French and Italian. The user could easily select the preferred language. The CD-ROM program contained animations, photos and voice-overs, all controlled via a touch-screen and large, clear illustrations and buttons designed for the use of elderly persons. The computer keyboard was not used at all, in order to make the program usable also for those without experience of computers. It took approximately 30–45 min to run the whole program and complete the self-test. The patients were instructed by one of the nurses participating in the study on how to use the program and the touch-screen. At first, the patient chose one of the modules in the main menu (Fig. 1), e.g. "symptoms" and after that one of the

Table 1
Titles and content of the eight different modules in the computer-based heart failure program; seven modules with educational topics and one module with the self-test

|	Title	Content
1	The circulatory system	Anatomy and physiology of the heart and circulatory system
2	What is heart failure?	Definition of heart failure, prevalence, aetiology, triggering and compensatory factors and prognosis
3	Symptoms	Symptoms of heart failure such as tiredness, shortness of breath, oedema, dizziness, palpitations, coughing, anxiety and depression
4	Diagnosis	Diagnosis with echocardiography, heart-lung X-ray and exercise test
5	Medicines	Medicines such as ACE-inhibitors, diuretics, β-blockers, digitalis and long-acting nitrates
6	Self-care	Self-care with advice for life-style changes such as restricting the daily intake of sodium, fluid and alcohol, adjusting physical activity, infection prophylaxis, smoking cessation, and monitoring of symptom changes
7	Frequent questions	About 21 of the most common questions about heart failure in the areas: fluid intake, physical exertion, travelling, medication and symptoms
8	Test	Self-test, with 15 multiple-choice questions
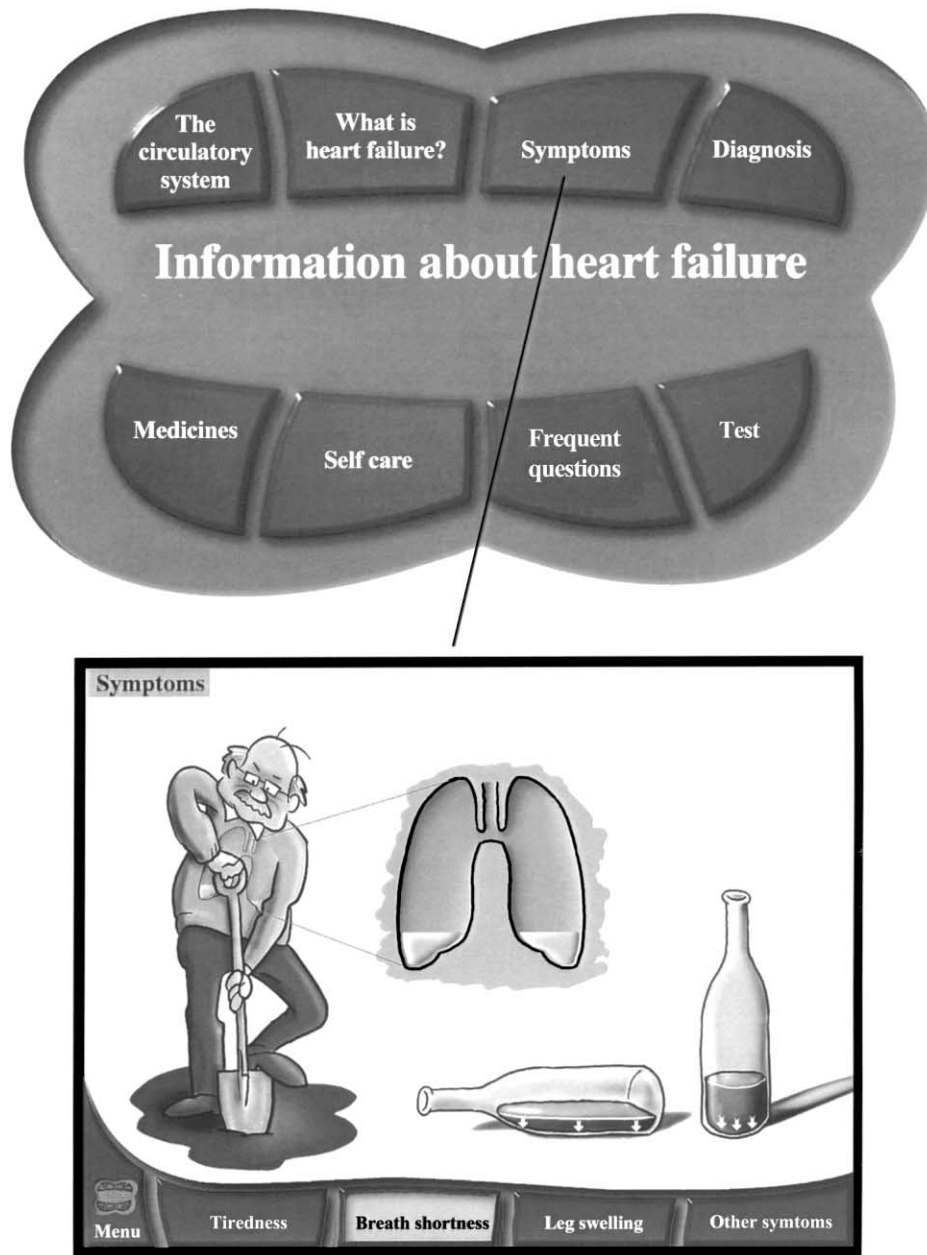
Fig. 1. The main menu in the computer-based heart failure program included eight modules with seven educational topics and a self-test. When one module with an educational topic was chosen, a menu with four to seven subheadings was shown. Each subheading included a sequence of teaching on the subject through animations, photos and voice-overs.

