TALLINN UNIVERSITY OF TECHNOLOGY

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Health Technology

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Healthcare Data Systems and Analysis IHT0010 Individual Final Report

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OVERVIEW

The goal of this course, Healthcare Data Systems and Analysis is to introduce students to different data systems for example registries and integration systems used in Estonian healthcare organisations and hospitals. It also demonstrates how these systems are created and designed, their purpose, integrations and whether they are able to meet the needs which they were created for so that at the end of the day, students can independently analyse from different perspectives and identify the limitations and certain drawbacks of different data systems.

Healthcare data are highly beneficial for individuals, public health, clinical decision making, diagnosis, how to better understand diseases, medical research and development, and how we approach population health. Big data has become one of the hottest topics and government and companies are spending more to collect more data with the goal of improving healthcare quality and increasing the personalisation of health service.

We had lectures delivered by Janek Metsalik, which covered different aspects that concerns healthcare data systems such as architectural framework, registries, data protection and security from the Estonian healthcare perspective . We also had research group works and practice in an intensive 2-day hackathon dedicated to brainstorming solutions to common problems experienced by the Estonian youth.

During the lectures, we were introduced to well proven and recognised methods for developing an enterprise architecture, for example The Open Group Architecture Framework (TOGAF) and HP Global Method. These methods provide a structured a way on how to create and use an architecture description of a system using different views and domains. We were also introduced to HTML basics, how to connect xquery to HTTP path, and XML, its structure and data model as the HL7 Clinical Document Architecture (CDA) is an XML-based markup standard of clinical documents exchange. We had several classroom activities to study some examples from the Estonian Health Information System (EHIS) document. We looked at some architecture elements such as technical view and systems view, then had class discussions from a personal perspective. This included listing some sensors on our smart devices and thinking about how it can be used to digitize health information. Another important part of the lectures was Information Security, what data to protect and why to protect and the challenges associated with the protection of digital data. The standards and legal aspects were also thought especially the GDPR which regulates law on data protection

and privacy in EU. We learned about the Three-level IT Baseline Security System ISKE which aims at ensuring the confidentiality, integrity and availability of data and assets.

We had a group work to research on different registries in Estonia, the task ended with the presentation of our findings. This gave us an indepth insight on the functions, components, governance and data access policies of each of the registries. The registries include Health Information System (EHIS, digilugu), Prescription Centre (e-retsept, ePrescription), Registries of Health Board, Health Insurance Registry, Cancer Registry, Myocardial Infarction Registry, Infectious Diseases Register, Business Registry, GP Medical Records (EMR), Genome Center Database, Pharmacy Information System, School Nurse Information System (EKTIS), Personal Health Records App, Health Statistics and Health Research Database, Database of Agency of Statistics, State Information System Management System, Digital Identity Certificates Service. In my group, we researched about Population Registry, Hospital Information System (HIS/EMR) and Registries of Agency of Medicines.

The practice was a 2 day workshop session where we worked in groups to brainstorm on solutions to problems affecting Estonian teenage youth. These included problems related with poor eating habits, substance abuse, mental health and physical health. All teams came up with prototypes of their solution. In my team, we created a prototype of an e-rehabilitation web application named T-Rehab. This was our proposed solution to the problem of substance abuse amongst teenagers. We learned a lot about business views, policy making which may impact solutions, protyping, pithching from the facilitators, within our group and from other teams. We were able to apply some of the classroom knowledge we learned in a real life situation. It was a well rounded experience.

SYNTHESIS

TOGAF Methodology

An architecture framework is a set of tools that can be used to develop a range of different architecture. The Open Group Architecture Framework (TOGAF) is a framework for enterprise architecture that provides an approach for designing, planning, implementing, and governing an enterprise information technology architecture.[1] TOGAF is based on an iterative process model supported by best practices and a re-usable set of existing architecture assets and it allows achievement of business objectives through IT standards. It is designed to support four architecture domains which consists of Business, Data, Application and Technology domains.

Business Architecture

This part defines the business strategy, governance, organization, and key business processes of the organization. The business architecture view addresses the concerns of users, planners, and business managers, and focus on the functional aspects of the system from the perspective of the users of the system; that is, on what the new system is intended to do, including performance, functionality, and usability.[2]

Data Architecture

The data architecture describes the structure of an organization's logical and physical data assets and the associated data management resources.

