Author: Catarina Isabel Ferreira Viveiros Tavares dos Reis

Director: Dr. Joaquín Fernández Sánchez

Co-Director: Dr. Josep M. Monguet Fierro

Monitor and Visualize Schizophrenic Patients’ Performance in e-Therapy Contexts

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por ti… maria…

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Abstract

e-Therapy appears in the context of e-Mental Health as a new way to conduct therapy sessions using new Information and Communication Technologies (ICTs). e-Therapy's main goal is to improve the quality of the services delivered and provide well-being to people, offering services and information through the Internet and other ICTs. This new way of helping people in their daily life habits, and enhancing existing relationships, works as a complement to improve the traditional therapeutic process. The work here described is a part of an e-Therapy project with a multidisciplinary team of health professionals and software and graphical designers. This project's ambition was to conceive, create and deploy an e-Therapy tool especially dedicated to a population of schizophrenia-diagnosed inpatients of the psychiatric Hospital of Sant Joan de Déu, in Barcelona, Spain. eSchi is the e-Therapy system that we developed. It appears as a solution that provides a web portal with an integrated set of multimedia tools that help in the cognitive rehabilitation process of schizophrenia-diagnosed individuals. This custom-made application provides an e-Therapy setting for schizophrenia patients and enables therapists to conduct cognitive-related therapy sessions using the multimedia tools. This system will also allow its users, both patients and therapists, to monitor and visualize the outcomes of the patients in the sessions. It is important to provide feedback to end users and let them know if he/she achieved the goals established for a session. As a result, the system uses a monitoring model to keep track of the patients' performance and a visualization model to provide adequate and graphical feedback to patients and therapists.

In summary, the key ambition is to study what we can learn from the monitoring and visualization of the outcomes of schizophrenia patients involved in e-Therapy sessions.

In order to provide an answer to our research question, we adopted an effective research methodology to conduct our empirical work. We elected the case study approach, specifically a multiple-case exploratory study. Only after collecting the data, *can the information be analyzed and explored and the outcome of such case studies is not predictable.*

Upon the selection of the case study method, care was taken to collect the data involving a broad variety of techniques (interviews, participant observation, fieldwork and written data sources such as memos, letters, reports and email messages). By using multiple sources of evidence, triangulation becomes possible and this allowed us to obtain more valid and complete results. The sites for application of the study are rather harsh environments. There are scarce resources available; including patients and therapists, and most times, it is not possible to gather a reliable amount of information. Therefore, our reality is a social construct defined by the human perception of those involved in the usage of the information system, influencing and being influenced by the system.

To design and develop the system we used a Patient Centered Design (PCD) approach. First, we listened to the patient's needs and requirements besides considering the social and technical context for the implementation of the product. The method implies the active engagement of end-users in all the design phases starting from early in the life-cycle development process. This PCD approach improved communication between health professionals that were early involved in the system development, and the development team.

We conducted the study in real clinical settings and we were fortunate to have access to two rich samples, which is something unusual in the e-mental health context. Despite the efforts to minimize existing confounding factors that might distress the results collected, we were unable to guarantee the perfect environment. The number of users that actually used the system was low.

However, with our study we discovered some particularly relevant aspects. There are some new insights into the patient's behavior during his/her sessions that improved the effectiveness of the decision-making process. The results obtained revealed that patients seem to develop their ability through training. Repetition of the same activities though a certain period seems to improve their outcomes, which is relevant when con-

sidering schizophrenia patients. Each patient's results seem to follow the pattern formed by all the users of the system and it appears that the repeated usage of the tool and the performance improvements in the activities encourages the users' acceptation of the tool, improving their satisfaction level. Finally, there are two more aspects worth mentioning. First, all the users that engaged in the study asked for further enhancements of the system, requesting new and improved activities. This reveals their interest in keeping on using the system. Second, eSchi is currently in use in a third site, at the Sant Joan de Déu Institution – Serveis Socio Sanitaris, by a new group of users. This application of the system occurred through a professional recommendation of the therapist of the first site. The psychiatrist found eSchi suitable for her professional usage and worth of recommendation to other professionals in the area.

Resumen

La e-Salud Mental consiste en la utilización de las nuevas Tecnologías de la Información y de la Comunicación (TICs) para mejorar la calidad de los servicios de la sanidad mental. Se basa en la aplicación de la electrónica para la mejora del bienestar de las personas y ofrece servicios e información a través de Internet y de otros medios de comunicación. La e-Terapia es una parte de la e-Salud Mental y se presenta como el modo de conducir las sesiones de terapia mediante la aplicación de las TIC. Esta nueva forma de ayudar a las personas en su actividad cotidiana permite mejorar sus relaciones y, además, es un complemento que facilita el proceso terapéutico tradicional. En este entorno, se desarrolla una aplicación "ad-hoc" para el hospital psiquiátrico Sant Joan de Deu, en Barcelona – el sistema eSchi. eSchi es un portal multimedia que recrea un escenario de e-Terapia para pacientes con esquizofrenia y que facilita a los profesionales de la salud la realización de las sesiones de terapia cognitiva con el apoyo de las herramientas informáticas. El sistema provee a los usuarios, tanto a los pacientes como a los profesionales de la salud, el monitoreo y la visualización de los resultados de los pacientes en sus sesiones. Las sesiones de e-Terapia recurren a técnicas semejantes a las de los ambientes tradicionales y, como cualquier proceso de entrenamiento/rehabilitación, cuando el terapeuta establece el conjunto de actividades a ejecutar en una sesión concreta también los objetivos específicos para el paciente. De esta forma se define una programa de evaluación en el cual hay objetivos a cumplir. Un aspecto destacado de esta evaluación es el feedback que se ofrece a los usuarios, en el que se usa un modelo de monitoreo para registrar el desempeño de los pacientes y un modelo de visualización para representarlo gráficamente de forma adecuado a las necesidades de los usuarios.

De este modo, el principal objetivo de la investigación ha sido definir el modelo con el que se deben registrar y visualizar los resultados de los pacientes involucrados en las sesiones de e-Terapia. Este modelo ayudará en el proceso de toma de decisiones de los profesionales de la salud.

Para responder a las cuestiones de la investigación se ha elegido una metodología eficiente para conducir el trabajo empírico. Escogimos el método del caso de estudio como medio para abordarla y la aplicamos en múltiples casos de estudio exploratorios. Sólo después de que los datos de la investigación sean obtenidos será posible analizar y explorar la información. Los resultados de estos casos de estudio no son del todo previsibles.

En la selección del caso de estudio se tuvo en especial consideración la posibilidad de obtener los datos recurriendo a una gran diversidad de técnicas (entrevistas, observación participativa, trabajo de campo y fuentes de datos escritas cómo informes, cartas y mensajes de correo electrónico). Al usar varias fuentes de evidencia se hace posible la triangulación que nos permite obtener resultados más válidos y completos. Los entornos de aplicación del estudio han sido complejos y arduos. Se caracterizan por la escasez de recursos disponibles, tanto para los pacientes como para los profesionales de la salud, que dificultan la consecución de información fiable en grandes cantidades. Por ello, nuestra experiencia se apoya en un constructo social que se define por la percepción humana de los que están involucrados en el uso del sistema de información y que influencian y son influenciados por él.

Se ha recurrido a la aplicación del diseño centrado en los pacientes (PCD) comenzando por oír atentamente sus necesidades y considerando el contexto socio-técnico para la implementación del sistema. El método ha implicado el compromiso activo por parte de los usuarios en todas las fases del proyecto. La aplicación del PCD aumentó la comunicación con los profesionales de salud que estaban directamente involucrados en el desarrollo de proyecto.

El trabajo ha sido implementado en un entorno clínico real y hemos tenido la suerte de contar con dos muestras muy ricas, algo poco frecuente en el contexto de la e-salud mental. Se han intentado minimizar los factores de confusión que podrían impactar en los resultados recogidos, pero el entorno perfecto no se ha obtenido. El número de usuarios que finalmente han usado el sistema ha sido muy bajo.

A pesar de esto, el estudio nos ha permitido descubrir algunos aspectos particulares o relevantes. El proceso de toma de decisión de los profesionales de la salud fue mejorado en eficiencia y eficacia. Los resultados obtenidos permiten obtener algún conocimiento sobre el comportamiento de los pacientes en las sesiones realizadas, en general revelan mejorías en sus habilidades derivadas del entrenamiento con el sistema. La repetición de las mismas actividades en un determinado periodo de tiempo parece mejorar sus resultados. Estos resultados parecen seguir un patrón de comportamiento definido por todos los usuarios del sistema y, aparentemente, la utilización continuada de la herramienta y las mejorías del nivel de desempeño de las actividades favorecen la su aceptación por parte de los usuarios y aumenta su nivel de satisfacción. Finalmente, hay dos aspectos relevantes en la evaluación de eSchi que son merecedores de mención. Todos los usuarios que han participado en el estudio han solicitado mejoras del sistema: nuevas y mejores actividades, lo que revela su interés por seguir utilizándolo. Actualmente el eSchi es usado en la división Socio Sanitaria del Hospital Sant Joan de Deu por un tercer grupo de usuarios, gracias a la recomendación profesional de la psiquiatra que ha participado en el primer estudio. La psiquiatra ha considerado que eSchi no sólo es adecuado para ser usado en sus sesiones sino merecedor de ser recomendado a otros profesionales del área.

Resumo

A e-Terapia surge no contexto da e-Saúde Mental como uma nova forma de conduzir sessões de terapia através da utilização das Tecnologias da Informação e da Comunicação (TIC). A e-Terapia tem como principal objectivo melhorar a qualidade dos serviços fornecidos e o bem-estar das pessoas, oferecendo serviços e informação através da Internet e de outras TIC. Esta nova forma de ajuda permite melhorar a qualidade de vida das pessoas no seu dia-a-dia e, eventualmente, os seus relacionamentos interpessoais. O trabalho aqui descrito está integrado num projecto de e-Terapia com uma equipa multidisciplinar de profissionais de saúde, engenheiros de software e designers gráficos. O intuito deste projecto consiste na concepção, criação e entrega de uma ferramenta de e-Terapia especialmente dedicada à população dos utentes diagnosticados com esquizofrenia do Hospital Sant Joan de Déu, em Barcelona, Espanha. eSchi é o sistema de e-Terapia que desenvolvemos. Surge como solução que fornece um portal web com um conjunto integrado de ferramentas multimédia que ajudam no processo de reabilitação cognitiva dos utentes com diagnóstico de esquizofrenia. Esta aplicação, feita à medida, fornece um ambiente de e-Terapia para os utentes esquizofrénicos e permite aos profissionais de saúde conduzirem sessões de terapia relacionadas com a cognição usando ferramentas multimédia. Este sistema também irá permitir aos seus utilizadores, tanto aos utentes como aos profissionais de saúde, monitorizar e visualizar os resultados obtidos nas diversas sessões. É importante fornecer feedback aos utilizadores finais e dar-lhes a conhecer o seu desempenho e, em que medida, atingiram os objectivos pretendidos para cada sessão. Como resultado, o sistema usa um modelo de monitorização para registar o desempenho dos utentes e um modelo de visualização para apresentar o feedback gráfico e visual adequado para os utilizadores.

Resumindo, o principal objectivo é estudar o que se pode aprender quando se registam e visualizam os resultados de utentes diagnosticados com esquizofrenia envolvidos em sessões de e-Terapia.

De forma a obter uma resposta para a questão de investigação, adoptámos uma metodologia eficiente para conduzir o trabalho empírico. Elegemos o caso de estudo como meio de abordagem e, mais especificamente, optámos por múltiplos casos de estudo exploratórios. Só depois de obter os dados será possível analisar e explorar a informação. Os resultados destes casos de estudo não são previsíveis.

Perante a selecção do método de caso de estudo foi tido em especial consideração o facto de se obter os dados recorrendo a uma grande diversidade de técnicas (entrevistas, observação participatória, trabalho de campo e fontes de dados escritas tais como memos, cartas, relatórios e mensagens de correio electrónico). Ao usar múltiplas fontes de dados, a triangulação torna-se possível e isto permite-nos obter resultados mais válidos e completos. Os locais de aplicação do estudo são ambientes difíceis. Os recursos são escassos incluindo utentes e profissionais de saúde e, muitas vezes, não é possível obter um conjunto de informação confiável. Assim, a nossa realidade é um construto social definido pela percepção humana dos que estão envolvidos na utilização do sistema e que influenciam e são influenciados pelo próprio sistema.

Recorreu-se à abordagem de desenho centrada nos utentes (PCD) que começou por ouvir atentamente as suas necessidades e requisitos para além de considerar o contexto sócio-técnico para a implementação do produto. O método implicou um compromisso activo por parte dos utilizadores finais, em todas as fases do projecto e desde uma fase inicial do processo de desenvolvimento. Esta abordagem melhorou a comunicação com os profissionais de saúde que estavam directamente ligados ao desenvolvimento do projecto.

O trabalho foi conduzido num contexto clínico real a partir do qual se obteve duas amostras, o que é algo extremamente raro no contexto da e-saúde mental. Tentou-se minimizar factores de confusão que pudessem influenciar os resultados obtidos, não se conseguindo, no entanto, obter o ambiente perfeito para o desenvolvimento do trabalho de campo. Tal foi devido, essencialmente, ao número reduzido de utilizadores que usou o sistema.

Contudo, o estudo permitiu descobrir alguns aspectos particulares e relevantes. O processo de tomada de decisão dos profissionais de saúde foi melhorado a nível de eficiência e eficácia. Os resultados obtidos pelo sistema permitem fornecer algum conhecimento sobre o comportamento dos utentes durante as sessões realizadas, nomeadamente, revelam as melhorias das suas habilidades através do treino. A repetição das actividades, durante um determinado período de tempo, parece melhorar os resultados de cada utente sujeito a este sistema. Estes resultados parecem seguir o padrão de comportamento formado por todos os utilizadores do sistema e, aparentemente, a utilização continuada da ferramenta bem como as melhorias ao nível do desempenho das actividades, encorajam a aceitação da ferramenta por parte dos utilizadores, melhorando o seu nível de satisfação. Por fim, há dois aspectos relevantes para a avaliação do sistema eSchi que são merecedores de menção. Por um lado, todos os utilizadores que participaram no estudo, solicitaram melhorias no sistema, bem como novas e melhores actividades, o que revela o seu interesse em continuar o uso do sistema. Por outro, o eSchi está actualmente a ser utilizado por um terceiro grupo de utilizadores, num terceiro local do Hospital Sant Joan de Déu. Isto deve-se a uma recomendação profissional da psiquiatra que participou no primeiro estudo e que considerou que o eSchi era, não só, adequado para ser usado nas suas sessões, como merecedor de ser recomendado a outros profissionais da área.

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List of Acronyms and Abbreviations

ALS	Amyotrophic Lateral Sclerosis
AMIA	American Medical Informatics Association
APA	American Psychiatric Association
ASQ	After Scenario Questionnaire
CBT	Cognitive Behavioral Therapy
CDSS	Clinical Decision Support System
CINP	Collegium Internationale Neuro-Psychopharmacologicum
CSUQ	Computer System Usability Questionnaire
DALY	Disability-Adjusted Life Year
DSM	Diagnostic and Statistical Manual
ECGs	Electrocardiograms
EEGs	Electroencephalograms
EU	European
GBD	Global Burden of Disease
GUI	Graphical User Interface
HCD	Human-Centered Design
HCI	Human Computer Interaction
HCIL	Human Computer Interaction Laboratory
HE	Heuristic Evaluation
HIS	Health Information System
HML	Hospital Magalhães de Lemos
HP	Health Professional
HSJD	Hospital Sant Joan Déu
HTTPS	HyperText Transport Protocol Secure
IAPT	Improving Access to Psychological Therapies
ICD	International Classification of Diseases
ICT	Information and Communication Technology
IPA	International Psychopharmacology Algorithm
IPAP	International Psychopharmacology Algorithm Project
IPBC	Interactive Parallel Bar Chart
IPR	Integrated Patient Records
IS	Information System
ISMHO	International Society for Mental Health On-Line
ISO	International Organization for Standardization

IT	Information Technology
ITO	Interpretation Tool
LIWC	Linguistic Inquiry and Word Count
LPM	Learning Progress Monitoring
MA	Monitoring Agent
MATRICS	Measurement and Treatment Research to Improve Cognition in Schizophrenia
MD	Monitoring Database
MDI	Medical Data Index
MHIS	Mental Health Information System
MM	Monitoring Manager
MNS	Mental, Neurological and Substance Use Disorder
MO	Monitoring Object
MOD	Monitoring Objects Database
MP	Monitoring Points
NASA	National Aeronautics and Space Administration
NIMH	National Institute for Mental Health
PACT	Program for Assertive Community Treatment
PANSS	Positive And Negative Symptoms Scale
PCD	Patient Centered Design
PCs	Personal Computers
PDAs	Personal Digital Assistants
PSI	Psychiatric Society for Informatics
PSUQ	Post-Study System Usability Questionnaire
RCT	Randomized Control Trial
SM	Service Manager
SMI	Severe Mental Illness
SOPO	Set Of Possible Occurrences
SST	Social Skill Training
ST	Session Try
SUMI	Software Usability Measurement Inventory
TVD	TimeLine a Visualization Dictionary
UCD	User Centered Design
UPA	Usability Professional’s Association
UPC	Polytechnic University of Catalonia
USA	United States of America
UX	User eXperience

UXD	User eXperience and Design
VT	Visualization Tool
WHO	World Health Organization
WSDL	Web Service Definition Language
WWW	World Wide Web

1. Introduction

e-Therapy, according to experts, is the process of conducting therapy using electronic mediums to complement traditional therapy sessions. eSchi is an e-Therapy solution that provides a web portal with an integrated set of multimedia tools that help in the cognitive rehabilitation process of schizophrenia-diagnosed individuals. eSchi has a functional side that helps the health professionals and an entertaining side that provides multimedia activities for patients. It enables the collection of data that later provides some insights on the patients' behavior and performance in therapy sessions. This section introduces the characteristics of our work, clarifying the motivation, the goals and the major contributions.

1.1. Motivation

The mental health area is a major concern in the global health context (World Health Organization, 2004). Mental health is the 21st century epidemic since almost everyone currently suffers or will suffer, in the near future, from a mental condition. The number of patients and future patients seems to grow exponentially each day (World Health Organization, 2008; World Health Organization, 2009).

The topic is receiving growing attention both by the scientific community and by the public. In fact, even world governments are reassessing their health funding system to increase mental health assistance and their main idea is to provide mental health services via emerging ICT (Agence d'Évaluation des Technologies et des Modes d´Intervention en Santé, 2006; Christensen, Griffiths, & Evans, 2002; K. M. Griffiths, Farrer, & Christensen, 2007; D. M. Hilty, Luo, Morache, Marcelo, & Nesbitt, 2002). In 2011, health professionals use computer based training/learning/rehabilitation systems that have proven their effectiveness, especially the ones that provide cognitive behavioral therapy (Christensen, 2007; C. Jones, Cormac, Silveira da Mota Neto, & Campbell, 2004; Sams, Collins, & Reynolds, 2006).

e-Therapy is a relatively new concept applied to health contexts where therapy is involved. According to experts, it is the process of conducting therapy in a digital manner or using electronic mediums to complement traditional therapy sessions (Castelnuovo, Gaggioli, Mantovani, & Riva, 2003a; Manhal-Baugus, 2001). This intends to provide a better service both for patients and for therapists and will allow them to access distinct activities and engage in distinct therapeutic sessions, different from the ones available in traditional settings. The literature refers that this type of solution should work mainly as a complement to the traditional therapy process. It does not intend to replace it (Carroll & Rounsaville, 2010; N. Titov, 2007). Thus, these solutions are actually information systems with functionalities that facilitate therapy sessions (Christensen, 2007; Copeland & Martin, 2004).

e-Therapy has several advantages and disadvantages specified in the literature, but in fact, few controlled and reliable studies have proven its effectiveness or "lack of" (D.

M. Hilty, Liu, Marks, & Callahan, 2003). Thus, an effective assessment of this type of solution is essential (Reis, Freire, & Monguet, 2010).

End users of such systems include not only patients and health professionals (therapists and caretakers) but also the patients' families. The inner benefit for patients is obvious; they will be able to access a set of more diversified therapeutic activities (Marks, Shaw, & Parkin, 1998; M. G. Newman, Consoli, & Taylor, 1997). Health professionals will be able to focus on aspects that are more important for therapy sessions, leaving the recurring and minor work for the system (Carroll & Rounsaville, 2010; Marks et al., 1998). As far as families are concerned, they will be able to follow their relatives' treatments and evolution more closely.

Schizophrenia is a chronic mental condition with a high prevalence. A valid treatment for schizophrenia is not known and there is a wide spectrum of typologies of the illness that provide a large amount of distinct medical situations, including comorbidity states, that lead to rather serious and poor prognoses (World Health Organization, 2007a). There are an increasing number of schizophrenia-diagnosed patients despite the fact that according to the experts, a simple schizophrenia diagnosis is rare. The wide spectrum of existing typologies of the pathology and the fact that morbidity is a reality produces a rather complex working scenario, especially for non-experts in the field (Bhugra, 2005; McGrath, 2008; S. Saha, Chant, Welham, & McGrath, 2005; S. Saha, Barendregt, Vos, Whiteford, & McGrath, 2008).

It is imperative to have an effective way to monitor patients diagnosed with a schizophrenia typology that have a poor prognosis and a cognitive rehabilitation training program as part of the treatment plan (Marks et al., 1998). Their progress, evolution and performance during the treatment sessions should be available for future use in their own personal treatment or for other, similarly diagnosed patients (C. B. Taylor & Luce, February 2003).

There is a scientific belief that the treatment of schizophrenia patients should not follow a pattern and that there is no cognitive enhancement whatsoever. There is a lack of tools to help health professionals conduct their research studies (IPAP, 2004; World Health Organization, 2007a).

A project in this e-Therapy context already existed. This e-Therapy project is a joint effort of a multidisciplinary team that includes a team of health professionals and software and graphical designers. The members of the health team work at the Hospital Sant Joan de Déu in Barcelona, one of the biggest mental health institutions in Spain, with a large population of schizophrenia-diagnosed inpatients. The software and graphical designers are students and professors of the Multimedia Engineering PhD group at the Polytechnic University of Catalonia. The project's ambition was to conceive, create and deploy an e-Therapy tool. The team of the e-Therapy project had already done some of the work regarding the requirements elicitation. Nevertheless, the actual design, conception and implementation of the e-therapy tool – the eSchi system, was yet to be conducted. The team lacked software developers to implement the eSchi system.

According to my software engineer profile and background, my first contribution to the existing e-Therapy project was the initial design and implementation of the eSchi system's prototype that later evolved to a full-scale modular system.

In this context, eSchi appears as an e-Therapy solution that provides a web portal with an integrated set of multimedia tools that help in the cognitive rehabilitation process of schizophrenia-diagnosed individuals. Besides, eSchi monitors the patients' usage of the system, transforms the data collected and provides useful information in a visual format to both patients and health professionals. Hence, while health professionals are able to conduct cognitive-related therapy sessions, patients are able to engage in new activities using a new context.

In the eSchi system, e-Therapy sessions have the same concept as a training plan. The health professional must specify a set of activities that a patient will conduct in a session and establish specific goals for her. After this, patients can execute their training plan by engaging in sessions and undertaking the activities. This implies that some sort of evaluation occurs, patients have goals to achieve and eSchi assesses their work. One important aspect of evaluation is the feedback provided to the users. eSchi provides detailed performance statistics regarding patients' performance.

Considering the requirements of the system, the final product – eSchi – is the *de facto* implementation of a monitoring model to register patients' performance data during e-Therapy sessions and a visualization model to provide adequate graphical feedback to the users. These data gathering, analysis and visualization processes let users track the performance presented in e-Therapy sessions, by schizophrenia patients. It provides feedback that therapists can use in the therapeutic process in order to improve future e-Therapy sessions. eSchi provides insights on the patients' behavior, while in therapy.

Bearing in mind the specific context that is the mental health area and especially the schizophrenia field, we considered the patient centered design (PCD) method as the best approach to develop the system. After establishing the initial conceptual model for monitoring and visualization of patients' performance in e-Therapy contexts, we made an actual code-implementation and eSchi was born.

1.2. Objectives and Major Contributions

The key ambition of this work consists in the development of a conceptual model that allows monitoring and visualizing the outcomes of patients involved in e-Therapy contexts.

In order to achieve the development of this model we had to develop an entire system that could provide an e-Therapy context for patients and for therapists. eSchi is an e-Therapy system that provides a set of multimedia tools to be used in therapy sessions and that includes monitor and visualization' modules where the conceptual model developed, is applied.

We developed the eSchi system accordingly to current software engineering methodologies and usability standards, in an iterative way. Then, two distinct settings lodged the system: at the Hospital Sant Joan de Déu, in Barcelona, Spain, and at the Hospital Magalhães de Lemos (HML), in Porto, Portugal. Two distinct scenarios implied not only distinct patients and health professionals but also completely different clinical settings.

The first site is a psychiatric clinical hospital with a population of inpatients, while the second site is a psychiatric clinical hospital where all the patients were outpatients.

The analysis of the outcomes produced on these e-Therapy contexts should enable the study of performance signs, as far as cognitive skills enhancement and rehabilitation are concerned. It will show both similarities and differences between the two sites and supply feedback into the therapeutic model, to help health professionals while conducting future e-Therapy sessions. Advances in the empirical work led to advancements in the theoretical framework and vice-versa. Thus, we updated and improved the developed system, accordingly to the literature reviewed and the actual experience of the fieldwork.

Health professionals could use eSchi as a useful complement for their work, an auxiliary tool in the therapy process and an aid tool to complement the patient's clinical eva-luation and enhance further scientific studies. Besides, the data gathered by the system will be available for further and future research studies that will open new frontiers in the research of this field.

The research methodology selected is the exploratory case study approach that, used together with a set of valid instruments, allowed us to answer to the following question:

- What can we learn with the introduction of an ICT system that monitors and provides visualization of the performance of schizophrenia patients, in e-Therapy settings?

The details that relate to the research questions, choice of methodology, research method and the research design are later depicted in chapter 4-Research Design.

In order to obtain some insight over the theoretical aspect that leads the investigation we researched the theoretical background on the subject of e-Therapy, specifically applied to e-Mental Health circumstances. This work lead to the proposal of assessment items specifically for e-Therapy settings that includes quality of care, education and empowerment, access, costs and satisfaction (Reis et al., 2010).

Finally, the results obtained and their analysis allowed the acceptance of the system by the end users. This led to the acceptance of the new model that enables the monitoring and visualization of patients' performance in e-Therapy settings.

1.3. Reading Guidance

This work proposal begins with this chapter, 1-Introduction that describes the motivation, major goals and contributions of the research. First, we present the motivation that led to the development of this work and was responsible for the orientation of the research. Then, we present the objectives and the major contributions of the work.

We describe the theoretical basis for the work in chapter 2-Conceptual Framework, introducing concepts such as Mental Health Information Systems (MHIS) and e-Therapy. Several guidelines and best practice' recommendations on these systems' design and development were included in the review, since we identified them as one of the existing voids in the field.

Another relevant theme introduced in that same chapter is the subject of Schizophrenia as a unique and complex disorder that leads to extremely specific considerations that later have a direct impact in the work produced, e.g. the medication made by some patients interferes with their performance while conducting the multimedia activities.

Chapter 3-Related Work provides some insight over the areas of monitoring models and visualization models. We present an overview of what these systems should provide generically, the available systems, techniques and tools and then, describe in detail their specificities in order to apply them in the empirical work conducted.

The research methodology selected is the "case study" approach that we further complement with valid instruments that help us in the collection of information. The research questions, the options available for the design of the research and the selection made, as far as research method is concerned, are depicted in chapter 4-Research Design.

Chapter 5-Empirical Work provides a description of the empirical work conducted. We describe the analysis, design and development of the eSchi system, besides the layout and design of the case studies for the deployment of eSchi. Another deliverable is the list of assessment items and guidelines for e-Therapy systems, present in this chapter.

Chapter 6-Results and Discussion presents a summary of the major findings in the studies, supporting a comparison of the results in the two sites of application.

Chapter 7-Conclusions offer the observable contrasts between the findings and the conceptual framework depicted. This chapter also presents additional insights discovered during the fieldwork that we considered relevant, as well as the study limitations that were possible to identify. This dissertation describes a specific period that includes fieldwork and theoretical research. However, this is just a first-step approach to this research field. The work is still in a beginning phase and has several directions for further evolution and growth, as it is shown in chapter 7.4-Future Work.

Each section of the dissertation includes a summary that in an articulated way provides the necessary awareness of the work. Thus, it is easy to skip the extended reading and accompany the progress through a skim reading of the summaries.

In order to have an overview of the work here described, one can use the following list of sections for guidance:

- a global understanding of the problem (1-Introduction);
- the conceptual framework that defines the field of action (2.4-Summary);
- the related work that will contribute to achieve the proposed goals (3.3-Summary);
- the research design that includes the sites established for the deployment of the proposed solutions (4-Research Design);
- the eSchi system (5.1-eSchi – the system's design);
- the outcomes of the fieldwork (6.3-Summary);
- and the major contributions of the work developed (7.1-Contributions).

2. Conceptual Framework

Mental Health Information Systems (MHIS) provide mental health information and services using digital communication mediums (e-Mental Health). These systems provide services that improve health care of mental health disorders such as schizophrenia – a chronic disorder with unique characteristics. E-Therapy is a specific service available through an MHIS that appears as a necessary evolution on the mental health field. This section provides the theoretical background for the context of the empirical work conducted, introducing concepts such as mental health information systems (MHIS) and e-Therapy.

2.1. Mental Health Information Systems

“There is no health without mental health” is the guiding principle to improve health worldwide (Health and Consumer Protection Directorate-General, 2005; World Health Organization, 2008).

The World Health Organization (WHO), through its Global Burden of Disease (GBD) project, draws on a wide range of data sources to quantify global and regional effects of diseases, injuries and risk factors on the population’s health (World Health Organization, 2004). The GBD project uses the Disability-Adjusted Life Year (DALY), a metric based on years of life lost from premature death and years of life lived in less than full health. DALY quantifies the burden of disease – the gap between the current health status and the ideal situation. Thus, it becomes possible to evaluate the status of global health in the world, despite the fact that there is still much information unavailable, concerning mental disorders (Levinson et al., 2010). The latest assessment of GBD, completed in 2004, includes updated projections up to the year 2030. According to the published information and the summary of the most relevant facts, mental disorders (e.g. bipolar disorder and schizophrenia) are among the 20 leading causes of disability worldwide. Depression alone, affects around 120 million people worldwide. Around 450 million people suffer from a mental disorder and 25% of adults will develop a mental disorder at some point in their lifetime. The authors of the report believe that these figures will increase in the upcoming years as can be seen in Figure 1.

Mental health is “not just the absence of mental disorder. It is defined as a state of well-being in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community” (World Health Organization, 2007c).

2004 Disease or injury	As % of total DALYs	Rank	Rank	As % of total DALYs	2030 Disease or injury
Lower respiratory infections	6.2	1	1	6.2	Unipolar depressive disorders
Diarrhoeal diseases	4.8	2	2	5.5	Ischaemic heart disease
Unipolar depressive disorders	4.3	3	3	4.9	Road traffic accidents
Ischaemic heart disease	4.1	4	4	4.3	Cerebrovascular disease
HIV/AIDS	3.8	5	5	3.8	COPD
Cerebrovascular disease	3.1	6	6	3.2	Lower respiratory infections
Prematurity and low birth weight	2.9	7	7	2.9	Hearing loss, adult onset
Birth asphyxia and birth trauma	2.7	8	8	2.7	Refractive errors
Road traffic accidents	2.7	9	9	2.5	HIV/AIDS
Neonatal infections and other[a]	2.7	10	10	2.3	Diabetes mellitus
COPD	2.0	13	11	1.9	Neonatal infections and other[a]
Refractive errors	1.8	14	12	1.9	Prematurity and low birth weight
Hearing loss, adult onset	1.8	15	15	1.9	Birth asphyxia and birth trauma
Diabetes mellitus	1.3	19	18	1.6	Diarrhoeal diseases

Figure 1 – Ten leading causes of burden of disease in the world (World Health Organization, 2004)

Some authors explicitly state the "well-being" factor in their definitions of mental health as a "must-have" to accomplish health as a whole (Campion & Nurse, 2007; Cloninger, 2006; Keyes, 2002; D. G. Myers & Diener, 1996). This also encourages the development and implementation of action plans for general well-being, mental health promotion and mental disorder prevention (Cloninger, 2006; D. G. Myers & Diener, 1996).

Since 2005, action areas and principles appeared as guidelines to help countries in this important aspect that influences society's prosperity, solidarity and social justice (Campion & Nurse, 2007; Jané-Llopis & Anderson, 2005; World Health Organization, 2008; World Health Organization, 2009). In 2008, WHO launched a program, the Mental Health Gap Action Program (mhGap) to provide a set of activities and programs for countries to scale up care for mental, neurological and substance use (MNS) disorders (World Health Organization, 2008). The mhGAP provides a set of key suggestions, especially dedicated to countries with lower/middle incomes. Their limited resources, both financial and human, allow them to have the potential for maximum impact. Conditions identified as priorities include depression, schizophrenia, psychotic disorders and disorders due to the use of alcohol and illicit drugs. The mhGAP delivers an integrated package of interventions for priority conditions on the grounds of the best scientific and epidemiologic evidence available. One of the aspects highlighted in the guidelines is the need to ensure an adequate planning and delivery of the services, through the establishment of mental health information systems (MHIS) (World Health Organization, 2009).

2.1.1. Mental Health Information Systems Overview

A Mental Health Information System (MHIS) is a system that collects, processes, analyses and disseminates the information about a mental health service and the requirements of the population it serves. It "(…) is a system for action: it should exist not simply for the purpose of gathering data, but also for enabling well-informed decision-making in all aspects of the mental health system" (World Health Organization, 2005).

These systems have many stakeholders that might become end users of the system, whether for professional or personal/health reasons: people with mental disorders and their relatives; clinicians; managers and policy-makers. For managers and policy-makers, such systems provide an assessment mechanism for goals and objectives. For mental health workers, they provide as assessment mechanism for the needs of the users and their response to interventions. For users of mental health services and the wider population, it provides an access medium for the mental health services available.

Such a system is so much a planning tool, as a service delivery tool or a monitoring tool. It improves the way policies are implemented and evaluated, the way to deliver services, the usage of resources and improve their quality and efficiency. It also helps in the definition of the measures needed for providing equitable care with scarce resources.

In 2010, information systems usage in the health sector is widespread, and in the mental health arena, besides the typical applications of clinical administration, there are new and innovative applications on diagnostic procedures, self-help, communication and delivery of psychotherapy. According to Plovnick (2009), mental health information systems implement many aspects of care, including screening and treatment.

Electronic health (e-Health) is the provision of health services over a wide range of information and communication technologies (ICT). The services include electronic health records, contained in health information networks, applications, databases, and telehealth, e.g. videoconferencing. e-Health refers to ICT to improve or enable health and health care, delivering services in new ways (Le, 2007).

Telehealth, also known as telemedicine, or the way to conduct medicine at a distance, exists since the beginning of the twentieth century with the use of the analogue telephone to transmit electrocardiograms (ECGs) and electroencephalograms (EEGs) (Guler & Ubeyli, 2002). Some designate the National Aeronautics and Space Administration (NASA) as the pioneer in the area, with the use of remote monitoring of astronauts since 1960 (Myron & Irene, 2004). It is impossible to state a specific date to the beginning of telemedicine, but information and communication technologies (ICT) advances have brought a new breath to this concept. In 2010, telemedicine can be defined as the use of ICT to provide medical information and services, like health information, assessment, diagnosis, education and other services across geographical distance (Castelnuovo, Gaggioli, Mantovani, & Riva, 2003). Hence, the principles of telecommunications and computer systems, Internet-applications such as email and web browsers, videoconferencing, and remote data monitoring and file transfers provide the basis for telemedicine. Clinical Decision Support System (CDSS), also known as expert systems, try to help in the clinical decision making process that receives the characteristics of individuals and submits patient-specific assessments and recommendations to health professionals' consideration (Hunt, Haynes, Hanna, & Smith, 1998).

Despite the current efforts to provide several services of the health field using ICT, there are still many unexplored potentials. Mental Health is no exception. The introduction of new technologies in this field is usually referred as e-Mental Health (Agence d'Évaluation des Technologies et des Modes d´Intervention en Santé, 2006; K. M. Griffiths et al., 2007; D. M. Hilty et al., 2002; McGinty, Saeed, Simmons, & Yidirim, 2006; Walter & Matheson, 2008). The goal is to allow an equal access to therapies and counseling, as well as other services, to those who may suffer from mental disorders and, for some reason, do not seek face-to-face professional help.

e-Mental Health is, as a result, an approach to provide support for the “well-being” state, while using electronic mediums. Campion & Nurse (2007) define it “as that form of e-health which deals with mental health and mental health disorders. Thus, the term e-mental health refers to mental health services and information delivered or enhanced through the Internet and related technologies.”

Other terms used to define this scope include Telepsychiatry, the use of electronic communication mediums and information technologies that provide or support psychiatric care to individuals, in the form of services and e-Psychiatry or “online psychiatry” (K. M. Griffiths et al., 2007; D. M. Hilty et al., 2002). In 2010, the Internet seems to be the most tried medium to offer psychiatric information. It combines the mass communication effect with interpersonal communication and provides an effective mean to conduct behavioral health interventions. Interactivity is one of the strengths of online interventions, besides the flexibility and the convenience of use (Christensen, 2007; Copeland & Martin, 2004; Mutter, Bouras, & Marescaux, 2005).

Some authors refer that the most successful services available in 2010 are the ones that address the most unmet needs of both patients and doctors (Lauriks et al., 2007). Some of the identified needs include dissemination of information, clinical care, social contact and education (Christensen et al., 2002).

Dissemination of information includes the offer of general content regarding an illness, support for treatment and prevention information. Education relates to patients, families/caregivers and doctors that learn new activities and the training of patients and doctors, including formation programs. Social contact is a transversal topic and it enables tracking patients, and the interaction of patients and families in communities, sharing their real and practical knowledge with interested parties, such as other families and caregivers. Clinical care is the area where the term teleconsultation is considered. Several topics are included in clinical care services such as assessment and confirmation of diagnosis, development of clinical care plans, psychiatric therapy, medication monitoring and review, treatment follow-up and review, psychological assessment amongst others (Agence d'Évaluation des Technologies et des Modes d´Intervention en Santé, 2006).

Mental disorders such as depression already have Internet-based interventions that might range from interactive multimedia applications that are self-contained and have no direct intervention from the therapist to online treatments where structured assignments and therapist feedback is employed (Copeland & Martin, 2004).

Regardless of the type and extent of the MHIS required for a specific context, the WHO provides a set of guidelines to conduct the process for the design and implementation of such systems.

2.1.2. Guidelines for Design and Implementation

Data in an MHIS flows through several stages: collection, processing, analysis, dissemination and use. The first stage, data collection, can occur at four distinct levels also known as subsystems, from the episode level up to the system level (Figure 2). An episode occurs when an individual has contact with the service. A case is a set of episodes that occur over time. The facility level implies keeping track of the entire service with all its cases and, finally, the system level includes all the existing facilities and is the level at which policies and plans are developed and monitored.

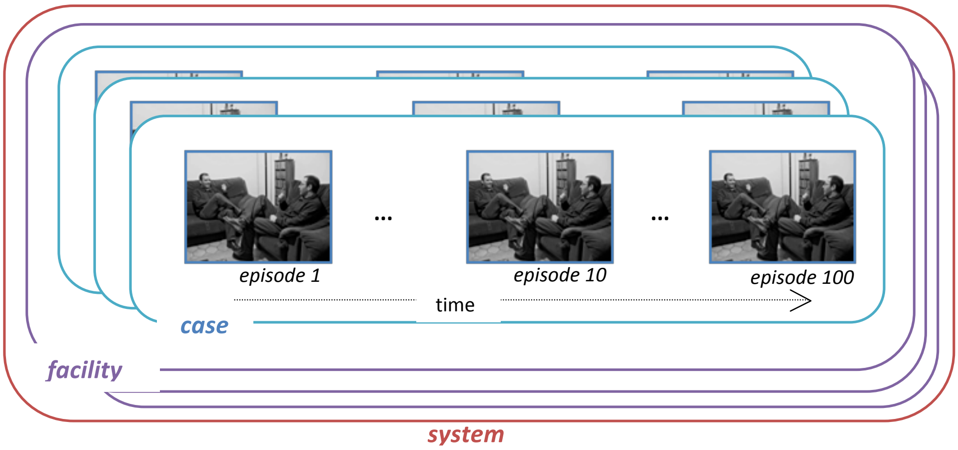


Figure 2 – MHIS subsystems

The WHO has several recommendations to what it considers essential for achieving success in the development and implementation of an MHIS. One should start small but keep an eye on the big picture, use indicators and consider data collection frequencies (routine and non-routine) while establishing a minimum data set. Make it user-friendly and make sure to consult all the stakeholders, clarify its relationship with other existing health systems and link its development to a wider service development are extremely important aspects. Finally, consider how to include epidemiologic data into the system, ensure privacy, confidentiality, access to information and consent and address specific mental health needs are some of the recommended principles.

Figure 3 presents the steps advocated by the WHO to design and implement an MHIS. The cycle they form represents an ongoing process, where the evaluation of the MHIS starts early in the design and implementation phases. The revision tasks that the WHO proposes for steps one and two, the quality checks of step three and the framework established in step four are major indicators of the concern with the evaluation process.

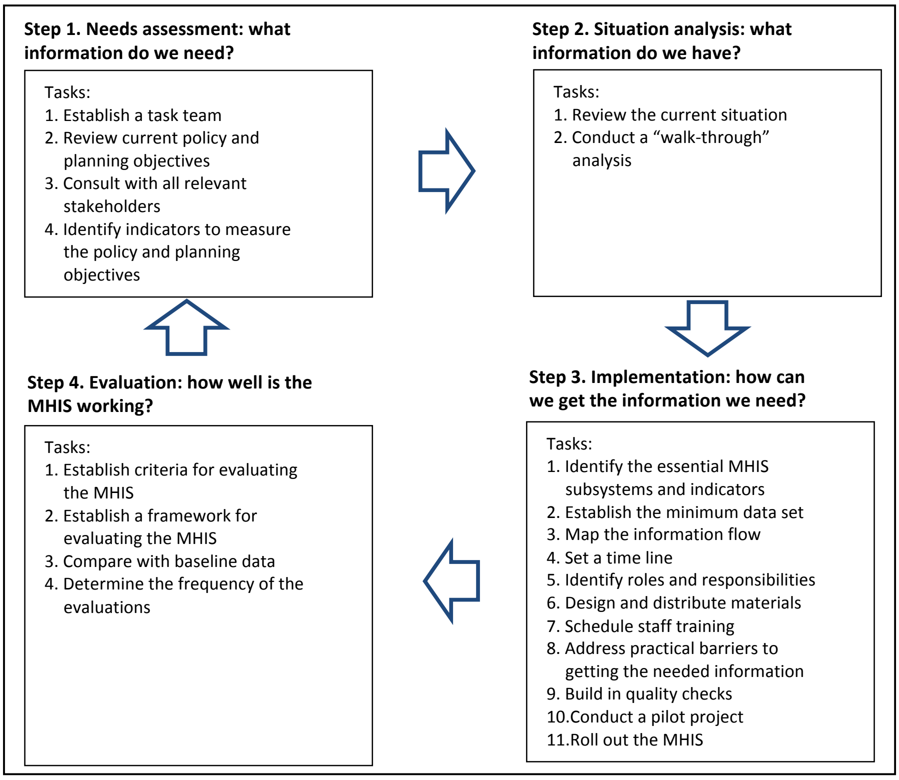


Figure 3 – Steps in the development of a mental health information system – adapted from (World Health Organization, 2005)

The first thing to establish is a task team responsible for the design and implementation of the information system. This task team should be multidisciplinary to include all the organizational, managerial and technical complexities inherent in such systems (Lippeveld, 2000).

The team's first task is to identify indicators, structure the expected goals for the system and transform them into measurable items (Lippeveld & Sauerborn, 2000). Indicators are measures that summarize the relevant information for the system stakeholders. They allow the assessment of the distribution of the resources and services' activities across the distinct service levels of mental health as well as discovering the data to collect. The identification is not a linear process and the list of indicators usually grows exponentially. Thus, it is necessary to keep the list simple and straightforward selecting only the most relevant indicators (Bodart & Shrestha, 2000; World Health Organization, 2005).

Discovering the existing MHIS, their issues and areas of improvement, is the "walk-through" analysis that the team should do. This analysis shows existing indicators and their function – enabling the task team to know what data is currently being collected and for what purpose. The task team should visit clinics and hospitals; track data collection and corresponding flow. This process might include interviews with the health professionals in the services and will provide a valuable insight on problems and shortcomings of current information systems.

As a result of this background analysis, the task team can choose to or extend current MHIS to encapsulate the new indicators found or reduce the list of indicators to fit in the current MHIS or combine the two previous options. It is thus necessary to identify which indicators are viable and then operationalize them. A minimum data set needs to be established and each indicator depicted. A compromise is required between what is desirable to collect and what is feasible to collect.

Agile methods offer a fast way to develop a system that can accommodate all the requirements. This software development methodology tries to lessen friction as much as possible to deliver the final product, while keeping the development process in a sustainable way, with special consideration on requirements handling and testing (Boehm & Turner, 2003).

Another valid concern is to consider the thoughts and opinions of all stakeholders. At least one representative for each group should be listened to in order to bring some insight into the discussion. This process raises the cost and time of the entire design process, but it has proven to be rather successful when engaging all the actors. Each party should have a role and responsibility attributed in a formal list so that managers, administrative and clinical staff clearly understand how to interact with the MHIS. The usage information to deliver to end-users should be prepared in advance and should be simple and easy to understand (Castelnuovo et al., 2003a; Guler & Ubeyli, 2002; Kanani & Regehr, 2003). Such documentation includes instruction and procedure manuals as well as data collection forms. Further, training should be available and scheduled (Le, 2007).

Upon the introduction of a new MHIS into a site, the team should consider the implementation of a pilot project that provides valuable lessons for the design, development and implementation of wider systems.

Quality is the key for the system's success and evaluating a system improves its quality. It is essential to the measure the real value of the system to introduce evaluation milestones where users measure the extent of the systems' impact and its usefulness. Assessment occurs with the introduction of quality checks that enable the continuous improvement of the evolving system.

Criteria such as reliability, validity, sensitivity, accuracy, completeness, timeliness, relevance and utility, simplicity of administration, acceptability, feasibility and flexibility are the general principles to evaluate an MHIS, according to the WHO. Establishing how to conduct the assessment with the users of the system and the frequency of these evaluations is important. Interviews, observation, record reviews and self-administered questionnaires are the proposed approaches to engage in the evaluation of the MHIS (World Health Organization, 2005).

In the deployment process of an MHIS, as it happens with every information system, several barriers will inevitable be encountered. Staff opposition and inadequate technology introduction, are two common problems that the team should detect as early as possible and avoid.

Staff opposition can occur for several reasons that include changes in established work patterns; requirements for new skills; added responsibilities or demands on their time. One of the most important explanations is certainly the fact that health workers have a work overload or see no use in proceeding with the data collection. Thus, simplifying the collection process, prioritizing the data to collect, providing adequate training to the personnel involved and awarding benefits to successful data collectors are some of the proposed solutions. Changes of structure and staff turnovers are also important aspects. These oppositions might take direct, e.g. outspoken refusal to complete a task and indirect, e.g. poor data quality, forms. The team should address these oppositions as soon as possible. Prevention mode is preferred to ensure that the system runs smoothly.