subheadings in that module, e.g. "shortness of breath". Then a sequence showing different aspects of dyspnoea was shown. It was illustrated, as shown in Fig. 1, with an animation of a man getting short of breath during exertion when digging, lungs with volume overload, and bottles of water illustrating the reason for increased dyspnoea when lying down (orthopnoea). During the animation a voice-over explained the process and the main points were written on the computer-screen. The patients used the program independently and if they needed some help to run the program, the nurse was available during the session.

2.3. Evaluation of the program

2.3.1. Patients

A total of 42 patients, 18 women and 24 men, aged 51–92 years (mean 74 years) tested the program. A total of 10 patients were included while they were in hospital and the rest at the heart failure clinic. All had their diagnosis of heart failure based on clinical symptoms and objective evaluation of the cardiac function, thus, fulfilling the criteria of the guidelines from European Society of Cardiology [22] and were in New York Heart Association-classes II and III. The

cause for heart failure was in 74% of the cases, ischaemic heart disease or hypertension, 21% dilated cardiomyopathy and 5% valve disease. The mean duration of heart failure was 13 months, 60% of the patients had been diagnosed within 1 month. The majority of the patients had only gone through elementary school, less than one-third of the patients (29%) had 12 years or more years of education. Sampling was made by convenience.

2.3.2. Nurses

Three heart failure nurses participated in the study. The role of the nurses was to instruct the patients on how to use the program and to evaluate how the patients used the program and their attitudes towards the computer. The nurses were women, aged between 30 and 54, experienced in cardiac care, had worked as nurses for 8–18 years and in the heart failure clinic between 6 and 8 years. The nurses were not involved in the development of the program nor as investigators in the testing of the program.

2.4. Data collection

2.4.1. Questionnaire to patients and log file

All the patients had, prior to the computer-based education, received education about heart failure by means of a booklet and a videotape. After using the program, all patients completed a 13-item questionnaire with both closed and open-ended questions about former experience of computers, the content and level of the information in the program and evaluation of the computer compared to other teaching materials such as booklets or videos. There were also questions about the user-friendliness and utility of the program, if it generated new knowledge that would improve health and if the program would facilitate contacts with health care services. The patients were also asked to describe if they had experienced any advantages and disadvantages with the computer-based education.

All user activities and test results were logged in a plain text file in the program for statistical follow-up. This log file could be read by any word processing program, and easily distributed. The log file contained data, given in %, on how frequently each subheading in the eight modules had been accessed, and the number of right answers to the questions in the quiz. Data on how the patients used the program were collected from the log file. All of the study patients were aware of the log file and had consented to it being analysed.

2.4.2. Questionnaire to nurses

The nurses instructing the patients to use the program were also given a questionnaire with seven closed and open-ended questions. The questionnaire covered the patients' reactions when introduced to the computer, difficulties in using the touch-screen and explaining how the program worked. It also included how the patients understood the information in the program and the amount of questions they had compared to ordinary patient education and the advan-

tages and disadvantages of using computer-based information from the nurse's point of view.