Application Architecture

The application architecture provides a blueprint for the individual systems to be established, the interactions between the application systems, and their relationships to the core business processes of the organization with the frameworks for services to be exposed as business functions for integration.

Technology Architecture

Technology architecture describes the hardware, software, and network infrastructure needed to support the deployment of core, mission-critical applications such as networks, communications, processing.
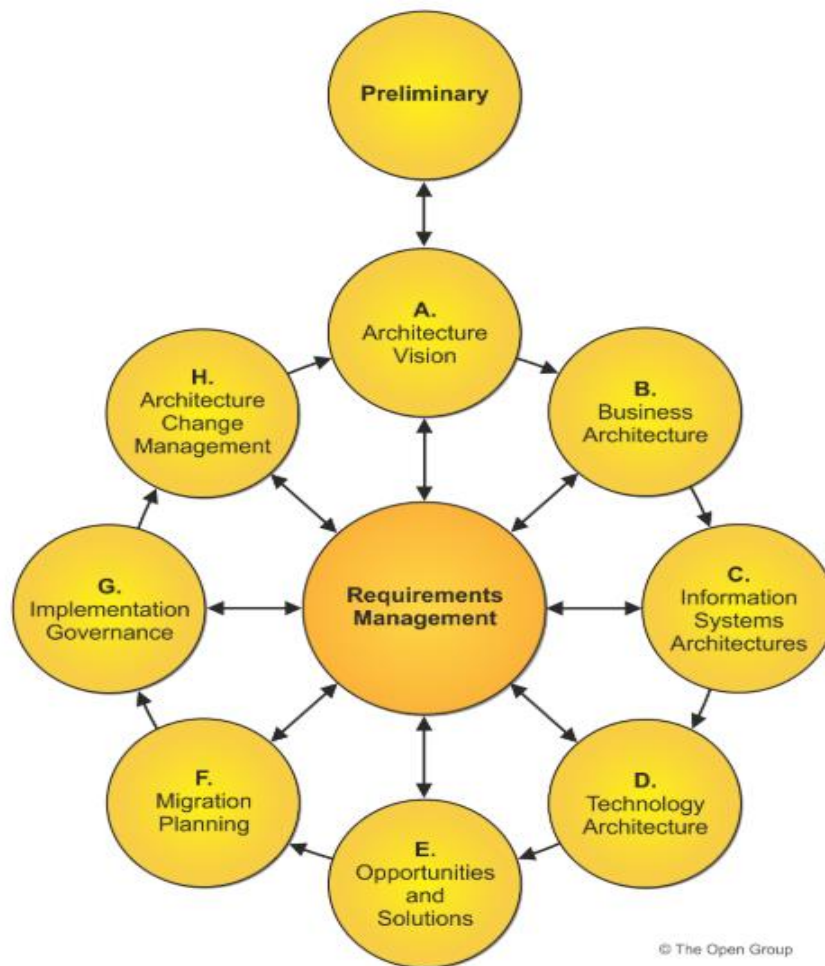
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[1] Draheim, Dirk, and Gerald Weber, eds. Trends in Enterprise Application Architecture: 2nd International Conference, TEAA 2006, Berlin, Germany, November 29-Dezember 1, 2006, Revised Selcted Papers. Vol. 4473. Springer, 2007.
[2] The Open Group. 'Developing a Business Architecture View.' pubs.opengroup.org http://pubs.opengroup.org/architecture/togaf8-doc/arch/chap31.html (accessed May 18, 2019).

Architecture Development Method

The TOGAF Architecture Development Method (ADM) provides a tested and repeatable process for developing architectures. The ADM includes establishing an architecture framework, developing architecture content, transitioning, and governing the realization of architectures. It may be tailored to the organization's needs and is then employed to manage the execution of architecture planning activities to meet its business and information technology needs.

All these activities are carried out within an iterative cycle of continuous architecture definition and realization that allows organizations to transform their enterprises in a controlled manner in response to business goals and opportunities.