The team should pay attention when trying to introduce a system with inadequate technology into an existing environment that does not have the resources to support it. Sometimes, and especially for low-income countries, a blended approach with a "paper-and-pencil" plus a "computerized" mixture is the perfect and practical choice. When a technology solution is proposed, health professionals should receive adequate training and managerial support is essential.

Recommended proceedings to overcome the barriers include ensuring that local collected data is used locally before being used at superior (national) levels and providing feedback – applying and presenting the obtained results for each of the indicators, according to the level of the service. Furthermore, presenting the information to the users of the system in a simple and attractive way and plan training on a regular basis and in a consistent way to enable health workers to know accurately what is being asked of them, is also important.

Another important aspect relates to managing information systems. After their implementation and deployment, there should be enough flexibility to allow the system to change and expand.

Actually, the guidelines here depicted resemble the ones used in the analysis, design and development of general information systems (B. W. Boehm, 1984; Ghezzi, Jazayeri, & Mandrioli, 2002; Laudon & Laudon, 2001; Schwalbe, 2003). Hence, development teams only need to consider the general guidelines and apply them to a specific context for which they are developing the system, the mental health area.

2.1.3. User Centered Design

In the software development industry, the major aim is to obtain a high quality product that satisfies its end-users. To achieve this goal it is essential to first define what “high quality” means and then, make the product according to it. Usability is a high-level quality objective and serves as the base principle for User-Centered Design (UCD) as we shall see.

UCD was proposed and referred by a large amount of authors and the industry has already proven, like IBM and Google for instance, that the best reason for using UCD is that “if the user can’t use it, it doesn’t work” (attributed to Susan Dray by (Anderson, 2007)). The easy-of-use is a key differentiator (Beyer & Holtzblatt, 1998; Cooper, 2004; Hix & Hartson, 1993; Mayhew, 1999; J. Nielsen, 1993; Rosson & Carroll, 2002). "People ignore design that ignores people" says Frank Chimero (Chimero, 2008).

User Centered Design (UCD) has three principles: focus on users and tasks, measure usability empirically and develop usability iteratively (Dabbs et al., 2009). These processes should be cyclic and imply several iterations before reaching a solution (Wijk, 2006).

It might seem obvious that users should be involved directly in projects, but when real-life projects are concerned, several difficulties arise (Catarci, Matarazzo, & Raiss, 2002). For instance, many organizations do not seem to realize the cost-benefit of involving users right from the start of the software development process; also, there is a cultural issue. According to some authors, UCD has cost benefits, while according to others (R. G. Bias & Mayhew, 1994; Karat, 1997) the usability evaluation methods are not cost effective.

Some disambiguation is required at this moment: UCD is often used seamlessly to refer to Human-Centered Design (HCD). In fact, the terms are regularly used in the same context and bearing the same meaning. Despite the existence of these two terms, we consider that there is no difference amongst them and either one is a valid reference. From this point forward, we will only use UCD, conscientiously, to refer to the process described here.

Several ISO standards are defined and currently in use in the industry. IBM, Apple and Google are some of the companies, to name a few, that use them and are widely known and successful. They seek to provide effective, efficient and satisfying products for use in a specific context. This requires the design of an appropriate interaction and interface, achieved through a user-centered process that is only viable with a consistent organizational capability. IBM is rearranging their development methodologies to lodge the usability experience centered in the final users. Now, the User Experience and Design (UXD) professionals have to adapt their tasks, activities and deliverables to center their work in the users' feedback and iterative development ((IBM Design, 2010)). As far as Google is concerned, in 2007 its User eXperience (UX) experts' team published a set of *Googley* Design Principles that defines smart design approaches (Google User Experience Team, 2010). The ten published principles flow from well-known facts acquired by Google's experience and the UX team' stated mission: "design products that satisfy and delight our users". Thus, a product that accomplishes a harmonious balance between being useful, fast, simple, engaging, innovative, universal, profitable, beautiful, trustworthy and personable, is considered a *Googley* product.

The most referred standards are the ISO 9241 series (ISO, 2009a). These series are concerned with describing usability and the ergonomics in a specific context of use. The oldest part of the series comes back from 1992 and the newest was published in 2009 (ISO, 2009b).

The ISO/IEC 25000:2005, current combination of the former ISO/IEC 9126 and 14598 series, defines the software engineering approach to take when considering the quality of software products and its corresponding evaluation (ISO, 2005).

In order to provide requirements and recommendations to apply in the development of interactive systems, the ISO 13407:1999 (ISO, 1999) is currently under revision by the upcoming ISO/FDIS 9241-210 (ISO, 2010). This revision process is trying to enhance the human-system interaction of the systems.

An important part of the 9241 series is the ISO 9241-171:2008 (ISO, 2008; ISO, 2009a) that provides the guidelines specifically for the design of accessible software including the elderly and persons with disabilities and that complements the more general ones provided by ISO 14915 and ISO 13407 (ISO, 1999).

There are other important standards related to the theme and that somehow influenced our work, but we specially refer to both ISO/IEC TR 19766:2007 (ISO, 2007b) and ISO/IEC TR 19765:2007 (ISO, 2007a). These are the technical reports that provide guidelines and a list of icons and symbols to improve the use of information technology products by elderly and persons with disabilities.

Usability is an important aspect of software products. Probably the most used definition on usability is by Nielsen and dates from 1993: "usability is about learnability, efficiency, memorability, errors, and satisfaction" (J. Nielsen, 1993). The current standard definition of usability introduced in 1998 is as follows: "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" (ISO, 1998). The later definition is gaining ground in the research area and thus it is of major importance to contextualize and describe the concepts involved in the definition:

- effectiveness: the ability of producing or being capable to produce a desired effect,
- efficiency: the quality or degree of being efficient, producing a desired effect,

- satisfaction: fulfillment of a need or want (product provides what users want or need),
- context of use: environment where the product is to be used (knowledge on the users' profiles, tasks where the product is to be used and the physical and organizational ambience of usage),
- goal: the specified and desired effect, depicted as a set of results.

While ISO 9241 defines usability, another standard, the ISO 13407 refers to specificities of designing usability, the process of achieving usable systems (Jokela, Iivari, Matero, & Karukka, 2003). The product/system to be developed has humans/users in the center of the operations. Established since 1999, this standard aims to provide guidance into how to develop interactive computer systems centered on its future users. The idea is to accomplish a usable system.

There is relevant work done that discusses the usefulness and characteristics of ISO 13407 (Earthy, Jones, & Bevan, 2001; Jokela, 2002; Maguire, 2001). Reduced training and support costs, user satisfaction and productivity guarantees are some of the benefits depicted in the standard's rationale. All the previous referred work agrees on the fact that the standard is for those who manage design processes and does not provide detailed information of methods and techniques. Nevertheless, the standard identifies the following four general principles that characterize the user-centered design:

- The active involvement of users and a clear understanding of user and task requirements,
- An appropriate allocation of functions between users and technology,
- Iteration of design solutions,
- and Multi-disciplinary design.

The handbook by the European Usability Support Centers (EU INUSE project) publishes the techniques to support the user-centered design process (Bevan & Curson, 1999). It includes the most available-relevant, mature and cost effective techniques.

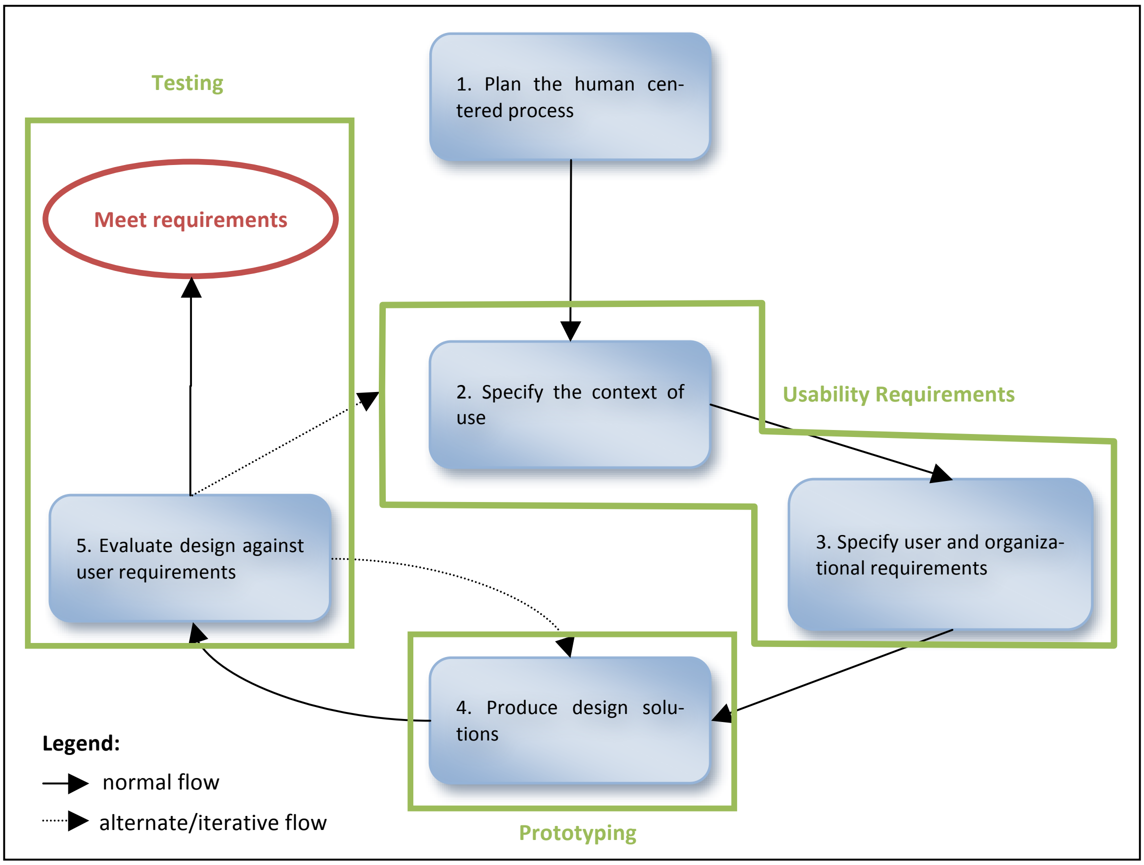


Figure 4 – User Centered Design Process (adapted from (Bevan & Curson, 1999)**)**

The UPA – Usability Professional's Association – defines a typical UCD methodology named "Designing the User Experience" based on the principle: "Providing a great user experience is an ongoing process" (UPA, 2010). In this methodology, UCD activities appear arranged into the four typical software development phases: analysis, design, implementation and deployment. Every phase of this methodology entails the five steps defined for UCD (Figure 4).

After identifying the need for human-centered design, the designer team should plan which methods to use during the distinct phases of the approach (step one). The referred handbook is particularly helpful here, since it provides useful information on the methods to use during the UCD process (Bevan & Curson, 1999). Teamwork and communication are extremely important.

Knowing the environment where the product will be used is essential for a good outcome (step two). The Usability Context Analysis tutorial, based on ISO 9241-11 defines how to gather and document such information and provides guidelines for use in specific organizations (ISO, 2009b).

In order to determine the tasks that users should accomplish when using the product (step three), the team should define users and personnel involved in the system and this specification can be achieved using direct user observation, interviews, questionnaires, focus groups or brainstorming.

To gather the requirements of the system, in step two and three of the UCD process, contextual inquiries, multi-disciplinary workshops and user interviews might be used (Catarci et al., 2002; Jokela, Koivumaa, Pirkola, Salminen, & Kantola, 2006). Furthermore, the Usability Maturity Model (ISO TR 18526) includes a set of base practices to ensure the representation and inclusion of users in a system lifecycle. To help in the development of a UCD approach there are the following well-known methods:

- Focus groups: meetings where all interested parties, including future users share their opinions and thoughts on a specific subject. These meetings are extremely useful to know the context of use of the system since people are able to build on one another's response, enabling crosschecking for factual errors or extreme points of view. Focus Groups directives refer a restricted number of participants (six to seven) and the production of a final report containing the relevant information on the profile of the attendants;
- Usability engineering: a selected person uses a system, following a series of tasks while someone keeps track of its actions and its difficulties (Malhotra, Laxmisan, Keselman, Zhang, & Patel, 2005; J. Nielsen, 1993). Users can use the Think-Aloud Protocol and verbalize every action they are doing (Lewis, 1982). This protocol is useful, inexpensive, but time consuming and if moderators decided to time users' actions in order to evaluate their performance, they must be aware of the fact that the protocol increases the measured times. And some authors state that it might influence the user's performance (Lewis, 1982);
- Participatory design: besides asking the users their opinions on design issues, users are invited to take part in the decision-making of the design process

(Clemensen, Larsen, Kyng, & Kirkevold, 2007; Greenbaum, 1993; Johansson, 1999). This method creates the initial prototype, where a participatory design workshop involving developers, users and designers will accomplish the initial prototype. Participatory Design includes social factors and assumes a limited, rather homogenous user group, despite a group of heterogeneous users with multiple level hierarchies and temporary jobs is becoming a reality and designers in this process might influence users (Pilemalm & Timpka, 2008; Wright & Monk, 1991). Conducting walkthroughs is a useful process where users describe their actions and future use of the system, but is hard to accomplish and time consuming (R. Bias, 1991; Polson, Lewis, Rieman, & Wharton, 1992);

- Contextual Design: includes contextual inquiries to end-users to show how they, in their usual setting, conduct their tasks, the same tasks that will be assisted by the future ICT solution. Contextual inquiry is a specific interview done in the user context and that has little to none interference in the task being conducted. This interview starts as a traditional interview that evolves to a “master-apprentice” connection where the interviewer (apprentice) should be observing and occasionally interrupting the user (master) to ask things about what has happened (Dabbs et al., 2009; Kushniruk & Patel, 2004);
- Questionnaires: asking users their opinions can provide statistical information to increase the study’s credibility through the scientific appearance. There are also explanatory questionnaires that do not provide such statistical information. Usually developers that are geographically distant from end-users use this method. Examples of standardized questionnaires include the Software Usability Measurement Inventory (SUMI); the After Scenario Questionnaire (ASQ); the Post-Study System Usability Questionnaire (PSUQ) and the Computer System Usability Questionnaire (CSUQ). Questionnaires are a good example of subjective measurement (Åborg, Sandblad, Gulliksen, & Lif, 2003). While being inexpensive, they are hard to build and their results analysis is time-consuming. They often show low response rates;

- Interview: a conversation on a one-to-one basis between a developer and a future end-user. Interviews can present open-ended questions or close-ended questions. This allows a better understanding of the user's individual unique point of view. Early in the design process, this method allows a better requirements gathering.

Rapid prototyping presents itself as a fast way to develop, demonstrate and evaluate user interface designs (step four).

Several usability inspection methods, including heuristic evaluation, user satisfaction methods, and the performance measurement method evaluate the proposed design (step 5) (Macleod, Bowden, Bevan, & Curson, 1997). Nielsen's Heuristic Evaluation (1993) is a method for usability testing that enables the identification of problems supported by factor principles. Based on a set of evaluative criteria, the testers (or experts) should experiment with the system (prototype or actual implementation) and record their observations as a list of issues to solve. A priority can be set to each one of the issues in order to express the tester opinion on what to correct first in the development. It is a method extremely easy to learn and inexpensive to use.

The whole idea in testing is to assess the degree of achievement of requirements. In order to answer a simple question: "does this design support the user's tasks?" it is required to diagnose eventual usability problems and evaluate the achievement of the objectives. Testers often do not have the knowledge, instruments and/or time available to test for usability (B. Rahimi & Vimarlund, 2007).

As far as research methods are concerned, most studies identified in the literature refer surveys. These surveys can be set after the system enters the production phase. The most frequent analytical approach is the case study technique, usually retrospective cases that try to measure the impact of ICT in a context and studies that describe the design process (Keen & Packwood, 1995; B. Rahimi & Vimarlund, 2007; Rodriguez, Casper, & Brennan, 2007; Sjöberg & Timpka, 1998). Qualitative research methods also include interviews and existing documents on organizational change (Dabbs et al., 2009; Faber, 2003; Samaras & Horst, 2005). Within the case study scope, video recording and transcriptions are also used techniques. Randomized Control Trials (RCT) type studies, according to Kaplan's study on Clinical Decision Support Systems, do not seem to be the solution for discovering the reasons that lead a system to be used or why and when it is useful (Kaplan, 2001).

On the other hand, narratives and explanations of study participants through the think-aloud method or post-study open-ended interviews are some of the techniques mostly used for these systems' evaluation. There is still much work to be done, moments of reflection and observations of changes in work practices or home routines are extremely hard to capture (Smuc et al., 2009).

It is important to evaluate these tools. Rester (2007) proposes a classification system based on the outcomes as the measure that is highly dependent on the tasks the subjects have to solve. Rester proposal was used in a psychotherapeutic setting for anorectic young women, helping therapists to discover the success or failure in therapy. The evaluation was based on reports that formulate and document the findings of the exploration process that was conducted using distinct techniques. It was followed by the statistical analysis of the outcomes and focus groups were held with a discussion of relevant topics.

Actually, most of the published studies suffer from a weak methodology that includes poor design and leads to inconclusive results (Demiris et al., 2008). The outcome of the existing studies seems to be related to guidelines and instructions for both designers and non-designers with respect of design objectives, processes and ideologies.

2.1.3.1. Patient Centered Design for Mental Health Contexts

Patient Centered Design (PCD) is the designation of a methodology that implies involving patients in the decision-making and development process of an ICT solution. When using such a methodology, patient empowerment occurs and starts to have an active role that allows them to make choices and provide input regarding their treatments (Demiris et al., 2008).

This approach to design is tightly linked to the current development of patient-centered healthcare delivery processes (Dabbs et al., 2009). However, introducing ICT in clinical settings should be done cautiously, namely to support clinicians tasks and augment the services' delivery to patients (B. Rahimi & Vimarlund, 2007; Rothschild et al., 2005). The main idea is to replace pen and paper for computers and digital media with most of these services provided to the citizens through the Internet (NykÄNEN, 2008). In fact, this approach is a fundamental piece to provide Healthcare ICT solutions and implies partnerships between practitioners, patients and families/caretakers (Demiris et al., 2008). Some identify the partnerships as clinical microsystems where everyone is responsible for the actual care conditions, patients included. These liaisons and their nature will have a direct impact on the social context for the product implementation and its complete acceptance, later. The product is an artifact that results from the social exchanges in the group and is close to the users (Sjöberg & Timpka, 1998). This multiplicity of users usually implies multiple user interfaces and plenty to describe regarding approaches to the concept, design and development of such systems (Samaras & Horst, 2005).

In summary, PCD is a particular type of User Centered Design (UCD) where the end-user is a patient that will use a healthcare solution that should meet his/her expectations (Dabbs et al., 2009; Demiris et al., 2008). UCD focus on needs, wants, skills and preferences of the product's primary user. Thus, as a specific type of UCD, PCD starts by listening to the patient's needs and requirements besides considering the social and technical context for the implementation of the product. Most failures come from the absence of feedback from end-users and success is achieved when product designers attend to the needs and wants of users, engaging them early in the design and test process (Pare, Sicotte, Jaana, & Girouard, 2008; Pilemalm & Timpka, 2008; B. Rahimi, Moberg, Timpka, & Vimarlund, 2008; Sjöberg & Timpka, 1998). Human factors engineering knowledge should not be ignored, neither assumed that the already acquired knowledge is enough (Samaras & Horst, 2005). To develop a better fitting organizational system and discover ways to achieve the proposed goal, user involvement is as important as it is necessary. Such a system should meet several goals as well as serve distinct types of users, while ensuring that their work routines are available (NykÄNEN, 2008; Rodriguez et al., 2007; Sjöberg & Timpka, 1998).

PCD should be the central point of a system implementation engineering process, based on existing guidelines for software development. Several approaches gather the vital knowledge needed to prevent rejection of the system, and reduce the information asymmetry usually existent in the implementation process (Pilemalm & Timpka, 2008; B. Rahimi, Vimarlund, & Timpka, 2009). Few have used a PCD approach in the development of ICT healthcare solutions (Asaro, 2000; Sjöberg & Timpka, 1998).

Benefits of PCD include the increase of the communication between the healthcare figures (Demiris et al., 2008). Involvement of clinicians and other staff in the system development and in human computer interface design is crucial for success (C. M. Johnson, Johnson, & Zhang, 2005; B. Rahimi et al., 2008). There should be an interest in linking organization goals with the user goals and the features delivered by the system.

Examples of undesirable outcomes include missing deadlines, poor user adoption and not achieving the expected benefits. Understanding the risks and prioritizing them enables the development team to conduct proper risk management (Pare et al., 2008; Schmidt, Lyytinen, Keil, & Cule, 2001). Amongst the findings of the referred studies, the risks considered most important include the importance of a project champion, the lack of commitment from upper management, the perceived usefulness associated with use of an information system, the project ambiguity and the result of the quality of alignment between the system characteristics and the organization of clinical work.

When it comes to the mental health arena, there are already some services available in the field, but there is no evidence of a sound and systematic method to develop ICT for schizophrenia or psychosis patients (Dabbs et al., 2009; R. B. Jones et al., 2001; Walker, 2006).

2.2. Schizophrenia – a unique and complex condition

Schizophrenia is one of the disorders identified as a priority by WHO in the mhGAP project (World Health Organization, 2008). Currently, it affects about seven per thousand of the world adult population, mostly in the age group 15-35 years, summing up to almost 24 million people worldwide. Nearly 50% of persons with schizophrenia do not receive appropriate care and almost 90% live in developing countries. Although the incidence rate is rather low, three per 10.000 inhabitants, the prevalence is high due to chronicity (World Health Organization, 2007a). The last known study on estimation of prevalence of schizophrenia in Spain indicates an average of three per 1000 inhabitants per year and uses a model to compare incidence figures with the ones reported in prevalence studies (J. L. Ayuso-Mateos, Gutierrez-Recacha, Haro, & Chisholm, 2006). The fact is that the epidemiology of schizophrenia is rather heterogeneous, geographically speaking, and mirrors the clinical and neurobiological heterogeneity of the disorder. Factors such as incidence, prevalence and mortality, together with clinical outcomes, vary according to many variables, e.g. cultural and socioeconomic factors, genetic differences between groups and geographical origin, thus providing the diversity of numbers present in the literature reviewed (Bhugra, 2005; McGrath, 2008; S. Saha et al., 2005; S. Saha et al., 2008).

Schizophrenia is a severe mental disorder characterized by disruptions in thinking. People find difficult "to tell the difference between real and unreal experiences, to think logically, to have normal emotional responses, and to behave normally in social situations" (MedlinePlus, 2008). Someone that endures this condition sees his/her language, perception, and sense of self affected. Seldom, the condition includes psychotic experiences, such as hearing voices or delusions, and can impair functioning through the loss of an acquired capability, disabling the person to earn a living or continue with its studies.

Schizophrenia is a condition usually detected in the early adulthood and there is no known cure. Yet, it is treatable and allows some of those who suffer from it to have an adequate and productive life, enabling them to integrate fully into society.

Eugen Bleuler is a Swiss psychiatrist known for having coined the term schizophrenia for a condition previously known as *dementia praecox*, introduced by the German physician, Emil Kraepelin. In the beginning of the 20^{th} century, Bleuler made a distinction between schizophrenia and *dementia praecox*, since, according to his knowledge, the condition did not always implied a mental deterioration and could occur anytime, both early or later in lifetime. Their work has been highly cited in the last century (Aleman, Hijman, de Haan, & Kahn, 1999; Bleuler, 1963; Harrison, 1999; Kandel, 1998; Meehl, 1962; Stevens, 1982). It is still used as a reference in 2010, despite recent scientific evidence that shows some gaps in their findings (Kalkstein, Hurford, & Gur, 2010; Levy et al., 2010; M. A. Taylor, Shorter, Vaidya, & Fink, 2010).

In the 1920s, Kurt Schneider introduced a list of symptoms (first-rank symptoms) that differentiated schizophrenia from other psychosis, namely hallucinations, delusions and disorganized thinking and speech. A rather common classification for schizophrenia, currently in use, is the Positive and Negative symptoms scale (PANSS) (Kay, Fiszbein, & Opler, 1987). While positive symptoms relate to first-rank symptoms, referred above as negative symptoms, include characteristics that are usually found in healthy persons but are not present in schizophrenic persons, e.g., alogia, anhedonia and asociality. Together, they allow health professionals worldwide to diagnose schizophrenia and provide adequate treatment.

First-rank symptoms were used as the basis for the standardized criteria present in the International Classification of Diseases and Related Health Problems, tenth revision, from WHO (ICD-10). Recent studies questioned the accuracy of these criteria suggesting that upcoming versions of the ICD de-emphasized them. Other standardized criterion for the diagnosis of schizophrenia is the “Diagnostic and Statistical Manual of Mental Disorders”, from the American Psychiatric Association, currently in the fourth “text revision” edition (DSM-IV-TR). The two classification scales subsist: ICD-10 is the international standard that includes the classification for all the diseases known by humanity and DSM-IV-TR is specific for mental disorders. Despite the existence of these two scales, they have a high level of agreement and support the following schizophrenia' subtypes: paranoid; hebephrenic or disorganized; catatonic; undifferentiated and residual (Carpenter & Stephens, 1979; McGlashan & Fenton, 1991). DSM-IV-TR is currently under revision and the new DSM V, estimated for 2013, has already received recommendations to drop the existing subtypes from the classification (American Psychiatric Association (APA), 2010). Nevertheless, the categorical classification of schizophrenia in distinct subtypes is still the current standard, widely used, and will be a reference for this document.

Severe cognitive deficits such as memory loss are a reality for schizophrenia patients, regardless of the schizophrenia' subtype considered (Elvevag, Maylor, & Gilbert, 2003). Schizophrenics suffer from grossly disorganized behavior that can range from very unpredictable agitation to inappropriate behavior. Some of the most common examples include little or no attention to personal hygiene, inability to organize meals, dressing in an unusual manner or becoming agitated and shouting.

Treatment is available in developed countries for affordable prices. A recent study shows its burden is bigger in the first year after the onset and corresponding initial diagnose and afterwards becomes stable (Nicholl, Akhras, Diels, & Schadrack, 2010). Based on new data, recent studies lead the revision of long-time established principles, namely the dogma of superior schizophrenia outcomes in developing countries when compared with high income countries (Cohen, Patel, Thara, & Gureje, 2008; McGrath, Saha, Chant, & Welham, 2008; S. Saha, Chant, & Mcgrath, 2008). Either way, in developing countries, e.g. India, Tanzania and Guinea-Bissau, pilot programs are showing that is feasible to provide effective treatment through primary health care systems.

Health professionals consider both pharmacological and psychosocial interventions effective, but there is a general belief that pharmacological interventions are, besides mandatory, the most effective treatment. WHO recommends the Schizophrenia Algorithm, developed in association with the *Collegium Internationale Neuro-*

Psychopharmacologicum (CINP) and published by the International Psychopharmacology Algorithm (IPA) Project, to be used in the management of schizophrenia (IPAP, 2004). This algorithm encloses 12 steps and illustrates the belief in the effectiveness of the psychotropic drugs. It only introduces the psychosocial treatment in the last step – the maintenance treatment. According to the experts, the reasons for the late inclusion of the psychosocial component in the treatment relate to the fact that patients in this stage accept these treatments better. Patients become more amenable and provide improved cognitive responses.

One major problem of treating schizophrenia is the non-adherence problem since it significantly contributes to the possibility of relapse. Patients easily forget or simply decide not to take the prescribed medication that helps in the control of the disease's symptoms. Fighting this problem is of utmost importance because relapses of schizophrenic patient bring back not only the return of augmented psychotic episodes, but also increase the risk of suicide (Zygmunt, Olfson, Boyer, & Mechanic, 2002). Thus, it has a severe impact in the lives of patients and their family and caretakers. Hence, the need to reinforce the psychosocial component in the maintenance phase.

Adolf Meyer (1957) and George Engel (1977) are accountable for introducing a biopsychosocial approach. Recent studies show the relevance and demonstrate the effectiveness of this approach, despite of an initially undermine by the biomedical reaction to anti-psychiatry (Double, 2007). One of the recognized mental health treatments for numerous illnesses, especially depressive or smoking and eating disorders, are psychotherapies (Briffault, Sapinho, Villamaux, & Kovess, 2008).

The National Institute for Mental Health (NIMH - USA) funded the Measurement and Treatment Research to Improve Cognition in Schizophrenia (MATRICS) initiative that assumes making cognition a rationale for treatment (Green et al., 2004). Cognitive deficits of schizophrenia are a core feature of the illness and relate to the daily functioning of patients.

The subgroup of the Neurocognition Committee of the MATRICS reached a consensus for a battery of clinical trials in the following cognitive domains: working memory; attention/vigilance; verbal learning and memory; visual learning and memory; reasoning and problem solving; speed of processing; and social cognition.

Psychosocial approaches consider each patient as unique and the treatment should consider his/her individual background, psychological makeup, service needs and social support network. Thus, after guarantying the provision of basic needs and services, a set of recommended general treatment approaches are in order. Namely, the attitude towards the patient, providing patient's respect, the education about the illness, to develop partnerships with both patients and families in treatment planning, handle complications due to the illness (side effects) and equal access to rehabilitation opportunities. As far as selecting specific psychosocial interventions, mental health professionals should consider each patient's needs and preferences. These professionals can consider several types of intervention such as Cognitive Behavioral Therapy (CBT) and Social Skills Training (SST).

CBT tries to link feelings with patterns of thinking which influence subjective well-being. This type of intervention may engage patients in real life tasks, where the therapist may help improve the social skills and reinforce the vocational skills of schizophrenic patients (Beck & Rector, 2000; Vauth et al., 2005; Velligan, Kern, & Gold, 2006). Social skills training studied by Liberman (1986) include the impact of teaching aspects of everyday life in patient's autonomy – independent living skills. Other interventions consist in socio-psychological modules, e.g. Program for Assertive Community Treatment (PACT) and family/community integration programs. Together with CBT and SST, rehabilitation programs emerge and introduce the follow up of the treatment for both patients and their families. Society can provide care with active family and community involvement.

Back in 2004, CBT was a scarce commodity, provided by highly skilled and experienced professionals, and thus, a limited resource not available on a daily basis (*Cognitive-behavior therapy*2004). In 2010, it has a growing number of adepts and is actually one of the psychosocial interventions most widely used in the mental health arena (Brent et al., 2008; Kuyken et al., 2008; Leichsenring et al., 2009).

Several studies refer CBT efficacy has reducing relapse rates and of overall symptoms, especially delusions, when compared to routine care (C. Jones et al., 2004; Krabbendam & Aleman, 2003). In fact, research suggests that the best practice in first-line treatment, for most adolescents and adults with mild-to-moderate depression, consists in CBT instead of medication (Christensen, 2007). Besides that, psychological therapy is also the first choice of patients.

CBT resides in an active engagement between a patient and a therapist where they both undertake several tasks such as mood monitoring, identifying and registering thoughts, identifying links between thoughts, feelings and behaviors (Sams et al., 2006). One basic aspect for CBT to work is that the patient should be able to recognize and refer to distinct emotions. Patients should also be able to share and understand some basic concepts such as thinking, doing and feeling.

According to some studies, the record of the sessions, including multi and complex interactions between groups' members is not an easy task to accomplish (Haug, Strauss, Gallas, & Kordy, 2008). Several tools such as questionnaires, sociograms, audio or video recordings, and session transcripts were suggested for providing process information for the therapist but were never integrated into clinical practice routine since gathering the data is too time consuming.

2.3. e-Therapy

e-Therapy is a component of an MHIS that enables the electronic provision of a specific health service, the therapy, where both patients and health professionals are involved. It is a novel mode of delivery for an already existing type of health intervention. There are several computer-assisted approaches available for a wide range of disorders, including physical issues, but the focus given here relates only to the mental area, e.g. CBT (Carroll & Rounsaville, 2010).

2.3.1. Overview

e-Therapy “is a new modality of helping people resolve life and relationship issues. It uses the power and convenience of the Internet to allow simultaneous (synchronous) and time-delayed (asynchronous) communication between an individual and a professional” for Castelnuovo et al. (2003a) (p. 376). While Manhal-Baugus defines e-Therapy as “a licensed mental health care professional providing mental health services via e-mail, video conferencing, virtual reality technology, chat technology, or any combination of these” (Manhal-Baugus, 2001) (p. 4).

e-Therapy is also referred by other terms such as online psychotherapy, Internet based therapy, online therapy, cybertherapy, web counseling, behavioral telehealth, and sometimes as telepsychiatry. It uses text-based forms of communication such as e-mail or chat, and/or video and audio conferencing (Ganapathy, 2005; Heinlen, Welfel, Richmond, & O'Donnell, 2003). These communication mediums usually imply live involvement of a therapist, whether in real time or through asynchronous services, and provide an alternative to the traditional face-to-face context (Mutter et al., 2005).

Using the Internet for online psychotherapeutic interventions covers unmet needs of the mental health arena and includes areas such as clinical care, social contact and education and research (information dissemination). Online interaction might solve the social stigma issue and help working out inhibition issues related to receiving support. Some people disclose their problems more openly to a computer system then to other people (M. Griffiths & Cooper, 2003). On the other hand, people that have mobility limitations, that do not have access to the needed mental health services, e.g. rural areas or that have time constraints, can use the online delivery of the service (Kanani & Regehr, 2003).

According to Wangberg et al. (2007), psychotherapists' theoretical bases may influence the tendency to embrace or reject e-media. Psychotherapists who practice the dynamic-oriented approach, based on transference processes occurring in an established relationship, typically used in group therapy, seem to hold negative attitudes towards e-Therapy. On the other hand, psychotherapists who practice cognitive approaches appear to hold positive attitudes towards e-Therapy. It is important to refer that e-Therapy does not intend to modify theories of already existing approaches, but can affect the patient-therapist relationship (Castelnuovo et al., 2003). e-Therapy can occur at home and facilitate communication between patient-therapist to a friendlier mode minimizing the therapeutic process (A. Barak, 2007; Lester, 2006; Recupero & Rainey, 2006). According to Kanani (2003), there is already evidence of highly intimate-professional relationships over the Internet that becomes closer in less time than those in face-to-face sessions.

The quality of care provided by e-Therapy must demonstrate no significant difference between the one provided in face-to-face contexts (Agence d'Évaluation des Technologies et des Modes d´Intervention en Santé, 2006). Ample evidence shows that services are being provided with satisfactory levels of quality similar to those in traditional settings (Neufeld, Yellowlees, Hilty, Cobb, & Bourgeois, 2007; Postel, de Haan, & De Jong, 2008).

Then again, e-Therapy raises legal and ethical issues. It is important to address privacy and confidentiality considerations and regulate guidelines (Childress, 2000; Christensen, 2007; M. Griffiths & Cooper, 2003; Kanani & Regehr, 2003). Despite these legal concerns, computer-delivered Cognitive Behavior Therapy (cCBT) over the Internet exists and, in general, some of the controlled trials that study their effectiveness have shown that there are no differences between CBT delivered by a therapist or a computer (Christensen, 2007). These interventions seem to be the best ones to adapt to computer software, especially when all the information is taking on some new and more appealing formats such as multimedia content (Copeland & Martin, 2004).

2.3.2. Actors

In the e-Mental Health context there are many actors involved and contributing to the global welfare such as patients, families, caregivers and health professionals such as psychiatrists, therapists and psychologists (R. P. Liberman, Hilty, Drake, & Tsang, 2001). People who suffer of mental disorders have multiple needs related to health and even to other common things, like employment, education, among others (World Health Organization, 2007b).

Whenever there is a service there is always someone that provides the service (provider) and someone that consumes it (consumer) (Castelnuovo et al., 2003). Usually, and particularly in e-Therapy, a patient is regarded as a client, the consumer of the service, while the health professional is seen as the provider of the service (A. Barak, 2007; Castelnuovo et al., 2003; M. Griffiths & Cooper, 2003; Grolleman, van Dijk, Nijholt, & van Emst, 2006; Kanani & Regehr, 2003; Wangberg et al., 2007). As depicted in Figure 5, several actors (patient, health professional, family and caregivers) play the provider and consumer role while providing or consuming e-Therapy services.

One of e-Therapy's goals is to decrease the existing dependency on the health professional by providing a service through electronic communication mediums, to enable patient empowerment. Hence, patients will be able to complete, in an autonomous way, a therapy session – a set of activities that their therapists previously arranged. In an e-Therapy session, the dependency of a patient on the health professional is time consuming and obstructs the health professional real work. In fact, health professionals' main concern is to assist and provide autonomy to the patient. They are not supposed to conduct a set of repetitive tasks that will retain them away from being vigilant of the patient's health (Castelnuovo et al., 2003).

Families and caregivers may also act as “providers” assisting patients in the completion of their therapy sessions at home (Grolleman et al., 2006). They play an important role supporting patients whether in the task to take their medication and help in their daily tasks (World Health Organization & World Organization of Family Doctors, 2008).

The community also has an important role contributing to patient welfare. Patients suffer with fear and prejudice of others. The stigma increases personal pain, which contributes to social exclusion (Health and Consumer Protection Directorate-General, 2005). This results in a low adherence to treatments and decreasing clinical and functional outcomes. Thus, organizations, institutions and communities are also actors. The most common communities generated around e-mental health services are the patients’ communities. There are also families and caregivers communities (independent or included in patient communities). Primary care practitioners, experts and medical staff create a large health professionals’ community.

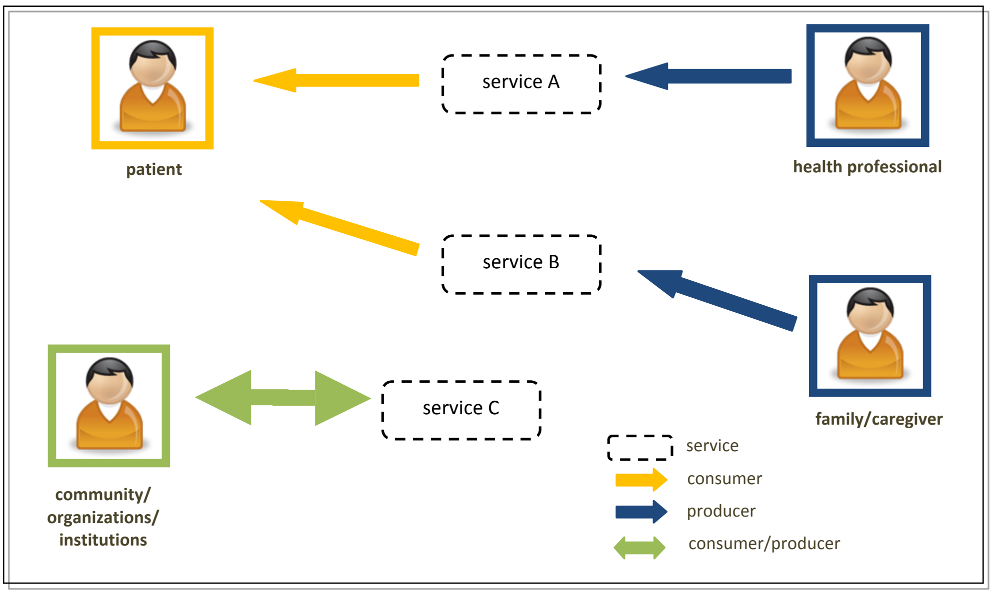


Figure 5 – Actors roles in e-Therapy

There is a clear need for education and training of all these actors regarding mental health issues. e-Therapy may have an important role contributing not only to the patient’s treatment but also in the education process. Thus, several sites, known as points of services, namely hospital emergency rooms, schools, patients’ homes, forensic facilities and even in the “battlefront”, the military sites where actual war combats take place, should be considered as places to deliver e-Therapy (McGinty et al., 2006).

In the near future, new contexts could appear and evolve, namely the family that takes in the role of “provider” but in a family setting – at home or even a first primary care provider trained to conduct an e-Therapy session by an outsider that is an expert in the field (Castelnuovo et al., 2003; Grolleman et al., 2006).

2.3.3. Computer based learning and training systems in e-Mental Health

According to the Institute of Medicine’s report, *Crossing the Quality Chasm*, developing ‘‘patient-specific clinical information’’ computer systems is critical to improve the care of individuals with a chronic illness such as a severe mental illness (SMI) (Chinman et al., 2007). Computer systems have the potential to improve the quality of health care, they are able to summarize patients’ specific information, perform evaluations, present results to therapists and support clinical decisions (Hunt et al., 1998). The majority of existing expert systems (or CDSS) and other general knowledge management computer based systems do not relate to the mental health area, neither to e-Therapy. Online psychotherapy will facilitate the development of the therapeutic relationship between patient and therapist as it usually happens in contexts that are more traditional. Hence, developers of such systems should pay special attention to this requirement (Childress, 2000). Cognitive training involves a guided practice of a set of activities that reflect the cognitive domains. Therapist support is essential for this training, whether it is an individual or group session. Family members can also conduct this training, using the before mentioned professional support. They can take the format of paper-and-pencil, computerized format or analogues to daily activities (Clare & Woods, 2004).

Computer-guided therapy is an innovative strategy that can play an important role in the future of psychological treatment (M. G. Newman et al., 1997; Postel et al., 2008). When this option is available to patients, they are free to accept/reject it with all the benefits of traditional Cognitive Behavior Therapy (CBT) available in a computer and with less therapist involvement. In fact, Computer-assisted therapy programs can increase the cost-effectiveness of CBT by reducing the therapist contact time.

Computerized Cognitive Behavioral Therapy (cCBT) is a set of "computer programs that present the principles and methods of CBT in an interactive manner via a computer interface in two or more sessions. These sessions of cCBT can be presented either on-site (in a treatment facility), online (via the Internet), or via palmtop computers, and the level of therapist involvement can range from none to considerable." (N. Titov, Andrews, Schwencke, Drobny, & Einstein, 2008) (p. 96).

"Intherapy" seems to be the most recent designation for internet-based psychological interventions (Carlbring & Andersson, 2006). The author subdivides the available interventions into four distinct categories: 1 – self-administered therapy; 2 – predominantly self-help therapy; 3 – minimal contact therapy and 4 – predominantly therapist administered therapy. The studies reviewed and that reflect this division suggest the Internet as a promising medium for the dissemination of psychological treatments, specifically for cognitive behavioral therapy.

Computer-aided cognitive retraining programs have several benefits for both patients and clinicians involved.

As it happens with self-help treatments and patient empowerment services, patients can self-administer these programs (Marks et al., 1998). These programs provide more therapeutic-time; allow an easy scheduling and a boost in the access to treatment. Some find it easier to disclosure to a computer system that provides safety/confidentiality guarantees. The consistency of the treatment instructions, plus the content adaption to users' preferences, e.g. language, accent, age and gender of the voice of the program, enhances the patients' motivation (Marks et al., 1998; M. G. Newman et al., 1997).

For clinicians, these programs allow for an unlimited number of repetitions of a given task with changes in the level of difficulty; provide reliable records on patients' performance and do not interfere with other medication (Solari et al., 2004). They free up some of the time to improve the given care and provide easier access to updated information (Carroll & Rounsaville, 2010; Marks et al., 1998). The first step in therapy is assessment and diagnostic evaluation. Health professionals can administer these programs using a computer in an extremely effective way. It becomes possible to avoid the lack of responses to questions, as well as, all paper related expenses (M. G. Newman et al., 1997). It also improves control on therapeutic conditions since systems provide the same instructions always in the same way. Ethical considerations are easier to preserve and the usage of these systems speeds up data collection, retrieval and analysis (including word content), that can provide feedback into the therapeutic process (Marks et al., 1998; C. B. Taylor & Luce, February 2003).

These systems also present some disadvantages: technophobia by users; inability to detect and deal with complications not solved by the system; the lack of flexibility according to a specific cognitive process and it is difficult and risky to design and maintain such a system without the help from a health professional (Marks et al., 1998).

As far as existing counseling and therapy, the online procedure mimics a face-to-face psychotherapy session, using email, virtual chat rooms, web telephony and videoconferencing (A. Barak, 1999). These programs are highly structured and use several multimedia techniques such as web pages, animations, video, sound and cartoons, they include homework assignments, follow-up and feedback sessions (N. Titov, 2007). "Traditional paper-based self-report instruments are easily adapted to the computer format and offer a number of advantages that include ensuring data completeness and standardization." (C. B. Taylor & Luce, February 2003) (p. 2).

Treatment programs available through the Internet are being designed to blend computer assisted psychotherapy and psycho-education with case management. These programs will include face-to-face contact and support groups. The expectations are that therapists include these technical approaches into their standard care practice. This is hard to accomplish since usable programs are not easily available (C. B. Taylor & Luce, February 2003). Nevertheless, the act of designing a computer-aided system can clarify what therapists really do, and so naturally, that do not even realize it. This is easy to understand for any software engineer that had to develop a system to assist an expert in another area. Experts rarely describe their work functions accurately; they tend to minimize some steps considering them non-important (Marks et al., 1998).

It is important to keep in mind that these tools will not replace the therapist, but in fact, they will extend their power and avoid time-consuming and less profitable tasks (Carroll & Rounsaville, 2010; N. Titov, 2007).

A recent Delphi poll with a panel of 62 psychotherapy experts predicted that computerized therapies, use of virtual reality, self-help resources, and self-help techniques would substantially increase in the next 10 years (M. G. Newman, 2004).

There are several software systems available for personal use by patients such as Beating the Blues, Overcoming Depression, FearFighter, Cope and BTSteps, MoodGym, RehaCom, to name a few (Schuhfried, 2010; Tumur, Kaltenthaler, Ferriter, Beverley, & Parry, 2007). Several online sites that hold information – data banks – cover psychological occurrences, symptoms and diseases. Some provide specific self-help topics and psychological assessments that lead to counseling on whether the patient needs therapy (A. Barak, 1999).

More recently, new mobile technologies are starting to be used and there are some reports on the usage of smartphones, handheld computers, tablet PCs and personal digital assistants (PDAs) to collect real-time data on a variety of variables such as patients' thoughts and behaviors. Thus, they are extending the potential for data gathering, even though ubiquitous technology has not proved to be useful when incorporated into clinical practice (C. B. Taylor & Luce, February 2003).

In fact, there is still much work to do as far as proving the utility of all these approaches when used in clinical practices.

2.3.4. Effectiveness: Assessment and Guidelines

Effectiveness is the power to produce a decisive effect (Merriam Webster Online Dictionary, 2010). Effectiveness is a measure typically employed in the assessment of telepsychiatry to find what technology is used (D. M. Hilty et al., 2003). How it incorporates with other services, already existing or non-existing? What are the costs? How it compares to other services and its quality?

Telepsychiatry has already proven to be effective regarding quality of care, satisfaction and education (Ganapathy, 2005). It empowers patients, providers and communities, but it is still not possible to claim that it is cost-effective (D. M. Hilty et al., 2003). Hilty provided a table with recommendations to evaluate telepsychiatry's effectiveness and, in summary, refer to the following items: access; quality of care; satisfaction; costs; realistic estimates of costs; education; empowerment and miscellaneous. There are reports on guidelines for telepsychiatry services in general, for email practices and electronic records such as the Medical Data Index (MDI) (Gadit, 2006; D. M. Hilty et al., 2002; Lauriks et al., 2007; McGinty et al., 2006; Pheby & Thorne, 1994; Todis, Sohlberg, Hood, & Fickas, 2005). Some Internet sites that also provide telepsychiatry guidelines and recommendations are the International Society for Mental Health On-line (ISMHO), the Psychiatric Society for Informatics (PSI), the Canadian Psychiatric Association Web site, the National Guideline Clearinghouse and the American Psychiatric Association (Agency for Healthcare Research and Quality, U.S. Department of Health and Human Services, 2010; American Psychiatric Association, 2010; Canadian Psychiatric Association, 2010; Dyer, 2001; Styra, 2004).

