DOKUZ EYLÜL UNIVERSITY

GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

ANALYSIS OF DATA FROM THE MEDICAL DEVICE

by

Seçil BAYRAK

July, 2016

İZMİR

ANALYSIS OF DATA FROM THE MEDICAL DEVICE

A Thesis Submitted to the
Graduate School of Natural and Applied Sciences of Dokuz Eylül University
In Partial Fulfillment of the Requirements for the Degree of Master of Sciences
in Computer Engineering

by

Seçil BAYRAK

July, 2016

İZMİR

M.Sc THESIS EXAMINATION RESULT FORM

We have read the thesis entitled **"ANALYSIS OF DATA FROM THE MEDICAL DEVICE"** completed by **SEÇİL BAYRAK** under supervision of **PROF. DR. ALP KUT** and we certify that in our opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Science.

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Seçil BAYRAK

ANALYSIS OF DATA FROM THE MEDICAL DEVICE

ABSTRACT

Vital Data Mining and Risk Identification of conditions that could be done to determine in advance through Decision Support System to use the technical form of therapy for him and in the process change practitioners guiding system are realized. In this way it is intended to be positive developments in the patient's vital status.

In intensive care units, which is the most common disease of sepsis and acute renal failure, depending on growing her. Failure to early diagnosis and treatment, initially, and then leads to organ failure resulting in death. According to the research of sepsis disease that affects 30 million people worldwide and is a disease that caused the death of more than 8 million people. 1 person dies every 3 seconds from sepsis in the world and recent studies indicate that in the intensive care unit died of sepsis caused by more than one third of the patients treated.

Data Mining Decision Support System is used for the technique which is made the detection of this disease, treatment methods and processes of a system change was carried out in guidance to physicians. In this way it is intended to be positive developments in the patient's vital status.

Keywords: Data analysis, data mining, decision support system, hospital information systems, web services

TIBBİ CİHAZLARDAN ALINAN VERİLERİN ANALİZİ

ÖZ

Veri Madenciliği ve Yaşamsal Risk Belirleme tekniklerinin kullanılacağı Karar Destek Sistemi sayesinde önceden oluşabilecek durumların tespiti yapılıp ona göre tedavi şekli ve sürecinin değişiminde hekime yol gösterici bir sistem gerçekleştirilmiştir. Bu sayede hastanın hayati durumu konusunda olumlu yönde gelişmeler olması amaçlanmaktadır.

Yoğun bakım ünitelerinde en çok karşılaşılan hastalık olan Sepsis ve ona bağlı olarak gelişen Akut Böbrek Yetmezliğidir. Erken tanı ve tedavi yapılmaması durumunda, başlangıçta organ yetmezliğine sebep olmaktadır ve ardından da ölümle sonuçlanmaktadır. Yapılan araştırmalara göre Sepsis hastalığı dünyada 30 milyon civarında insanı etkileyen ve 8 milyondan fazla kişinin ölümüne yol açan bir hastalıktır. Dünyada Sepsisten her 3 saniyede 1 kişi ölüyor ve yakın zamanda yapılan çalışmalar yoğun bakım ünitelerinde Sepsis nedeni ile tedavi edilen hastaların üçte birinden fazlasının kaybedildiğini göstermektedir.

Veri Madenciliği tekniklerinin kullanılacağı Karar Destek Sistemi ile bu hastalıkların tespiti yapılıp, tedavi şekli ve sürecinin değişiminde hekime yol gösterici bir sistem gerçekleştirilmiştir. Bu sayede hastanın hayati durumu konusunda olumlu yönde gelişmeler olması amaçlanmaktadır.

Anahtar Kelimeler: Veri analizi, veri madenciliği, karar destek sistemi, hastane bilgi yönetim sistemleri, web servisler

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CHAPTER ONE
INTRODUCTION

1.1 Background

The aim of the project is easy to use, user-friendly, integrated with the Hospital Information System is a device that works with and create an intensive care information and decision support system. Thus, store vital patient data with the data in information systems from the mechanical ventilator and then to make clinical research on these data which is possible.

1.2 Motivation

The main lines of this project can be summarized as follows:
Due to data entered manually, which can consist of people are at least a reduction of errors in digital data. Intensive Care Unit staff physicians and nurses by transferring data to the database of the instant device manually to the patient information form were saved when they lost by the entrance. In addition to this, Through Risk Identification and Vital Data Mining Decision Support System has been used techniques which already makes the determination of situations that may occur guiding physicians performed a variation of the type of treatment and process systems based on. In this way, it has been intended to be positive developments in the patient's vital status.

CHAPTER TWO
RELATED WORKS

2.1 Literature Review

Relations which are not discovered is the Data Mining for examination. Figure 2.1 below shows the network in order to create chronicity in the care unit. (Hanson, C.W., & Marshall, B.E., 2001).

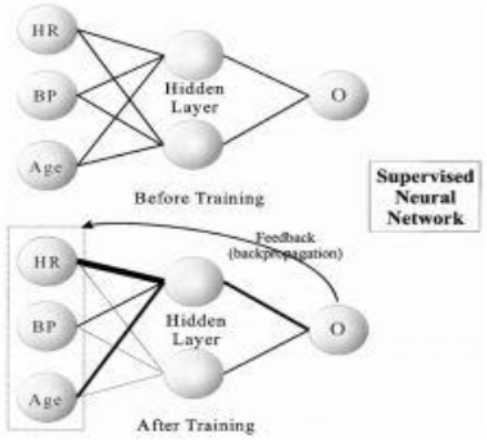


Figure 2.1 Neural network view

Heart Rate (HR), Blood Pressure (BP) values are reinforced. The network is like the Bunchman.

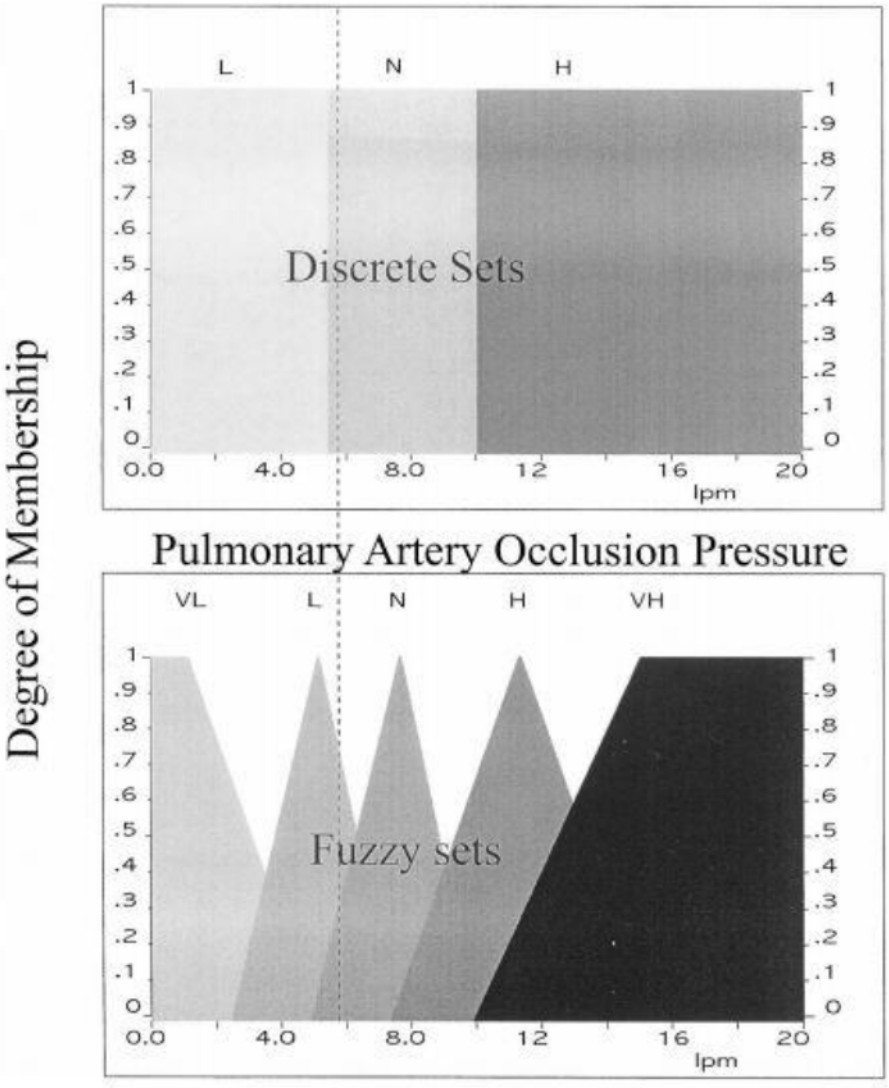


Figure 2.2 Discrete sets and fuzzy sets

Traditional and Fuzzy classification schemes are matched to fuzzy sorting in order to access the fuzzy sets. From this research that has been carried out, it is possible to conclude that if the occlusion pressure is 5.5, that is arranged in classes to single classic set. Low and normal values are the members of two fuzzy sets.

2.2 Clinical Decision Review

There are also many works which are set on Clinical Decision Support System by using Service Oriented Architecture. It is briefly pointed that the usage of Service Oriented Architecture has been specified in order to enhance the Clinical Decision Support System. Figure 2.3 below represents the general information about related works and literature search about the service oriented architecture (SOA) in (Wright, A., & Sittig, D. F, 2008).

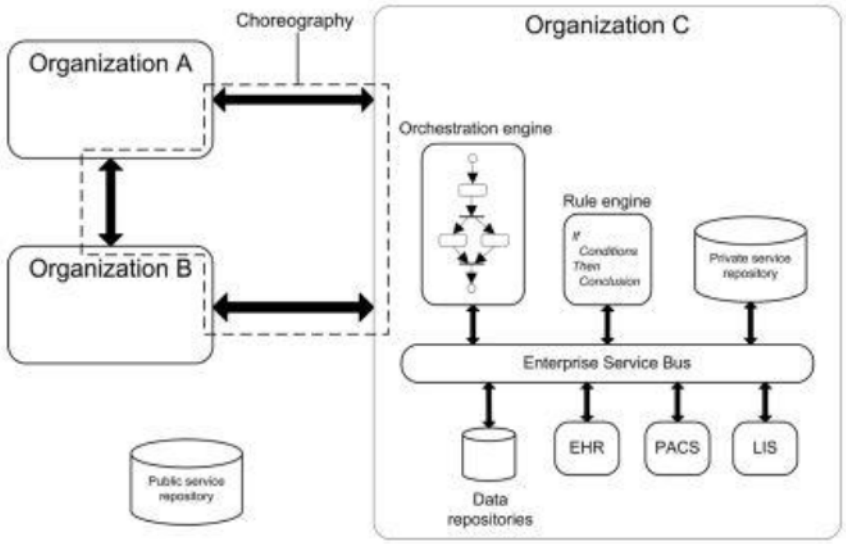


Figure 2.3 Architectural patterns scenario

From the outcome of our investigation it is possible to conclude that HealthFlow's authors have difficulty understand that the algorithms in graphical representations.

In addition to this, there are two solutions to deal with this problem. The first one is hierarchical regulation that take place the more than one steps. Moreover, the second one is some of the logic nodes are known as the comprehensive rule base. By means of this method, tolerance for latency has been accomplished considering the high risk clinical scripts.

CHAPTER THREE
IMPLEMENTATION OF THE SYSTEM

3.1 R & D Methods to Be Used in the Process

Requirements Analysis, Functional and non-functional requirements are determined. Requirements analysis report should be prepared in accordance with the IEEE 830 standard. Design of the modeling "Unified Modeling Language" (UML) is used. Design modeled User Scenarios (Use-Case diagram) and Class / Object diagrams are drawn.

In order to create the database Entity Relationship Diagram (Entity Relationship Diagram) design are made. SOA (service-oriented / based architecture) is drawn on the diagram.

3.2 Device Integration

Serial interface to provide conversion from the Ethernet interface hardware units are developed under the project.

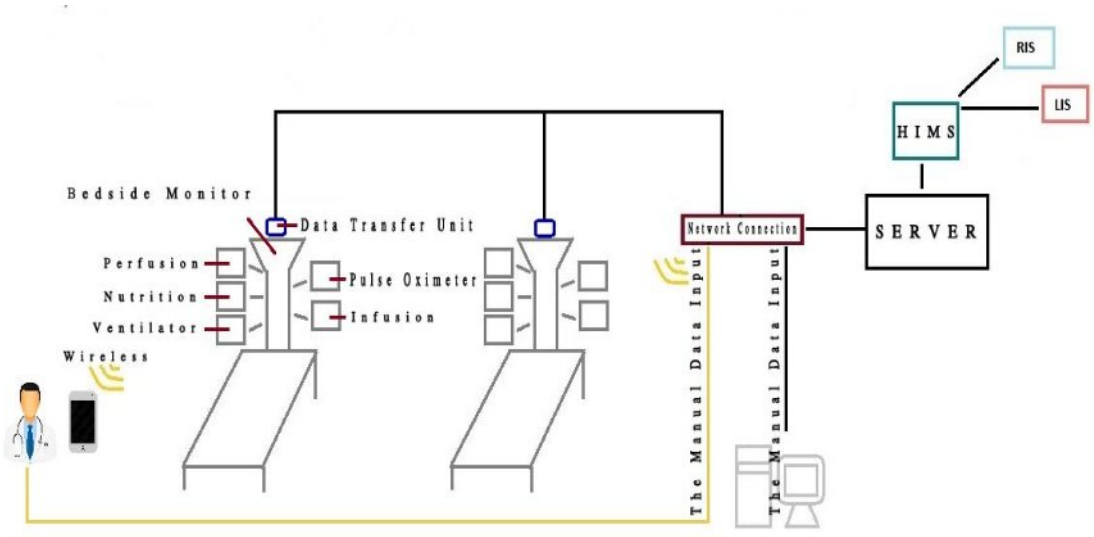


Figure 3.1 Hospital system view

This unit can support more than one medical device connection and technology have a buffer against communication failure. Besides, the system consists of data from server, hospital information system, laboratory information system and radiology information system.

In addition to this, the manual data input which is inserted by the doctors and nurses gathers to the system. By means of this situation, a plurality of data which collects from the patients piles up to the system.

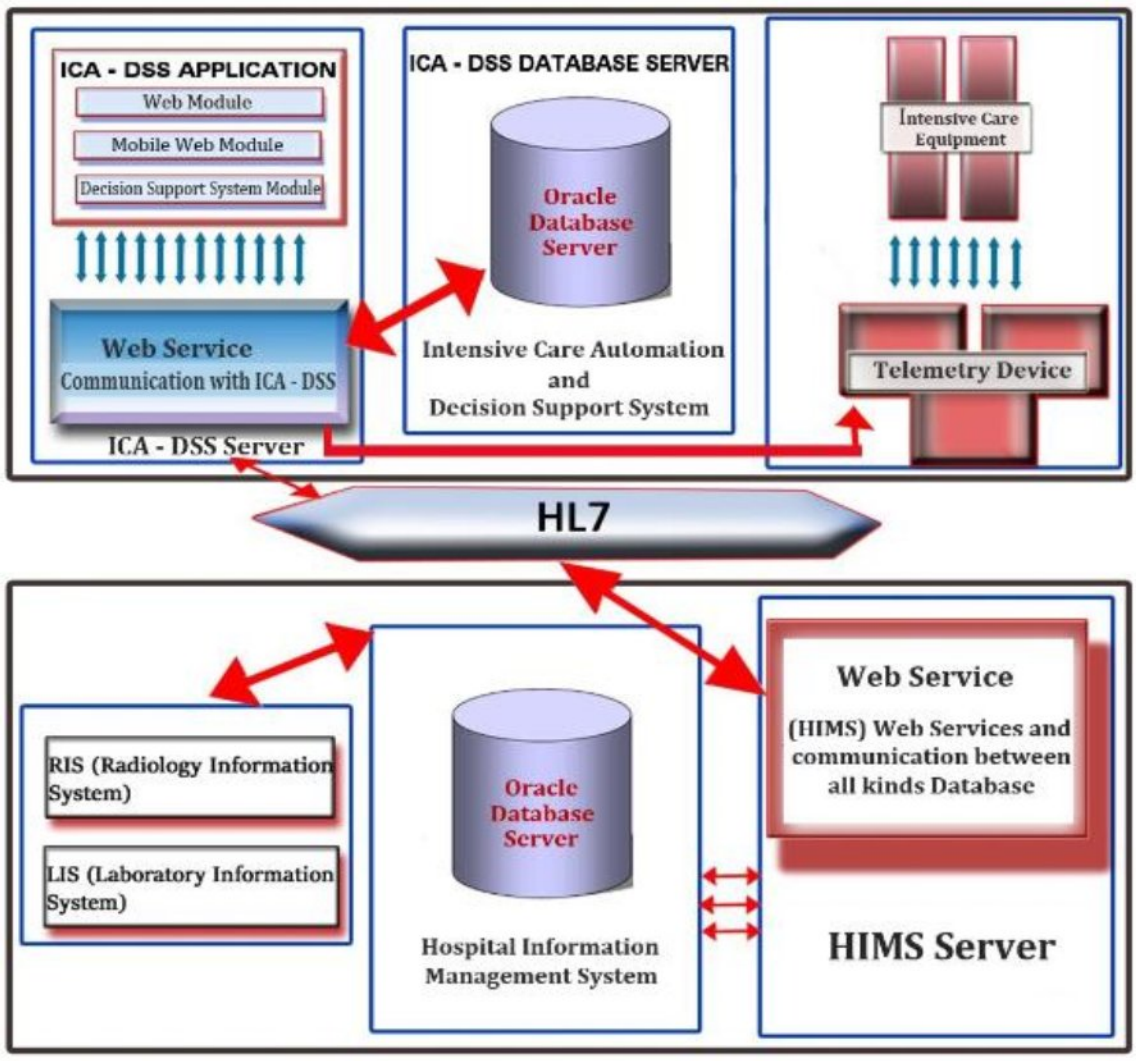


Figure 3.2 Interaction modules

Used in intensive care units of all medical devices, a device that transfers data to the snapshot automation software developoment is designed. This data can be accessed instantly via any mobile or fixed devices are recorded.

