FAKULTÄT FÜR !NFORMATIK

Analysis, Design and Training Concepts of A Telematic Application for Supporting Patients with Chronic Diseases

DIPLOMARBEIT

zur Erlangung des akademischen Grades

Mag.rer.soc.oec

im Rahmen des Studiums

Informatikmanagement

eingereicht von

Junyun Yang
Matrikelnummer 0261108

an der
Fakultät für Informatik der Technischen Universität Wien

Betreuung:
Betreuer/Betreuerin: Thomas Grechenig

Wien, 26.08.2009

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(Unterschrift Verfasser/in)   (Unterschrift Betreuer/in)

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ausgeführt am
Institut für Rechnergestützte Automation
Forschungsgruppe Industrial Software
der Fakultät für Informatik der Technischen Universität Wien

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Betreuer: Thomas Grechenig
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Wien, 26.08.2009

Eidesstattliche Erklärung

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Wien, am 26.08.2009   ---
                                       Junyun Yang

Acknowledgements

On the completion of my thesis, I first thank professor Thomas Grechenig and my advisors Christoph Gspandl and Rene Baranyi who have given me valuable instructions and have improved me in language.

I would also like to thank all my friends for their friendship, and constructive suggestions and constantly encouragement.

Thanks, especially, to my parents for always believing in me, and for their unwavering support during my study in Austria. Without you, I would never have a chance to complete my thesis. I love you.

Junyun Yang
Vienna

Kurzfassung

Der Schwerpunkt der vorliegenden Arbeit liegt auf dem Entwurf einer Telematikanwendung für Patienten mit chronischen Krankheiten, wobei als Fallbeispiel Behandlungsprozesse bei Hypertonie im Detail analysiert und Verbesserungsvorschläge für die Behandlung chronisch Erkrankter diskutiert werden.

Basierend auf einem breiten Literaturüberblick werden Grundlagen von modernem Care-Management und Case-Management vorgestellt und digital unterstützte Verfahren für die therapeutische Begleitung chronisch kranker Menschen untersucht. Bei der Behandlung von Bluthochdruck fehlen für eine präzise Medikation oft relevante medizinische Daten, die regelmäßig vom Patienten erfaßt und an behandelnde Ärzte übermittelt werden sollten. Als Ziel der vorliegenden Untersuchungen soll die Lebensqualität dieser Patientengruppe durch präzise Kenntnis signifikanter medizinischer Parameter und entsprechende Interventionen signifikant erhöht werden.

Das entwickelte Telematikprogramm unterstützt die Überwachung des Gesundheitsverlaufs der Patienten, wobei den behandelnden Ärzte Gesundheitsdaten in Echtzeit übermittelt werden können. Eine Synchronisierungsfunktion überträgt dabei diese Gesundheitsdaten von Client zu Server, die den medizinischen Fachleuten erlaubt, aktuelle Daten ihrer Patienten unabhängig von Zeit und geographischer Position abzurufen. Dabei können Mobilfunktelefone oder PDAs von Patienten verwendet werden, um rasch und kostengünstig relevante Parameter wie Ernährungsspezifika, auftretende Symptome, Blutdruck, Gewicht, sportliche Betätigung etc. tagesaktuell festzuhalten.

Abschließend werden unterschiedliche Ausbildungskursszenarien für Endbenutzer der vorgestellten Anwendung präsentiert, wobei unterschiedliche Vorkenntnisse der Endbenutzer berücksichtigt werden.

Keywords: *Care-Management, chronische Krankheit, Hypertonie, Gesundheitsdaten, Didaktik, Kursszenario*

Abstract

This thesis focuses on analysing the treatment processes of chronic diseases based on case study of hypertension, designing a telematic application for supporting patients with chronic conditions, and building training course scenarios of the application for end users.

As there is no cure for chronic diseases, the treatment processes usually last life long for chronic patients. Nevertheless, some problems still exist in the hypertension treatment process such as difficulty of tracking real-time health data, which makes it hard for medical specialists to be conscious of their patients' health conditions. Thus, it becomes important to improve the treatment processes and help chronic patients to reach a better life quality.

First, a literature overview of specific chronic diseases and didactics theories was presented. The analysis process is based on chronic care management and case management. Chronic patients with the same chronic disease such as hypertension patients are considered as a group in care management, while special cases of this group were addressed as case management. Different types of chronic diseases were explored, finding out the requirement of this group and their interactions with medical staff. Based on analysis results, a telematic application was designed for patients and their carers to monitor health conditions by collecting volumes of real-time health data, and modeling activities of patients' daily living. A synchronization function transfers health data from client to server, which allows medical specialists to access timely and accurate data of their patients regardless of time and geographical position. Concerning of end users both with and without knowledge background of computing, training course scenarios were designed to meet different needs of course participants.

Keywords: *care management, chronic disease, hypertension, health data, didactics, course scenario*

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1 Introduction

1.1 Problem Outline

Developing healthcare technology for chronic diseases has been brought to spotlight during the past decades, as the continuously augmenting elderly population and younger-aged tendency of chronic patients have increased the demand of medical expenditures for home healthcare and other medical sectors exponentially. Illnesses like hypertension and diabetes are classified as "chronicle" since those patients require an extended and multi-care treatment, even between different medical sectors, which raised the complexity of management and treatment processes.

Unfortunately, most of the current medical systems are designed for dealing with acute illnesses, relatively ignores managing a chronic condition, such as the data of disease's treatment and its after-care.[16] The Royal New Zealand College of General Practitioners notes that "the management of chronic disease is often fitted around this acute care and it remains largely unsystematic. This episodic care may be of a high standard, but has rarely been planned to meet the longer term needs of patients with chronic illnesses."[6] Patients data tends to be stored redundantly, which increases the intricacy of managing the flow of patient records and induces unnecessary patient treatment process. Besides, most healthcare applications are reserved for medical specialists, and rarely consider the needs of users like patients themselves and their carers.

1.2 Motivation

Heart disease, the number one killer among all chronic diseases, is reported to cause 32,864 deaths in Austria in 2007, which is 44 percent among all cases. Hypertension is the most common type among all heart diseases.

As there is no cure for hypertension, the extended treatment and after-care greatly affect the life quality of patients. Nevertheless, some problems still exist in the hypertension treatment process. For hypertension patients, daily diet must be strictly controlled on electrolytes, cholesterol, alcohol, and caffeine intake. It can also be dangerous for severe hypertension patients to skip or stop taking medication. Some medications may cause side effects to a few patients. For this reason, it is essential to monitor the progress of therapy especially in the first month. These health data, however, are difficult to be monitored and accessed by medical specialists.

1.3 Objective

Based on care and case management and analysis results of hypertension treatment process, a telematic application is designed to support homecare process for patients with hypertension. Unlike most of healthcare applications reserving for medical specialists, this application is designed especially for patients to monitor their health conditions at home. The telematic application aims at simplifying treatment process of hypertension patients by realizing the possibility of updating real-time health data to their physicians.

This thesis focuses on the current situation of chronic patients and works out how to improve the efficiency of their treatment process by analysing a set of possible applications and finally designing one specific application to support chronic patients. Training course scenarios of the application are builded based on the knowledge background of computing of end users.

1.4 Thesis Structure

The thesis is organized into theoretical part and practical part:

The theoretical part, as a foundation of the following practical part, contains three chapters discussing about care and case management, chronic diseases, and didactics of training course respectively.

Chapter two takes a peek at care and case management for chronic healthcare. Both care and case management aim at effective and efficient healthcare services, cost-saving, and help patients to achieve a better life quality. Care management will first be explored by showing its benefits to both patients and healthcare institutions with a number of facts, as well as its main components and two of the most frequently used chronic care models in the world. Case management will then be introduced by showing its definition, key principles, process and outcomes.

Based on chapter two, chapter three explores the most common chronic diseases in Austria in detail. Background study contains analysing of population and health status, prevalence of chronic diseases such as heart disease, cancer, respiratory disease, and diabetes, and healthcare financing in Austria. Hypertension is then chosen for further analysis, including risk factors, symptoms, diagnosis process, and treatment process.

In order to prepare for the training course design for end users, chapter four defines several didactic methods such as e-learning, open space technology, frontal teaching, and

group puzzle, as well as software applications for assisting education in various institutions, for example, Moodle and Hot Potatoes.

The practical part is also divided into three chapters, which are overall description of telematic application for chronic patients, specific requirements documents, and training course scenarios for end users.

Based on the analysis results of chapter three, a telematic application is designed for supporting patients with chronic condition - hypertension. Both chapter five and chapter six define the Software Requirements Specification (SRS) of this telematic application. Chapter four contains purpose of the application, product perspective including hardware interfaces, software interfaces, user interfaces and communications interface, and product functions in general. Chapter six shows all the software requirements at a level of detail sufficient by displaying a list of technical use case.

Chapter seven presents two training course scenarios for teaching end users how to operation the system. Participants are divided into two groups based on their knowledge of computing. User characteristics, course requirements, and course scenarios are discussed in detail.

2 Introduction to Chronic Care Management and Case Management

A study shows that 80 percent of overall healthcare costs spend on treating about 20 percent of the population with chronic conditions.[20] "Finding those 20 percent and getting them the care they need means managed care needs to go beyond utilization review and recognize the need for chronic care management." says Chris Wise, PhD, administrative director of the Medical Management Center.

Care and case management provide integrated, needs focussed, individuals focussed, holistic and flexible planning and care-delivery for chronic illness patients. The target of care and case management are quality care and cost effectiveness that will be discussed later.

The definition, advantages to both patients and providers, components and most widely used models of care management will first be explored. Second, case management will be introduced with its definition, benefits, key principles, process, and outcomes.

2.1 Care Management

In this part, care management is explored by showing its definition, benefits, components and two most frequently used models in detail.

2.1.1 Definition of Care Management

Care management is named variously by health care organizations in the world. It may also be referred as care management programs, disease management (DM) or other terms. According to Robert Mechanic, the director of Academic Medicine and Health Industry Forum of Brandeis University, care management apply systems, science, incentives, and information to improve medical practice and help patients manage medical conditions more effectively.[1] Concerning chronic patients, care management helps patients with chronic diseases such as hypertension and diabetes to be conscious of their health conditions and reach a better life quality as healthy people.

A more detailed definition is cited by Center for Medicare and Medicaid Services (CMS). Care Management is defined as a multidisciplinary program, which focuses on one single chronic disease or multiple chronic conditions. Following criterions are fulfilled:[4]

- All members of a specific chronic disease are considered as a whole group;
- Plans the care process, and improves the relationship between health practitioners and patients;

- Optimizes patient care through prevention, proactive, protocols based on professional consensus, demonstrated clinical practices, or evidence-based interventions;
- Improves overall health by evaluating health status and measuring outcomes, thereby enhancing quality of life and reducing the cost of care.

Chronic care management is "a system of coordinated healthcare interventions and communications for populations with long-term conditions in which patient self-care is significant". Chronic care management consists medical, pharmaceutical or social interventions, that are designed to improve outcomes of patients and enhance cost-effectiveness.[5]

2.1.2 Benefits of Care Management

Patients' Benefits

Patients play a central role in the treatment process. Rhineland University of Applied Sciences of Cologne has defined a number of benefits that care management brings to the patients.[9]

- Decrease the period of work incapacity by reducing the treatment time, which helps patients to maintain their jobs and reach better life quality.
- Standardise the treatment processes to provide patients a better information flow and transparency of the process.
- Avoid duplication of physical examinations to prevent patients from the harm of medical checkups, for example, radiography, at the same time, realize the possibility of time-saving and cost-saving.
- Integrated follow-up (examination) guarantees a better treatment through refinement of follow-up interval and evaluation of treatment quality.

Cost Saving

Care management programs have produced significant improvements over the last ten years, at the same time, they have also achieved cost found savings by reducing the cost for chronic patient care. Some study results are listed as following:

- One review of 27 studies shows the impact of care management on cost found savings in three of five congestive heart failure (CHF) management programs, eight of thirteen asthma management programs, and seven of nine diabetes management programs.[1]
- A study has compared 4,500 participants in an asthma care management program designed for low-income patients with a control group of 8,700 beneficiaries. "A cost-effectiveness analysis projected a savings to Medicaid of $3-$4 for each dollar spent on care management."[4]

- Participants in Humana's CHF care management program run by CorSolutions "eat less salt, can walk farther, are more mobile, and generally have a higher quality of life and a lower mortality rate" than those who are not utilizing the care management programs. Humana saved "an estimated $22 million in costs through disease management last year".[7]

Number of patients participated in health plan sponsored care management programs has raised exponentially since 2000.[1] Care management companies claimed that their programs results in positive financial outcomes. However, there are still skeptics about the effectiveness of care management.

2.1.3 Components of Care Management

A qualified full-service care management program should contain all the following components. [1][4]

- Population identification processes;
- Evidence-based practice guidelines;
- Collaborative practice models which include physician and support-service providers;
- Risk identification;
- Patient self-management education (may contain primary prevention, behavior modification programs, support groups, and compliance/surveillance);
- Process and outcomes measurement, evaluation and management;
- Routine reporting and feedback involving patients, physicians, plan and care team;
- Appropriate use of information technology (may consist specialized software, etc.).

The program, which does not include all the components, are referred as care management support services.

2.1.4 The Chronic Care Models

Two of the most well-known models of chronic illness care are introduced in this part, which are Wagner Chronic Care Model and Kaiser Permanente Chronic Care Model.

2.1.4.1 Wagner Chronic Care Model

In the 1990s, Edward H. Wagner and his colleagues from America's MacColl Institute for Health Care Innovation have developed a chronic care model offering a systematic approach to improve health delivery, which has then become one of the most frequently

used chronic care models in the world. The chronic care model can be applied to various chronic diseases, health care settings and target populations.

The major objective of the Wagner Chronic Care Model is healthier patients, more satisfied providers, and cost savings. It improves the quality of health outcomes for patients, so that healthcare can be delivered more effectively and efficiently. At the same time, providers are also supported with required resources, with which they can better assist their patients based on their conditions.

Wagner has suggested six interdependent components for the chronic care model. *Healthcare Organization* is situated itself in the *Community Resources and Policies*. There are four elements grouped together within the Healthcare Organization:[23]
- *Self-Management Support*,
- *Delivery System Design*,
- *Decision Support*,
- and *Clinical Information Systems*.

These four elements suggest the quality improvement initiatives, that effect care delivery for clients with chronic conditions, and concurrently are where the greatest attention should be payed for medical practitioners.
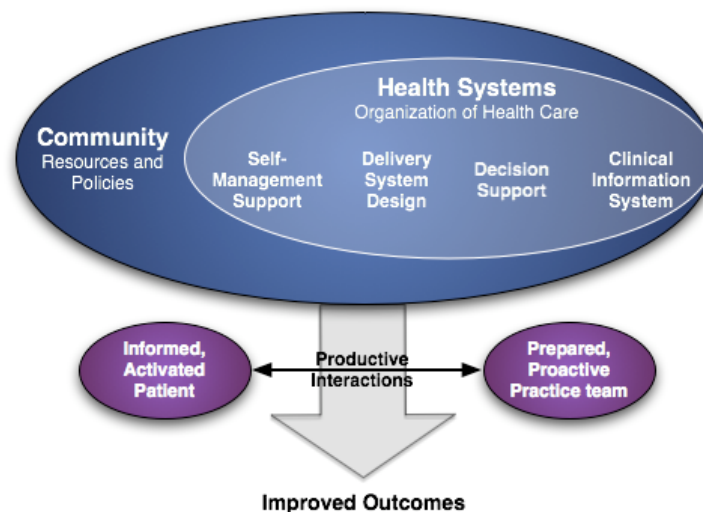
Figure 1: The Chronic Care Model
(Source: Wagner EH.: Chronic Disease Management: What will it take to improve care for chronic illness? Effective Clinical Practice. 1998, 1, 2-4)

• *Community Resources and Policies*

This element supports or expands the Healthcare Organization for chronic patients, as the Healthcare Organization alone cannot influence the management of chronic conditions. On the other hand, Community needs the Healthcare Organization to form durable and useful partnerships with other organizations within the wider community. Mobilize community resources encourage patients to attend effective community programs, fill gaps in needed services, and advocate for policies to improve patient care.

• *Healthcare Organization (Health System)*

It is necessary to create a culture, organization and mechanisms within the Health System which promotes safe and high quality care. All levels of the organization need to be motivated, beginning with the senior leader, who must identify the effort to improve chronic care, and translate it into clear goals reflected in policies, procedures, business plan and financial planning within and across organizations. With the aim of developing a comprehensive system, effective improvement strategies should be promoted. Besides, encourage open and systematic handling of errors and quality problems to improve healthcare is also a part of this element.

• *Self-Management Support*

Effective Self-Management Support emphasizes the patient's central role in managing their health conditions, and fostering a sense of responsibility for their own health. It includes the use of effective Self-Management Support strategies, such as assessment, goal-setting, action planning, problem-solving and follow-up, to assist the patients to plan for the change. Members of practice team, family, friends and community should be organized to provide ongoing Self-Management Support to patients. Disease control and outcomes greatly depend on the effectiveness of self-management.

• *Delivery System Design*

This element is all about teamwork, which may require redesign of the structure of medical practice to create a more effective division of labour between healthcare staffs. It includes defining roles and distributing tasks among team members, organising practice around planned care, providing clinical case management services for complex patients, and ensuring regular follow-up by the care team. The diverse cultural and linguistic needs of patients should be fitted in order to give care that patients understand.

• *Decision Support*

Treatment decisions need to work with evidence-based guidelines to provide standards for optimal care. Guidelines and information should be shared with patients to let them understand the principles behind their care and encourage them to participate in it. Pro-

viders receive ongoing education to stay up-to-date on the latest evidence. Integrate specialist expertise and primary care are also key components of this element.

• *Clinical Information Systems*

A registry is the foundation for successful integration of all the elements of the Wagner Chronic Care Model, as it is the technology to track individuals and groups as well as populations of patients. A clinical information system can provide timely reminders to enhance the care of individual patients. Moreover, an information system can identify patients needs, and monitor and evaluate care to individuals, groups and populations so as to improve the chronic care quality.

With the aim of improving healthcare for chronic patients, the effective combination of all six components of the Wagner Chronic Care Model provides a foundation for collaborative programs and researches, and has soon become a proven strategy itself. "The chronic care model is not a quick fix or a magic bullet;" it is claimed by Edward H. Wagner in the A.C.T (Accelerating Change Today) report, "it is a multi-dimensional solution to a complex problem."[10]

2.1.4.2 Kaiser Permanente Chronic Care Model

Kaiser Permanente, one of the biggest integrated managed care organizations in the world, has conceptualized chronic care at three main levels: [3]
- Chronic care supports self-care for chronic patients who are at low risk of complications and hospitalizations;
- Disease management supports patients who need regular routine follow-up and are at high risk;
- Case management supports patients with multiple needs who require high-intensity of unplanned secondary care.

Figure 2. Three Levels of Kaiser Permanente Chronic Care Model
(Source: Dr. Jason Cheah: Framework and Working Model for the Implementation of Chronic Disease Management in Singapore. National Healthcare Group, 2003.)

According to the three levels of chronic care, care management, on the other hand, is process of co-ordination and plan at management level.

2.2 Case Management

In this part, case management will be introduced by presenting its definition, benefits, key principles, process, and outcomes.

2.2.1 Definition of Case Management

Case management began in the 1970s. A definition of case management given by Nadine Henningsen, the executive director of Canadian Home Care Association, is referred as "a collaborative client-driven strategy for the provision of quality health and support services through the effective and efficient use of available resources in order to support the client's achievement of goals related to healthy life and living in the context of the person and their ability."[11] "Effective chronic case management stresses risk identification, interventions for prevention and treatment, and patient education."[12]

Case management is based on the patients needs and shares the information between the health practitioner and the client/caregivers. Compared to care management, case management lays emphasis on "the development of individually tailored care plans, with a person-centred and multi-disciplinary focus delivered through a case manager or a team".[2]

Case management is applied in various areas including
- community care for old people, disabled people, and patients who have mental health illnesses; acute health settings;
- injury management;
- chronic health conditions management;
- child and youth welfare;
- and many other areas.[18]

Combined with care management, case management is that "the planning and delivery of a package of care for an older person should be integrated, needs focussed, person focussed, holistic and flexible".[2] Case management is an essential element of all health professionals' scope of practice.