Preliminary

A. Architecture Vision

H. Architecture Change Management

B. Business Architecture

G. Implementation Governance

Requirements Management

C. Information Systems Architectures

F. Migration Planning

E. Opportunities and Solutions

D. Technology Architecture

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Introduction

Cancer was estimated to account for 9.6 million deaths in 2018 and it is the second leading cause of death in the world. While prostate, lung and colorectal cancer are amongst the commonest types of cancer in men, breast, colorectal, cervix and thyroid cancer are common amongst women. A way of reducing this burgeoning problem is the need for effective affordable interventions that results in early diagnosis, screening, treatment and palliative care across healthcare organizations and institutions. This will improve the quality of life of patients and their families which is an important component of cancer care. [3]

There is a need for accelerated action to achieve global targets to reduce the incident of deaths and healthcare provision for all with universal health coverage. Research has shown that when cancer patients were given care that demonstrated good adherence to the quality indicators, there were statistically significant improvements in overall and progression-free survivals [4]. One of such recommendations is to ensure that breast cancer patients begin oncology treatment within 42 days from the date of their first visit to an oncologist. Inability to fulfil this recommended guideline is a problem faced by many Estonian hospitals.

Vision

To help medical professionals save time, effectively manage and improve quality of care for oncology patients.

Indicators of Performance and Success

Performance can be measured using already defined a set of quality indicators which will be routinely measured and evaluated to confirm that the clinical outcome reaches the requested standards and guidelines. An example is the EUSOMA and some other EU Guidelines on waiting times between the date of first diagnostic examination within the unit and the date of surgery or start of treatment within 6 weeks (42 days) [5]. We can objectively see a successful impact If more patients are able to begin treatment on time.

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[3] World Health Organization. "Cancer." WHO.int. https://www.who.int/cancer/en/ (accessed May 9, 2019).

[4] Cheng, Skye H., C. Jason Wang, Jin-Long Lin, Cheng-Fang Horng, Mei-Chun Lu, Steven M. Asch, Lee H. Hilborne, Mei-Ching Liu, Chii-Ming Chen, and Andrew T. Huang. "Adherence to quality indicators and survival in patients with breast cancer." Medical care 47, no. 2 (2009): 217-225.

[5] Del Turco, M. Rosselli, A. Ponti, U. Bick, L. Biganzoli, G. Cserni, B. Cutuli, T. Decker et al. "Quality indicators in breast cancer care." *European journal of cancer* 46, no. 13 (2010): 2344-2356.

During the course of our study, we proposed a solution that can be integrated into the hospital information system and named it the ORBIS Dashboard. This was motivated by the need for hospitals to ensure that cancer patients begin treatment on time as recommended by the guidelines. The ORBIS Dashboard is a software which will automate parts of the current processes involved in delivering care for cancer patients. The software will help doctors, nurses and quality managers track patient data, to make decisions (diagnosis and treatment decisions), to refer patients to specialists and procedures on time, to be notified of feedback from specialists and procedures. It uses different automated alert systems, reminders and recommended activities to manage and prioritize patients leading to improvement in patient outcomes. Hospital information systems such as Liisa systems are good, but they lack many functionalities that are important for both health care providers and patients to start cancer treatment on time. The doctors and nurses are having much trouble due to poorly integrated IT-system which lack the ability to track their cancer patients effectively.

Stakeholders/ Participants

We identified and described the roles and interests of stakeholders and participants involved with this solution.

Software developer: Responsible for developing and testing the application.

Payer/Controller: Healthcare providers are the payers because they want to be able to provide health care services effectively and timely. If meeting the criteria of quality indicators is a condition of funding from Health Insurance Fund, healthcare providers will be interested in buying the solution to speed up the process of treatment and saves valuable time of the doctors and nurses.Their motivation is improving their reputation by meeting the criteria of quality indicators.

Beneficiary/Consumer: There are four beneficiaries of this application, the doctors, nurses, quality managers(consumers/users) and the patients(beneficiary). The applicaton will speed up the process of treatment and saves valuable time of the doctors and nurses. It will also improve the quality of care delivered to patients.

- Quality manager: It allows quality managers to monitor the quality indicators in their healthcare institution .
- Doctors/nurses: To be able to treat patients fast and effectively. To be able to track patient data, to make decisions (diagnosis and treatment decisions), to refer patients to specialists and procedures on time, to be notified of feedback from specialists and procedures.

