Effective Communication Improvement in Chemotherapy Services in Hospitals Through the Development of the ChemoCarePlan Application Prototype

Putri Yuliani[1,2*], Wahyu Sulistiadi[1]

[1]*Department of Health Administration and Policy, Faculty of Public Health, Universitas Indonesia*
[2]*Quality and Patient Safety Committee, Awal Bros Batam Hospital, Riau Island Province*
Corresponding Author Email:
putri.yuliani@awalbros.com

ABSTRACT

The flow process of chemotherapy services involves multidisciplinary and multidepartmental processes, so it needs to be well designed to prevent patient safety incidents that can cause injury to patients. Based on the aggregate root cause analysis conducted by the Quality and Patient Safety Committee, it was found that the dominant contributing factor which influenced the occurrence of incidents related to chemotherapy services was the ineffective hand-off communication method. The new communication flow is poured into a workflow diagram which is then developed into a mobile application prototype called "ChemoCarePlan". The purpose of this study was to measure the impact of implementing the application in terms of user experience (UX) and the accuracy of critical information exchange related to chemotherapy services during the application trial period. The method used is a qualitative approach (interviews and direct observation) during the application trial period and quantitative approach through filling out a questionnaire by users after the application trial period ends. The data collected was then analyzed using the content analysis method. It was found that the use of the "ChemoCarePlan" application had a positive impact on the user experience in scheduling chemotherapy patients, making it easier for staff to ensure that information related to chemotherapy protocols was always up to date, reducing the risk of patient misidentification in preparation and chemotherapy drugs. We recommend that the application implementation to be continued to the next stage where it involves a wider range of users while still undergoing periodic evaluations by the Quality and Patient Safety Committee and related unit leaders.

Keywords: *Patient Safety, Health Information Technology, Chemotherapy, Effective Communication*

1. INTRODUCTION

Chemotherapy services in hospitals are high-risk services because in their implementation they have the potential to cause patient morbidity and mortality.[1] The process flow of chemotherapy services involves multidisciplinary and multidepartmental processes so that it needs to be properly designed to prevent patient safety incidents that can cause injury to patients.[2] During the period of June 2019 to July 2020, Awal Bros Batam Hospital has provided chemotherapy services to 592 patients in inpatient units. Based on the annual performance report of the Quality and Patient Safety Committee of Awal Bros Batam Hospital, there were 23 patient safety incident report (PSI) data related to chemotherapy services, of which 15 reports were incidents related to ineffective communication between professions and between units that caused errors in the process of preparing and administering chemotherapy to patients. Although all of these patient safety incidents did not cause any injury to the patient, considering the potential risk of injury which was concerning, hence in August 2020, it was decided to conduct a broad-themed aggregate root cause analysis investigation of the entire process flow of chemotherapy services for inpatient patients in Awal Bros Batam Hospital. Based on the results of the aggregate root cause analysis, it was found that the dominant contributing factor which
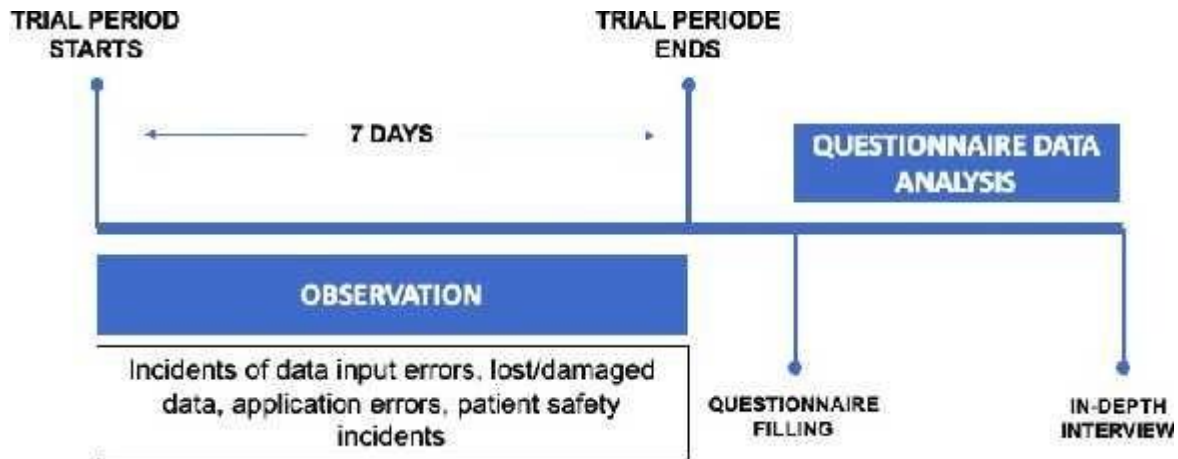
Figure 1 Data collection time frame