Evaluation is "the act of measuring or exploring some property of a system, the result of which informs a decision concerning that system in a specific context" (E. Ammenwerth et al., 2004). Evaluation of health information systems (HIS) has to deal with the actors, the people, the artifacts, the technology and the environment in which it is implemented, as well as with their interaction (Friedman & Wyatt, 2006). HIS includes "all computer-based components which are used by health care professionals or the patients themselves in the context of inpatient or outpatient patient care to process patient-related data, information or knowledge" (E. Ammenwerth & de Keizer, 2005).

The most common focus of evaluation studies are: appropriateness and efficiency of patient care, user satisfaction, and software quality.

User acceptance and satisfaction sheds a light into the usefulness of the system. Usability description from the perspective of the end-users is required. Indicators such as the time of service delivery, feasibility and changes in the number of visits and improvements in the processes of work and management (the needed higher quality of care) exist in several studies. In addition, the amount and the quality of the information provided by the system is a good usefulness indicator (Dabbs et al., 2009; B. Rahimi & Vimarlund, 2007; Rodriguez et al., 2007). Accessibility for these ICT specific solutions implies special design considerations. Consequently, it is mandatory to account for the different needs for disabled people or for the elderly, where functional limitations are a fact. A simple example to enhance access includes the translation of the application to the native language. Other examples include text colors and typefaces that are more adequate to read (Rodriguez et al., 2007; Välimäki et al., 2008).

Cost effectiveness of these applications is yet to be proved. While economic benefits can be measured as the reduction of the time spent per patient during the visits, Vimarlund et al. (2002) suggests that time and effort invested in the participation of healthcare staff in the development of information systems, exceeds in benefits the costs.

It is not straightforward to know the exact impact at the health and social levels of computer-based patient-centered applications (*E-health: Current situation and examples of implemented and beneficial E-health applications*2004; NykÄNEN, 2008; Wilson & Leitner, C. and Moussalli, A., 2004). No known standard framework exists to evaluate ICT in a healthcare setting, namely the system's productivity and effectiveness (B. Rahimi & Vimarlund, 2007).

There is a proposal with assessment items specifically for e-Therapy settings based on the existing recommendations for telepsychiatry and for MHIS in general that includes quality of care, education and empowerment, access, costs and satisfaction (Reis et al., 2010). Chapter 5.1.6-Assessment and Guidelines for e-Therapy Systems presents further and detailed information on these items.

2.4. Summary

Mental disorders such as schizophrenia are amongst the 20 leading causes of disability worldwide (World Health Organization, 2004). Current national policies are especially dedicated to prevent and improve mental health assistance, considering mental disorders as a public health case (World Health Organization, 2008). One of these policies includes the digital provision of mental health (e-Mental Health) information and services through Mental Health Information Systems (MHIS) (World Health Organization, 2009). There are already innumerous health information systems available in the field, and some are specific for the use in the mental health context. Nevertheless, they are not yet widely accepted and often, users report issues with their usage. Therefore, guidelines for their correct design and implementation are mandatory and the world health organization (WHO) provides a list of steps based on simple principles such as start small but keep an eye on the big picture, make it user-friendly and ensure privacy, confidentiality and address specific mental health needs (World Health Organization, 2005).

User Centered Design (UCD) is a technique based on three principles: focus on users and tasks, measure usability empirically and develop usability iteratively (Dabbs et al., 2009). Patient Centered Design (PCD) is a particular type of UCD where the end-user is a patient that will use a healthcare solution that should meet his/her expectations (Demiris et al., 2008). Several standards relate to these design approaches such as the ISO 9241 series (ISO, 2009a), that includes a revision of the former ISO 13407:1999 (ISO, 1999) and the ISO/IEC 25000:2005 (ISO, 2005). They provide practical recommendations to apply in the development of interactive systems, the software engineering approach to take when considering the usability and quality of software products and its corresponding evaluation.

e-Therapy stands as a subsystem of an MHIS that enables the electronic provision of a specific health service – therapy – where both patients and health professionals are involved. It is a novel mode of delivery for an already existing type of intervention

(Castelnuovo et al., 2003a). There are several computer-assisted approaches already available but the focus here relates only to the mental area and schizophrenia in particular. The act of designing computer-aided systems like these can clarify what therapists really do, including those tasks that they do so naturally; they do not even realize it. In addition, in the actual implementation of these systems, it is important to keep in mind that these tools will not replace the therapist, but in fact will extend their power and avoid time-consuming and less profitable tasks. One should use a framework for measuring the effectiveness of e-Therapy since this field lacks evidence of systems' effectiveness (Improving Access to Psychological Therapies (IAPT) Programme, 2007).

Experts in the field often debate what produces effective feedback; but they all agree that continuous monitoring of the patients' treatment response and provision of the information to the treating clinician are vital.

3. Related Work

e-Therapy contexts should deliver quality services and provide adequate feedback to its users. Providing therapy through new ICTs requires suitable models to correctly monitor and provide visualization to health professionals, assisting them in their tasks and allowing patients to be more aware of their performance. Hence, it is important to have a model to capture the system's usage allowing the continuous monitoring of the users' actions and, on the other hand, have a proper way to provide feedback to the system users. Information visualization's primarily role is to communicate with the end-user and provide insight to them, increasing their knowledge. This section provides background material concerning models for monitoring performance in specific contexts and information visualization models.

3.1. Monitoring Performance Models

e-Therapy will provide training to patients and will help them in their rehabilitation process. One of the effective items credited to computer-based systems was their ability to provide feedback to end-users. Hence, e-Therapy contexts should also provide adequate feedback to its users (Bailey & Forbes, 2005; Marrs & Novak, 2004; Thelwall, 2000).

Health professionals configure activities to setup sessions for their patients and, as a result, establish specific goals for each one of them. In other words, the health professional establishes an evaluation process where the activities defined will help the patient achieve the specified goals. Therefore, when a patient engages in a session and completes the activities defined, an evaluation occurs, and end-users are able to get immediate feedback from the activity that was just completed. This session-evaluation process is similar to what happens in traditional educational settings.

Besides the feedback provided "on-the-fly", in real time, it should also be available "on demand", both for patients and health professionals. While a patient needs more real-time and user-related information, gathered from his/her sessions, a health professional requires a deeper knowledge about his/her patients' performance. The information provided to health professionals regards not only the performance of patients on a specific activity of a particular session but also the complete overview of their performance within a specific timeframe. Moreover, the health professional will need access to this type of information for all of his/her patients.

In order to gather the data to use while providing the evaluation feedback, it is necessary to monitor each e-Therapy session. Thus, keeping a record for all the activities completed in every session.

Recent work offers a literature review of monitoring models in learning contexts and provides a conceptual model for monitoring e-learning contexts (Sampieri, 2008), the Learning Progress Monitoring (LPM) model.

As mentioned before, e-Therapy has numerous similarities to a learning environment where evaluation occurs naturally and is essential to provide adequate feedback to end-users. To accomplish this, it becomes crucial to have a monitoring model that effectively supports such a structure. Thus, special attention is given to the conceptual model (LPM) presented by (Sampieri, 2008).

The LPM defines a monitoring system as an implementation that supervises a process. It has the simple assumption that it is possible to monitor a learning environment using a set of pre-established indicators. An indicator is a measure obtained from the data of an event in the process, inside a predefined context (Sampieri, 2008). The indicator is a variable whose evolution on time, is of special interest. Records will support the tracking of the data that will provide the information for the established indicators. Techniques, tools and methods used to explain (interpret) the evidence present in the data collected compose the interpretation items.

Visualization is the graphical representation of the indicators' state in a specific moment of their evolution, from one state to the next, during certain periods.

The LPM model allows the supervision of the behavior of students in their interaction with the learning management subsystems, contents, tools and activities during the course. It provides feedback to the teachers, organizations, students and other subsystems. Figure 6 represents its main components:

- Indicator Components: Monitoring Objects (MO)

  Each monitoring object holds their indicator definition, the description of the variables required for the data collection and the context for its interpretation.

- Record Components: Monitoring Points (MP)

  Each monitoring point holds the reference of at least one monitoring object. All these objects will be instantiated upon the monitoring point's scheduling. The Monitoring Agent (MA) might ask for information from the monitoring point or a specific event might occur that allows the monitoring point to work autonomously and send the information to the monitoring agent. Hence, there are two distinct types of monitoring points: synchronous (timer and on schedule) and asynchronous (when a specific event occurs).

- Interpretation Components: Interpretation Tools (ITO)

Each monitoring object may have several and distinct interpretations, for instance goal achievement and participation index. An Interpretation tool will define the usage of a monitoring object to provide the explanation of the existing context.

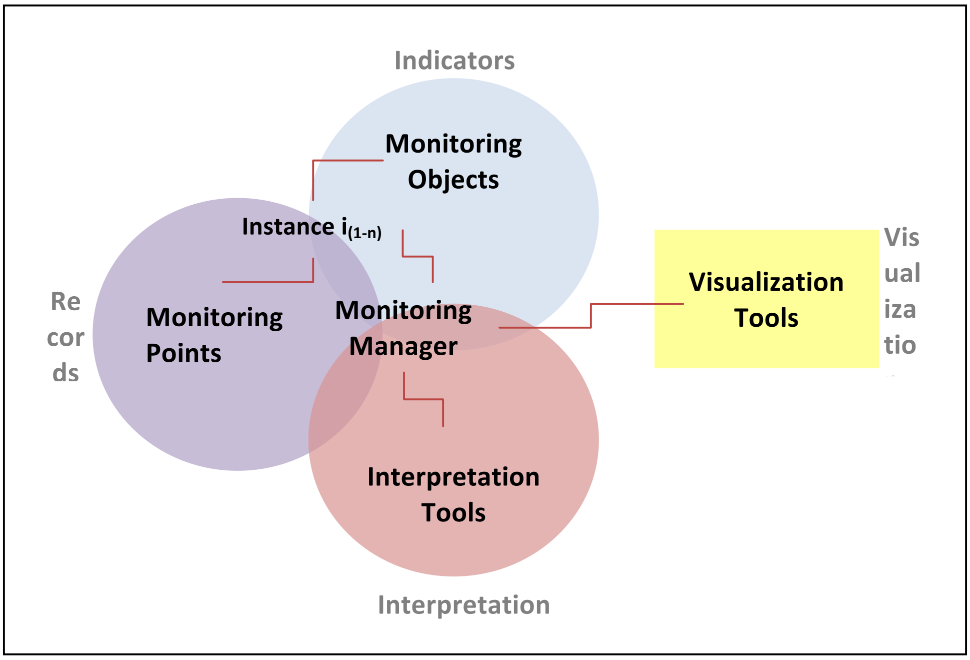


Figure 6 – Basic components of the Learning Progress Monitoring Model - adapted from (Sampieri, 2008)

- Visualization components: Visualization Tools (VT)

Every report and chart, with distinct formats, e.g. text, charts and data structures, is suitable for tailoring, for specific system users. The idea is to provide feedback to the users according to the interpretation tools implemented in the system. This part of the system is significant enough to be included as an independent chapter (3.2-Information Visualization).

- Monitoring Manager (MM)

This is the main module of the monitoring system that enables communication through the system's agent, allows the definition of system procedures (service manager) and storing information in the database.

- Monitoring Agent (MA)

Integral part of the monitoring manager (MM), this agent is responsible for the communication between modules, it uses messages to write data or ask for data.

- Service Manager (SM), Event (E), Monitoring Database (MD) and Monitoring Objects Database (MOD)

The system has external and internal services that managed through the Service Manager (SM). This management is conducted inside the monitoring manager (MM) of which the SM is a part. The state of the system in a given time, the Event (E) works in conjunction with the interpretation tools and there are two databases used to keep information on the generated events, the Monitoring Database (MD) and the monitoring objects database (MOD).

The LPM provides a first approach for the type of monitoring that is required in an e-Therapy system. Nevertheless, temporal considerations require specific attention.

Continuous monitoring of the patient treatment's outcome, providing feedback to therapists, is a good practice that helps to improve the treatment's success and can be easily accomplished using ICT (Percevic, Lambert, & Kordy, 2004). This concern is included in the required quality management for the evolution of managed care. Some authors have already demonstrated how worthy it is to provide feedback to therapists regarding patients at risk or to motivate and educate therapists to adapt therapy length to the impairment of a specific patient. Others consider that the feedback provided should be correctional – should state what had or has to be done and why. Despite the opinion on what produces effective feedback, frequent monitoring of patient treatment response and provision of the information to the treating clinician, are required (Percevic et al., 2004).

To provide adequate feedback, systems usually use psychometric instruments such as short symptom-oriented scales and self-report scales, e.g. questionnaire presentation module and the scoring/feedback module. These instruments allow the surveillance of progress and are already available in electronic format.

To enhance ICT tools for monitoring psychotherapy progress, one can use contributions from research on statistical data presentation (visualization). User interface design and its evaluation should get more attention (van Veenendaal, 2002). While providing feedback has demonstrated positive effects, further research will help to determine what factors contribute to their effectiveness. Why do therapists accept the suggestions proposed by the systems? Are the “soft factors” such as expectations, learning, attention and psychological reactance, considered?

3.2. Information Visualization

"A picture is worth a thousand words" is a popular saying usually labeled as a Chinese proverb that refers to the idea that a graphic representation is the best way humans have to understand concepts (Dansereau & Simpson, 2009). In fact, our neural processes optimize the organization of visual displays that allow us to recognize important complex patterns, otherwise difficult to understand.

Information Visualization, also known as InfoVis, "starts with information in the form of data" and then proceeds with the process of transforming information into knowledge. Finally, knowledge assumes a visual form that makes use of humans' natural visual capabilities (S. K. Card & Mackinlay, 1997; Chittaro, 2001). Visualization provides an interface between the human mind and the modern computer (Gershon, Eick, & Card, 1998). The idea is to enable this knowledge transformation using computers and provide a better understanding of the information available. Thus, users will be able to use their visual pattern recognition, detecting aspects that are unnoticed by automatic systems (Larkin & Simon, 1987).

The primary role of functional information visualization is to communicate with the end-user, while the goal of aesthetical information visualization is to elicit an emotional response from users (Chen, 2010). "*Beauty and brains, pleasure and usability go hand-in-hand in good design*" (Norman, 2005). Emotion is essential for every human being. It goes hand-in-hand with affect and cognition. While cognition allows us to interpret the world, affect, that includes emotion, provides a judgment mechanism that allows us to evaluate a context (good or bad, safe or dangerous) and provides means to improve our probability of survival. An attractive design is not necessarily the most efficient one. On the other hand, while utility and usability are important, emotions, fun, pleasure, joy, excitement, anxiety, danger, fear and range affect the way we behave and think. Beauty is a fact in our everyday life and has a direct impact on the products we buy and use.

One of the greatest challenges of the 21st century is to effectively understand and make use of the vast amount of information produced in distinct areas (C. Johnson et al., 2006). InfoVis allows the illustration of large datasets and provides users with the ability to manipulate data interactively. This way, it is easier to detect patterns, assess situations and prioritize tasks. It reduces and refines data streams rapidly, providing a competitive edge to its users. A computational tool allows users to derive knowledge from data. Contrary to other computer science disciplines, visualization does not try to replace humans with some type of automation; it requires explicit human interaction in the system's loop to extend its capabilities.

Edward Tufte (1983) has an excellent exposition on visualization of data and methods to display information. Tufte provides two and three dimensional (2D/3D) semantics and general rules for layout, color composition and attribute mapping. However, aspects such as data abstraction, dynamic interaction and utility of the display assessment are practically ignored (Martins et al., 2008). Later, Shneiderman (1996) proposed a useful approach for designing advanced user graphical interfaces the Visual Information-Seeking Mantra – Overview, zoom and filter, and details "on demand". Shneiderman classified InfoVis approaches according to two dimensions data type and task each with seven levels.

InfoVis data types include: one dimension (1D) for linear data sequentially ordered, e.g. alphabetical list of names, program source code and textual documents, two dimensions (2D) for planar or map data covering some part of an area, e.g. maps, newspapers layouts and photographs, three dimensions (3D) for data with volume, e.g. molecules, human body and buildings and multi-dimensional for data with *n* attributes in a *n*-dimensional space, e.g. records in relational and statistical databases. Other dimensions include temporal data with start time, end time and possible overlaps on a timescale, e.g. medical records, project management and video editing, trees for collection of items hierarchically linked, e.g. computer directories, business organizations and genealogy trees and network for collection of items linked through a graph structure, e.g. telecommunication networks and the Web. Visualizing *n*-dimensional data and, particularly, temporal dimensions, where data can be linear as well as cyclical over time and is collected and presented in different granularities of time, is a real challenge (Bade, Schlechtweg, & Miksch, 2004).

InfoVis tasks considered by Shneiderman, include overview of the entire data set at a glance, zoom to watch more closely a subset of the data, filter out uninteresting items, details-on-demand to select a couple of items to get more details, view relationships amongst items, support undo, replay and progressive refinement (history) and allow the extraction of a subset of items. While not being a part of the initially proposed set, interactivity is gaining respect in the field (Heer, Card, & Landay, 2005). It increases the user engagement with the observed data and enhances the exploration abilities.

These tasks and data types mixed and combined into InfoVis tools and techniques allow users to explore their data sets and obtain some insight.

The best information visualization is the one that conveys meaning, insight, to its users (Rester et al., 2007). Insights are something unexpected that provides a deeper understanding, a new-way of thinking, and eureka-like experiences. Discovering hidden connections and patterns is important. A brokerage mechanism and a burst function of recognition characterize the nature of an insight. A brokerage mechanism occurs when previous unconnected thoughts are linked together while the burst function usually appears connected to emotional reactions. Insight is "the understanding gained by an individual using a visualization tool (or parts thereof) for the purpose of data analysis which is a gradual process towards discovering new knowledge" (Smuc et al., 2009).

Van Wijk (2006) refers that an InfoVis system can be, at its most simple, a visualization of a "single bit" – the smallest quanta of information. Card, Mackinlay and Shneiderman (1999) extend its meaning to support that InfoVis aims to amplify cognition and provide insight. Pousman et al. (2007) presents a set of different types of insights that are not mutually exclusive:

- Analytic – the most traditional approach. It relates to exploratory analysis and extrapolation. Awareness is a special case of insight that mostly relates to social communication and people's abilities to keep up to date on the outside world and on the information that will influence the future.

- Social – relates to social networks, their social situations and life. These insights are usually something that the user already suspects but requires confirmation.
- Reflective – relates to the personal perspective one can have of the data, by adjusting the point of view to accomplish a certain "distance" from the situation.

Medical staff, e.g., in intensive care units, monitors a huge amount of high-dimensional and time-oriented data that, when visualized, helps in the diagnosis and in the treatment planning (Bade et al., 2004). The visualization process aims to provide insight. Nevertheless, much of the available techniques do not provide adequate interaction techniques to explore and navigate the data and its temporal dimensions.

Medicine requires new methods to improve health. These methods should allow the visualization and monitoring of development, progress and therapies, thus enabling researchers and providers to adjust policies to the actual situation, based on the vast amount of information available today. Visualization has the power to transform health care enabling users' empowerment, improving quality, research and lowering the associated costs (C. Johnson et al., 2006).

It is important to evaluate InfoVis tools and techniques in order to know whether they are actually useful or not for their users. Rester (2007) proposes a classification system based on insights as the outcome measure. Results are highly dependent on the tasks the subjects have to solve. According to a recent review of the state of the art in information visualization, there is a substantial lack of theoretical foundations in the field (Chen, 2010). Moreover, there is no adequate quantitative measure for information visualizations. They can relate to different perspectives, the technological perspective measures in terms of efficiency and effectiveness, the economical one, benefits and costs associated with the development of the visualization method and the ones for user tasks perception and exploration, and its consequences and limitations (Wijk, 2006). InfoVis can be seen both as an art form, as design and as a scientific discipline.

The human visual system allows us to detect interesting patterns rather quickly. This helps in the discovery of insights in large amounts of somewhat unstructured data.

3.2.1. InfoVis Tools and Techniques

Several methods and processes used in applications allow users to visualize and interact with the presented information. These are the so-called InfoVis tools and techniques.

According to Keim (1997), visualization techniques have three major goals, explorative analysis, confirmative analysis and presentation. Explorative analysis starts with a set of data and no hypotheses, the process is interactive, usually in the search for patterns, structures or trends. The outcome of the process is the visualization of the hypotheses discovered. Confirmative analysis starts from a set of hypotheses, the examination of the data is goal-oriented and the visualization allows the confirmation or rejection of the hypotheses. Presentation assumes that the facts and the visualization techniques are pre-determined, so the facts are final, static and visualized in high quality.

In his review, Keim classified visualization techniques according to three distinct dimensions: data visualization, distortion and interaction, as can be seen in Figure 7.

Data can be represented as geometric transformations and projections, symbols, colored pixels, hierarchical partitioning into subspaces, graphs or a hybrid combination of all of them. Data visualization techniques frequently used include scatterplots, landscapes, projection pursuit, hyperslice, parallel coordinates, chernoff faces, stick figures, tilebars, recursive pattern technique, circle segments technique; dimensional stacking, worlds-within-worlds, treemap, cone trees, infocube and basic and specific graphs.

Distortion implies a modification of the image to allow a visualization of larger or smaller amounts of data. Perspective wall, bifocal lenses and fisheye views are examples of simple modifications.

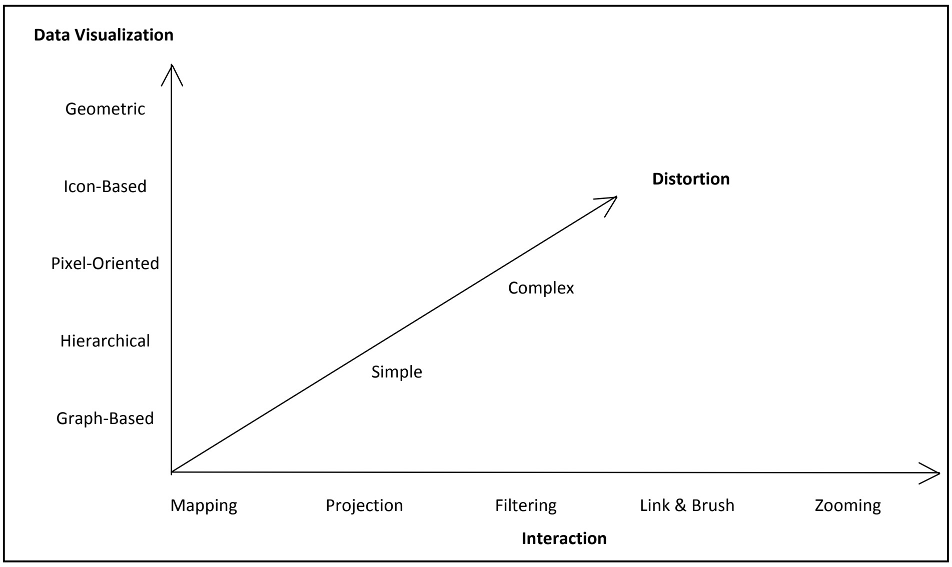


Figure 7 – Visualization Techniques Classification (D. A. Keim, 1997)

Interaction allows a more effective exploration of the data, enabling the dynamic generation of new visualizations. It is possible to have a simple and direct mapping between data attributes and axes or variations of the data with projections and animations in 2D or 3D. Some techniques allow the selection of subsets (filters), linking and brushing with other visualizations, upon change, zoom to provide an overview of the data and the possibility of interactively obtaining further details on a subset of the data presented.

The above mentioned visualization tools have much to gain from other areas of interest, such as statistics, data mining and image processing, to facilitate the analysis of both the qualitative and quantitative perspectives. The visual exploration process is based on the nature, options, limitations and effects of human perception and cognition. One should research new possible systems and techniques and design interaction according to it, in order to lead visualization to its maximum power (McCandless, 2010).

Wijk (2006) presents a simple model for visualization (Figure 8). The model does not provide a taxonomy to position the different visualization methods; it simply tries to describe the context where visualization occurs. Rectangles indicate containers while circles refer to processes.

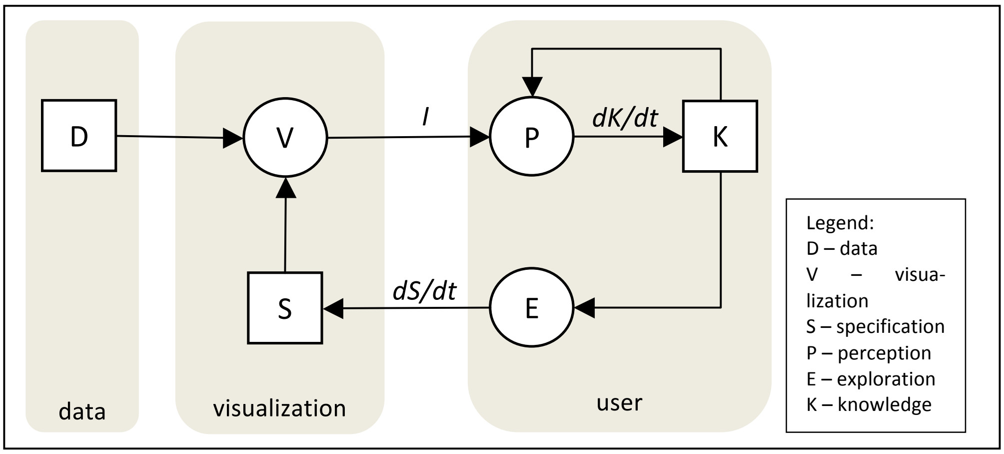


Figure 8 – A Simple Model for InfoVis - adapted from (Wijk, 2006)

The central process in the model is the visualization (*V*) that occurs upon application of a certain specification (*S*) to the transformation of the data (*D*). This produces a specific image (*I*) that varies according to time. The user has a perception (*P*) of the image presented and this process augments its knowledge (*K*). This increase in knowledge depends on the current knowledge of the user and its perceptual and cognitive abilities. The process itself will also change these abilities. The available interactive exploration techniques (*E*) will allow users to change the specification and, thus, obtain new visualizations with new timely images.

Visualization tools' success is highly dependent on the interaction techniques used (Saraiya, North, & Duca, 2005). Designers of such tools should provide a consistent and usable interface and clear feedback to the users. Another important aspect that usually is not well thought-out is the domain relevant inference linking that enriches the insights' discovery process.

Saraiya et al. (2005) conducted the evaluation process of these tools in a different way. They started by providing their own definition of insight and then, measured them accordingly, using their characteristics as parameters, for instance, the amount of time taken to reach the insight. They used the think-aloud protocol in a rather extensive way, as it allowed a deeper and qualitative explanations of the qualitative results obtained.

Keim (1997) also provides a comparison table of the techniques and concludes that different techniques are more useful when used with different types of data among others, relational databases, hierarchies, graphs and time-related data.

3.2.2. InfoVis in Medical Systems

Information systems in the health domain have changed in the last 30 years especially in shifting from knowledge to data-intensive systems (Horn, 2001). There has been also a shift from static to dynamic systems where, besides capturing the patient's current situation, they capture continuous data from the patient's treatment process. A treatment is a medical procedure that is highly correlated with time, and patient data grows over time and forms the basis for many medical decisions (Kosara & Miksch, 2001).

Presenting the data and information in a coherent way in order to support the data analysis process is a major concern expressed by Aigner & Miksch (2006). So far, information regarding treatments, plans, steps performed and results obtained in the process, is roughly included in the analysis process by means of physicians' memory recall. In the health domain, data is collected on a "per patient" and "per episode" basis, growing exponentially over time. Time-related data has a substantial large number of data points present in a simple visualization when compared to what usually happens with other data types (Lammarsch et al., 2009). Therefore, aggregation and scrolling becomes necessary for a single conventional visualization. The corresponding medical databases are becoming even more complex and are growing continuously (Dugas, Kuhn, Kaiser, & Überla, 2001). Hence, patient data monitoring systems face a variety of challenges that include the combination of low frequency and high frequency data and the corresponding processing of high dimensional data.

Hence, InfoVis becomes essential for health professionals and patients (Heer et al., 2005). It is one of the stages in the process of continuous monitoring, querying and analysis of time-oriented clinical data (Spokoiny & Shahar, 2004), that is crucial for making sense of complex data. Visualization techniques have proven to be useful in data exploration for discovering patterns and trends (D. A. Keim, Hao, Dayal, & Lyons, 2007).

The chief goal of InfoVis in a medical system is to provide a more intuitive visual presentation of data that is easy to learn, understand, recognize, navigate and manage (Martins et al., 2008). It delivers the visual possibility to magnify subtle aspects otherwise difficult to notice such as the diagnostic, therapeutic, patient management and healing processes. It also prevents information overload, allowing users to master larger quantities of information. Horn (2001) refers several aspects to explore such as analysis and abstraction of temporal data, plus graphical visualization tools. The tools will provide a better understanding of the recent past of a patient and will be able to present the large extent of information gathered by current ICT systems. By providing this information in an adequate and useful way, it will be possible to enhance the effectiveness and efficacy of the decision-making process (Martins et al., 2008).

It is essential to prove the usability of these tools in order to improve both time and accuracy when performing clinical interpretation. In fact, systems such as computer-supported protocol-based care must demonstrate immediate benefits in solving the patients' problems in order to be more widely used (Gorman & Helfand, 1995).

Plaisant (2004) supports that, while it is possible to measure the usability of information-visualization tools in a laboratory, the real test should be done in a real setting, with real end-users. Empirical evaluations of information-visualization methods will help in the development of innovative information visualization techniques and in their assessment (Martins et al., 2008). To evaluate such systems and techniques, a laboratory setting that allows a quantitative user study that measures user performance on selected tasks might not be enough. In fact, qualitative methodologies can work as a complement to discover if a visualization tool has helped a person solve a problem. Such studies include ethnographic analysis and are a powerful measure of success, especially when the tool becomes so widespread, that its use is considered commonplace.

There is an actual need for models, methods and tools to improve analysis and visualization of data in the decision-making and learning process in health related contexts, namely in the support of the daily diagnostic work (Falkman, 2001). It is necessary to understand how to implement the “formalize-collect-view-analyze-learn” flow. The available clinical information needs to be integrated and presented in multiple and understandable ways to provide new perspectives to research (Bui, Aberle, & Kangarloo, 2007).

Despite the fact that this growing concern with information visualization has started rather recently, visualization techniques such as maps, bar and pie charts and flow diagrams, have been available for a while now (Kosara & Miksch, 2001). Nevertheless, experts that need to perform data analysis on large multidimensional data sets need to rapidly identify problem areas and easily drill into them, to get detailed information. This type of feature is not achievable through charts and tables since they lack data distribution of the attributes, patterns, correlations, trends and detailed information (D. A. Keim et al., 2007).

There are multiple methods to visualize data, especially of time-oriented data in medical domains (Martins et al., 2008; Shahar, Dina Goren-Bar, Boaz, & Tahan, 2006). The time dimension includes both temporal reasoning and data maintenance. The first one refers to the data acquired upon patient monitoring, disorders diagnosing, therapy scheduling and application. While the second refers to the post-fact data stored and further extracted (Spokoiny & Shahar, 2004). Time-dimension conditions possess time annotations such as start time, stop time, and duration (Kosara & Miksch, 2001). A mandatory technique in temporal visualization is time lines, that according to Tufte (1983), is a very powerful visualization technique used long before computers even appeared.

Currently, there are innumerous InfoVis systems and techniques in use in the health context. Several systems include one or more techniques, and seldom, the literature treats a system and corresponding techniques as one, a unique and single item.

Temporal Objects provides visualization of temporal data with distinct granularities and depict complex time annotations. The Set of Possible Occurrences (SOPO) view provides special consideration on uncertainty and indeterminacy of temporal constraints, but does not make time notions easy to understand. Facets are vertical segments that represent a group of similar events that show different views of the same information. TimeFinder is an ontology-based approach that constructs queries from the underlying data, a distinct approach to temporal-abstraction ontologies. Multiple Views is a proposal for an information visualization method that provides numerous representations focusing on distinct aspects of the data and includes two focus plus context techniques: overview plus detail and fisheye view (Aigner & Miksch, 2006; Combi, Portoni, & Pinciroli, 1999; Kosara & Miksch, 2001).

Besides these time-related systems, there are also others and more general options such as the use of concept and mind mapping as a way to express and organize knowledge and pass it from experts in a field to others, MediMap is such an example. MediMap is a data mining and decision support system that tries to improve health-care knowledge management. The *mdplot* is a medical database plot that uses a XML-based graphical straightforward representation of structure and content of medical databases. Table lens displays large data tables by distortion of spreadsheet's table cells, the same transformation function used for the Bifocal Lens applied to two dimensions. There is a Fisheye View for hierarchically clustered networks, called Variable Zoom. It provides a method for zooming into clusters magnifying the zoomed content and shrinking the other nodes/clusters. InfoZoom displays multiple data sets in a highly compressed table that fits into the screen. Another information-visualization technique is the Interactive Parallel Bar Charts (IPBC) system that is the outcome of integration of two and three-dimensional interactive techniques. These are all adapted and widely used in the health context. SimVis and The Cube were designed to help in the classification and clustering of clinical examination data. They possess an architecture that separates the recording of data from the visualization process. SimVis has a similarity assessment-based interaction model and The Cube appears as the preferred option of clinicians since it suggests that the visualization model, space of interconnected points, is closer to the conceptual model of clinical experience. A 3D experience is preferred to a 2D visualization that seemed obvious and easier to understand. Most 3D layout techniques include visual clues like transparency, depth cueing and shadows, among others and the ability to navigate and traverse the structure (Dansereau & Simpson, 2009; Falkman, 2001; Lavrac et al., 2007).

Aigner et al. (2006) researched several commercial software products that include IntelliVue, Chart +, Visual Care and QCare. IntelliVue by Philips Medical Systems, formerly known as CareVue by Hewlett-Packard, is a highly customizable patient data monitoring system used for a broad range of different medical units. Chart+ is a module of a comprehensive software package for critical care units offered by Picis. Visual Care is another software module offered by Picis, which mainly focuses on patient care, and planning. The Critical Care Company that offers a palette of applications for critical care is the owner of QCare. None of these commercial solutions provides visualization logic for treatment plans and do not include several temporal concerns that are extremely important to make sense of the existing information.

We refer here only the most relevant systems available and currently in use in our context of action, although there are many systems available that are not mentioned. Thus, and according to the specificities of our context, a health context with patients' treatments data gathered trough time, we will consider with greater depth, two classes of systems: desktop standalone applications and online applications. The scientific visibility and the online report of community usage are the chief aspects considered in the selection of the systems presented below.

3.2.2.1. Standalone Systems

The LifeLines project enables the exploration and visualization of personal histories using patients' personal records. The project had its origins inside the Human Computer Interaction Laboratory (HCIL), Visualization Area, of the University of Maryland, USA. The prime investigators of the project were Catherine Plaisant and Ben Shneiderman that first described the system in 1996 (Plaisant, Milash, Rose, Widoff, & Shneiderman, 1996). LifeLines introduced lines that translated into graphical form the lives of patients. Cousins and Kahn (1991) first introduced the concept of graphical clinical timelines and temporal visualizations. LifeLines further developed the idea to display chronologies of medical data and social histories. It is based on lines that represent time spans and is extremely similar to Gantt charts. It cannot represent time uncertainty or undefined values and, thus, cannot be used to depict time annotations (Kosara & Miksch, 2001). While it presents the temporal abstractions in a quite intuitive way, i.e. treatment plans with different states such as suspend, reactivate, and abort it is not able to provide domain-specific abstraction knowledge (Plaisant, 2004). It lacks an abstraction knowledge module, similar to the one present in KNAVE-II, a client for the visualization, explanation and the interactive navigation through temporal data from the medical domain ontology (Martins et al., 2008). Currently, the system has evolved to LifeLines2 (2010) where some new interaction techniques were added. The "Align-Rank-Filter" framework, for instance, has shown to improve user performance speed in the tool usage, but this recent version shows no further improvements on dealing with time uncertainty or knowledge abstraction.

Another rather relevant project is the Asgaard Project that includes Asbru, an XML-based language, used to represent clinical guidelines, protocols and plans. The authors included flow-chart and structograms (Nassi-Shneiderman diagrams), PERT charts, Petri nets and state transition diagram (Aigner & Miksch, 2006).

AsbruView is a graphical tool that supports creation and manipulation of time-oriented, skeletal plans, clinical protocols and guidelines (Kosara & Miksch, 2001). Its purpose is to provide a user interface for comparing and analyzing treatment plans as well as patient data of several patients on a single screen. AsbruView's Time Annotation Glyph is a timeline and glyph based visualization specially designed to depict time annotations, thus making time easy to understand.

3.2.2.2. Online Systems

"Many Eyes" is a web site that enables each individual user to access to the visualizations and data sets contributed by other users, trying to reach a broader audience and "democratize" visualization technology (F. B. Viegas, Wattenberg, van Ham, Kriss, & McKeon, 2007). "Many Eyes" is a joint program by IBM Research and IBM Cognos software group that continue to provide a free public experiment, betting on the "power of human visual intelligence to find patterns" (F. B. Viegas et al., 2007). "Many

Eyes"' visualizations are always created online; users do not have to create them separately and then publish them. The system provides several visualization options suggesting categories to end users. Thus, users have categories that range from relationships among data points, scatterplots and network diagrams, to temporal representations, line and stack graph, passing through text analysis and geographical map representations. "Many Eyes" provide guidelines for the data format to upload for their site, enables users to create their own visualizations, share them, and comment on theirs and others results.

Another web site that also makes use of several techniques for visualization of clinical information is "PatientsLikeMe" (Frost & Massagli, 2008). It is a health information system where online communities of patients, with the same disease, share their clinical data. Each patient reports its health information, which is then, presented graphically. The first implementation of the system assisted patients with amyotrophic lateral sclerosis (ALS), also known as motor neuron disease or Lou Gehrig's disease (Frost & Massagli, 2008). The goal was to discover how the data-sharing model affects patients' participation in medical decisions and their daily organization. This community tool currently provides support to patients from other disorders including epilepsy, organ transplant and mood conditions. It offers a graphical display of health information instead of static lists and tables. There is a line graph chart with the individual's functional level over time and a backdrop of the population-level data. Several modified Gantt charts show all the treatments and symptoms experienced by the patient. It also houses a set of user-generated comments about the data or other medical information.

On the same line, but more recently, *CommentSpace* (2010), a new visualization tool that allows users to interact socially while exploring the data, appeared. It works within a social network, the Facebook™ and enables users to explore existing datasets and discuss their data analyses with other users. This tool was developed by researchers of the Berkeley Institute of Design (BiD) from where the *prefuse* development kit (Java) and the corresponding *flare* development kit (Actionscript), also appeared. These last two tools are open source libraries that allow a configuration for a specific context and reflect existing theoretical models, information visualization' reference model or data state model.

Recently, the founders of "Many Eyes", Fernanda Viégas and Martin Wattenberg, considered informal visualizations not only important but fundamental sources for InfoVis development (F. B. Viegas & Wattenberg, 2008). Techniques such as tag clouds that did not emerge from within the visualization research community, can and should be acknowledged and adopted by theorists. "Phrase Nets" is based on tag clouds and is a success example of this line of thinking (van Ham, Wattenberg, & Viegas, 2009). Both researchers are currently leading Google's "Big Picture" visualization research group in Cambridge, Massachusetts.

The TimeLine project approaches the situation from a different perspective (Bui et al., 2007). The framework enables the reorganization and filtering of clinical data and specification of relationships and conditions that dictate the presentation of a data element (graphically). The system provides visualization of Integrated Patient Records (IPR) and has three modules: data access and integration, data mapping reorganization and clustering and data visualization. The time-based display can support context-sensitive visualization, while providing a problem-centric solution. TimeLine uses a visualization dictionary (TVD): a 3D space (data type, medical problem and visualization metaphor) where each point defines for each data item a preferred visualization method. The system classifies time using chronological clusters or time semantics. The k-means algorithm and a later reference to the time between events as the distance is the way to form clusters. Semantic periods encompass several time abstractions such as episodes of care, diagnostic phase, treatment – onset, intervention and resolution. Since then, several authors have used to the timeline technique to improve their data sets visualization (Gill, Chearman, Carey, Nijjer, & Cross, 2010; Mazur, 2008).

Nevertheless, whenever considering temporal visualizations, there are still open problems to handle and solve. How can one represent cyclical events in the best way? How should one deal with uncertainty? How can one introduce context and domain-specific semantic and produce useful knowledge?

3.3. Summary

Continuous monitoring of the patient treatment's outcome, providing feedback to therapists, can improve the treatment's success and can be easily accomplished using ICT. Experts in the field often debate what produces effective feedback; but continuous monitoring of the patients' treatment response and provision of the information to the treating clinician are required. The Learning Progress Monitoring (LPM) model defines a monitoring system as an implementation that supervises a process. It provides a first approach for the type of monitoring that is required in an e-Therapy context.

Nevertheless, temporal considerations are an important aspect and require specific attention. Especially in an e-Therapy setting, patients do not use the system at specific moments of time. Despite the fact that sessions are scheduled, patients are free to conduct their virtual sessions whenever they feel like it. They can repeat the sessions and inclosing activities and this produces a vast amount of information with corresponding timestamps. There is no specific time pattern in the information gathered, but it still needs to be presented in a suitable and useful way for users.

The best information visualization is the one that conveys meaning – insight – to its users. Something unexpected that provides a deeper understanding and eureka-like experiences, allows user to discover hidden connections and patterns. The InfoVis model proposed by Van Wijk (2006) is quite simple and tries to describe the context where visualization occurs. Data undergoes trough a transformation according to a certain specification, an interactive exploration technique, and visualization occurs. The user has a perception based on the image presented and this process augments his/her knowledge. The user controls this cyclic and interactive process. Visualization tools' success is highly dependent on the interaction techniques used and should contain a consistent and usable interface and provide clear feedback to the users.

Following the guidelines provided by Keim (1997) a system that integrates visualization techniques must aim at three goals: enable an explorative analysis, allow a confirmative analysis and present the information. Therefore, an e-Therapy system must, besides presenting and providing the final information in a static and high quality environment, possess an interactive process, allowing users to search for patterns or trends.

Although the existence of many InfoVis systems, visible in the selection mentioned above, there is an actual need for models, methods and tools to improve analysis and visualization of data in the decision-making and learning process in health related contexts, namely in the support of the daily diagnostic work (Falkman, 2001).

4. Research Design

According to Munzner (2008) one should present one’s work as a possible option amongst the alternatives available and then, demonstrate why it is the best choice. Simply documenting the end result is not enough to justify why it is a solution for the problem (Wijk, 2006). Results can rely on laboratory settings, or can rely on field studies, that involve a set of well-combined techniques.

This section presents the design of the research conducted. First, we clarify the domain of the problem and the specific intervention point of the work. Then, we present the research question of the study and describe the methodology and research method chosen, to collect and analyze the data.

4.1. Problem Statement

e-Mental Health is still in an embryonic phase and so are the related and currently available e-Therapy's sites. Schizophrenia is a chronic mental condition with a high prevalence. Its treatment is not yet known by the scientific community and there is a wide spectrum of typologies of the illness that provide a large amount of distinct medical situations, including comorbidity states, that lead to rather serious and poor prognoses (World Health Organization, 2007a). There are an increasing number of schizophrenia-diagnosed patients despite the fact that according to the experts, a simple schizophrenia diagnosis is rare. The wide spectrum of existing typologies of the pathology and the fact that morbidity is a reality produces a rather complex working scenario, especially for non-experts in the field (Bhugra, 2005; McGrath, 2008; S. Saha et al., 2005; S. Saha et al., 2008).

Furthermore, clinicians often refer a certain loss of accuracy since some of the information generated in therapy sessions with the patients is often lost or only remains in the health professional's memory. The few ICT tools available, mostly commercial and proprietary are only available as standalone installations on a per-desktop licensing base (D. M. Hilty et al., 2002). Moreover, besides not being very appealing for the end-user, they are extremely difficult to work with (Christensen, 2007).

Another typical situation occurs for outpatients that need to access the information from outside of the clinical facilities. Suggestions to solve the problem include providing a web-enabled solution available anywhere and at any time (K. M. Griffiths et al., 2007).

It is imperative to have an effective way to monitor patients diagnosed with a schizophrenia typology that have a poor prognosis and a cognitive rehabilitation training program as part of the treatment plan (Marks et al., 1998). Their progress, evolution and performance during the treatment sessions should be available for future use in their own personal treatment or for other, similarly diagnosed patients (C. B. Taylor & Luce, February 2003).

Therefore, it is important to create an ICT system that proposes a solution to overcome some of these difficulties while satisfying the needs here described. It should provide support to traditional therapy sessions, presenting the similarities and differences regarding patients' outcomes. It should also enhance the cognitive training at home, outside the clinical settings that allows families to be an active part of the treatment process of their relative. Health professionals could use it as a useful complement for their work, an auxiliary tool in the therapy process and an aid tool to complement the patient's clinical evaluation and enhance further scientific studies.

4.2. Research Questions and Objectives

As new data accumulate, only a few lucky hypotheses survive the fresh empirical onslaught. Over time, most hypotheses eventually need amendment or outright rejection (McGrath et al., 2008). This thought allowed us to provide an answer to the following research question:

- What can we learn with the introduction of an ICT system that monitors and provides visualization of the performance of schizophrenia patients, in e-Therapy settings?

The analysis of the outcomes produced on specific e-Therapy contexts should enable: the study of performance signs, as far as cognitive skills enhancement (rehabilitation) is concerned and the feedback of obtained results provided into the therapeutic model. Besides, the data gathered by the system will be available for further and future research studies that will open new frontiers in the research of this field.

Several additional questions emerged naturally during our study. The following are other significant questions to which we provide some insight in this dissertation:

- How is it that the introduction of an ICT system influences the existing therapy process? Which is better: the traditional setting or having an ICT system as an e-Therapy tool that complements the session?
- How do patients use an ICT system?
- How do psychiatrists and therapists use an ICT system?

- Why do patients and health professionals use an ICT system? Are there differences amongst sites of application of the system?

In order to achieve the initial proposed goal we had to accomplish the following milestones:

- Develop an e-Therapy platform that provided an actual therapy environment for patients and health professionals;
- Monitor patient's execution of activities in e-Therapy sessions - develop a system that collects information, using established measures (indicators) and records states, during e-Therapy sessions;
- Apply the system in a real setting (with real users: patients and therapists);
- Visualize the results obtained in e-Therapy sessions - develop a system with a graphical representation of the state of the indicators and states considering a temporal axis. Thus, it should be possible to see the system global state, the statistical information centered on the performance of the patients that use the system, in a specific moment and its evolution from a state to the next, during certain periods of time;
- Establish a monitoring and visualization model that easily translates the outcomes measured and how the results were obtained - develop a model that, using the actual measures (indicators and states) of real users of a system, can be applied to set up and conduct new e-Therapy sessions;
- Apply the model to a new real setting, monitoring and visualizing the obtained results;
- Identify the level of satisfaction of the users with the system's usage;
- Provide additional insights on the data collected, presenting the information under different perspectives, such as graphical representations of the indicators considering a temporal axis.

In order to complete all the milestones listed above, provide an answer to the research question and achieve the established goals, we adopted an effective research methodology to conduct our empirical work.

4.3. Methodology

In order to select an adequate research strategy, we compared the available strategies. These strategies incorporate tried and valid methodologies that have already proven to be adequate for specific circumstances.