Estonian Patients Union: To be able to receive treatment on time. Patients' organisations are interested in having on time, high quality and fast treatment for patients to ensure best possible health outcomes.

Health Insurance Fund: To be able to do financial and quality audits for health care providers and the services which they provide.To be able to check the number of visits and procedures provided to insured patients. Health Insurance Fund is interested in having on time, high quality and fast treatment for patients to ensure best possible health outcomes.

Unions and Associations of Other Specialities: They own the best knowledge and practice in their speciality and can give valuable input for developing software for their speciality. They can be interested in adapting and adopting our product in their specialities.

How activity is organized today

They large hospitals in Estonia that are using different hospital information systems that are available today. Those hospital information (such as Liisa)

systems are good, but they lack of many functionalities that are important for both health care providers and patients to start cancer treatment on time. The doctors and nurses are having much trouble due to poorly integrated IT-system to track their cancer patients to make sure they get necessary treatment.

What will be done differently

Our target user is using hospital information system which has standard integrations with National HIS, EHR, LIS, PACS. ORBIS dashboard will use information from different modules of hospital information system, so it has to be integrated with existing hospital information system (such as LIISA). It will make the users accomplish more within a shorter period of time by pulling vital patient information from HIS and aggregating on the dashboard. The user-personalized features, alerts and notification systems serves as reminders, decision support for healthcare professionals and will increase their efficiency.

Benefits to the organization

If developed and implemented, it can help the hospital meet the criteria of quality indicators which is a condition of funding from Health Insurance Fund. It will also improve reputation and enable the hospital provide healthcare services to cancer patients in an effective and timely manner.

Time Saving
Increases productivity and saves time.
Effective
It makes it possible to track patient data, make decisions (diagnosis and treatment decisions), to refer patients to specialists and procedures on time, to be notified of feedback from specialists and procedures.
Easy to use
ORBIS dashboard can be used from the LIISA interface, which means ORBIS dashboard can be opened on top of LIISA when used
Convenient and Cost-effective
Because it functions on top of the existing HIS, it less costly compared to developing the entire HIS which has these functionalities.
Quality
Improve quality of care and helps fulfil quality indicators.

SYSTEMS VIEW
ORBIS includes following modules:
- Doctor's Dashboard for doctors and nurses
- Quality Dashboard for quality managers

- Automated alert and reminder module
- Automated recommendations
- Automated activities module
- Quality monitoring module

Product Features

ORBIS Doctor's Dashboard features

Patient information overview
Description: A specific data viewer of information from cancer patients. Doctor can see patient history from the ORBIS platform and can follow the patient treatment steps.

Feedback from reports (lab, radiology, etc)
Description: Doctor will be prompted when there is a feedback from referred specialist visit or procedure, also if there is report from lab which is ready to see. ORBIS will notify doctor or nurse which makes it easier and faster to see the results.

Visualized patient pathway
Description: ORBIS allows the doctor to easily see what point the patient is on the treatment pathway between first visit and start of treatment.

Procedure and visit status
Description: ORBIS shows if patients with referrals are waiting for their visit or procedure or if the visit or procedure has been completed.

Alerts and notifications
Description: Automated alerts and reminders avoid situations where doctors might miss some important information. For example, doctor gets alert when there are some abnormalities with patients' health situation or in any of patient treatment steps so that doctors can take actions on time.

Automated referral recommendations
Description: ORBIS recognizes idle patients and automatically recommends doctors to refer patients to appropriate visit or procedure.

Automated decision support
Description: ORBIS suggests the next line of action when there is an alert.

ORBIS Quality Dashboard features

Quality   monitor
Description: Automated quality indicator monitoring and generates automatic reports on hospital level.

Application to User Mapping

User	Application
Doctors, nurses	ORBIS has a dashboard for medical professionals that automatically collects necessary data about patient, their visits and procedures from hospital information system and national health information system and brings it together on doctor's dashboard.
Doctors, nurses	The patient data viewer is a visual display of where the patient is along the treatment pathway. The automated decision support system suggests the next action to the doctor
Doctors, nurses	ORBIS offers automated recommendations and activities which help doctors to save time and be more efficient. ORBIS initiates activities (such as referrals) automatically and doctor has to check and confirm those activities.
Quality manager	ORBIS qualty dashboard offers automated quality indicator monitoring and automatic reports on hospital level.

