Developing an Aseptic Technique Assistive Tool for CAPD Users in Avoiding Peritonitis

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Abstract—Aseptic Techniques is one of the most important steps that needs to be utilized by Continuous Ambulatory Peritoneal Dialysis (CAPD) users. This technique is crucial to avoid them from bacterial contamination which leads to peritonitis while performing CAPD procedures. Therefore, this study was conducted to assist CAPD users in learning and practicing Aseptic Techniques. A multimedia application has been developed with the integration of multimedia elements such as text, image, and video in order to help renal patients in learning the Aseptic Techniques. A usability test and an interview were conducted to evaluate the usefulness of the multimedia application. The result indicates that the application is successful in increasing knowledge, understanding and guidance for CAPD users in aseptic activities. This application provides users with a different experience in learning aseptic activities as they are able to learn at their own pace. It is discovered that the multimedia application has successfully met the objective and it is beneficial for renal patients as one of the means to avoid Peritonitis.

Keywords— CAPD (Continuous Ambulatory Peritoneal Dialysis); Aseptic Technique; Peritonitis; Kidney Failure

I. Introduction
Kidney failure is when a person’s kidney failed to perform its functions to filter toxic and urine. There are three (3) stages of kidney failure which are Acute Kidney Failure, Chronic Kidney Failure and End Stage Kidney Failure. Acute Kidney failure is the sudden loss of kidney functions over a few hours or days. It can be due to one of the various types of kidney diseases or it may be due to infections or low blood pressure after an accident. When the loss of kidney functions is gradual and progressive, it is referred to as Chronic Kidney Failure. Eventually, the kidneys are unable to remove wastes or maintain the body’s salt and fluid balance, resulting in the need to receive dialysis treatment. End Stage Kidney Failure means that the kidneys have failed completely and can no longer support life. Some people stop passing urine completely; others will still pass some weak, watery urine [1].

The rest of this paper is organized as follows: The next two sections discuss on the literature review including Continuous Ambulatory Peritoneal Dialysis (CAPD), Aseptic Techniques, Peritonitis and related works. In methodology section, it includes the construction of Aseptic Techniques Assistive Tool and followed by Application Architecture. The paper concludes with discussions of results and analysis of the application and finally recommendation for future works.

II. Literature Review
A. Continuous Ambulatory Peritoneal Dialysis (CAPD)
Thus, in order to treat kidney failure, Continuous Ambulatory Peritoneal Dialysis (CAPD) can be used as a treatment method. In this method, the process takes place inside the body using the natural lining of the abdomen, a dialysis fluid is infused into the peritoneal membrane and then drains out intermittently [2]. Continuous Ambulatory Peritoneal Dialysis (CAPD) was discovered by Robert Popovich and Jack Moncrief in 1975 when they discussed for another way to dialyze a patient who was unable to undergo haemodialysis. As a result of the discussion, Dr. Popovich developed comprehensive calculations based on the amount and dwell time of the dialysis solution, determining the effective removal of uremic toxins. Dr. Popovich concluded that a two-liter bag should be exchanged 4-6 times per day and a long dwell time should be allowed between the exchanges [2].

The first step of CAPD process is to drain off the waste products into the lower bag. Then the user has to drain the fresh dialysis solution from the top bag into the peritoneal cavity. This process is known as ‘Exchange’ that is fresh fluid replacing the old. The dialysis solution is left in the body for about 5 hours. After 5 hours the process can be simply repeated again as shown in Fig. 1 [3].
B. Aseptic Techniques

The CAPD process comprises the handling of aseptic technique. Aseptic technique is a set of specific practices and procedures performed under carefully controlled conditions with the goal of minimizing contamination by pathogens [4]. This is the method that prevents unwanted organisms into the environment. This is employed to maximize and maintain asepsis, the absence of pathogenic organisms during the clinical setting. The main goal of aseptic technique is to protect patients from infection which will lead to peritonitis. A literature search for aseptic technique revealed a variety of practices and much guidance on hand hygiene, using proper personal protective equipment and maintaining a safe environment in the operating room [5]. Fig. 2 below shows the example of hand sanitizing process in order to eliminate germs before performing CAPD [6].