These data is based on the V model process use our software and see the data warehouse decision support system tasks.

The focus of recent research has been on Integrating with Hospital Information System intensive care unit data has been held for the first time in our country. This proposal for a Decision Support System physicians in the project will be a first removal. Patients are able to start the required sterilization process with the appropriate touch interface.

3.3 ICA-DSS Operation Steps

- Requirements Analysis;

At this stage, performing work with physicians to determine user needs and making project team meetings as software requirements are determined. The system supports all standards and requirements related to these standards to be determined (interfaces, security and performance requirements) are removed. The documentation in accordance with the standards have been defined by all the requirements are prepared.

- Design of All System Components;

Literature during the system design is held both in parallel by computer engineering, both by medical and technical / economic feasibility of the framework, the project investigated the technical approach methods to support the goals required to be achieved with and determined all the standards required to support the system.

- Data Transferred To The Intensive Care Device;

Dokuz Eylul University Faculty of Medicine at the beginning of each patient hospitalized in the Intensive Care Unit, a team providing treatment and life support equipment. Current operating system of instantaneous information from these devices in

hand with physicians and / or follow-patients by nurses are written on the form and to give direction to the treatment process according to the patient's condition from these data is realized by making inferences from these forms. This module to obtain real-time data transfer to the database through the front of the devices formed in the design stage will take place at this stage.

- Development of Intensive Care Patient Tracking Application Process;

Patient registration and connection to the service at this stage, both through the Web-Based Software Module Module via Mobile Web Web Services methods that are written question from the central database of patient medical information was carried out. Applications that can be served within the system to platforms including Mobile Web Patient Information Service do not have to connect to the database. Simultanesously, this increases the security of the system and provides the ability to support the new platform.

- Risk Identification and Development of Decision Support System;

Patient demographics, laboratory results, diagnostic and treatment data, such as results formed an important part of parameters to be investigated. Subsequently, data mining literature review on the use of algorithms, provides a vision for the work to be done.

- Development of Mobile Web Applications;

The main task is to improve the visual interface on the stage of the Mobile Web application. Therefore, considering the ease of use of mobile devices and requirements analysis to provide all of the components obtain at the design stage, doctors and taking their time nurse, fatigue and aims to perform a simple application.

- Integration and Testing of Software Modules and Pilot Application and User Tests;

The project team work together in the testing process, analyzing the potential problems are tested again.

3.4 Proposed Solution for Intensive Care Unit Clinical Decision Support System (Intensive Care Unit – Clinical Decision Support System)

Our project from the intensive care unit provides medical devices used in a system to record patient data in an instant way. It offers a solution to patient data instantly followed in intensive care units in Turkey are not stored in the electronic media, it is a big disadvantage in terms of operation and clinical research. Thanks to our project data is stored electronically and shall be protected in the effective security mechanism.

Patients in intensive care intranet and offers access to the required data after the process with the support of mobile devices were provided.

Patient data often can be taken automatically by the system software modules in the system to input some information was created. Many patients also access data on batches for clinical trials may be held in some seconds.

Intensive Care Unit and Decision Support System (ICU-DSS) hospital in the primary recording system "Hospital Information Management System" is able to communicate with the HL7 protocol.

Another factor which is enable private cloud computing innovation of our project (Private Cloud Computing) is to be used. Cloud Computing can enable on-demand capacity increase and reduction of the speed of the patient to be able to maximize the use of resources that can be easily processed information from the Dashboard. Through an Internet connection, the computer of the doctors and nurses are not need any file to be saved.

Statement of changes in that instant by whom the recorded data and amendments (Log Table) by keeping the data security of patient safety is subject to access rights to various elections increase significantly. The presence of logical relations can not be earlier differences between the data using project our domestic and the biggest

advantage of a variety of data mining on data collected from others outside algorithms can improve both the quality of patient care in this way is to be the source for both clinical trials.

Prevented the error, nurses and doctors by increasing surveillance on the improvement of care, but that will also provide automatic alerts can go to the doctor responsible in any emergency.

3.5 Vital Risk Identification Techniques for Data Mining and Decision Support System

The presence of logical relations can not be earlier differences between the data using project our domestic and the biggest advantage of a variety of data mining on data collected from others outside algorithms can improve both the quality of patient care in this way is to be the source for both clinical trials.

The project, Knowledge Discovery in Databases (Knowledge Discovery in Databases – KDD) steps (Problem Definition, Data Processing, Data Mining, Information Report) are monitored.

Clustering, Data Mining Association Rules such as classification and analysis methods are used. Neural network classification algorithms, decision trees and Bayesian, Association Rules Apriori and Fp-Growth For the analysis, clustering algorithm is also planned to be used as SOM and K-means ++.

This project demonstrates the feasibility of questioning the intensive care unit disease severity: APACHE, SOFA and RIFLE scoring standards. APACHE-I (Acute Physiology and Chronic Healthy Evoluation I-II) is a 34-parameter classification system. Initially, patients with APS (Acute Physiology Score) lead to chronic health conditions are taken into account APACHE-II which is in simplified form, is based on the evaluation of 12 physiological parameters. General condition of the patient, age 12, and admission to the

hospital the following physiological measurements, including the worst value in the first 24 hours it takes into account the three groups score. APACHE-II system uses in thousands of patients in multiple centers prospectively and enables comparison of different treatment methods. RIFLE (Risk-Injury-Failure-Loss-End stage renal disease) is the most commonly used staging system. RIFLE, violence three phased (risk, injury, failure) as well as the identification of two separate clinics Results (loss, end stage renal disease) presents. SOFA (Sequential Organ Failure Assessment) is a morbidity scoring system and also improve from a huge sample of Intensive Care Unit patients. Unlike other scoring systems like APACHE II and RIFLE, SOFA is designed for organ dysfunction and morbidity.

It has been shown that, Apache and Sofa which are intensive care unit scoring standards are used as Rifle. In addition, Decision Support Systems for solving complex problems of ensuring the effective use of data and models are created. Thus, this system are able to identify situations that could occur in advance, instant analysis capabilities and provides the advanced communications capabilities.

3.6 The Advantages of the Project

The main customer of the project outputs are domestic and abroad adult intensive care clinics. The resources allocate to the health sector in our country and focus on the human health is the one. In addition to this, the fastest growing sector of the fastest growing and needs abroad is increasing day by day. In our country, there is a similar solution for automation in our project. Almost all projects are imported from abroad and similar solutions, the prices are quite high. By providing a significant competitive advantage for our produce domestic solution, both increases and decreases in the market share. Moreover, ensuring situated decision support in the project, Intensive Care Service Devices Hospital Information System integration and tracking of patient information using mobile devices based on analytical methods and estimation procedures are opened to the many innovations sectors such as management. Today, all features are no more than the anticipated hosting Turkish-backed products.

CHAPTER FOUR
ARCHITECTURE

4.1 System Installation Requirements

System Installation Requirements are needed to 4 GB SDHC memory card. Raspberry RPI Linux based operating system. SD Card is used for the computer. Win32DiskImage program is used to write the image files for the card.

4.2 System Architecture

In the first activity of requirements analysis software it is set user and hardware requirements. The second activity is the software functions. The third activity is discussed on safety and performance. In addition to this, the fourth function of the requirements of the activity has been reported to associate with each other.

Made in regular meetings with our physicians working in intensive care needs have been identified during the requirements analysis package. If the device is the second work package we will talk about the transfer of data, protocols, devices (0. Index heart rate, blood pressure 10) were identified.

4.3 Audio Cable Connection

For example, it seems a Response obtained rest from Drager device.

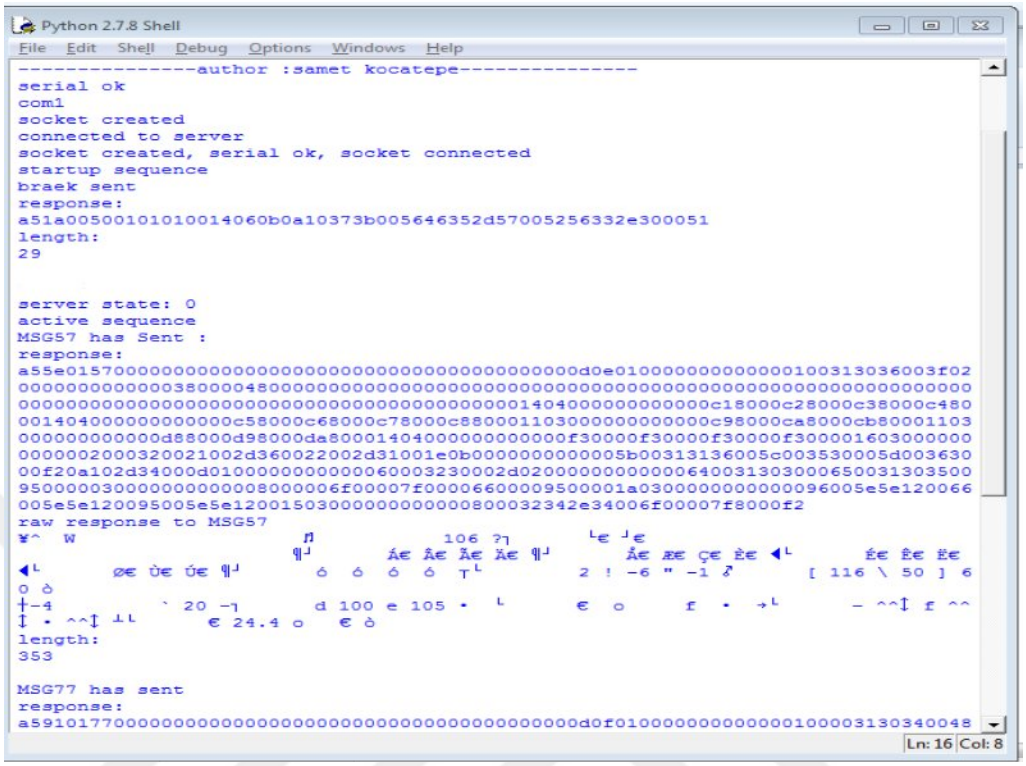


Figure 4.1 Message from the telemetry device

The creation of telemetry devices and Database to our significant transfer process has been completed via Web Services. The message which collects from the device have been inserted to the database after read and resolve in the system.

These messages are distinct in every device according to the identification mark. By means of this, resolving process have to be done in each devices. After that, data starts to be added to the system from the telemetry device.

As noticed in Figure 4.2, there is no matter which brand of device that is installed in order to insert the data to the system.

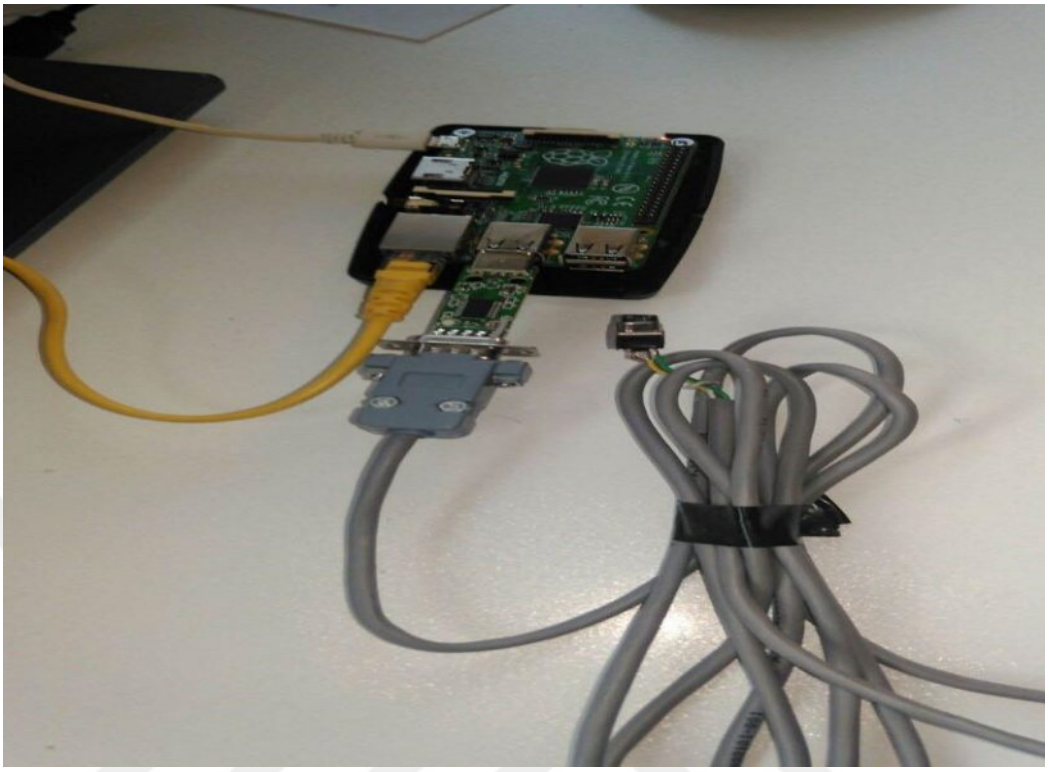


Figure 4.2 Telemetry device

Telemetry device creation and the transfer of significant transactions through our Database, Web services is completed by a large majority. Owing to the telemetry device, the devices brand in Hamilton, Drager, Galileo and so on can analyze the data.

All data have been collected in a single device. Thus, it is a very useful telemetry device which is produced. In addition to this, telemetry device connection is shown in Figure 4.3.

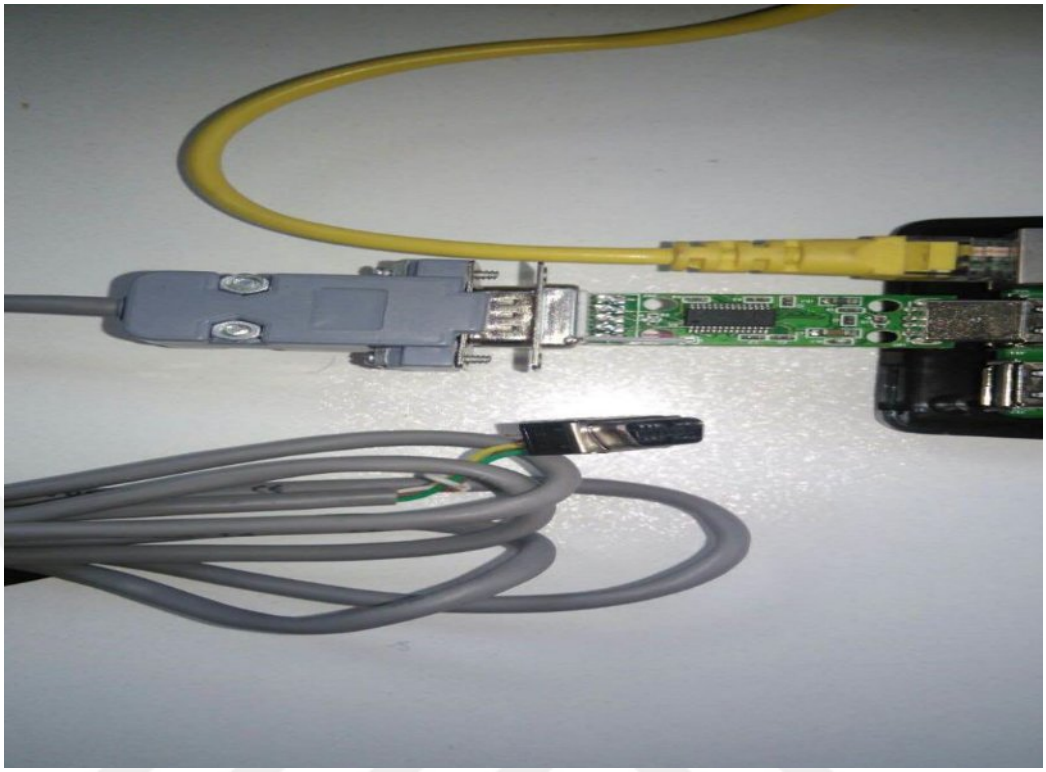


Figure 4.3 Telemetry device connection

4.4 Database Design

Database of Intensive Care Automation and Decision Support System project is created in Oracle. Oracle database software is especially common database systems have used in the corporate field. Oracle consists of a number of tools and also allows easy development flexible applications.

As with other database management systems at Oracle, stored procedures, packages, components such as triggers are also included. It can hold large amounts of data and offers the possibility of adjusting the areas where the data is stored.

Oracle can simultaneously serve a plurality of disrupting the integrity of the user. Operating system, data access language and is compatible with standard networking protocols.

It also provides the possibility to control and prevent unauthorized access. Integrity can provide the database level, by this way less code is written. Client / server architecture can use all the advantages.

Oracle is a relational database management system, and thus the Oracle products are often used in applications that require the large-scale data control.

Another of the advantages, primarily a network Oracle database installed on a computer called a server only. The server may be running with any operating system supported by Oracle. So Oracle has different versions for different operating systems.

Oracle features performance, reliability, security, and virtualization increases efficiency and therefore provides full compatibility with existing rich portfolio of application software products have been developed within the company by third parties.

In addition, Oracle partners, mobile solutions, reporting, human resources, enterprise resource planning to field sales taking place at the summit with solutions such as the automation of Oracle data base of institutional knowledge of the foremost institutions with enhanced features and workflows, faster and safely take control of their including features that will allow, it brings several advantages.

4.4.1 Static Tables and Static Log Tables

As a result of requirements analysis, it need to create 4 different types of table. (Static- in dynamic intervals and log tables including)

When we talk about the purpose of static table: date based on unchanging, all general not connected to patients in intensive care unit

There are tables containing titles. For example, subheadings body temperature in the static vital follow-up statement is the heart rate and blood pressure.