influenced the occurrence of incidents was an in-effective hand-off communication method-especially regarding the transfer of information on the Chemotherapy Protocol; changes in the Chemotherapy Protocol; and the procurement of chemotherapy drugs according to the planned schedule. Once a potential risk has been identified, it is important to find the root cause and fix the system. Risks are assessed, and information is gathered from all fields and disciplines involved in the process (patients, doctors, nurses, pharmacists, etc.).

The investigation team then redesigned the communication flow in chemotherapy services by conducting research and collecting appropriate references to obtain a more reliable communication flow. The new communication flow design is then poured into a workflow diagram which is then developed into a mobile application prototype named "ChemoCarePlan". The application is specifically designed to accommodate and deliver chemotherapy scheduling information, delivery of chemotherapy protocols, important information related to protocol updates, changes in patient care, and information on chemotherapy drug availability by medical logistics in real-time and mobile-based manner.

The mobile application which is a form of software product must be reliable, portable, operational, safe, friendly, simple, integrated, fast, easy to use, and without errors.[3] The purpose of this research is to measure the impact of implementing the ChemoCarePlan application in terms of user experience (UX) and the accuracy of the exchange of critical information related to chemotherapy services during the application trial period so as to produce recommendations in the form of a follow-up to the decision to continue the next phase of the trial period to a wider range of users.

2. METHOD

Study setting

Awal Bros Batam Hospital is a class B hospital with 212 beds capacity, is privately owned, and is located in Batam, Riau Islands Province. The total outpatient visits were 441,367 visits and the total inpatients were 17,458 during the 2019 period. Oncology services at Awal Bros Batam Hospital were carried out with a multidisciplinary and cross-departmental approach consisting of oncology specialists/subspecialists, specialists /subspecialists in other fields with the competence and clinical authority to provide oncology services, general practitioners, nurses with special expertise in chemotherapy, nurses in inpatient rooms without special expertise in the field of chemotherapy, outpatient clinic nurses, pharmacists, and so on. In its operations, Awal Bros Batam Hospital has used a Hospital Management Information System (HIS) integrated with a comprehensive Electronic Medical Record (EMR) for both inpatient and

outpatient services.

Study design and data collection methods

The method used in this study is a qualitative approach with (1) in-depth interviews based on the results of filling out the questionnaire, (2) direct observation during the application trial period and a quantitative approach through filling out a questionnaire using Google Form after the application trial period ends. The application trial period is carried out for 7 calendar days to limited users.

Observations were made for the number of data entry errors into the application, data loss/damage incidents, application errors, and patient safety incidents during the trial period. The results of these observations are then compared with the entire input data.

informants consisted of Hospital Director, Nursing Manager, Person in Charge for Medical Services Quality, Head of Inpatient Unit, Head of Pharmacy Unit, Head of Chemotherapy Room, Chemotherapy Nurse, Oncology Clinic Nurse, IV Admixter Pharmacy Staff, and Medical Logistics Staff. The data collected was then analyzed using content analysis method and the quantitative data from questionnaire are analyzed using Excel software.