C. Peritonitis

Peritonitis is an acute or chronic inflammation of the peritoneum, the membrane that lines the abdominal cavity and covers the visceral organs or is also known as acute abdomen [8, 9]. The feature of peritonitis is shown in Fig. 3 [10]. There are two major types of peritonitis which are primary and secondary peritonitis [8]. Primary peritonitis is caused by liver disease. Fluid builds up in the abdomen, creating a prime environment for the growth of bacteria. This is a rare type of peritonitis. The more common type of peritonitis, called secondary peritonitis, is caused when other conditions that allow bacteria, enzymes, or bile into the peritoneum from a hole or tears in the gastrointestinal or biliary tracts. Such tears can be caused by pancreatitis, a ruptured appendix, stomach ulcer, Crohn's disease, or diverticulitis. Peritoneal dialysis, which uses the blood vessels in the peritoneum to filter waste from your blood when your kidneys are not able to do so, may also cause peritonitis. Both cases of peritonitis are very serious and can be life threatening if not treated quickly [7].

Fig. 2. Proper Hand Washing Procedure [6]

1. Wet hands and wrist. Apply soap.
2. Right palm over left, left over right.
3. Palm to palm, fingers interlaced.
4. Backfingers to opposing fingers, interlaced.
5. Rotational rubbing of right thumb, wrapped in left palm and vice versa.
6. Rotational rubbing backwards and forwards with tops of fingers and palm wrapped in hand to left and vice versa.

Therefore, this Aseptic Technique Assistive Tool is developed to assist users in learning about the procedure of aseptic technique in practicing CAPD using an interactive multimedia application. It is to ease users in practicing CAPD more effectively through combining multimedia approaches such as video, audio, text and graphic. By using the application, users can learn the proper way in handling aseptic technique that prevents unwanted organisms from the environment that should be applied in performing dialysis [11].

III. RELATED WORKS

This research was a continual from the previous projects that have been conducted focusing on the CAPD procedures, where the steps taken in CAPD processes were...
documented in an interesting and interactive ways. In the previous project, a CAPD eBook was developed for renal patients who undergo CAPD as their dialysis method [12]. It is a multimedia application that is designed as a guide for renal patients on how to perform CAPD in their daily life. Additionally, this multimedia application is specifically designed to support the patients in their CAPD training process and to assist in learning and performing CAPD as a way to remove waste from their body. It can be easily used by nurses, patients and family members in order to assist patients in their learning process and can be easily implemented in a hospital especially in CAPD Unit or at home for training purposes.

Evaluation on the usefulness of CAPD eBook also has been performed where a usability test was done to assess the application [13]. The assessment includes interactivity, navigation, design, color, and integration of multimedia elements. The result reveals that by the usage of multimedia elements, significant impact in CAPD training for renal patients is provided.

Besides that, Persuasive Technology principles have been implemented in CAPD eBook to enhance the usefulness and effectiveness of the application [14]. Persuasive Technology is one of the techniques to persuade and encourage people in many aspects especially in learning process. A Heuristic Test has been conducted to evaluate the convenience and significance of the Persuasive Technology Principles in the CAPD eBook. It was proven that CAPD eBook has achieved the objective and benefited the renal patients.

However it is found that the most critical factors before performing CAPD is to practice a good aseptic technique [7]. Therefore, this Aseptic Technique Assistive Tool project has been conducted to fulfill the needs.

IV. METHODOLOGY

The study was conducted based on the research model as represented in Fig. 4. The first step involves information gathering activities in order to gain insights of the target audience as well as the CAPD process environment, where the tool will be deployed. These include activities such as interviewing the nurses and observing the patients in CAPD Unit during CAPD process. Special attention is given towards patients’ behaviors and reactions while performing the aseptic technique in order to have better understanding on the process.

This information is later used as input in “Storyboard Design” where multimedia elements are incorporated into the aseptic technique tool. In this phase, the graphics, videos and sounds are carefully chosen to stimulate the patients’ learning experience. The design of the storyboard closely follows Application Architecture as shown in Fig. 5. The storyboard would then undergo a number of revisions based on the researchers’ and medical practitioners’ input until the final version is produced.

The design is translated into multimedia application. Here the multimedia elements, together with the application activities are put together using multimedia packages software (Adobe flash, Photoscape, Windows Movie Maker, Vegas Pro and more video widget). The resulting application is then pre-tested to ensure it is free from glitches before it is used by the target audience.

The final step consists of measuring the application’s acceptability among the targeted audience by performing Usability Test. The nurses will be given questionnaires that consist of Likert Scale Based responses. The result is then analyzed to determine the acceptance rate of the application.