Case manager is the people who coordinates care processes, organizes consultation to informal carers, and identifies appropriate services and options throughout the healthcare continuum. The case manager and the organization are responsible for the quality in service provision for individual patients and the population. According to the explica-

tion of 12th Case Management Society of Australia Conference 2009, case manager can be "human service, health and allied health professionals, people with experience in the particular sector where case management is implemented" and designated administrative staffs.[80]

2.2.2 Benefits of Case Management

Patrice L. Spath has divided the benefits of case management into tangible and intangible parts.[52]

Tangible benefits include:
- Reduction in service cycle time.
- Decrease quality defects with its attendant readmissions, long-term stay, repeat surgery and other costs of correction.
- Clinicians have more ability to make choices concerning intervention.
- Improve the management's ability to evaluate effectiveness of processes, treatments, devices, procedures, and interventions.
- Redesign of inefficient processes.
- Improve labor efficiency, and solve redundancy of health care delivery service problems.
- Achieve same outcomes with less use of expensive interventions.
- Improve clinical quality.
- Provide better communication and collaboration.

The intangible benefits are as following:
- Provide a more accurate assessment of service costs, and enhance the accuracy of bid proposals for managed care contracts.
- Improve of reporting of reliable performance measures.
- Improve client satisfaction.
- More flexible in design of client services to meet customer needs.

2.2.3 Key Principles of Case Management

Case management is guided by the following core principles:[13]
- Case management is centred around by clients/caregivers of all ages.
- Case management provides pro-active care to patients in the community with highest burdens of disease.
- Case management stratifies patients population to identify patients who are at high risk of unplanned admissions to hospital.
- Different types of case management are based on specific client characteristics and needs.

- Case management works across boundaries and builds partnership with secondary care clinicians and social services.
- Case management is creative and innovative, and requires effective communication.
- Case management is collaborative, and requires engagement of family and community resources for needed support.
- Case managers design personalised care plans based on needs, preferences and choices of patients.
- Case management incorporates evidence-based practice to guarantee quality care and outcomes.
- Case management integrates patient journey throughout all parts of health and social care system.
- Case management strategies lean on clinical expertise and collaborative relationships between providers and clients.
- Case management strategies enhance health promotion, illness prevention and risk mitigation.
- Case management is guided by an ethical framework which is primarily embedded in professional's practice guidelines and considers client rights, beneficence, equity, non-maleficence and autonomy and power imbalances.

2.2.4 Case Management Process

Case management is a coordinating and therapeutic function for patients with specific chronic conditions, and requires a dynamic interaction between an individual patient and many environments. Case management process is considered dynamic and interactive, which places emphasis on ongoing analysis, decision-making and record keeping.[17] Regardless of case management model, case management process includes the following essential elements:[11]

• *Intake and Assessment of Need*
Refer to intake, an intake assessment form can be used to gather information from patients, in order to determine individual capacities, needs and goals, and provide a continuous process of analysing available information. Nevertheless, it is always necessary to determine whether individuals are in the target group or not. This element also includes screening and determining eligibility.

• *Service Planning*
Service planning is an interactive process involving participation of patients and their families and carers, whose point of view will be taken into consideration. The whole planning process must be documented. The main purpose is to identify goals, objec-

tives, and tasks with clearly identified responsibilities and timeframes, which can be achieved within available resources.

• *Service Coordination*

Coordination of services requires effective regular communication to ensure client needs are being met, and considers cost-effectiveness.

• *Care Implementation*

Based on the elements above, care implementation delivers or arranges services within available resources to meet the identified case plan goal.

• *Monitoring and Evaluating*

Monitoring and evaluating outcomes from a client and population to determine whether care services are being delivered properly, and check whether patient needs have changed.

• *Reassessment of Care Plan*

Reassess case plan to determine if the case plan goal has been met, and if it is necessary to modificate the plan.

• *Service Completion*

When appropriate, disengage, discharge complete a case.

2.2.5 Outcomes of Case Management

Outcomes shows the value of case management. According to the report of Home Care Case Management Invitational Roundtable in 2005[11], typical outcomes of case management includes following sources:

- Delivering appropriate services at the right time;
- Decrease duplication of services;
- Reduction of hospital/emergency utilization;
- Improved patient health status;
- Decreased caregiver burden;
- Improved connections across the system;
- Improved disease management;
- Avoidance of institutionalization;
- Increased patient participation in care;
- Achievement of patient goals;
- Patient satisfaction.

3 Chronic Diseases and Problem Analysis

Chronic diseases, leading by heart disease, stroke, cancer, chronic respiratory disease, are the major causes of death and disability in the world, which has been projected to account for 86 percent of all deaths. "If the major risk factors for chronic disease were eliminated, at least 80 percent of heart disease, stroke and type 2 diabetes would be prevented; and 40 percent of cancer would be prevented", according to Ten Facts about Chronic Disease of World Health Organization (WHO).[81]

This chapter is based on care and case management of chronic illnesses. The first part is the background study of chronic diseases, including an general introduction to chronic diseases, analysis of population background and health status of people in Austria, prevalence of several most common chronic disease in Austria such as heart disease, cancer, respiratory disease and diabetes, and report of healthcare financing in Austria. The second part explored the most common type of heart disease, hypertension, in detail by analysing its risk factors, symptoms, diagnosis process and treatment process. After all, an example case is presented to showing the problems of treatment process.

All the number sources in this chapter are reorganized after collecting from HFA-DB (Health For All DataBase) of WHO Regional Office for Europe, which is a central database of independent, comparable and up-to-date basic health statistics. HFA-DB contains time series from 1970, and the last update was in January 2009. The most recently time series are till 2007.

3.1 Background Study of Chronic Diseases

In this part, chronic disease is explored by presenting its definition, as well as the most recent factors.

3.1.1 An Introduction to Chronic Diseases

World Health Organization (WHO) has defined chronic diseases as "diseases of long duration and generally slow progression", and it is also referred as "conditions that are not cured once acquired... Additionally, other conditions must have been present three months or longer to be considered chronic".[3]

WHO suggests following important features of chronic diseases:[27]
- chronic disease epidemics take decades to become fully established - they have their origins at young ages;
- given their long duration, there are many opportunities for prevention;
- they require a long-term and systematic approach to treatment;

- health services must integrate response to these diseases with the response to acute, infectious diseases.

Both modifiable and non-modifiable risk factors explain the cause of the majority of chronic diseases. The most important modifiable risk factors of chronic diseases includes:[27]

- unhealthy diet and excessive energy intake;
- physical inactivity;
- tobacco use.

These factors are the same in men and women in all regions. There are two features of non-modifiable risk factors:

- age;
- heredity.
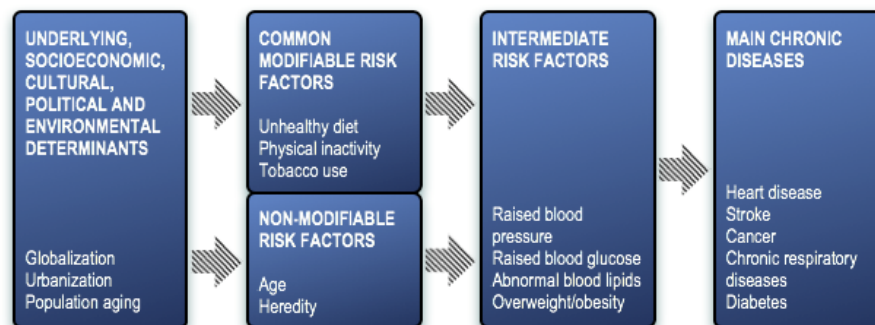
Figure 3. Causes of Chronic Diseases
(Source: Preventing chronic diseases: a vital investment. Geneva, WHO, 2005)

Many other causes of chronic diseases have been identified such as alcohol use and air pollution, which however have relative smaller impact on chronic diseases.

Chronic diseases are the major cause of death and disability worldwide. In European Region, the most common chronic diseases are

- heart disease,
- stroke,
- cancer (malignant neoplasms),
- chronic respiratory disease,
- diabetes,
- and mental health problems,

which are by far the leading cause of mortality, representing 60% of all deaths in the world.[27] Figure 4 shows causes of death in all ages in Europe in 2005. Chronic diseases are projected to account for 86% of all deaths (8,414,000 cases due to chronic disease), where 52% are caused by cardiovascular disease and 19% by cancer. Deaths due

to chronic diseases are projected to increase by 17% in the world in the next ten years, according to Lee Jong-wook, the general director of WHO, in 2005. In Europe, WHO projected that over the next ten years deaths from chronic diseases will increase by 4%, which means 88 million people will die from chronic diseases.[25]

- Cardiovascular disease
- Cancer
- Chronic respiratory disease
- Diabetes
- Other chronic diseases
- Communicable, maternal and perinatal, nutritional deficiencies
- Injuries
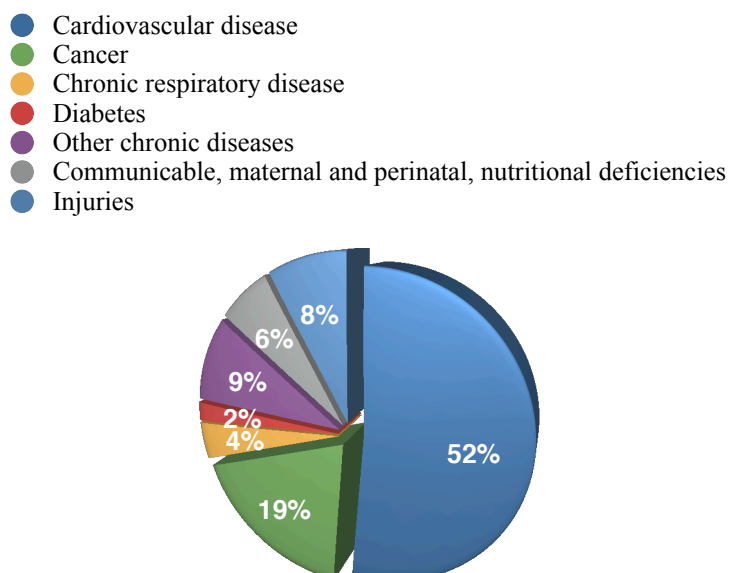
Figure 4. Projected deaths by cause, all ages, WHO Region for Europe, 2005
(Source: Facing the Facts - The Impact of Chronic Disease in Europe[25])

Chronic diseases can be prevented and controlled. Care management and case management have played a big roll in implementation directing at both whole population and individuals.

3.1.2 Population Background and Health Status in Austria

Table 1 shows the changes in the number of population in different age groups over the period from 2003 to 2007. The number of population of mid-year group remained steady during this five years, while there is an upward trend in the percentage of population aged above 65 years reaching a figure of 17.03%.

Age Group	2003	2004	2005	2006	2007
Population aged 0-14 years	16.43%	16.22%	16%	15.74%	15.47%
Mid-year population	68.09%	68.04%	67.74%	67.57%	67.50%
Population aged 65+ years	15.48%	15.74%	16.26%	16.69%	17.03%

Table 1. Population Age Percentage in Austria
(Source: HFA-DB of WHO Regional Office for Europe)

Table 2 illustrates the trend of health status in Austria in the last five years. From 2004 on, there is a gradual reduction in crude birth rate, reaching a low point of 9.17 per thousand person, at the same time, the crude death rate has an decreased to 8.97 per thousand person. The continuous growth of life expectancy at birth indicates that people in Austria tends to live longer from 78.93 years old in 2003 to over 80 years old in 2007.

Health Status		2003	2004	2005	2006	2007
Crude Birth Rate		9.48‰	9.66‰	9.5‰	9.41‰	9.17‰
Crude Death Rate		9.51‰	9.09‰	9.13‰	8.97‰	8.97‰
Life Expectancy at Birth	All	78.93	79.47	79.7	80.24	80.5
	Male	76.03	76.52	76.81	77.31	77.59
	Female	81.59	82.18	82.37	82.93	83.21

Table 2. Health Status in Austria
(Source: HFA-DB of WHO Regional Office for Europe)

Both tables describe the aged tendency of population in Austria, which has a great influence on the number of chronically illness patients[31] and healthcare expenditures[1]. Since the proportion of working population in society is decreasing, the health and social care services have more pressure of caring older people in the country.

Based on modifiable risk factors of chronic diseases, the following two tables provides some interesting data regarding health factors of people in Austria in the recent several years. The figures of table 3 lead to the conclusion that Austrian people have less healthy diets in contrast to average nutrition intake in European Region. Nevertheless, the proportion of regular daily smokers in the population is pronounced below average in European Region.

Health Factors	Austria	European Region
Fat available per person per day	161g	-
Protein available per person per day	110.3g	-

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[1] See 3.1.4 Healthcare Financing in Austria

Health Factors	Austria	European Region
Average amount of cereal available per person per year	110.8kg	129.02kg
Average amount of fruits and vegetables available per person per year	227.6kg	233.18kg
Regular daily smokers in the population, age 15+	23.20%	29.20%

Table 3. Health Factors in Austria and European Region
(Source: HFA-DB of WHO Regional Office for Europe)

It is apparent from table 4 that men are physical more active than women in each age groups. The proportion of men who are physical active drops sharply from 42% of age group 15 to 29 years to 12% among those who above 75. The percentage of physical active women rises slightly before 60 years old, and falls rapidly after 74 years old, reaching the bottom at 5.4%.

Physical activity* groups	15-29 years	30-44 years	45-59 years	60-74 years	75+ years	Average
Men	42.10%	32.70%	28.40%	27.30%	12%	**31.60%**
Women	25.50%	26.80%	27.70%	21.60%	5.40%	**23.30%**

Table 4. Physical Activity in Austria
*Physical "active" are people, who sweat on 3 or more days because of bicycling, jogging or aerobics.
(Source: Health Interview Survey 2006/2007; STATISTICS AUSTRIA, The Information Manager. Compiled on 23 October 2007.)

3.1.3 Prevalence of Chronic Diseases in Austria

The following numbers are all from HFA-DB of WHO Regional Office for Europe unless stated otherwise.

3.1.3.1 Heart Disease

It is reported by the Association of Austrian Social Insurance Agency that 32,864 people died because of cardiovascular diseases in 2007, which is 44 percent among all cases. In Austria, the mortality of cardiovascular diseases is 204 per 100,000 population, which is the number one killer among all diseases. Both cardiovascular diseases and cancer caused seven death in ten in 2007.

3.1.3.2 Cancer

Cancer, or malignant neoplasms, is another most common disease next to cardiovascular diseases, which kills 18966 people or 25.4 percent among all cases, reported by Statistics Austria. There are approximately 37,000 new cases of cancer found in Austria every year in the last five years. The number keeps on increasing from 29,484 in 1983 to 36,919 in 2006, according to Statistik Austria.

3.1.3.3 Respiratory Disease

The number three chronic disease is the diseases of respiratory organs, which caused 4,552 death or 6.1 percent of all cases in 2007 according to Statistik Austria. The Standard Death Rate of respiratory diseases is 32 per 100,000 in all age groups.

3.1.3.4 Diabetes

The prevalence of diabetes is reported as 4.71 percent in Austria. The number of all cases of diabetes at the end of 2006 is approximate 390,000. The Standard Death Rate of diabetes of all age groups is 22.03 per 100,000, where rate for male is 7 points higher than the one of female.

3.1.4 Healthcare Financing in Austria

Table 5 represents the expenditure on healthcare in Austria between 2003 and 2007 in million Euro.

Healthcare Expenditure	2003	2004	2005	2006	2007
Total expenditure on health	22980	24230	25340	26329	27453
Public expenditure on health	17356	18341	19294	19971	20977
Private expenditure on health	5625	5889	6046	6358	6476
Occupational health care	30	34	35	36	38
Total expenditure on health without expenditure on long-term care, % of GDP*	9%	9.10%	9.10%	8.90%	8.80%

*Table 5. Healthcare Expenditure in Austria according to the System of Health Accounts**, million Euro*
*GDP: Gross Domestic Product
**Health expenditure according to the System of Health Accounts include expenditure for long-term nursing care.
(Source: STATISTICS AUSTRIA - National Accounts, balances, company reports, own calculation/ estimations. Compiled on 23. February 2009)

The total expenditure, including both public and private healthcare, rises steadily during five years. There is also an upward trend in the number of occupational healthcare, while the total expenditure on healthcare without expenditure on long-term care decreases year by year, which indicates the growing trend of the long-term healthcare.

3.2 Heart Diseases with Main Focus on Hypertension

As heart disease is the most frequently occurred chronic illness, and the the number one killer in Austria and all over the world, it is selected for further analysis in this chapter. The first part introduces several different types of heart diseases. Hypertension is the most common type among all of them, affects health conditions of 12 percent of population in Vienna, and has been proved to be one of the biggest risk factors for many other chronic illnesses.[28] Part two to part five explores risk factors, symptoms, diagnosis process, and treatment process of hypertension. Part six shows a real example case about hypertension patient, and finding out the problem of treatment process.

3.2.1 Types of Heart Diseases

Different types of heart diseases will be introduced in this part, including hypertension and other common forms of heart diseases such as atherosclerosis, coronary artery disease, heart attacks, valvular heart disease, congestive heart failure, cardiomyopathy, and dysrhythmias.

3.2.1.1 Hypertension

Hypertension, or high blood pressure, is caused by resistance of the arteries, when the heart pumps blood out. It the most common form among all types of heart diseases. A study of health examinations in Vienna in the year 2001 shows that 12.3% people examined were identified as suspected hypertensives.[28] It has been proved to be one of the biggest risk factors for cardiovascular diseases, along with high cholesterol levels and cigarette smoking.[30]

Hypertension, however, is hard to detect, only if people check their blood pressure regularly. Mark Jenkins has categorized all levels of blood pressure including normal, high-normal, and stage 1 to stage 4 hypertension (see Table 6). For patient who has either systolic or diastolic number in one of these categories, the patient is considered to be in that category.

Condition	Systolic (mm Hg*)	Diastolic (mm Hg)	What to do
Normal	Less than 130	Less than 85	Have your doctor recheck in 2 years.

Condition	Systolic (mm Hg*)	Diastolic (mm Hg)	What to do
High-normal	130 to 139	85 to 89	Have your doctor recheck in 1 years.
Stage 1 hypertension	140 to 159	90 to 99	Have your doctor confirm diagnosis within 2 months.
Stage 2 hypertension	160 to 179	100 to 109	Start treatment within 1 month.
Stage 3 hypertension	180 to 209	110 to 119	Start treatment within 1 week.
Stage 4 hypertension	210 or higher	120 or higher	Start treatment immediately!

Table 6. Classification of High Blood Pressure Readings
* The numbers represent millimeters of mercury, abbreviated mm Hg.
(Source: Mark Jenkins: High Blood Pressure: Practical, Medical, and Spiritual Guidelines for Daily Living with Hypertension[32])

There are three types of hypertension based on their causes:[29]
- Primary Hypertension
- Secondary Hypertension
- Renovascular Hypertension

Primary hypertension, or essential or idiopathic hypertension, is the most common form of all types of hypertension. The precise cause of this condition remains unknown. Genetic component and lifestyles including diets and physical activity are considered to be the most important risk factors. Secondary hypertension is the one related to a specific medical problem such as kidney disorder in most cases. Besides, medication caused hypertension also falls under the category of type. Renovascular hypertension is a rare form, which is caused by narrowing of one or both of renal arteries.

Interestingly, there is also another type known as "white-coat hypertension". At least 10% of people have a bit of anxiety which causes "white coat hypertension" when visting doctors.[29] For example, people who have blood pressure level 135/85 at home, may have a raised blood pressure level at 140/90 in the doctor's office. There are several ways to avoid false reading caused by this type of hypertension, including visiting the doctor's office regularly, using blood pressure cuff at home, or using a device to continuously monitor blood pressure over twenty-four hours.

3.2.1.2 Other Common Forms of Heart Diseases

According to the literatures research, the most common forms of heart diseases including atherosclerosis, coronary artery disease, heart attack, valvular heart disease, congestive heart failure, cardiomyopathy and rhythm disturbances.