3. RESULTS

Based on observations during the seven-day application trial period, 23 chemotherapy patient data were inputted, where each data consisted of 9 sub-data consisting of the patient's full name, date of birth, medical record number, gender, name of the doctor in charge of the chemotherapy, diagnosis, patient/family
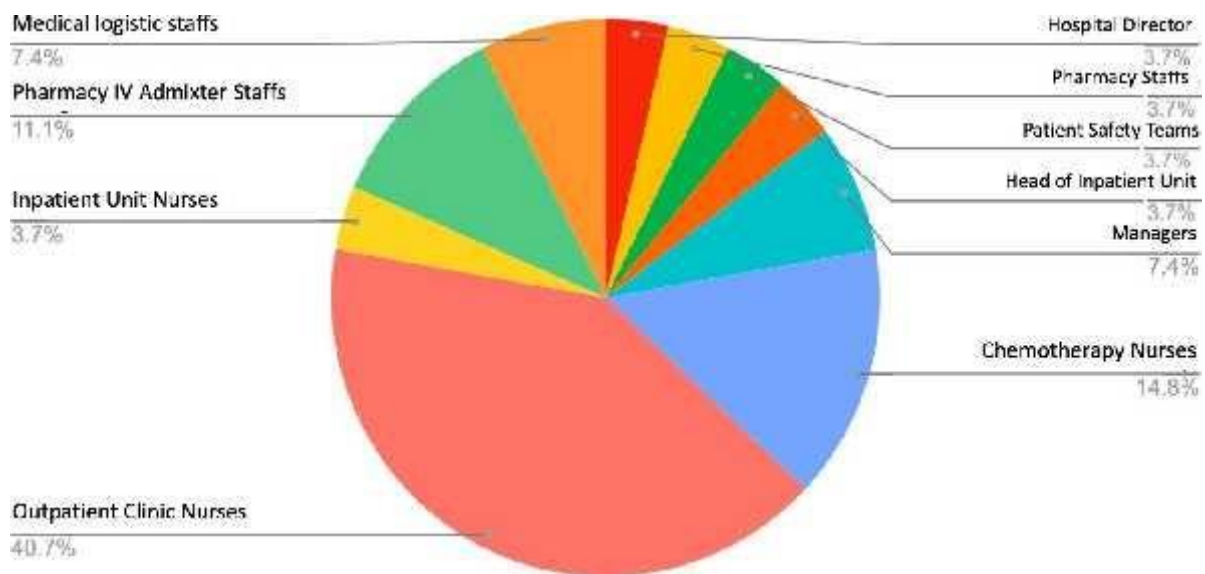
Figure 2 Respondents based on the origin of their unit / position in the hospital

In-depth interviews were then conducted with several staff members who were considered to represent different roles and units in chemotherapy services using a structured interview guide. The selection of informants is based on their position, function, and ability in chemotherapy services to get a comprehensive picture of their perceptions of the application being tested in terms of user experience and its impact on improving patient safety. In this study, the