Another main reason for the creation of our static table; new case from the admin panel for use in other projects in our hospital

Our projects can be added to ensure that the vital follow-up sub-titles are easy to integrins.

In the log table; when there is any change in the static table is transmitted in the same way in the log table. IP address, MAC address, date and it holds that the user makes. Static tables are created in order to insert the unchanging data into to the system. In addition to this, static tables are improved for admin pages. The users can change the data by using the static tables.

Methods of static tables;

Table 4.1 Methods of static tables

statikAktivite Ekle	isim	periyot		
statikAlerjiEkle	isim			
statikAtesliPerspiratioEkle	ates1	ates2	deger	birim
statikBasiAktiviteEkle	isim	puan	periyot	aciklama
statikBasiBasliklarEkle	isim	aciklama		
statikDigerEkle	isim	periyot		
statikDigerGunEkle	isim			
statikDrenBolgeEkle	isim			
statikDrenCesitleriEkle	isim			
statikDrenYeriEkle	isim			
statikGirdiTipEkle	isim			

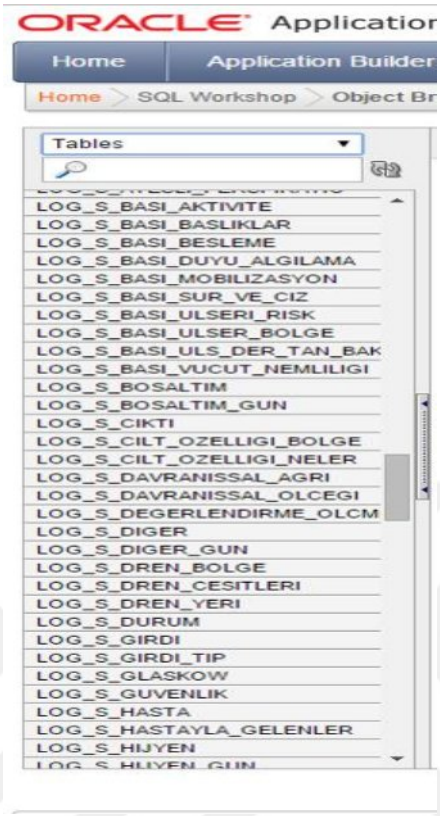


Figure 4.4 Methods of static log tables

4.4.2 Dynamic Tables and Log Tables

The purpose of the establishment of our dynamic table; based on the date depending on the patient and the associated static tables are tables that hang their elaboration process has been done. To give an example from the dynamic vital follow-up table which monitor vital date on which the patient, which the user is registered with the results which made the vital follow-up process.

We see the log table for changes in our dynamic table. Our goal here is because of sudden changes affecting the status of patients in the intensive care unit at any time transactions made for each user, is recorded. When forensic been created to provide recycling.

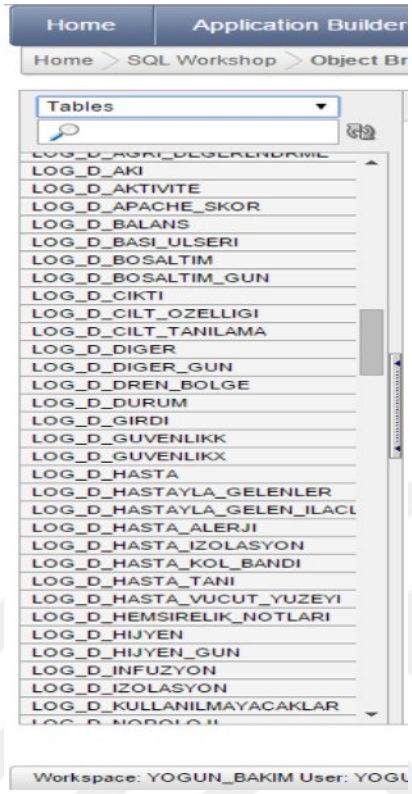


Figure 4.5 Methods of dynamic log tables

4.4.3 Periot Tables

Medication of a patient's disease levels in the ICU varies maintenance and other audiences. Therefore, any action at different periods on a daily basis for each patient must be followed. That is going to give this timeline, it is the period table for each title. Hasta_id, operation_id, a period and history.

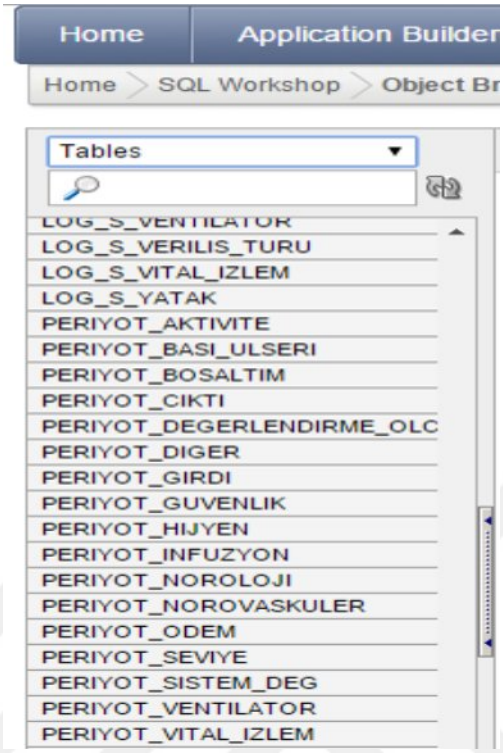


Figure 4.6 Methods of periot tables

4.4.4 Views

To make reporting easier, we are combining our Viewer Static and Dynamic statements. Data mining while fresh data we have created in order to bring together Viewer. The aim of the view tables is to observe the data of the nested tables. By creating the views, the static and dynamic tables have become more accessible to see all data.

In addition to this, the goal of these views are the virtual tables by using the Select queries. It provides the questioning again and also simplifies the complex queries. This reduces the query time and reduces traffic on.

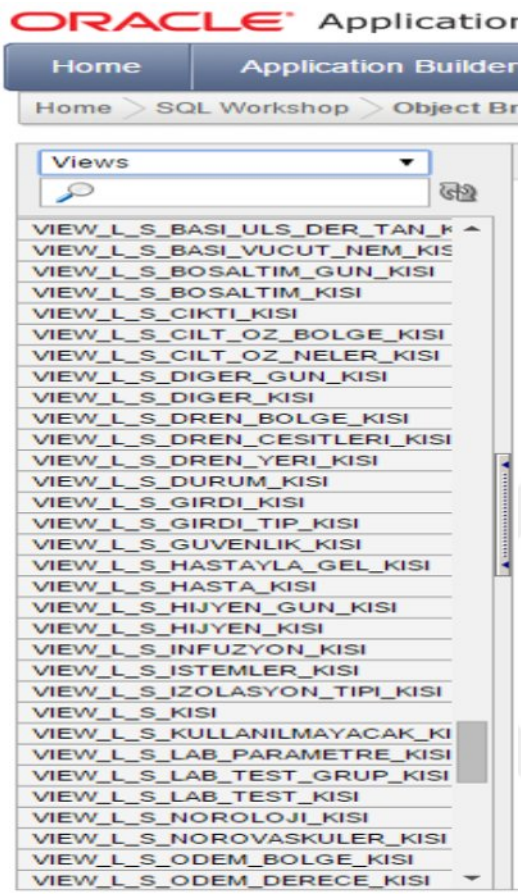


Figure 4.7 Methods of static log views

Log tables have been created in order to insert the operations to the database. When the users actualize the operations in the application, data is inserted to table. By means of this, it is easy to check which processes are used. If there is a statment in view which operations such as insert, delete and so on, it can be done easily. In order to modify on views, Alter operation has to be written. Through; view of data definition, it is possible to people that which is wanted to control. Drop clause is used to create or delete on a view which is necessary for the authorization.

Between our class employees with our Application Database

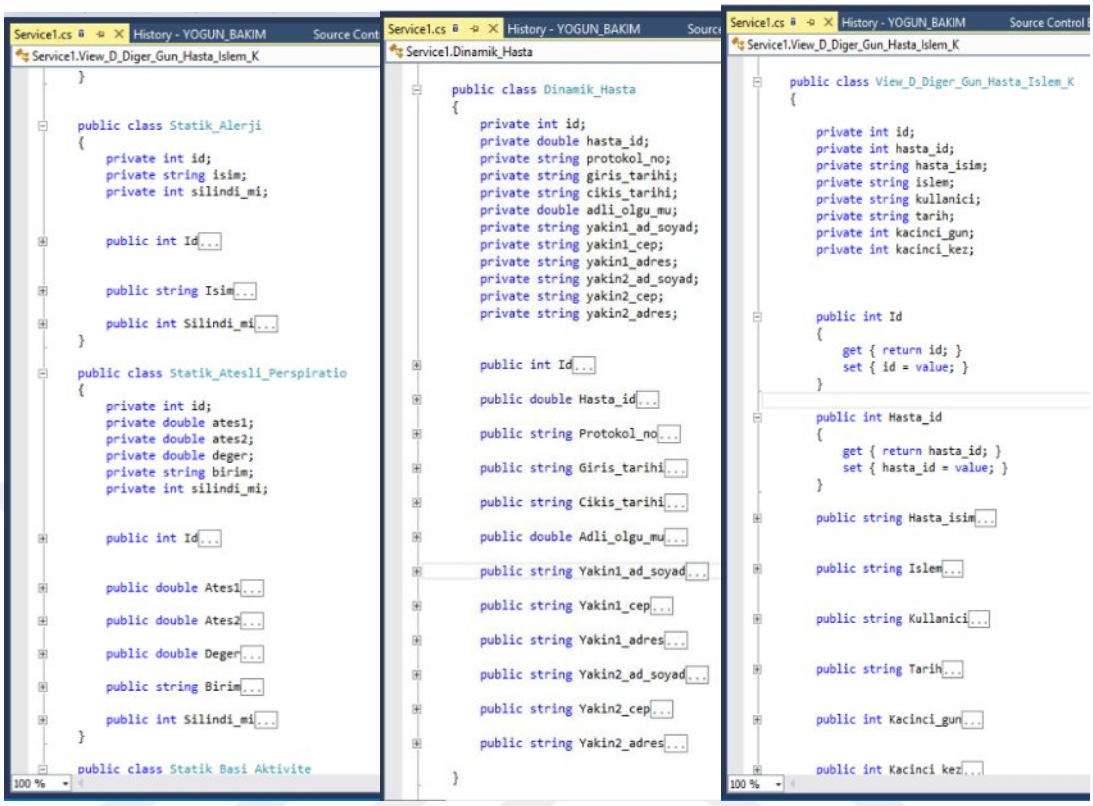


Figure 4.8 Methods in service

There are two basic pages which all patients can see. The first one is in the list view. One of the big advantages of this view is the history of our patients to access. Discharge, treatment and care of all exe have been carried out in other services or have been removed even though the intensive care unit can be made through this list view page.

The first stage is based on a specific date range listed patients from Hospital Information Management System of patient information and the page can be seen more as new patients are added as needed. In this section the patient's Name, Last Name, Gender, Age and Identity Number, Protocol Number, diagnosis, condition, entry and exit dates, general information about whether or not there are legal cases.

In this section users can choose the dates that they want to see patients who have or may in history. Preliminary information related to the patient which is important when it is required to add a new patient is entered and is being completed in the patient record.

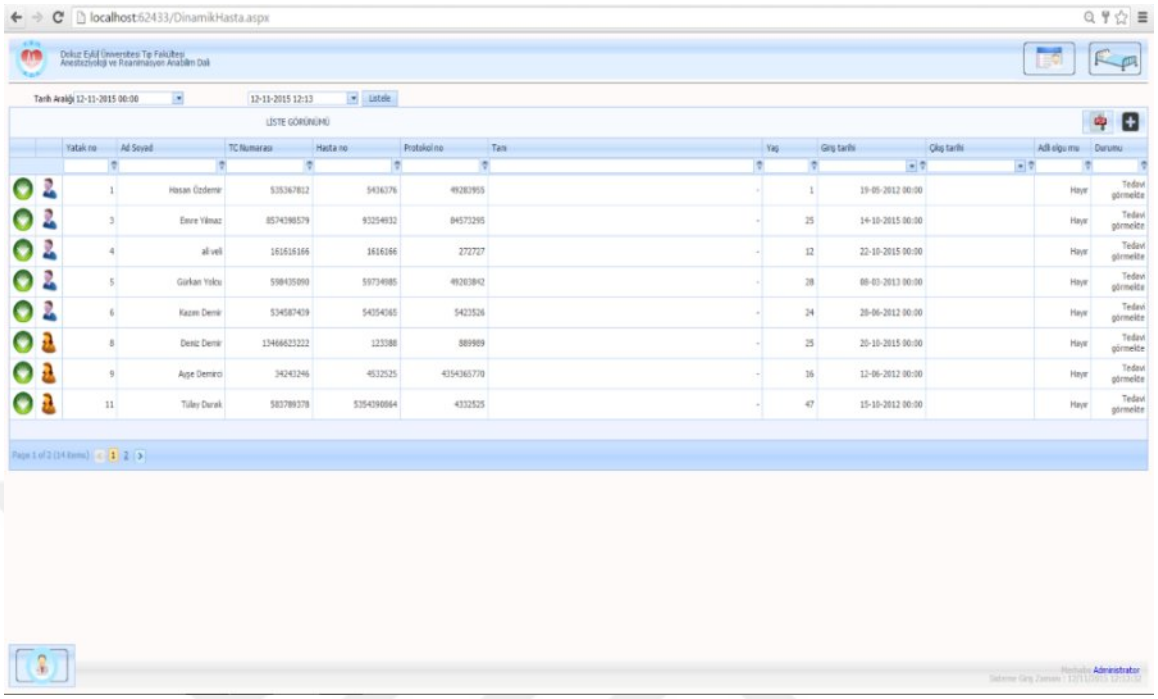


Figure 4.9 List of patients

This is illustrated in Figure 5 that if you press the up arrow key in the list view relevant patient beds, cases, relatives, attending physician, nurse responsible for scoring and relevant theme to-date information can be seen.

By pressing the i icon to go into the details of the transactions can be made via pop-up, just clicked the patient data is displayed on the page at the moment, it does not appear if you press the down arrow key to the information.

To enter more detailed information about the patient ( ) close to the profile of the patient by clicking on the button, the patient bed number, patient status information, the responsible physician, nurse responsible for arm band wearer information, patient apache, rifle and sofa score information can be added in this section and can be updated.

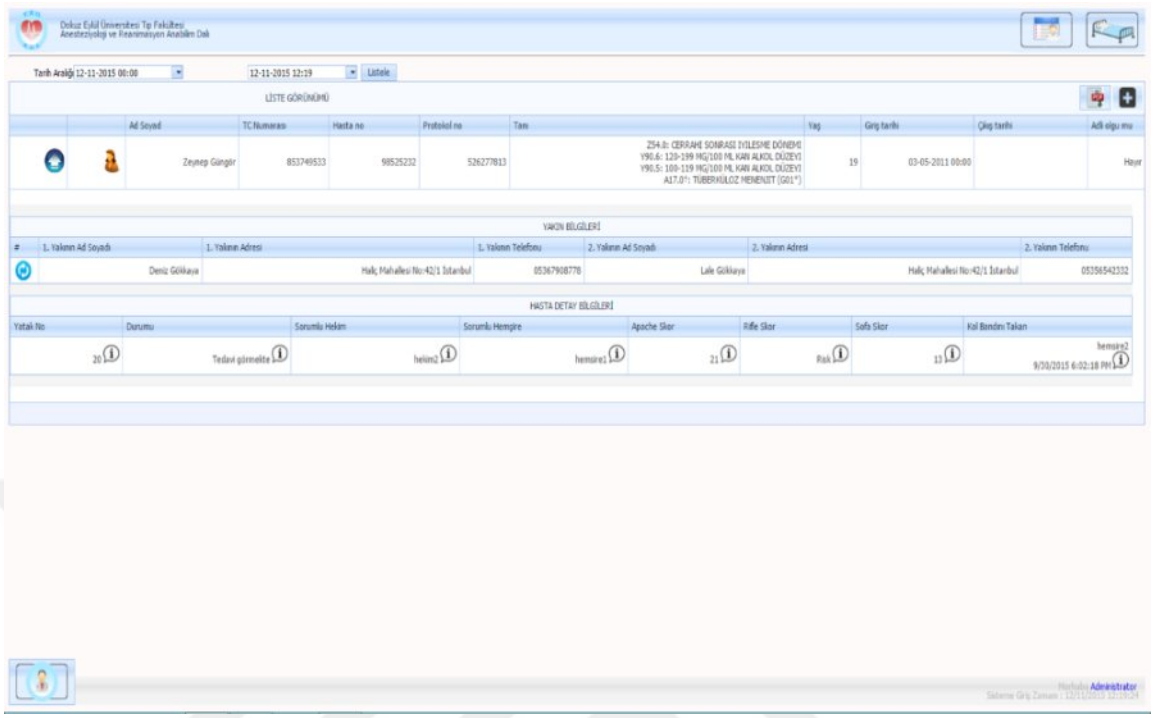


Figure 4.10 Patients detail information

As follows from the figures shown above, detail page is accessed by selecting the patient from the patient list view. This page is open on one monitor at the top of the page to be found in all patients. All patient-related transactions will be managed by doctors and nurses on this page.

Other pages will only be used by physicians and nurses responsible. Ventilator, monitoring of vital inputs and outputs are located on the same page as lab results graphically is the most important titles. This section will list on the bed one bed for patients when choosing idle. In addition to this, information can be updated by the existing bed and delete operations can be performed. The first patient is included when the situation is as patient registration, patient bed assignment after performing as a treatment for patients with status information is changing. At a later stage it can be updated based on patient status conditions. In short, adding the situation in this part, it is able to delete and update operations. After adding the patients of doctors and nurses

assignment procedures are carried out. Adding to change the information doctors and nurses when necessary, delete and update operations can also be performed.