Atherosclerosis

Atherosclerosis, hardening of the arteries, is caused by the deposit of fat into the walls of blood vessels, especially the arteries, that is usually found in branch areas of large arteries. Tobacco use, physical inactive, obesity, suffering high blood cholesterol levels can increase the risk of having atherosclerosis. Besides, hypertension accelerates the development of atherosclerosis. In young and middle-aged, it is more common for men to cause atherosclerosis then women of the same ages. After the menopause of women, the chance for both is equal. The plaques of atherosclerosis narrow the arteries, reducing the blood flow, or even worse, blocking the artery. Atherosclerosis may also cause thrombosis and aneurysm.

Coronary Artery Disease

Coronary artery disease is another common form of heart diseases, which is atherosclerosis of the coronary arteries. It is caused by the enlarging plaques, that makes the lumen of the coronary arteries getting smaller, and less blood flowing to the heart tissue. The most common symptom is angina pectoris. Medical therapy of coronary artery disease involves lowering cholesterol or controlling hypertension.

Heart Attacks

Heart attack, also myocardial infarction, occurs when a branch of a coronary artery becomes obstructed and the heart cells that it supplies die. The symptoms of heart attack are similar to the angina, although they are more severe and last longer than fifteen minutes. Besides, patients may also feel faint or dizzy, get sweaty, and short of breath. Heart attack can damage a large amount of cardiac muscle, which causes death from heart failure. Even survivors may be left with some cardiac abnormalities.

Valvular Heart Disease

Valvular heart disease occurs when the valves of the heart have become damaged or do not function properly. Severe valvular disease can affect the heart's pumping ability, which is a relatively rare type of heart disease. Mitral valve prolapse, a mild congenital form of valvular disease, can be happened to one of every twenty people. Valvular disease can be caused by calcium deposits depending on age, or by infections of the valves. Treatment of valvular disease involves medication and surgery.

Congestive Heart Failure

The retention of fluid in the tissues, or "congestion", causes that the heart can not pump enough blood to the whole body, is referred to as congestive heart failure. Many types of heart diseases such as coronary artery disease, valvular heart disease, cardiomyopathy and severe lund problems may eventually result in heart failure. The symptoms of mild heart failure may be only a mild swelling around the ankles and shortness of breath, while severe heart failure can lead to more fluid retention that causes swelling in legs and hands, and shortness of breath even at rest.

Cardiomyopathy

Cardiomyopathy is a disease of heart muscle, main symptom of which is congestive heart failure. There are three major categories of cardiomyopathy, which are dilated cardiomyopathy, hypertrophic cardiomyopathy, and restrictive cardiomyopathy.

Rhythm Disturbances

Dysrhythmias, or abnormal rhythms, means abnormal heartbeats, which is caused by damages to any part of the heart's conducting system that result from a heart attack, chemical or nutritional abnormalities, a genetic defect, or aging process. Dysrhythmias are grouped into two types, which are conduction defects and abnormal pacemakers.

3.2.2 Categorization of Risk Factors

The risk factors of hypertension are concluded in table 7. Most cases of hypertension, however, have no specific known reason.[29][30]

Risk Factors		Description
Individual factors	Genes	Family medical history increases the risk of developing hypertension.
	Age	In young and middle-aged, it is more common for men to cause hypertension then women of the same ages.
	Racial group	It is far more common in blacks than others, and occurs less in people of East Asian origin.

Risk Factors		Description
Effects from other diseases	Kidney disease	The most frequent cause is kidney (renal) disorder. Tumors of the adrenal gland can also be a risk factor.
	Hormonal ab-normality	Abnormalities in any of several regulating mechanisms can cause hypertension.
	Diabetes	
Medication history	Amphetamines	Even the ones found in cold pills.
	Cocaine	
	Birth control pills	Medication that contains hormones raises blood pressure in some patients.
	Steroids	Medication contains hormones.
Diet	Sodium	Diet high in salt and sodium-based ingredients.
	Cholesterol	Diet high in cholesterol food.
Lifestyle	Obesity	The greater the body mass, the more blood is needed to supply oxygen and nutrients.
	Physical inac-tive	Physical activity strengthens the heart muscles and dilates blood vessels.
	Alcohol	(controversial) Excessive drinking may raise blood pressure, while moderate alcohol intake helps to keep it under control.
	Stress	(controversial) Stress increases the heart rate and blood requirements.
	Tobacco use	

Table 7. Risk Factors of Hypertension

3.2.3 Symptoms

Hypertension by itself generally causes few symptoms. An exception is that a headache in the back of the head usually in the morning. Only for patients with severe hypertension, ordinary headaches, dizziness, and nosebleeds can occur.[29]

However, hypertension can cause damage to several organs and tissues inside the body. Kidney failure and stroke (bleeding or blood clots in the brain) are two significant re-

sults of severe hypertension. The damaged kidneys cause symptoms including excessive perspiration, muscle cramps, weakness, frequent urination, and a rapid or irregular heartbeat. Hypertension also results in several forms of heart diseases, which are [29]

- *Hypertrophic cardiomyopathy*: is an excessive thickening of the heart muscle, which forces the heart to work harder to pump blood leaving the heart.
- *Coronary artery disease*[2]
- *Congestive heart failure*
- and *Heart attack* (with those who have coronary artery disease).

3.2.4 Diagnosis Process

A complete examination process for hypertension including checking specific cause for probable hypertension such as damage to blood vessels in the brain, heart, kidneys, and other organs, is listed as following.[32]

Several questions are also essential before the examination:

- *Symptoms*
- *Family history*: especially hypertension, stroke, and heart diseases
- *Lifestyles*: alcohol consumption, tabacco use, cholesterol levels
- *Medical records*: diabetes

Physical examination probably including the following components:

- *Check blood pressure* in three positions: seated, standing, and lying down.
- *Eye examination*: check for signs of retinal disease related to hypertension.
- *Neck examination*: listen if there is unusual sounds in arteries, swollen neck veins, and enlarged thyroid.
- *Heart examination*: check if there is an evidence of an enlarged heart, abnormal heart sounds (murmurs), irregular heartbeats, or other heart disease symptoms.
- *Chest examination*: listen if there is abnormal lung sounds.
- *Abdomen examination* for bruits: check if there is any symptoms of enlarged liver, spleen, or kidney, and other kidney disorders.
- *Arms and legs examination*: check for weak or absent pulses and swelling.
- *Neurological examination*: check for evidence of a stroke or nerve damage, especially if the patient has a history of diabets or alcoholism.
- *Electrocardiography (ECG or EKG)*: determine the severity of any risk factors for cardiovascular disease and any organ damage.
- *Chest radiography*

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[2] Coronary artery disease, Congestive heart failure, and Heart attack, see 3.2.1.2

Laboratory tests may include following aspects:
- *Complete blood count (CBC)*
- *Serum chemistry*: including potassium, creatinine, and magnesium
- *Urinalysis*
- *Fasting blood sugar*
- *Fasting lipoprotein profile*: including low-density lipoprotein (LDL), high-density lipoprotein (HDL), cholesterol and triglycerides

Further specific tests may required depending on the results of the examination.

3.2.5 Treatment Process Analysis

Generally, hypertension can be controlled easily by medications and changes in life-style. For *mild hypertension* patients, the blood pressure can be reduced through:[29]
- Loss weight (for all),
- Diet with less salt, avoid sodium,
- Reduce alcohol intake,
- Exercise (for all): over-vigorous exercise can be dangerous, especially for patients with coronary disease and heart failure. Patients should ask their doctors before starting training.

Unfortunately, for patients with severe hypertension, medical therapy is required for the rest of their life, as there is no cure for hypertension. It is very dangerous for severe hypertension patients to stop taking medication by themselves, which may cause dramatically increased blood pressure and result in cerebral hemorrhage (bleeding within the brain), sudden heart failure, or heart attack.

The treatment process is explored in detail with tables of factors which should be useful for software function requirements in Chapter 6.

3.2.5.1 Nutrition Control

There are four electrolytes needed by the body to achieve its daily functions, which are sodium, calcium, magnesium and potassium. Without the proper combination of these four electrolytes, the heart would not function correctly. It has been shown that supplemental potassium, calcium, and magnesium may have a beneficial effect for people with hypertension condition.[30] It is important to check with doctors before taking these supplements, since taken in high may results in harmful effects, especially magnesium.

Sodium

People who have hypertension should specially restrict dietary sodium. A teaspoon of table salt (approximate 60g) contains 2,300 milligrams sodium.[54] The 2005 Dietary Guidelines Advisory Committee Report said that hypertension patients need to go as low as 1,500 milligrams per day, and listed several tips to sodium intake, which is concluded in table 8.

Prefer	Avoid
fresh or plain frozen vegetables, or canned vegetables without salt	canned with salt
fresh or plain frozen fish, shellfish, poultry, and meat	canned and processed ones
frozen dinners, packaged mixes, cereals, cheese, breads, soups, salad dressings and sauces with lower amount of sodium labels	the one with more sodium, or without low sodium label
spices and herbs	salt
plain foods such as grilled or roasted entrees, baked potatoes and salad with oil and vinegar	fried foods, stews and pasta with sauce
fruit, vegetables, and water	-

Table 8. Top Tips to Lower Sodium Intake
(Source: Feed Your Family Right!: How to Make Smart Food and Fitness Choices for a Healthy Lifestyle.[50])

Potassium

Potassium is a chemical element that helps to maintain normal functioning of muscles, the heart, and the nervous system.[30] University of Pennsylvania researchers found in 1991 that too little potassium in the body signals the kidneys to raise blood pressure. It is recommended to take at least 4.7 grams daily to lower blood pressure. Ideally, the ratio of potassium to sodium in the diet should be about five to one.[30] Table 9 shows the amount of potassium of some fruits and vegetables.

Fruits*	Potassium (mg)	Vegetables*	Potassium (mg)
Apples	60	Green beans	76
Lemon	80	Peppers	89
Strawberries	124	Carrots	116

Fruits*	Potassium (mg)	Vegetables*	Potassium (mg)
Pineapple, canned	133	Onions	124
Pear, Asian	148	Broccoli	127
Cherries	152	Mushrooms	130
Kiwi	252	Corn	204
Papaya	390	Tomato	251-273
Avocado	549	Cabbage	316
Peaches	797	Potato, baked, no skin	610

Table 9. Potassium Content in Fruits and Vegetables
*Serving = ½ cup raw unless stated otherwise
(Source: Agricultural Handbook No. 8, United States Department of Agriculture[55])

Calcium

Lack of calcium in the diet can be as important as consuming too much sodium to patients with hypertension. Study shows that increasing daily calcium intake by 1 gram lowered the risk of hypertension by 12 percent. Nonfat or low-fat milk, yogurt, cheese, or even ice cream are good source of of calcium. Women require 1,200 to 1,600 mg daily for both bone health and blood pressure control, while men need 800 mg.[30]

Magnesium

People with higher magnesium consumption have lower risk of developing hypertension. For each 180 mg increase in daily magnesium intake, systolic and diastolic blood pressure reduced by 4.3 mm Hg and 2.3 mm Hg respectively. Women require at least 320 mg magnesium intake every day and men require 420 mg, both with maximum 700 mg, according to U.S. nutrition authorities. Rich magnesium food including plant foods such as beans, bananas, almonds and cashews, and greens. Five small clams can also provide up to 112 mg magnesium.[30]

Cholesterol

Cholesterol level is another important measurement that has a great influence to blood pressure and other heart diseases. The higher people's cholesterol level during middle age, the more risk they have of developing hypertension. Cholesterol, a kind of lipid, travels through blood via particles called lipoproteins. There are three major classes of lipoproteins: very low density lipoprotein (VLDL), low-density lipoprotein (LDL), and

high-density lipoprotein (HDL). LDL is known as "bad cholesterol", while HDL refers to "good cholesterol", as it carries bad cholesterol out of the body.[29] Table 10 represents the disease risk based on the number an adult obtains for total cholesterol (TC), HDL, and LDL cholesterol levels. Besides, the glucose level should be less than 6.93 mmol/L, optimally under 5.5 mmol/L. Triglycerides (TG) counts should be under 1.69 mmol/L, and ideally below 1.129 mmol/L.[77]

Classification	Cholesterol level	Disease risk
Total Cholesterol	< 200	desirable
	200 to 239	borderline high risk
	> 240	high risk
HDL Cholesterol	< 40 for men; < 50 for women	low HDL; a major risk factor for heart disease
	> 60	high HDL; protective against heart disease
LDL Cholesterol	< 100	optimal
	100 to 129	near or above optimal
	130 to 159	borderline high risk
	160 to 189	high risk
	> 190	very high risk

Table 10. Counting Cholesterol (in mg/dL) for Adults
* Multiply mg/dL by 0.02586 to get mmol/L.
(Source:National Cholesterol Education Program, National Heart, Lung, and Blood Institute, National Institutes of Health, NIH Publication No. 01-3670, May 2001[77])

Daily dietary cholesterol intake should be limited under 300 milligrams. According to Dietary Guidelines 2005 Advisory Committee Report, top sources of dietary cholesterol (from most to least) are:[78]

- eggs,
- beef,
- poultry,
- cheese,
- milk,
- fish/shellfish,
- cakes/cookies/quick breads/doughnuts,

- pork (fresh unprocessed),
- ice cream/sherbet/frozen yogurt,
- and sausage.

3.2.5.2 Change of Lifestyles

Change of lifestyles is as important as diet control for hypertension patients, which including weight control, physical activity, tobacco, alcohol, and caffeine intake control, and stress management.

Weight

Study shows that the more overweight a person becomes, the higher blood pressure will likely go. Losing weight is, thus, one of the most solidly documented lifestyle modifications shown to control blood pressure. BMI (body-mass index), one of the most common classification systems, calculated based on weight and height regardless age and gender. It is considered to be healthy and normal for having a BMI between 18.5 and 24.9.[30]

$$BMI = \frac{weight\ (kg)}{height \times height\ (m)}$$

WC (waist circumference) is another simple measurement to determine weight-related health risk. A combination of both measurements shows if a person has a normal weight.

Classification	BMI	Men: < 102 cm Women: < 88 cm	Men: ≥ 102 cm Women: ≥ 88 cm
Normal	18.5 to 24.9	-	-
Overweight	25 to 29.9	Increased risk	High risk
Obesity I	30-34.9	High risk	Very high risk
Obesity II	35 to 39.9	Very high risk	Very high risk
Obesity III	40 or above	Extremely high risk	Extremely high risk

Table 11. Risk for Diseases According to BMI and WC
(Source: Revolutionhealth™, Your home for health and balance, 2007[51])

For patients, keep writing a daily diet diary or journal is a good way to learn from their own eating and drinking habits, and control their weight. Record everything, including what the patients have eaten and drunk, how many or how much, and when.

Physical Activity

Regular physical activity is an efficient way of weight loss, cholesterol control, stress management, and blood pressure maintenance. For patients with hypertension, physical fitness should be moderate and slow. Medical authorities have defined sufficient daily exercise as "walking briskly for thirty to forty minutes a day, at between three and four miles per hour"[30], which equals 3.2 kilometers a day, 22.5 kilometers a week. The metabolic equivalent, or MET, is a measure of physical performance or level of activity. That walk will burn from *90 MET-minutes* (30 min x 3 METs) to *160 MET-minutes* (40 min x 4 METs) per day, approximately 500 to 1,000 MET-minutes per week, according to Advisory Committee Report.[53] Table 12 shows the amount of energy needed of a specific activity.

Amount of energy	Activities
1 MET	Sleeping; Lying in bed; Sitting quietly in chair
2 METs	Standing; Talking; Walking (1 mph); Reading; Writing; Playing cards; Light housekeeping (dusting); Typing or word processing; Shaving; Dressing or brushing your hair
2-3 METs	Walking (2 mph); Playing the piano; Playing golf (electric cart); Bathing or showering; Washing your hair; Moderate housekeeping (light laundry); Meal preparation; Bicycling (5 mph); Bowling
3-4 METs	Walking (3 mph); Bicycling (8 mph); Driving a car in light traffic; Climbing stairs slowly; Heavier housework (scrubbing dishes); Ballroom dancing (foxtrot); Factory labor
4-5 METs	Walking (4 mph); Gardening or raking; Light carpentry; Mowing the lawn; Playing badminton or light tennis; Heavy housekeeping (mopping, vacuuming); House painting; Driving a car in heavy traffic; Washing windows
5-6 METs	Walking (4.5 mph); Bicycling (10 mph); Roller-skating; Light shoveling, digging; Golfing; Very heavy housework (scrubbing floors); Carrying wood or groceries Social dancing (tango)
6-7 METs	Walking (5 mph); Bicycling (11 mph); Playing tennis (singles); Waterskiing; Swimming leisurely; Square dancing, swing dancing; Splitting wood; Snow shoveling; Moving furniture
7-8 METs	Jogging (5 mph); Bicycling (12 mph); Downhill skiing; Canoeing; Swimming laps (slow); Playing football; Horseback riding at a gallop; Climbing hills (moderate); Climbing stairs (continuous); Playing tennis (competitive singles)

Amount of energy	Activities
8-9 METs	Jogging (5.5 mph); Bicycling (13 mph); Swimming laps (fast); Cross-country skiing; Playing basketball; Carrying groceries upstairs
10+METs	Handball, racquetball, squash, jogging (6 mph or faster); Climbing hills with a load

Table 12. Energy Requirements of Common Activities in METs
(Source: Blood Pressure Cure: 8 Weeks to Lower Blood Pressure Without Prescription Drugs[30])

Tobacco

Withdrawal from nicotine is important for patients who have hypertension. However, the psychological addiction takes longer to deal with. There are several forms nicotine replacement such as gum, lozenges, inhalers, and sprays to wean smokers off nicotine. Getting support from family, friends, and coworkers will be helpful while quitting smoking.

Alcohol

Alcohol can raise levels of the protective "good" HDL cholesterol, and reduce the risk of developing blood clots. Moderate alcohol intake lower the incidence of heart diseases mortality from strokes and heart attacks. For hypertension patients, report shows that moderate alcohol consumption reduces both systolic and diastolic blood pressure. The word "moderate" means no more than one drink a day for women and two drinks a day for men, where one drink equals approximate 350 mL of beer, or 150 mL of wine with 12 percent alcohol, or 45 mL of 80-proof distilled spirits such as whisky or vodka.[30]

Caffeine

For people who don't consume caffeine regularly or who consume more than usual, caffeine can sharply raise the blood pressure temporarily. Caffeine can be found in coffee, tea, soft drinks and chocolate. If the patients have hypertension, daily caffeine intake should be limited to about 200 milligram.[30]

Source	Type	Caffeine (mg)
Coffee (180 mL)	Brewed, drip	130
	Instant	57
	Decaffeinated, brewed and instant	2

Source	Type	Caffeine (mg)
Espresso	Regular	100
	Decaffeinated	5
Tea (180 mL)	Black, brewed 3 minutes	40
	Instant	30
	Decaffeinated	1
Soft drinks (360 mL)	Cola type, regular and diet	31 to 70
	Non-cola type	0 to 55
Chocolate	Cocoa, dry powder, 1tbsp	10
	Baking chocolate (30 g)	25
	Chocolate milk (250 mL)	10
	Milk chocolate bar (45 g)	10

Table 13. Amount of Caffeine Contained in Some Common Sources
(Source: Bowes and Church's Food Values of Portions Commonly Used, 17th ed. Lippincott-Raven Publishers, 1998, by permission[79])

Stress

Stress and other negative emotions affect human's bodies in very physiological ways. Stress can be from dislike of the job, stress at work, family life, and type of personality. People that were angry, time-obsessed, and driven, are having type-A personality[30], who are more likely to develop heart disease and hypertension.

3.2.5.3 Medication

For some patients, it is not adequate only to have lifestyles changed, medication is also essential to improve their health conditions. There are great varieties of anti-hypertensive medications to fit different kinds of medical conditions. Hypertension medications are designed to alter *(1) how much fluid is in the body*, *(2) how hard the heart pumps*, or *(3) how much the blood vessels widen and narrow*. The main categories are listed as following:[29]

- *Diuretics*: There are different kinds of diuretics, usually work together with other hypertension medication. They work in the kidneys and flush excess water and sodium from the body through urine. (1)
- *Beta blockers*: They help to reduce nerve impulse to the heart and blood vessels, so that the heart beat less often and with less force. (2)

- *Angiotensin antagonists, or angiotensin receptor blockers (ARBs)*: They guard blood vessels against a hormone called angiotensin II, which may cause vessels to narrow. (3)
- *Angiotensin converting enzyme (ACE) inhibitors*: They prevent angiotensin II from being formed. (3)
- *Calcium channel blockers (CCBs)*: They prevent calcium from entering muscle cells of the heart and blood vessels. There are short-acting and long-acting types of CCB. (3)
- *Alpha blockers*: They works on the nervous system to relax blood vessels. (3)
- *Nervous system inhibitors*: They helps to relax blood vessels by controlling nerve impulses. (3)
- *Vasodilators*: These open blood vessels by relaxing the muscle in the vessel walls. (3)
- *Alpha-beta blockers*: This kind of medication is a combination of both beta blockers and alpha blocks. (2, 3)

Each of these categories contains several different drugs, and each drug may have two or more sub-branches. When the doctors choose medications for patients, they have to consider severity of high blood pressure, age, race, associated disease, drug interaction, and cost.