telephone number, name of staff who performed data input, and date and time of input. There are also 21 chemotherapy cycle scheduling data input has been carried out, where each scheduling data consists of 13 sub-data consisting of (1) scheduling booking code, (2) scheduling input date, (3) scheduling input hours, (4) chemotherapy plan date, (5) patient name, (6) name of doctor in charge of chemotherapy services, (7) planned number of chemotherapy cycles, (8) chemotherapy
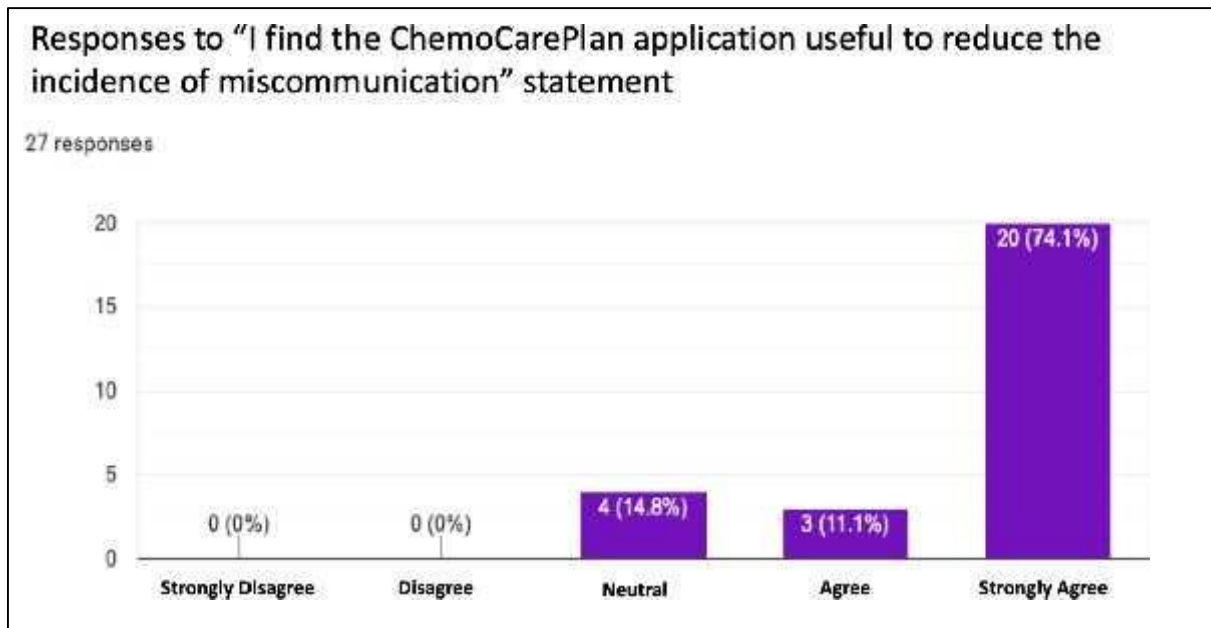
Responses to "I find the ChemoCarePlan application useful to reduce the incidence of miscommunication" statement

27 responses

Figure 3 Response to the use of the 'ChemoCarePlan' application

cycles, (9) photos of protocols, (10) photos of regimens, (11) photos prescription, (12) photos of laboratory results, (13) the name of the chemotherapy scheduling data input officer.

Researchers recorded 8 incidents of data entry errors, no incidents of data loss or damage, no application errors, and no patient safety incidents reported related to chemotherapy services. Of the 8 observed data entry errors, 6 were input errors for the patient's date of birth and the rest were multiple data entry for the same name and medical record number. All errors are detected on the same day as the entry day and corrected as soon as they are identified.

The questionnaire made in the form of Google Form was filled in by 27 respondents; 11 respondents were oncology polyclinic nurses, 4 respondents were chemotherapy special nurses, 3 respondents were IV admixter pharmacy officers, 2 respondents were medical logistic officers, the rest were managerial respondents such as directors, managers, and the Hospital Quality and Safety Committee.

From 27 respondents, 74.1% "Strongly Agree" that inputting chemotherapy patient data on the "ChemoCarePlan" application is easy to do, 63% of respondents "Strongly Agree" that inputting chemotherapy protocol changes in the "ChemoCarePlan" application is easy to do, 74.1%

"Strongly Agree" that the use of the "ChemoCarePlan" application is useful for reducing the incidence of miscommunication, and 70.4% "Strongly Agree" that the use of the "ChemoCarePlan" application is useful for reducing the incidence of misidentification.