2.5. Data analyses

Descriptive analyses were used to describe the sample and the responses to the study variables. The results from closed-ended questions were tabulated to illustrate frequency distribution and ranges. Open-ended questions were analysed by content and categorised.

3. Results

3.1. Questionnaire to patients

All patients could use the program in the initial test, despite the fact that only 6 of the 42 patients had used a computer before. About 16 of the 42 patients were satisfied and the rest of the patients were very satisfied with the computer-based information. A total of 36 patients reported that it was a better way of receiving information than reading a booklet and 37 of the patients preferred the computer compared to watching a video about heart failure. According to the patients, the learning process was facilitated due to the program being interactive, flexible and that they themselves were active during the education and could work at their own pace and choose areas of their own interest. They also reported that it was easier to learn and recall their knowledge due to the short and concise information divided into main areas and that they were presented with animation, text and a speaker-voice at the same time. The patients expressed the opinion that it was an advantage that the information could be repeated. It was much easier to run a part of the program over again, than asking health care professionals the same question more than once. The self-test was also seen as a good way to test their new knowledge. The majority of the patients reported that the content of the program was sufficient and that it did not contain any words or conceptions that were difficult to understand. One patient stated that the program was too extensive and two patients that the content and the answers to the questions in the module "frequent questions" were not sufficiently extensive and clarifying enough. Two-thirds of the patients reported that the computer-based education had increased their knowledge about heart failure. About 38% thought that the new knowledge would improve their health and one-third of the patients stated that it would facilitate contacts with health care services.

3.2. Log file

The log file showed that the most frequently used module was "the circulatory system", 33 of the patients chose to look at all the five subheadings in this module. A total of 30 patients looked at all the subheadings in the modules

"what is heart failure" and "medicines", 29 patients chose everything in "symptoms" and self-care", 25 patients looked at all areas in "diagnosis" and 19 patients went through all of the 22 most frequent questions. The most frequently used subheading was "the structure of the heart", 41 patients looked at it and 35 patients chose "ACE-inhibitors". The other most frequently used subheadings were in falling order: heart valves, fluid intake, causes of heart failure, shortness of breath, function of the heart. All patients completed the self-test, with 80% of correct answers to the questions on average. All patients gave the right answer to six of the questions. They knew about salt and fluid restrictions and the reason for them, symptoms of decompensation and the definition of heart failure. All patients knew why they should weigh themselves, but 1 patient out of 10 did not know how often they should do it. The questions about the cause of heart failure, adverse effects of ACE-inhibitors and diagnostics generated the lowest frequency of correct answers.

3.3. Questionnaire to nurses

The nurses reported that 39 of the patients were positive when they were introduced to the computer. The nurses found it easy to explain how the program worked and the patients did not have any problems using the touch-screen. The nurses had the impression that the patients understood the information. Some patients did not have any questions after the program and some had many questions. The nurses noticed that the patients could discuss their disease in a better way after using the program. The advantages with the computer-based information were, from the nurses' point of view, that the patients could adjust the information to their own level and their own pace. It also saved time when the patients could seek knowledge on their own. The nurses were available to assist and answer questions if needed, but they were not present during the whole computer-based education. They could, therefore, perform other tasks and assist other patients in the ward or at the clinic in between. At the heart failure clinics the patients were occupied with the program during the time needed for drug-titration, when they were waiting for their blood pressure to be measured. The disadvantages were that some of the personal interaction was lost when the patients used the computer and that some of the issues in the computer-program needed some additional explanation to the patients.

4. Discussion and conclusion

4.1. Advantages with the computer-based program

We found that the patients in the study were satisfied with the computer-based education, there was no need for previous computer experience to run the program and high age was not a problem for using the program independently. The nurses reported that the patients had a positive attitude towards the computer, they seemed to understand the information and could more easily discuss their disease after using the program. Another advantage with the computer is that the patients chose areas of their own interest. Heart failure patients and nurses rate the importance of the information areas differently and nurses tend to rate the information as less important than the patients in most areas [23–25]. It is, therefore, better and probably more motivating that the patients individually decide on what they want to learn. Compared with other media for patient education, such as booklets and videos, the advantage with the computer-based program is that it provides interactive learning, which has been shown to be more effective than traditional teaching [17,19,26,27]. Furthermore, earlier studies [28,29] have shown that patients with low literature skills benefit more from individualised education at their own pace, such as computer-based education. This is important when planning patient education for heart failure patients, since they in general are elderly and therefore have a lower educational level than the younger population. Learning from a physician or nurse can perhaps be more stressful than using a computer. The patients might not want to appear foolish or unintelligent, by asking the wrong questions or, due to stressful consultations, the information might be given without time for reflection and interaction. The nurses in the present study reported that it saved time when the patient was educated by the computer. Reis and Wrestler [30] found that computer-based education about intervention for the common cold reduced the time of health care visits. Computer-based education can not substitute the personal interaction and verbal education given by health care professionals, but since it is often a problem to find time to educate the patient it can be an advantage that part of the education and the repetition is done with the computer. Huss et al. [31] showed that repeated computer-based education to patients with atopic asthma was more effective in changing behaviour than single-session traditional education.