The instructions of the medications can also be different, including the dosage and the intervals at which patients should take the drug. There are several aspects need to be considered by patients while taking a new medication:[29]
- With food, or without food
- With other medications, or without other medications
- What time of day to take medication
- How many times a day to take the medication
- Interactions with other medications that the patient is taking
- Possible short- and long-term side effects
- Doctor's evaluation of the therapy progress

It is important for patients not to skip or stop taking pills by themselves. Some patients don't feel fine with the side effects caused by the medicine such as sleepy, tired, dizziness, faintness, skin rash, or cough. Patients are always encouraged to discuss such side effects with their doctors, so that another medicine can be prescribed.

Once a patient starts a medication treatment, the doctor will evaluate the progress within in the first month of therapy. Based on the evaluation results, changes of medication type and dosage, or repeat some or all the initial tests will be advised.

3.2.6 Problem Analysis

According to the analysis results in previous sections, here are some problems may occur to the hypertension treatment process:

- Problem 1. "White coat hypertension": This causes difficulty for doctors to obtain real blood pressure of their patients. One of the solutions is to measure blood pressure at home by patients themselves and report the results to their doctors.

- Problem 2. Difficult to monitor the symptoms: For patients with severe hypertension, symptoms may occur during the day. It can be profitable for doctors to access the real-time data of their patients' health conditions.

- Problem 3. Difficult to check if the patient is having a controlled diet such as restrictions on electrolytes, cholesterol, alcohol, and caffeine intake: For patients, it is also beneficial to keep notes of their nutritional therapies.

- Problem 4. Difficult to monitor if severe hypertension patients have taken medication regularly. As some patients may skip or stop taking medication either intentional or unintentional, a medication tracker keeping track of consumption of medication helps to prevent under and over dosages.

- Problem 5. Difficult to monitor side effects of medication: Medicines may cause side effects to some patients. Doctors need to be informed of these side effects, so that another medicine can be prescribed.

- Problem 6. Difficult to monitor the progress of therapy, especially in the first month: Doctors need to evaluate treatment progress based on the therapy results, so that changes of medication type or instruction can be advised if necessary.

- Problem 7. Set a doctor appointment: For some patients, it is required to see the doctors regularly. It can be helpful to set doctor appointments and remind patients of the time.

Keep these in mind, functions of the telematic application are designed especially to solve these problems and improve the efficiency of the treatment process. Details of functions will be discussed in chapter five and six.

4 An Introduction to Didactics

A training course scenario about teaching end users how to use the telematic application will be discussed at the end of this paper. There are several didactic methods and didactic softwares used in the designing the course scenario, which will be first introduced in this chapter.

The first part gives a general introduction to the definition of didactics. The second part takes a peek at four didactic methods: e-Learning, Open Space Technology, Frontal Teaching, and Group Puzzle. Characteristics and implementing process of each method will be introduced. Part three presents two widely used software application assisting education, which are Moodle and Hot Potatoes.

4.1 Definitions of Didactics

Didactics is a sub-discipline of pedagogics. The word "didactics" comes from the Greek word "didáskein", which means lore of teaching. In general, didactics deals with the design of courses and the development of study skills, independently from the learning contents. Teaching and learning with specific contents are referred as *specialized didactics*.[75]

Didactic model is one of the integrated constructions of theorie to analyse and design didactic activity in schools and other education organisations. There are several aspects of didactic model: critical constrictive didactics, curricular didactics, learning relative teaching theoretical didactics, information theoretical cybernetic didactics, communicative didactics, subjective didactics, and constructivist didactics.[75]
With regard to German speaking publications, *constructivist didactics* - "Education and Constructivism" - focuses on formulating a new approach on the theoretical as well as practical levels. There are five dimensions used in constructivist didactics: support of self-determination, self-realization, self-assertion, self-reliance, and personal contribution.

4.2 Didactic Methods

Methodology is a sub-discipline of didactics, and regarded as a flexible educational process always in change. The quality of a specific methodology is appreciated by: aspect, dosage, combination of proceedings.

University of Cologne presents a list of constructive methods of didactics.[69]

- *Classical methods* include classes with frontal teaching/presentation, classes using question developing methods, individual work, pair work, and group work.
- *Activity oriented methods*, also "big methods": for example, anchored instruction, cognitive apprenticeship, E-learning, experiment, free work, portfolio, role play etc.
- *Small methods* comprise, for example, clustering, brainstorming, concept learning, memory, mind mapping, open space, dairy method, weekly plan, quiz etc.
- *Workmanship* includes computer workshop, workshop class, future workshop etc.
- *Democracy* contains communities of practice, students parliament, class council, small-sized democracy etc.
- *Learning arrangement*: contract method, junior company, learning island, effective students company etc.
- *Public relations* includes performance, exhibition, Internet presentation, class magazine etc.

Here are four didactic forms, which will be used in designing training course scenarios of teaching end users how to use the telematic application for chronic patients.

4.2.1 e-Learning

e-Learning using computer and networking technologies to enable students to learn independent from time and location becomes an important and growing market of pedagogics. e-Learning can include training, the delivery of just-in-time information and guidance from experts.[70]

There are different e-learning delivery methods designed to support different learning needs. Table 14 shows the four dimensions of technical methods of e-Learning.[69]

	Unidirectional	Bidirectional
Synchronous	Analysis and evaluation; Tracking; Group, teams and rolls; Cookies	Virtual Classroom; Audio/video conference; Application sharing; Chat
Asynchronous	Interactive learning unit; Form; Website	Wiki-web; Forum; eMail

Table 14. Technical methods of e-Learning
(Source: Konstruktiver Methodenpool, Universität Köln)

• *Synchronous Methods*

Synchronous means that two person use the methods at the same time. One of the examples from everyday life is the telephone.

• *Asynchronous Methods*

Asynchronous means that two person use the methods, but not occurring at the same time. To give an example of asynchronous technology, is the telephone answering machine.

• *Unidirectional Methods*

Unidirectional means that the information flow goes in one direction, considering no technical aspect, but pedagogical one.

• *Bidirectional Methods*

Bidirectional, or multidirectional means that there are two person control the two sides of the pipeline respectively, the information flow goes back and forth, each time only in one direction. For example, question and answer, action and reaction.

4.2.2 Open Space Technology

Open Space Technology (OST) was first designed by Harrison Owen, an organizational consultant, in the mid-1980s. He discovered that people attending his conferences prefer coffee breaks than the formal sessions. With the combination of his experience in an African village, he created this new conferencing form.

OST is a simple and powerful way to create inspired meetings and events, suitable for five to over two thousand participates. Unlike normal conferences, in OST conferences, there are no keynote speakers, pre-announced schedules, or panel discussions. Open Space conference is an chaotic, productive and interesting interactive process where participants will first sit in a large circle and create and manage their own agenda. Anyone who wants to start a discussion, can stand up with a big sheet of his/her theme and announces it to the group. OST provides the opportunity for participants to be each other's teachers and leaders. Participants then paste all the information about their themes and groups on a broad.

Open Space conferences can be held in one day, and can be powerful go on for two or three days. There are seven phases included in the process, when organising the conference within a week:[75]
  • *Moon Phase*: Give participates enough time to think over the theme and prepare the important relevant requests.

- *Mars Phase*: Each participate has a chance to introduce himself/herself, and briefly presents his/her requests.
- *Mercury Phase*: Discussions about the themes between participants are proceeded. Room organisation is eventually resolved.
- *Jupiter Phase*: Inspirations may be anticipated.
- *Venus Phase*: Mutual acceptance and acknowledgment between participants. It is a good opportunity for individuals to obtain new opinions.
- *Saturn Phase*: Summarize the results and post on the white board.
- *Sun Phase*: Review the whole process, make appointments, and establish acquaintanceship.

OST has been applied in thousands of meeting around the world, and provided powerful and satisfactory results.

4.2.3 Frontal Teaching

The frontal teaching activities are explained as:[61]

the teacher typically begins a lesson by reviewing prerequisite material, then introduces and develops new concepts or skills, then leads the group in a recitation or supervised practice or application activity, and then assigns seatwork or homework for students to do on their own.

Frontal teaching is so far one of the most used organisational forms of didactics, presented in forms of talking, lecturing, showing, demonstrating, explaining through illustration, writing seminar papers etc. Frontal teaching is a teacher-controlled organisational form, with which the teacher usually acts as a controller or assessor, claimed by Jeremy Harmer who has first defined frontal teaching as a grouping where the whole class is working together with the teacher.

There are four kinds of methods of teaching in a whole class, which are
- interacting with individual students,
- letting students work with one another,
- doing chorus work,
- and doing team work.[61]

Frontal teaching provides the opportunity for teachers to present specific skills and knowledges to a large group of learners at the same time. For students, frontal organisational form creates more engaging atmosphere, so that they are more likely to study and work together and share experiences.

However, one of the shortages of frontal teaching is the limitation of interaction between teacher and students, and the co-operation between students. Students have less opportunity to talk and practice. Besides, all the students are forced to do the same thing at the same time and at the same pace.[61]

4.2.4 Group Puzzle

Group Puzzle, also called Group-Expert-Rallye, or JigSaw Classroom, was first created by professor Aronson in 1971 in Texas in America.[64] It is a specific and supplemented didactics form of group work, which allows learners to gain new knowledges and teach the others at the same time.
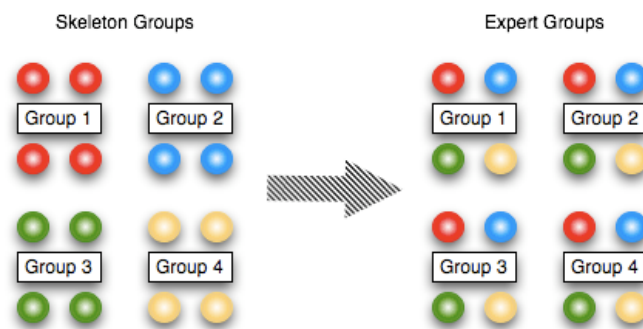
Figure 5. Implementation of Group Puzzle
(Source: Gruppenpuzzle in Kürze; Landesakademie Für Fortbildung und Personalentwicklung an Schulen)

Before starting, teachers should first divide the topic into several aspects (there are four in figure 5), and prepare information materials of each aspect. The steps of implementing Group Puzzle is as following:[62][63][64]

- *Step 1*: Divide the whole class into four groups, which are referred to as *skeleton groups*. Each group receives information materials on one of the four aspects of the topic.
- *Step 2*: Participants of the same group work through their own materials. Enough time should be given to make sure everyone has understood the material and become familiar with it.
- *Step 3*: Form *expert groups* by four participants being chosen from each skeleton group.
- *Step 4*: Each individual participant of each expert group explains the main point of his/her segment comprehensibly. In this way, all the participants are motivated to contribute to group work.
- *Step 5*: The participants return to their original skeleton groups. Each participant summarise the results of exchange in the expert groups. Encourage others to ask questions.

- *Step 6*: Evaluate the contextual results of the work and the result of the specific method.

Besides cognitive goals for learning, social skills are also required while applying this method. The outcomes of this method highly depend on the quality of the material prepared by the teacher.

4.3 Applications for Education

There are a lot softwares developed for supporting education, either for free or for purchasing. Moodle and Hot Potatoes are two of the most popular applications widely used today, and will be chosen to support the training courses later[3].

4.3.1 Moodle

Moodle is an Open Source software package supporting social constructionist framework of education. It assists online study process by producing Internet-based courses and websites, and provides space for online courses, where teachers and students can upload and download study materials and communicate with each others.

The application is today widely used by variety of people in different teaching situation, for example, universities, high schools, non-profit organisations, and private companies. One of the main advantage of Moodle is that although it is a computer-based application, it requires no knowledge of programming languages for customization.

Moodle can run on different operating systems, including Windows, Macintosh, and Linux. To install Moodle, the computer should support PHP and SQL type database such as MySQL.

Moodle provides users flexible array of activities to manage courses, which including [65]

- *Assignment Module*: Students can upload their assignments in any file format to the server. System automatically represents the date of update to the teacher. Feedback from teacher is appended to the assignment page of individual student.
- *Chat Module*: This module allow synchronous text communication between users, supporting URLs, smilies, embedded HTML, and images. Conversation history is logged for later viewing.
- *Choice Module*: Teacher can start a poll to either vote on something, or get feedback from students.

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[3] See Chapter 6.

- *Forum Module*: Forums are available in types such as teacher-only, course news, open-to-all, and one-thread-per-user. Subscription of individual forum is allowed, so that copies can be forwarded via email.
- *Glossary Module*: This module allows participants to create and maintain a list of definitions. Review of entries before publishing, and comment on glossary entries are possible. Modules of Moodle can be hyperlinked to word or phrase in the glossary.
- *Lesson Module*: A series of pages can be presented in a linear fashion allowing students choices through answers to teacher directed questions or descriptions. Progress bars and running score are presented to students. Question forms include multiple choice, multi-answer, true or false, numeric, short answer and essay.
- *Quiz Module*: Quiz can be created by teachers to evaluate the courses based on what the students have learnt. Different forms of questions are allowed, including multiple-choice, short answer, true or false, matching, random, numerical and cloze text. The results of the quizzes are automatically graded. Regrade is possible if questions are modified.
- *Resource Module*: Different types of electronic contents can be displayed on Moodle, including Word files, Flash, videos and sounds. Many operations can be realized such as zip, unzip, create folder, rename, move, etc. Both internal pages and external content are allowed.
- *Survey Module*: Built-in surveys can be started to analyse online classes. Reports are available in graphs, Excel spreadsheet and CSV text file.
- *Wiki Module*: Wiki pages are also allowed to support collaborative learning. Everyone can add and edit on the web page.
- *Workshop Module*: This module allows peer assessment of documents. Teacher can manage and grade the assessment, as well as provide sample documents for students.

4.3.2 Hot Potatoes

Hot Potatoes was created by the Research and Development team at the University of Victoria Humanities Computing and Media Centre. There is no knowledge of XHTML or JavaScript required to use the application. Users only need to enter their data such as texts, questions, and answers. Hot Potatoes then generates exercise web pages automatically for users to post on their own websites.

The exercise pages can be displayed by most modern browsers, including Internet Explorer 6+, Mozilla 1.2+, Phoenix, Safari, etc. Create exercises in different languages are

possible. Hot Potatoes can run on different operating systems, including Windows, Macintosh, and Linux.

Hot Potatoes suite has six authoring tools, which allows users to create web-based interactive multiple-choice, short-answer, jumbled-sentence, crossword, matching/ordering and gap-fill exercises. [76]

- *JQuiz* (Question-based exercises): JQuiz allows users to create four basic types of questions, which are multiple-choice questions, short-answer questions, hybrid questions, and multi-select questions. The answers from students will be automatically checked based on the specified correct answers.
- *JCloze* (Gap-fill exercises): JCloze allows users to create gap-fill or cloze exercises. Students can press the "check" button to mark the answers after all the questions have been finished. There are also "hint" and "clue" buttons available for students to use during the exercises.
- *JMatch* (Matching exercises): JMatch allows users to create matching exercises in two types: standard and drag-drop. Standard type is based on a drop-down list, usually used for less than eight items. For more than eight items, drag-drop is recommended.
- *JMix* (Jumble exercises): With JMix users can create jumble exercises in two output formats: standard and drag-drop. Users can either jumble the words in sentence, or the letters in a word.
- *JCross* (Crosswords): JCross is used to create crossword exercises.
- *Masher* (Building linked units of material): The Masher has two basic functions: create complete units of Hot Potatoes exercises, and upload non-Hot Potatoes file to the server.

5 Overall Description of Telematic Application for Chronic Patients (TACP)

This chapter provides an overview of the entire Software Requirements Specifications (SRS) document for the telematic application for chronic patients, TACP in short. In general, the purpose of this SRS document is to define software requirements instead of software design details.

This section does not state specific requirements. Instead, it provides a background for those requirements, which are defined in chapter 6, and makes them easier to understand. Purpose, product perspective including hardware interfaces, software interfaces, user interfaces, and communications interfaces, typical functions in general, as well as user characteristics are described in this chapter. Source code are not presented in this document.

5.1 Purpose

As the proportion of working population getting smaller, there will be a lack of qualified healthcare professionals to manage people with chronic conditions. Telematic application for chronic patients (TACP) is a tool based on the use of a range of communications technology to help hypertension patients and their carers to better model and unterstand the daily health data from home.

For patients, TACP let them be aware of their own clinical situations, so that they can follow correctly the proper treatment. For medical specialists, TACP provides the real-time health data of their patients, so that they can treat their patients accordingly. The main purpose is to help chronic patients to reach a better life quality as normal people by providing the opportunity of a high-quality care for hypertension patients to monitor their health conditions, collect real-time health data, and model activities of their daily living.

5.2 Product Perspective

Each aspect of TACP is discussed in this part, including hardware interfaces, software interfaces, user interfaces, and communications interfaces.

5.2.1 Hardware Interfaces

Mobile technology is now widely used in the world. TACP is designed as a mobile application that can be installed on a specific mobile device which can be one of the following features:

- *Cell phone*: For example, AT&T LG with Qualcomm 528 MHz processor, 128 MB RAM and 256 MB ROM, up to 32 GB expandable memory, and 3" touch screen.
- *PDA*: For example, ASUS A626 PDA with Marvell XScale 312 MHz processor, 128 MB ROM and 64 MB RAM, up to 4 GB expandable memory, and 3.5" touch screen.

These devices are chosen as they provide Internet access amongst its features. One of the main benefits of using portable mobile devices is that users can carry the devices with them and update their health data anytime and anywhere. It is also a cost-saving solution for users, as the price of a mobile device is much lower than a PC.

5.2.2 Software Interfaces

TACP runs under the system softwares Windows Mobile 5.0 or above versions for cell phone and PDA.

5.2.3 User Interfaces

The graphical user interfaces (GUI) are designed for mobile devices and with easy-to-use in mind, since most users have little experience with medical softwares. Most of the functionalities can be accessed via stylus pen or finger. Each function has its own view in the form of a panel. There will be a Sync button, with which users can synchronize all the health data to their doctors. Each function is described in detail in chapter 6.

5.2.4 Communications Interfaces

Figure 6 represents the communications interfaces of TACP.
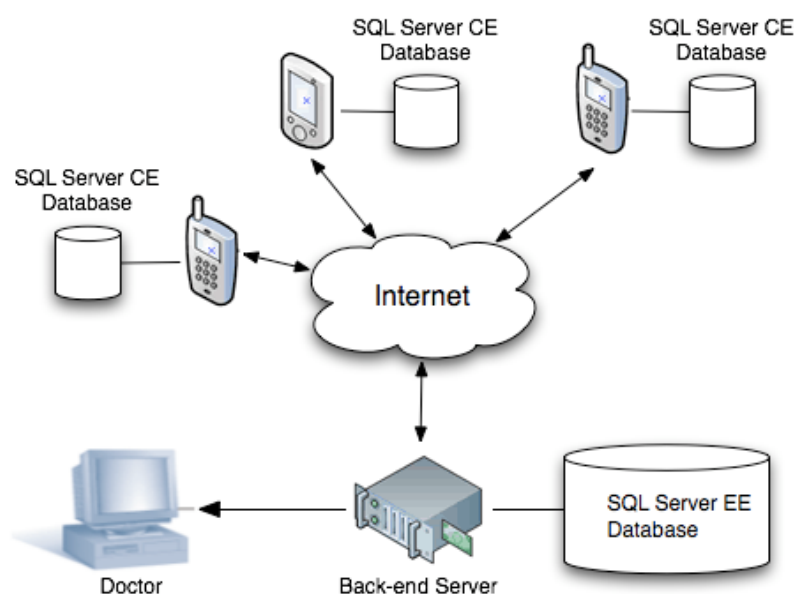
Figure 6. Communication Architecture

For the mobile devices, the data management software Microsoft SQL Server® 2005 Compact Edition will be installed, which requires 3 to 5 MB disk space. For the back-end server, Microsoft SQL Server® 2005 Enterprise Edition will be used to process and store data transported from the mobile devices. Data transmission is realized via Internet access.