Databases

ORBIS is connected to National patient registration system, hospital information system, booking system, referral system, digital health record, lab information system,   PACS,   Prescription   Center.

Data security ISKE level is as same as HIS ISKE level

TECHNICAL VIEW

ORBIS is compatible with Windows and Mac computers, needs internet and intranet connection. It has to be adjusted in cases of HIS updates. ORBIS needs connection to other registries and databases mentioned above.
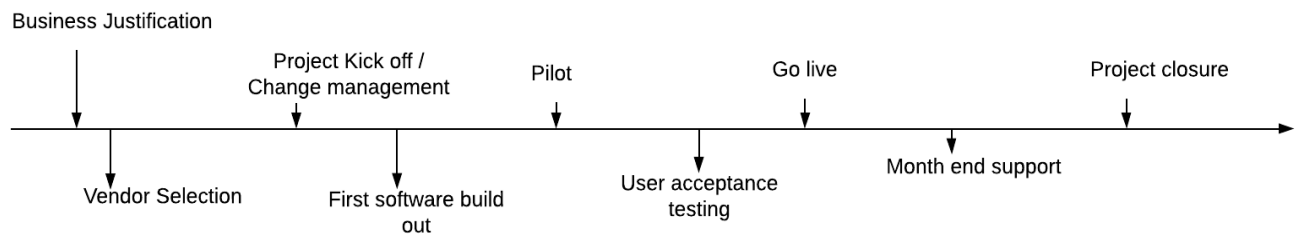Dependencies

ORBIS dashboard is not independent application - HIS breakdown means also ORBIS breakdown (business continuity issue).
Access
The practitioner/users (doctors, nurses, quality managers) have access.