V. APPLICATION ARCHITECTURE

Fig. 5 shows the architecture of the application. It consists of five main segments which are the Main Menu, Introduction to CAPD, Aseptic Techniques and Peritonitis, Personal Protective Equipment, Hand Hygiene and Sanitized Environment.

Fig. 4. Methodology

Fig. 5. Application Architecture

A. Aseptic Technique Assistive Tool Menu

Aseptic Technique Assistive Tool menu in Fig. 6 is the main scene for the CAPD Procedure application; it will appear when users enter the multimedia application. The
main menu page consists of four types of navigation link which are hand wash, sanitized environment, proper protective equipment and information on CAPD, Aseptic Techniques and Peritonitis. Users can hit any button to go to another scene with an integrated background audio.

B. Information Segment

The information scene shows a dynamic text explaining about CAPD, Aseptic Techniques and Peritonitis. Users can learn the basic information on these topics before continuing on using the application. Fig. 7 summarizes how the introduction page will appear.

C. Hand Wash Segment

For many years, research has shown that hand hygiene is the most significant factor to trim down the spread of infections in healthcare settings [15]. Most infections are thought to be transmitted by the hands of users. Therefore, hand washing is considered to be the most effective measure to reduce the risk of infection [16].

Fig. 8 shows the interface of hand wash scene, in the integrated video. Users will be explained about how to hand wash their hands properly and in an organized manner.

D. Personal Protective Equipment

Personal protective equipment (PPE) is any type of face mask, glove, or clothing that acts as a barrier between infectious materials and the skin, mouth, nose, or eyes. When used properly, personal protective equipment can help prevent the spread of infection from one person to another [17]. Personal protective equipment interface in Fig. 9 shows an example of equipment that can be used by patients to prevent bacteria from spreading.

E. Sanitized Environment Segment

The environment in which aseptic technique is performed should be visibly clean and free from other potential sources of contamination; for example, medication should not be prepared beside a sink because of the risk of contamination through water splashing. The environment should also be easy to clean, free from clutter, free from fans and replaced with air-conditioner, closed window, and any work surfaces or trays used should be clean [5]. In the integrated video as in Fig. 10, users will be explained about how the environment should be prepared for the purpose of performing CAPD procedures.
VI. RESULT AND ANALYSIS

According to the International Standards Organization (ISO), usability testing is important to measure the extension of a product that can be used by specified users to achieve specified goals with the elements of effectiveness, efficiency and satisfaction in a specified context of use. Usually, usability testing is done right after an application has been developed, so that any significant issues identified can be resolved.

Usability testing is a technique for ensuring that the intended users of the application can produce the main objective precisely [18]. In this research, the researcher has carried out a usability testing on two different groups of users comprised of CAPD users and hospital staff from health care sector in the South of Malaysia. Firstly, the participants were given an opportunity to explore the application. Then, the participants were asked to complete a task provided by the researcher. The task required the participants to do a simulation of aseptic technique activities.

A set of questionnaires has been distributed to the respondents to obtain their feedback and the ranks used are as listed in Table 1.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Agree</td>
<td>5</td>
</tr>
<tr>
<td>Agree</td>
<td>4</td>
</tr>
<tr>
<td>Average</td>
<td>3</td>
</tr>
<tr>
<td>Disagree</td>
<td>2</td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td>1</td>
</tr>
</tbody>
</table>

Results were obtained based on the usability test that has been carried out. Fig. 11 shows the percentage of the results from the participants evaluated in the usability test. Referring to this chart, it can be concluded that 100% of the participants agreed with the objective of the development of aseptic technique using a multimedia application.

VII. CONCLUSION

A multimedia application was developed for the end stage renal patients who used Continuous Ambulatory Peritoneal Dialysis (CAPD) as a way to remove wastes in the blood when their kidneys are not functioning. This application is intended to guide the patients in practicing aseptic activities. In general, during the usability test, it has been found that the application is beneficial because it gives users a different experience in learning aseptic activities as they only need to click on the application to start the learning process.

The research has shown that this application is useful and able to guide CAPD users in aseptic activities. Besides, this application provides every single step that CAPD users should do in practicing aseptic technique, for example in performing correct hand sanitizing, preparing a clean environment and using proper protective equipment. In future, this multimedia application could be enhanced to improve its design, for example by adding narration in every step so that the application can be clearly understood by users.

In conclusion, this application has achieved its objective as to guide users in aseptic activities and it can be utilized by all age range. It is hoped that this application can assist patients in order to avoid peritonitis.

REFERENCES


