Developing a Consolidated Management View by Integrating Financial, Operational and Clinical Data

Zeynep Bulbul

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ABSTRACT

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Demographic, economic and social changes create pressure on healthcare industry to adapt itself to increase quality by decreasing cost along with the upcoming changes. Innovative developments in technology are capable to bring new solutions. By the use of technology, data have become more instrumental to understand where exactly quality and cost can be balanced to improve healthcare services.

However, collection and processing of data bring new challenges. Collected from many different points, massive amount of data are continuously accumulated. Data need to be analysed systematically in order to gain actionable insight for decision-making on strategic, tactical and practical level. Gaining such insight requires industry know-how, thinking out of box and having right tools in place to see the big picture in multiple dimensions. Healthcare managers require customized data analytic tools to visualize and interpret collected data, in order to solve the challenge of quality and cost balance further on the road.

This thesis work reveals a practical way how to approach to the concept of data analysis by developing a data analytics application for the thesis commissioner, Helsinki University Hospital (HUH) Psychiatry. Using Qlikview Business Intelligence platform, a customised data analytics tool is developed to analyse HUH Psychiatry’s collected data set, as a part of their ongoing operational excellence program, which targeted to specify, standardize, record and report services as products.

Key words: data analytic tool, data analysis, healthcare, service, efficiency, effectiveness, quality, cost, resource, Qlikview, application, development
## CONTENTS

1 INTRODUCTION .................................................................................................................. 5

2 RESEARCH TOPIC ........................................................................................................... 7
   2.1 Research purpose and requirements ........................................................................... 7
      2.1.1 Initial motivation ................................................................................................. 8
      2.1.2 Revised idea as the basis of the thesis work ....................................................... 10
      2.1.3 Introduction of Thesis Commissioner ................................................................. 11
      2.1.4 Introduction of Qlikview tool ............................................................................. 13
   2.2 Methodology .............................................................................................................. 15
   2.3 Thesis workflow ....................................................................................................... 18

3 BACKGROUND AND FORMER RESEARCH ..................................................................... 19
   3.1 Challenges of healthcare industry ............................................................................. 19
   3.2 Challenges in hospital information systems ............................................................... 20
   3.3 Concepts and theory on healthcare quality ............................................................... 21
   3.4 Dilemma of achieving high quality with low cost ..................................................... 23
   3.5 Other relevant topics ............................................................................................... 24
      3.5.1 Data: small or big ............................................................................................... 24
      3.5.2 Data analytics ................................................................................................... 25
      3.5.3 Dashboards ....................................................................................................... 27

4 QLIKVIEW TOOL AND DATA ANALYSIS ....................................................................... 28
   4.1 Data fields ................................................................................................................ 28
   4.2 Data processing ....................................................................................................... 30
   4.3 Qlikview data analytic application ........................................................................... 31
      4.3.1 Cost overview ................................................................................................... 32
      4.3.2 Cost center analysis ......................................................................................... 34
      4.3.3 Cost per service activity types ......................................................................... 35
      4.3.4 Service structure report .................................................................................. 37
      4.3.5 Resource analysis ............................................................................................ 39
      4.3.6 Diagnosis and services .................................................................................... 40
      4.3.7 Patient overview .............................................................................................. 41
      4.3.8 Patient statistics ............................................................................................... 42

5 CONCLUSIONS .................................................................................................................. 43
   5.1 Outlook .................................................................................................................... 43
   5.2 Recommendations ................................................................................................. 44

REFERENCES ...................................................................................................................... 45

APPENDICES ....................................................................................................................... 49
   Appendix 1. Porter and Kaplan’s Time-Driven Activity-Based Costing ............ 49
## GLOSSARY

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABC</td>
<td>Activity Based Costing</td>
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<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>GUI</td>
<td>Graphical User Interface</td>
</tr>
<tr>
<td>INTB</td>
<td>Biological intervention</td>
</tr>
<tr>
<td>INTK</td>
<td>Psychosocial intervention</td>
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<tr>
<td>INTM</td>
<td>Other intervention</td>
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<tr>
<td>INTP</td>
<td>Psychotherapy intervention</td>
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<tr>
<td>HIPAA</td>
<td>Healthcare Insurance Portability and Accountability Act</td>
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<tr>
<td>HIS</td>
<td>Hospital Information System</td>
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<tr>
<td>HOSU</td>
<td>Care Planning (Hoito Suunitelma in Finnish)</td>
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<tr>
<td>HUH</td>
<td>Helsinki University Hospital</td>
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<tr>
<td>HUS</td>
<td>Hospital District of Helsinki and Uusimaa</td>
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<tr>
<td>IoT</td>
<td>Internet of Things</td>
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<tr>
<td>KONS</td>
<td>Psychiatric Consultation</td>
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<tr>
<td>KPI</td>
<td>Key Performance Indicator</td>
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<tr>
<td>NCSP</td>
<td>NOMESCO Classification of Surgical Procedures</td>
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<tr>
<td>NOMESCO</td>
<td>Nordic Medico-Statistical Committee</td>
</tr>
<tr>
<td>OECD</td>
<td>Organization for Economic Co-operation and Development</td>
</tr>
<tr>
<td>OPCS</td>
<td>Office of Population Censuses and Surveys</td>
</tr>
<tr>
<td>PCP</td>
<td>Patient Care Plan</td>
</tr>
<tr>
<td>TD-ABC</td>
<td>Time Driven Activity Based Costing</td>
</tr>
<tr>
<td>TUTK</td>
<td>Investigation (Tutkimus in Finnish)</td>
</tr>
<tr>
<td>USA</td>
<td>United States of America</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organization</td>
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1 INTRODUCTION

Health being so important denominator in our life quality, no matter where we live, from birth till end of our lives, we desire to get the best health care for ourselves and for our beloved ones. Even when there is no urgency in getting healthcare service, it is so important to feel secure about it. In case of urgency, there cannot even be a question mark.