The application utilizes the fat client technology, which means the application code sits on the client. TACP is installed on each client mobile device separately from the server. All data processing is done on the client, and the server merely serves as a data repository. The fat client technology provides users the flexibility to update their health data even when the mobile devices are disconnected to the server. By clicking on the Sync button when accessed to the Internet, all the data are exchanged to the server.

5.3 Product Functions

TACP helps patients with hypertension to record and monitor the data of their health status, medication use and treatment processes, which can be synchronized with their medical specialists regardless of time and geographical position. Main categories of functions of TACP including following aspects:

5.3.1 General Information

By creating a new account, data such as personal information and medical history are required. This, in particular, helps doctors to understand the risk factors of an individual patient who suffers from hypertension, so that specific treatment can be provided accordingly.

5.3.2 Symptoms Monitor

Although hypertension generally causes few symptoms, for some patients with severe hypertension, headaches in the morning, dizziness, and nosebleeds may still occur. It would be difficult for doctors to collect such information from their patients. With the help of TACP, patients can update their symptoms (if occurred) everyday, and transmit all the data to their doctors. Furthermore, this function would also be beneficial for doctors to evaluate the progress within the first month of therapy.

5.3.3 Diagnosis Results

The examination process for hypertension probably generates plenty of
check results. In order to avoid unnecessary recheck and data redundancy, all the examination results can be stored and updated in TACP by both patients and doctors.

5.3.4 Diet Control

For hypertension patients, a healthy diet is an essential part in the treatment process. There are strict constraints about the daily amount of sodium and cholesterol intake. Most of the patients, however, are not aware of how much they should have and they have had every day. TACP calculates daily amount of electrolytes and cholesterol intake based on the food and drink that the patients have had, and provides a curve chart or a table for comparison.

5.3.5 Lifestyle Monitor

Change lifestyle is another primary part of the hypertension treatment process. Physical activity is important for hypertension patients, which can also be harmful if exercising too much. TACP helps patients to be conscious of the amount of energy they have burned by calculate the MET-minutes from their activities. It also calculates the BMI from weight and height and analyse risk class according to BMI and WC to help patients to control their weight. Furthermore, monitor daily tobacco, alcohol, caffeine use, and emotional state are also included to let doctors be informed of their patients' health status.

5.3.6 Medication Control

It can be dangerous for hypertension patients to skip or stop taking pills by themselves. However, a large number of hypertension patients are in old age, who can forget to take pills easily. TACP can be used to monitor patients daily medication use according to the instruction from doctors.

5.3.7 Doctor Appointment Reminder

Although it is necessary for hypertension patients to visit doctors and repeat some of the examination process regularly, some of the patients still forget or ignore the importance re-checkup. Doctor appointments reminder reminds patients of the appointment time, and reduces the risk of developing further unnecessary symptoms.

5.4 User Classes and Characteristics

The main target user group of TACP are people suffering from hypertension, who are usually in middle or old age. These people have varying degrees of computing skills. A large number of them probably have little or even none experience of using a mobile application. The group may also have different educational and working backgrounds. Some works in a office environment, others can be manual workers. Medical staffs can also be a small part of the user group. The majority, however, are non-medical specialists, and have little or none knowledge of home care.

The carers and relatives of the patients are also considered as a part of the user group.

6 Specific Requirements

This section contains all the software requirements at a level of detail sufficient to enable software designers to develop a system to satisfy those requirements, and software testers to test that the system meets those requirements. In this chapter, all the functions are described by showing a list of technical Use-Case, including a description of input value to the system and output values from the system, and all functions performed by the system in response to an input or support of an output.

6.1 Functions and Technical Use Case Diagrams

Use-Case is the description of functional requirements of a software system, presenting external performance of the system from the perspective of users. An actor can be a person or another system interacting with the main system. Use-Case draws an outline of the system reactions and summarize services provided by the system. Use-Case model is consisted of Use-Cases and actors, which describes following information:

- what the system can do;
- who is the actor(s) of the system;
- how does the system response according to user's performance.

For customers, Use-Case model shows the expected functions of the software based on their requirements. On the other hand, Use-Case model helps software developers to better understand the concept of the software, and to prepare for designing software test model.

The description of Use-Cases including a list of key elements:[73][74]

- *Use Case*: Each Use-Case has a short name showing its purpose. An active verb phrase is usually used.
- *ID*: Each Use-Case has a unique numeric identifier.
- *Description*: This field displays a short description of the main purpose of a specific Use-Case.
- *Actor*: All the actors who have involved in the Use-Case and have the interest in the outcomes should be listed in this field. There are two kinds of actors - primary and secondary, which means one having an aim requiring the support of the system and one from which the system needs support to satisfy its aim respectively.
- *Trigger*: Trigger describes the action or event which starts the Use-Case.
- *Pre Conditions*: The Use-Case can only be executed when all the conditions are true.
- *Execution*: Here lists the workflow of events to successfully meet the goal. Each step of the interaction between actors and the system is described in de-

tail, including actions of actors, and system responses. Each step has a sequence number. Conditions of execution of one or more steps can be indicated by IF-THEN-ELSE programming language. REPEAT-UNTIL can be used to describe repeated executions.

- *Success End Conditions*: Here is the successful end condition after all the steps of interaction have been executed.
- *Failure End Conditions*: Here is the failure end condition, which also means the goal of actors has not been satisfied.
- *Variations*: Some steps may have different selections of data entry or technology.
- *Error Handling*: This field describes possible errors may be occurred when executing each step.
- *Referring Use Cases*: Here states reference Use-Cases.

All the functions are described in this part with a number of use case diagrams. Table 15 is the summary of all use cases with their ID and chapter number.

Use Case Name	ID	Chpt.
Create_Account	UC01_AM_01	6.1.1.1
Login_Account	UC01_AM_02	6.1.1.2
Logout_Account	UC01_AM_03	6.1.1.3
Delete_Account	UC01_AM_04	6.1.1.4
Select_Application	UC02_SA_01	6.1.2.1
Edit_Personal_Data	UC03_PDA_01	6.1.3.1
Edit_General_Information	UC03_PDA_02 **extends** UC03_PDA_01	6.1.3.2
Edit_Medical_History	UC03_PDA_03 **extends** UC03_PDA_01	6.1.3.3
Personal_Data_View_Summary	UC03_PDA_04	6.1.3.4
Edit_Diagnosis_Process	UC04_HDR_01	6.1.4.1
Diagnosis_View_Summary	UC04_HDR_02	6.1.4.2
Edit_Medication	UC05_MC_01	6.1.5.1

Use Case Name	ID	Chpt.
Medication_Set_Reminder	UC05_MC_02 **ref. to** UC05_MC_01	6.1.5.2
Control_Medication_Intake	UC05_MC_03	6.1.5.3
Medication_View_Statistics	UC05_MC_04	6.1.5.4
Edit_Daily_Health_Condition	UC06_DHC_01	6.1.6.1
Edit_Symptoms	UC06_DHC_02 **extends** UC06_DHC_01	6.1.6.2
Edit_Nutrition	UC06_DHC_03 **extends** UC06_DHC_01	6.1.6.3
Edit_Physical_Activity	UC06_DHC_04 **extends** UC06_DHC_01	6.1.6.4
Edit_Tobacco_Use	UC06_DHC_05 **extends** UC06_DHC_01	6.1.6.5
Edit_Alcohol_Use	UC06_DHC_06 **extends** UC06_DHC_01	6.1.6.6
Edit_Caffeine_Intake	UC06_DHC_07 **extends** UC06_DHC_01	6.1.6.7
Edit_Stress	UC06_DHC_08 **extends** UC06_DHC_01	6.1.6.8
Edit_Weight	UC06_DHC_09 **extends** UC06_DHC_01	6.1.6.9
Health_Condition_View _Statistics	UC06_DHC_10	6.1.6.10
Edit_Appointment	UC07_DAR_01	6.1.7.1
Appointment_Set_Reminder	UC07_DAR_02 **ref. to** UC07_DAR_01	6.1.7.2
View_Appointment_List	UC07_DAR_03	6.1.7.3
Synchronize_Data	UC08_SYN_01	6.1.8.1

Table 15. Use Case Summary

6.1.1 Accounts Management

This part describes use cases involving Create_Account, Loging_Account, Logout_Account and Delete_Account.
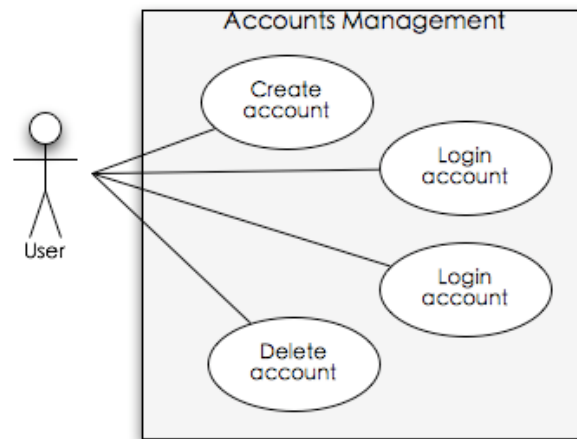
Figure 7. Use Case Diagram of Accounts Management

6.1.1.1 Create Account

The following table presents a list of key elements of the use case Create_Account, which allows the end user to create a new account for managing information of an individual hypertension patient.

Use Case	Create_Account
ID	UC01_AM_01
Description	This use case creates a new account for the first time the user launches the application, or add another (or more) account afterwards.
Actor	Application user.
Trigger	The user clicks on the "Create a new account" button.
Pre Conditions	-

Execution	1) User requests to create a new account.
	2) System confirms from user.
	3) IF User answers "Yes"
	    3.1) System creates a new account.
	  ELSE
	    3.2) System does nothing.

Success End Conditions	A new account has been created.
Failure End Conditions	-
Variations	-

Use Case	Create_Account
Error Handling	-
References	-
Referring Use Cases	-
Notes	TACP allows users to create one or more accounts on one device, in case of such situation: an old couple hires a carer for home care, and the carer uses a PDA to update the daily health data of both.

Figure 16. Use Case - Create Account

6.1.1.2 Login Account

The following table presents a list of key elements of the use case Login_Account. The system demonstrates a catalog involving all the existing accounts, from which the user selects to login.

Use Case	Login_Account
ID	UC01_AM_02
Description	User logs into an account to read or update health data.
Actor	Application user.
Trigger	The user clicks on the name of the account.
Pre Conditions	At least one account exists.
Execution	1)User requests system to login to an account. 2)System logs into the account.
Success End Conditions	System provides user a list of buttons for further actions.
Failure End Conditions	-
Variations	-
Error Handling	-
References	-
Referring Use Cases	-

Use Case	Login_Account
Notes	-

Figure 17. Use Case - Login Account

6.1.1.2 Logout Account

The following table presents a list of key elements of the use case Logout_Account. The system asks the user to confirm before logs out.

Use Case	Logout_Account
ID	UC01_AM_03
Description	User logs out when finishing reading or updating health data.
Actor	Application user.
Trigger	The user clicks on the "logout" button.
Pre Conditions	User has logged into the account.
Execution	1)User requests to logout. 2)System confirms from user. 3)IF User answers "Yes" 3.1) System logs out and closes the current screen. ELSE 3.2) System does nothing.
Success End Conditions	System logs out and closes the current screen.
Failure End Conditions	-
Variations	-
Error Handling	-
References	-
Referring Use Cases	-
Notes	-

*Figure 18. Use Case - Logout Account*

6.1.1.4 Delete Account

The following table presents a list of key elements of the use case Delete_Account, which allows the user to delete a certain account.

Use Case	Delete_Account
ID	UC01_AM_04
Description	User delete an account
Actor	Application user.
Trigger	The user clicks on the "delete" button.
Pre Conditions	At least one account exists.

Execution	1)User requests system to delete an account.
	2)System confirms from user.
	3)IF User answers "Yes"
	    3.1) System deletes the account.
	  ELSE
	    3.2) System does nothing.

Success End Conditions	System provides user a list of accounts for further actions.
Failure End Conditions	-
Variations	-
Error Handling	-
References	-
Referring Use Cases	-
Notes	-

Figure 19. Use Case - Delete Account

6.1.2 Select Application

This part describes use case Select_Application, which launches after user logged into an account.
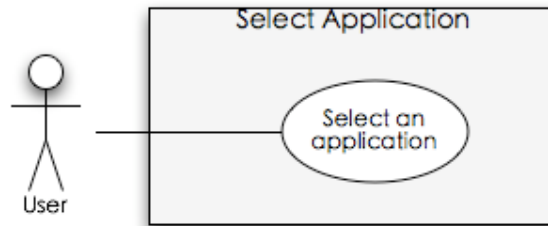
*Figure 8. Use Case Diagram of Select Application*

6.1.2.1 Select Application

The following table presents a list of key elements of the use case Select_Application. The system presents a catalog of all possible applications after the user logged into the account. The user select one from the catalog for further operation.

Use Case	Select_Application
ID	UC02_SA_01
Description	User selects one application from the application list for further operation.
Actor	Application user.
Trigger	The user clicks on the name of the application.
Pre Conditions	User has logged into the account.
Execution	1)User requests to further operate an application by clicking on the name of this application. 2)System accesses to this application.
Success End Conditions	System provides user further actions of the selected application.
Failure End Conditions	-
Variations	-
Error Handling	-
References	-
Referring Use Cases	-
Notes	See 6.2.1 Application List.

Figure 20. Use Case - Select Application

6.1.3 Personal Data Arrangement

This part describes use cases involving Edit_Personal_Data and Personal_Data_View_Summary.
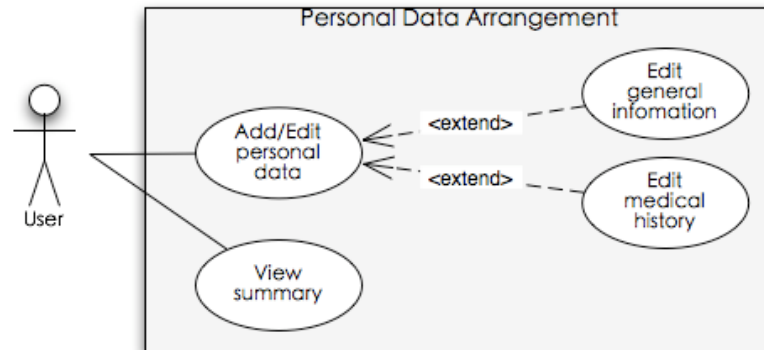
Figure 9. Use Case Diagram of Personal Data Arrangement

6.1.3.1 Add/Edit Personal Data

The following table presents a list of key elements of the use case Edit_Personal_Data. The system requires personal data of a specific hypertension patient, for example, general information and medical history. This use case allows the user to add/edit all these data.

Use Case	Edit_Personal_Data
ID	UC03_PDA_01
Description	User adds/edits general information and medical history.
Actor	Application user.
Trigger	The user clicks on the "Add/Edit Personal Data" button.
Pre Conditions	User has logged into the account.

Use Case	Edit_Personal_Data

Execution	1) REPEAT
	      1.1) User edits an input field.
	     IF Add records allowed
	        REPEAT
	           1.1.1) User clicks on "Add" button.
	           1.1.2) User edits input fields.
	        UNTIL No more click on "Add" button.
	     ELSE
	        GOTO 1)
	   UNTIL User clicks on "Save" button.
	2)System saves all the information.

Success End Conditions	Input data saved.
Failure End Conditions	One or more input data cannot be saved.

Variations	#1. User may type short texts in the input fields OR
	    select from drop-down lists OR
	    select from radio boxes OR
	    select from check boxes.

Error Handling	Incorrect input value.
References	Chapter 3.2.2 Table 7
Referring Use Cases	-
Notes	This use case has two sub use cases.

Figure 21. Use Case - Edit Personal Data

6.1.3.2 Add/Edit General Information

The following use case Edit_General_Information is an extension to use case Edit_Personal_Data (see 6.1.3.1). This use case adds/edits general information of a specific hypertension patient.

Use Case	Edit_General_Information
ID	UC03_PDA_02
Use Case Extension	UC03_PDA_01
Description	User adds/edits general information.
Execution Change	-

Use Case	Edit_General_Information
Reference	Chapter 3.2.2 Table 7
Notes	See required input data of General Information 6.2.2.

Figure 22. Use Case - Edit General Information

6.1.3.3 Add/Edit Medical History

The following use case Edit_Medical_History is an extension to use case Edit_Personal_Data (see 6.1.3.1). This use case adds/edits medical history of a specific hypertension patient.

Use Case	Edit_Medical_History
ID	UC03_PDA_03
Use Case Extension	UC03_PDA_01
Description	User adds/edits medical history.
Execution Change	-
Reference	Chapter 3.2.2 Table 7
Notes	See required input data of Medical History 6.2.3.

Figure 23. Use Case - Edit Medical History

6.1.3.4 View Summary

The following table presents a list of key elements of the use case Personal_Data_View_Summary. The use case provides an overview of all information of a specific patient on demand from the user.

Use Case	Personal_Data_View_Summary
ID	UC03_PDA_04
Description	User views the summary of general information and medical history.
Actor	Application user.
Trigger	The user clicks on the "View Summary" button.
Pre Conditions	User has logged into the account.

Use Case	Personal_Data_View_Summary
Execution	1)User requests to view the summary. 2)System provides summary to user.
Success End Conditions	Data summary provided to user.
Failure End Conditions	-
Variations	-
Error Handling	-
References	UC02_PDA_01
Referring Use Cases	-
Notes	-

Figure 24. Use Case - Personal Data View Summary

6.1.4 Hypertension Diagnosis Results

This part describes use cases involving Edit_Diagnosis_Process and Diagnosis_View_Summary.
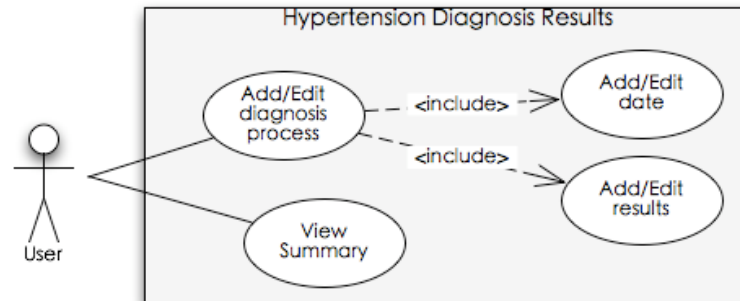
Figure 10. Use Case Diagram of Hypertension Diagnosis Results

6.1.4.1 Add/Edit Diagnosis Process

The following table presents a list of key elements of the use case Edit_Diagnosis_Process. The user adds/edits the results of each components of diagnosis process including name and date of diagnosis to the system. Further update is possible.

Use Case	Edit_Diagnosis_Process
ID	UC04_HDR_01
Description	User inputs the results of each components of diagnosis process.

Use Case	Edit_Diagnosis_Process
Actor	Application user.
Trigger	The user clicks on the "Add/Edit Personal Data" button.
Pre Conditions	User has logged into the account.

Execution	1) REPEAT
	        1.1) User edits an input field.
	    UNTIL User clicks on "Save" button.
	2)System saves all the information.

Success End Conditions	Input data saved.
Failure End Conditions	One or more input data cannot be saved.
Variations	#1. User may type short texts in the input fields OR select from drop-down lists.
Error Handling	Incorrect input value.
References	Chapter 3.2.4
Referring Use Cases	-
Notes	See required input data of Diagnosis Results 6.2.4.

Figure 25. Use Case - Edit Diagnosis Process

6.1.4.2 View Summary

The following table presents a list of key elements of the use case Diagnosis_Results_View_Summary. The use case provides an overview of all components of diagnosis process on demand from the user.

Use Case	Diagnosis_Results_View_Summary
ID	UC04_HDR_02
Description	User views the summary of all the diagnosis results.
Actor	Application user.
Trigger	The user clicks on the "View Summary" button.
Pre Conditions	User has logged into the account.