Patients are initially recorded when it is attached to the arm band to the patient. There are patients in arm band name and protocol number. In this section, it is added the officer wearing the armband patients, delete and update parts can be realized. As a result, patients' relatives information, inpatient data, the patient's condition, the physician in charge of the table after the charge nurse and armband detail information is updated as in the figure attached.

At the beginning, ventilator patients see instant and future data from the Vital follow-up device to keep track of patient follow-up nursing care plans in the form. In this way, it will be clearly stood at the bedside constantly following screen. In the event of any data from the device, when maintenance needs to be done in a critical condition, the panel will alert the physician or nurse or icons changing color.

There is a total of five panel in this section. It is watched by nursing care of the patient is the first title in the form panel is located. They are divided among themselves in terms of coloring. The first part of the Pain Assessment, Braden Scale Score Pressure Ulcer and neurology nurses in critical condition, according to calculations made by changing the colors themselves are warned. That security in other parts, other, Excretion, Activity, Infusion, Hygiene, neurovascular, such areas are colored by the System Assessment carried out period if it's time for a necessary procedure to the patient and gives warning. Adding data by clicking on this icon, update and delete operations can be performed.



Figure 4.11 Patients detail page

Patients ranked according to the number of beds in the bedroom view that we are second main pages of icons to access detailed information. The purpose of this is to give warning of icons outside of the color red is converted to an emergency.

Bedroom view is the page where the bed as the doctor checks listed based on all patients. Follow the doctor the patient's vital on this page, ventilator, neurology, laboratory, Input-Output can see the results in detail when clicking on the appropriate icon. Simultaneously, personal information about the patient has been achieved by pressure to the bearing number. Order by clicking on the icon that should be given to the patient medication record system, and also this is recorded in the entry of drugs that nurses are shown to give to the patient. Finally, the patient-related morbidity scoring description page, the mortality rate can be calculated with a variety of scoring systems.

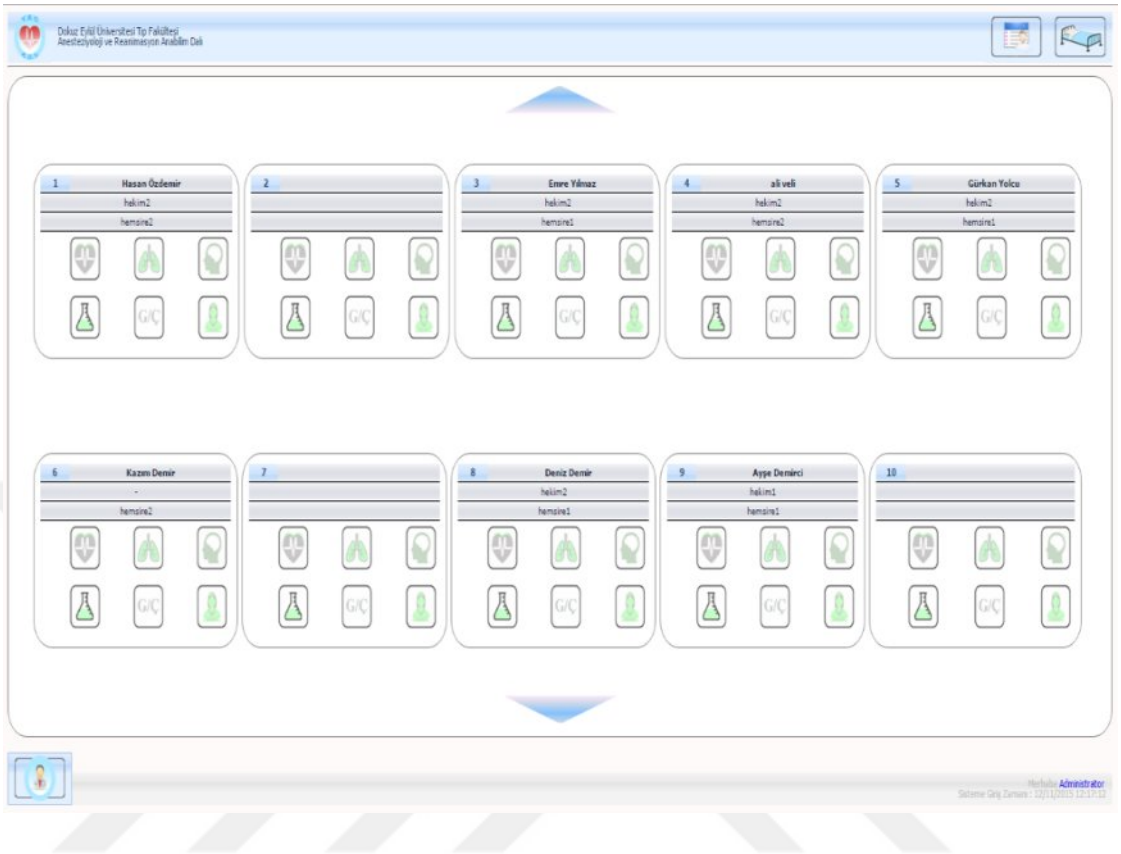


Figure 4.12 The list of patients

Intensive Care Automation and Decision Support System project of the Mobile Web section that provides all of the components obtained with the physicians and nurses who take their time, look and simple application have been carried out. Mobile Web applications in a centralized database connection fourth Pack Patient Information Service is prepared to provide methods. Doctors and nurses in the intensive care unit will be able to easily interface with the mobile tracking system from the patient information on mobile devices.

In this way, doctors and nurses will be forwarded information to be carried quickly and communicate with the device as a warning when any emergency. Additionally, it is going to be instant tracking system interventions will be carried out easily. The data of the patient by facilitating the use of the mobile base that provides both safe and quickly be achieved.

First, when entering the system with mobile devices in mobile applications where the list of currently shows an overview of patients hospitalized in intensive care. A patient is chosen from this list that reached the page with the more detailed information about the patient.

By means of this, the doctor can see the all patients's health situations about their maintenance. If there is a bad situation, the system is going to begin providing system alarm. Thus, doctors and nurses can intervene immediately. With the bed list view, the doctors can provide the opportunity in order to look again at the situation of patients. This page has access to facilities only for the doctors.

However; as a special case, it is given the same authority responsible for the nurses. When there is an emergency situation, the alarm warning system are apperance for the doctors and nurses in the bed pages. If the icon alarm is clicked, the patient's details page can be reached for responsible doctors and nurses. Whereby the interference can be done immediately.

CHAPTER FIVE
THE APPLICATION

5.1 Mobile Design

All subtitles at the Web application on this page is represented by an icon. Detailed information of the patient, ventilator and vital follow-up device data received in real time from the nursing care plans.

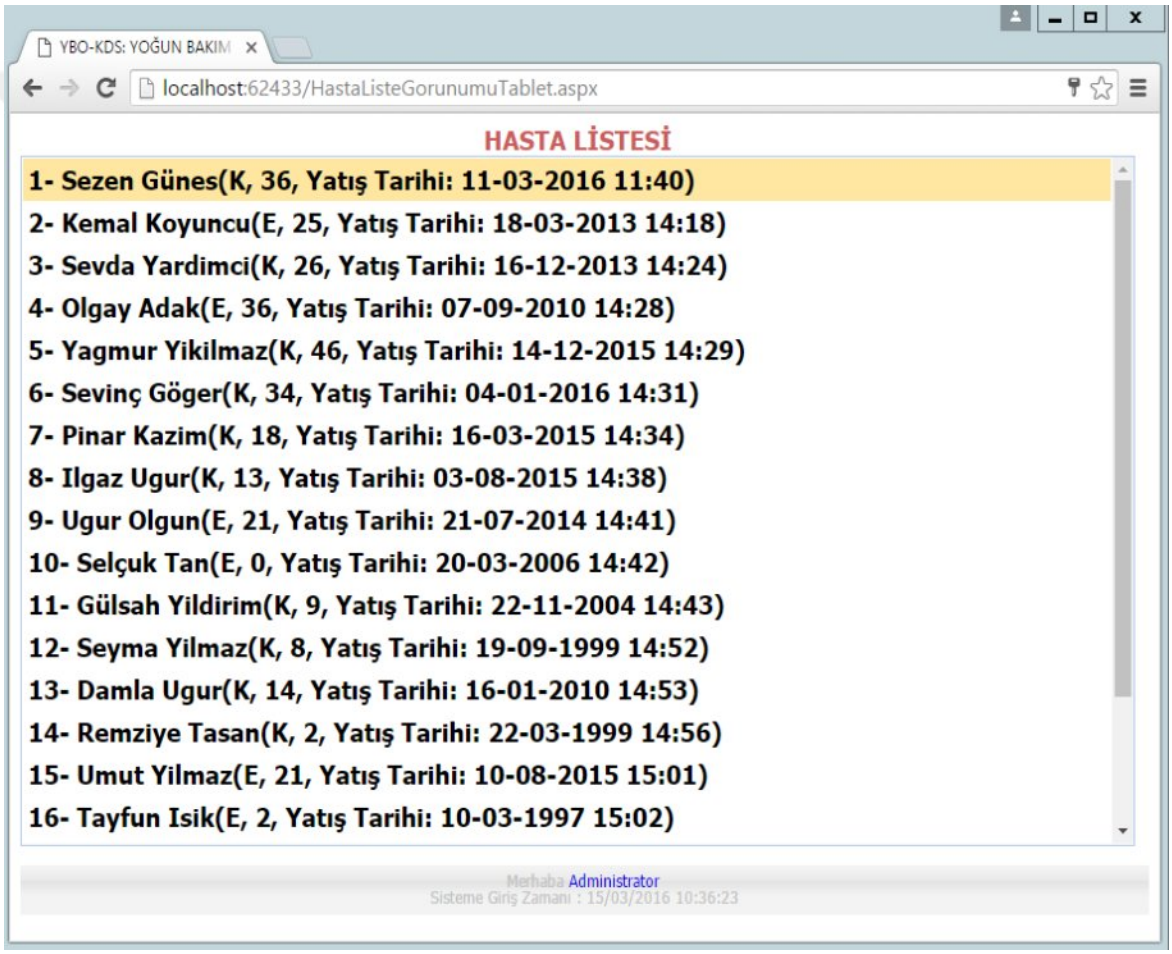


Figure 5.1 Patient list for mobile design

Physician medication order information, admin operations to do the part, and intensive care unit used scoring ups related calculations page is accessed through this icon.

The most important point given by doctors, it is required an appearance in general to special. Whereby, each desired item would be capable of being accessible by clicking directly without any difficulty for the nurses and doctors. The alarm system is also available for this patient information details view.



Figure 5.2 Patient information icons

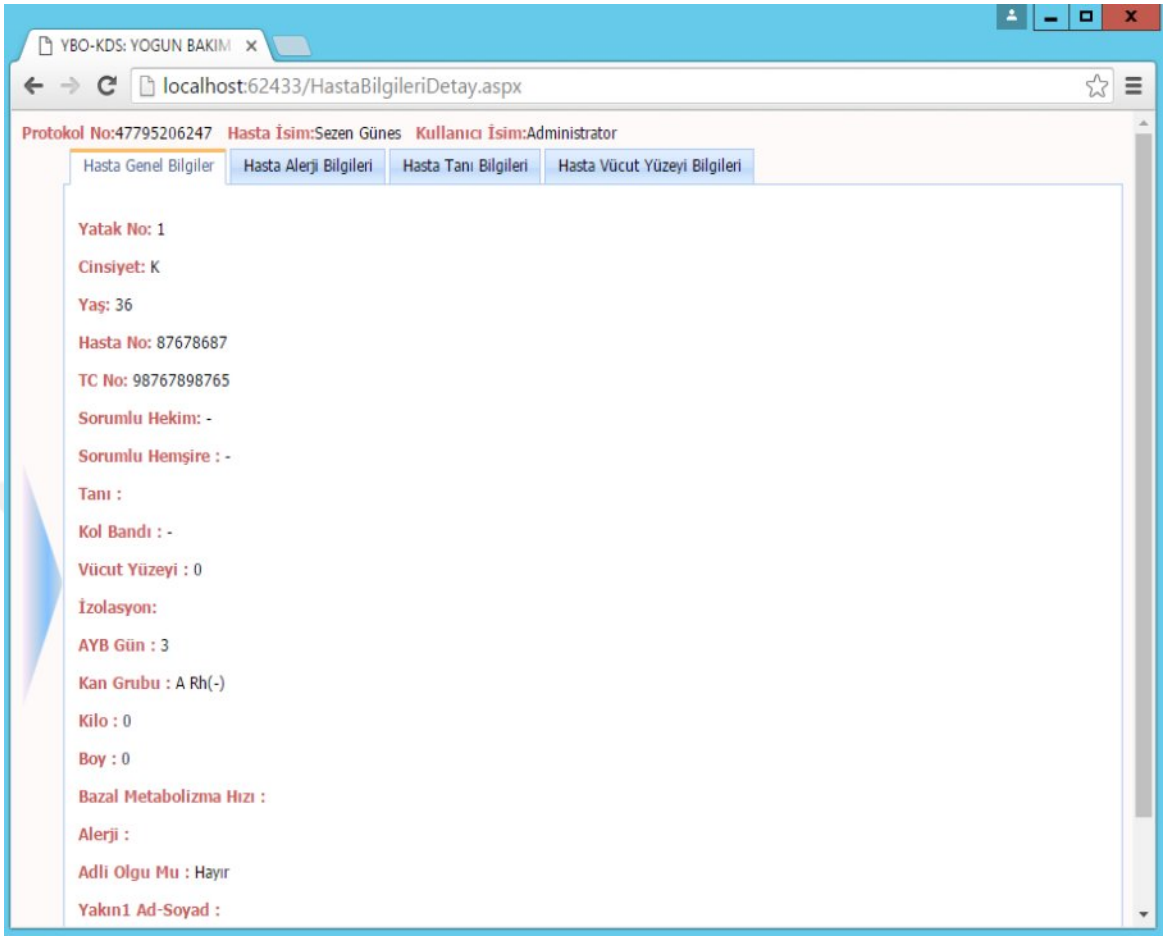


Figure 5.3 General patient information

When the first icon is pressed, patients Detail Information page is opened. In this section, the patient's name, last name, gender, age, attending physician, nurse responsible for the diagnosis, etc. In the other tab, patient allergy information, a part related to patient diagnostic information and patient's body surface area calculation.

Diagnosis of patients with allergies this section and add, delete and update operations are performed. When the patients first came to the service, landing page is filled by the responsible doctors.

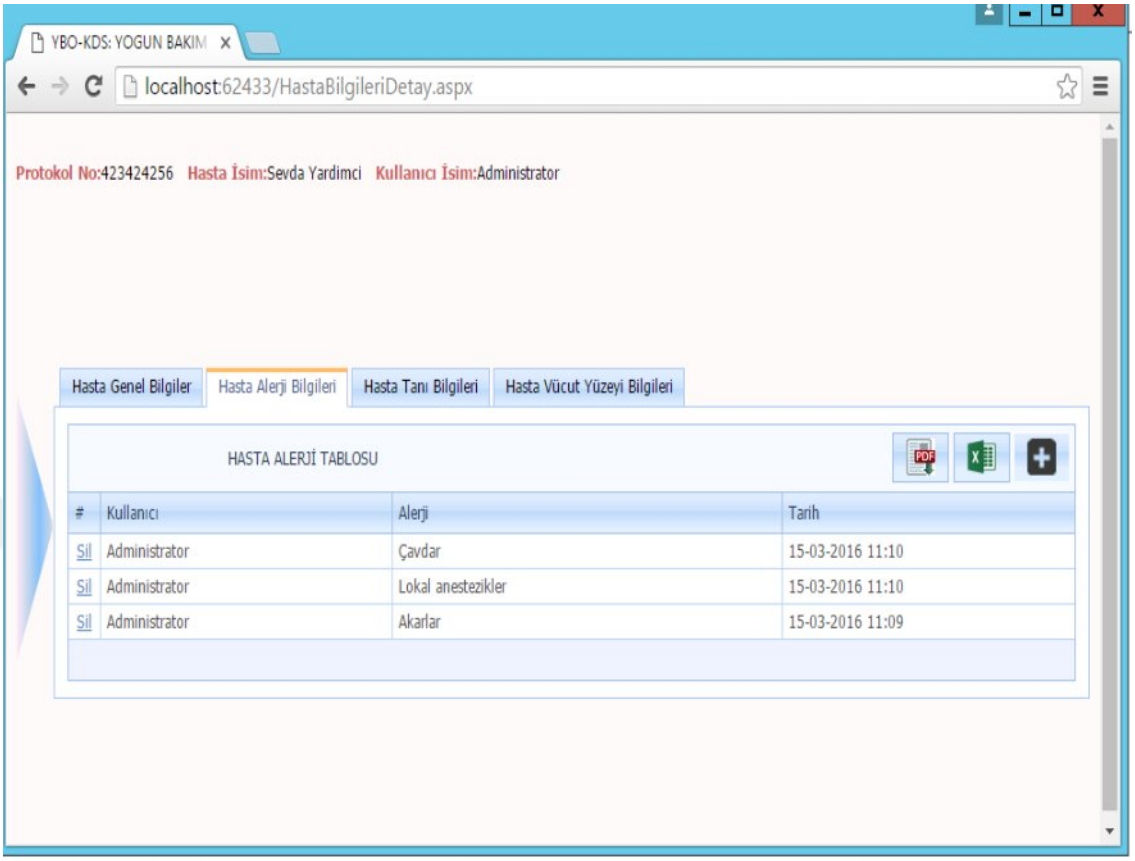


Figure 5.4 Patient allergy information

Patient diagnosis, allergies and Body Surface Area Detail page to enter patient information at the patient's bed number is written must be clicked the icon. Screen pop-patient diagnosis, allergies, body surface to add information, delete and update operations can be performed.

The users, allergies and patient history information are located in the allergies table. These information can also save as pdf and excel paper in order to check the patients's details. If the doctor want to add the new allergy, the icon which appears as a plus can be clicked for adding.