According to Office of Population Censuses and Surveys (OPCS) Omnibus Survey, health was rated among top five priorities in life. The rank was increased in cases where there was a disability or long lasting illness where living a normal life was challenged, meaning getting out, standing, walking, going to shopping, working and finding a job could not take place normally as expected (Bowling 1995).

Needs, preferences and experiences on individual level create accumulated effect on the society, especially when we are living in the era of change. People live longer, demographics is aging. On the other hand, life is getting more complicated for the working class people, who are not enough by number to keep the engine of economy running and too busy to take care of their elders. Aged or disabled people have to rely more on the system than their own families, which create demand and increase cost of healthcare services.

These kinds of demographic, social and economic changes require inevitable, structural renewals in healthcare services, due to the fact that, the equation needs to be solved with limited resources and budgets. Innovative developments in technology can act as catalyster in solving the unbalanced needs, yet there needs to be solid understanding in the big picture where technology can devise workable solutions within time and budget.

Even so, technology comes into the picture with its own set of challenges. Healthcare is in the process of being digitalized to be able to diagnose and monitor the patients or anyone who is simply interested in. Along with Internet of Things (IoT), every piece of equipment will eventually get connected to produce, transmit or receive data, also in case of healthcare. The outcome is an enormous explosion of data to be processed in order to grasp and get control of the situations, diseases and patients. Not long ago, the storage of
so called Big Data has been the issue, to which cloud based systems have brought solutions. Today’s hot topic is not anymore how to store data, but how to analyse, interpret and get the right insight out of it. Data itself cannot bring any value without correct translation into actionable insight.

Ensuring high quality and affordable care services with limited resources and budget is clearly a management problem that has critical impact in the future. As always, defining the problem thoughtfully is the first step towards finding the solution. Do healthcare managers have visibility to evaluate, optimize and improve healthcare services? Do they have the right tools in place to utilize resource capacity at the most optimum way with the lowest possible cost in order to provide more affordable services to the people?

Scope of this thesis work looks exactly into this question. It aimed to develop a visual overview to analyse financial, operational and clinical aspects of healthcare services provided to the patients by developing a data analytics application tool on Qlikview Business Intelligence platform. Such a view is believed to be instrumental especially for the hospital executive management and service providers to optimize resources, track costs and improve quality of services for the benefit of the patients.

Thesis work has been carried out together with Helsinki University Hospital (HUH) Psychiatry. They have already initiated an extensive operational excellence change project before the thesis, with the same question in mind. Having developed standardized data reporting and streamlined data collection from all regions and branches, HUH Psychiatry’s collected data have been used as an input in the design of the application.

It has been the uttermost desire and intention for the thesis work to produce a functional data analytics tool that creates visibility for Hospital District of Helsinki and Uusimaa (HUS) management. In the succeeding chapters, you will explore the application as the outcome of the thesis work.
2 RESEARCH TOPIC

2.1 Research purpose and requirements

The objective of the thesis has been to develop a practical approach to visually present administrative, financial and clinical data with Qlikview tool in order to create clarity and visibility for hospital services, activities, resources and cost levels.

Hence, the research question can be described as:

How can financial, operational and clinical data be organized and visualized to provide an integrated view on efficiency, effectiveness and cost of healthcare resources and service activities for further decision making?

Underlying primary requirement for the research question is availability, quality and accessibility of the data, which are received from Hospital Information Systems (HIS). To be able to construct an integrated view, the data need to contain extensive information on patients, diagnosis, delivered healthcare services, service activities, resources, cost and invoice of the provided care. Only having this range of information would allow to design such a view to reveal clinical, operational and financial performance of the hospital.

The purpose of research is exploratory. The intention is to explore how to create visibility on healthcare services, process efficiency and resource allocation by processing the available data collected from HIS. Such a view would support hospital management to understand their state of operational and financial performance and to take necessary actions in order to improve quality of care services delivered to the patients.

The data which fulfilled above mentioned criteria have been provided by thesis commissioner HUH Psychiatry. As the outcome of the thesis work, an application has been developed with Qlikview tool by face-to-face interactive discussions with thesis commissioner. The application presented HUH Psychiatry’s data set visually for monitoring and decision-making purpose for HUS Management.
There are a vast number of different HIS in use in hospitals, with different architectures and data collection capabilities. The tool developed in this thesis work applies only to HUS Psychiatry’s data structure. Any change in data structure would result in an adaptation need in the integrated view. Therefore, the application which has been developed in the scope of thesis requires high level of customization in case of change in the data set.

### 2.1.1 Initial motivation

In Michael Porter and Robert Kaplan’s famous article called “How to solve the cost crisis in Health Care” (Porter and Kaplan 2011), Time-driven activity based costing (TD-ABC) was described as the solution for measuring and allocating particularly overhead costs according to the consumption in healthcare services. The article has given the motivation to study activity-based costing (ABC) in hospitals or clinics in the scope of thesis work, knowing that, ABC has been in use in the industry already for a long time.

Porter and Kaplan proposed developing process maps to capture each service activity in the care delivery value chain. The process maps enclose the paths the patients would follow as they move through their care cycle at the hospitals (See Appendix 1). Calculating the cost of resources and allocating their resource capacity by time would allow to determine the cost of service for delivering that particular service activity to the patient in the care delivery chain. Summing up then the costs of each delivered service activity would result in the total cost of care delivery around the patient (Porter and Kaplan 2011).

Applying ABC concept on healthcare cost calculations seem to be revolutionary concept, even though it has been the practice in the industry. However, developing and maintaining process maps for each care delivery chain would be an exhaustive work for implementation of ABC for each service delivery chain. The initial idea for the thesis work was to explore developing a two-step approach to interlink cost, quality and value of healthcare services, instead of implementing process maps. Once tested, this could perhaps then be considered as an alternative version of applying process maps in healthcare.
The first step would intend to understand how healthcare service activities are organized from hospital admission up to diagnosis phase. Here, all the service workflows provided to the patient from the admission till diagnosis would be analysed and described as care service activities within own delivery value chain. All the resources, equipment and facilities would be identified and mapped to the corresponding healthcare service activity with time and unit cost estimates. Cost estimation of care services would be calculated by applying ABC principles. This step would specify each service activity as a package with time and cost estimates.