Use Case	Diagnosis_Results_View_Summary
Execution	1)User requests to view the summary of diagnosis results. 2)System provides summary to user.
Success End Conditions	Data summary provided to user.
Failure End Conditions	-
Variations	-
Error Handling	-
References	UC04_HDR_01
Referring Use Cases	-
Notes	-

Figure 26. Use Case - Diagnosis Results View Summary

6.1.5 Medication Control

This part describes use cases involving Edit_Medication, Medication_Set_Reminder, Control_Medication_Intake and Medication_View_Statistics.
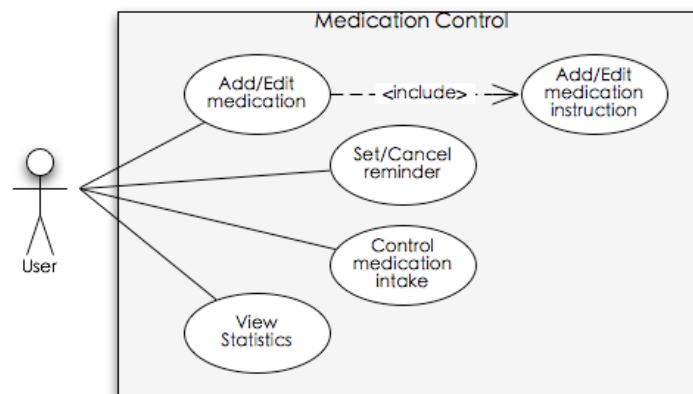
Figure 11. Use Case Diagram of Medication Control

6.1.5.1 Add/Edit Medication

The following table presents a list of key elements of the use case Edit_Medication, which requires medication information for the user, involving medication name and instruction.

Use Case	Edit_Medication
ID	UC05_MC_01
Description	User adds/edits medication information such as name and instruction.
Actor	Application user.
Trigger	User clicks on the "Add/Edit Medication" Button.
Pre Conditions	User has logged into the account.

Execution	1) REPEAT
	      1.1) User edits an input field.
	   UNTIL User clicks on "Save" button.
	2) System saves all the information.

Success End Conditions	Medication information saved.
Failure End Conditions	One or more input data cannot be saved.

Variations	#1. User may type short texts in the input fields OR
	    select from drop-down lists OR
	    select from radio boxes OR
	    select from check boxes.

Error Handling	Incorrect input value.
References	Chapter 3.2.5.3
Referring Use Cases	-
Notes	See required information of Medication 6.2.5.

Figure 27. Use Case - Edit Medication

6.1.5.2 Set/Cancel Reminder

The following table presents a list of key elements of the use case Medication_Set_Reminder. In case that patients may forget to take medication, this use case sets alarm according to the medication instruction to remind patients of the time to take medication. Cancel alarm is also possible based on users needs.

Use Case	Medication_Set_Reminder
ID	UC05_MC_02

Use Case	Medication_Set_Reminder
Description	This use case sets alarm to remind patient to take medicine, and cancels alarm if unnecessary.
Actor	Application actor.
Trigger	User clicks on the check box "Set Reminder".
Pre Conditions	User has logged into the account. User has input the time to take medicine.

Execution	1) User clicks on the check box.
	IF checked = TRUE
	   2.1) System sets the reminder active.
	ELSE IF checked = FALSE
	   2.2) System cancels the reminder.
	3)User clicks on the "Save" button.
	4)System saves the setting.

Success End Conditions	Reminder is set active. OR Reminder is cancelled.
Failure End Conditions	Set reminder failed.
Variations	-
Error Handling	Input value "time" not available.
References	-
Referring Use Cases	UC05_MC_01
Notes	

Figure 28. Use Case - Medication Set Reminder

6.1.5.3 Control Medication Intake

The following table presents a list of key elements of the use case Control_Medication_Intake. The system controls the medication intake of the patient by presenting check boxes, with which the user notifies the system after the medications were taken.

Use Case	Control_Medication_Intake
ID	UC05_MC_03

Use Case	Control_Medication_Intake
Description	User checks on the "Taken" check box, after the patient took the medicine. System saves the results and generates statistics.
Actor	Application user.
Trigger	User checks on the "Taken" check box.
Pre Conditions	User has logged into the account. User has input the medicine name, dosage, time, start date and end date of taking medicine.
Execution	1) System presents one or more medication names with dosage and time to take the medicine. Each with a "Taken" check box beside. 2) REPEAT 2.1) User checks/unchecks the "Taken" check box, after the patient took the medicine. UNTIL User clicks "Save" button. 3) System saves the results. 4) System generates statistics of medication intake.
Success End Conditions	All the results saved.
Failure End Conditions	-
Variations	-
Error Handling	-
References	UC05_MC_01
Referring Use Cases	-
Notes	This user case helps patients to control medication intake, prevent from medicine skip or medicine retake.

*Figure 29. Use Case - Control Medication Intake*

6.1.5.4 View Statistics

The following table presents a list of key elements of the use case Medication_View_Summary. The use case analyses the information of medication intake, and presents statistics in form of table, chart, or line graph on demand from the user.

Use Case	Medication_View_Statistics
ID	UC05_MC_04
Description	This user case presents statistics of medication intake.
Actor	Application actor.
Trigger	User clicks on "Statistics" button.
Pre Conditions	User has logged into the account.
Execution	1) User requests to view statistics of medication intake. 2) System provides statistics in form of daily, weekly, monthly, and annual.
Success End Conditions	Statistics presented.
Failure End Conditions	-

Variations	#1. Statistics may be in form of table OR
	    chart OR
	    line graph.

Error Handling	-
References	UC05_MC_01
Referring Use Cases	-
Notes	-

Figure 30. Use Case - Medication View Statistics

6.1.6 Daily Health Condition

This part describes use cases Edit_Daily_Health_Condition and Health_Condition_View_Statistics. Following perspects of information are included in health condion tracker: symtoms, nutrition intake, physical acitivity, tobacco use, alcohol use, caffeine intake, stress and weight.
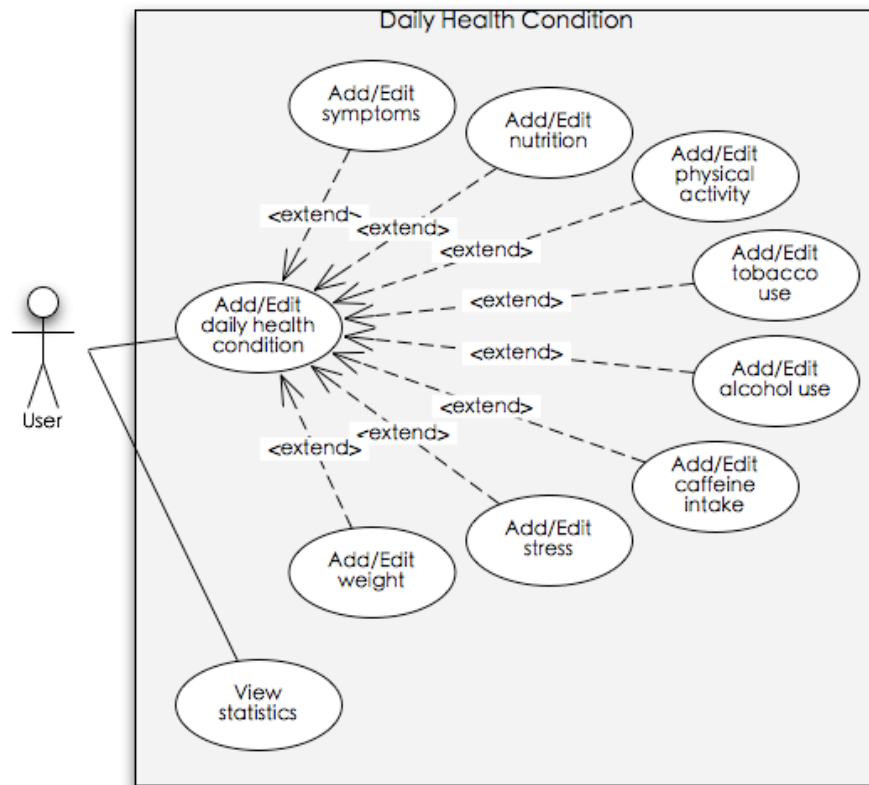
Figure 12. Use Case Diagram of Daily Health Condition

6.1.6.1 Add/Edit Daily Health Condition

The following table presents a list of key elements of the use case Edit_Daily_Health_Condition. The system requires daily health data of a specific hypertension patient, for example, symptoms and nutrition intake. This use case allows the user to add/edit all these data.

Use Case	Edit_Daily_Health_Condition
ID	UC06_DHC_01
Description	User adds/edits daily health conditions.
Actor	Application user.
Trigger	The user chooses the application "Daily Health Condition".
Pre Conditions	User has logged into the account.

Use Case	Edit_Daily_Health_Condition

Execution	1) System presents a calendar to user.
	2) User chooses a day.
	3) System requires health data from user.
	4) REPEAT
	    4.1) User edits an input field.
	    IF Add records allowed
	        REPEAT
	            4.1.1) User clicks on "Add" button.
	            4.1.2) User edits input fields.
	        UNTIL User clicks on "Save" button.
	    ELSE
	        GOTO 4)
	    UNTIL User clicks on "Save" button.
	5) System saves all the information, and generates statistics.

Success End Conditions	Input data saved, statistics generated.
Failure End Conditions	One or more input data cannot be saved.

Variations	#1. User may type short texts in the input fields OR
	    select from drop-down lists OR
	    select from radio boxes OR
	    select from check boxes.
	#2. User may click on a date from calendar OR
	    clicks on button "Today".

Error Handling	Incorrect input value.
References	-
Referring Use Cases	-
Notes	This use case has eight sub use cases.

Figure 31. Use Case - Edit Daily Health Condition

6.1.6.2 Add/Edit Symptoms

The following use case Edit_Symptoms is an extension to use case Edit_Daily_Health_Condition (see 6.1.6.1). This use case adds/edits symptoms (if occur) of a specific hypertension patient.

Use Case	Edit_Symptoms
ID	UC06_DHC_02

Use Case	Edit_Symptoms
Use Case Extension	UC06_DHC_01
Description	User updates symptoms if occurs.
Execution Change	-
Reference	Chapter 3.2.3
Notes	See Possible Symptoms 6.2.6.

Figure 32. Use Case - Edit Symptoms

6.1.6.3 Add/Edit Nutrition

The following use case Edit_Nutrition is an extension to use case Edit_Daily_Health_Condition (see 6.1.6.1). The user adds/edits daily diet of a specific hypertension patient. The system analyses the amount of nutrition intake and compares the results with objective amount.

Use Case	Edit_Nutrition
ID	UC06_DHC_03
Use Case Extension	UC06_DHC_01
Description	User updates daily diet. System generates the amount of sodium, potassium, calcium, and magnesium intake, and compares to the objective amount.

Execution Change	# 5) System saves all the input data.
	    System generates the results of the amount of
	    nutrition intake.
	    System compares the results with objective amount.
	    System generates statistics.

Reference	Chapter 3.2.5.1
Notes	See Objective Daily Amount of Electrolytes, and Food/Drink List 6.2.7.

Figure 33. Use Case - Edit Nutrition

6.1.6.4 Add/Edit Physical Activity

The following use case Edit_Physical Activity is an extension to use case Edit_Daily_Health_Condition (see 6.1.6.1). The user adds/edits daily physical activities including types and durations of activities of a specific hypertension patient. The system analyses the amount of energy burnt and compares the results with objective amount.

Use Case	Edit_Physical Activity
ID	UC06_DHC_04
Use Case Extension	UC06_DHC_01
Description	User updates daily physical activities. System generates the amount of energy, and compares to the objective amount.

Execution Change	# 5) System saves all the input data.
	        System generates the results of the amount of
	        energy burned.
	        System compares the results with objective amount.
	        System generates statistics.

Reference	Chapter 3.2.5.2
Notes	See Objective Amount of Energy, and Activities List 6.2.8.

Figure 34. Use Case - Edit Physical Activity

6.1.6.5 Add/Edit Tobacco Use

The following use case Edit_Tobacco_Use is an extension to use case Edit_Daily_Health_Condition (see 6.1.6.1). This use case adds/edits the forms and amount of tobacco use of a specific hypertension patient.

Use Case	Edit_Tobacco_Use
ID	UC06_DHC_05
Use Case Extension	UC06_DHC_01
Description	User updates the forms and amount of tobacco use.
Execution Change	-

Use Case	Edit_Tobacco_Use
Reference	Chapter 3.2.5.2
Notes	See Tobacco Form 6.2.9.

Figure 35. Use Case - Edit Tobacco Use

6.1.6.6 Add/Edit Alcohol Use

The following use case Edit_Alcohol_Use is an extension to use case Edit_Daily_Health_Condition (see 6.1.6.1). This use case adds/edits the types, vol-percent and amount of alcohol drink consumed by a specific hypertension patient. The system generates the amount of alcohol intake and compares the results with the maximal amount of alcohol intake.

Use Case	Edit_Alcohol_Use
ID	UC06_DHC_06
Use Case Extension	UC06_DHC_01
Description	User updates the name, vol-percent, amount of alcohol drink. System generates the statistics.
Execution Change	# 5) System saves all the input data. System generates the amount of alcohol intake. System compares the results with the maximal alcohol intake amount. System generates statistics.
Reference	Chapter 3.2.5.2
Notes	See Maximal Amount of Daily Alcohol Intake 6.2.10.

Figure 36. Use Case - Edit Alcohol Use

6.1.6.7 Add/Edit Caffeine Intake

The following use case Edit_Caffeine_Intake is an extension to use case Edit_Daily_Health_Condition (see 6.1.6.1). This use case adds/edits the types and amount of caffeine drink/food consumed by a specific hypertension patient. The system generates the amount of caffeine intake and compares the results with the maximal amount of caffeine intake.

Use Case	Edit_Caffeine_Intake
ID	UC06_DHC_07
Use Case Extension	UC06_DHC_01
Description	User updates the name, types, amount of caffeine drink/food. System generates the statistics.

Execution Change	# 5) System saves all the input data.
	        System generates the amount of caffeine intake.
	        System compares the results with the maximal caffeine intake amount.
	        System generates statistics.

Reference	Chapter 3.2.5.2
Notes	See Maximal Amount of Daily Caffeine Intake, and Caffeine Drink/Food List 6.2.11.

Figure 37. Use Case - Edit Caffeine Intake

6.1.6.8 Add/Edit Stress

The following use case Edit_Caffeine_Intake is an extension to use case Edit_Daily_Health_Condition (see 6.1.6.1). The system monitors the stress of the patient by demonstrating five radio buttons with numbers from 1 to 5, which indicates least stressful to most stressful. The user chooses one of the five numbers to measure the stress of the patient.

Use Case	Edit_Stress
ID	UC06_DHC_08
Use Case Extension	UC06_DHC_01
Description	User update daily stress status. System generates statistics.
Execution Change	-
Reference	Chapter 3.2.5.2
Notes	Mood status is displayed as numbers from 1 to 5, which indicates least stressful to most stressful.

Figure 38. Use Case - Edit Stress

6.1.6.9 Add/Edit Weight

The following use case Edit_Weight is an extension to use case Edit_Daily_Health_Condition (see 6.1.6.1). This use case adds/edits height, weight and waist circumference of a specific hypertension patient. The system generates BMI and analyses the risk classification of the patient.

Use Case	Edit_Weight
ID	UC06_DHC_09
Use Case Extension	UC06_DHC_01
Description	User input height, weight, and waist circumference (WC). System generates BMI and identifies the risk classification.

Execution Change	# 5) System saves all the input data.
	     System generates BMI.
	     System identifies the risk classification based on
	     BMI and WC.
	     System generates statistics.

Reference	Chapter 3.2.5.2
Notes	See Risk Classification 6.2.12.

Figure 39. Use Case - Edit Weight

6.1.6.10 View Statistics

The following table presents a list of key elements of the use case Health_Condition_View_Summary. The use case analyses the health condition of the patient, and presents daily, weekly, monthly, or annual statistics in form of table, chart, or line graph on demand from the user.

Use Case	Health_Condition_View_Statistics
ID	UC06_DHC_10
Description	This user case presents statistics of medication intake.
Actor	Application actor.
Trigger	User chooses a statistics types.

Use Case	Health_Condition_View_Statistics
Pre Conditions	User has logged into the account.
Execution	1) User chooses one of the statistics types to view statistics of health condition. 2) System provides statistics of eight components.
Success End Conditions	Statistics presented.
Failure End Conditions	-
Variations	#1. Statistics may be in form of table OR chart OR line graph. #2. Statistics types can be daily OR weekly OR monthly OR annual.
Error Handling	-
References	UC06_DHC_01
Referring Use Cases	-
Notes	-

Figure 40. Use Case - Health Condition View Statistics

6.1.7 Doctor Appointment Reminder

This part describes use cases involving Edit_Appointment, Appointment_Set_Reminder and View_Appointment_List.
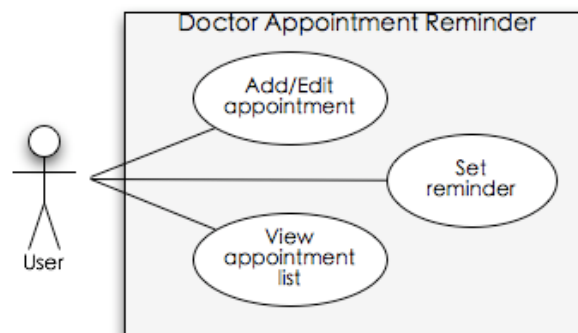
Figure 13. Use Case Diagram of Doctor Appointment Reminder

6.1.7.1 Add/Edit Appointment

The following table presents a list of key elements of the use case Edit_Appointment, which allows the user to keep a note of doctor appointments.

Use Case	Edit_Appointment
ID	UC07_DAR_01
Description	User adds/edits doctor appointment.
Actor	Application user.
Trigger	User chooses the application "Doctor Appointment Reminder".
Pre Conditions	User has logged into the account.

Execution	1) System presents a calendar to user.
	2) User chooses a day.
	3) System requires appointment information from user.
	4) REPEAT
	    4.1) User edits an input field.
	  UNTIL User clicks on "Save" button.
	5) System saves all the input data, and mark this date in red in the calendar.

Success End Conditions	Input data saved.
Failure End Conditions	One or more input data cannot be saved.
Variations	#1. User chooses a day from calendar OR chooses a record from the appointment list to edit.
Error Handling	Input incorrect.
References	-
Referring Use Cases	-
Notes	See required data of Add Appointment 6.2.13.

Figure 41. Use Case - Edit Appointment

6.1.7.2 Set Reminder

The following table presents a list of key elements of the use case Appointment_Set_Reminder. In case that patients may forget their doctor appointments, this use

case sets alarm according to the pre-entered appointments to remind patients of the time to see the doctors. Cancel alarm is also possible based on users needs.

Use Case	Appointment_Set_Reminder
ID	UC07_DAR_02
Description	This use case sets alarm to remind patient of the doctor appointment, and cancels alarm if unnecessary.
Actor	Application actor.
Trigger	User clicks on the check box "Set Reminder".
Pre Conditions	User has logged into the account. User has input the time to visit doctor.
Execution	1) User clicks on the check box. 2) IF checked = TRUE 2.1) System sets the reminder active. ELSE IF checked = FALSE 2.2) System cancels the reminder. 3)User clicks on "Save" button. 4)Systems saves the setting.
Success End Conditions	Reminder is set active. OR Reminder is cancelled.
Failure End Conditions	Set reminder failed.
Variations	-
Error Handling	Input value "time" not available.
References	-
Referring Use Cases	UC07_DAR_01
Notes	-

Figure 42. Use Case - Appointment Set Reminder

6.1.7.3 View Appointment List

The following table presents a list of key elements of the use case View_Appointment_List. The use case provides an overview of all doctor appointments of a specific patient.