By using a log file in the program it is possible to evaluate how the patients have used the program and their results in the quiz. This information can be used for further evaluation and improvement of the program.

4.2. Disadvantages with the program

The majority of the patients were very positive about the computer-based program, only a few patients had negative comments about it. The criticism reported by these patients was that the program was not sufficiently extensive and clarifying enough. In order to satisfy the educational needs for all patients with heart failure it might be an idea to have two levels in the program, basic and advanced. Another possibility for satisfying the patient with higher demands on knowledge is to create a new CD-ROM program with more advanced education. It has been suggested that the most effective way of using computers is tailored education [32].

This means programs that can generate individualised education based on the information that the patient puts into the computer. Bennett et al. [33] have developed a tailored, web-based intervention with heart messages in order to improve self-care in patients with heart failure, and this intervention will be further evaluated.

The log file revealed that the questions about the cause of heart failure, adverse effects of ACE-inhibitors and diagnostics were most difficult to answer correctly in the self-test. This is somewhat surprising since heart failure patients rate medications, risk factors and physiology as the most important educational categories [23–25]. May be these issues about aetiology, medication and diagnostics were not sufficiently explained in the program or more likely are these areas more difficult for the patients to understand. The nurses reported that some of the issues in the computer-program needed some additional explanation to the patients, maybe due to the fact that the personal interaction was lost when the patients used the computer. More testing is needed in order to evaluate if the computer-based program needs to be remade to improve the education on aetiology, medication and diagnostics.

4.3. Study limitations

Patients from both genders, aged between 50 and 90 tested the program, but it was a small, convenience sample. It might not be representative for the whole heart failure population and the results can thus not be generalised. Another method suitable for data collection would have been qualitative interviews. The advantage with interviews is that follow-up questions can be asked and the answers might have been more substantial. However, it is very time consuming to conduct and analyse interviews and the sample would then have been even smaller. There is also a risk for bias, perhaps the patients would have been more positive about the computer when faced with an investigator compared to filling in a questionnaire. It is always important to analyse if the answers to the questionnaire could have been affected by the conditions at the session. In order to reduce this bias, the nurses that administered the questionnaires and observed and instructed the patients on how to use the program were not involved in the development of the program and not active as investigators in the testing of the program.

Two evaluations have been conducted in the present study, one evaluation of the content and one of the method for delivering the content. There is no established content on heart failure education, and therefore, experts and guidelines were used in the development of the program, while patients and other experts evaluated the content.

The patients were able to compare different methods of delivering education on heart failure since they saw a video, read a booklet and used the computer. This could have been controlled even better if all the different media had been evaluated on the same level, not just compared to the CD-ROM. However, this would have needed another design and been more complicated to implement in a clinical setting.

4.4. Conclusions

The evaluation determined that the CD-ROM program gave sufficient information about heart failure and there was no need for computer experience to run the program and high age was not a problem for using the program independently. Computer-based education may well be used in this elderly patient group as a complement to the education about heart failure given by health care professionals. The computer can not replace the personal interaction between the heart failure patient and the health care professionals, but it is a useful and time saving tool to incorporate in the educational toolbox. The heart failure population is a heterogeneous group with different experiences and learning preferences and it is, therefore, important to offer various models and media for educational purposes.

4.5. Clinical and research implications

The program can be available in hospital wards, heart failure clinics, primary health care centres, pharmacies and also for home use if the patients have access to a computer. It might be an advantage if the program has two levels, basic and advanced, or if it is tailored. The family of the patient also needs to use the computer program, since they have an important role in supporting the patient to comply with treatment. To further evaluate the effect of computer-based education, a randomised, controlled study is needed in order to see if this kind of education can improve knowledge, compliance and quality of life.

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