![Diagram](image)

**FIGURE 1.** Step1 defines healthcare service activities to create administrative view.

The second step would focus on the quality of treatment provided to the patient per given diagnosis. As in the first step, all the resources, equipment and facilities would have been identified and mapped to the corresponding care service activity packages, with cost estimates. Care service activity packages would be bundled together according to the delivery sequence to the patient upon diagnosis. Patient health status at the diagnosis phase would be measured and compared to the status at the outcome of the delivered services.

This step would interlink diagnosis, delivered care services and value based outcome into a chain of care services with accumulated time and cost estimates.
FIGURE 2. Step2 links healthcare service activities around patient to obtain clinical outcome.

For both the first and the second steps, a combined healthcare service catalogue would be developed. Service catalogue would be the key to structure HIS data, in order to map cost and quality of healthcare services around patient.

2.1.2 Revised idea as the basis of the thesis work

The original idea had to be revised due to two main reasons.

The first reason was because of its comprehensive requirements on defining and implementing a profound basis for services, activities, resources, quality and cost dimensions. Even if it would be piloted for a certain care domain, it would require an extensive amount of definition time and effort which would go beyond the thesis work. It would also be experimental, due to the fact that, it was not tried before in healthcare service delivery chain, even though a similar approach is in use in the industry. In addition, obtaining value based outcome on the patient status would not be straightforward, especially in case of psychiatry services.
The second reason was the possibility to continue and expand the ongoing work of thesis commissioner. Thesis commissioner HUH Psychiatry Development Manager and team have already initiated a comprehensive work to specify, define and productize their services, adapt tool landscape and reporting practices to be able to comply with quality standards of services three years ago.

They have introduced new service codes to better describe care services delivered by assigned care service providers in a duration of time, so to monitor and report them in detail. Their cost calculation methodology already implements ABC principles, hence the initial idea would not bring any additional value in that respect. They have already piloted their approach and received the consolidated data from approximately 300 different systems into an excel form, which needed to be visually presented and analysed for management decision-making by the use of a data analytic application as a next step. Creating the application tool for visual presentation of data for further interpretation was their primary need.

Therefore, it was agreed to contribute to HUH Psychiatry’s well planned and already ongoing project by developing an application for their data set by the use of Qlikview platform.

2.1.3 Introduction of Thesis Commissioner

HUH Psychiatry is a part of Hospital District of Helsinki and Uusimaa (HUS) which provides healthcare services to 24 municipals in Helsinki and Capital region (Figure 3). Located at the same area which was previously called Hesperia Hospital, it includes outpatient clinics and wards belonging to the HUH Department of Psychiatry and teaching operations of the Faculty of Medicine at the University of Helsinki.
FIGURE 3. HUS Hospital areas.

TABLE 1. HUS member municipalities

<table>
<thead>
<tr>
<th>Askola</th>
<th>Järvensää</th>
<th>Lohja</th>
<th>Raasepori</th>
</tr>
</thead>
<tbody>
<tr>
<td>Espoo</td>
<td>Karkkila</td>
<td>Loviisa</td>
<td>Sipoo</td>
</tr>
<tr>
<td>Hanko</td>
<td>Kauniainen</td>
<td>Mäntsälä</td>
<td>Siuntio</td>
</tr>
<tr>
<td>Helsinki</td>
<td>Kerava</td>
<td>Nurmijärvi</td>
<td>Tuusula</td>
</tr>
<tr>
<td>Hyvinkää</td>
<td>Kirkkonummi</td>
<td>Pornainen</td>
<td>Vantaa</td>
</tr>
<tr>
<td>Inkoo</td>
<td>Lapinjärvi</td>
<td>Porvoo</td>
<td>Vihti</td>
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In Finland, in administrative terms, the present hospital districts will be combined into so called five “specific catchment areas”, in order to manage the common, centralised duties of the municipalities and social welfare and health care regions. In Finnish language, this is called “erityisvastuualue” (Erva). Specific catchment areas will be responsible for the provision of certain centralised services and services for special groups of people, as well as for the coordination of services in the defined areas. Specification of their duties in detail is Finnish Government’s high priority for the time being and under ongoing work.

In special and demanding cases, other than the Capital region, HUS also provides services to South Karelia Social and Health Services (Eksote) and Kymenlaakso Social and Health services (Carea). Eksote, Carea as well as HUS member municipalities belong to HUH specific catchment area.
In addition to this, HUH Hospital Area has also national responsibilities. Some special treatments are provided for the whole country.

2.1.4 Introduction of Qlikview tool

Since developed by the Swedish company Qlik Technologies, Qlikview has been one of the most favoured business intelligence tool suites to create and deploy data analytic applications.

Its strength comes from being able to offer highly interactive dashboard development environment and being easy to use. It has its own native scripting environment, where learning is supported by online Qlik community, as well as all the documents and online training possibilities.

There are three important components in Qlikview Business Discovery Platform. These are:

1. Qlikview Server
2. Qlikview Publisher
3. Qlikview Desktop

Qlikview Desktop is a Windows based tool that is used to create a model to analyse the data and a graphical user interface (GUI) to visualize the Qlikview applications that are developed by business analysts and developers. It provides the environment that is used to develop this thesis work as well, where source data (in excel form) are transformed by the use of script-like expressions, functions and linkages.
Qlikview Server handles in-memory analytic engine and client-server communication. In-memory processing speeds up data processing and it is one of the strengths of Qlik products. Qlikview Server handles administrative access control for the important aspects of server deployments such as security, clustering and distribution. It also provides a web server for the users to access the documents according to their authorization. This is important for security. Via so called “Access Points”, users can retrieve documents that they are authorized to use by different client tools (PC, Ipad, Iphone etc).