Implementation Road map

Screenshots from Prototype

ORBIS Doctors dashboard

Doctors dashboard to be used by doctors and nurses. The green box contains data of patients who are progessing according to the recommended treatment path. The yellow box has the list of patients who have gotten a feedback from a procedure or the lab which the doctor needs to check to make decision or initiate the next activity. The red box notifies the doctor of patients who are late for a procedure. He can use the ORBIS patient data viewer to see what the problem is and take the necessary action. The gray box contains patients who have exceeded the recommended time and have not started treatment.
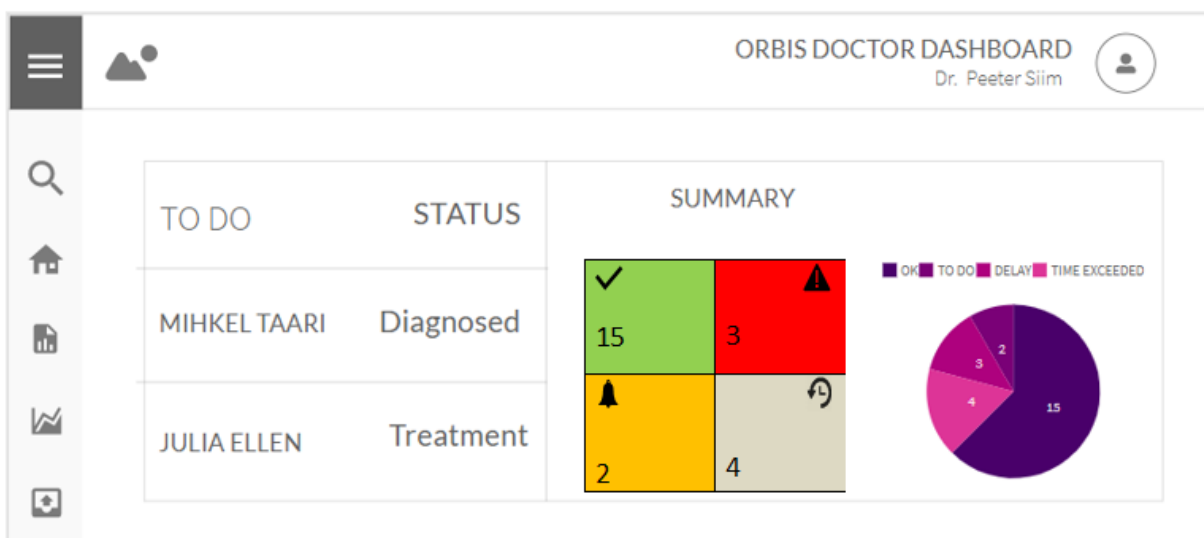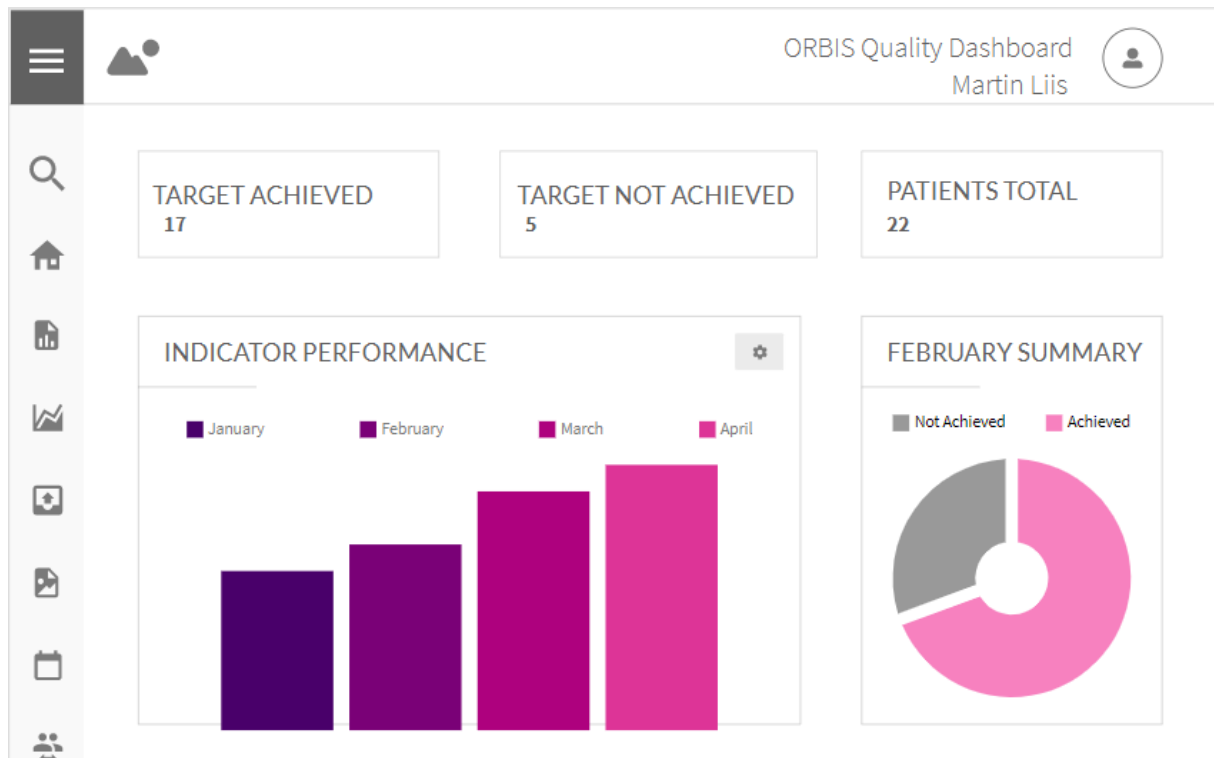
ORBIS Quality dashboard