During the in-depth interview session, the informant was asked to elaborate on what they liked most about the application being tested. The following is the response given by the informant:

a) Data input is easy to do and chemotherapy patient data information can be seen directly as well as chemotherapy scheduling history and protocol changes in these patients

b) Chemotherapy patient information is clearer because it has been grouped by chemotherapy plan date and the doctor in charge of chemotherapy services. In addition, information on chemotherapy scheduling and chemotherapy drug protocols to be used can be seen by all staff from the related unit anytime and anywhere.

c) The application is easy to use and is well structured so it is very helpful in monitoring the chemotherapy service process, especially the the information of availability of chemotherapy drugs on

schedule because there is a notification feature via email every time there is a data change

Whereas for the most disliked thing about the ChemoCarePlan application, an informant who has a profession as a chemotherapy nurse complained that not all chemotherapy patient data was entered into the application and also the repetition of certain data items that still needed to be input such as medical record numbers and names of doctors in charge. Another informant stated that the inputting date of birth in a calendar format is often not compatible hence resulted in the inputting of wrong date of birth to the application. In addition to problems related to data input, another thing that becomes a complaint of users is the dependence of applications on the internet network so that data input will be hampered if there is an internet network disruption. Basically, the application has been designed to be able to store inputted data even though it is not connected to the internet network (offline data), however it was observed that not all informants were aware of this feature.

Despite the application deficiencies identified during the trial period and various user input, the researcher noted that 77.8% of respondents gave a "Strongly Agree" response to the questionnaire questions about whether they thought using the ChemoCarePlan application was feasible to continue. There were no respondents who gave a negative response to this statement so that it was considered that the use of the application could begin to be applied to a wider range of users at a later stage.

4. DISCUSSION

The chemotherapy service process involves the following processes: (1) the patient coming and being registered as an outpatient or inpatient; (2) the process of measuring vital signs and the initial history by the nurse; (3) medical consultation with a specialist who is competent to provide chemotherapy services; (4) providing cycle plan information chemotherapy,

requests for approval of medical treatment, and education related to chemotherapy services; (5) laboratory tests and other support in preparation for chemotherapy; (6) evaluation of the results of laboratory and other supporting tests by doctors; (7) determining a schedule and chemotherapy cycle according to the needs and clinical conditions of the patient; (8) preparation of chemotherapy protocols, regimens, and prescriptions; (9) transfer of information on protocols, regimens, and chemotherapy prescriptions to pharmacists and medical logistics officers; (10) the process of providing / purchasing chemotherapy drugs according to protocol; (11) checking back if there are changes in protocols or chemotherapy regimen; (12) validation of the suitability of therapy by a doctor, nurses, and pharmacy officers and involving patients; (13) patients were contacted for inpatient admission schedule for chemotherapy; (14) patients were admitted to the chemotherapy treatment room; (14) final validation of protocols and regimens to doctors; (15) preparation of chemotherapy drugs by pharmacists; (16) handover of chemotherapy drugs by pharmacists to chemotherapy nurses; (17) validation of suitability of chemotherapy drug administration and identification of patients before drug administration; (18) administration of chemotherapy drugs; (19) monitoring of chemotherapy drugs; (20) monitoring of side effects after chemotherapy administration; (21) preparation discharge of patients and education on side effects of chemotherapy independently while at home; (22) planning chemotherapy protocols and regimens for the schedule of the next chemotherapy cycle.[4]