Qlikview Publisher has two main roles. The first role is to load data directly from different data sources. Qlikview can access standard open databases or files such as Microsoft Excel, XML or other systems like SAP NetWeaver, Salesforce.com or Informatica. The second role of Qlikview Publisher is to act as a distribution service provider to reduce data
and applications based on various rules, to share personalized and secured documents and to distribute these documents to the appropriate Qlikview server. This way, users can make changes and enhancements in the documents for their own use. (Qlikview Architecture).

2.2 Methodology

The thesis complements the development work of HUH Psychiatry’s change project to improve and ensure their operational excellence. The methodology applied to the thesis is therefore part of planning, design, development, implementation, analysis and reporting phases to enhance efficiency, effectiveness and cost of psychiatry services delivered by care service providers.

FIGURE 5. The methodology.

HUH Psychiatry has already initiated the operational change project three years ago. They specified quality standards of services, defined services as products with the content, determined processes, developed registration and reporting practices with the new codes in their tool landscape.

The main instrument to register, report and monitor services as products has been the service codes designed in accordance with Nordic Medico-Statistical Committee (NOMESCO) Classification of Surgical Procedures (NCSP) system. Services were recorded by the use of the following four service codes, designed to answer corresponding questions:

1. Service activity description: what is done for the patient?
2. Care resource description: who provides the service activity?
3. Duration of service: how long it takes to provide the service activity?
4. Mode of service: how is the service activity provided to the patient?
These codes have been recorded in the electronic patient record system by healthcare service providers (professional groups such as doctors, nurses, psychiatrists etc.). Reporting also followed the same codes.

Thesis work developed a management view for their revised data structure to bring visibility in their financial, operational and clinical performance. Therefore, scope of the thesis would be considered as a part of development, implementation and analysis phases of HUH Psychiatry’s change project.

FIGURE 6. Scope of thesis

The following steps were carried out during the thesis work:

1. Getting familiarity with thesis commissioner’s needs and expectations, hospital data structure, healthcare system and Qlikview as an application development platform.
2. Developing a pilot data analytic application with Qlikview, to monitor financial, operational and clinical hospital performance with sample data.
3. Iteratively improving the application according to thesis commissioner’s feedbacks.
4. Loading the hospital data into the application and fine tuning.
5. Analysing the application to see whether it captured financial, operational and clinical performance of HUH Psychiatry.
In the first step (1), the background work has been carried out to build an understanding on thesis commissioner’s needs and expectations and to become familiar with the hospital data structure with thesis commissioner’s support. Here the view of thesis commissioner has been prioritized, due to their insight for the healthcare services, urgency in needs and for the sake of practicality in the implementation work. In addition, Qlikview was investigated as an application development tool.

In the second step (2), the Qlikview data analytic application has been developed according to thesis commissioner’s needs by using two months sample hospital data. The application contained several views in different sheets on cost overview, cost center analysis, cost per service types, service structure report, diagnosis and services, patient overview, patient statistics and resource analysis. Here the purpose has been to be able to provide different perspectives to the hospital management, as well as to the service providers, to see how resources have been utilized to provide healthcare services to volume of patients with different backgrounds, in what cost level.

In the third step (3), the pilot application has been iteratively enhanced and fine-tuned according to thesis commissioner’s feedbacks in face-to-face meetings. Two more data sources were integrated into the hospital data, to bring specific catchment area information and resource capacity per cost center.

In the fourth step (4), consolidated five months hospital data have been uploaded to the application. As the sample data have been only for two months, the application needed to be checked to present dates and graphs correctly.

In the fifth step (5), the application has been tested and crosschecked with the five months data to see what level of understanding it could generate. The most important findings will be produced by taking the application into daily use by HUH Psychiatry.
2.3 Thesis workflow

The introduction part briefly explains the relevance of the thesis topic to the challenges in the healthcare industry and what it aims to achieve.

The second chapter opens up the thesis topic in more detail. It starts with the thesis objective, purpose and research question, continues with the initial motivation which had to be revised according to thesis commissioner’s needs and available data set. It continues with the applied methodology and process to develop customized data analytic application. Thesis commissioner and Qlikview as a business intelligence platform are also introduced in this chapter.

The third chapter aims to bring perspective to the challenges of healthcare industry in more profound way. It introduces concepts of quality in healthcare through-out history and illustrates the dilemma of achieving high quality with low cost. It also describes relevant topics, such as small and big data, data analytics and dashboards.

The fourth chapter displays the application itself with graphical views. Each view is explained by sample data analysis, to be able to outline how data are presented to show the information it holds.

The fifth chapter concludes the thesis, summarizing why and what have been done, with the brief evaluation of the main items seen through-out the study. It also includes recommendations for further development.
3 BACKGROUND AND FORMER RESEARCH

3.1 Challenges of healthcare industry

Unfortunately, investments in healthcare do not necessarily go hand in hand with global economic trends. According to OECD statistics on health in 2014, total healthcare expenditure has been on an increasing trend in spite of the economic crisis. In 2014, average of 9.3% of GDP was allocated to health in OECD countries, with a slight increase from the previous year, but in a sensible growing direction compared to the average of 7.7% in 2000. In 2014, USA was the global leader with the budget allocation of 16.9% to healthcare, Turkey scored the bottom with 5.4 % and Finland was close to OECD average with 9.1 % (OECD 2014).

Even though public spending in some countries has been forced to get reduced due to the economic crisis, overall health expenditure has been increasing along with population aging. During last 50 years, life expectancy at birth has increased by 12 years in average among OECD countries, up to 80.2 years in average among OECD countries, up to 80.2 years in 2012 (OECD 2014).