The first major distinction in the classification of methodologies is usually between quantitative vs. qualitative methods. Initially, quantitative methods were related to natural sciences but nowadays are commonly accepted in social sciences, e.g. surveys and laboratory experiments. Qualitative methods were initially developed for the social sciences. They include methods such as action research and case studies. In recent times, researchers suggest triangulation that deals with the combination of methods and approaches to conduct a better evaluation study (Kaplan & Duchon, 1988). It usually refers to the employment of multiple sources of data, observers, methods and theories while investigating the same event. The goal is to obtain more valid and complete results.

In science, it is important to know the philosophical assumptions that provide "validity" to a specific research, and, which research methods are more appropriate. There are many and divergent perspectives on this subject, including authors that state that philosophies are not always on opposite sides and can be lodged into the same study (Lee, 1989). The position, followed by Orlikowski (1991) and later adopted by Myers (1997), assumes three distinct philosophies or paradigms: positivist, interpretative and critical. For the positivist approach, researchers assume that reality is objective and, as such, is measurable independently of the researcher and instruments used. Generally used to test theory, includes formal propositions, hypothesis testing and quantifiable variables. The critical approach assumes reality in social terms, produced and reproduced by people. In this line of thought, a social critique tries to shed some light into the oppositions, conflicts and contradictions that exist in society. The interpretive approach considers reality as a social construct based on language, consciousness and common values. Used to attempt to understand phenomena, without the strictness of pre-defined variables, an interpretive researcher relies on the human perceptions upon the phenomena.

For Information Systems (IS), the interpretive approach is "aimed at producing an understanding of the context of the information system, and the process whereby the information system influences and is influenced by the context" (Walsham, 1993) (p. 45). For our study, this appears as the most adequate paradigm since the sites for application of the study are rather harsh environments. There are scarce resources available; including patients and therapists, and most times, it is not possible to gather a reliable amount of information. Therefore, we can say that our reality is a social construct defined by the human perception of those involved in the usage of the information system, influencing and being influenced by the system.

Another important aspect of the strategy to employ in the study is to choose a qualitative research method that is accountable for the process used by the researcher to collect the data. Amongst the various options available, “Action research aims to contribute both to the practical concerns of people in an immediate problematic situation and to the goals of social science by joint collaboration within a mutually acceptable ethical framework” (Rapoport, 1970)(p. 499). Ethnography is another approach that implies that the researcher must live in the context of study, and then describe and contextualize the observed phenomena (Orlikowski & Baroudi, 1991). Grounded theory is "an inductive, theory discovery methodology that allows the researcher to develop a theoretical account of the general features of a topic while simultaneously grounding the account in empirical observations or data" (Martin & Turner, 1986). As far as the “case study” method is concerned, there are several interpretations available. The most cited author is Yin (R. K. Yin, 2002) that defines a case study as “an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used” (R. K. Yin, 2002) (p. 23).

From the methodologies presented above and as far as qualitative approaches are concerned, each has its own advantages and disadvantages. Nevertheless, they all provide the collection and analysis of empirical evidence. The data collection is achieved in distinct ways and can be used for three purposes: exploratory, descriptive or explanatory.

According to Yin (R. K. Yin, 2002; R. K. Yin, 2003) the selection should consider the following three conditions: the type of research question posed; the control the investigator has over behavioral events and the focus on contemporary over historical events. The research question and secondary questions proposed in section 4.2 refer to “how” or “why” questions about a contemporary set of events, over which the investigator has little or no control. Thus, the reviewed literature suggests that the viable option in the methodology falls within a group of case studies’ typologies.

Distinct typologies of case studies are available, regarding both the number of cases to study and their implementation conditions. Upon the possibility to replicate a case study, enhancing the analytical conclusions that can be drawn from the two cases, using multiple-case designs is favored over a single-case option (R. K. Yin, 2002). Using more than two cases produces a stronger effect, but at least two cases should be a goal, since single-case studies are highly criticized for their uniqueness conditions. Multiple-case studies are likely to have higher quality the more they include positivist-like features, such as hypotheses and rival explanations. Case study protocols with a clear distinction between evidence and interpretation are also considered valid approaches (R. K. Yin, 1999).

An important fact is that for case studies, data collection should involve a broad variety of techniques. We already depicted, in the conceptual framework chapters, the most frequently used techniques (M. D. Myers, 1997). Interviews, participant observation, fieldwork and written data sources such as company reports, memos, letters, reports and email messages. By using multiple sources of evidence, triangulation for a given fact becomes possible (Keen & Packwood, 1995). Hence, the integration of methods and approaches to conduct a better evaluation study will allow us to obtain more valid and complete results (E. Ammenwerth, Iller, & Mansmann, 2003).

The empirical work was conducted in a realistic and full-scale e-Therapy project, where the eSchi system was deployed – and the goals defined in section 4.1 led to an exploratory study. This typology of case studies states that only after collecting the data can the information be analyzed and explored. The outcome of such case studies is not predictable. Actually, according to the classification of the design typology provided by Juaréz (1993) both case studies can be thought as pre-experimental design. Namely, posttest designs without control groups defined by an "*X O*" approach. There is a single case observation made directly by the experimenter replicated at distinct geographical locations. Despite the well-known weaknesses of this approach, pre-experimental designs are adequate when it is not possible to conduct true experimental designs. To take on conclusions of such studies require extreme caution and are not appropriate. Hence, these studies' results are explanatory for a specific situation and, at best, provided as suggestions for future and similar cases.

The work involves the use of a new information and communication technology and, related case studies usually compare the effect of a new technology with that of other technologies or current practices (Kitchenham, Pickard, & Pfleeger, 1995). There are several examples of similar work depicted as case study and previous work in the evaluation of medical informatics applications. Kaplan (2001) shows that there are few field tests and that the majority of studies use quantitative methods such as the Randomized Control Trial designs (RCT). Nevertheless, the author states that this specific research method is not enough to define whether the systems will be used or not.

Kitchenham (Kitchenham et al., 1995) extended the "how?" and "why?" questions suggested by Yin (2002). Kitchenham added other question: "which is better?" that is specific to the software engineering and development area. The aim is to provide an additional insight into which option is the most useful choice, amongst the possibilities.

We followed a seven-step checklist of guidelines to accomplish the design and administration of the proposed case studies (Kitchenham et al., 1995) with the adjustments we considered necessary for our context of study.

The first adjustment regards the set of hypothesis that we should define in order to provide the initial exploratory base for our research. Instead of hypothesis, we will call them propositions, as we will explain later. Then, we chose the sites for application of the pilot projects and defined a results' comparison method. Attention was given to a set of possible confusing factors that might undermine the work' results; and we depicted the plan to conduct the case studies. This plan was, later, implemented and monitored; and the results obtained were analyzed and are discussed in later sections of this dissertation.

Despite its exploratory nature, the initial proposal for the fieldwork was based on generic premises. We adjusted this initial statement of premises and presented them as propositions. The following list of statements provides our proposal of propositions, the premises, for the study:

- *there is a difference between using an ICT system as a complement in therapy sessions and conducting the traditional therapy sessions;*
- *there is a difference between automatically keeping track of the performance of a patient while conducting a set of virtual activities in a therapy session or not;*
- *there is a difference between visualizing the performance of a patient in e-Therapy contexts and within a specific period or not;*
- *a custom-made ICT system does not suffer updates upon its application to a real setting;*
- *the application of a custom-made ICT system has differences when applied to distinct sites.*

The pilot project sites were selected for several reasons. The willingness of the institutions and their availability for conducting the fieldwork in their facilities were the most important. Mental Health institutions are not easily accessible to the general public, because not only there is still some ICT introduction resistance, but mainly because these environments enclose an intense emotional level where people are frail and confidentiality and security issues must be highly considered.

Two distinct sites, real clinical settings, were selected to serve as an umbrella for the project and serve as the unit of analysis for the multiple-case study approach. The first site is the Hospital Sant Joan de Déu (HSJD), in Barcelona, Spain, a psychiatric institution whose population mainly suffers from schizophrenia or schizoaffective disorders. The entire patient population consists in interns of the institution, some of them in acute stage of the treatment. The second site is the Hospital Magalhães de Lemos (HML), in Porto, Portugal, a psychiatric institution whose population mainly suffers from depression and depression-related pathologies. They have a small population with schizophrenia or schizoaffective disorders that makes use of the facilities on an external visit basis.

For both sites, the only subjects considered in the study are the ones selected by their psychiatrist or therapist amongst the schizophrenia-diagnosed patients. The two sites are located in distinct countries and will be using the same system, but in their own language, namely Spanish and Portuguese. Each site has its own internment policy and thus patients even when correlated by type of pathology are not grouped. At the HSJD some of the patients have been living in the facilities for several years while at the HML all the patients live outside of the facilities and some are totally integrated into society and in an actual family environment.

The results obtained in each site are compared with the corresponding initial baselines. Neither baseline was collected in a systematic way. They are mostly based on the professional opinion on the medical team about the treatment sessions. Afterwards, we compare the results of each site with one another and depict the similarities and differences. As far as the mode of analysis, the approach that we will use when gathering, analyzing and interpreting the data, there are several options available. Hermeneutics relates to the meaning of a text: what is the meaning of this text? When used in an IS context, this technique aims to make sense of the organization and the relationship between people and information technology. Semiotics is primarily concerned with the meaning of signs and symbols and deals with patterns of text and context, by content or conversation. At last, narrative and metaphor play a rather relevant role in types of thinking and social practice. In the IS field, it has been focused on understanding the communication that occurs between system developers and organizational members (M. D. Myers, 1997). In our study, we use the hermeneutics approach since we are mainly interested in analyzing the meaning and the relationships that involve the use of a specific ICT system.

A protocol plan was elaborated for each case study (9.6-Case Studies Implementation Protocol Plans). It was presented to and approved by the psychiatrists and therapists involved. The protocol plans specified the training phase, the schedule and a brief description of the procedures that will be considered in the study. These protocols assumed an extremely important part in the study since it was impossible for me to monitor in person the implementation of the system. It was part of the communication medium used between the end users and the development and research team. Being geographically distant from the implementation sites (either in Barcelona or in Porto), the development and research team had contact with the system users through the system's usage logs and specific monitoring data from the system. In order to minimize possible confounding factors an initial training phase was conducted at each site in order to enable the psychiatrists or therapists to adequately use the system. According to the software development methodology chosen, the user-centered approach, the development team was open to every suggestion made by the future users of the system. Their indications were promptly introduced into the system (annex B-Personal Communications). Every situation that occurred during the implementation phase was recorded, in order to improve future procedures. All the data that was collected, either automatically or upon request of the research team was analyzed and the corresponding results are presented in later sections of this document.

4.4. Research Design Approach

After the methodology and research methods chosen, we planned a set of iterative steps that allowed us to conduct our research work (Figure 9).

First, we conceived a conceptual framework in order to obtain some insight on the theoretical aspects that led the investigation. We researched the theoretical background on the subject Mental Health Information Systems (MHIS) and of e-Therapy, specifically applied to e-Mental Health circumstances. A better understanding of the actual needs in the area as well as the existing work and ICT applications available led to the description made in chapter 2-Conceptual Framework. We also presented a brief overview of schizophrenia as a chronic condition, mentioning the relevance that led to its selection for the case study application. Throughout this process of defining and contextualizing the major themes for the conceptual framework, we reviewed the current software engineering methods and usability standards in order to select and apply the most suitable to the development of the requested system.

Chapter 3-Related Work describes other concepts that relate to the state-of-the-art as far as monitoring and visualization models are concerned. The literature presents these two models connected through a common database that the monitoring process fills in *(input)* and the visualization process uses *(output)*.

Both the conceptual framework as the related work has evolved in an iterative way according to the needs of the empirical work.

The first step of the empirical work consisted in the production of a proposal with a list of guidelines to use in the assessment of e-Therapy ICT systems. The proposal depicts a list of items based on the previous work we were acquainted with and the feedback provided by the process of design and development of the eSchi system as well as its deployment to both case studies.

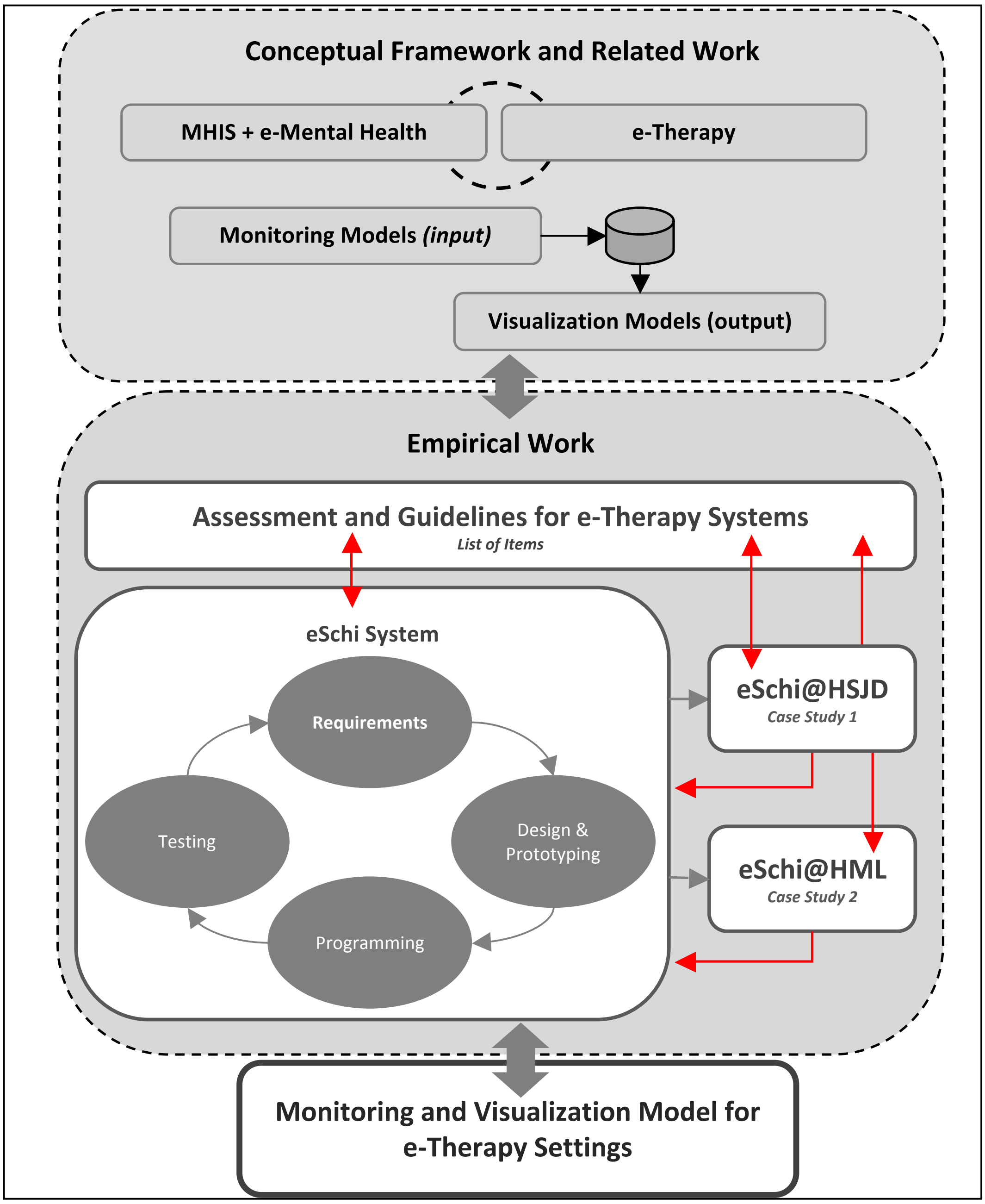


Figure 9 – Research Design Approach

We developed the eSchi system accordingly to current software engineering methodologies and usability standards, in an iterative way. Then, two distinct settings lodged the system: at the Hospital Sant Joan de Déu, in Barcelona, Spain, and at the Hospital Magalhães de Lemos (HML), in Porto, Portugal. The e-Therapy project founders had already established the circumstances for the application of the eSchi system to the Hospital Sant Joan de Déu (HSJD). The e-Therapy project's initial plan did not include a second site. It appeared as an opportunity to test the system under distinct environmental conditions, patients and health professionals and even nationality. The studies occurred in a chronological sequence. The first study conducted was the one at HSJD after which, the system was deployed at HML. Currently, the system is still in use in both sites, plus an additional one, also in Barcelona, at the Hospital Sant Joan de Déu, *Serveis Socio Sanitaris*.

Advances in the empirical work led to advancements in the theoretical framework and vice-versa. Thus, we updated and improved the developed system, accordingly to the literature reviewed and the actual experience of the fieldwork.

We describe the work done in the next sections, where we provide the analysis, design and development process of the eSchi system according to the current software engineering methodologies and usability standards, described in chapter 2-Conceptual Framework.

We provide the list of assessment items and guidelines used in the design of the system. Finally, we present the deployment of eSchi at two distinct sites: at the Hospital Sant Joan de Déu at Barcelona, Spain and at the Hospital Magalhães de Lemos at Porto, Portugal. These are the sites referred in Figure 9 as the case studies.

The results obtained with the case studies and their analysis allowed the acceptance by the final users of the system of the new model that enables the monitoring and visualization of patients' performance in e-Therapy settings, presented in chapters 6 and 7.

5. Empirical Work

In this section, we discuss the design and implementation process for the exploratory study conducted. eSchi, an e-Therapy application was designed and developed. To achieve this, we followed a User-Centered Approach. A conceptual model for monitoring and visualizing schizophrenic patients' performance in e-Therapy settings is presented as well as the assessment items and guidelines used to develop the system. eSchi was deployed into two distinct sites and used in the rehabilitation process of schizophrenic patients.

5.1. eSchi – the system's design

eSchi is a web-enabled multimedia system intended for use in therapy settings. The system provides a commonplace for patients, health professionals and caregivers to relate and communicate with each other. eSchi, amongst other functionalities, allows the management of patients and therapy sessions, as well as carrying out sessions and visualizing the results obtained in those sessions. While patients can conduct cognitive-related activities, where the system plays a more entertaining role, health professionals can monitor and visualize the patients' performance in e-Therapy settings.

The eSchi system contains a set of multimedia tools, available online, that enable schizophrenic patients' cognitive enhancement (Freire, Reis, & Monguet, 2008). The tools help patients in their cognitive rehabilitation and therapists in their work. The main idea was to develop an e-Therapy tool that can be seen as a learning tool to teach and train schizophrenic patients to acquire basic skills that were once lost because of the cognitive impairments suffered.

eSchi is designed as a modular system with two separate modules: the patient module and the therapist module. While the patient module relates to aspects concerning the learning and training of cognitive functions of the patients, the therapist module is more dedicated to the management issues regarding patients and sessions.

Patients will first have to train their motion skills with simple games for the usage of the mouse: moving objects around, clicking on specific places and dragging and dropping objects. Accurate data regarding the patient performance, during the training is recorded. Hence, it is possible to know the patient behavior during a specific activity. There are also basic cognition activities related to recognition and association of objects. In a recognition activity, a stimulus object is shown to the patient for some seconds and after that time, the stimulus disappears. The patient is presented with a set of distinct stimuli, and he/she must identify the stimulus he/she has seen before. In an association activity, a stimulus object is shown associated with other stimulus (for instance, milk associated with the color yellow). When these stimuli disappear, the patient will be presented with unrelated stimuli and the patient must identify the previous relationship between stimuli.

Therapists are able to manage information regarding patients' data, see patients' performance and configure sessions and activities for the patients. The therapist may choose an easier or more complex activity, with more or less time dedicated per activity, according to the type of patient. After conducting the session with the patient, the therapist is able to see the patients' performance during a specific period of time and program future sessions according to the observed results.

The eSchi system was analyzed, designed and implemented using a PCD approach, depicted in the next topics.

5.1.1. Plan the User Centered Process

The eSchi system is the resulting product of an e-Thearpy project conceived by a multidisciplinary team with health professionals (HP Team) and information systems analysts, designers and developers (IT Team). The HP Team was composed by health professionals of the Hospital Sant Joan de Déu (HSJD), in Barcelona, and the IT Team by analysts, designer and developers of the Polytechnic University of Catalonia (UPC) Multimedia Engineering PhD Group of the Polytechnic Institute of Leiria. Both teams shared the dream to improve the quality of life of schizophrenic patients and the quality of their therapy sessions while recurring to new information and communication technologies.

The e-Therapy project started back in 2006. Previously to the work here described and evolved through a series of interviews and meetings to discuss the best way to approach the issues at hand. In the later months of 2008, two new PhD students entered the IT Team and in a certain way boosted the development and implementation of the system. A User Centered Approach was defined to allow the system to evolve and reach an actual and real implementation on site. In 2008, the status of the e-Therapy project was rather well documented (9.1-Meetings and Focus Groups) and all the initial interviewing work had already been done.

5.1.2. Specify the Context of Use

There were many informal conversations and meetings before the first focus group session actually occurred. In this first official meeting, the initial requirements for the system were defined. The meeting was recorded on camera and later a written transcript was made (9.1-Meetings and Focus Groups).

The focus group recognized the system's magnitude and complexity and settled in a prototype approach to the system that complied with the first basic functionalities that could be provided to both patients and the health professionals (9.2-Requirements Specification). Thus, an initial web portal with only two profiles would be available: patient and health professional. Health professionals would be able to manage their patients and manage their patients' therapy sessions. For each session, they could choose from the set of existing multimedia activities. As far as the patients were concerned, they could conduct a session with the activities that were defined by their health professionals. An aspect that was considered relevant was feedback information. Thus, every user should be able to visualize statistical information on the sessions' performance with distinct detail levels.

It was established that the HP Team would provide the contents for the specific therapy activities to be developed under the system and that the IT team would be responsible for the design and development of the system's architecture.

Several focus group meetings took place. It was extremely important to include all the stakeholders including final users as a part of the entire process; to listen and take into consideration their ideas and professional remarks. The following summarizes the main ideas achieved:

- Multimedia activities will be electronic versions of the traditional settings of therapy sessions, tailored to the online environment;
- The act of a therapist creating a session, defining activities as learning and building blocks to be used in the therapy session can be regarded as the definition of a treatment protocol. The protocol algorithm is built for a specific

treatment goal and can be reused or new ones created for specific patients' needs;

- There will be an option available that enables the therapist, or family or care-giver, to take textual free-form notes. The goal is to keep a record of all the visual and non-verbal cues provided by the patient, observed by the person who conducts the session;
- Security issues are contained. Patient records will have restricted access and will not be integrally available. There are already some digital records for patients that will not be included in eSchi;
- A built-in authentication system will limit the access only to known users that provide a valid username/password pair;
- A secure and encrypted access using the HyperText Transport Protocol Secure (HTTPS) technology that enables a secure communication channel, data encryption, and authenticity certificates and signing will also be provided.

Hence, the system was defined in simple diagrams that include the results of the meetings. The following section presents the definition of a therapy session mapped to the digital world.

5.1.2.1. Therapy Session

The initial focus group allowed the non-health professional members of the team to have a more accurate perception on the aspects of a classical therapy session, including its real surroundings.

A classical therapy session takes place in a quiet and comfortable place (an office) and involves a therapist, usually a psychiatrist, and a patient. During a session, both therapist and patient engage in a conversation about the patient's state of mind, its life and its current medication. After that, the patient is invited to take on a couple of activities that will train his/her motion skills and cognitive domains, such as memory.

Carrying out the session involves a major participation of the Therapist, while conducting a specific activity mainly involves a Patient, as depicted in Figure 10. Carrying out a session ("Give session") requires the therapist to follow a set of steps.

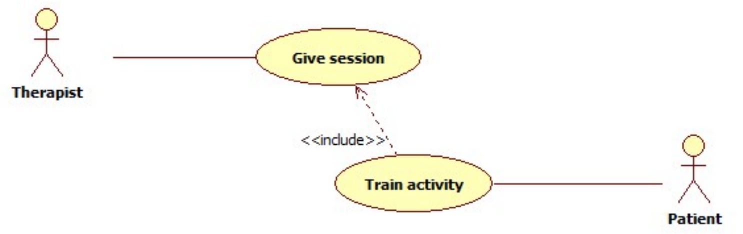


Figure 10 – Actors and activities involved in a traditional therapy session setting

Figure 11 depicts the sequence of steps (algorithm) that are traditionally followed by a therapist in a session, and that the system mimics.

Each session has a predefined length of time. First, the therapist checks the patient clinical information and previous therapeutic sessions' notes and simply waits for the patient to attend to the session.

When the patient enters the office, the session begins and the therapist gives initial psychotherapy to the patient, a casual talk regarding how he/she has been since the last session. The main idea is to assess the physical and psychological situation of the patient in that moment.

After that assessment is done, the therapist checks the patient's personal folder with the activities to be carried in the session. The first activities to be conducted are the ones included as homework in the previous session. Figure 12 presents the flow of activity training.

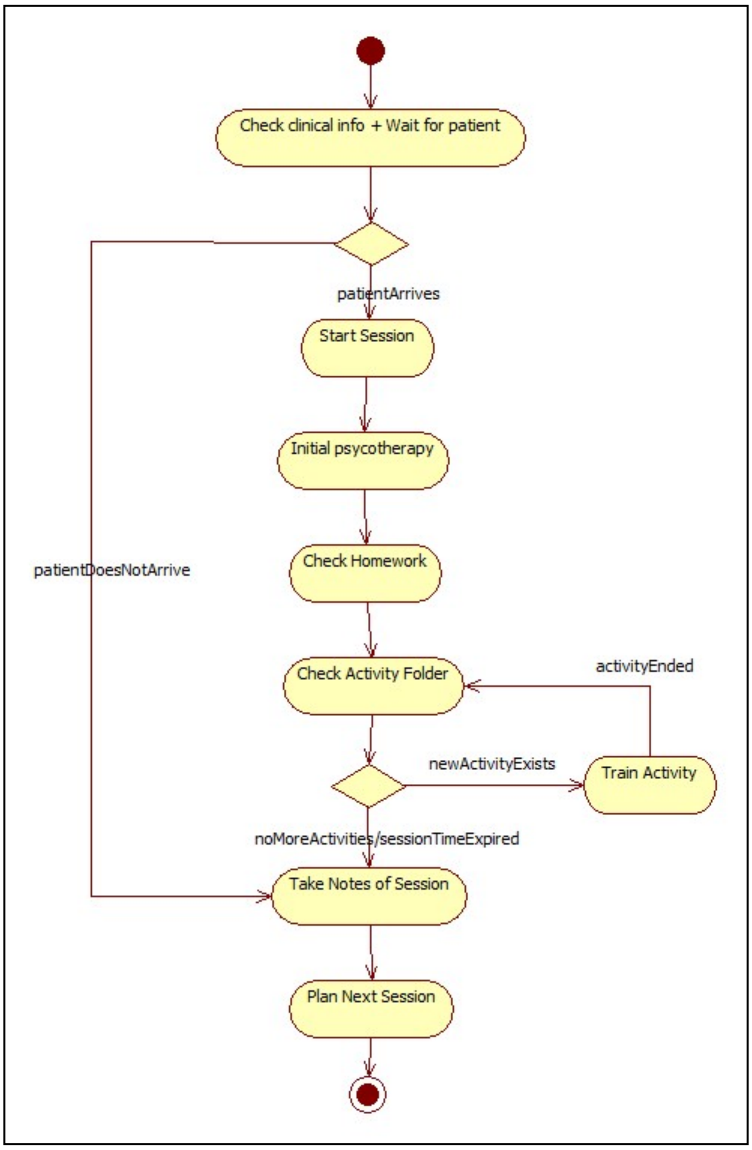


Figure 11 – Treatment Algorithm of a Therapeutic Session – Activity Diagram

Whenever an activity is presented to the patient, "Train activity", he/she might choose to conduct it or not. The activity has a maximum duration time during which the patient should demonstrate its motion or cognitive skills following a pre-defined set of steps. The patient succeeds in the completion of the activity if he/she totally completes the sequence of steps within the proposed time. If, on the other hand, the activity reaches its maximum duration time, the therapist terminates the activity and registers the patient's results.

After each activity is completed, the therapist proceeds with the next one in the folder and hands it over to the patient. The session ends when there are no more activities to carry on or when the time for the session expires.

The therapist can take notes from what occurred in the session and then make plans for the activities for the next session, according to complexity issues of each session-patient.

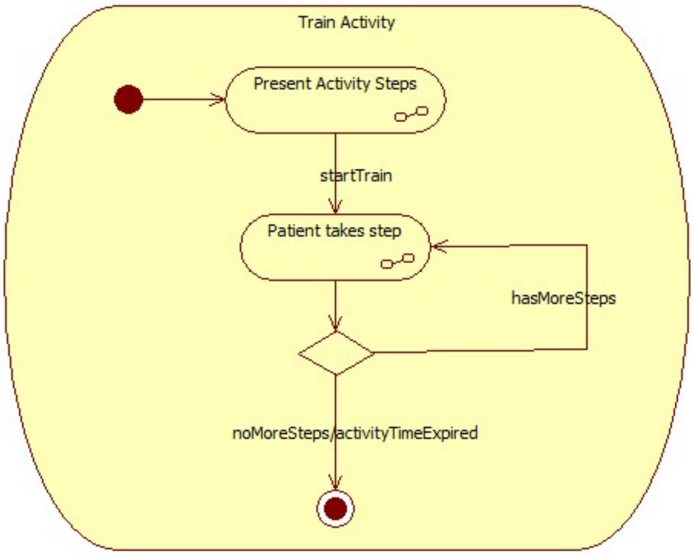


Figure 12 – Patient Steps to Train an Activity – Activity Diagram

If the patient does not attend the session, the therapist registers the absence, registers this situation and then prepares the next session.

5.1.3. Produce Design Solutions

In this phase of development of the system, we designed it according to the knowledge we had gathered in previous phases. Therefore, we provide our considerations while designing the eSchi system architecture, its major functional modules: health professional and patient and the monitor and visualization module.

5.1.3.1. eSchi System Architecture

Figure 13 presents eSchi as a modular system, with the different profiles a user may assume before it.

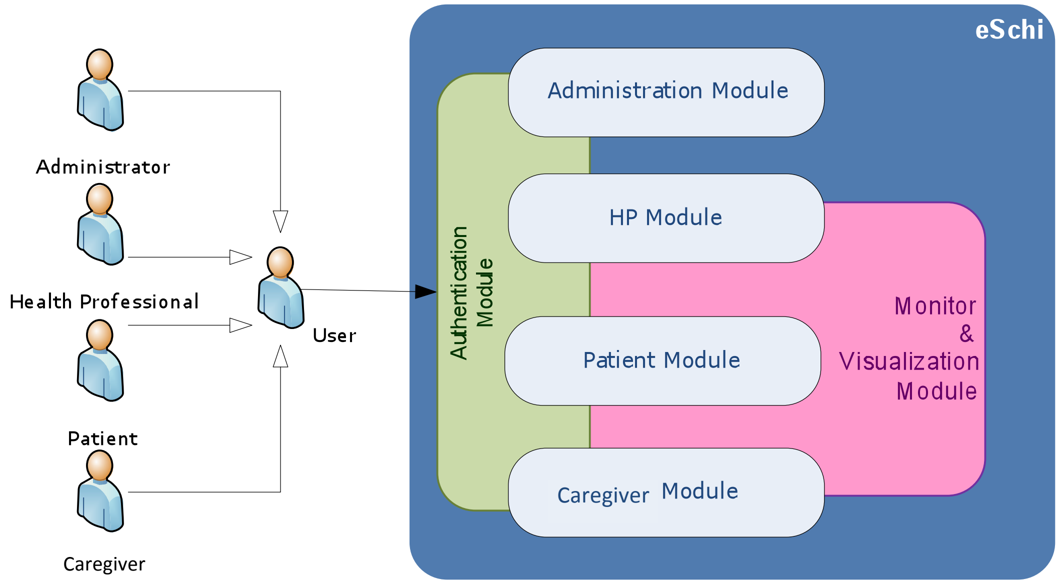


Figure 13 – ESCHI Architecture

Every user can access the system through the authentication module. Upon verification of the user credentials (username and password), the system redirects the user according to its profile and thus enables access to user specific features and data. For instance, a health professional is only able to manage sessions for his/her patients, and is not able to manage his/her colleague's sessions. On the other hand, a patient conducts his/her sessions but not, other patients' sessions.

The following sections will describe the design of the most relevant modules: the health professional module, the patient module, and the monitor and visualization module that assumes a transverse role in the system.

5.1.3.2. Health Professional Module

The health professional (HP) module provides configuration, planning and basic management features to health professionals.

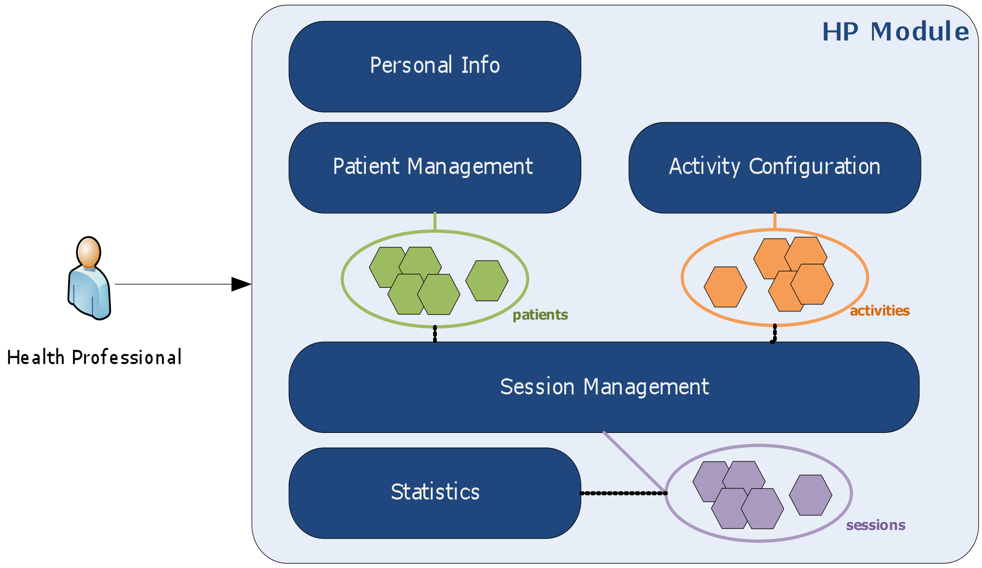


Figure 14 – Health Professional Module Architecture

As Figure 14 shows, the health professional (HP) is able to create new and manage existing patients (green pool of items displayed as patients), as well as activities (orange pool of items displayed as activities) and sessions (purple pool of items displayed as sessions). The HP has access to the pool of patients and to the pool of activities and uses them when performing sessions' management, whether by creating new sessions or updating existing ones (in the sessions pool).

The HP creates new system users, enabling system access to new patients. Besides, it is also possible to update and remove existing patients, disabling their access to the system.

Several activities were defined in the initial focus group and implemented for the first milestone of the system. A list and description of the implemented therapy activities is available in 9.3-eSchi Users' Manual.

There are two types of activities available in the system: motion training activities and simple cognition activities. Motion training activities provide users with a first approach to the system and improve their usage of the physical system: computer, sound system, mouse and keyboard. The activities include sound target shooting, visual target shooting and drag and drop activities. Simple cognition activities are cognitive domain training tasks. The idea is to recall stimulus (recognition) and match up pairs of stimuli (association).

Each type of activity in the system has a small set of configuration parameters. Name, description, activity type, stimulus complexity and duration are the parameters common to all activities and Table 1 provides the configuration parameters that are specific to each one:

Table 1 – Configuration Parameters per Activity Type

Activity Type	Parameters
Sound Target Shooting	number of stimuli time between stimulus
Visual Target Shooting	number of stimuli time between stimulus
Drag and Drop	number of moving stimuli number of target stimuli
Recognition	number of stimuli
Association	number of stimuli pairs

Each parameter configuration combination creates a new activity that can be used in a session by a patient. Specific values for these parameters are responsible for defining a unique environment for the end user/patient. The configuration of parameters is done by the health professional that will try to adapt an existing exercise to the actual needs of a specific patient. A patient could have more difficulties completing an activity on time and that could jeopardize her engagement in the therapy process. If the extent of the activity were altered to comply with her needs, he/she would probably feel more cared, secure and understood.

The above parameters are the ones used internally as monitoring objects and corresponding indicators, for the LPM model, as we will describe in section 5.1.3.4.

A therapy session is a meeting between a health professional and a patient on a specific date and time. Throughout the meeting, the health professional proposes a set of distinct activities to the patient. These activities are cognitive training activities similar to the ones previously referred above.

A health professional creates new therapy sessions choosing the patient it is intended to, the date for the session to be held and the activities that will be undertaken during the session. In the context for implementation of the system, sessions occur on a daily basis, thus, there is only one session configured per day. Nevertheless, a patient is able to repeat its daily session every time he/she desires.

Every session has a status that changes automatically according to the usage of the system. Both HP users and patients have a direct influence on a session state, as can be seen in Figure 15.

Upon its creation, a session enters in the “Created” state. When the patient starts taking a session, the session automatically enters the “OnGoing” state, where it remains up until the instant the patient ends the session. At this point, the session is considered as being “Terminated”. Nevertheless, since a patient can repeat his/her daily session countless times, the session can re-enter the “OnGoing” state after being “Terminated”. A session can only be updated while it is still in the “Created” state. Once the session starts for the first time and then ends (being both in the “OnGoing” and in “Terminated” state) it cannot be updated.

These state changes are the internal monitoring points for the LPM model. They determine the instants in time for recording the indicators of the monitoring objects and are responsible for obtaining the system’s “usage data”.

According to the LPM model used, every system that monitors and then provides some sort of visualization to its users, requires visualization interpretation tools. The details on how the interpretation tools and corresponding visualization tools are implemented are described in section 5.1.3.4. Here we only provide some screenshots that show some of the results, in chart format provided to end-users.

Figure 16 shows the performance of a patient for every try he/she has on a specific activity. This scatterplot provides details such as total time and precision (number of correct guesses) for each try of the activity.

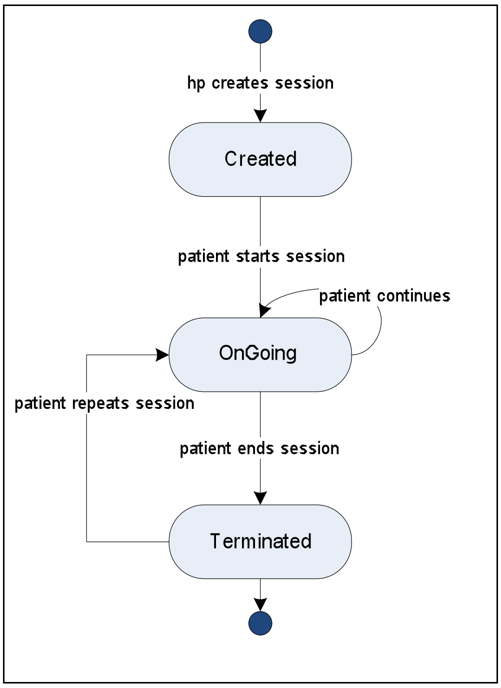


Figure 15 – Session state chart

This is the visualization available for a patient in a specific session or day, where he/she has conducted the activity several times. For instance, he/she has tried the activity twice at 14h13m, once at 14h19m and at 14h30m,… and the last try was at 15h04m. There was a loss of precision up until 14h38m and that was majored by the last try of the day.

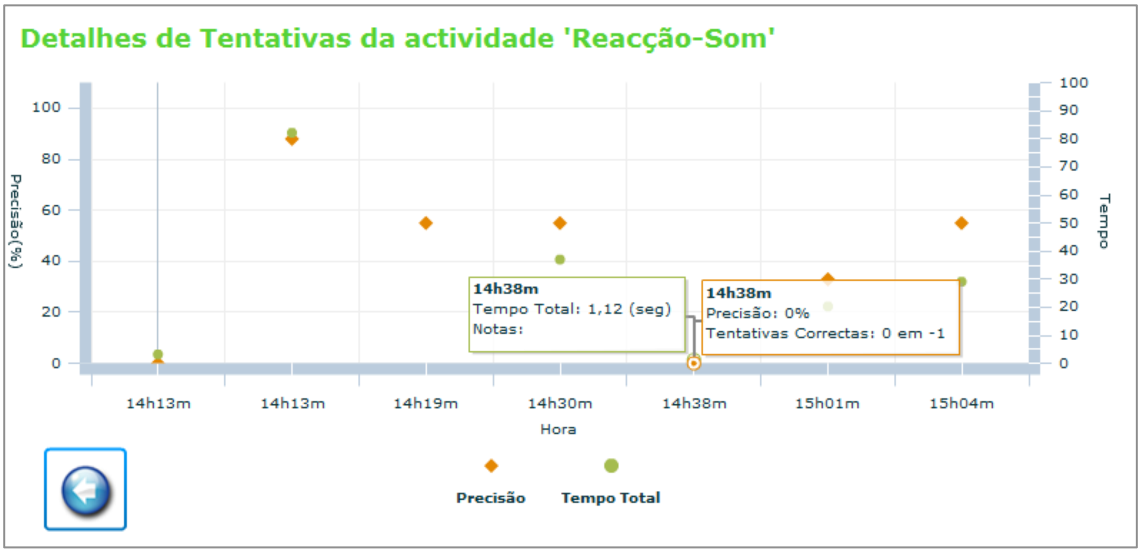


Figure 16 – Visualization of the Details for the Performance of a patient for all his/her tries of a specific activity

Figure 17 presents the average session length for a patient. This bubble chart provides additional information regarding the number of attempts to conduct activities the patient made. Thus, the health professional can visualize the performance of the patient according to the days. One possible instant insight from this visualization is the fact that the patient was more dynamic or involved in 24 November. The number of attempts, visible by the size of the circle on that day, surpasses the other days.

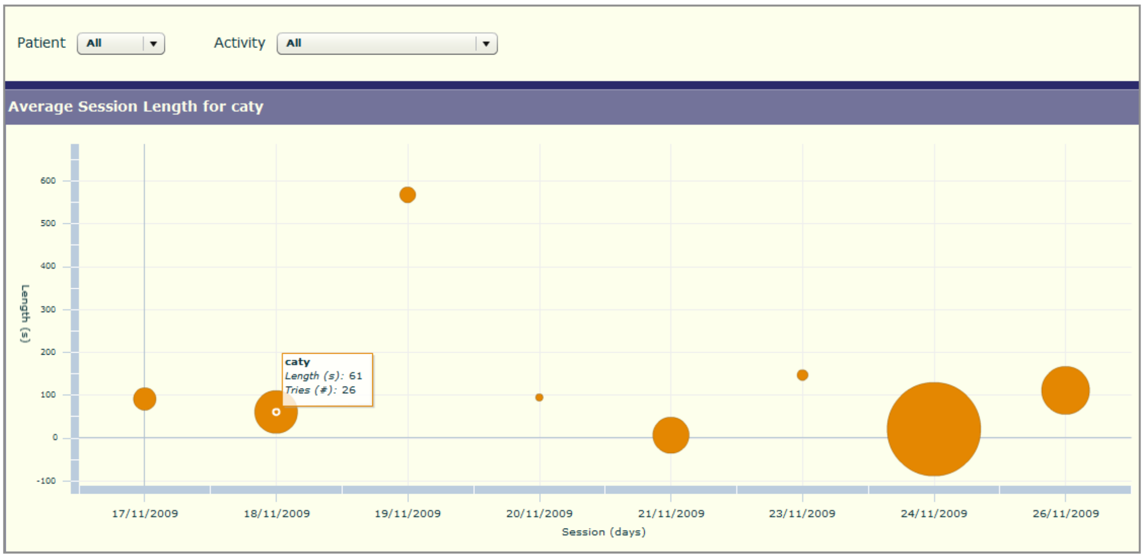


Figure 17 – Visualization of the Average Session Length for a patient

There are additional visualization options in chapter 9.3-eSchi Users' Manual.

5.1.3.3. Patient Module

This module enables patients to carry out therapy sessions, completing cognitive activities, and to visualize their results. Only patients access this module. Both HP users and caretakers might also access it for therapy matters but they must do it using patient credentials; they assume the role of a session therapy assistant.

Figure 18 presents the features available for a patient. When he/she accesses the system, the list of activities that were scheduled for the current day is shown and the system considers the "session execution" has started. On the subject of sessions' scheduling, please refer to the previous section (Health Professional Module).

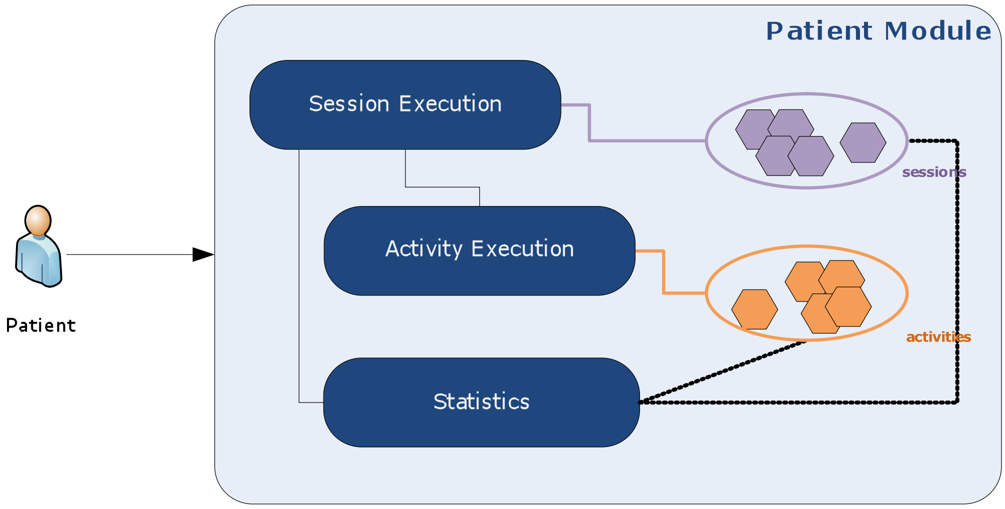


Figure 18 – Patient Module Architecture

There are several types of activities implemented in the system and they all comply with the same interface that easily allows any new activity to be added to the system. All the activities follow the same sequence of steps shown in Figure 19.

Similarly, to what happens in the health professional module, these are the internal monitoring points considered for the identified monitoring objects. The execution of an activity starts when the patient selects/chooses the activity to carry out.

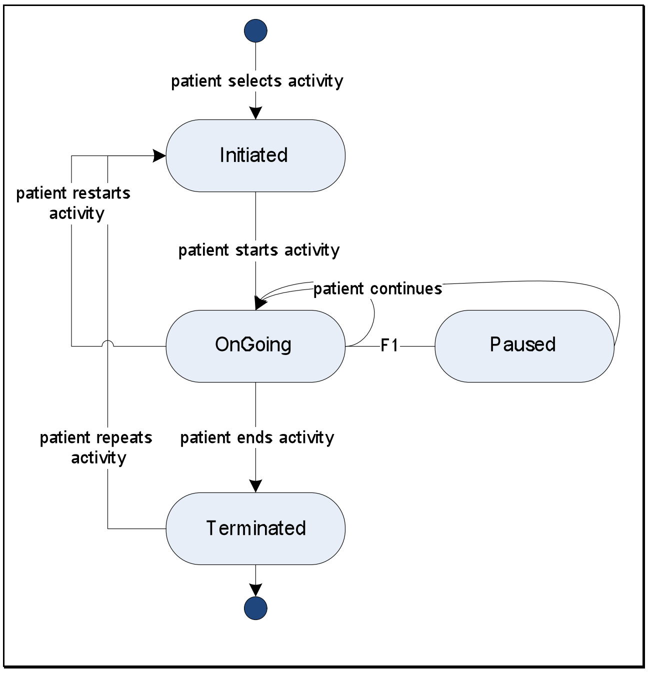


Figure 19 - Activity state chart

After that, the activity is said to be "Initiated" and an initial message with instructions for the activity is presented. At this point, the patient can actually engage in the activity that assumes the "OnGoing" state. When in the "OnGoing" state, each activity defines a set of actions that the user can take. For instance, in a typical drag-n-drop activity, the patient must select an object, drag and drop it into a specific target (see the description of "The oranges and baskets" activity in 9.3-eSchi Users' Manual).