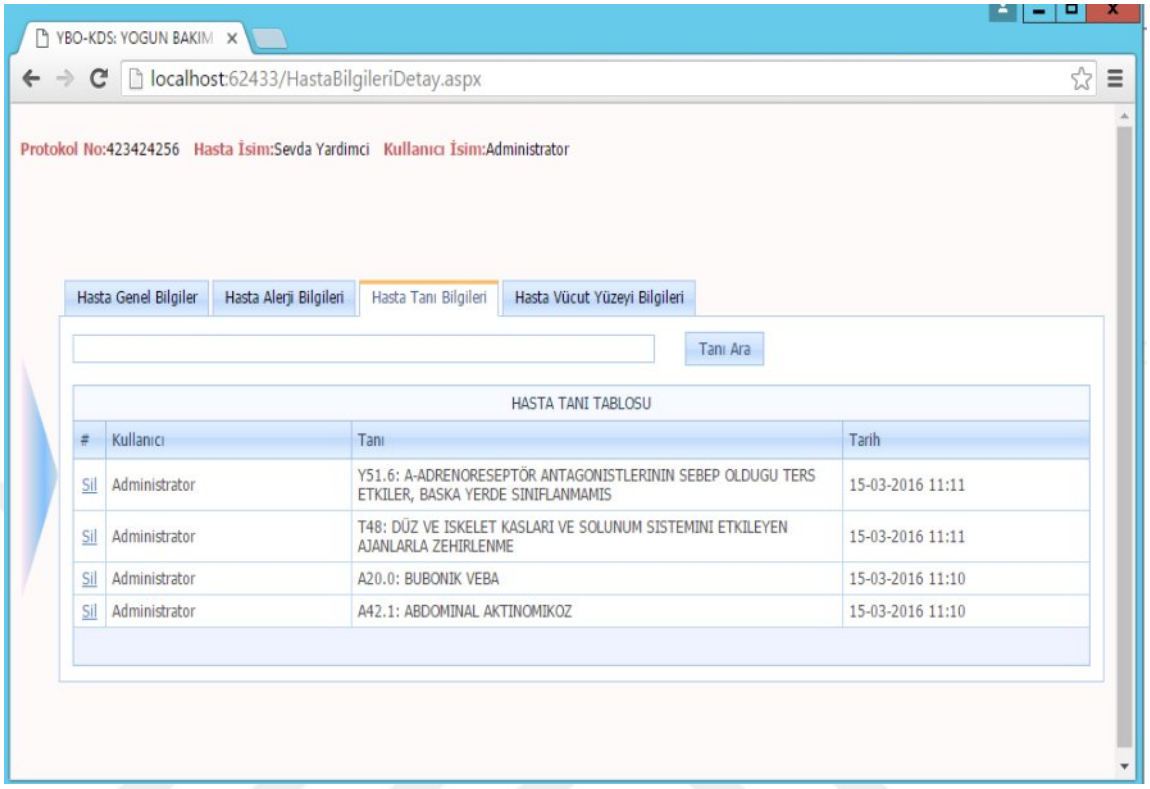


Figure 5.5 Patient diagnosis information

The patient's height and weight recorded in the patient's body surface tab is calculated by entering the body surface.

As mentioned earlier, it is also possible to update and delete operations can be performed as in the other portion. With the patient’s diagnostic history information of patients can be seen. The user, diagnosis and date information is included in the patient diagnosis table. By the search button, it is possible to recognize the diagnostic sought easily.

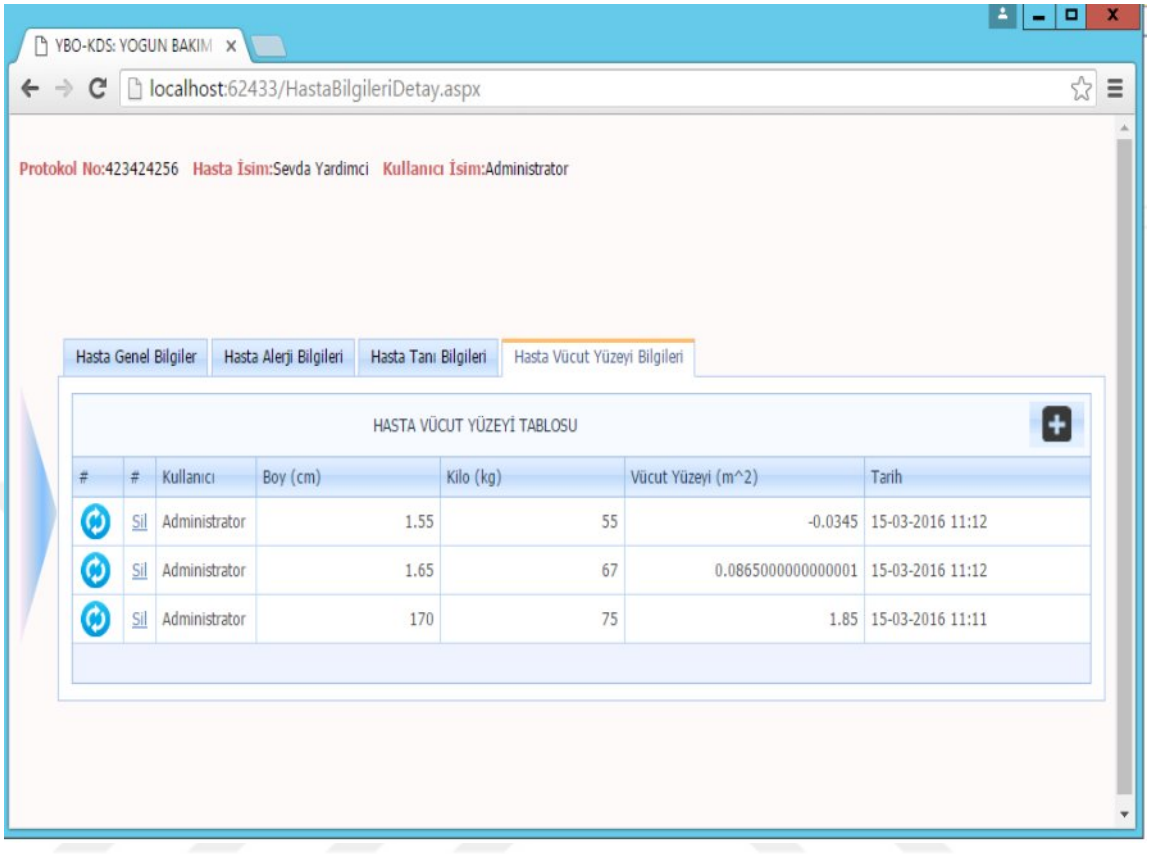


Figure 5.6 Patient body surface information

Nursing care plans in the activity should be done in a certain period, excretion, Hygiene, Safety, Other, Infusion System Assessment, a sub-project in areas such as neurovascular and they are represented by an icon. For example, in the Activity Details page that there are procedures to be done at certain intervals related to the patient and the nurse caring for the patient that can be done by pressing the button marked time is updated in order to make these operations. In addition, all of the transactions made during the day can be seen through the other tabs. If the color of the icon is not done in time to alert, the patient to the required processes are changing the nurse or physician. These operations return to normal when the color of the icon in the specified time.

This process applies to all other areas must be connected to the above-mentioned period.

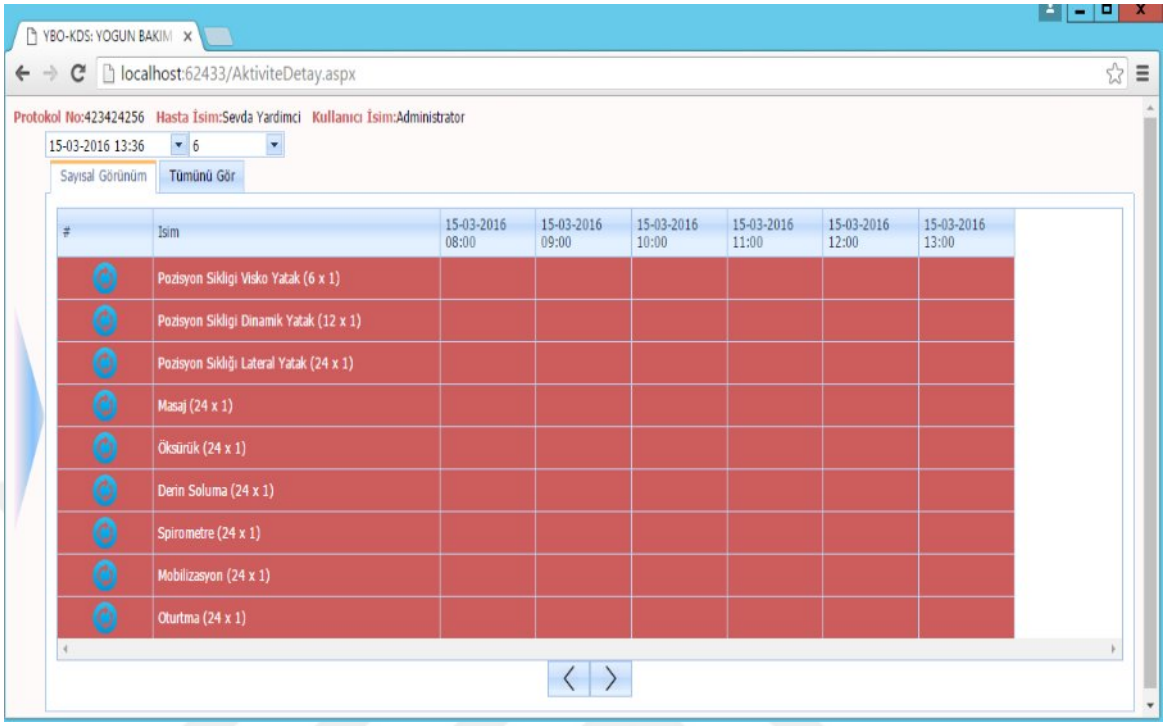


Figure 5.7 Patient week activity detail information

Specific classification and scoring systems are used to assess the patient's condition in intensive care. Apache-II, Sapsan-II, Glasgow, Four scores and Rifle, Akin are classified. Scoring icon is pressed when the page is redirected to the calculations for the scorings and the calculations are done here.

Icons related to nursing care of patients in the first panel in the Details page is located. The first part of the Pain Assessment, Braden Scale Score Pressure Ulcer and neurology nurses in critical condition, according to calculations made by changing the colors themselves are warned.

Activity Digital View pages in minutes, hourly, daily, and add data shows Activity information upon request as well, the update process can be performed. In addition, all parameters in the Insert tab Data made for the convenience of doctors and nurses can be added simultaneously.

Activity Graphical View tab graphically shows the change in the patient's nursing score, and other sub-parameters. There is also a button which last recorded data to use the data to be repeated for the convenience of the doctors and nurses Digital View tab.

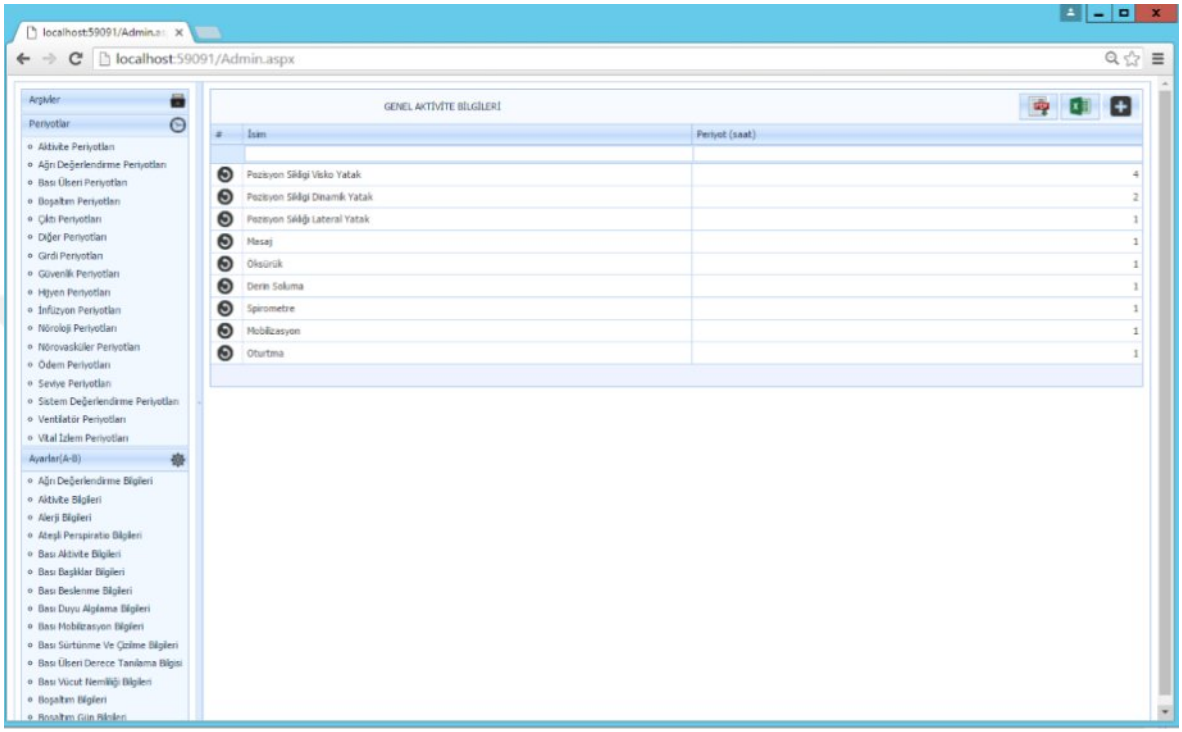


Figure 5.8 Admin operations-settings

Pressing the Admin icon where the operations master can be performed redirected to the admin page. Admin page on the Settings tab in the user name and period of patient follow-up in the areas where the form (h) information and keep the page that contains the same time can also be added and updated. There is no wiping operation. In addition to this, only deletion is disabled by changing the color of the desired field of use.

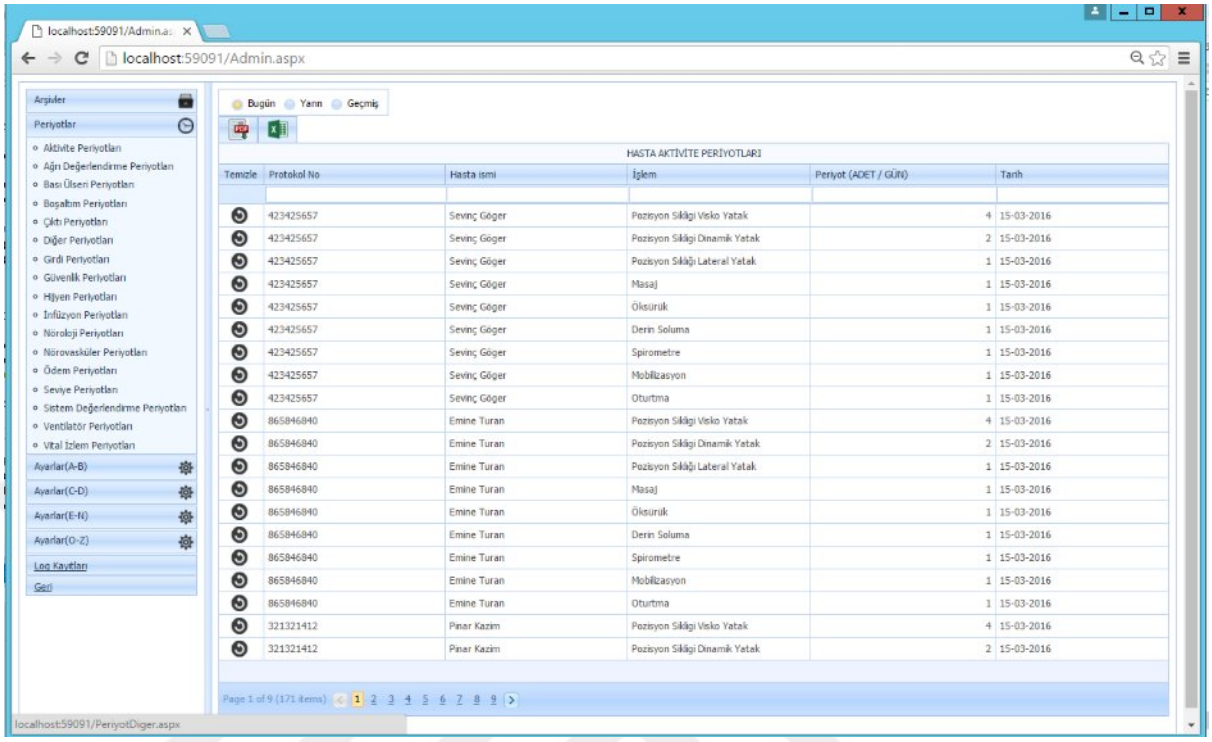


Figure 5.9 Admin-operations periods

Period tab on the Admin page in intensive care units in place or being received by the pages of the period are based transactions patients. Period of each transaction as patients based on these pages can be changed.

That day in the night and the next day for each patient at 12:00 of the period in which an application is written in addition. Thus, it is created a dynamic structure. In addition to this, there are periot pages which are available for the admin periot pages. By means of this, responsible nurses and doctors can change the periot for the patients.