Does spending more money produce more favourable outcomes? So long the mechanism that runs the system stays the same, inefficiencies cannot be avoided simply by increasing the money flow. In addition, there comes a limit how much more can be poured into healthcare, as this means trade-off from other areas that drives economy, such as education of young people. The challenge in healthcare is to develop a flexible and transparent system that answers the changing demands of different needs as efficiently as possible.
Looking at this picture, it would be relevant to ask how the healthcare resources are organized to provide equal and affordable care services. This is an important question to answer, because according to the latest OECD/EC report (2014), inequalities in healthcare access contribute to inequalities in health. It is mentioned that, in EU countries, the proportion of low-income people reporting some unmet needs for medical care and dental care is two-times greater than the population as a whole, and four-times greater than high-income groups. Obviously, such unmet care needs will cause more long-term health issues and more expensive consequences (OECD/EC report 2014).

So, even if the priority of healthcare services is clearly indicated by increased GDP allocation, it is extremely important to provide equal access to all citizens despite of the geographical location and the level of income. The answer of providing equal access goes through organizing care resources thoughtfully and efficiently according to the needs.

### 3.2 Challenges in hospital information systems

Hospitals and clinics use integrated Hospital Information Systems (HIS), to handle the workflow and content of medical services, as well as to manage financial, administrative and clinical data. HIS consist of different software modules, which are usually customized to serve the needs of hospitals, register, keep track and share patient data during and after delivering healthcare services. They are used to make informative decisions.

There are a vast number of hospital information systems in use globally. Due to the business and legal demands, they need to comply with commonly agreed standards, such as the Healthcare Insurance Portability and Accountability Act (HIPAA) in the United States of America (USA). The most important feature and challenge of HIS is ensuring data integrity between the deployed modules for not only certain departments, but for overall at the level of hospitals. Hospital Information Systems are supposed to make the right information and knowledge available to the right people, in the right place, at the right time and in the right form (Balaraman & Kosalram 2013).
3.3 Concepts and theory on healthcare quality

According to Øvretveit (2004), the quality in healthcare is described as;

“A quality health service provides the range of services which meet the most important health needs of the population (including preventative services) in a safe and effective way, without waste and within higher-level regulations.”

The most important and systematic approach to build the pillars of quality in medical care was taken by Avedis Donabedian (1819-2000), who was born in Beirut, Lebanon, in an Armenian family originally from Turkey. He produced a wealth of concepts and methods to define, evaluate and structure quality in medical care. His paper “Evaluating the Quality of Medical Care” (Donabedian 1966) created high attention on quality and is being cited still to this day.

His approach was first looking at the “outcome” to assess quality, which could be considered as valid, stable and concrete option, with many advantages. On the other hand, the approach contained also limitations, because outcomes had to be relevant to the object of measurement. He explained this by the example of “survival” as outcome, in such cases where the criteria of success was not fatal, but leaving the patient in an unfortunate suboptimal health. He noted also about the outcomes that were difficult to measure (Donabedian 1966).

As another approach to assess quality, he considered focusing on the “process of care”, rather than the outcome. Judgements were based on considerations, such as appropriateness, completeness and redundancy of information obtained through clinical history, physical examination and diagnostic tests, justification of diagnosis and therapy, technical competence in the performance of procedures, coordination and continuity of care and so on. This approach required specifications on relevant dimensions, values and standards to be used in the assessment. Compared to the outcome approach, it might have been less standardized with more room for improvement, yet more relevant to the original question in hand (Donabedian 1966).
As the third approach, he looked at the “resources”, such as adequacy of facilities and equipment, qualifications of medical staff and the organization, administrative structure, operations of programs and institutions providing care, fiscal organizations and so on. He considered this would provide fairly concrete and accessible information (Donabedian 1966).

In spite of the passed spur of time, Donabedian’s approach can still be considered as valid today. Capturing the outcome of delivered service on patient health depends on the context how care service was provided. For example, in case of psychiatry, it is not straightforward to assess the effect of the care services on patient’s status, due to the fact that, outer factors do have also impact on patient’s health status. Process of care is nowadays supported by the use of more standardized processes which follow specifications. This is an ongoing effort at all times. On the other hand, the third approach “resources” can be captured by the use of data in hospital information systems, which can be analysed to find ways for quality improvement.

There is a huge need to discuss quality issues in healthcare on a much higher level than what was experienced in the past. The healthcare sector has the challenge of reaching the triple aim of providing care, enhancing health and maintaining low cost. (Dahlgaard 2011).

Porter also focused on the outcome and brought categorized approach to measure outcomes of provided health care services around the patient by defining and using process maps (Porter 2010). Looking at the outcomes with process maps could capture majority of the aspects that would influence the end result. Doing so can ease Donabedian’s concern on the disadvantages of looking only at the outcomes to measure quality in healthcare.
3.4 Dilemma of achieving high quality with low cost

According to OECD forecast, the amount of aged people over 65 years old will increase by approximately 2.5 times by 2050, when the world population will increase only by 1.3 times in the same time period. So, speed of aging will be double of the whole population increase. This will bring burden on the working class. Dependency ratio of aged people (65+) over the working class (20-64) will increase from 14.3% in 2015 to 27.8% in 2050 (OECD Statistics 2012).

The future looks alarming, already by today. There will be less people to take care of elders and there will be more elders who will need more expensive care. Healthcare industry is facing the pressure of increasing quality and efficiency by decreasing cost. Unfortunately while quality indicators, such as availability of care go down, there is a tendency everywhere to try to solve the problems by increasing more money flow into the areas that are poorest on the quality indicators (Dahlgaard 2011). This is also one explanation why health expenditure continue to occupy larger portion of GDP.

Development of new treatments is also behind some of the unbalanced quality-cost equation, other than aging populations. Third party payers (insurance companies and governments) reimburse for procedures rather than the outcomes achieved. But the fundamental source of escalating cost is the system behind by which costs are measured. Instead of
focusing on the cost of treatment for specific medical conditions over their life cycle of care, providers aggregate and analyse costs at the specialty or service department level (Porter and Kaplan 2011).

The challenge is not in the ability to collect and process data. The challenge is in deploying a different way of thinking to create clarity on how care resources are utilized to deliver healthcare services to patient at the most optimum way to ensure better quality with lower cost. The data need to be organized in such a way that lets healthcare executives gain visibility on the effectiveness and efficiency of their care service deliveries. Only through-out this clarity, through innovative thinking and deployment of technology, it is possible to find new ways to solve the dilemma.