The patient can end the activity in two distinct ways: by accomplishing the activity goals and thus, taking all the steps and actions to successfully complete the activity; or, the activity can reach its maximum duration time and end without success. At this point the activity assumes the "Terminated" state.

During the activity, the patient can decide to "stop" or "restart" it. This has a direct impact on the timer with the activity's duration and the current performance outcome – the results of the patient. When the activity is restarted, the initial message is presented again and the activity proceeds as usual. When the activity is stopped, the patient is taken to the initial list of available activities for the session.

All the features of the patient module are available in a simple way. The graphical interface was kept as plain as possible, removing all the possible confusing items and several artifacts that usually are seen as "must-have" in traditional applications. An initial impression on the application might classify it as "too simple and plain" but the team dissected each detail to produce the simplest and plainest application possible. It was not an easy task, since this required simplicity might be difficult to understand. We present two of such examples in Figure 20 and Figure 21.

In Figure 20 is an initial presentation message for an activity. According to usability standards, there should be a button or another similar artifact that allowed users to proceed with their actions. There is no such button available in this page. According to the feedback that the development team received from the psychiatrist, having such a button was blocking patients. They were unable to proceed and conduct the activities.

Figure 20 – Initial Message of an Activity with Instructions

Reasons for such an issue are available in 9.8-Personal Communications, where the psychiatrist explains that severe medication is connected with this issue.

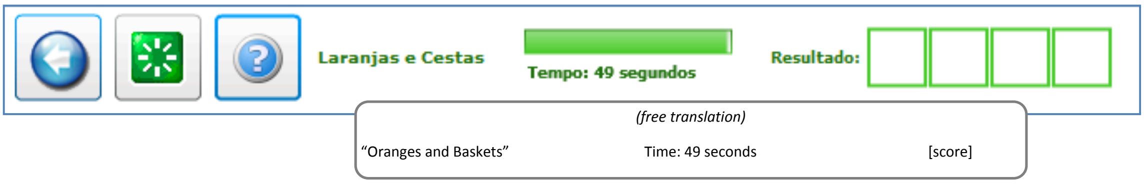


Figure 21 – Toolbar + Status Bar for the Patients Module

In Figure 21 it is possible to see the toolbar and status bar for the patient module. This bar is always available. The interface only has three buttons: a back button, a restart button and a help button. The remainder of the bar provides information about the current activity, namely the activity name, the time left to complete it and the current score, updated in real time. The "exit" button does not exist since it was a distracting element. If the patient needs to stop the activity, he/she just clicks in the "back" button and if he/she wishes to leave the application, he/she might simple close the browser window.

The patient has access to his/her previous results available from preceding sessions or even of this same session, conducted earlier in the day. A section of the statistics modules presents the performance result for a specific activity. This result is based on the ratio between number of goals achieved and the total number of goals for the activity. The patient is also able to see a summary chart with the best results achieved in the activities of the current session and there is a data-drill option available to check the performance achieved in the same set of activities in previous tries of the session.

Thus, the patient is able to navigate between the two types of visualization provided in Figure 22. The interaction and drill-down is available upon selection of the name of an activity in the summary chart or through navigation arrows, available in the application (9.3-eSchi Users' Manual).

This visualization had a special handling because of the target audience. The results are visible to patients in the format of "smiling faces". It is a chart of "smileys", where there is a mixture of the usual bar chart with a customized chernoff faces chart.

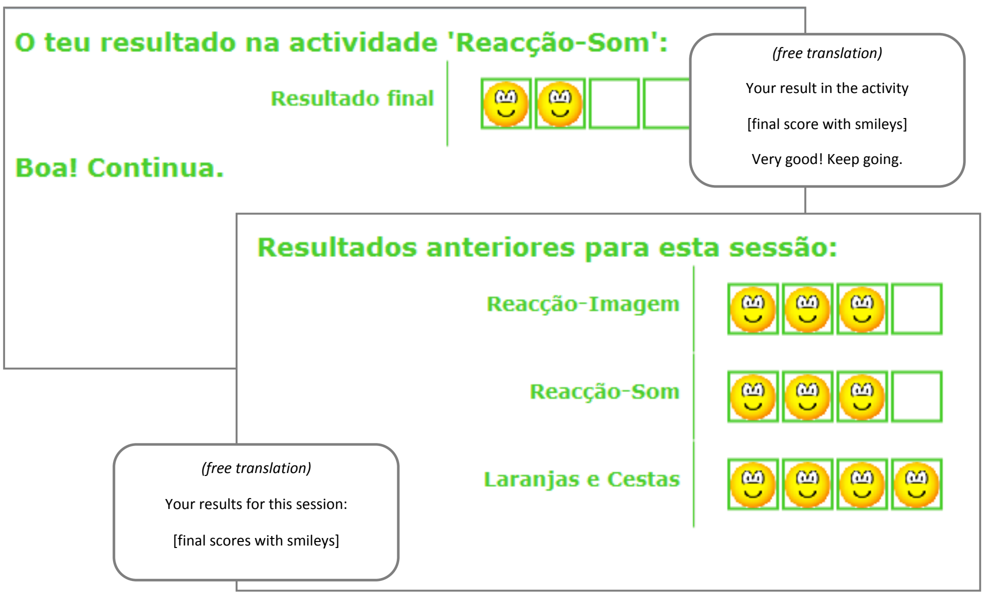


Figure 22 – Examples of the Visualization Available in the Patients' Module

The team, with the health professionals, designed these visualizations with three major concerns in mind: keeping the interface with the application as simple as possible, keeping the results, and thus the performance observation, easy to understand by patients and, finally, in order to keep the patients motivated with their results in the activities.

5.1.3.4. Monitor and Visualization Module

The module is based in the conceptual framework depicted above in chapter 3-Related Work. For the sake of simplicity, the design team projected a single module that contains two sections that are highly interrelated. Hence, the module has two major sections: the monitor section and the visualization section. The first one is responsible for gathering the data in an automatic and transparent way, while the second one is responsible for presenting the data in an understandable and useful way.

As can be seen in Figure 13, this module is transverse to the other modules. This implies that it does the background job when the other modules are in use. Thus, when the patient module is used, the monitoring section gathers all the information possible according to the pre-defined set of indicators. As far as the visualization section is concerned, it is available in both the patient module and therapist module, providing distinct visualization approaches to the data gathered and interpreted by the interpretation tools in the monitoring section.

The monitoring tool, that enables the collection of valuable information during sessions, available afterwards for analysis and feedback, is designed according to a list of items adapted to the conceptual model for monitoring in e-learning contexts (Sampieri, 2008). The existing model, LPM, defines "a system of learning progress monitoring from a general overview of monitoring systems." that "could be implemented in different learning environments and adapted to different forms of training", thus making it perfect to adapt and implement to the eSchi system.

An additional statistical module will be a part of this monitoring tool and will keep track of the system's usage, namely, visitors (demographic data), time per session, number of tries in activities and access to the information available.

According to the LPM model it is necessary to identify, in the design phase, the monitoring objects (MOs), the monitoring points (MPs), the interpretation tools (ITOs) and the visualization tools (VTs) that will provide the support for the eSchi system. Hence:

- Monitoring Objects (MOs): four distinct objects will be considered as monitoring objects: Activity, Session, ActivityTry and SessionTry. For each object a set of indicators is established as depicted in Table 2;
- Monitoring Points (MPs): each monitoring object requires a specific instant in time to be registered into the application. Thus, every Activity (or ActivityTry) and Session (or SessionTry) should be recorded whenever it occurs. Each monitoring object has two corresponding monitoring points: the first one when the action starts and the second when it ends;
- Interpretation Tools (ITOs): two tools allow the system to conduct the mapping between the established goals and the obtained results. The ActivityInterpretationTool and the SessionInterpretationTool provide the interpretation of the results, for each activity and session on a single patient base. Later they could be extended to implement some type of data (text) mining system that allows the cross checking of data with the notes (free form) taken.
- Visualization Tools (VTs): the initial set of InfoVis tools available in the system are related to each monitoring object. There are two distinct types of tools: charts and text. They both present the results either from patients or notes taken by therapists. These tools will be further discussed later.

According to the list of items identified below, concerning monitoring objects and corresponding indicators, we will now provide a deeper understanding of how we implemented the monitoring and visualization module. To do this, we will also refer to the monitoring points and interpretation tools identified.

Table 2 – Indicators for each Monitoring Object

Activity	Total number of tries made in the activity • Total number of incorrect tries made in the activity • Total number of correct tries made in the activity Total time spent in the activity • Average time between tries Historic info per try • List of all the tries in the activity (ActivityTry) Activity Start Time Activity End Time Reason to end? • Time expired • Concluded correctly • Stopped • Restarted Notes (free form) taken regarding the activity
Session	List of activities defined Date for session Patient for session Historic info • List of tries of the session (SessionTry) • Initial timestamp • Final timestamp Notes (free form) taken regarding the session
ActivityTry	Description of the action • object picked up • start time and position • object dropped • end time and position Stopped Restarted
SessionTry	Total number of activities • Number of activities taken • Number of activities repeated (finished and started over) • Number of activities stopped • Number of activities restarted (not finished and started over) Historic info • List of tries of the activity Notes (free form) taken regarding the session

The monitoring objects include the previously defined pools of items:

- $P = set\ of\ patients : p = p_i\ i = 1, \ldots, n$
- $A = set\ of\ activities : a = a_j (j = 1, \ldots, n)$
- $S = set\ of\ sessions : s = s_k\ k = 1, \ldots, n$

These indicators are directly correlated to actions performed by the users that also have to be monitored by the system. These actions are the monitoring points that specify when to register the indicators. There are two actions that a patient' user initiates and that require monitoring: activity try and session try. When the patient enters the system and the list of available activities is shown, the system interprets this as the beginning of a "session try". The patient can repeat his/her daily session several times per day and each one is considered a new try. Whenever the user selects and conducts an activity from the activity's list, the system is before an "activity try". The user can repeat the activity several times or, since they are not mandatory, an activity can be never completed. The "activity try" action has also other records associated, namely every interaction click of the user with the system's graphical user interface (GUI). Each click has a time and a position for occurring, a when and where information, besides a reason for happening and a status for the outcome of the action (to obtain more detailed information on this please refer to section 9.3-eSchi Users' Manual).

Thus, the monitoring points provide two new pools of items:

- $AT = set\ of\ activity\ tries\ per\ activity\ a : at = a_j t_l\ j = 1, \ldots, n,\ (l = 1, \ldots, n)$
- $ST = set\ of\ session\ tries\ per\ session\ s : st = s_k t_l\ k = 1, \ldots, n,\ (l = 1, \ldots, n)$

Indicators can be either records (rec) or calculated (calc) fields that are shown later in the visualization section. The calculated fields are the outcome of the interpretation tools defined for the system. In order to keep a trace of usage data that includes every action of the user within the system, a "record field" is the name given to a trace of an actual action. A “calculated field” is the name given to a system’s process output that is based on existing records that are transformed according to specific rules.

The records kept are the most basic form of information gathered automatically by the system (Table 3). The following is the list of available records that trace the usage of the system by a patient profile user.

Table 3 – List of Basic Records (traceable)

Records	Description
session initial timestamp	when patient enters the system
session final timestamp	when patient leaves the system
activity initial timestamp	when patient starts the activity
activity final timestamp	when patient completes the activity
activity effective time	timer sets off when patient starts the activity and stops whenever the patient pauses or ends the activity
number of correct goals	number of goals achieved for the activity (activity specific)
percentage complete	ratio between the number of goals achieved in the activity and the total goals for the activity.
activity try initial timestamp position	when and where the patient interacts with the GUI
activity try final timestamp position	when and where the patient stops his/her interaction with the GUI
activity try reason	the purpose for the patient interaction (e.g., activity re-started, stimulus OK,...)
activity try status	the patient interaction obtained result (e.g., correct, incor-rect)

In Table 4, the list of the most basic indicators (including some calculated fields) is presented. These indicators already use some of the trace records presented above in Table 3.

Table 4 - Indicators for “Session Try” and “Activity Try”

Indicators	Type	Description
SessionTry$_i$ Length	calc	*= session initial timestamp – session final timestamp*
SessionTry$_i$ Status	Rec	= current status must take one of up to three possible values: created, ongoing, paused and terminated.
SessionTry$_i$ Notes	rec	= notes – free text to be used in later text mining.
ActivityTry$_i$ Length	Rec	*= effective time*
ActivityTry$_i$ Performance	Rec	= percentage complete
i = a sequence number for the session/activity try		

In a single "session try" there can be several "activity try" occurrences as Figure 23 shows:

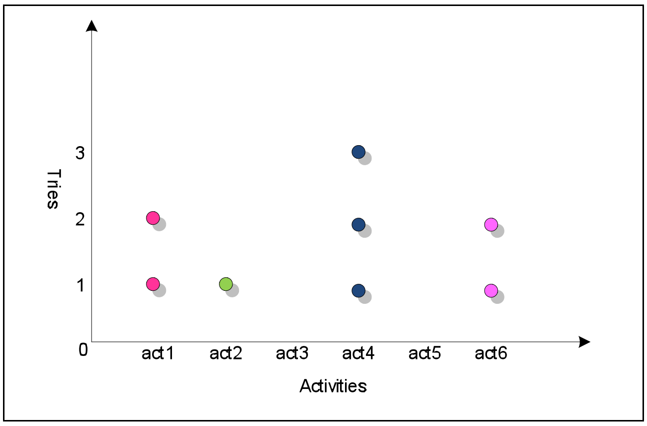


Figure 23 – Activities tries per "Session Try"

The list of indicators and related variables specially designed for the monitoring process of "activity tries" per "session try" can be seen in Table 5.

Table 5 – Indicators for a "Session Try" (ST)

Indicators	Type	Description
ST Activity$_j$ Tries	calc	number of entries of initial + final timestamps for a specific activity j.
Average ST Activity Tries	calc	sum of all the tries for all activities divided by the number of activities
Average ST Activity$_j$ Length	calc	sum of all the activity j's length divided by the number of activity j tries
Average ST Activity Length	calc	sum of all the activities' length divided by the number of activities
Average ST Activity$_j$ Performance	calc	sum of all the activity j's performance divided by the number of activity j tries
Average ST Activity Performance	calc	sum of all the activities' performance divided by the number of activities
j = a specific activity conducted within the "session try"		

The same session (for a specific D day) can have several tries (try1, try2, try3,...) and, at each try, the activities (act1, act2, act3,...) may have several occurrences or none. Figure 24 shows the occurrence of "activity tries" where one try implies one color circle, per activity, in all "session tries" for a session (D day).

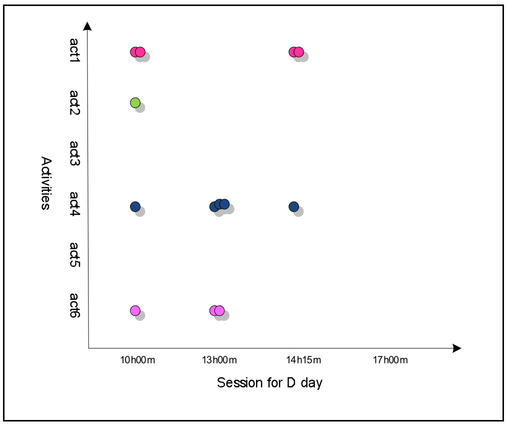


Figure 24 – Activities and Session's Tries per Session

Thus, a new pool of items appears from the calculated fields by the interpretation tools:

- $STkAT = set\ of\ activity\ tries\ per\ activity\ a\ per\ session\ try\ st: \ stkat = stkajtlk = 1, \ldots, n\ , j = 1, \ldots, n\ , (l = 1, \ldots, n)$

The list of indicators for keeping track of activity tries per session tries for a session (S) is shown in Table 6:

Table 6 – Indicators for a Session (S)

Indicators	Type	Description
Session Tries	calc	number of entries of initial + final timestamps for the session.
Average Session Length	calc	sum of all session tries' <u>SessionTry$_j$ Length</u> divided by the number of session tries
S Activity$_j$ Tries	calc	number of entries of initial + final timestamps for a specific activity j.
Average S Activity Tries	calc	sum of all the tries for all activities divided by the number of activities
Average S Activity$_j$ Length	calc	sum of all the activity j's length divided by the number of activity j tries
Average S Activity Length	calc	sum of all the activities' length divided by the number of activities
Average S Activity$_j$ Performance	calc	sum of all the activity j's performance divided by the number of activity j tries
Average S Activity Performance	calc	sum of all the activities' performance divided by the number of activities
j = a specific activity conducted within the session		

Despite the similarities between the lists in Table 5 and Table 6, the fact is that all the values are distinct and some of the values for a session can be calculated using the ones previously calculated for each one of its session tries. Hence, values in Table 6 are dependent on the values of Table 5.

In summary, a session might have several tries and each session try might imply several activity tries. Sessions occur on a daily basis and each patient can have a multitude of therapy sessions.

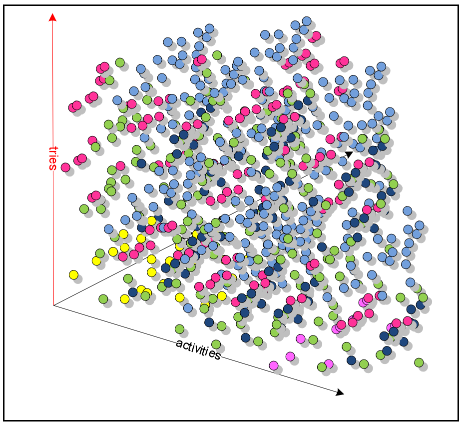


Figure 25 - Session/Activity Occurrences for a single Patient over time

Thus, for one specific patient, the number of occurrences to monitor grows exponentially over time and it is impossible to predict the data increase. Figure 25 depicts an overview of the amount of data to handle, once in the system.

Table 7 presents the indicators considered for a patient with all its sessions' and activities' tries.

Table 7 – Indicators for all the sessions of a Patient (P)

Indicators	Type	Description
Average Session Tries	Calc	sum of all the sessions' tries divided by the number of sessions
Average Activity Tries	Calc	sum of all the activities' tries divided by the number of activities

Each session is directly connected to a specific patient. Thus, the calculations done for a single patient consists on summing up his/her sessions records. When it is necessary to visualize all the patients in the system, the indicators used for a single patient are applied individually to all of them.

The last pool of items that is generated by the interpretation tool can be described as follows:

- $PiSTkAT = \text{set of } STkAT \text{ per patient } p: \quad pistkat = pistkajtlp = 1,\ldots,n \ ,k=1,\ldots,n \ ,j=1,\ldots,n \ ,(l=1,\ldots,n)$

The representations presented above are only to provide the reader with the vast amount of information that the system collects. The temporal dimensions are responsible for the vast amount of information collected that grows exponentially.

Next, we will present additional information regarding the visualization of the data collected concerning the Health Professional module.

To accomplish the implementation of the interpretation and visualization tools under the eSchi system, the following items were considered relevant to filter the data:

- patient: each one is referred by his/her unique username;
- activity: each one is referred by its unique name that is provided upon its configuration;
- session (day of): since each one occurs on a daily basis, there can only be one per day and
- session try (time of): each one is referred by the time of the day when the patient starts or restarts the session.

The first two filters will be used to produce the Patient InterpretationTool and the last two the Activity InterpretationTool. Both interpretation tools will also make use of the aggregated information that exists to all the sessions and session tries.

The visualization tools of the system will follow the model proposed by Wijk (2006) for an InfoVis tool. It is a rather simple model that applies directly to our situation (Figure 8).

In this conceptual model, the central process is the visualization (*V*). In eSchi, there are eight possible visualization options and each one corresponds to a specific image (I). The images are dynamically generated, according to the existing data and presented to the end-user. Thus, the eight charts defined and their corresponding images are the V + I parts of the model (Table 8). Every image (I) is generated upon the application of a certain specification (*S*) to the transformation of the data. We present the definition of the specifications in Table 9. These specifications are implemented according to the equations and calculus provided above. We chose to map the specifications (S) of Wijk's model directly to the Interpretation Tools (ITOs) of the LPM model.

As far as the interactive exploration techniques (*E*) that allows users to change the specification (S) and, thus, obtain new visualizations with new timely images. We provide two exploration options: filters and data selection for drill-down. The flow and navigation available to end-users is depicted in Figure 26. These exploration techniques are also visible in the screenshots provided early (Figure 17 and Figure 22).

The visualization tools of the system follow the major guidelines of conduct to provide useful information: overview, zoom and interaction (data drill). We defined an initial set of eight charts to comply with the guidelines.

Table 8 – Chart List with Name and Type

ID	Name	Type
1	Average Session Length per Patient	overview
2	Average Session Length for + *chosenPatient*	zoom-in
3	Session Length for Patient + *chosenPatient* + on the + *chosenDay*	zoom-in
4	Activities Performance for + *chosenPatient* + on the + *chosenDay* + @ + *chosenSessionTry*	zoom-in
5	Average Activity Performance	overview
6	Average Performance for + *chosenActivity*	zoom-in
7	Average Performance for + *chosenActivity* + by + *chosenPatient*	zoom-in
8	Performance for activity + *chosenActivity* + for patient + *chosenPatient* + for session + *chosenSession*	zoom-in

Table 8 presents the eight charts chosen, classified by type of visualization technique. Both chart 1 and chart 5 were designed on an overview perspective, where context information is presented. All other charts are the outcome of the data drill (down) process accomplished when users filter the available data and, interacting with the chart, ask for a zoom into the data.

From this point forward, we will use the identification numbers (ID) to refer to the charts. The next table (Table 9) describes the indicators and calculus involved in the creation of the charts. For instance, in order to present chart 5, the "Average Activity Performance", the system must:

- for every patient in the system, check its session tries and average its performance for every try of a specific activity;
- average the results for all the patients in the system.

Table 9 – Description of available charts

ID#	Indicators
1	An overview chart that presents the average duration of sessions (all the sessions, including tries, from all the patients) grouped by the day of the session.
2	A data drill chart that presents the average duration of the sessions (including tries) for a specific patient, grouped by the day of the session.
3	A data drill chart that presents the duration of the sessions tries on a specific day, for a specific patient.
4	A data drill chart that presents the performance accomplished by a specific patient on a specific day on a specific session try.
5	An overview chart that presents the average performance and duration of activities (all the activities, including tries, from all patients).
6	A data drill chart that presents the average performance and duration for a specific activity (including all the tries from all the patients)
7	A data drill chart that presents the average performance for a specific activity for a specific patient, grouped by session days.
8	A data drill chart that presents the performance for a specific activity, for a specific patient on a specific day, grouped by session tries.

The system's visualization interaction feature is accomplished through the navigation between the already available distinct charts (Figure 26).

The user has two options to interact with the data:

- using major filters – the round rectangles in the figure above;
- selecting the desired information on the chart – recurring to the data drill/zoom-in signaled in the arrows.

Two major filters are available for selection in the statistics module: Patient and Activity. Thus, it is possible to choose all or one of the available patients and all or one of the available activities. Upon the combined usage of the major filters, the module presents one of five charts: chart 1, chart 5, chart 2, chart 6 or chart 7. For instance, to see the statistical information for all the patients that completed a specific activity, it is necessary to choose the filters "all patients" and the desired activity. The statistics module will present chart 6.

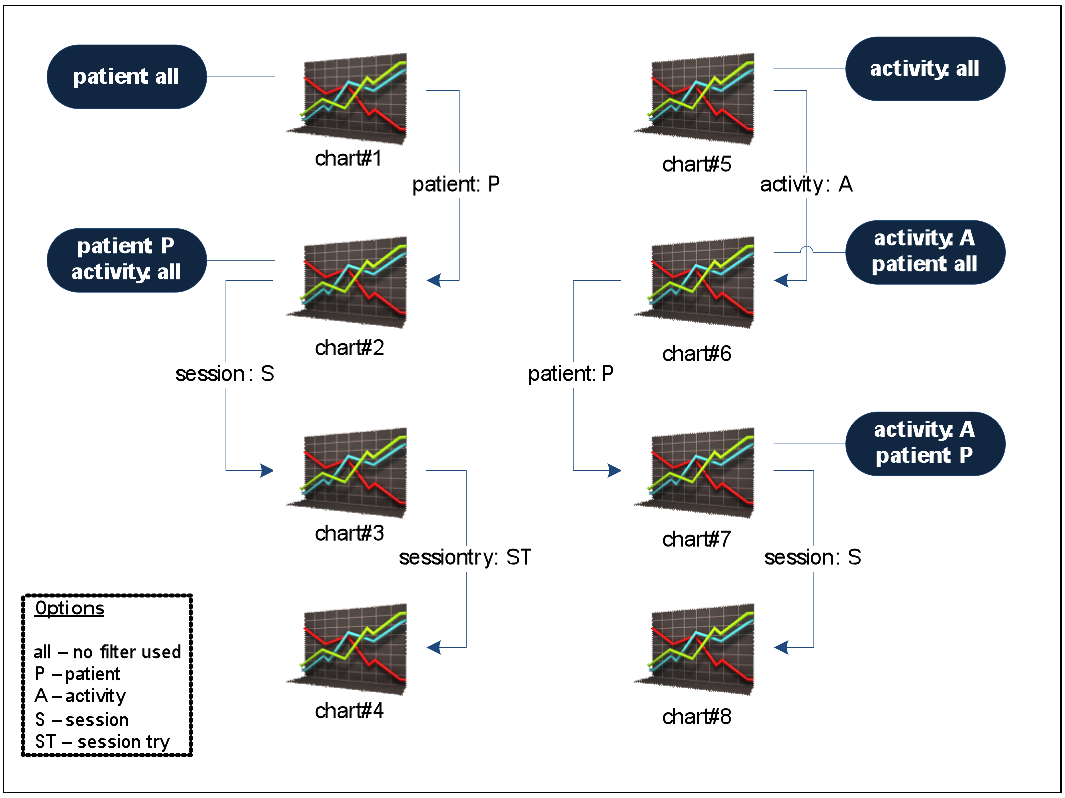


Figure 26 – Flow between charts with the indication of the filters used

The interaction with the currently displayed chart data is done using a data drill process. The health professional selects and clicks in the data to drill, on the chart. For instance, when chart 1 is available with information regarding all the patients of the health professional (one patient == one data point), by selecting (clicking) one of the data points, chart 2 is presented with specific information for the chosen patient.

Figure 26 presents the filters used in the chart flow when data drilling. Thus, for instance, when the system presents chart 4 the data has been filtered by patient, session and session try.

5.1.3.5. Technology Framework

The technology framework used for the development and deployment of the eSchi system is simple and straightforward as can be seen in Figure 27. The main goal was to achieve a simple and universal deployment environment to provide the system on an anywhere-anytime policy.

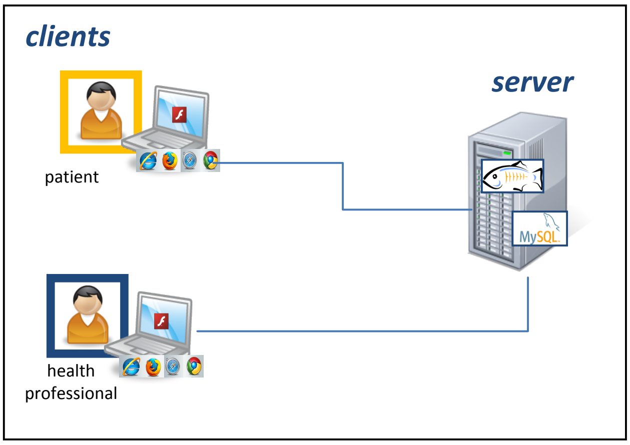


Figure 27 – The technology infrastructure for the eSchi system

The architecture of the system has a typical client-server approach. On the server side the information is kept under a well-known database management system – MySQL – accessed through web services. The web services use the standard communication interface for the Web Service Definition Language (WSDL) and are lodged in a Glassfish Application Server. On the client side, a browser is used to interact with the application. The browser has a Flash enabled player that allows the correct visualization of the application developed in a Flex environment and compiled as a Flash resource.

5.1.4. Evaluate Design against User Requirements

In order to obtain some adequate and formal feedback before deploying eSchi into a real setting, a Heuristic Evaluation (HE) was conducted.

Despite several usability techniques have been scientifically proven to be more adequate and better, as far as results are concerned, they are more time and money consuming than this “discount usability engineering” approach. It provides a more agile method to keep track of usability problems, directly applied to iterative development projects and based in early user-focus (J. Nielsen, 1994a).

The Heuristic Evaluation method uses only a small subset of heuristics known as the ten basic usability principles. Nielsen’s (J. Nielsen, 1994b) ten basic principles of usability – the heuristics – are: 1-Visibility of system status, 2-Match between system and the real world, 3-User control and freedom, 4-Consistency and standards, 5-Error prevention, 6-Recognition rather than recall, 7-Flexibility and efficiency of use, 8-Aesthetic and minimalist design, 9-Help users recognize, diagnose, and recover from errors and 10-Help and documentation.

Different people should conduct heuristic evaluations since they usually find distinct usability problems. A small subset of evaluators (3 to 5) examines the interface and judges its compliance to the 10 basic principles (the “heuristics”). The number of evaluators should be kept small since there is not much gain in information by using a large number. The interface examination session implies that each evaluator will conduct its evaluation alone, in order to ensure independent evaluations. The evaluator goes through the interface several times and checks the compliance of the various elements with the list of general rules. He/she is also allowed to take notes on something else additional that comes into mind. For each issue found in the examination, a severity degree can be assigned using a rating scale from zero (less serious problems) to four (more serious problems). A severity estimates can help in the prioritization of solving the usability issues, in the development process. The results can be presented as written reports (one per evaluator) or as verbal comments to an outside observer as they go along the interface.

According to the conceptual study conducted and presented in chapter 2, a test scenario was created to evaluate eSchi's patient module usability. Seven evaluators were asked to conduct a heuristic evaluation to the module and the information needed to conduct the evaluation was sent to each one. Each evaluator was asked to provide a written report with the issues examined, severity levels and further observations they considered useful.

Five evaluators completed the evaluation process and presented a written report with the list of issues grouped by heuristic principle. A total amount of 39 issues was raised besides having 35 items assigned as positive aspects of the interface that respected the heuristic principles. The severity assigned to the negative issues ranged from 0 to 4 points.

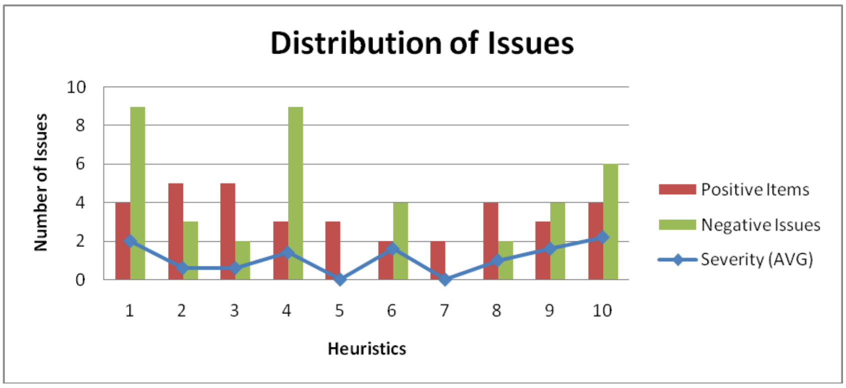


Figure 28 - Original Distribution of Items (Positive and Negative) and the average of severity assigned to the issues

From the initial list of issues (Figure 28), the positive items were archived and only the negative items received statistical treatment. The first statistical treatment technique used consisted in filtering the items in order to eliminate duplicate items. Since distinct evaluators raised the same five issues, the original list was reduced to 24 unique issues. Finally, items were shifted to another heuristic to comply with the rules and the final distribution of the issues was the one presented in Figure 29.

After having the final distribution of issues per heuristic principle, they were scheduled to be solved in a new release of the application. The list of items was ordered by the severity assigned to an issue and the major issues were the ones that were first revised and solved in the development of the application.

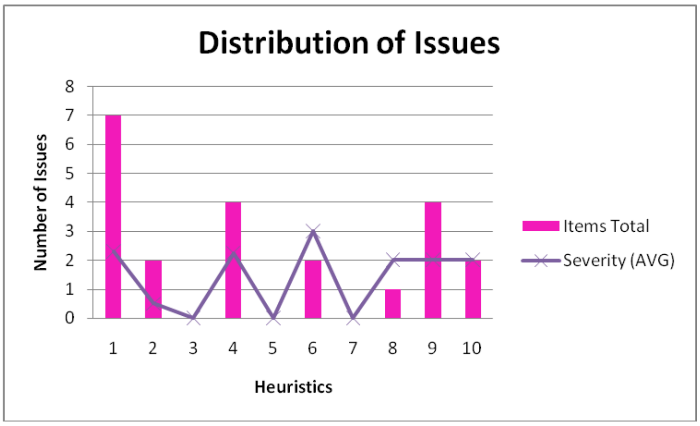


Figure 29 – Final Distribution of Issues (Negative) and the average of severity assigned to the issues

A new release of the system was published, as well as the work conducted (Reis, Freire, Fernandez, & Monguet, 2009) and the system was considered ready to be deployed in a real setting.

The functional tests that mapped each user requirement to the actual features of the system were conducted directly in the field with the final users – patients and therapists.

5.1.5. Conceptual Model Proposal for e-Therapy Contexts

According to the conceptual framework studied and the needed adaptations to the LPM model, the following figures provide our proposal for a model to monitor and visualize patients' performance in e-Therapy settings.

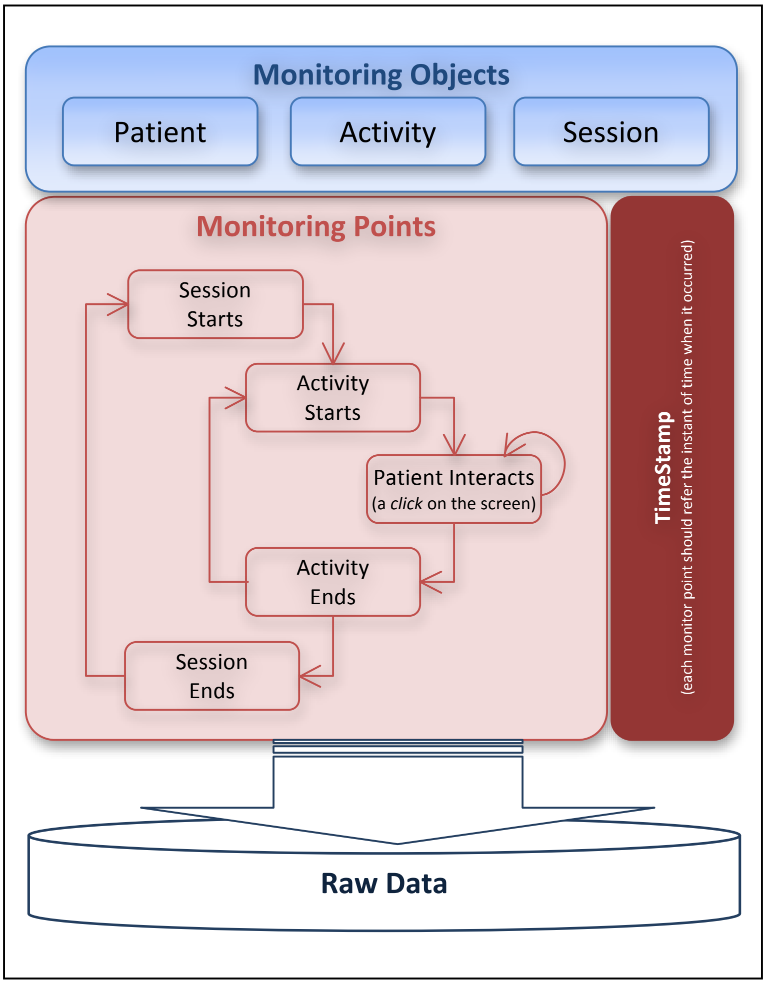


Figure 30 – Monitoring Objects and Monitoring Points for e-Therapy contexts

As shown in Figure 30 the data collected from the application usage is in raw format. At the specified instants of time, known as monitoring points, the system registers the indicators of each monitoring object and corresponding timestamp. After the collection of the raw data, the second level of treatment of the data transforms it according to a set of pre-defined rules provided by the interpretation tools (Figure 31).

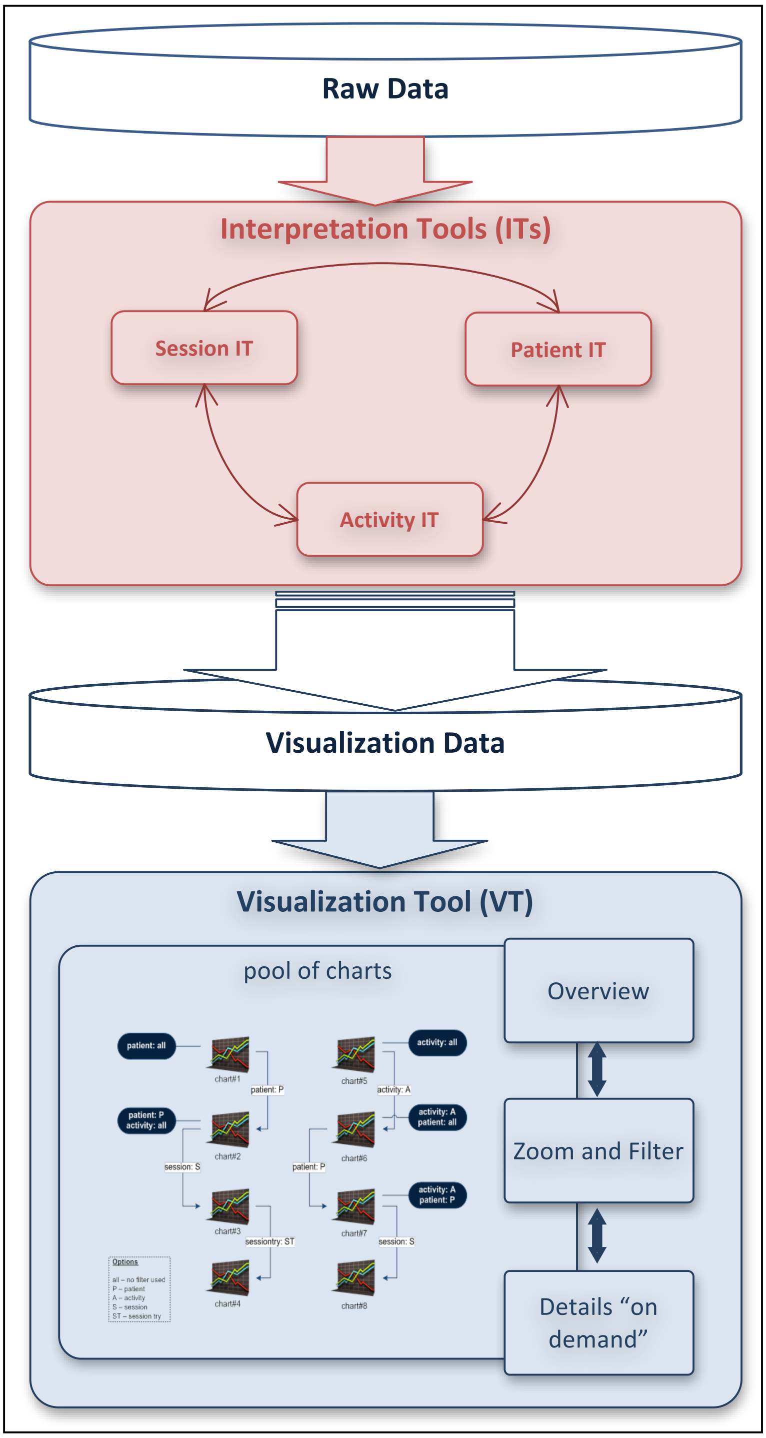


Figure 31 – Interpretation Tools for e-Therapy contexts

After producing the visualization data, it is used for the charts of the visualization tool that are presented to end-users. The users of the system may filter and drill-down the data, thus navigating in the pool of available charts.

5.1.6. Assessment and Guidelines for e-Therapy Systems

Before the system deployment into its actual site, we conducted several informal tests: the functional and integration tests commonly conducted by software development teams. Nevertheless, the team believed that further testing was required. In order to evaluate the design against user requirements, we provide the following list that depicts a proposal with assessment items for e-Therapy settings, based on the existing recommendations for telepsychiatry and for MHIS in general: Quality of Care; Education and Empowerment; Access; Costs and Satisfaction (Reis et al., 2010). The following items were used in the design and development decisions of the eSchi system.

5.1.6.1. Quality of Care

The quality of care provided by online psychotherapy must demonstrate no significant difference between the one provided in face-to-face contexts (Agence d'Évaluation des Technologies et des Modes d´Intervention en Santé, 2006; Childress, 2000; Christensen et al., 2002).

Patient's outcome assessment is possible using valid tests, scores and scales that physicians apply on a daily basis during traditional therapy sessions (Solari et al., 2004). The use of well-validated assessment scales, capable of detecting changes on patients and symptoms assessment, using structured instruments available through informatics systems can improve care and reduce errors (Pheby & Thorne, 1994; Trivedi, Kern, Grannemann, Altshuler, & Sunderajan, 2004; Young, Mintz, Cohen, & Chinman, 2004).

Online group psychotherapy assessment should include process variables such as activity, belongingness to the group and receiving therapist feedback as well as the textual dimensions available through specific tools such as the Linguistic Inquiry and Word Count (LIWC). In fact, the continuous monitoring of patients during a session can provide valuable information to improve the therapeutic processes (Haug et al., 2008).

Care should be taken to overcome the contextual intent loss (non-verbal cues are non-existing) in email and all text-based communication mediums that are extremely important to the therapists' assessment and diagnosis procedures (Childress, 2000).

5.1.6.2. Education and Empowerment

One of the major concerns regarding education and empowerment is the quality of the information that is available. Depression web sites and the ones regarding substance use disorders are reported has having low quality of information and as being harmful to uninformed users. Besides, information is not always correct, since sponsors and potential conflicts of interest are not properly disclosed (Christensen et al., 2002; Copeland & Martin, 2004; K. M. Griffiths & Christensen, 2002).

With the large amount of available information, a person may have difficulty finding the online help to his/her specific problem (Recupero & Rainey, 2006). When trust issues arise, patients depend on the information that physicians' recommend. Health professionals should guide and assist patients while choosing the most accurate information and making an informed choice considering services reputation (Graeff-Martins et al., 2008; K. M. Griffiths et al., 2007; M. Griffiths & Cooper, 2003; Styra, 2004).

The provider of the service should have general and specific expertise to conduct a session and should follow adequate procedures to get the key component(s) of the record to provide them to the consulting physician (D. M. Hilty et al., 2002; Styra, 2004). When establishing communication standards that might, for instance, prevent the abusive use of email as consultation medium, patients and physicians should receive instruction on their rights and duties and should adhere to them. Training regarding the technical and procedural aspects of the service, making them fit to use the technology, is important (Gadit, 2006; McGinty et al., 2006).

Self-help groups allows patients to meet and exchange experiences lessening symptoms of isolation, and to exchange information such as written, visual, audio or recorded material that can be used in a treatment program. Patients can self-administer this kind of treatment program with or without guidance, which may decrease the dependency on the therapist (Castelnuovo et al., 2003a; Castelnuovo et al., 2003).

Some instruments used as a website quality indicator, provided similar results to the quality of site content when evaluating an application developed to provide health content (K. M. Griffiths & Christensen, 2002). It allows an inexperienced person to rate several aspects of written health treatment information: extent of the treatment alternatives – risks and benefits; degree of balanced and unbiased information; documentation of areas of uncertainty.

Information should be on a standard format that is easy to reuse (Pheby & Thorne, 1994). The standard format should include not only the technological level, but also the semantic and medical level.

5.1.6.3. Access

Some barriers limit the access to the services and reduce the use of e-Therapy: 1 – Resistance to change and technology literacy and 2 – Legal, Privacy, Security and Ethical Issues.

Ganapathy (2005) (p. 860) states: "What is required is not implementing better technology and getting funds but changing the mindset of the people involved". In fact, one of the major barriers of implementing telepsychiatry is in the attitude, both patients and psychiatrists adapt to new technology and not the installation of the technology by itself (Agence d'Évaluation des Technologies et des Modes d´Intervention en Santé, 2006).

By educating every possible user in the use of the technology and reinforcing its importance in their life quality, it is possible to fight technology illiteracy (Christensen, 2007; Finn, 2002). To carry out e-Therapy, therapists are not required to be experts in technologies but they need to be prepared to face technologies in order to know when and how to use them in patients' welfare.

Services should use already clinically proven technology and, for each consultation, technology should adapt to the service and needs of the patient and corresponding treatment (D. M. Hilty et al., 2002).

On the other hand, people that have mobility limitations and time constraints; special needs persons, those termed "socially unskilled", or that live in correctional facilities, do not have an easy access to standard mental health services (Antonacci, Bloch, Saeed, Yildirim, & Talley, 2008; Finn, 2002; Heinlen et al., 2003; Kanani & Regehr, 2003). E-Therapy breaks out space boundaries, reaching out for underserved population across geographical distance and enhancing the quality of health information anytime and anywhere (A. Barak, 2007; Castelnuovo et al., 2003; M. Griffiths & Cooper, 2003).

Regarding the legal, privacy, security and ethical issues, there are always, security, privacy and confidentiality issues to consider for the type of services that exist in the mental health field, especially for those that use the Internet (Farrell, Mahone, & Guilbaud, 2004).

Experts identified privacy issues as the constant tension between the need to access health records and the need to secure them. This dichotomy intensifies since there is useful information hidden away in private records, waiting for its extraction, handling and usage on other medical cases (Christensen et al., 2002).

Anonymity is a major concern for most users of e-mental health services regarding the social stigma they suffer (Richards & Tangney, 2008). Online interaction solves this since the therapist blends in with the virtual world. Actually, some people disclose their problems more openly to a computer system than to other people (A. Barak, 2007; Christensen, 2007; M. Griffiths & Cooper, 2003; Heinlen et al., 2003; Kanani & Regehr, 2003; Lester, 2006; Recupero & Rainey, 2006; Wangberg et al., 2007).

Online therapists need to be aware of their patients' surrounding context. Factors such as location and specific conditions such as risk of suicide, homicide, child abuse, culture and others, e.g. potential violence of a patient, are relevant to avoid inappropriate counseling (Finn, 2002; M. Griffiths & Cooper, 2003; Heinlen et al., 2003; Kanani & Regehr, 2003).

e-Therapy should be used with extreme care and should be avoided in emergencies, when the patient's wellbeing, health or safety is at risk (Agence d'Évaluation des Technologies et des Modes d´Intervention en Santé, 2006).

Like patient's confidentiality, data security is crucial for these systems' success. To prevent unauthorized data access, they should use encryption mechanisms, and secure electronic signatures and record all accesses. Most of the services that use the Internet present severe security concerns, such as eavesdropping, identity theft, invasion of privacy, message modification, false messages, message replay, unprotected backups and repudiation (Childress, 2000; Gadit, 2006; Ganapathy, 2005; Recupero, 2005; Styra, 2004).