Use Case	View_Appointment_List
ID	UC07_DAR_03
Description	This user case presents all the appointments in a list.
Actor	Application actor.
Trigger	User clicks on "Appointment List" button.
Pre Conditions	User has logged into the account.
Execution	1) User requests to view the doctor appointment list. 2) System provides the appointment list to user.
Success End Conditions	Appointment list presented.
Failure End Conditions	-
Variations	-
Error Handling	-
References	UC07_DAR_01
Referring Use Cases	-
Notes	-

Figure 43. Use Case - View Appointment List

6.1.8 Synchronization

This part describes use case Synchronize_Data, which allows users to transfer information to the server.
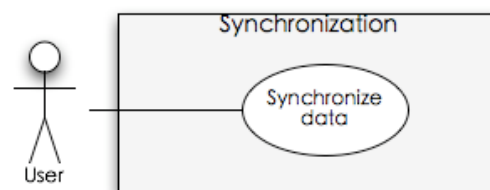
Figure 14. Use Case Diagram of Synchronization

6.1.8.1 Synchronize Data

The following table presents a list of key elements of the use case Synchronize_Data, which allows the system to synchronize all the health data to the server, so that medical

specialists can access to it when necessary. The system presents a "Sync" button to the user, and synchronizes data each time the user clicks on the button.

Use Case	Synchronize_Data
ID	UC08_SYN_01
Description	This use case synchronizes all the data to the server.
Actor	Application user.
Trigger	User clicks on the "Sync" button.
Pre Conditions	User has logged into the account. Internet access is available.
Execution	1) User requests to synchronize data. 2) System synchronizes all the data to the server.
Success End Conditions	Synchronization successful.
Failure End Conditions	Synchronization failed.
Variations	-
Error Handling	No Internet access.
References	-
Referring Use Cases	-
Notes	-

Figure 44. Use Case - Synchronize Data

6.2 Required Data for Functions

This part lists all the required data for each specific use case.

6.2.1 Select Application

The *Application List* includes following components:
- *Personal Data*
- *Hypertension Diagnosis Results*
- *Medication Control*
- *Daily Health Condition*
- *Doctor Appointment Reminder*

- *Synchronization*

6.2.2 Add/Edit General Information

Here are all the required input information of *General Information*:

- *Insurance number*
- *Name*: First name, Last name
- *Date of birth*
- *Gender*
- *Relationship status*
- *Blood group*
- *Racial group*
- *Contact address*: Street, City, Country
- *Phone number*
- *Email address*
- *Education background*
- *Occupation*
- *Physician information**: Name, Speciality, Phone number, Address
- *Emergency contact*: Name, Phone number
- *Insurance details*: Provider name, Plan type, Date of expiry

*Add more records in this field allowed. An "Add" button should be provided beside this field.

6.2.3 Add/Edit Medical History

Medical History including following information:

- *Family history**: Relationship, Health condition
- *Allergies**: Allergic to, Date, Reaction, Status
- *Vaccination**: Name, Date, Dosage
- *Health condition**: Name, Date, Status, Diagnosed by, Applied medications
- *Medication history**: Name, Instructions, Start date, End date
- *Operation history**: Name, Date, Done by
- *Life styles*: Cigarette use, Alcohol use

*Add more records in this field allowed. An "Add" button should be provided beside this field.

6.2.4 Add/Edit Diagnosis Process

Diagnosis Results including following components:

- *Blood pressure**: Date, Systolic, Diastolic

- *Eye examination*: Date, Result
- *Neck examination*: Date, Result
- *Heart examination*: Date, Heart beat rate, Result
- *Chest examination*: Date, Result
- *Abdomen examination*: Date, Result
- *Arms and legs examination*: Date, Result
- *Neurological examination*: Date, Result
- *Complete blood count (CBC)*: Date, Result
- *Serum chemistry*: Date, Potassium, Creatinine, Magnesium
- *Urinalysis*: Date, Result
- *Fasting blood sugar*: Date, Blood sugar
- *Fasting lipoprotein profile***: Date, LDL, HDL, Cholesterol, Triglycerides
- *Electrocardiography (ECG or EKG)*: Date, Result
- *Chest radiography*: Date, Result

*Blood pressure reference: Table 6. Classification of High Blood Pressure Readings
***Fasting lipoprotein profile* reference: Table 10. Counting Cholesterol (in mg/dL) for Adults.

6.2.5 Add/Edit Medication

Medication Information including following data:
- *Name*
- *Type*: select from *Diuretics, Beta blockers, Angiotensin receptor blockers, Angiotensin converting enzyme inhibitors, Calcium channel blockers, Alpha blockers, Nervous system inhibitors, Vasodilators, Alpha-beta blockers.*
- *How many times a day*
- *Dosage*
- *Time*
- *Start date*
- *End date*
- *With food or without food*
- *With other medications or without other medications*
- *Note*

6.2.6 Add/Edit Symptoms

Here are some possible symptoms for user to select from. Adding new symptoms is allowed.
- *Headache in the back of the head*
- *Ordinary headache*

- *Dizziness*
- *Nosebleed*

For each symptom, a specific time is required.

6.2.7 Add/Edit Nutrition

Objective Daily Amount of Electrolytes are as following:
- *Sodium*: < 1,500 mg
- *Potassium*: ≥ 4.7 g
- *Calcium*: 1,200 to 1,600 mg for women; 800 mg for men
- *Magnesium*: 320 to 700 mg for women; 420 to 700 mg for men

Food/Drink List reference: Chapter 3.2.5.1

6.2.8 Add/Edit Physical Activity

Objective Amount of Energy is as following:
- *Daily*: 90 to 160 MET-minutes
- *Weekly*: 500 to 1,000 MET-minutes

Activities List reference: Table 12. Energy Requirements of Common Activities in METs.

6.2.9 Add/Edit Tobacco Use

Tobacco Form including:
- *Cigarette*
- *Chewing tobacco*
- *Dipping tobacco*
- *Snuff*

It is possible for user to add tobacco forms.

6.2.10 Add/Edit Alcohol Use

Maximal Amount of Daily Alcohol Intake:
- *Women*: 18 mL = 350 mL beer, or 150 mL 12 vol% wein, or 45 mL vodka
- *Men*: 36 mL = 700 mL beer, or 300 mL 12 vol% wein, or 90 mL vodka

6.2.11 Add/Edit Caffeine Intake

Maximal Amount of Daily Caffeine Intake: 200 mg

Caffein Drink/Food List including:

- *Coffee*: Brewed, drip; Instant; Decaffeinated, brewed and instant
- *Espresso*: Regular; Decaffeinated
- *Tea*: Black, brewed; Instant; Decaffeinated
- *Soft drinks*: Cola type; Non-cola type
- *Chocolate*: Cocoa, dry powder; Baking chocolate; Chocolate milk; Milk chocolate bar

It is possible for user to add caffeine drink/food forms.

6.2.12 Add/Edit Weight

Risk Classification reference: Table 11. Risk for Diseases According to BMI and WC

6.2.13 Add/Edit Appointment

Following input data are required from user when add an appointment:
- *Purpose*
- *Doctor name*
- *Time*
- *Doctor address*
- *Doctor telephone*
- *Preparation*
- *Note*

6.3 Main User Interfaces

Here are some example sketches of graphical user interfaces (GUI) of TACP.

The following figure shows the screen of Application List, which contains seven buttons: personal data, hypertension diagnosis results, medication control, daily health condition, doctor appointment reminder, synchronize data, and log out. Users click on the buttons for further operation.
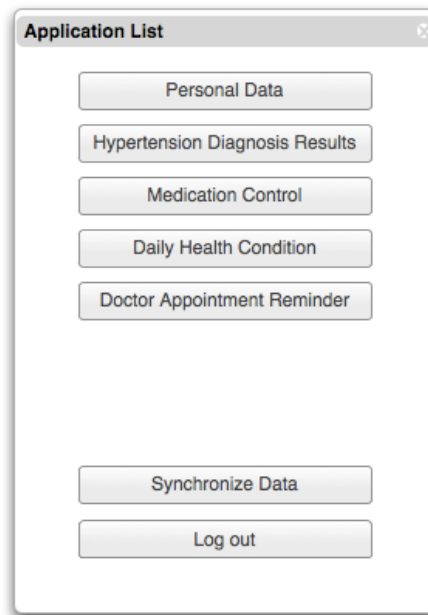
Figure 15. Application List

The following figure shows the screen of General Information. In the screen, patients' information such as insurance number and blood type are required from users.


Figure 16. General Information

The following figure shows the first screen displayed when users clicked on button Daily Health Condition in figure 15. Users choose a date from the calendar to update the recent information. There are four buttons displayed under the calendar, from which users choose the types of statistics illustrated: daily, weekly, monthly or annual.

Figure 17. Daily Health Condition

The following figure shows the screen of Control Medication Intake. Names of medicines and exact time to take medicines are based on the medication information input by users themselves. Users check the checkbox after patients took the medication. Data is saved after user clicked on button "save".
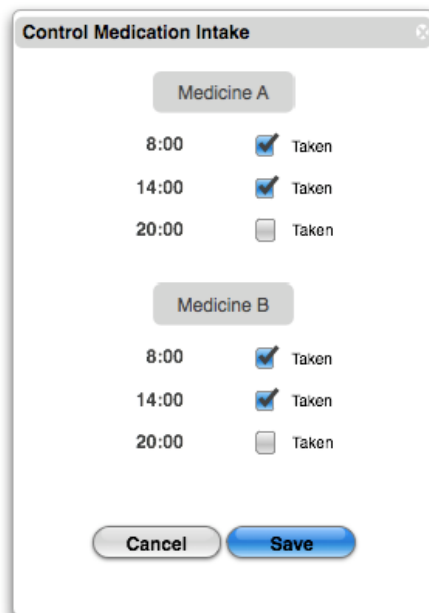
Figure 18. Control Medication Intake

The following figure shows the screen of Edit Daily Health Condition. Information such as symptoms and nutrition intake are required from users. For example, users choose

time and a symptom from the drop down list or enter a symptom by themselves. The symptom is displayed below the input area, after users click the button "add". One or more symptoms can be input according to users' needs.

Figure 19. Edit Daily Health Condition

The following figure shows the screen of Weekly Statistics of calcium intake in form of line graph. Users click on "previous" and "next" to view the statistics of previous week and the week after respectively. Users click on "go back" to return to the previous screen.
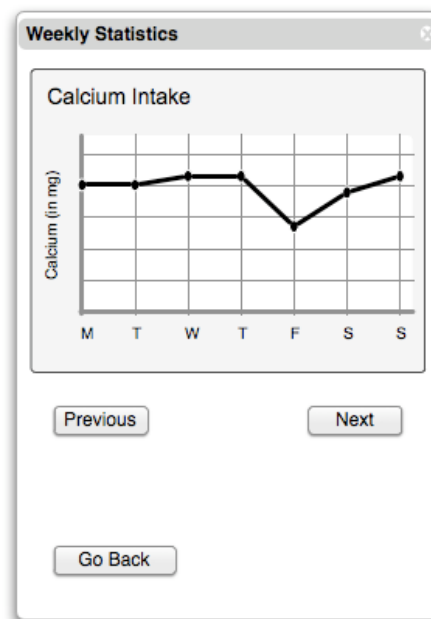
Figure 20. Weekly Statistics

6.4 Software Architecture
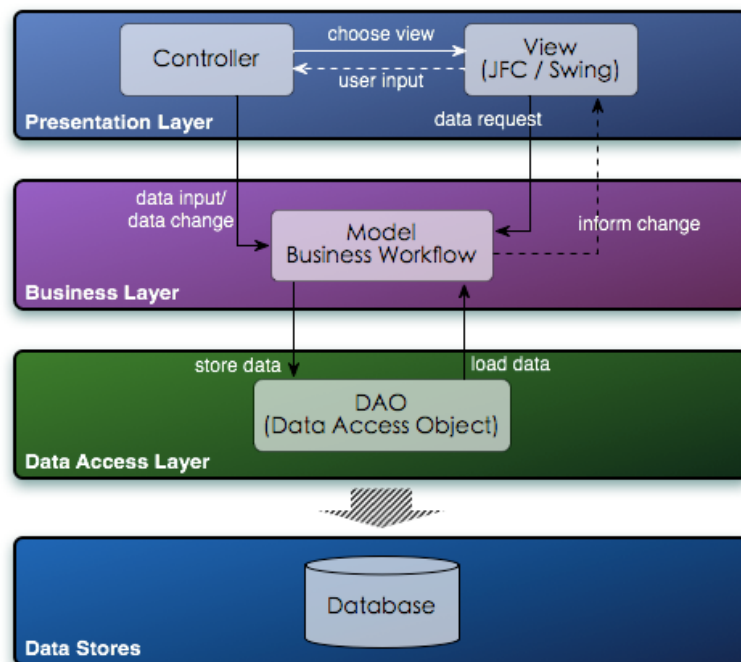
Figure 21. Software Architecture

The layered architecture is selected to develop the system on the client mobile device. There are three layers in the software architecture: presentation layer, business layer, and data access layer. Data access layer contains component data access object. In business and presentation layer are the components Model, View, and Controller (MVC). Class Model provides functional core of application, registers dependent views and controllers, and notifies dependent components about state changes. Class View initializes associated controller, retrieves data from model, implements update procedure, and displays information to users. Class Controller accepts user input as event, translates events to service requests for model or display requests for views.

7 Training Course Scenarios

The end users of TACP may have very different background such as education back-ground and knowledge background of computing. It is not practical to send all these end users in the same classroom to do the same thing at the same time and at the same pace. For that reason, two training courses scenarios are designed to meet different needs of course participants.

7.1 Training Course A

7.1.1 Target Group

The main target participants of this group are people with following user characteristics:

- Have middel or higher educational background.
- Have at least elementary knowledge of medical care.
- Experience with Internet, including knowing how to use Internet Explorer, download and upload a file, watch an online video, use a forum, and join a chat room.
- Experience with using software applications on both computers and mobile devices.
- Experience of software installation.
- or Have finished the training course B.

Hypertension patients who meet these characteristics are considered as the participants of the training course. Private carers and qualified relatives of hypertension patients are regarded as a large part of this group.

7.1.2 Requirements

Since all the participants have computing background, e-Learning is selected as the di-dactic methods of the course. Compare to face-to-face education, e-Learning benefits both organizers and participants from cost-saving. Moodle is the main application used in the course. Open Space technology is selected to hold the conference, with the aim of get feedback from TACP end users to improve the functions of the application.

For organizers, a domain need to be prepared for online courses. Adequate storage space is required to upload all the training materials. Before the conference, a white board need to be prepared for participants to stick their notes with discussion results. Finger foods and drinks should be supplied during the conference.

For individual participant, the only thing required is a computer with Internet access, so that he/she can get up-to-dated information from online courses.

7.1.3 Course Scenarios

The training courses are divided into two parts: self-training and conference.

7.1.3.1 Self-Training

Self-training is a Moodle-based e-Learning course. The training course is divided into following parts according to the application list (6.2.1), plus installation guide teaching users how to install the application on their mobile devices, and self-care options giving nutritional, clinical and lifestyle guidelines to patients daily life.

- Installation Guide
- "Personal Data" Guide
- "Hypertension Diagnosis Results" Guide
- "Medication Control" Guide
- "Daily Health Condition" Guide
- "Doctor Appointment Reminder" Guide
- "Synchronization" Guide
- Self-Care Options for Hypertension Patients

Figure 22. Moodle-based Self-training Course

Figure 22 is a screenshot of the TACP Self-Training Course. The red square 1 is the main parts of the training course. Training materials of each part are uploaded by the

course provider, which can be PDF files, links, and videos. Participants only need to click on the material name to download file.

Square 2 lists several activities provided to course participants.

- *Q&A Forum*: Here users can post the problems which occurs when using the application. Course provider is responsible to answer these questions.
- *Meet Friends Forum*: This is a general discussion forum. Participants are free to talk about everything in this forum such as exchange their experience of handling hypertension.
- *Q&A Chat Room*: Online chat can be organized when necessary, in this way participants can talk to the course organizer directly.
- *Feedback*: It is alway important to get feedback from users, no matter about the online training course or about the application use. The purpose of questionnaire is to help course provider to evaluate the attitudes of participants. There are no "right" or "wrong" answers. Each question has five choices: strongly disagree, somewhat disagree, neither agree nor disagree, somewhat agree, and strongly agree.
- *Quiz*: A quiz about using the application and the knowledge of hypertension homecare is offered to participants. Participants are not forced to take the quiz. It just a way for them to better unterstand the usage of the application and self-care at home.

Square 3 lists all the upcoming events organized by course provider, for example, online chat and open space conference. Participants can click on the name of the event to explore more details. Figure 23 presents the open space conference in detail.

Figure 23. Upcoming Events of Self-Training Course

The progress of course is very leisurely and flexible, which is arranged by participants themselves. Instead of taking training course at a specific time, participants only need to sit in front of their computer at home and surf on the Internet. For participants who have less free time, the tempo of training course can be slower. For those who have more free time or with higher level computing knowledge, the duration of the whole course can be very short.

7.1.3.2 Conference

The conference is based on the didactic method "open space technology". The aim of holding conferences is to get suggestions about the usability of the application and advice of software further development from end users.

Since it is not a quite formal conference, duration will be set at about six hours from 10:00 in the morning to 16:00 in the afternoon. Course provider can choose weekends to hold the conference, so that participants having a regular job are able to attend. Unlike normal conference, there is no pre-organized schedule, instead, participants can join any discussion group at anytime. Finger foods and drinks should be provided during the conference.

The open space conference is organized into four units:
- *10:00 AM - 11:30 AM*: In the first hour, participates are give a chance to know each other. Afterwards, is group setup. Anyone who wants to start a discussion, can stand up with a big sheet of a theme and announces it to the group.
- *11:30 AM - 14:30 PM*: Discussions will take place in this three hours. Participants are free to leave and join a group. Lunch time is included.
- *14:30 PM - 15:00 PM*: Participant write the key words of the discussion results on a piece of paper, and post it on the white board.
- *15:00 PM - 16:00 PM*: Review the whole process. Participants can explain their results in front of all the people. Conference organizer make notes.

7.2 Training Course B

7.2.1 Target Group

Generally, users who do not fit participant characteristics of training course A, are considered to be participants of this group. These people are usually
- Have lower-level education background
- Have no experience with computer operation or Internet
- Have no experience with using a software application.

The majority of the participants can be those who are in the elder age.

7.2.2 Requirements

Since all the participants have little knowledge of computing, training courses will be given face-to-face by teachers. Didactic method "frontal teaching" is used in each unit of training course. In case that course participants will easily get bored in frontal teaching classroom, "group puzzle" will be applied in between.

For course organizers, a classroom (computer room if possible) for holding at least twenty five people need to be arranged. Besides, computer and video projector should be prepared for teacher to present powerpoint slides. The course materials should be printed out for participants before each class takes place.

Participants should bring their own mobile device to the class, which will be used to install and operate the TACP application.

7.2.3 Course Scenarios

The training courses is designed with 25 participants, to be finished in one week, each day with four teaching units. The progress of the course should not be very intense, so that teacher has enough time to take care of each students. For each class, teacher first presents powerpoint slides or a tutorial video to let students have a general idea about what will be taught in the class. After that is step by step teaching. Since participants have almost no experience with using such applications, teacher should make sure each student has finished the right steps.

The contents of the training courses including following parts:
- Installation Guide
- "Personal Data" Guide
- "Hypertension Diagnosis Results" Guide
- "Medication Control" Guide
- "Doctor Appointment Reminder" Guide
- "Daily Health Condition" Guide, including eight aspects
- "Synchronization" Guide
- Quiz

The schedule of one-week course is arranged as following:
- *Monday*: Software installation will be a big task for people without computing knowledge, so it will be the only training content on the first day. Teacher

should especially ascertain that each student has installed the application correctly.

- *Tuesday*: "Personal Data" and "Hypertension Diagnosis Results" are the main tasks on the second day. Frontal teaching plays a big role on this day. Students will be taught how to add, edit, and delete data, and view summary.

- *Wednesday*: Same as Tuesday, the class content including "Medication Control" and "Doctor Appointment Reminder".

- *Thursday*: "Daily Health Condition" contains eight aspects which are symptoms, nutrition, physical activity, tobacco use, alcohol use, caffeine intake, stress, and weight. Teacher can present the first three features by frontal teaching. For the next five features, group puzzle can be used. Students can be divided into five skeleton groups, each with five members. Each group studies on one single feature. Enough time should be given to ensure all the students have unterstand their materials thoroughly. Form five experts groups afterwards, so that each student has the chance to learn other four features. Teacher can give a conclusion eventually.