### 3.5 Other relevant topics

#### 3.5.1 Data: small or big

The terminology of “big data” has been pronounced already for over a decade. Coupled with the rising star of Internet of Things (IoT), big data have become one of the hottest topics in business. It refers to the unstructured data collected from multiple sources, which is defined with three “V”s: high in volume, velocity and variety (Datoo 2013). Some also use the fourth “V” for value. Unstructured, high volume data require the use of machine learning algorithms to process and extract the relevant information out (Vlad 2013), however due to the sophistication of such data processing, big data analytics are still in the hands of specialized data scientists, who need not only to develop such algorithms, but also to keep them up-to-date on a continuous basis.

While the storage of the big data was used to be the prime challenge a decade ago, during last five years, the focus has shifted on how to gain insight from the data itself (Datoo 2013). Extracting the right insight out of data processing craves highly specialized know-how in the industry in question. Yet, the right insight definitely brings value. If USA healthcare were to use big data creatively and effectively to drive efficiency and quality, the sector could create more than $300 billion in value every year. Two-thirds of that
would be in the form of reducing USA healthcare expenditure by about 8.0% (Manyika 2011)

Small data, on the other hand, are referred for the structured data, manageable in size that is collected usually from one source, with an intended purpose for analysis. Small data are controllable (Vlad 2013) and compared to big data, processing is more straightforward, which can be carried out by using data analytic tools available in the market. There is no need to be a data scientist to be able to analyse small data.

No matter what the size of the data, the most important practice is to ask the right question clearly and to stay in the question so long the right answer comes up. This may demand solid understanding of the context, business or industry, of which data can reveal an important insight (Larson 2014).

### 3.5.2 Data analytics

According to Cortada (2012), data analytics are the systematic use of data and business insights, which are developed through applied analytical disciplines to drive fact-based decision making for planning, management, measurement and learning. The value and the challenge of data analytics lay on what kind of actionable insight it can produce.

The systematic use is a process that starts from data collection that goes on to extracting the information, turning the knowledge into insights and taking required actions. It is all about finding the better, the faster, less expensive and the easier.

Data analytics help to improve quality and reduce waste, yet this takes place only when the data paradox is overcome. Stated by Cortada (2012), the data paradox of too much data and too little insight is an increasingly daunting obstacle to create effective data analytic strategies.

The need for data analytics creates a significant shift from using installed base, traditional, IT-centric platforms that are the enterprise standard, to more decentralized data discovery
deployments that are spreading across the enterprises. The transition is to deploy the platforms that can be rapidly implemented and can be taken into use by either analysts or business users to find insights quickly. So the tendency is towards data discovery platforms, where decentralized data are accessed interactively (Gartner 2015).

FIGURE 9. Gartner Magic Quadrant for Business Intelligence and Analytics Platforms (Gartner 2015)

According to Gartner’s Magic Quadrant report in 2015, Qlik has been evaluated in the leaders’ league, mentioned as a market leader in data discovery, particularly because of its interactive dashboard development product portfolio and ease of use (Gartner 2015).
3.5.3 Dashboards

Dashboards are used to provide summary data on key indicators, so that the management can get instant reading for their organization’s activities (Lumont 2007). Dashboards offer an easy way to read the outcome of data analytics in crisp form.

The main components of dashboards are the indicators, which are compared to their target metrics, where the variance is visually represented by the use of gauge-like images and color-coded arrows (Harrison 2012).

Data can be updated in real-time – in case they are received automatically from business intelligence systems at the back end -, presented visually and grouped meaningfully to extract the critical information.

Dashboards allow the management to assess changes in the critical program areas transparently across departments, especially when the measures relate to strategic plans. They are efficient reporting, monitoring and tracking tools useful for different layers in the organization. Even so, they also have a little use, unless they lead to action (Harrison 2012).

With the increasing amount of data collected, taking the right action requires to see a panoramic view from multiple sources. Dashboards need to present a wider visibility for the managers to assess the situations instantly and more objectively, so they need to collect information from multiple sources. People can make better decisions and anticipate problems sooner if they are aware of relevant events in the same context that occur elsewhere. (Yuen 2013).
4 QLIKVIEW TOOL AND DATA ANALYSIS

4.1 Data fields

HUH Psychiatry provided three flat excel datasheets for the purpose of Qlikview application development. Every patient has a unique registration number in HUS information system. To respect and preserve confidentiality, patient identity numbers were replaced with pseudo numbers by HUH Psychiatry before data were made available for use.

The first excel file was the largest by size. It contained data in 49 different columns and 86,071 lines, covering 5 months period from January, 2015 till May, 2015.

Content wise, the information were grouped in 5 categories:

1. Patient information
2. Institutional Information
3. Diagnostic Information
4. Healthcare Service Information
5. Financial Information

TABLE 2 below presents the data structure of the first excel file. Data fields in each category are listed briefly, in both Finnish and English, with a short description.

The second excel enclosed Full Time Equivalent (FTE) capacity of the care resources, per cost center and per profession (doctors, nurses, specialists and others). To be able to interlink with the first excel sheet in Qlikview, cost center information was pre-processed to hold same data fields for manual mapping.