The lack of legal regulation might lead to mental health provider resistance in the use of services (Christensen et al., 2002). Legal issues regarding the clinical responsibility, adequacy of client/patient to treatment, e.g. suicidal risk, therapist licensing and treatment effectiveness proliferate in e-Therapy contexts (Finn, 2002; Heinlen et al., 2003; Kanani & Regehr, 2003; Recupero & Rainey, 2006). Some of these issues do not occur in a normal setting, thus, patients able to avail themselves and in writing, should provide their informed consent. However, some of these could also occur in face-to-face contexts and with other communication mediums such as the telephone or fax. All communication technologies can be misused and misrepresentations or frauds are real concerns. It is possible to reach the breakeven by opposing potential benefits that justify the possible risks (Agence d'Évaluation des Technologies et des Modes d´Intervention en Santé, 2006; Childress, 2000; Gadit, 2006; Recupero, 2005).

As far as licensing issues are concerned, one solution includes a national licensing system to assign the responsibility to the physician. Another possible solution is to consider a special licensing system where "cyberdocs" have licenses to practice in cyberspace (Dyer, 2001).

All healthcare professional organizations have ethical standards defined for their associates, but only few have started to address the new concerns raised by the Internet and the behavior taken over this medium. Medical Internet ethics guidelines are yet required to conduct such practices.

5.1.6.4. Costs

This assessment item intersects all the others since every other item directly correlates to and somehow involves costs.

E-Therapy costs may be very attractive. Indeed, when compared with traditional psychotherapy, online communication reduces expenses and enables cost effective interventions (Castelnuovo et al., 2003; Finn, 2002; M. Griffiths & Cooper, 2003; Grolleman et al., 2006; Kanani & Regehr, 2003).

There is a strong correlation between providing free access and the demand for these services. Thus, providing free access might augment the demand for these new services and significantly create more pressure on the already overburden health system (Christensen et al., 2002). Nevertheless, on the other hand, Christensen (2007) states that, making Internet platforms freely accessible is one way to reduce the overall load. Costs with the technology involved in the implementation of e-therapy solutions are not very easy to estimate, but there is a belief that it is possible to dilute them by the amount/volume of use of the services provided (Agence d'Évaluation des Technologies et des Modes d´Intervention en Santé, 2006). For instance, the telecommunication costs considered sunk cost, can be shared between several types of applications besides the telepsychiatry services, such as email and Internet access (McGinty et al., 2006).

There is a growing interest from country governments regarding the costs associated to mental health programs' implementation and maintenance and in bringing the provision of such services into the spotlight (J. L. Ayuso-Mateos, Salvador-Carulla, & Chisholm, 2006; Christensen et al., 2002).

Reimbursement is also a financial issue when online services such as diagnostic interviews, medication management and psychotherapy must be a part of the organization and must integrate with the actual process of patient care and treatment (M. Griffiths & Cooper, 2003; McGinty et al., 2006; Recupero, 2005). This is an important aspect of the e-service: establish a suitable remuneration for the services provided (Styra, 2004).

5.1.6.5. Satisfaction

As far as users' satisfaction is concerned, there is evidence that they like online mental health interventions (K. M. Griffiths et al., 2007). Liking and disliking can be considered a simple way of showing satisfaction and, as far as patients are concerned, their satisfaction is an evaluation of the e-Therapy services used.

Actors' needs considered right from the start, even when designing the system, are important (McGinty et al., 2006). An ICT solution developed within a dialogue between developer and target-users accomplishes a more personalized; more helpful and fine-tuned application for the users' needs (D. M. Hilty et al., 2002; Lauriks et al., 2007; Todis et al., 2005). For instance, if users are not able to see any real improvements in their quality of life, why should they change to use a new system? Therefore, it is critical to involve target users in the development process of such type of supportive solution.

The flexibility that a new system shows, working as an always-on and trustworthy assistant that can deal with appointments and prescriptions, is a major advantage in order to accomplish physicians' satisfaction (Christensen, 2007).

Sometimes, statistical information gathered by the system complements its assessment and evaluation (Richards & Tangney, 2008). The data collected includes number of page views, unique visitors, time spent per page, number of posts and replies, number of users simultaneously in chat sessions and other demographic data from users. Online questionnaires are also used and provide an easy way to ask for the data required to complement the available system statistical information. All this information relates to the user satisfaction of the system, whether it is the patient or the physician.

5.2. Case Study at Hospital Sant Joan de Déu

The medical team of the Hospital Sant Joan de Déu – *Serveis de Salut Mental* – was a part of the development team of eSchi. The initial set of multimedia activities was defined with the help of that team and the actual implementation of the system in the setting was thought has being transparent. The base language support for the eSchi system was Spanish.

Sant Joan de Déu is a religious order that started back in the XVI century and that through the existence of many workers, collaborators, volunteers and benefactors, assists and helps the ill and the disadvantaged. This international institution is one of the biggest non-profit organizations that belongs to the Catholic Church and, thus, is a non-governmental organization that has several assistance points and health centers, hospitals, social services and religious communities. Their main goal is to cooperate in the development of society and eradicate the global poverty. The order has several centers in the Aragón province of Spain, Barcelona. One of them is the *Serveis de Salut Mental* and the other, the *Serveis Socio Sanitaris*. The first one is dedicated to provide specific services for mental health patients while the second one provides a wider range of services (health, social and hygienic) that includes disabled people and other patients, not only the mentally ill. They are both located near each other and close to the city of Barcelona, in Sant Boi de Llobregat and Esplugues de Llobregat.

The *Benito Menni Foundation* mainly acts in the Catalonia area, trying to create special working centers to employ both mental health patients and disabled people. This foundation has currently two centers near the Sant Joan de Déu Hospital, in Sant Boi de Llobregat in Barcelona. There is a joint effort between the hospital and the foundation to try to accomplish a successful reintegration of the mental health patients and of the disabled in the surrounding community. Hence, a sometimes-confusing factor is that the *Serveis de Salut Mental* of the Hospital Sant Joan de Déu is highly related to this foundation and they are considered, sometimes, as “one and the same” center. This case study was implemented in the facilities of the Hospital Sant Joan de Déu, together with the *Serveis de Salut Mental* health professional team.

Near this hospital exists another building where the *Serveis Socio Sanitaris* for the social hygienic services, is located. This is the implementation site where eSchi is currently being used.

5.2.1. Design of the study at the HSJD – *Serveis de Salut Mental*

The first step in the study was defining an implementation protocol plan (9.6-Case Studies Implementation Protocol Plans) that defined the steps to follow in the usage of the eSchi system. The protocol contained a brief explanation of the procedures and a plan with the needed resources: human and temporal.

The system was equipped with an initial set of users, 3 psychiatrists (health professionals and therapists) and 30 patients.

The protocol plan proposed a three-week period intervention subdivided into three distinct and sequential steps, relative to the usage of the system:

- Pre-Usage
  Both patients and psychiatrist, involved in the study, answered a questionnaire that will help identify their expectations regarding the usage of the system and obtain some demographic data. This occurs in the same day that the next phase (usage) starts.
- Usage
  This phase corresponds to a three-week period with a frequency of one session per day. During this phase, a psychiatrist conducts its patients' sessions using the eSchi system as a complement in the therapy and developing cognitive activities. After each session is completed, all the users answer to a simple questionnaire regarding their opinion and satisfaction with the usage of the system throughout the session.
- After-Usage
  Both patients and psychiatrists, involved in the study, are invited to answer to two questionnaires that will help identify their opinion and general satisfaction regarding their usage of the eSchi system. This last step occurs in two distinct

moments in time: in the same day of the last session and after a two-week interval, without using the tool.

5.2.1.1. Data Collection

In order to collect data from the study, from the several options available and previously referred in 2.1.3, both questionnaires and the eSchi system itself – as the monitoring tool – were used.

Table 10 – Data Collection Tools per Study Phase

Phase	Tool	Type of Measure
Pre-Usage	custom questionnaire	Quantitative + Qualitative
Usage	eSchi monitoring	Quantitative + Qualitative
	ASQ	Quantitative
After-Usage	custom questionnaire	Quantitative + Qualitative
	CSUQ	Quantitative + Qualitative

The custom questionnaires used (9.7-Questionnaires), besides obtaining an initial set of demographic data, are intended to obtain users' expectations before using an e-Therapy tool and their opinion/satisfaction after using the eSchi system.

Both the After Scenario Questionnaire (ASQ) and the Computer System Usability Questionnaire (CSUQ) were already validated instruments that were carefully translated to Spanish (9.7-Questionnaires) – the users' native tongue. Upon request by the health team and agreement inside the whole team, both the ASQ and CSUQ questionnaires were slightly adjusted to be applied to patients. The idea was to provide a clear questionnaire that could be easily understood and answered directly by patients. These adaptations were tested and validated by the health team. All the translations were verified and validated by the medical team inside the development team.

According to the monitoring model previously depicted in the document, usage data of the eSchi system was collected in an automatic and transparent way. All the indicators that were defined can be used to describe the usage of the system.

All the tools identified as “Qualitative”, in the type of measure available for the data collection, include some form of open ended answer or free text entry form option.

5.2.1.2. Special Considerations

User Selection

Only one psychiatrist applied to take part in the study: the supervisor for the schizophrenia ward in the hospital. She made the patients’ selection using as a major criterion the need for cognitive rehabilitation. Hence, the inclusion in the group of users was made upon consideration of having a positive impact on a patient’s treatment, as the psychiatrist’s personal communication included in 9.8-Personal Communications, refers.

Confidentiality

In order to assure confidentiality of the study applicants, prevent possible personal detection upon data analysis and maintain the integrity of the information being gathered in the study, a unique codename was given to each user. The codenames endorsed were, for the simplicity of the process, also used as the usernames to login in the eSchi system. Hence, the real names of the users are not known and the only person that can establish the mapping is the psychiatrist, which is obliged to respect the standard patient-doctor confidentiality rules.

5.2.1.3. Study enrolment

The first step to enable the study enrolment was the establishment of a physical scenario – an ICT laboratory – where a limited number of computers, only three, became preferred eSchi access points. Each desktop computer was equipped with a keyboard, a mouse and a set of headphone devices. The laboratory was located in the hospital’s ICT room that has a free access policy for most patients.

By the end of the first week of usage of the eSchi system, with the psychiatrist conducting sessions with the patients, several modifications to the application were requested. The suggestions came directly from the psychiatrist and revealed the patients' reactions while using the eSchi system (9.8-Personal Communications). According to the psychiatrist, some users were highly sedated and were unable to click the mouse buttons in an autonomous way. It was suggested that the application received key strokes from the keyboard and allowed a better flow of the activities. The updates made to the application concerned the usage of the mouse and keyboard enabling a more efficient use of the system. The changes were implemented and readily applied, as a sign of the patient centered (PCD) approach followed, and, at the beginning of the second week, the users started using the new version.

At the end of the study, all the headphone devices had disappeared, probably taken by the patients that were not engaged in the study. No additional issues or any major problems were reported.

5.3. Case Study at Hospital Magalhães de Lemos

The main idea was to replicate the study, similar to a sister-study (R. K. Yin, 2002), that started at the Serveis de Salut Mental at the Hospital Sant Joan de Déu in Barcelona. Thus, several aspects of the study were kept with minor changes, namely the design of the study.

The Hospital Magalhães de Lemos (HML) was created as an institution in the year of 1953 and its first building opened in 1962. Throughout the years, the designation of the hospital has changed from mental health center to specialized central hospital. Since 2002, it is considered a psychiatric-specialized hospital and is the only one that serves the north of Portugal. The hospital directs its available services to anyone that carries a severe and chronic mental illness; and with difficulties in the psychosocial functioning and community integration. The service *Serviço de Reabilitação Psicossocial* ensures the provision of rehabilitation services to patients and social reintegration to those that have no familiar back support and have been living in the facilities for long periods. The service has a multidisciplinary team and enables the acquisition of psychosocial skills by the patient allowing him to feel more confident and happy with his/her social role.

5.3.1. Design of the study at HML – *Serviço de Reabilitação Social*

Upon the selection of the second site for the implementation of the case study, a Portuguese mental health public institution, where the major spoken language is Portuguese, the application had to be available in Portuguese. Since the base language support was Spanish, the application suffered an upgrade to accommodate multilanguage support and became available in Portuguese. In fact, every step and document regarding the study became available in the Portuguese language also (e.g., users' manual, plans, protocols…).

Following the steps used in the first site of implementation, the first step consisted in the definition of the implementation protocol plan (9.6-Case Studies Implementation

Protocol Plans). Just like in the first site, the initial set of users, available in the system, included three psychiatrists (health professionals and therapists) and 30 patients.

It was also proposed a three-week period intervention subdivided into three distinct and sequential steps, already defined previously in the description for the first site implementation: pre-usage, usage and after-usage.

5.3.1.1. Data Collection

In order to collect data from the study, the same type of tools used in the first site was applied to this second site.

All the questionnaires used were translated to Portuguese (9.7-Questionnaires) – the users' native tongue. The translation was verified and validated by the medical team at the Portuguese site.

5.3.1.2. Special Considerations

User Selection

Only one therapist applied to take part in the study: the leading person of the occupational therapy section of the hospital. She made the patients' selection using as a major criterion the need for cognitive rehabilitation. Hence, the inclusion in the group of users was made upon consideration of being positive for a patient's treatment, as the therapist refers in the personal communication included in 9.8-Personal Communications.

Confidentiality

The same considerations regarding the confidentiality issues that were taken in the first site also apply to this site.

5.3.1.3. Study enrolment

The hospital has an ICT room that has a limited access policy: only patients engaged in computer related activities can access the room and under a specific schedule. There is always the supervision of an informatics technician in the free access periods. Each desktop computer in the ICT room is equipped with a keyboard, a mouse and a set of headphone devices. It was guaranteed that each desktop computer could become an eSchi access point.

By the end of the first week of a complete engagement from the users in the usage of eSchi, conducting sessions, the study went through a pause. According to the therapist, one of the users was discharged of the services, thus leaving the program and the other users required a higher level of complexity for the activities proposed. Hence, the technical team proposed a new set of activities (9.9-New Activities for eSchi) to the therapist. This was the turning point in the deployment and evolution of the eSchi system, which allowed us to end our study. According to the therapist, it was time to develop and deploy new activities, and this is what we present in section 7.4-Future Work.

6. Results and Discussion

This section provides a summary of the results obtained during the course of the research. The research design approach presented in Figure 9 and described in the previous chapter determined the conditions for the fieldwork conducted. We present the results of that same fieldwork and discuss the similarities and differences of the approach when applied to both case studies.

The studies occurred in a chronological sequence. The first study to be conducted was the one at the Hospital Sant Joan de Déu – *Serveis de Salut Mental*, in Barcelona. After this first study, the system was deployed to the Hospital Magalhães de Lemos – *Serviço de Reabilitação Social*, in Porto. The results are here provided according to the chronological sequence.

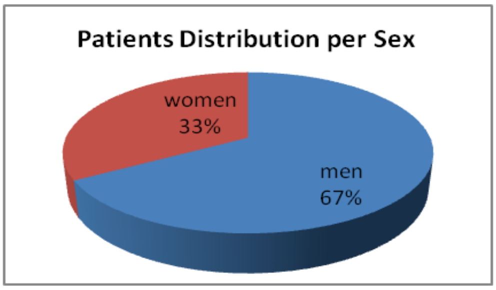
6.1. Hospital Sant Joan de Déu

The Hospital Sant Joan de Déu (HSJD), in Barcelona, Spain, is a psychiatric institution whose population mainly suffers from schizophrenia or schizoaffective disorders. The entire patient population consists in interns of the institution, some of them in acute stage of the treatment and some of them have been living in the facilities for several years. Subjects considered in the study are the ones selected by their psychiatrist amongst the schizophrenia-diagnosed patients.

6.1.1. Socio-Demographic Description

The sample refers to the users that applied for the study and went through the proposed set of sessions. One psychiatrist and nine patients compose the sample of this study.

The group of patients presents an average age of 49 years, within the range: 38 to 60 years. Their distribution according to sex and average age is presented in Figure 32:



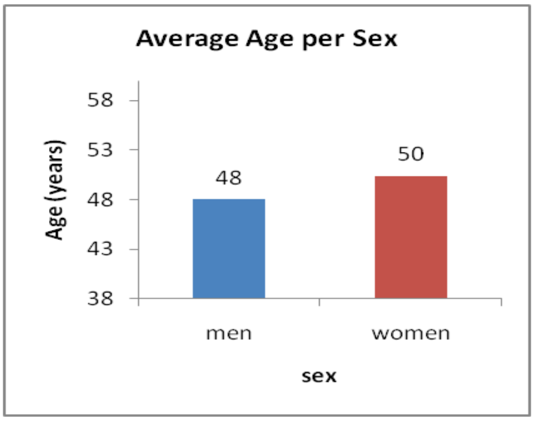


Figure 32 – Socio-Demographic Description of HSJD

Only three out of the nine participants in the study were women and their average age is 50 years, not significantly higher than the average age of the men that was 48 years.

They all declared having the basic-primary school level and primary-basic knowledge in informatics.

Each patient has a diagnosis of a specific typology of schizophrenia. Table 11 has the data provided by the psychiatrist:

Table 11 – Mental Condition Typology per Patient of HSJD

usuario1 – paranoid schizophrenia and schizotypal personality disorder
usuario2 – paranoid schizophrenia
usuario3 – paranoid schizophrenia
usuario4 – residual schizophrenia
usuario5 – unspecified psychotic disorder and schizotypal personality disorder
usuario6 – paranoid schizophrenia
usuario7 – chronic undifferentiated schizophrenia
usuario8 – chronic undifferentiated schizophrenia
usuario9 – disorganized schizophrenia and obsessive-compulsive personality

The participant's engagement point in the study can be established by the date of the answer to the first questionnaire (ASQ). Five users answered in November 9 of 2009. The rest of the users joined in on a per week basis, and the last two engaged in January of 2010.

6.1.2. Sessions and Activities Statistics

Figure 33 and Figure 34 provide a summary report on the data that was collected automatically by the eSchi system.

For each patient it is possible to compute the average performance per session ((a) column) and the average time length per activity ((b) column). The performance is composed by two sub measures: the average percentage of the activities completed (`% Complete`) in the sessions and the average number of stimuli that the user accurately got as correct (`# Corrects`). The average time length refers to the actual time spent on an activity while trying to accomplish the specified goals (time in seconds).

For each session, all the activities completed by the user (including all the attempts made) were averaged and the results are presented above.

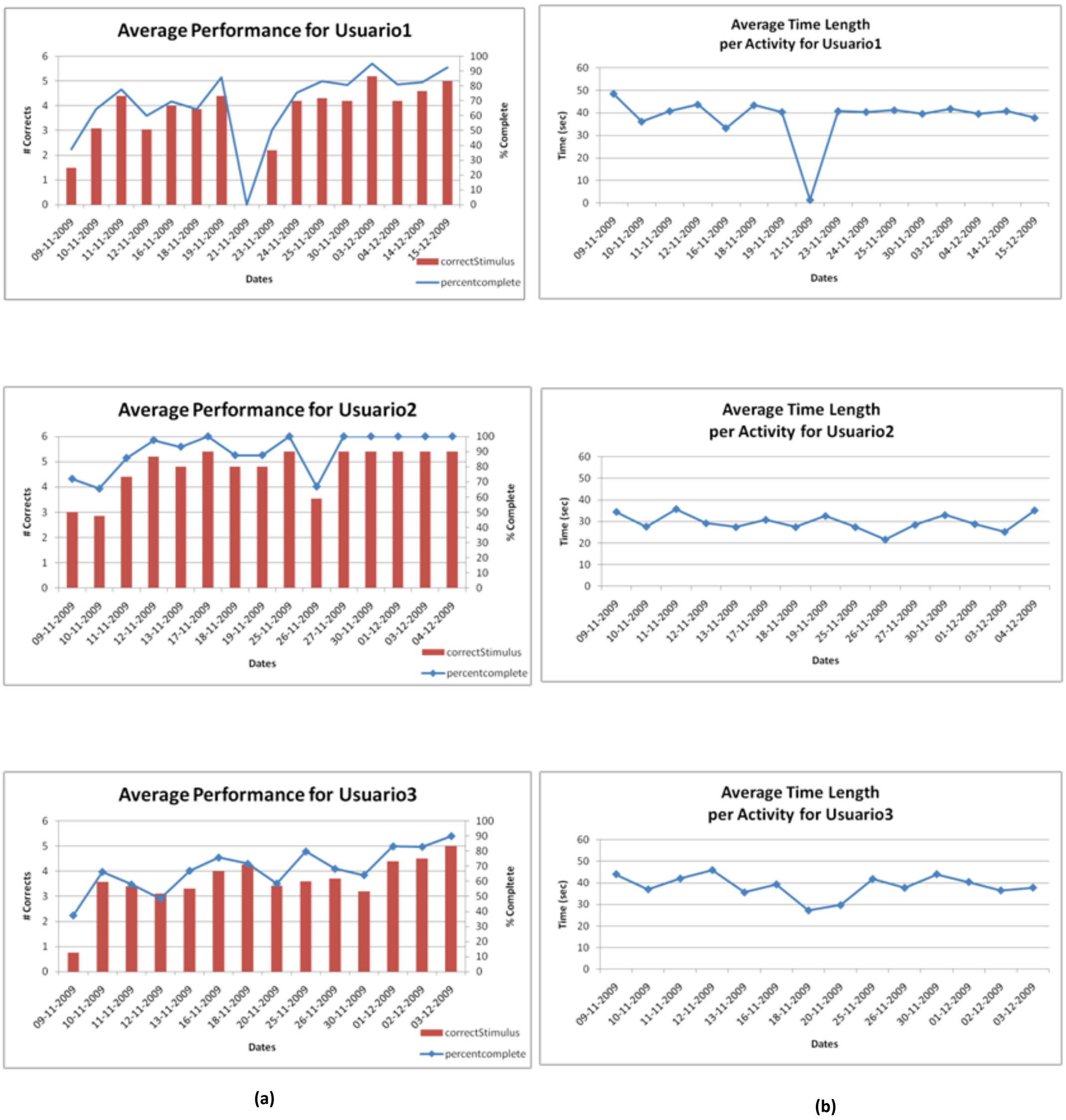


Figure 33 – Average Performance (a) and Average Time Length (b) per Patient (1/2) of HSJD

As it was already mentioned, the sites for application of this system are quite harsh. Patients miss their appointments, do not show at the scheduled therapy sessions and do not take the activities that are planned for the session. Hence, the number of sessions that are actually taken differs from patient to patient. As can be seen in the above charts, the x-axis categories are not identical in neither number nor type and each patient's performance to be presented separately. It is possible to see the progress of each patient in the sessions he/she took. A straightforward approach to the charts seems to indicate that there is a relationship between the average percentage completed by activity and the average number of correct stimuli. They seem to be directly correlated. As far as the average time length and the average performance there also seems to be a relationship. For usuario4, usuario5 and usuario6, as the average performance growths, the average time length diminishes.

(a) (b)

Figure 34 – Average Performance (a) and Average Time Length (b) per Patient (2/2) of HSJD

Another measure is the total effective time for each user. It relates to the total amount of time that a patient effectively uses per session. Thus, it refers to the sum of the actual time spent on each activity for that same session.

As Figure 35 shows, after some sessions, the amount of time patients spend on a session seems to stabilize. In fact, for usuario4, usuario5 and usuario6 the effective time seems to decrease over time.

Figure 35 – Total Effective Time per Patient of HSJD

Despite having data available for nine users, both usuario8 and usuario9 completed no more than two sessions. They abandoned the study and did not appear in further sessions, according to the testimony of the psychiatrist in section 9.8-Personal Communications. Thus, since no statistical relevance was found in their results, they were omitted from the report.

Two measures were computed for each activity: the average performance accomplished and the average time length taken by each user.

As can be seen in Figure 36, all the users accomplished averagely at least 50% of what was demanded in each activity. The activity with a better average result is the 18 – Memory, while the worst is activity 17 – Oranges and Baskets.

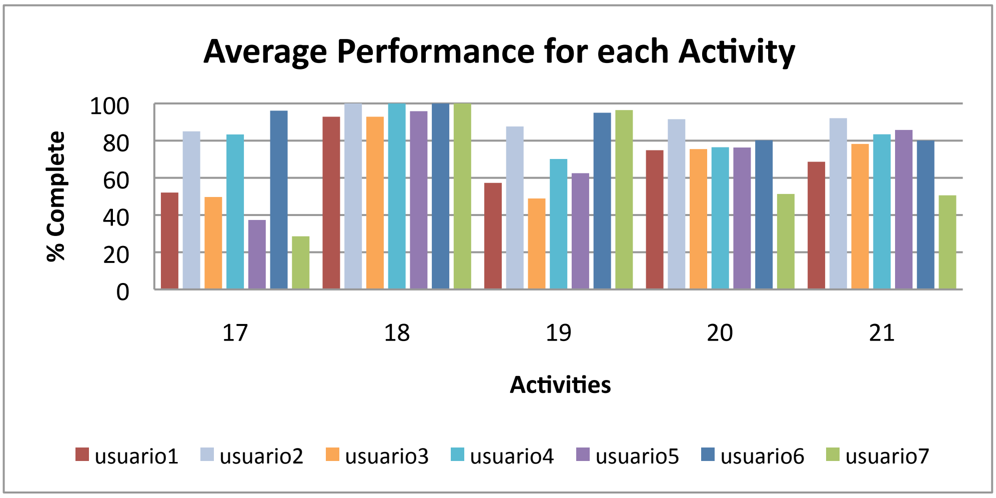


Figure 36 – Average Performance per Activity of HSJD

The following list provides the mapping between the name and the identification number of the activities, previously described in 5.1-eSchi – the system's design: 17 – Oranges and Baskets; 18 – Memory; 19 – Pairs; 20 – Sound Reaction and 21 – Visual Reaction.

Regarding the time taken to accomplish the demanded results per activity, the chart in Figure 37 presents a significant difference between the average times taken to complete activity 18 – Memory, particularly when contrasting with other activities' results.

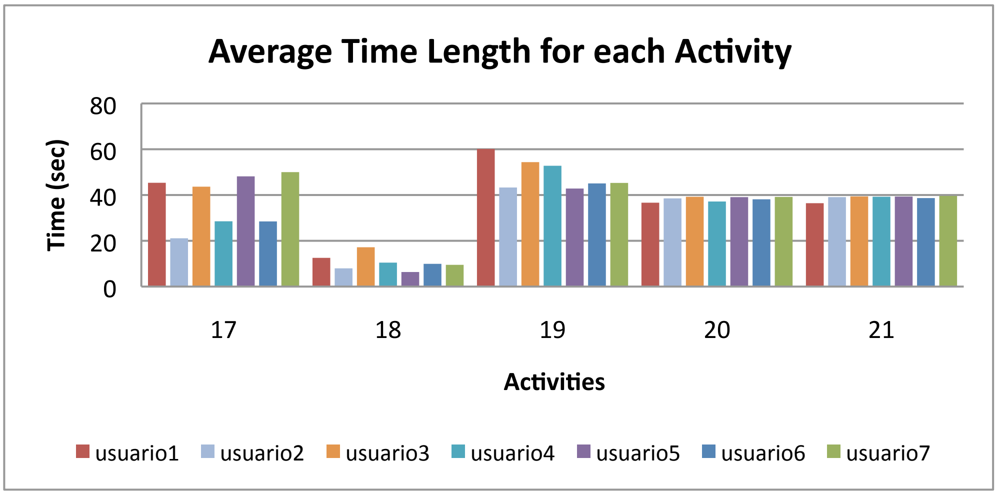


Figure 37 – Average Time Length per Activity of HSJD

Another observed measure relates to the amount of attempts a user makes for each activity trough the sessions. The number of attempts diminishes over time for every user and in the last sessions, the patients only conduct one try per activity.

6.1.3. ASQ Results

The ASQ instructions for administration and scoring were used to compute the ASQ Scores from the answers that were given by the users engaged in the study (9.7-Questionnaires).

The idea was to evaluate both therapist' and patients' satisfaction regarding the usage of eSchi on a per scenario basis. After each session, one per day, all the users answered to the 3-question questionnaire. According to the instructions, low scores are better than high scores due to the anchors used in the 7-point scales. Hence, a low score demonstrates a higher level of satisfaction with the tool.

The answers from the two profiles were separated for analysis purposes. First, the two profiles have differences in the system usage and, second, the answers have distinct time ranges.

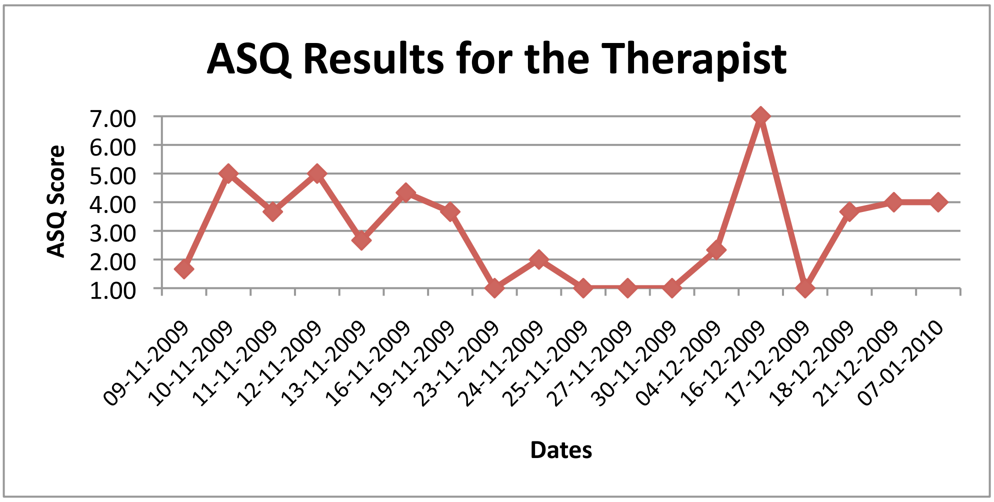


Figure 38 – ASQ Results for the Therapist of HSJD

The answers of the therapist provided an average ASQ score of 3,0 for the entire study length. The distribution of answers given during the study length is depicted in Figure 38. A relevant aspect of the chart is the value presented for day 16-12-2009 where the therapist provided a 7,0 score. This implies a total dissatisfaction with the system but no justification was provided for this fact.

As far as the answers of the patients, we will provide the average ASQ scores grouped by: date of scenario and patient. Additionally, it is also possible to see the ASQ score for each patient for the study length.

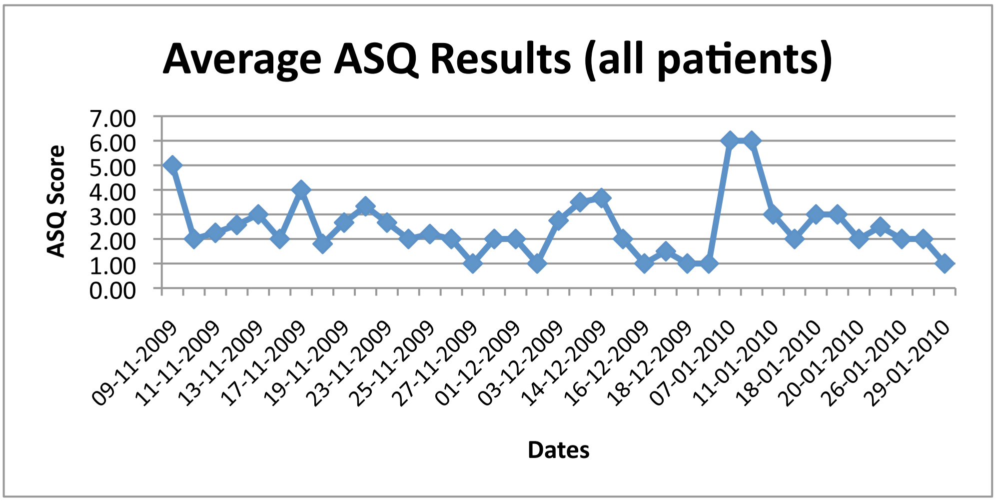


Figure 39 – Average ASQ for Patients of HSJD

The global average ASQ score accounting for all the patients and for all the sessions considered is 2,75. The average ASQ score given by the patients during the length of the study refers their opinion on the usage of the system as it is shown in Figure 39.

Figure 40 presents the number of sessions completed by each user:

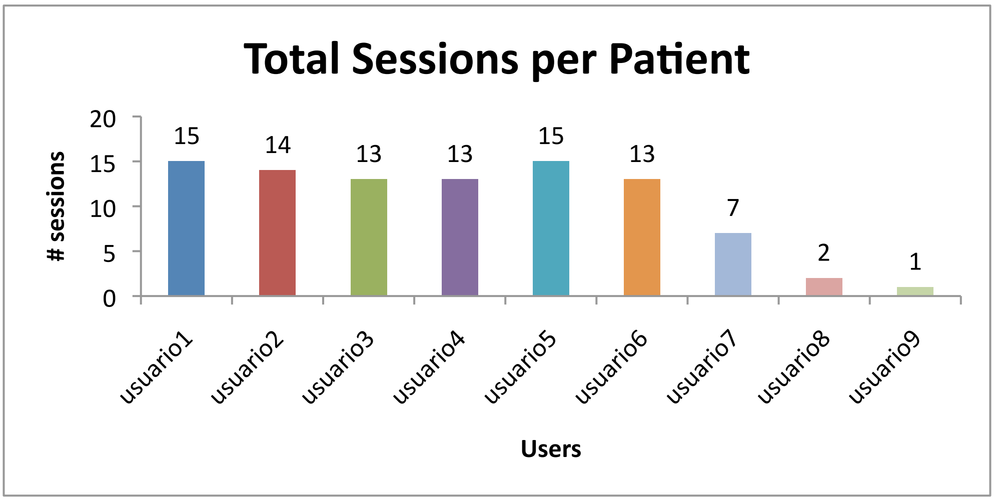


Figure 40 – Total Sessions per Patient of HSJD

Figure 41 presents the average ASQ score given by each patient for the study length. All the patients present similar ASQ scores, whithin a range of 1,86 up to 3,5.

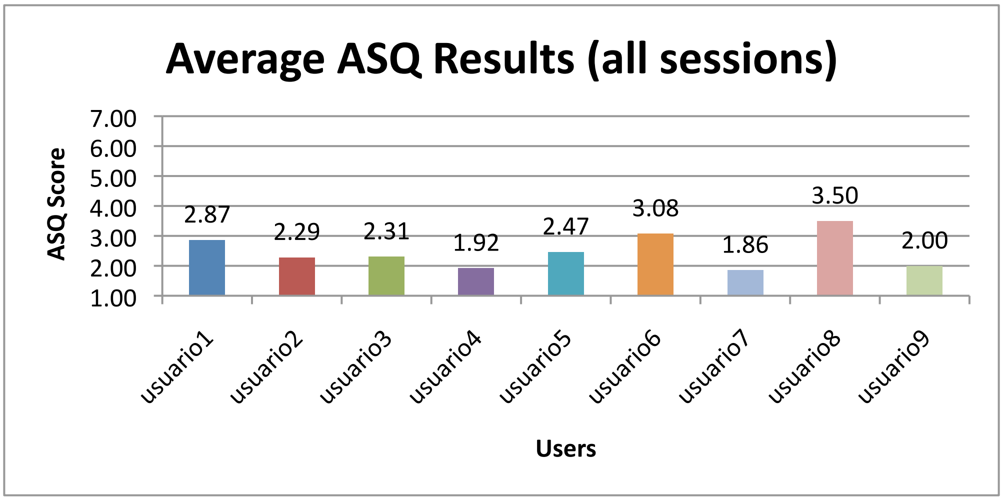


Figure 41 – Average ASQ Results of HSJD

Figure 42 presents an ASQ score chart for each patient trough their sessions. Patients that have taken less than seven sessions will not be subject of observation. The trend lines for each chart are similar and indicate an overall decrease in the ASQ score after an initial period of sessions.

Comparing the average results for all the patients and the score for the therapist, the therapist indicated a higher ASQ score in the last sessions, while the average of patients seems to lower over time, as shown in Figure 43.

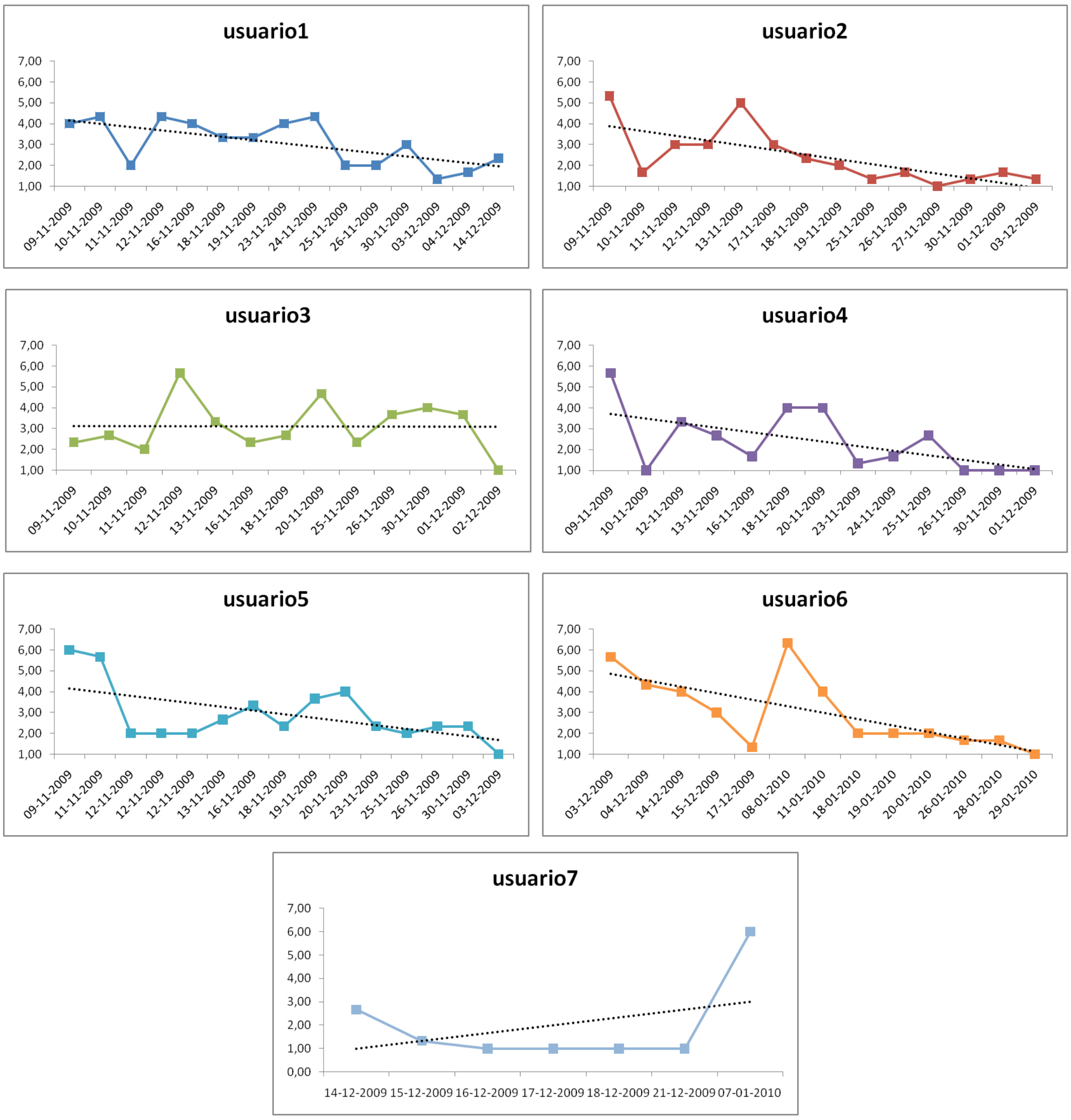


Figure 42 – ASQ score chart per patient of HSJD

Although not provided explicitly, the reasons for these results can be connected to the therapist's growing concern with the inclusion of further activities in the system. The feedback in 9.8-Personal Communications and the comments provided in Table 13 contain a reference to an expected upgrade in the system with the inclusion of newer activities with further levels of difficulty.

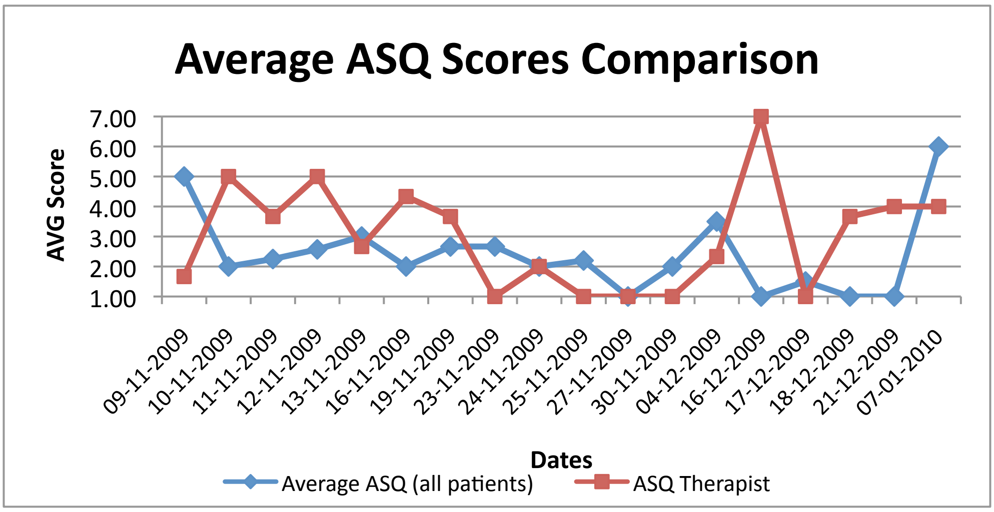


Figure 43 – Average ASQ Scores Comparison of HSJD

Comparing the ASQ results per session with the data that was gathered automatically by eSchi, there seems to be a direct relationship between the patient's ASQ score and the average performance demonstrated in the system's usage. They both improve over time.

6.1.4. CSUQ Results

The CSUQ instructions for administration and scoring were used to compute the CSUQ Scores from the answers that were given by the users engaged in the study. The scores include an OVERALL score, a SYSUSE score, an INFOQUAL score and an INTERQUAL score. For further information on the items and CSUQ administration and scoring rules please refer to section 9.7-Questionnaires.

Since the idea was to evaluate both therapist' and patients' opinion regarding the computer system usability, at the end of the study, all the users answered to the 19 questions and were able to make free-text observations.

The answers from the two profiles were separated for analysis purposes since the two profiles perceive the system differently.

The therapist provided two answers to this questionnaire with a time difference of about a month, presented in Table 12. The answer given in January of 2010 is due to the later inclusion of patients' usuario6 and usuario7 in the study. The Overall score provided by the therapist was 1,71 for the first application of the questionnaire and the second score was 5,32. One possible justification for the divergence in the scores is the fact that the second answer might be influenced by the therapist's previous knowledge and usage of eSchi.

Table 12 – CSUQ Scores for the Therapist of HSJD

	OVERALL	SYSUSE	INFOQUAL	INTERQUAL
Dates	*Items 1 through 19*	*Items 1 through 8*	*Items 9 through 15*	*Items 16 through 18*
17-12-2009	1,71	1,33	1,57	2,67
11-01-2010	5,32	5,63	5,43	4,33

The therapist also provided a couple of observations regarding items 16 – graphical user interface "allure" and 18 – functionalities available, presented in Table 13:

Table 13 – CSUQ Comments - free translation - of the Therapist of HSJD

16	**The keyboard, mouse, visual screens and language used in the application are enjoyable.**	The images for the "pairs" activity are too small.
18	**The application has all the features and functionalities that I expected.**	I expected more diversity of activities and with distinct levels of difficulty. It is too repetitive.

These comments were also endorsed to the development and research team through personal communications of the therapist that requested new and improved activities. According to the informal description concerning the last therapy sessions where eSchi was used, apparently, both therapist and patients thought that sessions had become a routine and it was time to improve the activities of the system. The requested improvements included new and more challenging activities.

The patients also answered to a similar version of the questionnaire and the overall and subscale scores were calculated.

Table 14 - CSUQ Scores per Patient of HSJD

	OVERALL	SYSUSE	INFOQUAL	INTERQUAL
Users	*Items 1 through 19*	*Items 1 through 8*	*Items 9 through 15*	*Items 16 through 18*
usuario1	3,32	3,00	3,14	4,67
usuario2	2,58	2,50	2,86	2,33
usuario3	3,00	2,63	3,71	3,00
usuario4	1,05	1,00	1,14	1,00
usuario5	5,53	5,75	5,14	6,00

The chart in Figure 44 presents another perspective of the calculated scores.

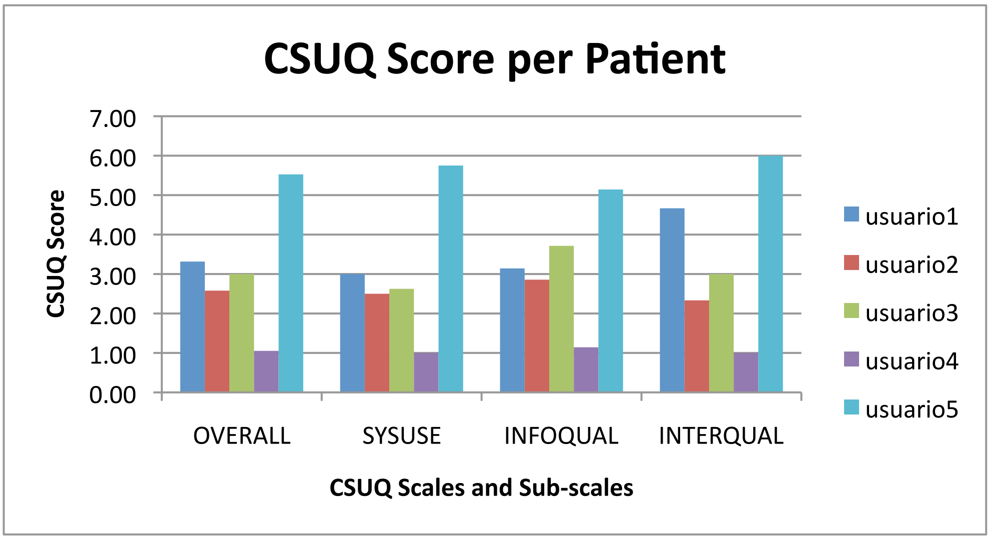


Figure 44 - CSUQ Score per Patient of HSJD

As far as observations and comments, only one patient made the following comments on items 15 and 16, concerning the graphical user interface “allure” and ease of use:

Table 15 - CSUQ Comments - free translation - of the Patients of HSJD

15	**The keyboard, mouse, visual screens and language used in the application are enjoyable.**	By being deaf it is difficult for me to use the mouse
16	**I like using the keyboard, mouse and screens of the application.**	Idem

These comments were also endorsed to the development and research team through personal communications of the therapist. The first comments on the subject of the graphical user interface led to the update of the system (already described in 5.2.1.3. Study enrolment), upon the application changes requested that included a better interaction with the activities using the keyboard. Further comments, according to the informal description concerning this specific user's sessions, did not seem coherent and the therapist decided to exclude the activity that involved audio stimuli from this user's sessions.