- *Friday*: On the last day, students will first learn how to synchronize health data to their doctors. After that, a small quiz can be given, including contents of the training courses, probably also knowledge of handling hypertension at home. Figure 24 shows an example quiz generated by Hot Potatoes. Students only need to open the quiz page in Internet Explore, and finish all the questionnaires. Results will be generated automatically. If no computer available in the classroom, a paper-base quiz is also feasible.

TACP Training Course

Quiz

Show questions one by one

1. Which one of the following statistic form is not included in Statistics of Daily Health Condition:

    A. ? | Daily

    B. ? | Weekly

    C. ? | Monthly

    D. ? | Quarterly

2. Doctor appointment alarm is automatically set when add into calendar

    A. ? | Yes

    B. ? | No

3. Edit Nutrition is a part of

    A. ? | Personal Data

    B. ? | Medication Control

    C. ? | Daily Health Condition

    D. ? | Hypertension Diagnosis Results

Figure 24. Hot-Potatoes-based Online Quiz

Participants may still have problems when using the application after the training courses. In case such situation, the Moodle-based self-training site can be provided to students who have finished the training course B.

8 Conclusion

The telematic application is a easy to use, mobile-based software solution that enables patients and their home carers to monitor patients' treatment process and transmit health information to their medical specialists in real time. Primary functions of the application focusing on hypertension treatment process includes

- *personal data arrangement*: It manages all useful data from patients involving medical history, family history and other basic data that help medical specialists to unterstand the health condition of patients.
- *hypertension diagnosis results*: Since the hypertension examination process contains various components, results are saved and synchronized to the central database to avoid recheck and data redundancy.
- *medication control*: This function helps to remind patients to take medicines according to the medication instructions input by users.
- *daily health condition*: This function monitors patients' health information in many aspects including symptoms, nutrition of diet, physical activities, tobacco use, alcohol use, caffeine intake, mental stress and weight, which are the essential points of the treatment process.
- *doctor appointment reminder*: It manages doctor appointments in a calendar and reminds patients of the appointments' time.

For application development, development system Microsoft Visual Studio supporting development of softwares for Windows Mobile, can be used to build and update the telematic application. Visual Studio provides integrated support for Microsoft SQL Server 2005 Compact Edition, which is the operating system installed on mobile devices. Local data on mobile devices can be synchronized using the Microsoft Sync Framework that allows collaboration and offline access for applications.[82] Developers can take advantage of the Model-View-Controller (MVC) design pattern to create a Microsoft ASP.NET-based application. Microsoft has released a MVC framework for Visual Studio to simplify ASP.NET development. To install the release, Windows XP .NET 3.5 SP1, Visual Studio 2008 are required to use certain parts of this feature.

Further development of the application will provide many opportunities for future chronic condition care. Treatment processes of other chronic conditions, for example, cancer, diabetes and chronic respiratory disease, can be explored and analysed, and new functions can be designed to expand the usability of the application. More chronic patients such as cancer patients and diabetes patients will be involved in using this application in their daily life.

Not only in Austria, the application can be designed to enable users to access and exchange health data in the whole European Region. In case that emergency happens during the time the patient travels to another country, medical records can be accessed accurately in time. This will provide great flexibility for patients, no matter moving to another country temporarily or permanently. Medical record can be synchronized regularly between databases in different medical sectors or even from different countries. There are plenty of database synchronization softwares providing such possibility. The software clones changes to a database on a remote server, when a local database is modified, so the remote database can always keep up-to-date.

The telematic application can be developed to fit more operating systems. As the Mac products are getting more and more popular today, users may operate the application on mobile operating system MacOS X on iPhone or iPod in the future. PC version may also be developed to meet the needs of users who prefer manipulating computers and laptops to operating mobile devices.

More people will be involved in using the application including nurses, physical therapists, occupational therapists, home care clinicians and medical social workers. The application also has the potential of managing patient documentations instead of paper-based system in hospitals. Nurses and therapists may complete patient information, coordinate patient daily schedules at their fingertips. Contents of training courses can be extended to keep up with further development of the application and support these new users.

With the significant improving tendency of computing technology and medical technology, it will not take long for chronic patients to reach a much better quality life than ever.

References

[1]   Robert Mechanic: Will Care Management Improve the Value of U.S. Health Care? Background paper for 11th Annual Princeton Conference, May 20-21, 2004, Schneider Institute for Health Policy, Brandeis University.

[2]   Sarah Delaney, Rebecca Garavan, Hannah McGee and Aodán Tynan: Care and Case Management for Older People in Ireland; An outline of current status and a best practice model for service development. Health Services Research Centre, Department of Psychology, Royal College of Surgeons in Ireland, 2001.

[3]   Debbie Singh: How can chronic disease management programmes operate across care settings and providers? World Health Organization 2008 and World Health Organization, on behalf of the European Observatory on Health Systems and Policies 2008.

[4]   Disease Management Association of America; Position Statement. Advancing the Integration of Accredited Disease Management Programs in Federal Health Care Programs.

[5]   Clinicians, Services and Commissioning in Chronic Disease Management in the NHS; The need for coordinated management programs; Report of a joint working party of the Royal College of Physicians of London, the Royal College of General Practitioners and the NHS Alliance. Royal College of Physicians of London, Royal College of General Practitioners, 2004.

[6]   Melanie Taylor, Katherine Gibbs: Practice Nurse; Chronic Care; The Wagner Model. June 2008.

[7]   Chris Rauber, Disease Management Can be Good for What Ails Patients and Insurers. 29 Modern Healthcare 48, 51, 1999.

[8]   Dr. Jason Cheah: Framework and Working Model for the Implementation of Chronic Disease Management in Singapore. National Healthcare Group, 2003.

[9]   Biet Th., Bosenius M., Dietrich Th., Henze H., Klitza K., Latz V., Liebsch B., Pesch C., Schnettger K.,: Leitfaden zur Integrierten Versorgung aus der Praxis; Rechtliche Grundlagen, Pfaderstellung, Konzeption und Mustervertrag. Prof. Dr. med. Dipl.-Kfm. (FH) Rainer Riedel, Studiengangsleiter Medizin-Ökonomie, Rheinische Fachhochschule Köln, 8. Juli 2004.

[10] Edward H. Wagner, Connie Davis, Charles J. Homer, Steven D. Hagedorn, Brian Austin, Abbi Kaplan: Curing the System, Stories of Change in Chronic Illness Care; Accelerating Change Today (A.C.T) for America's Health. The National Coalition on Health Care, The Institute for Healthcare Improvement, May 2002.

[11] Nadine Henningsen: Home Care Case Management; Invitational Roundtable, Summary of the Proceedings. Canadian HomeCare Association, March 3 & 4, 2005.

[12] Suzanne Leaphart, BA, RN, BSN, CWS; Liza G. Ovington, PhD, CWS: Case Management Resource Path on Chronic Wound Care. Funded by an educational grant provided by KCI USA, Inc., San Antonio, TX. © Copyright 2005 Case Management Society of America, Little Rock, Arkansas, USA.

[13] Nadine Henningsen: Case Management, A Strategy for Health Systems Integration; CHCA Position Paper. Canadian HomeCare Association, October 2005.

[14] Case Management Principles. WorkCover NSW, November 2005.

[15] Márcia Ito, José S. C. Martini, Lúcia C. Iochida: CPRM: A Chronic Patient's Management Model Based on the Concepts of Customer's Relationship. SAC'08, March 16-20, 2008, Fortaleza, Ceará, Brazil.

[16] Chronic Care Management of Family Doctors in Taiwan.

[17] Case Management Policy; clarifies terminology used in case management across the Early Intervention, Child Protection and Out-of-Home Care program streams. NSW Department of Community Services; February 2008.

[18] Margaret A Hanson BSc, Dr Kim Burton, Dr Nicholas A S Kendall PhD, Rebecca J Lancaster BSc, Dr Adele Pilkington MBBS: The costs and benefits of active case management and rehabilitation for musculoskeletal disorders. Prepared by Hu-Tech Associates Ltd. for the Health and Safety Executive 2006.

[19] Suzanne K. Powell: Case Management, A Practical Guide to Success in Managed Care. Lippincott Williams & Wilkins, 2000

[20] Martin Sipkoff: Health Plans Begin To Address Chronic Care Management. Reprinted from the December 2003 issue of MANAGED CARE; Published by MediMedia USA 2003.

[21]   VA Technology Assessment Program Short Report - Impacts of Case Management Programs. Technology Assessment Program; Office of Patient Care Services; July 2000.

[22]   Ruth Hutt, Rebecca Rosen, Janet McCauley: Case-Managing Long-term Conditions; What impact does it have in the treatment of older people? Published by King's Fund, 2004

[23]   The Chronic Care Model; Supported by The Robert Wood Johnson Foundation. http://www.improvingchroniccare.org/index.php?p=The_Chronic_Care_Model&s=2 (last visit: 17. Mar. 2009)

[24]   Models and Strategies of Case Management in Human Services, Level III. http://www.cpcs.umb.edu/support/studentsupport/red_book/case_mgmt.htm   Approved Nov. 2002 (last visit: 17. Mar. 2009)

[25]   Facing the Facts: The Impact of Chronic Disease in Europe. World Health Organization.

[26]   Tackling Europe's Major Diseases: The Challenges and The Solutions. World Health Organization, Europe; Copenhagen, 11 September 2006.

[27]   Preventing Chronic Diseases: a vital investment; World Health Organization global report. Public Health Agency of Canada, World Health Organization 2005.

[28]   Dornert T, Rieder A: Epidemiologische Daten zur Hypertonie; Journal für Hypertonie 2004; 8 (Sonderheft 2), 4-9.

[29]   Cicala, Roger: The Heart Disease Sourcebook. Los Angeles, Chicago NTC Contemporary, 1997.

[30]   Kowalski, Robert E.: Blood Pressure Cure: 8 Weeks to Lower Blood Pressure Without Prescription Drugs. Publication: Hoboken, N.J John Wiley & Sons, Inc. (US), 2007.

[31]   Edwards, Niloo M.; Mauerer, Mathew S.; Wellner, Rachel B.: Aging, Heart Disease, and Its Management: Facts and Controversies; Contemporary Cardiology (Totowa, N.J.: Unnumbered). Totowa, N.J. Humana Press, 2003.

[32] Mark Jenkins: High Blood Pressure: Practical, Medical, and Spiritual Guidelines for Daily Living with Hypertension; Hazelden Pocket Health Guide. Center City, Minn. Hazelden Publishing, 1999.

[33] Your Heart: Questions You Have - Answers You Need. Allentown, Pa. People's Medical Society, 1996.

[34] Safren, Steven A.; Gonzalez, Jeffrey S.; Soroudi, Nafisseh: Coping With Chronic Illness: A Cognitive-behavioral Therapy Approach for Adherence and Depression Workbook. Oxford, New York Oxford University Press, 2008.

[35] Morewitz, Stephen John.; Goldstein, Mark L.: Aging and Chronic Disorders. New York Springer Science & Business Media, 2007.

[36] Bronner, Felix: Nutritional and Clinical Management of Chronic Conditions and Disease. Boca Raton CRC Press, 2006.

[37] Clark, Carolyn Chambers: American Holistic Nurses' Association Guide to Common Chronic Conditions: Self-care Options to Complement Your Doctor's Advice. Hoboken, N.J. John Wiley & Sons, Inc. (US), 2003.

[38] Bauer, Joy: The Complete Idiot's Guide to Total Nutrition, 3Rd Ed. Indianapolis, IN Penguin, 2003.

[39] Duyff, Roberta Larson: The American Dietetic Association Complete Food and Nutrition Guide. New York John Wiley & Sons, Inc. (US), 2002.

[40] Sheps, Sheldon G.: Mayo Clinic On High Blood Pressure. Rochester, Minn. Mayo Clinic Health Information, 1999.

[41] Fried, Robert: Breathe Well, Be Well: A Program to Relieve Stress, Anxiety, Asthma, Hypertension, Migraine, and Other Disorders for Better Health. New York John Wiley & Sons, Inc. (US), 1999.

[42] Edlin, Gordon.; Golanty, Eric.; Brown, Kelli McCormack: Health and Wellness. Sudbury, Mass. Jones & Bartlett Publishers, Inc.,1998.

[43] Nieman, David C.: The Exercise Health Connection. Champaign, Ill. Human Kinetics, 1998.

[44] Powell, Don R.: The American Institute for Preventive Medicine's Self-care: Your Family Guide to Symptoms and How to Treat Them. Allentown, PA People's Medical Society, 1996.

[45] Silverstein, Alvin.; Silverstein, Virginia B.; Silverstein, Robert A.: The Circulatory System; Human Body Systems. New York Twenty-First Century Books, 1994.

[46] McCabe, Philip M.: Stress, Coping, and Cardiovascular Disease; Stress and Coping. Mahwah, N.J. Lawrence Erlbaum Associates, Inc.,2000.

[47] Pampel, Fred C.; Pauley, Seth.: Progress against Heart Disease. Westport, Conn Greenwood Publishing Group, 2004.

[48] Stansfeld, Stephen A.; Marmot, M. G.: Stress and the Heart: Psychosocial Pathways to Coronary Heart Disease. London BMJ Books, 2002.

[49] Sobel, Burton E.; Schneider, David J.: Medical Management of Diabetes and Heart Disease. New York Marcel Dekker, Inc.,2002.

[50] Zied, Elisa: Feed Your Family Right!: How to Make Smart Food and Fitness Choices for a Healthy Lifestyle. Hoboken, NJ John Wiley & Sons, Inc. (US), 2007.

[51] Body mass index (BMI) and the risk for diseases. Provided by Healthwise, April 20, 2007. Available online: http://www.revolutionhealth.com/articles/body-mass-index-waist-size-and-risk-for-disea se/ug2333 (last visit: 29. Mar. 2009)

[52] Patrice L. Spath: Measuring The Economic Benefit of Case Management. Copyright 1999 by Brown-Spath & Associates. Available online: http://www.brownspath.com/original_articles/casemgmt.htm (last visit: 5. April. 2009)

[53] Translating Scientific Evidence About Total Amount and Intensity of Physical Activity Into Guidelines. Available online: http://www.health.gov/PAGuidelines/guidelines/appendix1.aspx (last visit: 7. April. 2009)

[54] Sodium in Foods; Salt or Sodium Content, Composition of Food. Available online: http://www.annecollins.com/sodium-foods.htm (last visit: 8. April. 2009)

[55] Potassium Content in Foods and Drinks. Palo Alto Medical Foundation. Agricultural Handbook No. 8, United States Department of Agricultural.

[56] Lena Mamykina; Elizabeth D. Mynatt; Patricia R. Davidson; Daniel Greenblatt: MAHI: Investigation of Social Scaffolding for Reflective Thinking in Diabetes Management. CHI 2008 Proceedings, Health and Wellness. April 5-10, 2008, Florence, Italy.

[57] Amritpal Singh Bhachu; Nicolas Hine; John Arnott: Technology Devices for Older Adults to Aid Self Management of Chronic Health Conditions. ASSETS'08, October 13-15, 2008, Halifax, Nova Scotia, Canada.

[*] Windows Mobile for healthcare professionals. Available online: http://www.microsoft.com/windowsmobile/en-us/business/solutions/industry/healthcare.mspx (last visit: 18. April. 2009)

[58] Open Space Technology. The Co-Intelligence Institute. Available online: http://www.co-intelligence.org/P-Openspace.html (last visit: 23. April. 2009)

[59] Michael Herman: Open Space World. ©1998 Michael Herman Associates. Available online: http://www.openspaceworld.org/ (last visit: 23. April. 2009)

[60] Open Space Technology - The Method. Available online: http://www.openingspace.net/openSpaceTechnology_method.shtml (last visit: 23. April. 2009)

[61] Zorka Stínková: Frontal Teaching in EFL Classes. University of Pardubice, Faculty of philosophy, Department of English and American Studies, 2006.

[62] Gruppenpuzzle in Kürze. Landesakademie für Fortbildung und Personalentwicklung an Schulen. Available online: http://lehrerfortbildung-bw.de/kompetenzen/projektkompetenz/methoden_a_z/gruppenpuzzle/ (last visit: 24. April. 2009)

[63] Ragnar Müller; Prof. Dr. Wolfgang Schumann: Methods for Activating Lessons in Politics: Group Puzzle. D@dalos. Available online: http://www.dadalos.org/methoden_int/grundkurs_4/gruppenpuzzle.htm (last visit: 24. April. 2009)

[64] The Jigsaw Classroom. Available online: http://www.jigsaw.org/ (last visit: 24. April. 2009)

[65] About Moodle. Available online: http://www.moodle.org (last visit: 27. April. 2009)

[66] Amrhein-Kreml, R., Bartosch, I., Breyer, G., Dobler, K., Koenne, C., Mayr, J. & Schuster, A. (2008). *Prüfungskultur. Leistung und Bewertung (in) der Schule*. Klagenfurt: Institut für Unterrichts- und Schulentwicklung.

[67] Thomas Stern: Förderliche Leistungsbewertung. ÖZEPS, Herausgegeben vom Österreichischen Zentrum für Persönlichkeitsbildung und soziales Lernen.

[68] Beba Shternberg, Michal Yerushalmy: Didactic Model - Bridging A Concept with Phenomena

[69] K o n s t r u k t i v e r   M e t h o d e n p o o l .   A v a i l a b l e   o n l i n e : http://www.uni-koeln.de/hf/konstrukt/didaktik/uebersicht.html (last visit: 30. April. 2009)

[70] What is e-Learning. Available online: http://www.e-learningconsulting.com (last visit: 30. April. 2009)

[71] Doug Madden: 17 Elements of Good Online Courses. Honolulu Community College. Revised Aug 3. 1999.

[72] Jason Gorman: Use Case - An Introduction. Parlez UML, 2006.

[73] Rick Ross: Use Case Analysis - Enterprise Solution and Application Strategies. Good Advisor, December 2004.

[74] Derek Coleman: A Use Case Template. Hewlett-Packard Software Initiative.

[75] Prof. Franz Gansterer; Ass.Prof. Monika Di Angelo: Spezielle Kapitel der Schulinformatik

[76] Hot Potatoes. Available online:http://hotpot.uvic.ca/ (last visit: 23. June. 2009)

[77] Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults. National Cholesterol Education Program. National Institutes of Health, National Heart, Lung, and Blood Institute, NIH Publication No. 01-3679, May 2001. Available online: http://www.nhlbi.nih.gov/guidelines/cholesterol/atp3xsum.pdf (last visit: 23. August. 2009)

[78] The Report of the Dietary Guidelines Advisory Committee on Dietary Guidelines for Americans, 2005. Available online: http://www.health.gov/DietaryGuidelines/dga2005/report/ (last visit: 23. August. 2009)

[79] Jean A.T., Ph.D. Pennington, Anna De Planter Bowes, Helen Nichols Church: Bowes & Church's Food Values of Portions Commonly Used. 17th ed. Lippincott-Raven Publishers, 1998, by permission.

[80] What is Case Management? 12th Case Management Society of Australia Conference, June 2009. Available online: http://www.cmsa.org.au/definition.html (last visit: 23. August. 2009)

[81] Ten facts about chronic disease. World Health Organisation. Available online: http://www.who.int/features/factfiles/chp/01_en.html (last visit: 23. August. 2009)

[82] Key Benefits of Microsoft Visual Studio 2008, White Paper. December 2007.

Terms and Abbreviations

ACE   Angiotensin Converting Enzyme
ARB   Angiotensin Receptor Blockers
BMI   Body-Mass Index
CBC   Complete Blood Count
CCB   Calcium Channel Blocker
CCM   Chronic Care Model
CHF   Congestive Heart Failure
CMS   Center for Medicare and Medicaid Services
CPRM   Chronic Patient's Relationship Management
DM   Disease Management
DALYs   Disability-Adjusted Life Years
ECG   Electrocardiography
GDP   Gross Domestic Product
GUI   Graphical User Interface
HDL   High-Density Lipoprotein
HFA-DB   Health For All DataBase
JNC   Joint National Committee
LDL   Low-Density Lipoprotein
MET   Metabolic Equivalent
MVC   Model-View-Controller
OST   Open Space Technology
PDA   Personal Digital Assistant
SRS   Software Requirements Specification
TC   Total Cholesterol
TG   Triglycerides
VLDL   Very Low Density Lipoprotein
WC   Waist Circumference
WHO   World Health Organization
WHOSIS   World Health Organization Statistical Information System