The third excel contained the organizational structure of specific catchment areas, hospital care regions and municipals. Having the same municipal codes allowed data mapping automatically with Qlikview tool, so there was limited need for manual pre-processing work.
<table>
<thead>
<tr>
<th>Patient Information (Finnish)</th>
<th>Patient Information (English)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pot_aro</td>
<td>Patient Number</td>
<td>Unique numbers are replaced with fake codes.</td>
</tr>
<tr>
<td>Potaan_kotikunnan_koodi</td>
<td>Patient Homebase code</td>
<td>Code of the municipal patient lives in.</td>
</tr>
<tr>
<td>Potaan_kotikunnan_nimi</td>
<td>Patient Homebase name</td>
<td>Name of the municipal patient lives in.</td>
</tr>
<tr>
<td>Potaan_ikä</td>
<td>Patient Age</td>
<td>Nominal age of the patient.</td>
</tr>
<tr>
<td>Potaan_sukupuoeli</td>
<td>Patient Gender</td>
<td>Male or female.</td>
</tr>
<tr>
<td>Potaan_sukupuksen_koodi</td>
<td>Patient Gender code</td>
<td>1 or 2.</td>
</tr>
</tbody>
</table>

**Institutional Information (Finnish):** Institutional Information (English): Description

| Makasajan_koodi               | Payer's code                   | Code of the municipal which pays the cost. |
| Makasajan_nimi                | Payer's name                   | Name of the municipal which pays the cost. |
| Tulosahdekooodi               | Division code                  | 2-digit codes of 5 divisions of HYKS, Porvoo, Hyvinkää, Lohja and West-Uusimaa. |
| Tulosahdeennimi               | Division name                  | Names of 5 divisions of HYKS, Porvoo, Hyvinkää, Lohja and West-Uusimaa. |
| Tulosyksikkokooodi            | Division Unit code             | 3-digit codes of 19 division units that operate under own division. |
| Tulosyksikkominimi            | Division Unit name             | Names of 19 division units that operate under own division. |
| Vastuualue                    | Area of responsibility / department | 4-digit codes of 29 departments that operate under own division unit. |
| Vastuualueen_nimi             | Area of responsibility / department name | Names of 29 departments that operate under own division unit. |
| Vastunyksikkoryhmakooodi      | Cost Center group code         | 6-digit codes of 55 department groups that operate under own department. |
| Vastunyksikkoryhmantoimi      | Cost Center group name         | Names of 55 department groups that operate under own department. |
| Vastunykko                   | Cost Center                    | 7-digit codes of 135 cost centers that operate under own department group. |
| Vastunykko_nimi              | Cost Center name               | Names of 135 cost centers that operate under own department group. |
| Erikoala                     | Specialization                | Codes of 55 areas where specialized care is provided. |
| Erikoalanselite               | Specialization description     | Names of 55 areas where specialized care is provided. |

**Diagnostic Information (Finnish):** Diagnostic Information (English): Description

| Päädiagnoosin_ICD_10_koodi   | Main Diagnosis ICD_10 code     | ICD_10 codes for main diagnosis. There are 820 entries in the dataset. |
| Päädiagnoosin_selite         | Main Diagnosis description     | ICD_10 names for main diagnosis. There are 820 entries in the dataset. |

**Healthcare Service Information (Finnish):** Healthcare Service Information (English): Description

| Palvelupaiva                  | Service Date                   | Date and time of delivered service, in the format of DD.MM.YYYY HH:MM:SS. |
| Vuosii                       | Year                           | Year of delivered service, in the format of YYYY. |
| Kunukuusi                    | Month                          | Month of delivered service, in the number format (1-12). |
| Palvelutoimintojen_koodi     | Number of Service Activity     | Number of service activity delivered. Usually 1. |
| Käyntiyrityypin_koodi        | Code of visit type             | 2-digit codes of 19 different visit types. |
| Käyntiyrityypin_selite       | Description of visit type      | Description of 19 different visit types. |
| Palvelutoimintotyyppi        | Service Activity type          | 7 service activity types for consultancy, investigation, care planning and interventions. |
| Palvelutoimintotyyppiselite  | Service Activity type description | Descriptions of 7 service activity types for consultancy, investigation, care planning and interventions. |
| Palvelutoimintohaykkia       | Service Activity type class    | 1-digit class code of service activity types (1-7). |
| Palvelutoiminnon_koodi       | Service Activity code          | Codes of 119 service activities categorized under own service activity type. |
| Palvelutoiminnon_selite      | Service Activity type          | Description of 119 service activities categorized under own service activity type. |
| Palvelutoiminnon_lyhene      | Service Activity shortname     | Short description of 119 service activities categorized under own service activity type. |
| Palvelototuajantajenkoodi     | Service Provider's code        | Codes of 7 different types of service providers, in the format of Zxxxx. |
| Palvelototuajantajenselite    | Service Provider's description | Description of 7 different types of service providers, in the format of TOFE/professi. |
| Palvelototuajantajen_lyhene   | Service Provider's shortname   | Shortname of 7 different types of service providers. |
| Palvelototuajantajahaykkia   | Service Provider class         | 1-digit class code of service provider class. |
| Palvelenkestem_koodi         | Service Duration code          | Codes of service duration, indicating the length of delivered service. |
| Palvelenkstem_selite         | Service Duration description   | Description of service duration. |
| Palvelenkestem_lyhene        | Service Duration shortname     | Shortname of service duration. |
| Palvelenkesto_mannitena      | Service Duration in minutes    | Shortname of service duration in minutes. |
| Palvelenmooden_koodi         | Service Mode code              | Codes for modes of service delivered to the patient. |
| Palvelenmooden_selite        | Service Mode description       | Description of 19 modes of service delivered to the patient. |
| Palvelenmooden_lyhene        | Service Mode shortname         | Short description of 19 modes of service delivered to the patient. |
| ID_TUOTEPNO                  | Product number                 | Code of service visit type. |
| TUOTESTELITE                 | Product description            | Description of service visit type. |

**Financial Information (Finnish):** Financial Information (English): Description

| KUSTYHT                      | Cost                           | Cost of delivered service activity. |
| LASKUTUS                     | Bill                           | Bill of delivered service activity. |
4.2 Data processing

Qlikview creates an associative database as it loads data from a data source. The data source can be individual flat files, databases or other platforms (See 2.1.4). In our case, data sources were three flat excel sheets, described in section 4.1.

Qlikview’s associative database optimizes the data as it loads, creates table like views from data fields which are automatically linked together depending on the naming of the data fields. Indexes are not required, making every field available as a search field without any performance penalty (Qlikview Introduction).