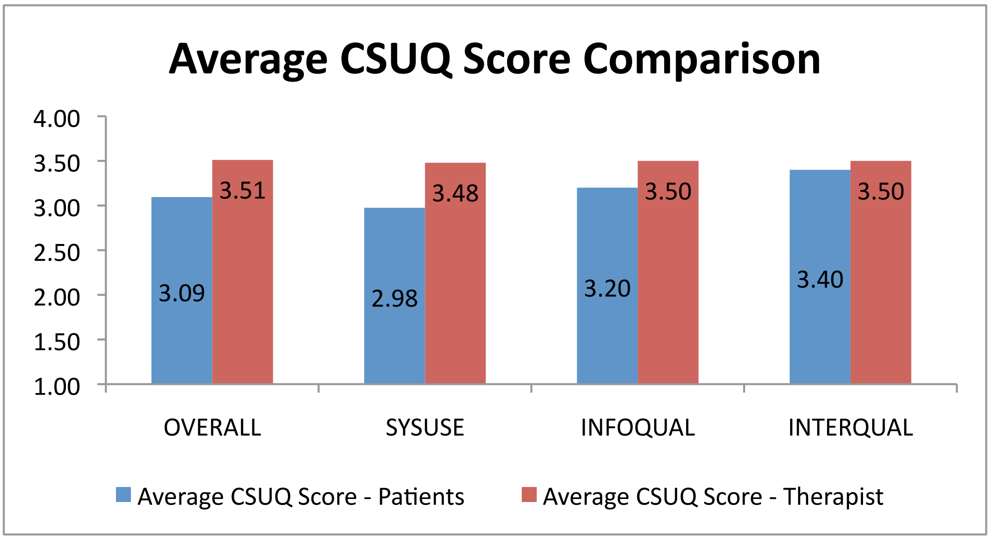


Figure 45 – Average CSUQ Score Comparison of HSJD

The results of both profiles can be compared, becoming visible that the satisfaction level after using eSchi is superior for patients than for the therapist (Figure 45 – Average CSUQ Score Comparison of HSJD). It is important to point out that the therapist answered to the questionnaire twice and that the expectations and usage satisfaction are considerable divergent in the two moments of the answers provided (1st CSUQ score = 1,71 vs. 2nd CSUQ score = 5,32). The supposed reasons for these deviating values were already pointed out.

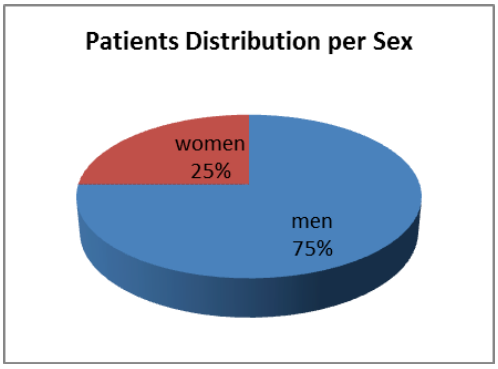
6.2. Hospital Magalhães de Lemos

The Hospital Magalhães de Lemos (HML), in Porto, Portugal, is a psychiatric institution whose population mainly suffers from depression and depression-related pathologies. They have a small population with schizophrenia or schizoaffective disorders that makes use of the facilities on an external visit basis. At the HML all the patients live outside of the facilities and some are totally integrated into society and in an actual family environment. Subjects considered in the study are the ones selected by their therapist amongst the schizophrenia-diagnosed patients.

6.2.1. Socio-Demographic Description

The sample refers to the users that applied for the study and went through the proposed set of sessions. One occupational therapist and four patients compose the sample of this study.

The group of patients presents an average age of 32 years, within the range: 23 to 37 years. Their distribution according to sex and average age is presented in Figure 46:



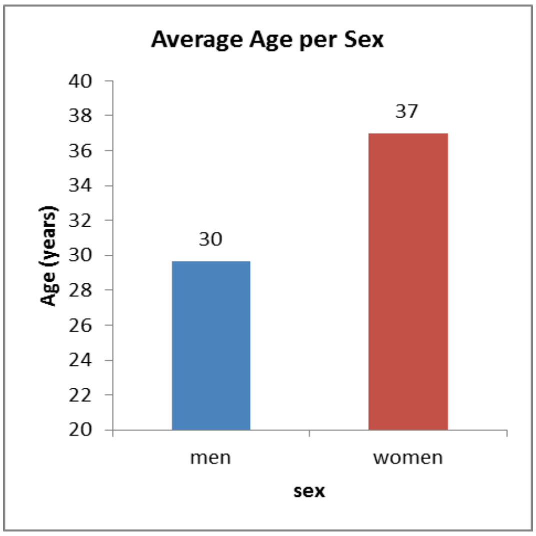


Figure 46 – Socio-Demographic Description of HML

Only one out of the four participants in the study was a woman with an age of 37 years, not significantly higher than the average age of the men that was 30 years.

They all declared having the basic-primary school level and primary-basic knowledge in informatics.

All the patients were diagnosed with psychotic schizophrenia according to the data provided by the therapist.

The participant's engagement point in the study can be established by the date that corresponds to answering the first questionnaire (ASQ). Two users answered in 15 January of 2010. The second user joined in on the 18th of the same month and the last one engaged on 22 January of 2010.

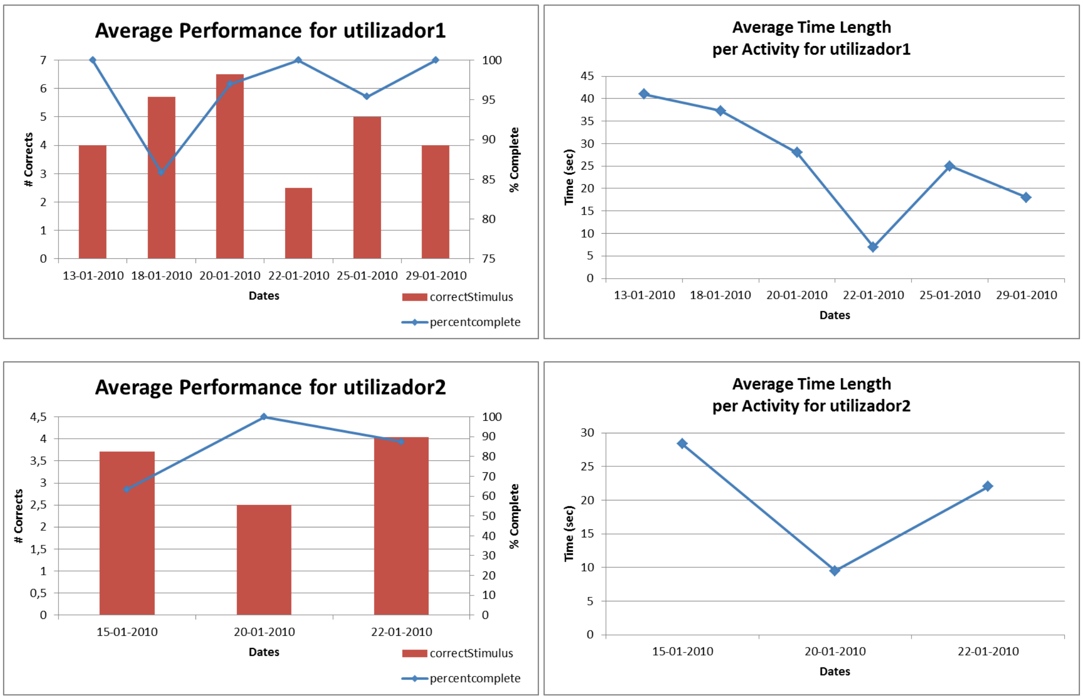
6.2.2. Sessions and Activities Statistics

Figure 47 and Figure 48 provide a summary report on the data that was collected automatically by the eSchi system.

For each patient it is possible to compute the average performance per session ((a) column) and the average time length per activity ((b) column). The performance is composed by two sub measures: the average percentage of the activities completed (`% Complete`) in the sessions and the average number of stimuli that the user accurately got as correct (`# Corrects`). The average time length refers to the actual time spent on an activity while trying to accomplish the specified goals (time in seconds).

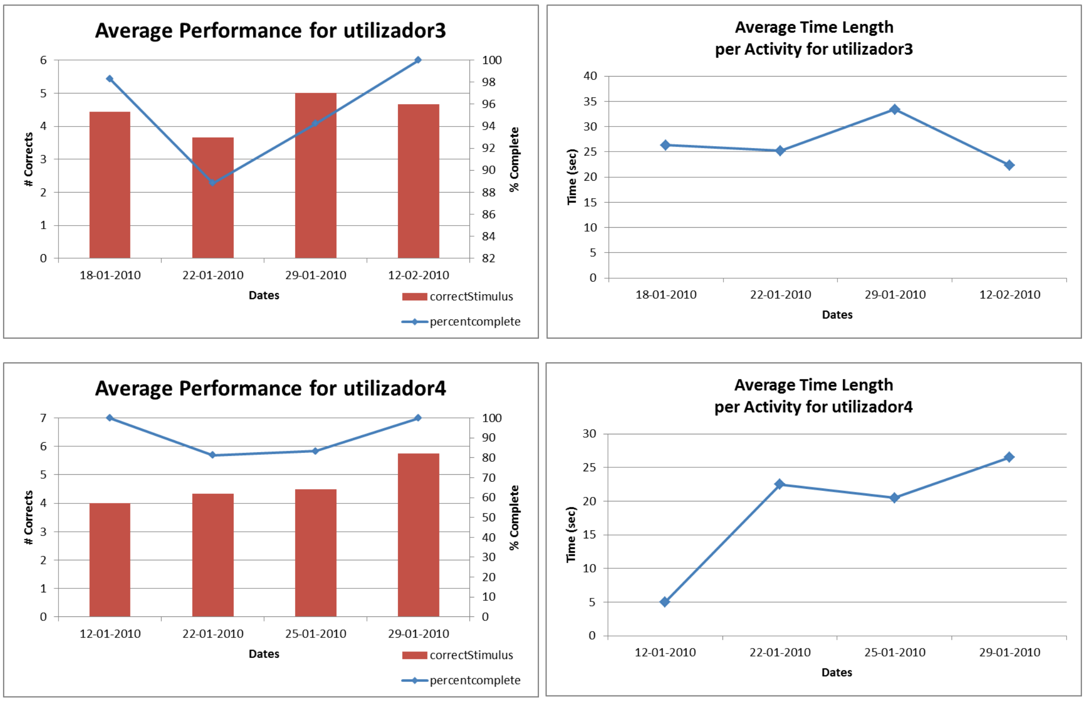
For each session, all the activities that were completed by the user (including all the attempts made) were averaged and the results are presented above.

Since not every user conducted the same number of sessions and not even in the same days, the statistics for each user had to be presented separately. The x-axis categories are not identical.



(a) (b)

Figure 47 – Average Performance (a) and Average Time Length (b) per Patient (1/2) of HML



(a) (b)

Figure 48 – Average Performance (a) and Average Time Length (b) per Patient (2/2) of HML

Nevertheless, it is possible to see the progress of each patient in the sessions he/she took. A straightforward approach to the charts seems to indicate that there is a relationship between the average percentage completed by activity and the average number of correct stimuli. They seem to be directly connected in direct variance. As far as the average time length and the average performance there also seems to be a relationship. At least for some of the users (utilizador1 and utilizador3), as the average performance growths, the average time length diminishes.

Another measure is the total effective time for each user. It relates to the total amount of time that a patient effectively uses per session. Thus, it refers to the sum of the actual time spent on each activity for that same session.

As Figure 49 shows, after some sessions, patients seem to stabilize the amount of time they spend on a session. In fact, for most patients (except utilizador2), the effective time seems to decrease over time.

Figure 49 – Total Effective Time per Patient of HML

Two measures were computed for each activity: the average performance accomplished and the average time length taken by each user.

The chart in Figure 50 shows that all the users accomplished averagely at least 75% of what was expected in each activity. The activity with a better average result is activity 17 – Oranges and Baskets. All other activities also present good average results without significant variance.

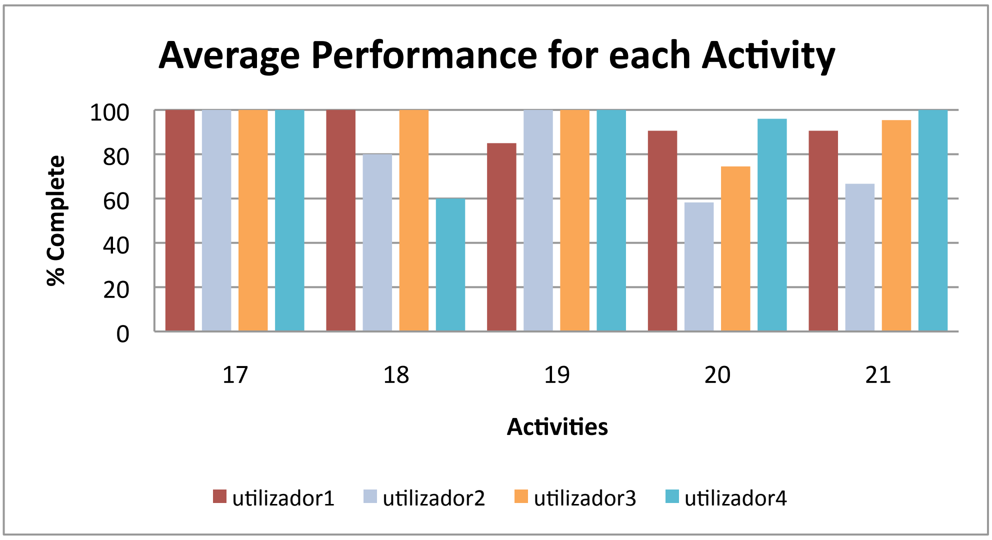


Figure 50 – Average Performance per Activity of HML

The following list provides the mapping between the name and the identification number of the activities, previously described in 5.1-eSchi – the system's design: 17 – Oranges and Baskets; 18 – Memory; 19 – Pairs; 20 – Sound Reaction and 21 – Visual Reaction.

Regarding the time taken to accomplish the demanded results per activity, the chart in Figure 51 presents a significant difference between the average times taken to complete activity 18 – Memory, particularly when contrasting with other activities' results. On average, the activity that took longer to complete was activity 19, approximately 40 seconds, while the drag and drop and memory activities present a significant lower difference, approximately 5 seconds. Both activities related with recognition take an average of 35 seconds to complete.

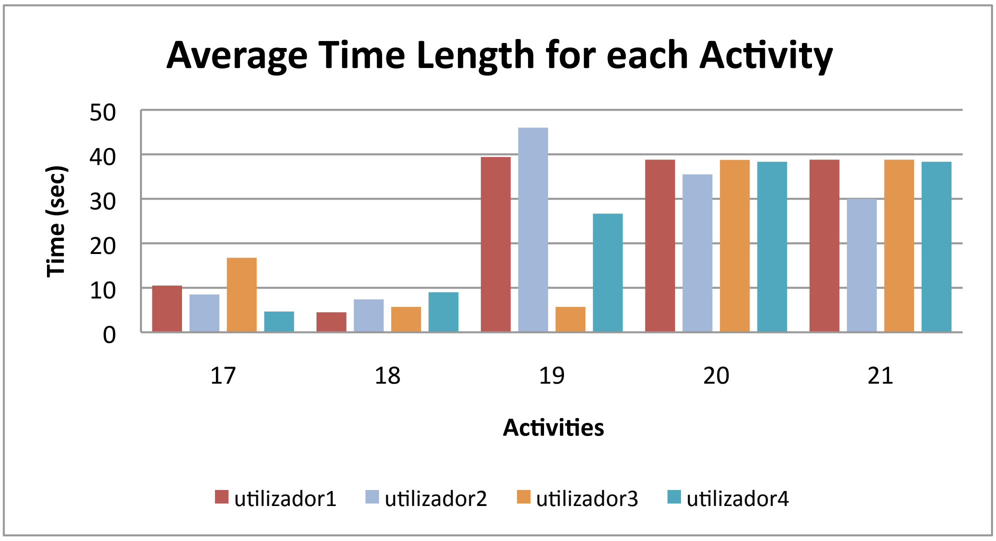


Figure 51 – Average Time Length per Activity of HML

Another observed measure relates to the amount of attempts a user makes for each activity trough the sessions. The number of attempts diminishes over time for every user and in the last sessions the patients only conducts one try per activity. The data also provides the information regarding the usage and commonly the users repeat an activity in order to improve their personal outcomes.

6.2.3. ASQ Results

The same rules and decisions to present the obtained results, applied early for the Hospital Sant Joan de Déu (6.1.3-ASQ Results) also apply here.

The answers of the therapist were quite consistent and provided a total average ASQ score of 2,67 for the entire study length.

Table 16 – ASQ Score Results for the Therapist of HML

Date	ASQ Score
15-01-2010	2,67
18-01-2010	2,67
20-01-2010	2,67
22-01-2010	2,67
25-01-2010	2,67
29-01-2010	2,67
12-02-2010	2,67

As far as the answers of the patients, we will provide the average ASQ scores grouped by: date of scenario and patient. Additionally, it is also possible to see the ASQ score for each patient for the study length.

The global average ASQ score accounting for all the patients and for all the sessions considered is 2,75. The average ASQ score given by the patients in the length of the study refers their opinion on the usage of the system (Figure 52).

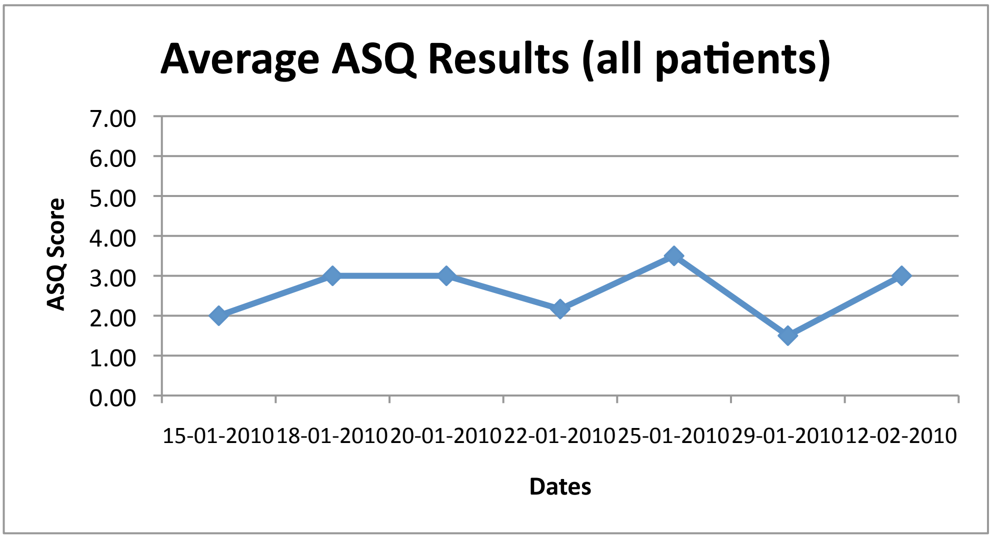


Figure 52 – Average ASQ for Patients of HML

Figure 53 presents the number of sessions completed by each user:

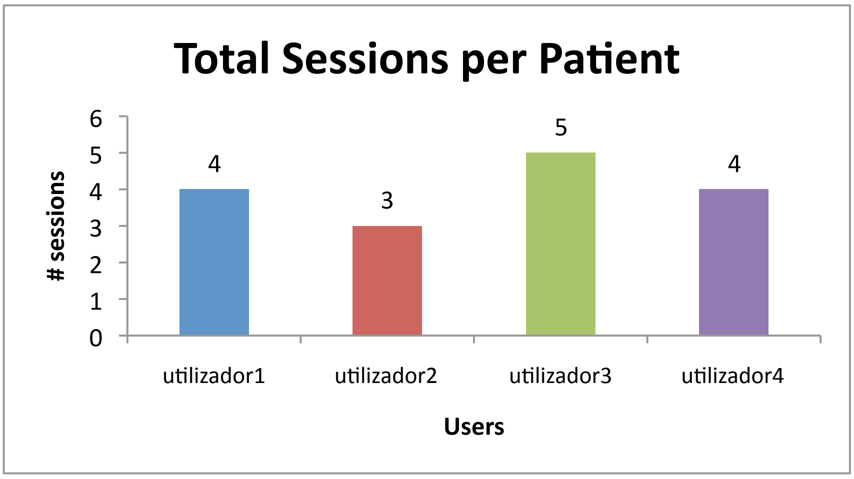


Figure 53 – Total Sessions per Patient of HML

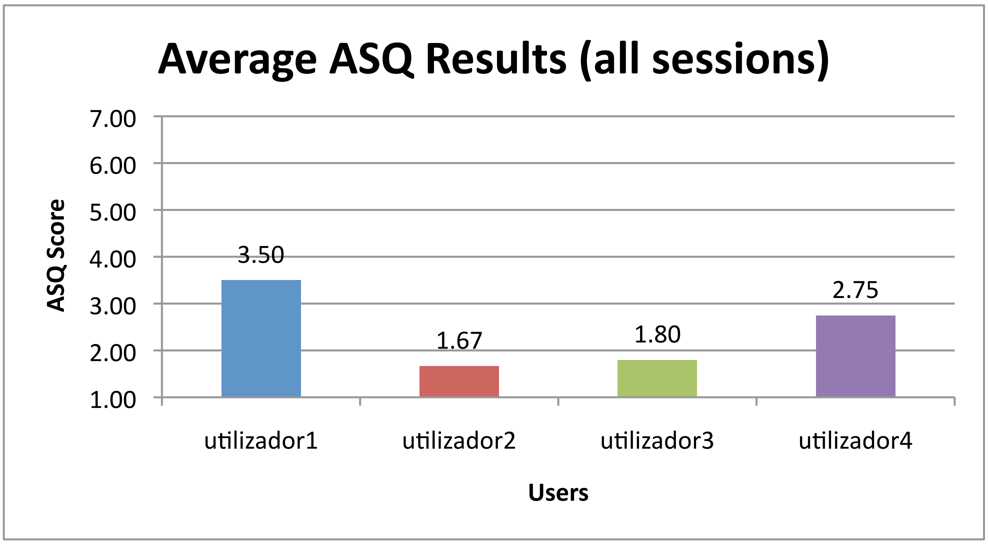


Figure 54 – Average ASQ Results of HML

Figure 54 presents the average ASQ score given by each patient for the study length.

Figure 55 presents an ASQ score chart for each patient trough their sessions. The trend lines for each chart are similar and indicate a decrease in the ASQ score after an initial period of sessions.

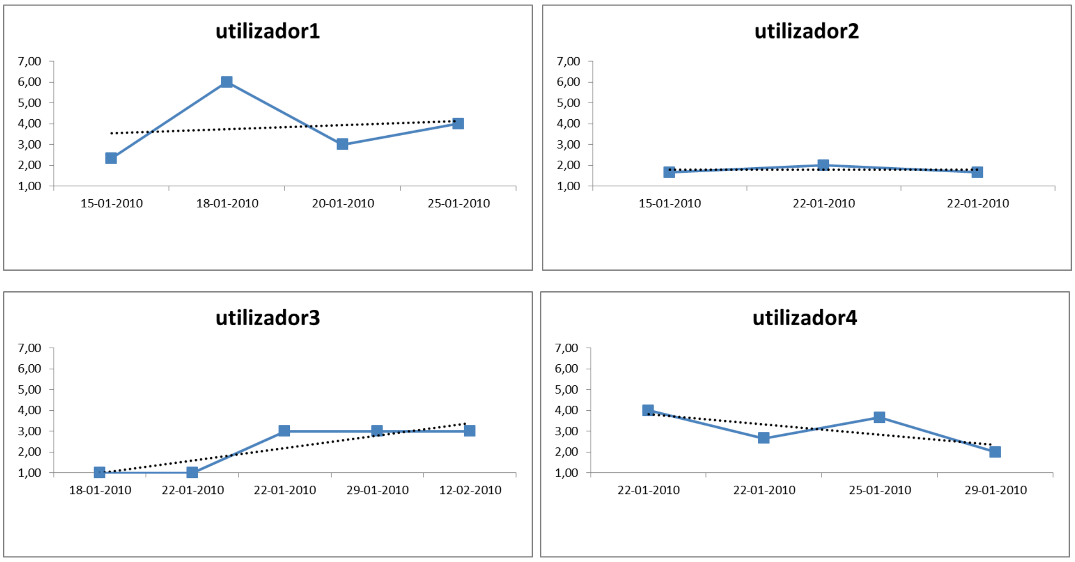


Figure 55 – ASQ score chart per patient of HML

Comparing the average results for all the patients and the score for the therapist, the therapist indicated a higher ASQ score in the last sessions, while the average of patients seems to lower over time.

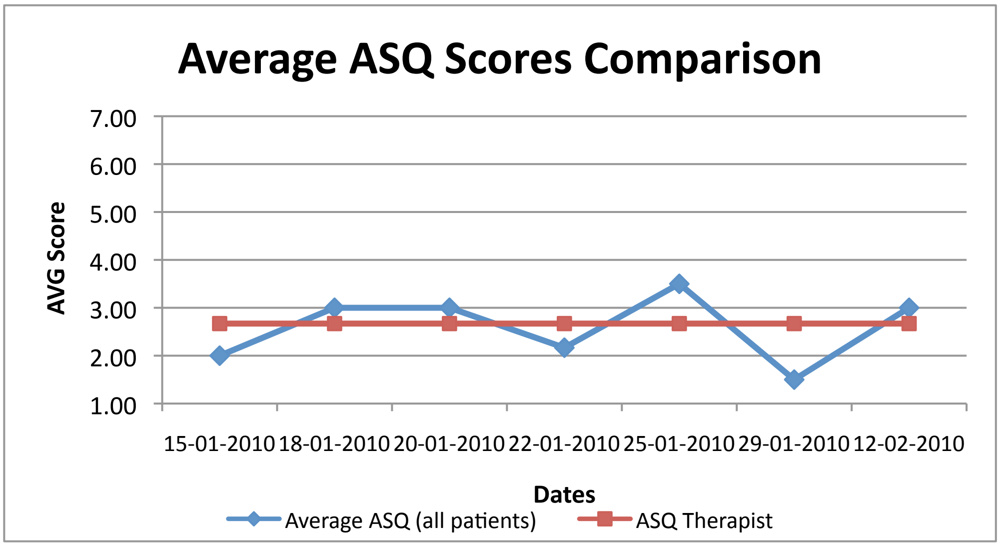


Figure 56 – Average ASQ Scores Comparison of HML

Comparing the ASQ results per session (scenario) with the data that was gathered automatically by eSchi, there seems to be a direct relationship between the user ASQ score and the average performance demonstrated in the system's usage. They both improve over time, as can be seen in Figure 56.

6.2.4. CSUQ Results

The CSUQ results provide information that mainly concerns to the need to upgrade and include new activities in the system. All the users, therapist included, provided feedback on the existing activities of the system and asked for a new activity to be implemented in order to evolve the system.

6.3. Summary

The eSchi system was implemented, deployed and data was collected from two distinct case studies. Each one of the case studies has brought some insight into the monitoring and visualization context of e-Therapy that is worth discussing with further detail.

Despite the efforts to minimize existing confounding factors that might influence the results collected, the perfect environment could not be achieved. The idea was to provide three similar sites in which the system would be implemented but reality is actually quite different. It is almost impossible to ensure the same type of conditions from site to site. Each site has its own unique conditions that include aspects such as including an internment ward or an ICT laboratory, schizophrenia typologies present… The number of patients that engaged in the study was considerable different, from site to site, and even the diagnosis, the typologies of schizophrenia and schizoaffective conditions were distinct.

“There are no illnesses, only patients” is a popular saying in the mental health area. Each patient has its own individual and unique condition and cannot, and should not, be grouped into a cluster either in diagnose or treatment. This is the belief of all the health professionals in the mental health field that we had the opportunity to meet. The patient individuality should be respected and this, sometimes, implies a particular treatment protocol. These concerns prove to be highly considerate for the patients and improve the environment lived in the facilities. Nevertheless, this is also one if not the major causes for the harsh situations found when trying to conduct valid research studies, such as this one. Research usually provides new and additional insights on some patterns and characteristics groups, helping in the science discovery process.

Despite the study limitations, presented bellow in section 7.2 and the fact that schizophrenia is a chronic illness that, at present, has no scientific evidence on cognition improvements, indicators attempt to provide some insight into the patient’s behavior within a session and throughout a sequence of episodes in time.

The results show that both the average percentage of the activities completed in the sessions and the average number of correct stimuli improve over time. Patients seem to develop their ability through training. Repetition of the same activities though a certain period seems to improve the outcomes. The actual time spent on an activity while trying to accomplish the specified goals helps to the validation of the other indicators. After some sessions, patients seem to stabilize the amount of time they spend on a session and actually, the effective time seems to decrease over time.

For each activity in the system, the average performance accomplished and the average time length taken by each user to complete it are also shown in chart format. It is possible to see a behavior pattern of patients through the distinct activities. Each patient's results seem to follow the pattern formed by the entire group's results and even the pattern formed by all the users of the system (both sites). The best example of such insight is the set of results presented for the memory related activity (number 18), both in Figure 37 – Average Time Length per Activity of HSJD and in Figure 51 – Average Time Length per Activity of HML, here grouped in Figure 57.

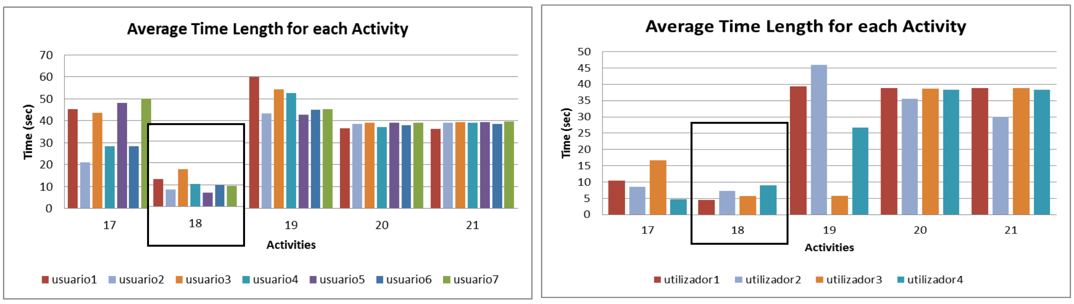


Figure 57 – Possible Insight on Patterns

All the patients, at the distinct sites, conducted the memory activity. It presents the lowest average performance and time for all the patients in both sites.

Another aspect worth mentioning is the fact that upon comparison of the ASQ results per session (scenario) with the data gathered automatically by the eSchi tool, they both improve over time. It appears that there is a direct relationship between the user ASQ score and the average performance demonstrated in the system's usage. This could mean that the repeated usage of the tool and the performance improvements in the activities encourage the users' acceptation of the tool, improving their satisfaction level.

On this line of thought, another possible insight is the fact that, simply by using the automatic and transparent monitoring available in the system is possible to have an insight on the users' satisfaction level. Answering to the ASQ, that occurred on a daily – per session – base and, that despite being only a 3-question questionnaire, is somewhat time consuming. Thus, since there seems to be some redundancy on the information, the ASQ answering could possibly be replaced by the data collection analysis enabled by the InfoVis features of eSchi.

The last data collection tool used was the CSUQ questionnaire that evaluated the therapist' and patients' opinion regarding the computer system usability. This tool was used after, at least, a two-week period from the last utilization of eSchi.

Regardless of the fact that the average CSUQ scores obtained were actually low enough to be considered satisfactory, there was some additional feedback worth mentioning. Some free-text comments, mainly made by the therapists, requested new and improved activities, based on their perception on the e-Therapy sessions where eSchi was used. Therapists considered eSchi as a valuable tool to be used in their e-Therapy sessions and even requested that improvements were included in future versions. This includes new and more challenging activities.

When both profiles (therapist and patient) are compared, it is obvious that the satisfaction level after using eSchi is superior for patients (Figure 45 – Average CSUQ Score Comparison of HSJD). It is important to point out that the fact that the therapist actually answered to the questionnaire twice and that the expectations and usage satisfaction are considerable distant in the two moments of the answers provided. This can be explained by the fact that therapists had higher expectations regarding the evolution of the tool, and the satisfaction score of using the system was strongly influenced by this fact.

7. Conclusions

Mental disorders such as Schizophrenia are amongst the 20 leading causes of disability worldwide. There are currently national policies dedicated to address this public health issue, preventing and improving mental health assistance. One of these policies includes the digital provision of mental health information and services through Mental Health Information Systems (MHIS). Such systems are not yet widely accepted by the health professional's community that still has some ICT introduction resistance. The World Health Organization (WHO) provides guidelines for the correct design and implementation of MHIS.

e-Therapy can be seen as a subsystem of an MHIS that enables the electronic provision of a specific health service – therapy. It is a novel mode of delivery for an already existing type of intervention, where both patients and health professionals are involved. There are several computer-assisted approaches available but the act of designing computer-aided systems, like these, can help to clarify what is the actual procedure followed by therapists. These tools will not replace the therapist, but rather will extend their power and avoid time-consuming and less profitable tasks. A framework for measuring the effectiveness of e-Therapy should be used when applying such systems. It should include items such as quality of care, education and empowerment, access, costs and satisfaction.

Continuous monitoring of the patient treatment's outcome and providing feedback to therapists can be used to improve the treatment's success. Regardless of what produces an effective feedback, quite often debated amongst experts in the field, continuous monitoring of the patients' treatment response and provision of the information to the treating clinician, are required. The Learning Progress Monitoring (LPM) model defines a monitoring system as an implementation that supervises a process. It provides a first approach for the type of monitoring that is required in an e-Therapy context.

The best information visualization (InfoVis) is the one that conveys meaning – insight – to its users. Something unexpected that provides a deeper understanding and eureka-like experiences, allows users to discover hidden connections and patterns. The model proposed by Van Wijk (Wijk, 2006) is quite simple and tries to describe the context where visualization occurs. Visualization tools' success is highly dependent on the interaction techniques used and should contain a consistent and usable interface and provide clear feedback to the users.

According to the conceptual framework summarized, a fieldwork was planned recurring to the well-known case study methodology proposed by Yin (R. K. Yin, 2002; R. K. Yin, 2003) and later expanded by Kitchenham (Kitchenham et al., 1995). To accomplish the study planned it was necessary to design, implement and deploy an e-Therapy tool. To accomplish such a product, the research team used the Patient-Centered Design (PCD) approach. PCD is a particular type of User Centered Design (UCD) approach where the end-user is a patient that will use a healthcare solution that should meet his/her expectations (Dabbs et al., 2009; Demiris et al., 2008). This approach is known as human-centered design and focus on needs, wants, skills and preferences of the product's primary user as well as those of the entire organization.

7.1. Contributions

After the design and implementation of the e-Therapy tool – eSchi – two distinct sites were chosen for the application of the tool to a real setting and in a true and natural environment. After the deployment and application of the tool under a formerly planned and conducted case study, the research team collected the data and then analyzed it. This allowed us to deliver some contributions, described next.

The conceptual model for monitoring in e-learning contexts (LPM) was successfully adapted to the specific conditions of e-Therapy sessions. We designed a new visualization model shown in Figure 58. This is the model implemented in eSchi.

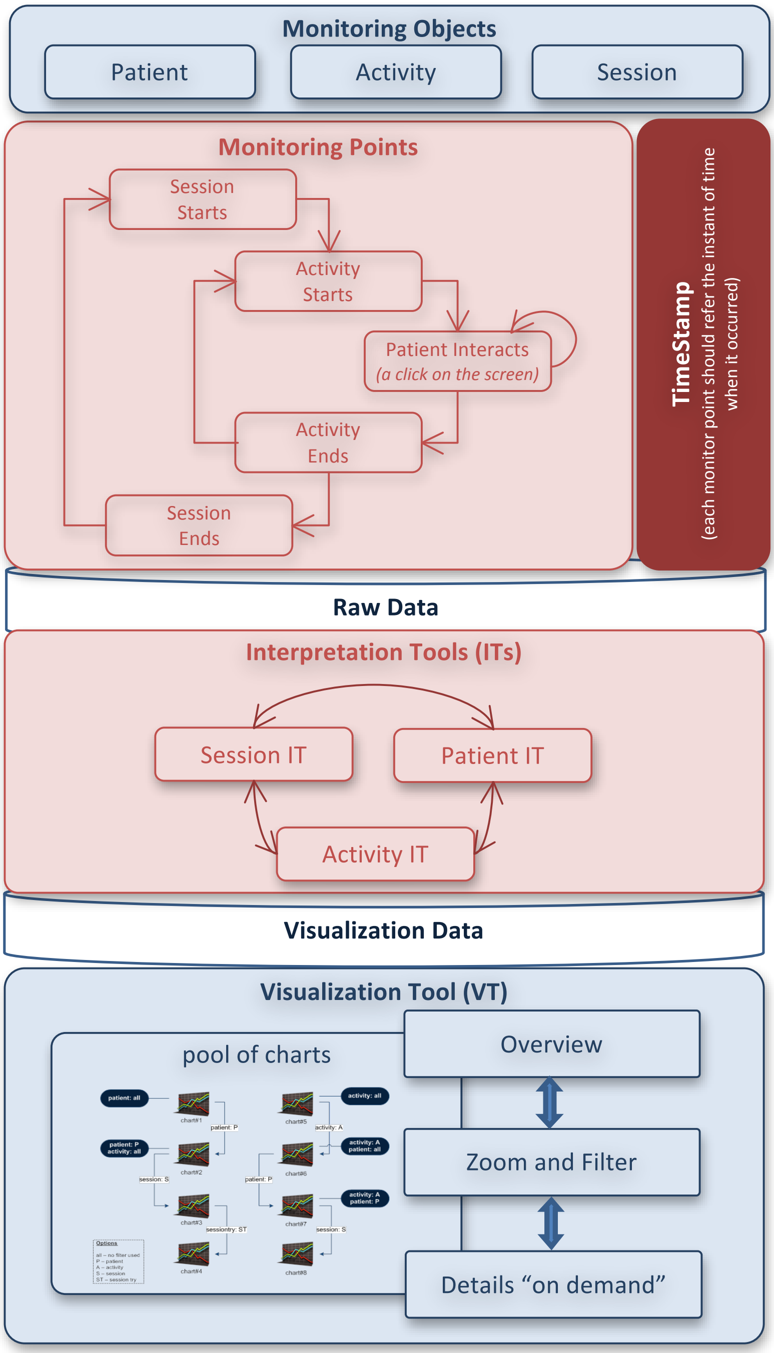


Figure 58 – Conceptual Model for Monitoring and Visualization of Patients' Performance in e-Therapy Contexts

We designed implementated and deployed eSchi, an e-Therapy application used as a complement in traditional therapy sessions. The e-Therapy application was designed and implemented according to the generic guidelines provided by WHO for MHIS systems. eSchi provides a set of multimedia tools that enable the cognitive rehabilitation of Schizophrenia patients, besides allowing therapists to manage their own sessions, patients and define the plan of activities per session. The final system is a simple and transparent structure that enables a fast and flexible integration with new add-ons (activities and additional modules). As far as the user interface is considered: it is clean, easy to learn and comprehend and saves time for its end users.

We successfuly deployed eSchi to two distinct real settings, two psychiatric institutions one in Barcelona and the other one in Porto. It was used a Patient Centered Design (PCD) approach that started by listening to the patient's needs and requirements besides considering the social and technical context for the implementation of the product. The method implied the active engagement of end-users in all the design phases starting from early in the lifecycle development process. The conceptual model of eSchi was separated from its implementation model. This is depicted in the plan followed for the empirical work. The PCD approach increased the communication between the health professionals that were involved in the system development.

Through eSchi, we provided support to therapists in the management of their patients' psychotherapy sessions. This improved the effectiveness of the decision-making process while providing some insight into the patient's behavior within a session (single episode) and throughout a sequence of episodes in time (a case) while in e-Therapy settings.

- the indicators chosen and the results of the fieldwork conducted show that patients seem to develop their ability through training. Repetition of the same activities though a certain period seems to improve their outcomes. After some sessions, patients seem to stabilize the amount of time they spend on a session and actually, that effective time seems to decrease over time. Each patient's results seem to follow the pattern formed by the entire group's results and even the pattern formed by all the users of the system (both sites);

- and it appears to exist a direct relationship between the user ASQ score and the average performance demonstrated in the system's usage. The repeated usage of the tool and the performance improvements in the activities encourage the users' acceptation of the tool, improving their satisfaction level as shown by ASQ scores. There seems to be some redundancy on the information, the ASQ answering could, possibly, be replaced by the data collection analysis provided by the InfoVis features of eSchi.

We propose an evaluation framework to measure the effectiveness of using similar systems to eSchi, in e-Therapy sessions. The framework has a set of guidelines that should be used when designing such systems. As far as eSchi is concerned:

- quality of care – the use of eSchi in a therapy session demonstrates no significant difference from the traditional therapy sessions. Patient's outcome assessment is done using valid tests, scores and scales;
- education and empowerment – all the information available through eSchi was previously validated by the health team, avoiding the ambiguity of that same information. eSchi is prepared to be used online and by patients in an independent way, outside of the sites geographical locations and not only in therapy sessions' periods;
- access – eSchi was a first approach to reduce the resistance to change and technology literacy issue present in mental health contexts. All the legal, privacy, security and ethical issues that are extremely sensible in this type of scenarios were considered and assured;
- costs – this is the most sensible and difficult aspect to measure in the application of such systems and eSchi was not an exception. The only costs that are accountable were the ones associated with the creation of the laboratory of the first site. The desktops and peripherals that were put in the field were given away for charity purposes; and

- satisfaction – eSchi users, both patients and therapists seemed satisfied to use the system, according to the results provided in the questionnaires, the monitoring and visualization of the system's usage data and the informal personal communications that came to our knowledge.

The research team defined no systematic approach to measure the effectiveness of the implementation of eSchi, despite following all of the above guidelines. Nevertheless, we find that there are two aspects extremely relevant for this evaluation. Firstly, all the users that engaged in the study asked for further enhancements of the system, requesting new and improved activities. This reveals their interest in keeping on using the system. Secondly, eSchi is currently in use in a third site of the Sant Joan de Déu Institution by a third group of new users. This application of the system occurred through a professional recommendation of the therapist of the first site. The psychiatrist found eSchi suitable for her professional usage (according to the questionnaires' results) but also worth of recommendation for other professionals in the area.

7.2. Limitations of the study

We had the privilege to deploy the application and conduct our study, test it, under real clinical settings. This is something incredible difficult to achieve (Spokoiny & Shahar, 2004).

Nevertheless, despite the efforts to minimize existing confounding factors that might influence the results collected, the perfect environment could not be achieved. The idea was to provide similar sites in which the system would be implemented but reality is actually quite different. It is almost impossible to ensure the same type of conditions from site to site. Each site has its own unique conditions that include aspects such as including an internment ward or an ICT laboratory, the number of patients to engage in the study and even the diagnosis, the typologies of schizophrenia and schizoaffective conditions. "There are no illnesses, only patients" is a popular saying in the mental health area. Each patient has its own individual and unique condition and cannot, and should not, be grouped into a cluster either in diagnose or treatment. This is the belief of all the health professionals in the mental health field that we had the opportunity to meet. The patient individuality should be respected and this, sometimes, implies a particular treatment protocol. Further, the fact that schizophrenia is a chronic illness that, at the present, has no scientific evidence on cognition improvements was also a factor that led to distinct sampling conditions.

While all of these concerns prove to be highly considerate for the patients and improve the environment lived in the facilities.

7.3. Publications

Most of the work here presented was already published or is in a final step of the publishing process:

- Ferreira, C., Freire, C. S., Reis, C. I., Costa, J., André, N., Gaspar, P., et al. Perspectives of ICT use in nursing in portugal: A survey. *(submitted December 2009).* Computers, Informatics Nursing,
- Freire, C. S., Reis, C. I., & Monguet, J. M. (2008). eSchi – A multimedia portal for schizophrenia learning and rehabilitation: Work in progress. Paper presented at the Proceedings of World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education, Las Vegas - Nevada - USA. 2175-2180.
- Reis, C. I., Freire, C. S., Fernandez, J., & Monguet, J. M. (2009). eSchi – an e-therapy tool for rehabilitation and training. ED-Media 2009 Proceedings, Honolulu, Hawaii - USA.
- Freire, C. S., Reis, C. I., Monguet, J. M., & Ojeda, J. (2009). eHealth major concepts. 2nd International ICST Conference on Electronic Healthcare for the 21st Century - eHealth'09, Istanbul, Turkey.
- Reis, C. I., Freire, C. S., & Monguet, J. M. (2010). e-therapy. In M. M. Cruz-Cunha, A. J. Tavares & R. Simoes (Eds.), Handbook of research on developments in e-health and telemedicine: Technological and social perspectives (pp. 882-882-903) IGI Global.

7.4. Future Work

ICT has many contributions to make in the psychotherapy area (Percevic et al., 2004) and the work here described only adds one small step in this never-ending task. No development work is ever complete and can always be improved. The following list provides a couple of ideas where the work can be improved and extended:

- A clinical validation of the scores used to evaluate the system and discover the user's satisfaction level should be accomplished. This will imply a valid and reliable sample for the study.
- Further applications of the system should be planned and their results published.
- The system should incorporate new and more engaging activities, the users have already asked for them.
- The new ubiquitous world provides new ideas and opportunities to have the same system but under different platforms, namely smartphones (iPhone and Android enabled systems) and tablets (e.g. iPad).
- The visualization module should be improved in a way that the tool could be easily used for future medical research of the clinical staff.
- A clinical valid and statistical valid study should be conducted, in order to evaluate the system and discover the user's satisfaction level.
- The data collected and future data to be collected might be of use in future versions of the system, namely for conducting some type of data mining.

8. References

Åborg, C., Sandblad, B., Gulliksen, J., & Lif, M. (2003). Integrating work environment considerations into usability evaluation methods—the ADA approach. *Interacting with Computers, 15*(3), 453-471.

Agence d'Évaluation des Technologies et des Modes d´Intervention en Santé. (2006). *Telehealth: Clinical guidelines and technical standards for telepsychiatry*

Agency for Healthcare Research and Quality, U.S. Department of Health and Human Services. (2010). *National guideline clearinghouse.* Retrieved 02/07, 2010, from http://www.guideline.gov

Aigner, W., & Miksch, S. (2006). CareVis: Integrated visualization of computerized protocols and temporal patient data. *Artificial Intelligence in Medicine, 37*(3), 203-218.

Aleman, A., Hijman, R., de Haan, E. H. F., & Kahn, R. S. (1999). Memory impairment in schizophrenia: A meta-analysis. *American Journal of Psychiatry, 156*(9), 1358-1366.

American Psychiatric Association. (2010). *American psychiatric association.* Retrieved 02/07, 2010, from http://www.psych.org

American Psychiatric Association (APA). (2010). *DSM-5: The future of psychiatric diagnosis.* Retrieved 09/09, 2010, from http://www.dsm5.org/

Ammenwerth, E., & de Keizer, N. (2005). An inventory of evaluation studies of information technology in health care - trends in evaluation research 1982-2002. *Methods of Information in Medicine, 44*, 44-56.

Ammenwerth, E., Brender, J., Nykänen, P., Prokosch, H., Rigby, M., & Talmon, J. (2004). Visions and strategies to improve evaluation of health information systems: Reflections and lessons based on the HIS-EVAL workshop in innsbruck. *International Journal of Medical Informatics, 73*(6), 479-491.

Ammenwerth, E., Iller, C., & Mansmann, U. (2003). Can evaluation studies benefit from triangulation? A case study. *International Journal of Medical Informatics, 70*(2-3), 237-248.

Anderson, C. (2007). *Thumbnail: Susan dray.*, 2010, from http://www.usabilityprofessionals.org/upa_publications/upa_voice/volumes/2007/june/susan.html

Antonacci, D. J., Bloch, R. M., Saeed, S. A., Yildirim, Y., & Talley, J. (2008). Empirical evidence on the use and effectiveness of telepsychiatry via videoconferencing: Implications for forensic and correctional psychiatry. *Behavioral Sciences & the Law, 26*(3), 253.