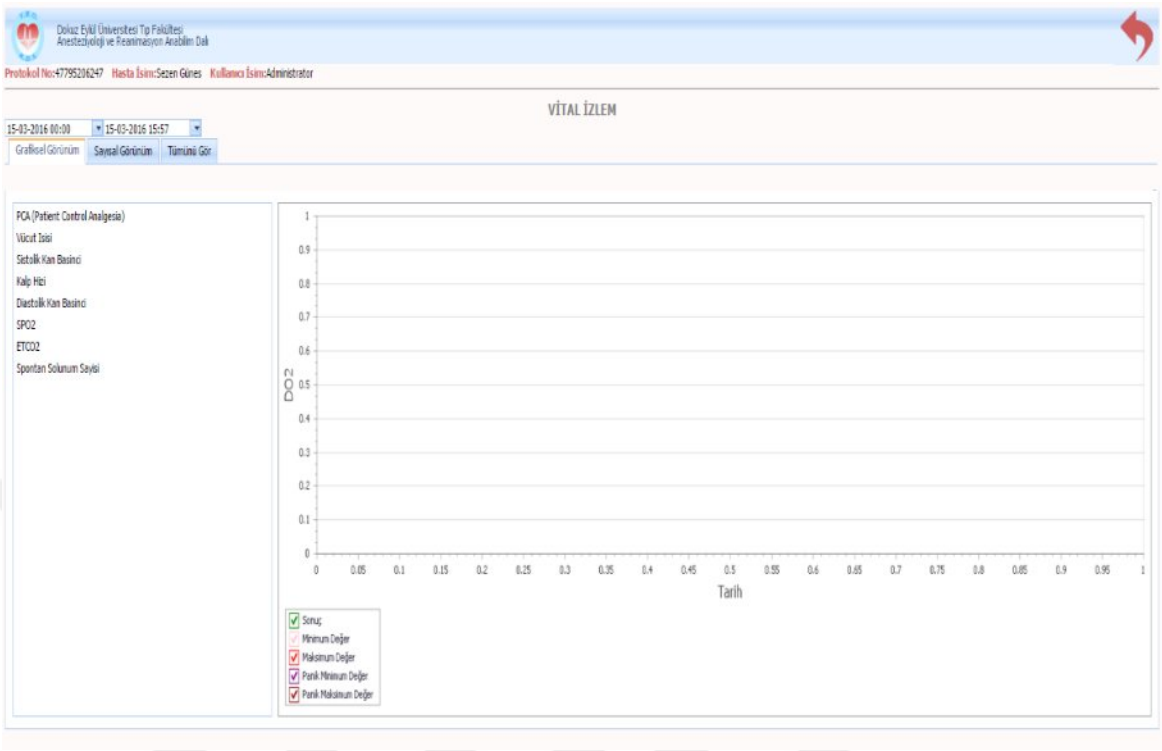


Figure 5.10 Vital follow detail

After clicking on the icon Follow Vital Graphical View, Digital Look and see all the tabs opened. Data is transferred to the system after the data coming from the device to place the process Purse. Then, there is the opportunity to see the data graphically in the Graphical View tab. If there is any trouble with the device, the opportunity to be saved to a database snapshot of the data provided. When all View tab is clicked, the data of which we see in the field Follow Vital and the date on which he recorded.

When the ventilator icon is clicked, the same way Graphical View, Digital View and see all the tabs opened. In order to see all the tabs, a detailed search of the patient and the date on which any date when entered, it is the opportunity to see what value the vital follow-up are provided.

Besides, Input / Output When the icon is clicked, the Graphical View of Input - Output of parts are available. In the numerical view of Input and Output List are available.

The all view tab, input - output list user transaction type, issue type, value, is composed of units and History section.

In the same way, this project has shown that all operations performed in the web application can also be performed in the mobile part.

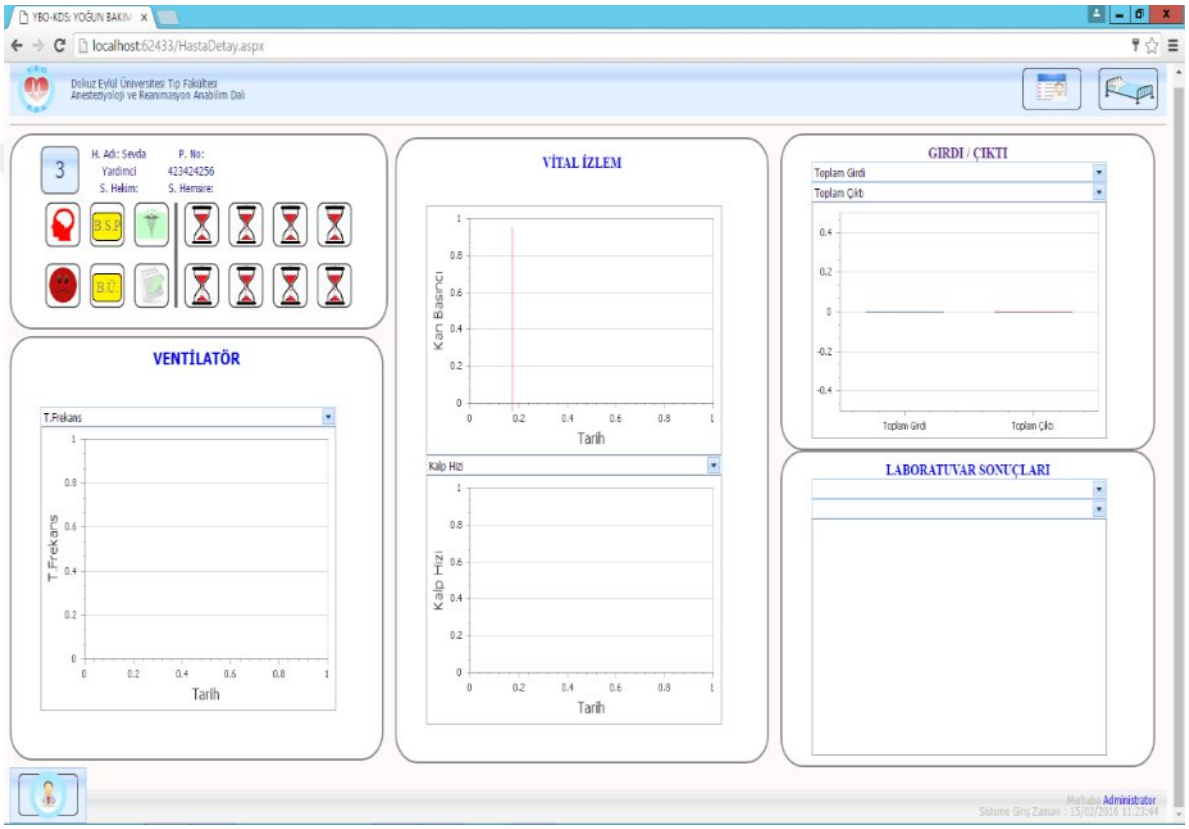


Figure 5.11 Patient detail for decision support

In fact, risk assessment and decision support system module are composed of two sub-modules on the basis of the analysis and all patients are analyzed on an individual basis.







Figure 5.12 Overview of general patient devices

Morbidity or mortality rates, a statistical measurement terms, the number of trapped disease in a given time period in a given population, the disease rate. Morbidity rate of patients who have survived the disease, but the disease afflicted result is the ratio of people dead.

The use of the RIFLE (Risk, Injury, Failure, Loss of kidney function, and End-stage kidney disease) classification; changes in renal function, allowing to recognize at an early stage, concluded that the opinion will contribute to the reduction of mortality and morbidity.

Especially, in this work and in related references it is observed that, Septicemia (blood poisoning) is the state of a microbe in the blood and resulting damage to the body tissue proliferation. 8 parameter list is used for sepsis disease. With the result that, it is also used this parameter for individual analysis. Septicemia (blood poisoning) is the state of a microbe in the blood and resulting damage to the body tissue proliferation.

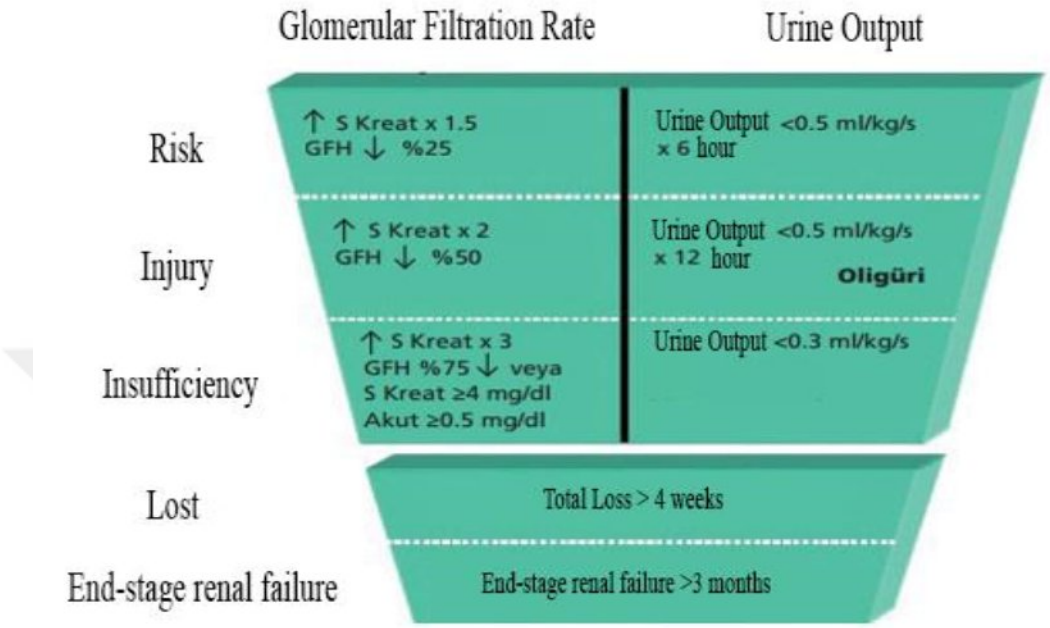


Figure 5.13 Overview of general patient devices (RenalEdRutland, 2011)

At the same time, Acute Kidney Injury Network (AKIN) is called acute renal failure is loss of kidney function. AKIN is described the characteristic such as urea nitrogen, creatinine and the kidneys in order to produce enough urine.

All dates are based on the AKIN classification stage and visual options are listed RIFLE classification.

5.2 Rifle Classification

Patients are listed according to the specific date range, named Rifle score is seen more as a patient information sheet. The patient's name in this part, Protocol No, there are sub-areas such as Rifle Results and History.

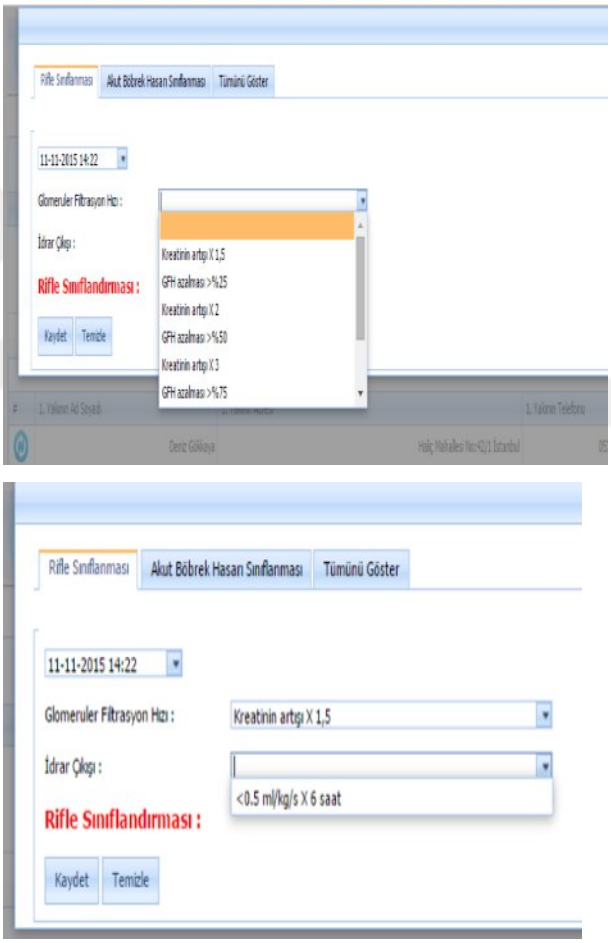


Figure 5.14 Rifle classification

History of patients based filtering can be achieved by making access to Rifle result.

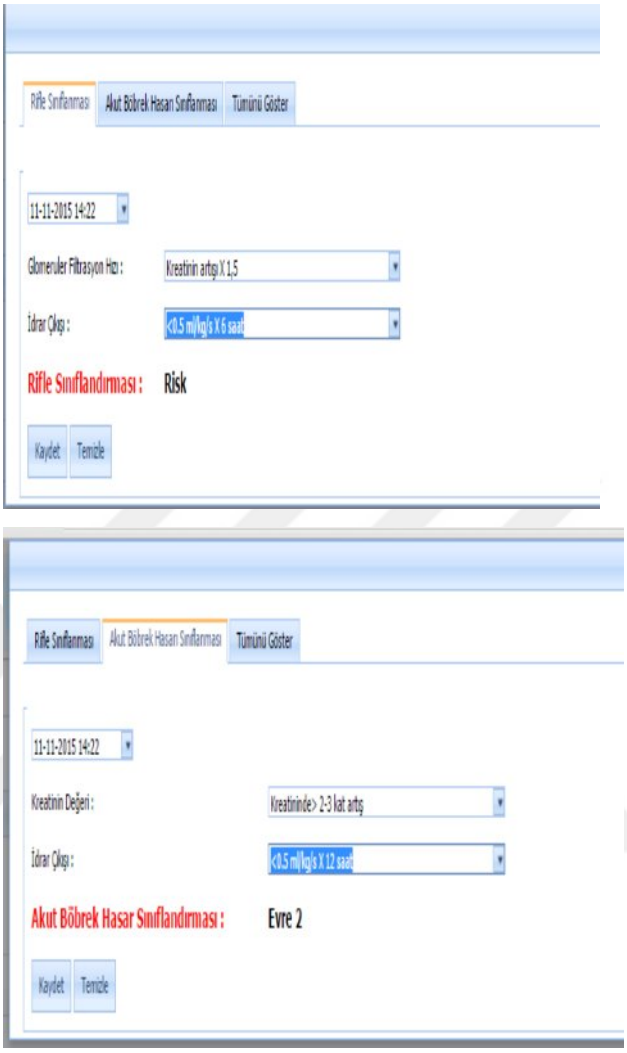


Figure 5.15 Classification of acute kidney injury

5.3 Apache Score Calculation

APACHE score and nonetheless expect mortality rate is calculated by selecting the parameters.

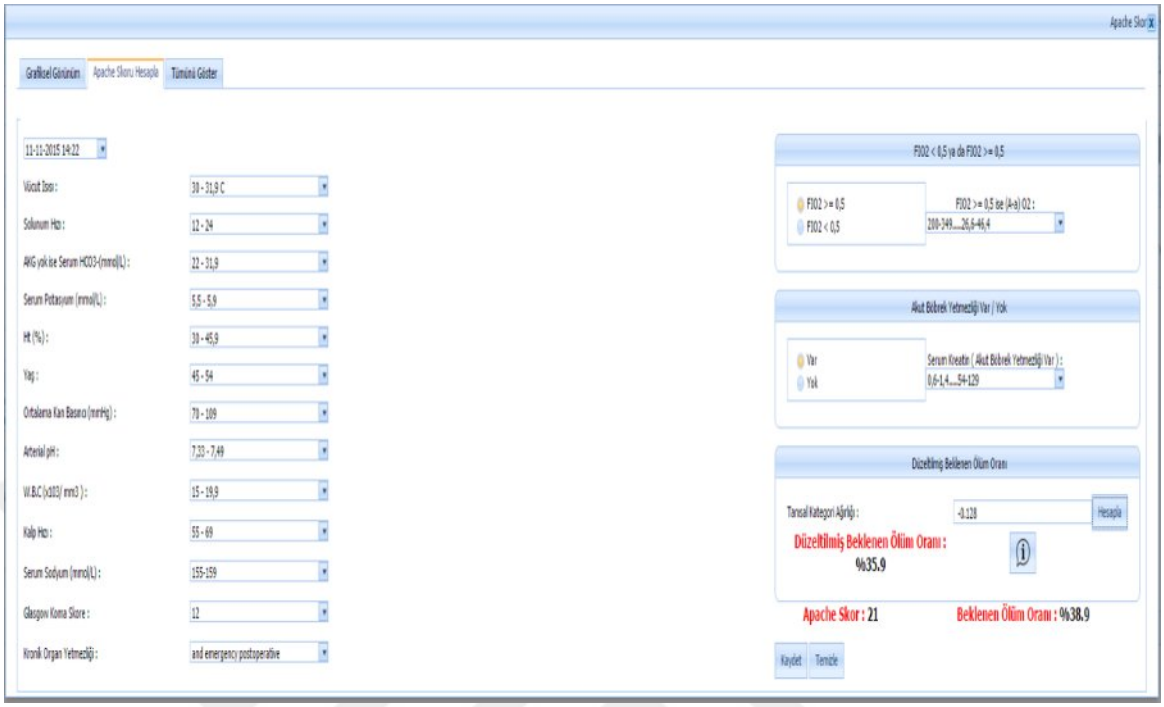


Figure 5.16 Apache score calculation

This figure illustrates that, it also has a graphical representation-wise and date of APACHE score. Patients are listed according to the specific date range, it is seen as the more we have a patient information sheet. Likewise, Rifle and the Sofa score and calculate the Rifle and Sofa score are available on our pages.

The patient's name in this part, protocol no, subdomains, such as Apache Score and History. History of patients based filtering can be achieved by making access to the Apache score.