Below is what the quality dashboard looks like. It provides the quality manager witha general overview of the performance indicators. It is used for quality indicator monitoring and generates automatic reports on hospital level.
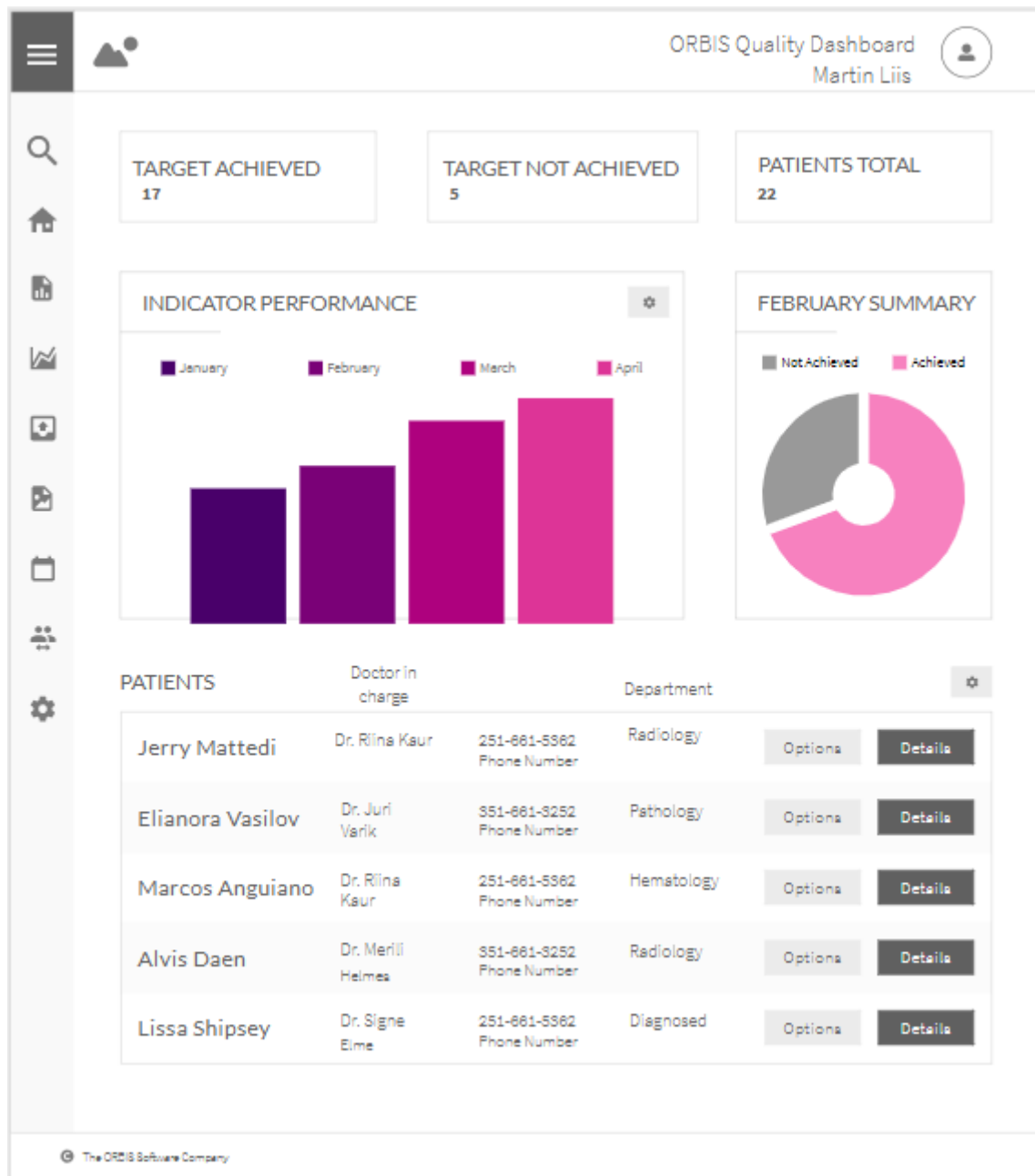
The first part display an overview. It can be displayed in months, weeks, and years.

The second part shows details of patients who have exceeded the recommended time and have not started treatment. It also shows the oncologist managing the patient and the department.

ORBIS Patient Data Viewer

The patient data viewer is a visual display of where the patient is along the treatment pathway. The automated decision support system suggests the next action.

ORBIS PATIENT DATA VIEWER

JERRY MATTEDI - DAY 25

First Oncology Visit	Day 1
Hematology	Day 10
Colonoscopy	**Day 15**
Biopsy	Day 20
TNM Staging	Day 30
Diagnosis	Day 40
Treatment	

STATUS INFORMATION

PROBLEM

Patient delayed in colonoscopy. The patient exceeded the time limit for colonoscopy. Biopsy should be done as soon as possible.

SUGGESTION

Contact gastroenterologist for feedback!

CONTACT

Gastroenterologist
Dr. Regina Oswald -558 98898

The ORBIS Software Company