All of the above processes of course involve the process of exchanging information and effective communication to reduce the risk of patient safety incidents because it often requires coordination between departments.[5] Hand-offs are risky for patient safety because handover communications are subject to time limits, interruptions, lack of clarity of information, and interpersonal relationships.[6]–[8] Based on the results of the broad-themed aggregate
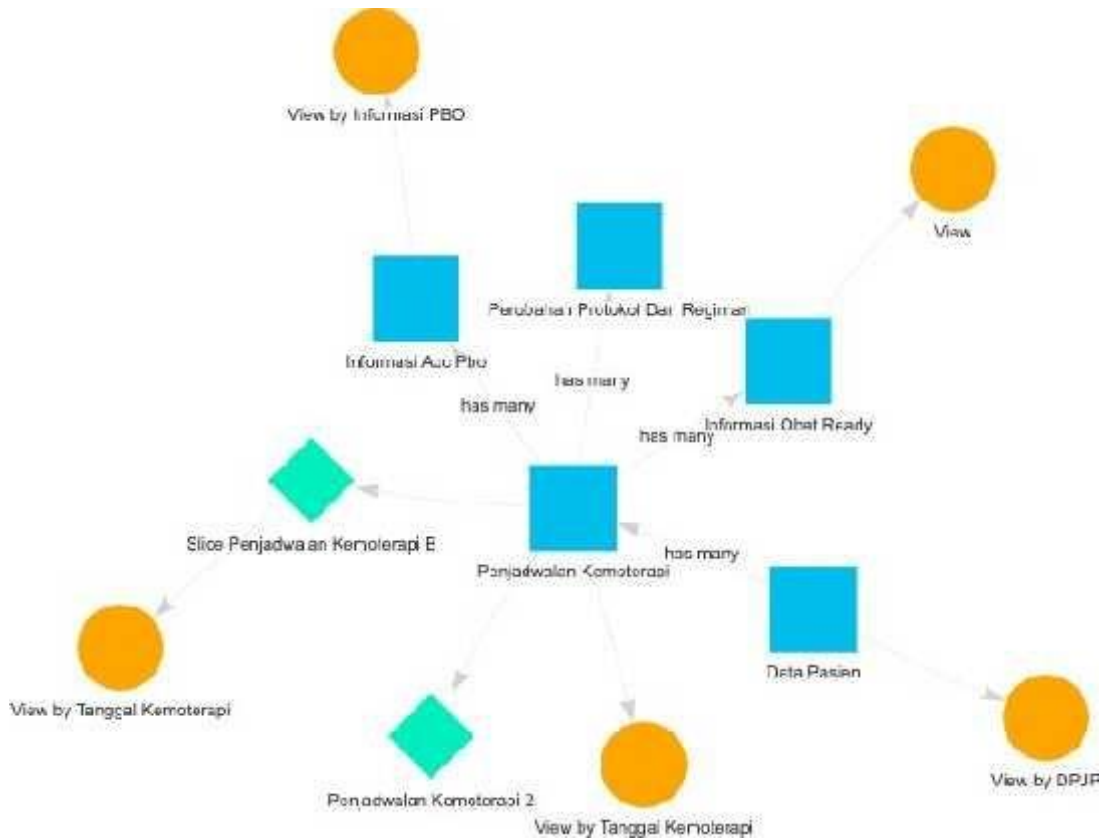
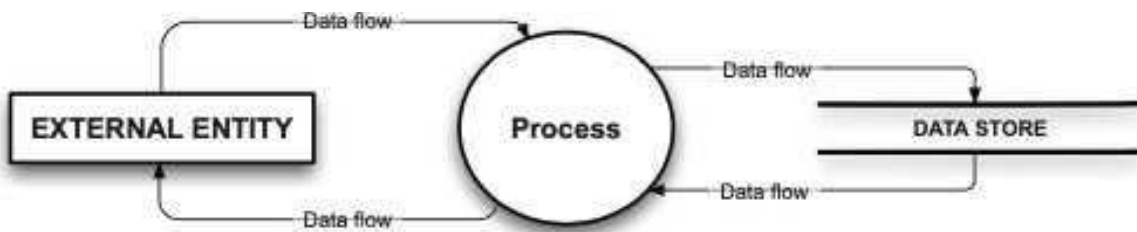**Figure 4** Dataflow Diagram of the ChemoCarePlan Application

Figure 5 Symbols in the Dataflow Diagram (Scarlat, 2012)

root cause analysis that has been carried out, communication methods are used to coordinate between units/department is using an internet based chat platform application. Although the speed of information exchange using this method was reliable, the results of the focused group discussion (FGD) from the root cause investigation team observed and noted that most of the staff complained about difficulties in tracking protocols, scheduling, and drug availability information to ensure accuracy with the identities of patients who intended. To overcome the risk of misinformation, it is necessary to standardize the

content of handover information with technology support.[9], [10]