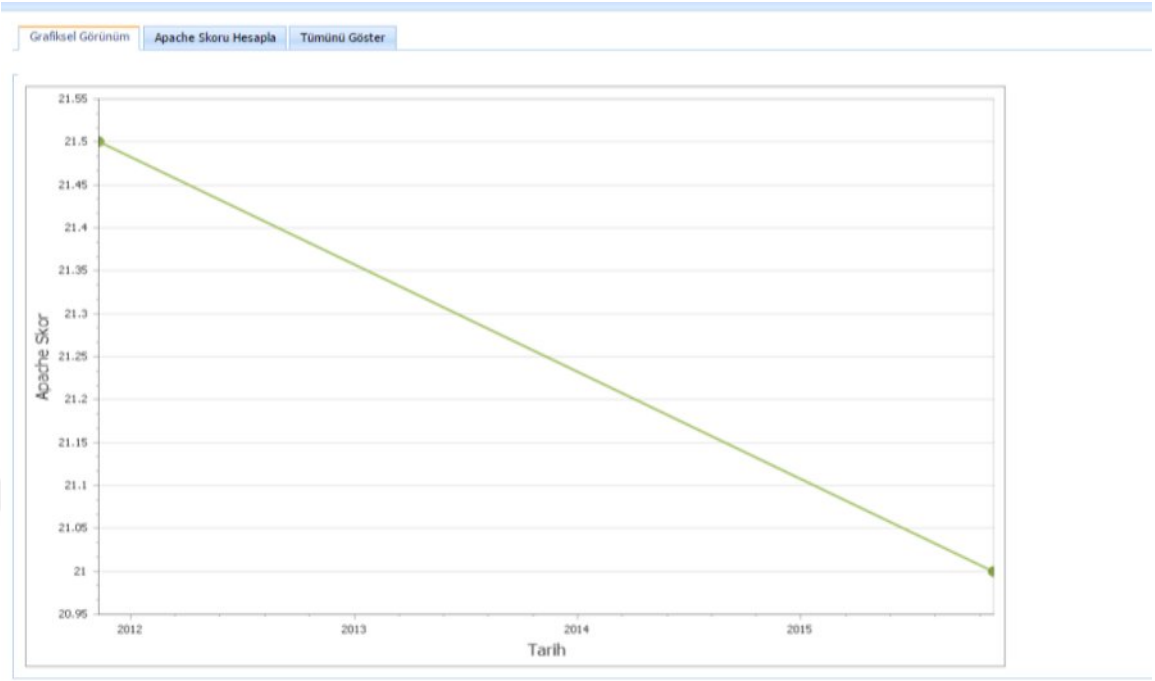


Figure 5.17 Apache score graphical view

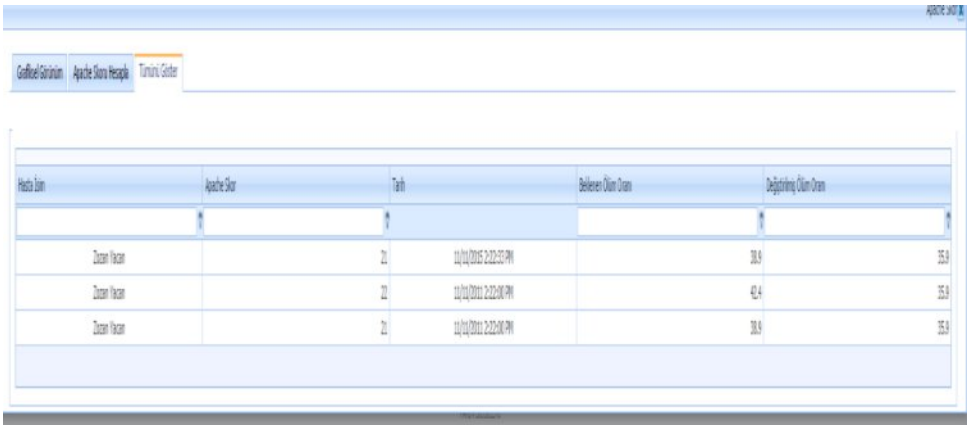


Figure 5.18 Apache score view all

The main objective of the patients with the help which have accumulated precious data of all patients currently being treated in intensive care admissions are at risk for various diseases is to decide what data mining algorithms.

General Topics :

Gender, age, Apache score Expected Mortality Ratio, Adjusted Expected Mortality, Sofa scores, neurovascular, Pressure Ulcers, Body Surface Measurement results, et_sevi to, ng_kontrol, og_kontrol, ft_kontrol, peg_kontrol and Global Balance

(A total of 17 observations title)

Follow Vital (15 observations title)

Ventilator (34 pieces observations title)

Neurology (5 pieces observations title)

Laboratory Tests (5786 Total observations title)

Input (mostly drugs including 8768)

Output (mostly urine drains and including 62)

A module can be assisted analysis is performed TOTAL 14 687 title.

5.4 Sofa Score Calculation

Patients are listed according to the specific date range, named Sofa score is seen as a patient information sheet.

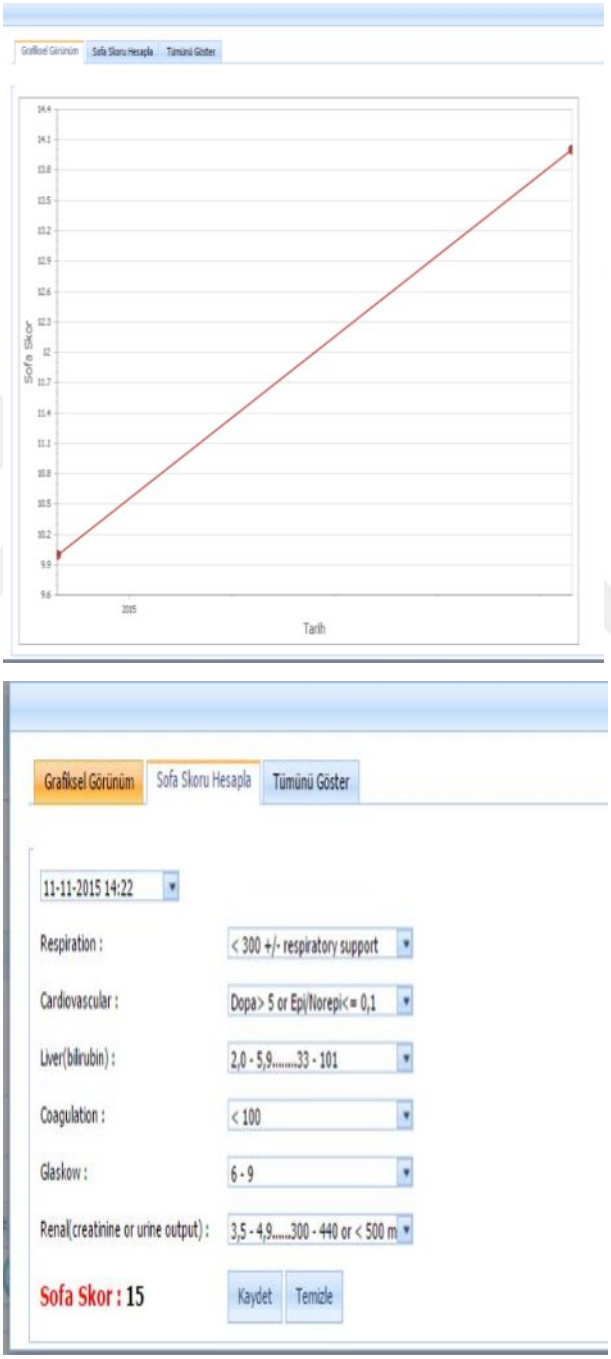


Figure 5.19 Sofa score calculation

The patient's name in this part, protocol no, there are subdomains, such as Sofa Score and History. History of patients based filtering can be achieved by making access to Rifle result.

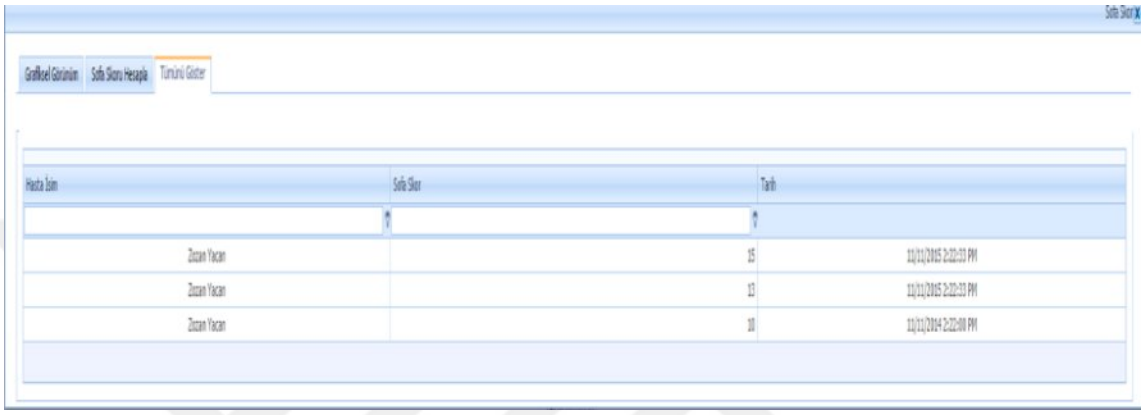


Figure 5.20 Sofa score view all

From this figure it can be seen that, the physician can select the title that you want to do data mining analysis of these subheadings. The patient name, sofa score and date information exist in the show all grid.

Patients are searchable by name, sofa score and date. By means of this, doctors and nurses have access to instant information at any moment. When the sofa scores are automatically calculated, sofa score information can be monitored graphically.

Whereby the decrease and increase in the sofa score become traceable very easily. Responsible doctors are able to use the scores in this way.

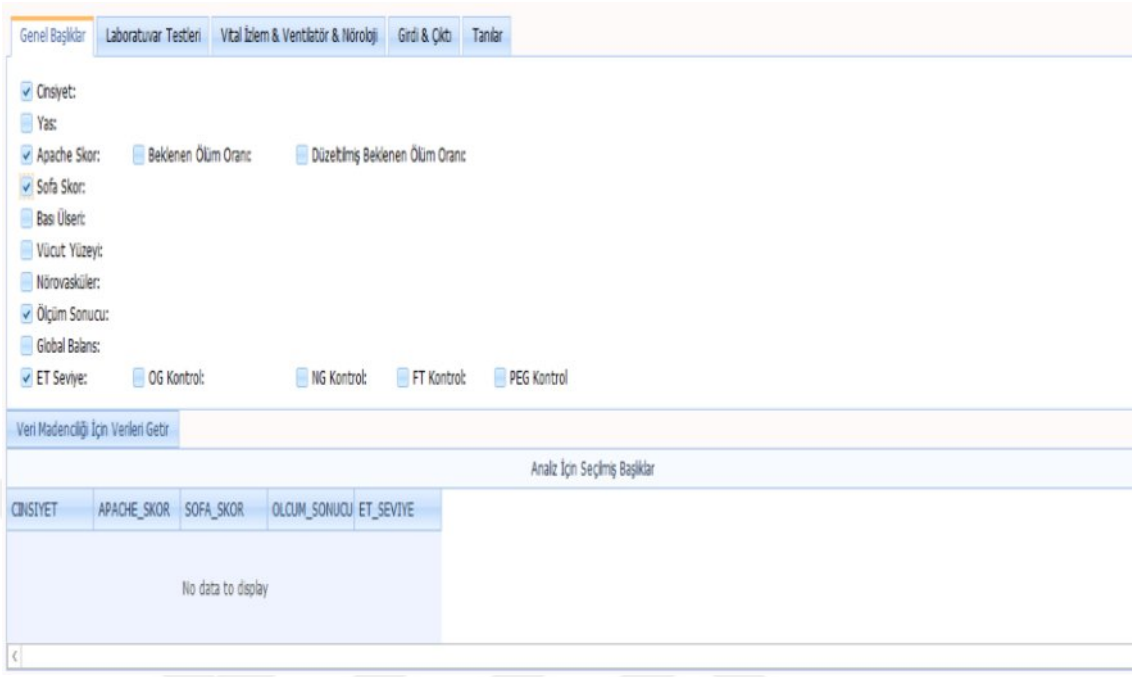


Figure 5.21 General topics for data mining

According to gender, apache_score, sofa_score, measurement result, et-level; selected topics have been used for analysis. After these topics have been used for data mining, the nurses and doctors can analyze about the patient's situation.

Laboratory tests, vital follow-ventilator-neurology, input-output and diagnoses heads have been used in order to obtain the results about data mining. Interesting patterns are shown to the user.

If it is desired, it can be saved the information. Accordingly, data mining process continues until one is found hidden patterns.

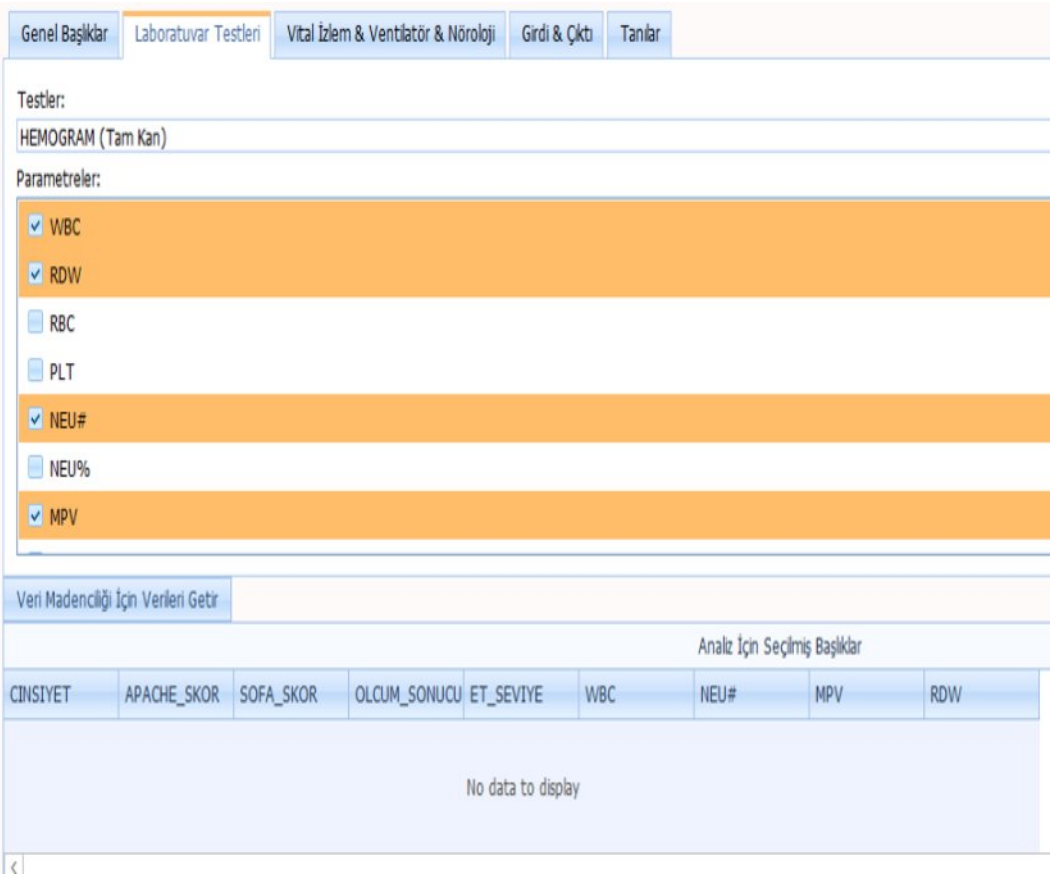


Figure 5.22 Laboratory tests for data mining

If the selected single disease for all patients in the database that T (True), for diseases that are not in F (False) target sub-domain is created.

If more than one disease selected and starts with the same identification code letter is desired to reach a clear distinction between these disorders and the destination sub-area is created.

Patterns or arrangements between the data sets is related to the use of data analysis and software techniques.

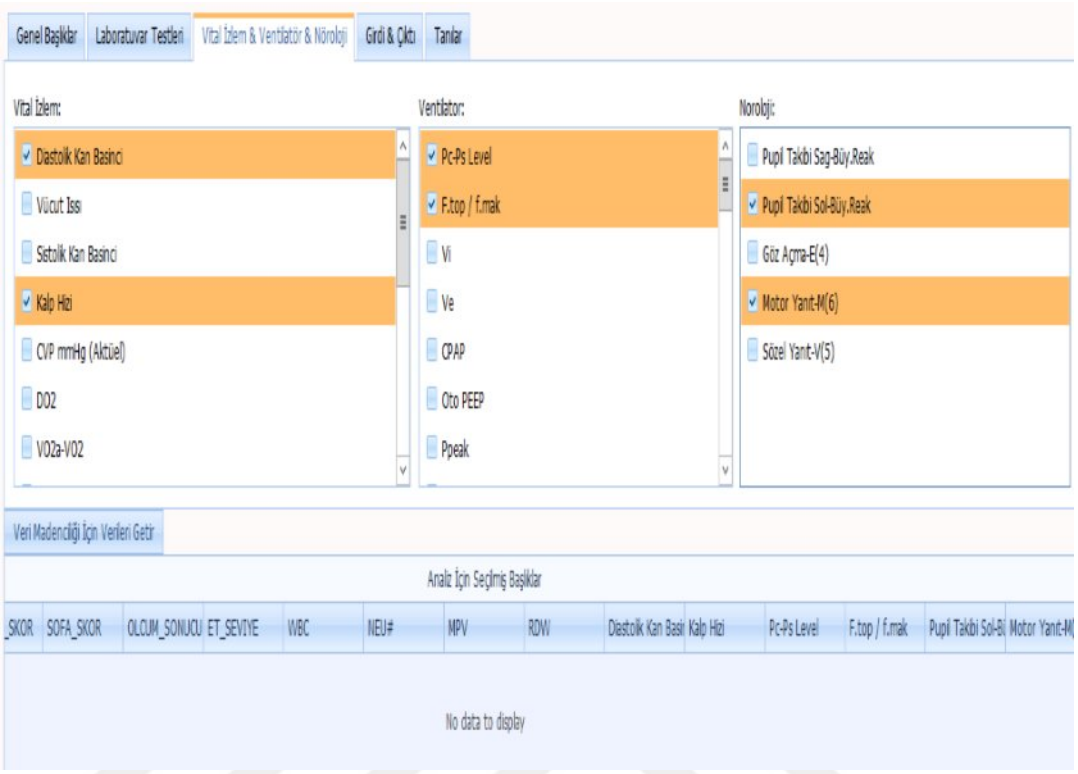


Figure 5.23 Monitoring vital & ventilator & neurology for data mining

Wbc, neu, mpv, rdw, diastolic blood pressure, heart rate, pc-ps level, f.top / f.max, pupil tracking and motor response are selected topics for analysis. After clicking the get data for data mining button, the results will view in the screen.