Asaro, P. M. (2000). Transforming society by transforming technology: The science and politics of participatory design. *Accounting, Management and Information Technologies, 10*(4), 257-290.

Ayuso-Mateos, J. L., Salvador-Carulla, L., & Chisholm, D. (2006). Use of quality of life measures in mental health economics and care planning. *Actas españolas de psiquiatría, 34*

Ayuso-Mateos, J. L., Gutierrez-Recacha, P., Haro, J. M., & Chisholm, D. (2006). Estimating the prevalence of schizophrenia in spain using a disease model. *Schizophrenia Research, 86*(1), 194-201.

Bade, R., Schlechtweg, S., & Miksch, S. (2004). Connecting time-oriented data and information to a coherent interactive visualization. *CHI '04: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems,* Vienna, Austria. 105-112.

Bailey, T., & Forbes, J. (2005). Just-in-time teaching for CS0. *SIGCSE Bulletin, 37*(1), 366-370.

Barak, A. (1999). Psychological applications on the internet: A discipline on the threshold of a new millennium. *Applied and Preventive Psychology, 8*, 231-246.

Barak, A. (2007). Emotional support and suicide prevention through the internet: A field project report. *Computers in Human Behavior, 23*(2), 971.

Beck, A. T., & Rector, N. A. (2000). Cognitive therapy of schizophrenia: A new therapy for the new millennium. *American Journal of Psychotherapy, 54*, 291-300.

Bevan, N., & Curson, I. (1999). Planning and implementing user-centred design. *CHI '99: CHI '99 Extended Abstracts on Human Factors in Computing Systems,* Pittsburgh, Pennsylvania. 137-138.

Beyer, H., & Holtzblatt, K. (1998). *Contextual design: Defining customer-centered systems*. San Francisco, CA, USA: Morgan Kaufmann Publishers Inc.

Bhugra, D. (2005). The global prevalence of schizophrenia. *PLoS Medicine, 2*(5), 151.

Bias, R. (1991). Interface-walkthroughs: Efficient collaborative testing. *IEEE Software, 8*(5), 94-95.

Bias, R. G., & Mayhew, D. J. (1994). *Cost-justifying usability*. Orlando, FL, USA: Academic Press, Inc.

Bleuler, M. (1963). Conception of schizophrenia within the last fifty years and today [abridged]. *Proceedings of the Royal Society of Medicine, 56(10)*(0035-9157), 945-52.

Bodart, C., & Shrestha, L. (2000). Identifying information needs and indicators. In World Health Organization (Ed.), *Design and implementation of health information systems.* (pp. 49-72). Geneva: WHO Press.

Boehm, B. W. (1984). Software engineering economics. *IEEE Transactions on Software Engineering, SE-10*(1), 4-21.

Boehm, & Turner, R. (2003). *Balancing agility and discipline: A guide for the perplexed*. Boston, MA, USA: Addison-Wesley Longman Publishing Co., Inc.

Brent, D., Emslie, G., Clarke, G., Wagner, K. D., Asarnow, J. R., Keller, M., et al. (2008). Switching to another SSRI or to venlafaxine with or without cognitive behavioral therapy for adolescents with SSRI-resistant depression: The TORDIA randomized controlled trial. *Journal of the American Medical Association (JAMA), 299*(8), 901-913.

Briffault, X., Sapinho, D., Villamaux, M., & Kovess, V. (2008). Factors associated with use of psychotherapy. *Social Psychiatry and Psychiatric Epidemiology, 43*(2), 165-171.

Bui, A. A., Aberle, D. R., & Kangarloo, H. (2007). TimeLine: Visualizing integrated patient records. *IEEE Trans Inf Technol Biomed., 11(4)*(1089-7771), 462-73.

Campion, J., & Nurse, J. (2007). A dynamic model for wellbeing. *Australasian Psychiatry, 15*(1), 24.

Canadian Psychiatric Association. (2010). *Canadian psychiatric association.* Retrieved 02/07, 2010, from http://www.cpa-apc.org/index.php

Card, S. K., & Mackinlay, J. (1997). The structure of the information visualization design space. *IEEE Symposium on Information Visualization,* , 92.

Card, S. K., Mackinlay, J. D., & Shneiderman, B. (1999). In Card S. K., Mackinlay J. D. and Shneiderman B. (Eds.), *Readings in information visualization: Using vision to think*. San Francisco, CA, USA: Morgan Kaufmann Publishers Inc.

Carlbring, P., & Andersson, G. (2006). Internet and psychological treatment. how well can they be combined? *Computers in Human Behavior, 22*(3), 545-553.

Carpenter, W. T., & Stephens, J. H. (1979). An attempted integration of information relevant to schizophrenic subtypes. *Schizophrenia Bulletin, 5*(3), 490-506.

Carroll, K., & Rounsaville, B. (2010). Computer-assisted therapy in psychiatry: Be Brave—It's a new world. *Current Psychiatry Reports, 12*(5), 426-432.

Castelnuovo, G., Gaggioli, A., Mantovani, F., & Riva, G. (2003). New and old tools in psychotherapy: The use of technology for the integration of traditional clinical treatments. *Psychotherapy: Theory/Research/Practice/Training, 40*(1-2)

Castelnuovo, G., Gaggioli, A., Mantovani, F., & Riva, G. (2003a). From psychotherapy to e-therapy: The integration of traditional techniques and new communication tools in clinical settings. *Cyberpsychology & Behavior, 6*(4), 375-82.

Catarci, T., Matarazzo, G., & Raiss, G. (2002). Driving usability into the public administration: The italian experience. *International Journal of Human-Computer Studies, 57*, 121-138(18).

Chen, C. (2010). Information visualization. *Wiley Interdisciplinary Reviews: Computational Statistics, 2*(4), 387-403.

Childress, C. A. (2000). Ethical issues in providing online psychotherapeutic interventions. *Journal of Medical Internet Research, 2*(1), E5.

Chimero, F. (2008). *People ignore design that ignores people*

Chinman, M., Hassell, J., Magnabosco, J., Nowlin-Finch, N., Marusak, S., & Young, A. (2007). The feasibility of computerized patient self-assessment at mental health clinics. *Administration and Policy in Mental Health and Mental Health Services Research, 34*(4), 401-409.

Chittaro, L. (2001). Information visualization and its application to medicine. *Artificial Intelligence in Medicine, 22*(2), 81-88.

Christensen, H. (2007). Computerised therapy for psychiatric disorders. *The Lancet, 370*(9582)

Christensen, H., Griffiths, K. M., & Evans, K. (2002). *e-mental health in australia: Implications of the internet and related technologies for policy*Centre for Mental Health Research The Australian National University.

Clare, L., & Woods, R. T. (2004). Cognitive training and cognitive rehabilitation for people with early-stage alzheimer's disease: A review. *Neuropsychological Rehabilitation, 14*(4), 385-401.

Clemensen, J., Larsen, S. B., Kyng, M., & Kirkevold, M. (2007). Participatory design in health sciences: Using cooperative experimental methods in developing health services and computer technology. *Qualitative Health Research, 17*(1), 122-130.

Cloninger, C. R. (2006). The science of well-being: An integrated approach to mental health and its disorders. *World Psychiatry, 5(2)*(1723-8617), 71-6.

Cognitive-behavior therapy(2004). In Wright J. H. (Ed.), . Washington DC, USA: American Psychiatric Publishing.

Cohen, A., Patel, V., Thara, R., & Gureje, O. (2008). Questioning an axiom: Better prognosis for schizophrenia in the developing world? *Schizophrenia Bulletin, 34*(2), 229-244.

Combi, C., Portoni, L., & Pinciroli, F. (1999). Visualizing temporal clinical data on the WWW. In W. Horn, Y. Shahar, G. Lindberg, S. Andreassen & J. Wyatt (Eds.), *Artificial intelligence in medicine* (pp. 301-311). Berlin / Heidelberg: Springer.

Comment Space. (2010). *Comment space.* Retrieved 12/02, 2010, from http://www.commentspace.net/

Cooper, A. (2004). *The inmates are running the asylum: Why high tech products drive us crazy and how to restore the sanity* (2nd ed.) Pearson Higher Education.

Copeland, J., & Martin, G. (2004). Web-based interventions for substance use disorders: A qualitative review. *Journal of Substance Abuse Treatment, 26*(2), 109-116.

Cousins, S. B., & Kahn, M. G. (1991). The visual display of temporal information. *Artificial Intelligence in Medicine, 3*(6), 341.

Dabbs, A. d. V., Myers, B. A., MC Curry, K. R., Dunbar-Jacob, J., Hawkins, R. P., Begey, A., et al. (2009). User-centered design and interactive health technologies for patients. *Computers, Informatics, Nursing, 27*(3), 175-183 10.1097/NCN.0b013e31819f7c7c.

Dansereau, D. F., & Simpson, D. D. (2009). A picture is worth a thousand words: The case for graphic representations. *Professional Psychology: Research and Practice, 40*(1), 104-110.

Demiris, G., Afrin, L. B., Speedie, S., Courtney, K. L., Sondhi, M., Vimarlund, V., et al. (2008). Patient-centered applications: Use of information technology to promote disease management and wellness. A white paper by the AMIA knowledge in motion working group. *Journal of the American Medical Informatics Association, 15*(1), 8-13.

Double, D. B. (2007). Adolf Meyer’s psychobiology and the challenge for biomedicine. *Philosophy, Psychiatry & Psychology, 14*(4), 331-339.

Dugas, K., Kuhn, N., Kaiser, K., & Überla, M. (2001). XML-based visualization of design and completeness in medical databases. *Informatics for Health and Social Care, 26*(4), 237-250.

Dyer, K. A. (2001). Ethical challenges of medicine and health on the internet: A review. *Journal of Medical Internet Research, 3*(2), E23.

Earthy, J., Jones, B. S., & Bevan, N. (2001). The improvement of human-centred processes---facing the challenge and reaping the benefit of ISO 13407. *Int.J.Hum.-Comput.Stud., 55*(4), 553-585.

E-health: Current situation and examples of implemented and beneficial E-health applications(2004). In Iakovidis I., Wilson P. and Healy J. C. (Eds.), . USA: IOS Press.

Elvevag, B., Maylor, E. A., & Gilbert, A. L. (2003). Habitual prospective memory in schizophrenia. *BMC Psychiatry, 3*, 9.

Faber, M. G. (2003). Design and introduction of an electronic patient record: How to involve users? *Methods of Information in Medicine, 42(4)*(0026-1270 (Print)), 371-5.

Falkman, G. (2001). Information visualisation in clinical odontology: Multidimensional analysis and interactive data exploration. *Artificial Intelligence in Medicine, 22*(2), 133-158.

Farrell, S. P., Mahone, I. H., & Guilbaud, P. (2004). Web technology for persons with serious mental illness. *Archives of Psychiatric Nursing, 18*(4), 121-125.

Finn, J. (2002). MSW student perceptions of the efficacy and ethics of internet-based therapy. *Journal of Social Work Education, 38*(3), 403-19.

Freire, C. S., Reis, C. I., & Monguet, J. M. (2008). eSchi – A multimedia portal for schizophrenia learning and rehabilitation: Work in progress. Paper presented at the *Proceedings of World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education,* Las Vegas - Nevada - USA. 2175-2180.

Friedman, C. P., & Wyatt, J. (2006). *Evaluation methods in biomedical informatics* (second ed.) Springer.

Frost, J. H., & Massagli, M. P. (2008). Social uses of personal health information within PatientsLikeMe, an online patient community: What can happen when patients have access to one another's data. *Journal of Medical Internet Research, 10(3)*(1438-8871)

Gadit, A. A. M. (2006). E-psychiatry: Uses atid limitations. *JPMA. the Journal of the Pakistan Medical Association, 56*(7), 327.

Gaitn, L., Urosa, B., Cabrera, P. J., Jurez Gallego, M., & Universidad Pontificia de Comillas. (1993). *Trabajo social e investigacin :Temas y perspectivas*. Madrid: Universidad Pontificia Comillas.

Ganapathy, K. (2005). Telemedicine and neurosciences. *Journal of Clinical Neuroscience, 12*(8), 851-862.

Gershon, N., Eick, S. G., & Card, S. (1998). Information visualization. *Interactions, 5*(2), 9-15.

Ghezzi, C., Jazayeri, M., & Mandrioli, D. (2002). *Fundamentals of software engineering* (2nd ed.). Upper Saddle River, NJ, USA: Prentice Hall PTR.

Gill, J., Chearman, T., Carey, M., Nijjer, S., & Cross, F. (2010). Presenting patient data in the electronic care record: The role of timelines. *JRSM Short Reports, 1*(4)

Google User Experience Team. (2010). *Google user experience.* Retrieved 12/02, 2010, from http://www.google.com/corporate/ux.html

Gorman, P. N., & Helfand, M. (1995). Information seeking in primary care: How physicians choose which clinical questions to pursue and which to leave unanswered. *Medical Decision Making, 15(2)*(0272-989X), 113-9.

Graeff-Martins, A. S., Flament, M. F., Fayyad, J., Tyano, S., Jensen, P., & Rohde, L. A. (2008). Diffusion of efficacious interventions for children and adolescents with mental health problems. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 49*(3), 335.

Green, M. F., Nuechterlein, K. H., Gold, J. M., Barch, D. M., Cohen, J., Essock, S., et al. (2004). Approaching a consensus cognitive battery for clinical trials in schizophrenia: The NIMH-MATRICS conference to select cognitive domains and test criteria. *Biological Psychiatry, 56*(5), 301-307.

Greenbaum, J. (1993). A design of One's own: Towards participatory design in the united states. In D. Schuler, & A. Namioka (Eds.), *Participatory design principles and practices.* (pp. 27-27-37). New Jersey: Lawrence Erlbaum Associated, Inc.

Griffiths, K. M., & Christensen, H. (2002). The quality and accessibility of australian depression sites on the world wide web. *Medical Journal of Australia, 176*

Griffiths, K. M., Farrer, L., & Christensen, H. (2007). Clickety-click: E-mental health train on track. *Australasian Psychiatry, 15*(2), 100.

Griffiths, M., & Cooper, G. (2003). Online therapy: Implications for problem gamblers and clinicians. *British Journal of Guidance and Counselling, 31*(1), 113.

Grolleman, J., van Dijk, B., Nijholt, A., & van Emst, A. (2006). Break the habit! designing an e-therapy intervention using a virtual coach in aid of smoking cessation. *Lecture Notes in Computer Science, 3962*, 133.

Guler, N. F., & Ubeyli, E. D. (2002). Theory and applications of telemedicine. *Journal of Medical Systems, 26*(3), 199-220.

Harrison, P. J. (1999). The neuropathology of schizophrenia: A critical review of the data and their interpretation. *Brain, 122*(4), 593-624.

Haug, S., Strauss, B., Gallas, C., & Kordy, H. (2008). New prospects for process research in group therapy: Text-based process variables in psychotherapeutic internet chat groups. *Psychotherapy Research, 18*(1), 88.

Health and Consumer Protection Directorate-General. (2005). *Green paper - improving the mental health of the population: Towards a strategy on mental health for the european union*. Brussels: European Communities.

Heer, J., Card, S. K., & Landay, J. A. (2005). Prefuse: A toolkit for interactive information visualization. *CHI '05: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems,* Portland, Oregon, USA. 421-430.

Heinlen, K. T., Welfel, E. R., Richmond, E. N., & O'Donnell, M. S. (2003). The nature, scope, and ethics of psychologists' e-therapy web sites: What consumers find when surfing the web. *Psychotherapy, 40*(1-2), 112-124.

Hilty, D. M., Liu, W., Marks, S., & Callahan, E. J. (2003). Telepsychiatry - the effectiveness of telepsychiatry: A review. *Canadian Psychiatric Association Bulletin of the Association Des Psychiatres Du Canada, 35*(5), 10.

Hilty, D. M., Luo, J. S., Morache, C., Marcelo, D. A., & Nesbitt, T. S. (2002). Telepsychiatry - an overview for psychiatrists. *Cns Drugs, 16*(8), 527-548.

Hix, D., & Hartson, H. R. (1993). *Developing user interfaces: Ensuring usability through product & process*. New York, NY, USA: John Wiley & Sons, Inc.

Horn, W. (2001). AI in medicine on its way from knowledge-intensive to data-intensive systems. *Artificial Intelligence in Medicine, 23*(1), 5-12.

Hunt, D. L., Haynes, R. B., Hanna, S. E., & Smith, K. (1998). Effects of computer-based clinical decision support systems on physician performance and patient outcomes: A systematic review. *Journal of the American Medical Association (JAMA), 280*(15), 1339-1346.

IBM Design. (2010). *Design patterns.* Retrieved 12/02, 2010, from http://www-01.ibm.com/software/ucd/designpatterns.html

Improving Access to Psychological Therapies (IAPT) Programme. (2007). *Improving access to psychological therapies (IAPT) programme: Computerised cognitive behavioural therapy (cCBT) implementation guidance.* Retrieved 12/02, 2010, from http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_073470

IPAP. (2004). *The international psychopharmacology algorithm project.* Retrieved 09/01, 2010, from http://www.ipap.org/algorithms.php

ISO. (1998). *ISO 9241-11:1998 - ergonomic requirements for office work with visual display terminals (VDTs) -- part 11: Guidance on usability.* Retrieved 12/02, 2010, from http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=16883

ISO. (1999). *ISO 13407:1999 - human-centred design processes for interactive systems.* Retrieved 12/02, 2010, from http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=21197

ISO. (2005). *ISO/IEC 25000:2005 - software engineering -- software product quality requirements and evaluation (SQuaRE) -- guide to SQuaRE.* Retrieved 12/02, 2010, from http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=35683

ISO. (2007a). *ISO/IEC TR 19765:2007 - information technology -- survey of icons and symbols that provide access to functions and facilities to improve the use of information technology products by the elderly and persons with disabilities.* Retrieved 12/02, 2010, from http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=33903

ISO. (2007b). *ISO/IEC TR 19766:2007 - information technology -- guidelines for the design of icons and symbols accessible to all users, including the elderly and persons with disabilities.* Retrieved 12/02, 2010, from http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=42128

ISO. (2008). *ISO 9241-171:2008 - ergonomics of human-system interaction -- part 171: Guidance on software accessibility.* Retrieved 12/02, 2010, from http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=39080

ISO. (2009a). *ISO 9241-1:1997 - ergonomic requirements for office work with visual display terminals (VDTs) -- part 1: General introduction.* Retrieved 12/02, 2010, from http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=21922

ISO. (2009b). *ISO 9241-920:2009 - ergonomics of human-system interaction -- part 920: Guidance on tactile and haptic interactions.* Retrieved 12/02, 2010, from http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=21922

ISO. (2010). *ISO/FDIS 9241-210 - ergonomics of human-system interaction -- part 210: Human-centred design for interactive systems.* Retrieved 12/02, 2010, from http://www.iso.org/iso/iso_catalogue/catalogue_ics/catalogue_detail_ics.htm?csnumber=52075

Jané-Llopis, E., & Anderson, P. (2005). *Mental health promotion and mental disorder prevention. A policy for europe.* Nijmegen: Radboud University Nijmegen.

Johansson, M. C. G. (1999). Social and organizational aspects of requirements engineering methods. A practice-oriented approach. Linköping Studies in Science and Technology, Linköping University).

Johnson, C., Moorhead, R., Munzner, T., Pfister, H., Rheingans, P., & Yoo, T. S. (2006). *NIH/NSF visualization research challenges report*. Los Alamitos, CA: USA: IEEE Press.

Johnson, C. M., Johnson, T. R., & Zhang, J. (2005). A user-centered framework for redesigning health care interfaces. *Journal of Biomedical Informatics, 38*(1), 75-87.

Jokela, T. (2002). Making user-centred design common sense: Striving for an unambiguous and communicative UCD process model. *NordiCHI '02: Proceedings of the Second Nordic Conference on Human-Computer Interaction,* Aarhus, Denmark. 19-26.

Jokela, T., Iivari, N., Matero, J., & Karukka, M. (2003). The standard of user-centered design and the standard definition of usability: Analyzing ISO 13407 against ISO 9241-11. *CLIHC '03: Proceedings of the Latin American Conference on Human-Computer Interaction,* Rio de Janeiro, Brazil. 53-60.

Jokela, T., Koivumaa, J., Pirkola, J., Salminen, P., & Kantola, N. (2006). Methods for quantitative usability requirements: A case study on the development of the user interface of a mobile phone. *Personal and Ubiquitous Computing, 10*(6), 345-355.

Jones, C., Cormac, I., Silveira da Mota Neto, J. I., & Campbell, C. (2004). Cognitive behaviour therapy for schizophrenia. *Cochrane Database Syst Rev., 4*(1469-493X)

Jones, R. B., Atkinson, J. M., Coia, D. A., Paterson, L., Morton, A. R., McKenna, K., et al. (2001). Randomised trial of personalised computer based information for patients with schizophrenia. *BMJ, 322*(7290), 835-840.

Kalkstein, S., Hurford, I., & Gur, R. C. (2010). Neurocognition in schizophrenia. In N. R. Swerdlow (Ed.), *Behavioral neurobiology of schizophrenia and its treatment* (pp. 373-390) Springer Berlin Heidelberg.

Kanani, K., & Regehr, C. (2003). Clinical, ethical, and legal issues in e-therapy. *Families in Society, 84*(2), 155.

Kandel, E. R. (1998). A new intellectual framework for psychiatry. *American Journal of Psychiatry, 155*(4), 457-469.

Kaplan, B. (2001). Evaluating informatics applications - clinical decision support systems literature review. *International Journal of Medical Informatics, 64*, 15-37.

Kaplan, B., & Duchon, D. (1988). Combining qualitative and quantitative methods in information systems research: A case study. *MIS Quarterly, 12*(4), 571-586.

Karat, C. (1997). Cost-justifying usability engineering in the software life cycle. In M. Helander, T. K. Landauer & P. Prabhu (Eds.), *Handbook of human computer interaction* (Second ed.,). Amsterdam: Elsevier.

Kay, S. R., Fiszbein, A., & Opler, L. A. (1987). The positive and negative syndrome scale (PANSS) for schizophrenia. *Schizophrenia Bulletin, 13*(2), 261-276.

Keen, J., & Packwood, T. (1995). *BMJ, 311(7002)*(0959-8138), 444-444-6.

Keim, D. A. (1997). Visual techniques for exploring databases. Newport Beach, CA, USA.

Keim, D. A., Hao, M. C., Dayal, U., & Lyons, M. (2007). Value-cell bar charts for visualizing large transaction data sets. *IEEE Transactions on Visualization and Computer Graphics, 13*(4), 822-833.

Keyes, C. L. (2002). The mental health continuum: From languishing to flourishing in life. *J Health Soc Behav., 43*(2), 207-22.

Kitchenham, B., Pickard, L., & Pfleeger, S. L. (1995). Case studies for method and tool evaluation. *IEEE SOFTWARE, 12*(4), 52-62.

Kosara, R., & Miksch, S. (2001). Visualizing complex notions of time. *Studies in Health Technology and Informatics, 84*(0926-9630), 211-5.

Krabbendam, L., & Aleman, A. (2003). Cognitive rehabilitation in schizophrenia: A quantitative analysis of controlled studies. *Psychopharmacology, 169*(3/4), 376.

Kushniruk, A. W., & Patel, V. L. (2004). Cognitive and usability engineering methods for the evaluation of clinical information systems. *Journal of Biomedical Informatics, 37*(1), 56-76.

Kuyken, W., Byford, S., Taylor, R. S., Watkins, E., Holden, E., White, K., et al. (2008). Mindfulness-based cognitive therapy to prevent relapse in recurrent depression. *Journal of Consulting and Clinical Psychology, 76*(6), 966-978.

Lammarsch, T., Aigner, W., Bertone, A., Gartner, J., Mayr, E., Miksch, S., et al. (2009). Hierarchical temporal patterns and interactive aggregated views for pixel-based visualizations. *IV '09: Proceedings of the 2009 13th International Conference Information Visualisation,* 44-50.

Larkin, J. H., & Simon, H. A. (1987). Why a diagram is (sometimes) worth ten thousand words. *Cognitive Science, 11*(1), 65-100.

Laudon, K. C., & Laudon, J. P. (2001). *Management information systems: Managing the digital firm* (7th ed.). Upper Saddle River, NJ, USA: Prentice Hall PTR.

Lauriks, S., Reinersmann, A., Van der Roest, H. G., Meiland, F. J. M., Davies, R. J., Moelaert, F., et al. (2007). Review of ICT-based services for identified unmet needs in people with dementia. *Ageing Research Reviews, 6*, 223-246.

Lavrac, N., Bohanec, M., Pur, A., Cestnik, B., Debeljak, M., & Kobler, A. (2007). Data mining and visualization for decision support and modeling of public health-care resources. *Journal of Biomedical Informatics, 40*(4), 438-447.

Le, Q. (2007). Health informatics: An intercultural perspective. *Studies in Health Technology and Informatics, 129*(Pt 2), 1194-8.

Lee, A. S. (1989). A scientific methodology for MIS case studies. *MIS Quarterly, 13*(1), 33-50.

Leichsenring, F., Salzer, S., Jaeger, U., Kachele, H., Kreische, R., Leweke, F., et al. (2009). Short-term psychodynamic psychotherapy and cognitive-behavioral therapy in generalized anxiety disorder: A randomized, controlled trial. *American Journal of Psychiatry, 166*(8), 875-881.

Lester, D. (2006). E-therapy: Caveats from experiences with telephone therapy. *Psychological Reports, 99*(3), 894-6.

Levinson, D., Lakoma, M. D., Petukhova, M., Schoenbaum, M., Zaslavsky, A. M., Angermeyer, M., et al. (2010). Associations of serious mental illness with earnings: Results from the WHO world mental health surveys. *The British Journal of Psychiatry, 197*(2), 114-121.

Levy, D. L., Coleman, M. J., Sung, H., Ji, F., Matthysse, S., Mendell, N. R., et al. (2010). The genetic basis of thought disorder and language and communication disturbances in schizophrenia. *Journal of Neurolinguistics, 23*(3), 176-192.

Lewis, C. (1982). *Using the 'thinking-aloud' method in cognitive interface design* No. 9265). Yorktown Heights, NY.: IBM T.J. Watson Research Center.

Liberman, R. P., Mueser, K. T., & Wallace, C. J. (1986). Social skills training for schizophrenic individuals at risk for relapse. *American Journal of Psychiatry, 143*(4), 523-526.

Liberman, R. P., Hilty, D. M., Drake, R. E., & Tsang, H. W. H. (2001). Requirements for multidisciplinary teamwork in psychiatric rehabilitation. *Psychiatric Services, 52*(10), 1331-1342.

LifeLines2. (2010). *LifeLines2.* Retrieved 12/02, 2010, from http://www.cs.umd.edu/hcil/lifelines2

Lippeveld, T. (2000). Routine data collection methods. In World Health Organization (Ed.), *Design and implementation of health information systems.* (pp. 88-113). Geneva: WHO Press.

Lippeveld, T., & Sauerborn, R. (2000). A framework for designing health information systems. In World Health Organization (Ed.), *Design and implementation of health information systems.* (pp. 15-32). Geneva: WHO Press.

Macleod, M., Bowden, R., Bevan, N., & Curson, I. (1997). The MUSiC performance measurement method. *Behaviour & Information Technology, 16*, 279-293(15).

Maguire, M. (2001). Methods to support human-centred design. *Int.J.Hum.-Comput.Stud., 55*(4), 587-634.

Malhotra, S., Laxmisan, A., Keselman, A., Zhang, J., & Patel, V. L. (2005). Designing the design phase of critical care devices: A cognitive approach. *Journal of Biomedical Informatics, 38*(1), 34-50.

Manhal-Baugus. (2001). E-therapy: Practical, ethical and legal issues. *Cyberpsychology & Behavior, 4*(5), 551-563.

Marks, I., Shaw, S., & Parkin, R. (1998). Computer-aided treatments of mental health problems. *Clinical Psychology: Science and Practice, 5*(2), 151-170.

Marrs, K. A., & Novak, G. (2004). Just-in-time teaching in biology: Creating an active learner classroom using the internet. *Cell Biology Education, 3*(1), 49-61.

Martin, P. Y., & Turner, B. A. (1986). Grounded theory and organizational research. *The Journal of Applied Behavioral Science, 22*(2), 141-157.

Martins, S. B., Shahar, Y., Dina Goren-Bar, Galperin, M., Kaizer, H., Basso, L. V., et al. (2008). Evaluation of an architecture for intelligent query and exploration of time-oriented clinical data. *Artificial Intelligence in Medicine, 43*(1), 17-34.

Mayhew, D. J. (1999). The usability engineering lifecycle. *CHI '99: CHI '99 Extended Abstracts on Human Factors in Computing Systems,* Pittsburgh, Pennsylvania. 147-148.

Mazur, P. (2008). *Tools and APIs for visualisation of timelines.* Retrieved 12/02, 2010, from http://web.science.mq.edu.au/~mpawel/publications/pdf/Mazur_timelines_2008.pdf

McCandless, D. (2010). *Information is beautiful.* Retrieved 12/02, 2010, from http://www.informationisbeautiful.net/

McGinty, K. L., Saeed, S. A., Simmons, S. C., & Yidirim, Y. (2006). Telepsychiatry and e-mental health services: Potential for improving access to mental health care. *Psychiatric Quarterly, 77*(4), 335.

McGlashan, T. H., & Fenton, W. S. (1991). Classical subtypes for schizophrenia: Literature review for DSM-IV. *Schizophrenia Bulletin, 17*(4), 609-632.

McGrath, J. (2008). Dissecting the heterogeneity of schizophrenia outcomes. *Schizophrenia Bulletin, 34*(2), 247-248.

McGrath, J., Saha, S., Chant, D., & Welham, J. (2008). Schizophrenia: A concise overview of incidence, prevalence, and mortality. *Epidemiologic Reviews, 30*(1), 67-76.

MedlinePlus. (2008). *Medical encyclopedia - schizophrenia.* Retrieved 10/13, 2008, from http://www.nlm.nih.gov/medlineplus/ency/article/000928.htm

Meehl, P. E. (1962). Schizotaxia, schizotypy, schizophrenia. *American Psychologist, 17*(12), 827-838.

Merriam Webster Online Dictionary. (2010). *Definition of effective.*, 2010, from http://www.merriam-webster.com/dictionary/effectivity

Munzner, T. (2008). Process and pitfalls in writing information visualization research papers. In A. Kerren, J. Stasko, J. Fekete & C. North (Eds.), *Information visualization* (pp. 134-153) Springer Berlin / Heidelberg.

Mutter, D., Bouras, G., & Marescaux, J. (2005). Digital technologies and quality improvement in cancer surgery. *Ejso, 31*(6), 689-694.

Myers, D. G., & Diener, E. (1996). The pursuit of happiness. *Scientific American, 274(5)*(0036-8733), 70-2.

Myers, M. D. (1997). Qualitative research in information systems. *MIS Quarterly, 21*(2), 241-242.

Myron, H., & Irene, H. (2004). Information technology in the future of health care. *Journal of Medical Systems, 28*(6), 673-688.

Neufeld, J. D., Yellowlees, P. M., Hilty, D. M., Cobb, H., & Bourgeois, J. A. (2007). The e-mental health consultation service: Providing enhanced primary-care mental health services through telemedicine. *Psychosomatics, 48*(2), 135.

Newman, M. G., Consoli, A., & Taylor, C. B. (1997). Computers in assessment and cognitive behavioral treatment of clinical disorders : Anxiety as a case in point : Cost-effectiveness, cost-benefits, and quality of life. *Behavior Therapy, 28*(2), 211-235.

Newman, M. G. (2004). Technology in psychotherapy: An introduction. *Journal of Clinical Psychology, 60*(2), 141-145.

Nicholl, D., Akhras, K. S., Diels, J., & Schadrack, J. (2010). Burden of schizophrenia in recently diagnosed patients: Healthcare utilisation and cost perspective. *Current Medical Research and Opinion, 26*(4), 943-955.

Nielsen, J. (1993). *Usability engineering* (1st ed.). San Francisco, USA: Morgan Kaufmann.

Nielsen, J. (1994a). Guerrilla HCI: Using discount usability engineering to penetrate the intimidation barrier. *Guerrilla {HCI},* , 245-272.

Nielsen, J. (1994b). In Nielsen J., Mack R. L. (Eds.), *Usability inspection methods* (1st ed.). New York, NY, USA: Wiley.

Norman, D. A. (2005). *Emotional design: Why we love (or hate) everyday things*. New York: Basic Books.

NykÄNEN, P. (2008). Requirements for user-friendly personal health information systems. In L. Bos, B. Blobel, A. Marsh & D. Carroll (Eds.), *Studies in health technology and informatics* (5th ed.,)

Orlikowski, W. J., & Baroudi, J. J. (1991). Studying information technology in organizations: Research approaches and assumptions. *Information Systems Research, 2*(1), 1-28.

Pare, G., Sicotte, C., Jaana, M., & Girouard, D. (2008). Prioritizing the risk factors influencing the success of clinical information system projects. A delphi study in canada. *Methods of Information in Medicine, 47(3)*(0026-1270 (Print); 0026-1270 (Linking)), 251-251-9.

Percevic, R., Lambert, M. J., & Kordy, H. (2004). Computer-supported monitoring of patient treatment response. *Journal of Clinical Psychology, 60*(3), 285-299.

Pheby, D. F. H., & Thorne, P. (1994). The medical data index (mdi) dependency module - a shared database to assist discharge planning and audit. *Journal of Advanced Nursing, 20*(2), 361-367.

Pilemalm, S., & Timpka, T. (2008). Third generation participatory design in health informatics—Making user participation applicable to large-scale information system projects. *Journal of Biomedical Informatics, 41*(2), 327-339.

Plaisant, C. (2004). The challenge of information visualization evaluation. *AVI '04: Proceedings of the Working Conference on Advanced Visual Interfaces,* Gallipoli, Italy. 109-116.

Plaisant, C., Milash, B., Rose, A., Widoff, S., & Shneiderman, B. (1996). LifeLines: Visualizing personal histories. 221-227.

Plovnick, R. M. (2009). Innovations in the utilization of health information technology in psychiatric services. *Epidemiologia e Psichiatra Sociale, 18*(1), 5-11.

Polson, P. G., Lewis, C., Rieman, J., & Wharton, C. (1992). Cognitive walkthroughs: A method for theory-based evaluation of user interfaces. *Int.J.Man-Mach.Stud., 36*(5), 741-773.

Postel, M. G., de Haan, H. A., & De Jong, C. A. J. (2008). E-therapy for mental health problems: A systematic review. *Telemedicine and e-Health, 14*(7), 707-714.

Pousman, Z., Stasko, J. T., & Mateas, M. (2007). Casual information visualization: Depictions of data in everyday life. *IEEE Trans.Visualization and Computer Graphics (TVCG) (Proc.InfoVis, 7*, 2007.

Rahimi, B., Moberg, A., Timpka, T., & Vimarlund, V. (2008). Implementing an integrated computerized patient record system: Towards an evidence-based information system implementation practice in healthcare. *AMIA Annual Symposium Proceedings, 6*(1942-597X (Electronic)), 616-616-20.

Rahimi, B., & Vimarlund, V. (2007). Methods to evaluate health information systems in healthcare settings: A literature review. *Journal of Medical Systems, 31*(5), 397-432.

Rahimi, B., Vimarlund, V., & Timpka, T. (2009). Health information system implementation: A qualitative meta-analysis. *Journal of Medical Systems, 33*(5), 359-368.

Rapoport, R. N. (1970). Three dilemmas in action research. *Human Relations, 23*(6), 499-513.

Recupero, P. R. (2005). E-mail and the psychiatrist-patient relationship. *Bulletin of the American Academy of Psychiatry and the Law, 33*(4), 465.

Recupero, P. R., & Rainey, S. E. (2006). Characteristics of e-therapy web sites. *Journal of Clinical Psychiatry, 67*(9), 1435-40.

Reis, C. I., Freire, C. S., Fernandez, J., & Monguet, J. M. (2009). eSchi – an e-therapy tool for rehabilitation and training. *ED-Media 2009 Proceedings,* Honolulu, Hawaii - USA.

Reis, C. I., Freire, C. S., & Monguet, J. M. (2010). e-therapy. In M. M. Cruz-Cunha, A. J. Tavares & R. Simoes (Eds.), *Handbook of research on developments in e-health and telemedicine: Technological and social perspectives* (pp. 882-903) IGI Global.

Rester, M., Pohl, M., Wiltner, S., Hinum, K., Miksch, S., Popow, C., et al. (2007). Evaluating an InfoVis technique using insight reports. *IV '07: Proceedings of the 11th International Conference Information Visualization,* 693-700.

Richards, D., & Tangney, B. (2008). An informal online learning community for student mental health at university: A preliminary investigation. *British Journal of Guidance and Counselling, 36*(1), 81.

Rodriguez, M. M., Casper, G., & Brennan, P. F. (2007). Patient-centered design: The potential of user-centered design in personal health records. *Journal of AHIMA, 78*(4), 44-46.

Rosson, M. B., & Carroll, J. M. (2002). *Usability engineering: Scenario-based development of human-computer interaction*. San Francisco, CA, USA: Morgan Kaufmann Publishers Inc.

Rothschild, A. S., Dietrich, L., Ball, M. J., Wurtz, H., Farish-Hunt, H., & Cortes-Comerer, N. (2005). Leveraging systems thinking to design patient-centered clinical documentation systems. *International Journal of Medical Informatics, 74*(5), 395-398.

Saha, S., Chant, D., Welham, J., & McGrath, J. (2005). A systematic review of the prevalence of schizophrenia. *PLoS Medicine, 2*(5), 141.

Saha, S., Chant, D., & Mcgrath, J. (2008). Meta-analyses of the incidence and prevalence of schizophrenia: Conceptual and methodological issues. *International Journal of Methods in Psychiatric Research, 17*(1), 55-61.

Saha, S., Barendregt, J. J., Vos, T., Whiteford, H., & McGrath, J. (2008). Modelling disease frequency measures in schizophrenia epidemiology. *Schizophrenia Research, 104*(1-3), 246-254.

Samaras, G. M., & Horst, R. L. (2005). A systems engineering perspective on the human-centered design of health information systems. *Journal of Biomedical Informatics, 38*(1), 61-74.

Sampieri, M. (2008). Monitorización del progreso en el aprendizaje. (PhD, Polythecnic University of Catalonia).

Sams, K., Collins, S., & Reynolds, S. (2006). Cognitive therapy abilities in people with learning disabilities. *Journal of Applied Research in Intellectual Disabilities, 19*(1), 25-33.

Saraiya, P., North, C., & Duca, K. (2005). An insight-based methodology for evaluating bioinformatics visualizations. *IEEE Transactions on Visualization and Computer Graphics, 11*(4), 443-456.

Schmidt, R., Lyytinen, K., Keil, M., & Cule, P. (2001). Identifying software project risks: An international delphi study. *Journal of Management Information Systems, 17*(4), 5-36.

Schuhfried. (2010). *RehaCom.* Retrieved 02/07, 2010, from http://www.schuhfried.at/index.php?id=258&L=0

Schwalbe, K. (2003). *Information technology project management* Course Technology}.

Shahar, Y., Dina Goren-Bar, Boaz, D., & Tahan, G. (2006). Distributed, intelligent, interactive visualization and exploration of time-oriented clinical data and their abstractions [Abstract]. *Artificial Intelligence in Medicine, 38*(2) 115-135.

Shneiderman, B. (1996). The eyes have it: A task by data type taxonomy for information visualizations. *IEEE Symposium on Visual Languages,* , 336.

Sjöberg, C., & Timpka, T. (1998). Participatory design of information systems in health care. *Journal of the American Medical Informatics Association, 5*(2), 177-183.

Smuc, M., Mayr, E., Lammarsch, T., Aigner, W., Miksch, S., & Gartner, J. (2009). To score or not to score? tripling insights for participatory design. *IEEE Comput.Graph.Appl., 29*(3), 29-38.

Solari, A., Motta, A., Mendozzi, L., Pucci, E., Forni, M., Mancardi, G., et al. (2004). Computer-aided retraining of memory and attention in people with multiple sclerosis: A randomized, double-blind controlled trial. *Journal of the Neurological Sciences, 222*(1-2), 99-104.

Spokoiny, A., & Shahar, Y. (2004). A knowledge-based time-oriented active database approach for intelligent abstraction, querying and continuous monitoring of clinical data. *Studies in Health Technology and Informatics, 107*(0926-9630), 84-8.

Stevens, J. R. (1982). The neuropathology of schizophrenia. *Psychological Medicine, 12*(04), 695.

Styra, R. (2004). The internet's impact on the practice of psychiatry. *Canadian Journal of Psychiatry, 49*(1), 5.

Taylor, C. B., & Luce, K. H. (February 2003). Computer- and internet-based psychotherapy interventions. *Current Directions in Psychological Science, 12*, 18-22(5).

Taylor, M. A., Shorter, E., Vaidya, N. A., & Fink, M. (2010). The failure of the schizophrenia concept and the argument for its replacement by hebephrenia: Applying the medical model for disease recognition. *Acta Psychiatrica Scandinavica, 122*(3), 173-183.

Thelwall, M. (2000). Computer-based assessment: A versatile educational tool. *Journal of Computers and Education, 34*, 37-49.

Titov, N. (2007). Status of computerized cognitive behavioural therapy for adults. *Australian and New Zealand Journal of Psychiatry, 41*(2), 95.

Titov, N., Andrews, G., Schwencke, G., Drobny, J., & Einstein, D. (2008). Shyness 1: Distance treatment of social phobia over the internet. *Australian and New Zealand Journal of Psychiatry, 42*(7), 585.

Todis, B., Sohlberg, M. M., Hood, D., & Fickas, S. (2005). Making electronic mail accessible: Perspectives of people with acquired cognitive impairments, caregivers and professionals. *Brain Injury, 19*(6), 389-401.

Trivedi, M. H., Kern, J. K., Grannemann, B. D., Altshuler, K. Z., & Sunderajan, P. (2004). A computerized clinical decision support system as a means of implementing depression guidelines. *Psychiatric Services, 55*(8), 879-885.

Tufte, E. R. (1983). *The visual display of quantitative information*. Cheshire, CT, USA: Graphics Press.

Tumur, I., Kaltenthaler, E., Ferriter, M., Beverley, C., & Parry, G. (2007). Computerised cognitive behaviour therapy for obsessive-compulsive disorder: A systematic review. *Psychotherapy and Psychosomatics, 76*(4), 196-202.

UPA. (2010). *Designing the user experience.*http://www.upassoc.org/usability_resources/about_usability/what_is_ucd.html

Välimäki, M., Anttila, M., Hätönen, H., Koivunen, M., Jakobsson, T., Pitkänen, A., et al. (2008). Design and development process of patient-centered computer-based support system for patients with schizophrenia spectrum psychosis. *Informatics for Health and Social Care, 33*(2), 113-123.

van Ham, F., Wattenberg, M., & Viegas, F. B. (2009). Mapping text with phrase nets. *IEEE Transactions on Visualization and Computer Graphics, 15*(6), 1169-1176.

van Veenendaal, E. (2002). Low-cost usability testing., 153-164.

Vauth, R., Corrigan, P. W., Clauss, M., Dietl, M., Dreher-Rudolph, M., Stieglitz, R. D., et al. (2005). Cognitive strategies versus self-management skills as adjunct to vocational rehabilitation. *Schizophrenia Bulletin, 31*(1), 55-66.

Velligan, D. I., Kern, R. S., & Gold, J. M. (2006). Cognitive rehabilitation for schizophrenia and the putative role of motivation and expectancies. *Schizophrenia Bulletin, 32*(3), 474-485.

Viegas, F. B., Wattenberg, M., van Ham, F., Kriss, J., & McKeon, M. (2007). ManyEyes: A site for visualization at internet scale. *IEEE Trans Vis Comput Graph., 13(6)*(1077-2626 (Print); 1077-2626 (Linking)), 1121.-1121-8.

Viegas, F. B., & Wattenberg, M. (2008). Timelines - tag clouds and the case for vernacular visualization. *Interactions, 15*(4), 49-52.

Vimarlund, V., & Timpka, T. (2002). Design participation as an insurance: Risk-management and end-user participation in the development of information systems in healthcare organizations. *Methods of Information in Medicine, 41(1)*(0026-1270 (Print); 0026-1270 (Linking)), 76-76-80.

Walker, H. (2006). Computer-based education for patients with psychosis. *Nursing Standard, 20(30)*(0029-6570 (Print); 0029-6570 (Linking)), 49-49-56.

Walsham, G. (1993). *Interpreting information systems in organizations* (1st ed.). New York, NY, USA: John Wiley \& Sons, Inc.

Walter, G., & Matheson, S. (2008). What is the role of e-technology in mental health services and psychiatric research? *J Psychosoc Nurs Ment Health Serv., 46(4)*(0279-3695 (Print); 0279-3695 (Linking)), 42-8.

Wangberg, S. C., Gammon, D., & Spitznogle, K. (2007). In the eyes of the beholder: Exploring psychologists' attitudes towards and use of e-therapy in norway. *Cyberpsychology & Behavior, 10*(3), 418.

Wijk, J. J. v. (2006). Views on visualization. *IEEE Transactions on Visualization and Computer Graphics, 12*, 421-433.

Wilson, P., & Leitner, C. and Moussalli, A. (2004). *Mapping the potential of eHealth: Empowering the citizen through eHealth tools and services*. Cork, Ireland: eHealth Conference.

World Health Organization. (2004). *The global burden of disease: 2004 update.* Retrieved 08/12, 2010, from http://www.who.int/healthinfo/global_burden_disease/GBD_report_2004update_full.pdf

World Health Organization. (2005). *Mental health information systems - mental health policy and service guidance package.* Retrieved 08/19, 2010, from http://www.who.int/mental_health/policy/mnh_info_sys.pdf

World Health Organization. (2007a). *Facts.* Retrieved October, 2010, from http://www.who.int/mental_health/management/schizophrenia/en/

World Health Organization. (2007b). Human resources and training for mental health.

World Health Organization. (2007c). *What is mental health?* Retrieved October, 2010, from http://www.who.int/features/qa/62/en/index.html

World Health Organization. (2008). *mhGAP - mental health gap action programme. scaling up care for mental, neurological, and substance use disorders.* Retrieved 08/17, 2010, from http://www.who.int/mental_health/mhgap_final_english.pdf

World Health Organization. (2009). *Improving health systems and services for mental health.* Retrieved 08/17, 2010, from http://whqlibdoc.who.int/publications/2009/9789241598774_eng.pdf

World Health Organization, & World Organization of Family Doctors. (2008). Integrating mental health into primary care: A global perspective. *WHO Press,*

Wright, P. C., & Monk, A. F. (1991). A cost-effective evaluation method for use by designers. *Int.J.Man-Mach.Stud., 35*(6), 891-912.

Yin, R. K. (1999). Enhancing the quality of case studies in health services research. *Health Serv Res., 34(5 Pt 2)*(0017-9124 (Print); 0017-9124 (Linking)), 1209-24.

Yin, R. K. (Ed.). (2002). *Case study research: Design and methods* (3rd ed.). Thousand Oaks, California, USA: Sage Publications.

Yin, R. K. (2003). *Applications of case study research* (2nd ed.). Thousand Oaks, California, USA: Sage Publications.

Young, A. S., Mintz, J., Cohen, A. N., & Chinman, M. J. (2004). A network-based system to improve care for schizophrenia: The medical informatics network tool (MINT). *Journal of the American Medical Informatics Association, 11*(5), 358-367.

Zygmunt, A., Olfson, M., Boyer, C. A., & Mechanic, D. (2002). Interventions to improve medication adherence in schizophrenia. *American Journal of Psychiatry, 159*(10), 1653-1664.