Standardization of information content related to chemotherapy services is poured into a Data Flow Diagram (DFD) which is then used as a reference for making data flows in the application (Figure 4). DFD is also called workflow diagrams, bubble diagrams, or process models, which are used to model (1) data origin and destination data in a system, (2) workflows, processes, activities, and task system, and (3) transforming inputs into outputs (Figure 5).[11]

DFD in Figure 4 can be narrated as: The

ChemoCarePlan application has Chemotherapy Patient Data, each Chemotherapy Patient Data has Chemotherapy Scheduling Data, each Chemotherapy Scheduling Data has Chemotherapy Protocol Change Data, Cost Estimation Information, and Drug Availability Information. Each chemotherapy schedule can be grouped by chemotherapy date and each patient data is grouped based on the name of the doctor in charge of chemotherapy services. So from the DFD it can be stated that, every data that is inputted and appears on the ChemoCarePlan application can be traced easily and reliably considering that no data is mixed with one another.

The data flow diagram in Figure 4 is made according to the DFD principle in Figure 5 where the External Entity box represents the application user who input the data and the Process circle represents the translation of the data inputted by the user into displaying information in the application. The data flow diagram (Figure 4) is made in such a way that each data is connected to each other with a parent-to-child relationship pattern where the parent data is Chemotherapy Patient Data. The main purpose of creating Data Flow Diagram using parent-and-child relationships is so that any data that is inputted and appears on the ChemoCarePlan Application can be traced easily and reliably. This goal is considered to have been achieved when observing the results of in-depth interviews with informants, where informants stated that the thing they liked most about using the ChemoCarePlan application was the clear identity of the patient, the drug and chemotherapy protocol and the ease of finding patient data. Another informant also stated that his favorite thing was being able to see all chemotherapy patient data and scheduling it in real time and making it easier to enter chemotherapy scheduling manually.

However, it was also observed that the informants stated that internet network constraints, monotonous display, and less simple data entry of birthdays were among the things they disliked the most from using the ChemoCarePlan application. The

application display or what is also called the user interface (UI), is measured for its quality based on its function and usability. Usability is defined as "the effectiveness, efficiency and satisfaction with which the intended users can complete their tasks in the context of the intended use of the product".[11]

According to the National Institute of Standards and Technology, effectiveness is measured by measuring the percentage of tasks that can be completed well over a certain period of time (for example, when a user can input patient data with completely correct data in the application), efficiency is measured in the old form. the time or number of steps required to complete a task (for example, to input a chemotherapy schedule, the user takes 55 seconds), whereas satisfaction is measured using a numerical scale such as the System Usability Scale (SUS) to allow it to be stratified.[12]

In this study, researchers did not use SUS to assess the usability of the application being tested but instead used a number of simpler questions to get user perceptions of application usage during the trial period using a Likert scale because it considered the relatively short development and trial period of the application. This is of course one of the limitations of this study which we are aware of but can be complemented by in-depth interviews and observations to get a more comprehensive picture. The use of SUS needs to be considered for use in the next trial period which involves more users in order to produce better evaluation of the usability of piloted applications. The results of the assessment can be used as a basis for making continuous improvements and updates to the application.

5. CONCLUSION

The use of the ChemoCarePlan application has positive impact on the user experience in scheduling chemotherapy patients, as well as making it easier for staff to ensure information related to chemotherapy protocols is always up-to-date, reducing the risk of misidentification of patients in the preparation and

administration of chemotherapy drugs. Recommendations for application implementation are forwarded to the next stage by involving a wider range of users and periodic evaluations are carried out by the Hospital Quality and Patient Safety Committee and related unit leaders using a more comprehensive evaluation instrument.

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