The relationship between data is responsible for the data mining rules and specifications which are determined. The aim of this technique is to identify previously unrecognized data patterns.

This data mining method can be seen as a statistical method fort he series. However, data mining differs in several ways from traditional statistics.

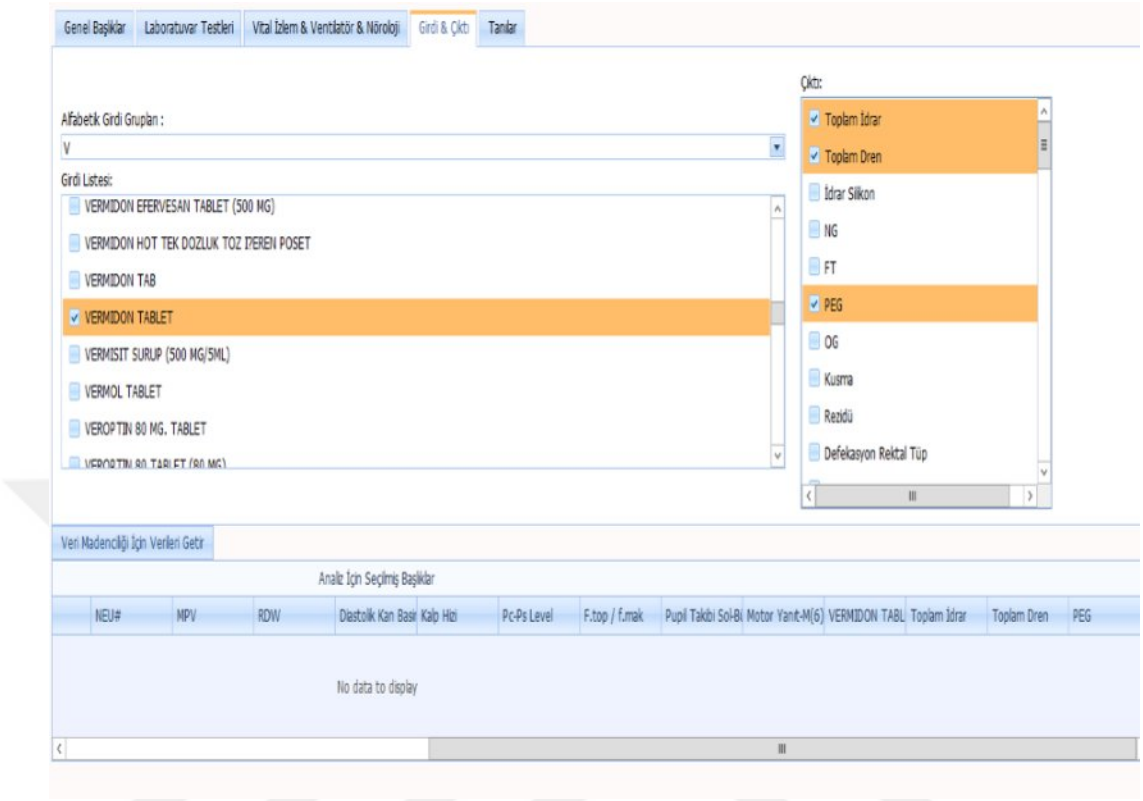


Figure 5.24 Input-output for data mining

In the Input-Output tab, it is needed to select a title from the alphabetical group entry. After entry is chosen, output selection tab is going to view for analysing the data mining.

The goal of the data mining is the removal quantitative models that can be translated into logical rules or visual presentation. In this page, data mining and computer interface are combined.

Data mining field, statistics, machine information and databases include like high performance computing.

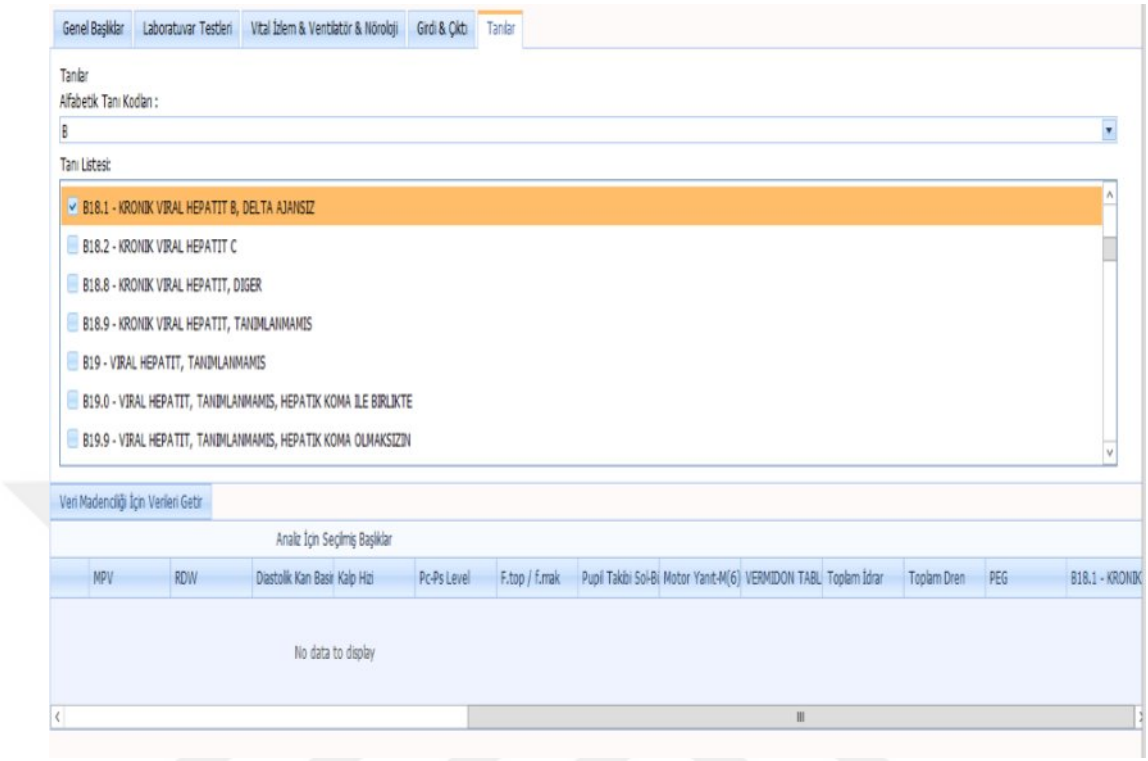


Figure 5.25 Diagnoses for data mining

DATE data in the database is registered with the sub domain to be used in case of a criminal case. Data mining professionals; data modeling and data mining techniques and the development of decision support systems are engaged in the issue.

By using the Data Mining methods, the patient diagnosis has been found which is undiscovered. By means of this, responsible doctors and nurses can analyze the results.

The usage of different areas Weka vehicle saved training model performed on applied on the different test sets. Firstly, our model has been educated by the training data and after that it is possible to use for many different tests.

DINAMIK_NOROLOJI

Table Data Indexes Model Constraints Grants Statistics UI Defaults Triggers Dependencies SQL

Query Count Rows Insert Row

EDIT	ID	HASTA_ID	ISLEM_ID	KULLANICI_ID	TARIH	DURUMU	SONUC	PROTOKOL_NO	REFERANS_ID
	205	1	3	1	25-AUG-15 11.43.00.000000 AM	-1	3	1	-1000000
	220	1	2	1	25-AUG-15 04.35.00.000000 PM	0	3	1	4
	222	1	2	1	25-AUG-15 04.44.00.000000 PM	2	2	1	4
	223	1	2	1	25-AUG-15 04.48.00.000000 PM	2	2	1	4
	344	130	1	1	16-SEP-15 10.56.00.000000 AM	-1	1	526277813	-1000000
	163	1	2	1	17-AUG-15 01.44.00.000000 PM	0	4	1	4
	204	1	2	1	25-AUG-15 11.41.00.000000 AM	0	5	1	4
	164	1	1	1	17-AUG-15 01.40.00.000000 PM	-1	2	1	-1000000
	215	1	3	1	25-AUG-15 03.27.00.000000 PM	-1	2	1	-1000000
	323	130	1	1	15-SEP-15 11.26.00.000000 AM	-1	5	526277813	-1000000
	216	1	2	1	25-AUG-15 03.28.00.000000 PM	2	1	1	4
	345	130	1	1	16-SEP-15 11.12.00.000000 AM	-1	1	526277813	-1000000
	203	1	1	1	24-AUG-15 05.45.00.000000 PM	-1	1	1	-1000000
	206	1	4	1	25-AUG-15 11.41.00.000000 AM	-1	4	1	-1000000
	89	1	5	8	12-JUN-20 10.00.00.000000 AM	2	110	1	4

row(s) 1 - 15 of 37

Figure 5.26 Table of dynamic neurology

On the contrary, the data for each title selected mining in order to reduce to a single instance of a patient and then in the name of protecting the natural structure of each title simply take the total average method would be to get as healthy. So it has benefited from multiple statistical methods.

Peak (MOD)

The median value (MEDIA)

Distribution Span (R)

Standard Deviation (STD_DEV)

Arithmetic Average (AVG)

Variance (VARIANCE)

Coefficient of Variation (COV)

After the data preparation stage

In the literature, it has been found to yield good results working in intensive care;

Types of data mining algorithms;

Table 4.2 Types of data mining algorithms

Support Vector Machine	It is supervised learning models with associated learning algorithms.
Multilayer Perceptron	Multilayer Perceptron (MLP) is a feedforward artifical neural network.
Naive Bayes	Naive Bayes methods are set of supervised learning algorithms based on the Bayes' theorem.
C4.5	C4.5 is one of the well-known decision tree algorithms.
KNN	K nearest neighbors is a simple algorithm that stores all available cases.

Methods will be found and that the most successful algorithm based classification algorithm and test pattern when used separately.

VIEW_D_VITAL_VM_1
VIEW_D_VITAL_VM_AVG
VIEW_D_VITAL_VM_AVG_LIST
VIEW_D_VITAL_VM_COV
VIEW_D_VITAL_VM_COV_LIST
VIEW_D_VITAL_VM_DIST_RANGE
VIEW_D_VITAL_VM_DR_LIST
VIEW_D_VITAL_VM_MEDIAN
VIEW_D_VITAL_VM_MED_LIST
VIEW_D_VITAL_VM_MOD
VIEW_D_VITAL_VM_MOD_LIST
VIEW_D_VITAL_VM_SD_LIST
VIEW_D_VITAL_VM_STDDEV
VIEW_D_VITAL_VM_VARIANCE
VIEW_D_VITAL_VM_VARI_LIST

Figure 5.27 View of dynamic neurology

At that moment the patients admitted to the intensive care unit can be determined that the potential risks for disease selected using this model.

In summary; in the past or in the intensive care unit has been selected to create a model of patient data with the disease and the patient is currently hospitalized predetermined carrying that disease status. By means of this, it is possible to gather the data for the data mining.

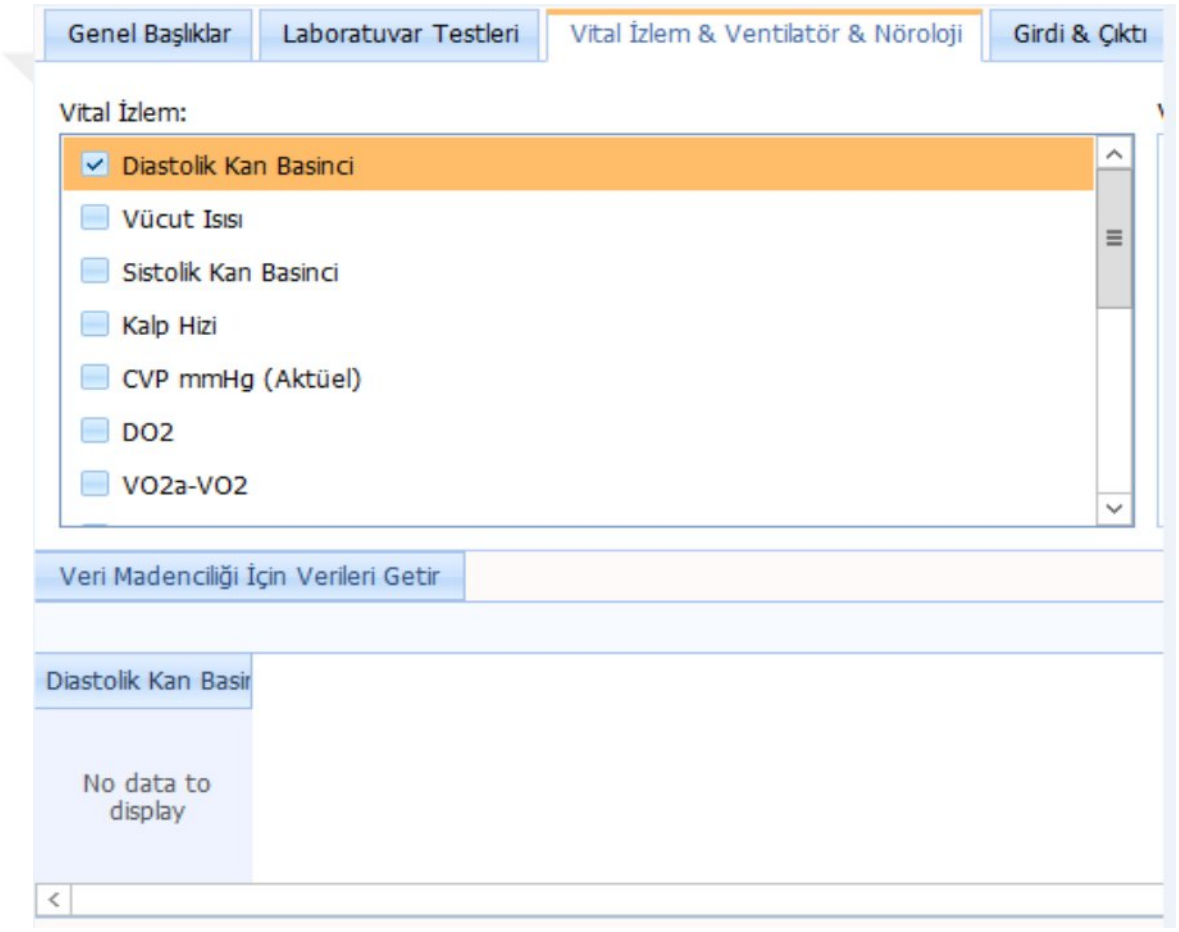


Figure 5.28 Data mining for monitoring vital & ventilator & neurology

CHAPTER SIX
CONCLUSION

In our country, expenditure on health considering the importance of human health is an important part of our country's course budget. Another important reason is the fact that too much dependence on foreign countries for medical expenses from time to time in our country, these expenditures may substantially burden our economy.

The devices used in hospitals and with a large portion coming from abroad is dependent on the software as well as hospitals are forced to go under the huge load. Because the software at least as much as equipment maintenance, updates and fixes have such licenses.

Dokuz Eylul University Faculty of Medicine, our work will begin as a pilot in the Intensive Care Unit is a stepping objective to eliminate the dependence on foreign software.

Another goal also provide reception in real time to the central database of the data transmission from overseas licensed device in operation again, we take place with local resources and equipment are also without support from abroad it will be fully carried out local projects. Unlike, example software we have seen abroad Data Mining algorithms to do with Decision Support System helps physicians and guidance to nurses with our realization of our software will be integrated smart module of our country at the technological level in order to ensure that one step ahead of examples abroad.

Moreover, even if the information display in different brands can easily be transferred to electronic media from the computer environment. Thus, ICA-DSS will be different from other hospital revealed the project.

Nurses and physicians follow their patients fill my hand with a pencil through the center form ridding the instant flow of data to the database of our physicians to make their medical studies abroad will reach the current fresh and processed data. Thus, to be held in our country for future medical research will also be a large data warehouse.

Storing electronic form of patient data between yield major projects, large amounts of data through order processing and data mining based on desired parameters within a short time due to the presence of unknown logical relations in medical informatics will be opened in front of a lot of research.

The first step in the organization of the completion of existing projects to develop new applications that can be created and started to expand the scope of the project will be Research-Development activities.

Employment projects present provides a more efficient and effective. From hand to record the desired information at any time about the patient by reducing the workload per nurse due to difficulties reaching the data significantly supports the effectiveness of the current employment.

ICA-DSS, thanks to an accurate interpretation of the data will be given a more reliable results of human health treatment reduced the rate of false origin. It is going to be a reduction in prejudice against our country consisting doctor. Patients and caregivers will increase the satisfaction. At the same time, doctors and nurses will be saving time, which allow them to serve more patients.

In addition, ICU doctors and nurses familiar with new technologies and technologically intensive care units of hospitals have taken a major step. However, doctors and nurses in a very friendly manner and analysis will provide the opportunity to comment.

The project included the reduction in the hospital environment as it is used in paper rate will be affected positively. As prevent waste of resources, it will allow to the use of products in the correct places needed.

Furthermore, it will be more reliable and provided quality treatment to patients in intensive care units.

In the preparation phase of the project with a working target and can be used to save lives, it has reached the following findings; Devices and terminals from the intensive

care unit, there is no network. The transition to full automation of all devices wired and / or wireless network to communicate with each other was over. The materials used are carefully selected according to the working environment of medicine. (Example: fireproof network cables, anti-bacterial touch devices)

After the transition to automation, at least 50 clients were installed at least 100Mbit communication network that can be accessed at the same time for the client to the server. Data stored on the disk group, the corporate types, expandable and fit out the backup. Discovering made medical devices, communication interfaces and data formats vary. Data communication was provided using the IEEE standards.

Since it is based on a system of private cloud architectures, systems and interfaces are web-based and supported mobile devices. Data privacy and HTTPS and SSL certificate to be used in the health sector was important for safety shall be used.

Projects targeted measures at the end of the application system usage and success with our target values.

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