As described earlier, Qlikview uses its own script language. Editing the load script, it is possible to link data fields manually, aggregate data, create new variables and make new groups of data etc. already at the upload phase.

In the developed application, the following data fields were pre-processed at the upload phase:

1. Department and cost center names in different sheets were linked manually by defining new variables.
2. A new key was formed to connect department and cost center names.
3. Age of the patients were grouped by distinct age groups: Under 16, 16-25, 26-35, 36-45, 46-55, 56-65 and 66-95.
4. Main diagnosis ICD 10 codes were grouped to reflect the main category, such as F20, F21 and F22 etc.
5. Service duration (in minutes) were mapped to ZXExx codes of service duration.
6. Service activity types and service provider’s short names were sorted in a pre-defined order, to show the data visually in certain flow, regardless of the value they hold.
7. Month names were extracted from service date in 3-letter format (Jan-Dec). Four months quadrimester groups were also created in the same style.
Because new data fields were formed during the load script phase, they were indicated with a small key logo and were used in the application just like the original data fields coming from the excel files.

### 4.3 Qlikview data analytic application

The application consists of 8 different views for cost overview, cost center analysis, cost per service types, service structure report, diagnosis and services, resource analysis, patient overview and patient statistics.

All views were developed with the same look and feel. On the left pane, under HUS logo, there are a number of selection possibilities to filter the data in the graphs automatically. These are namely age group, hospital care region, patient home base, department name, cost center name, diagnosis ICD_10 group name, service activity type, service activity and service provider. When a selection is made, it is highlighted with light green colour and shown on the upper pane in the “Current Selection” window to let the user see what is selected explicitly (Figure 11).

Under the current selection window, time intervals can be chosen by using year, quad-rimester (four months) and month selections, so that data can be screened for desired duration accordingly.

On the right pane, the blue buttons filter the data for capital region (Helsinki, Espoo and Vantaa) and for depression diagnosis group codes (F32 and F33). These selections can be also be made on the left pane from drop down filters. Yet, buttons were implemented for convenience in case of frequent use.

In the next subsections, each view is described for their individual properties, on top of these common features.
4.3.1 Cost overview

The financial status of 29 departments and 135 cost centers are shown in four main graphs. In each graph, it is possible to drill-down from upper level department to lower level cost center, to compare costs with invoices, to see cost per service type, cost per diagnosis group and invoice per professional group (service provider).

Cost centers are the minimum units where the costs get accumulated. Cost overview shows whether costs are collected and invoiced correctly at each cost center, which can be cumulated to department level. It also presents which service types and which diagnostic groups create the majority of the costs and invoices, as well as the contribution of the professional groups in the invoice.

Looking at the data, Youth Psychiatry Department seemed to create the majority of the accumulated costs, which was followed by Mood Disorder and Psychiatry Departments. The main reason was depression (diagnostic groups F32 and F33) among all three departments, which required excessive amount of intervention services to cure the patients, provided by nurses and psychiatrists. In Youth Psychiatry, investigations were also the other reason for cost.
Going one level down by using drill down icon in the graphs, it is possible to see which cost centers contribute to the cost at most (Figure 11). As an example, for Youth Psychiatry Department, Pasila, Töölö and Järvenpää were top three cost accumulators. In case a drill down icon is pressed for one graph, the selection becomes automatically active in the other graphs, as well.

**FIGURE 11.** Active selection of department in Cost Overview.

Trends provide valuable information on timely patterns. The monthly trend of costs and bills is located on the sheet in minimized form and it can be maximized if the user wants to see the accumulation by month as well as the gap between cost and invoice (Figure 12). In this data set, March 2015 seemed to be the busiest month and May 2015 the most peaceful.
FIGURE 12. Trend of costs and bills for 5 months.

4.3.2 Cost center analysis

FIGURE 13. Cost center analysis.
Cost centers are the units in an organization where costs are cumulated for accounting purposes. The responsibility to keep the cost levels within budget is assigned to own cost center manager.

In Cost Center Analysis, the managers can go deeper with their cost analysis to see how many patients have received what type of service activity per month and how many services have been provided. Five different graphs are inserted in a container to create a clean look in the view. Some graphs are available in the other views, yet having them in the container saves time and effort of the manager to go back and forth for finding necessary information.

With a selection of cost center on the left pane, manager can see the monthly patient and service volume distribution per activity type. In the container, cost distribution per service activity type, patient volume per month, service volume per month, personnel FTE and diagnostic group costs are presented. In the Trellis chart below the container, cost per professional groups indicate which service provider has provided what service activity at what cost.

In Youth Psychiatry Department, Pasila Youth Psychiatry Clinic served to 1836 patients since start of 2015. In total, 4030 services were provided, majority of which were interventions delivered by nurses. Again the main reason for care was depression.

### 4.3.3 Cost per service activity types

In HUH Psychiatry, there are well-defined processes for patient treatment. The operational excellence change project mapped care processes and defined them as service activity types to capture and monitor the content of delivered care services, meaning how they were planned and implemented at each stage of care process (Figure 14).

The architecture reflects four main groups of treatment: psychiatric consultation (KONS), investigation (TUTK), care planning (HOSU) and systematic interventions (INTP, INTK, INTB, INTM) for psychotherapy, psychosocial, biological or others respectively.
Psychiatric Care’s “Operational Architecture” maps the content and implementation of care processes

These treatment groups are referred as “service types” in the data set. Service types then contain “service activities” as their subgroups.

FIGURE 14. HUH Psychiatry’s operational architecture (Näätänen 2014).

FIGURE 15. Costs of service types and activities.
Cost per Service Activity view (Figure 15) presents the use of service activities in its own group by cost. The legend shows the nominal cost in € and pie charts present % value in own group. The view lets the user grasp distribution of service activities by cost and % both in own type and group.

Other interventions (INTM) were provided at most by HUH Psychiatry during the first 5 months in 2015. In case of Pasila Youth Psychiatry Clinic, the situation was the same. However data revealed that, among INTM, other care contacts held almost half of the costs, scoring 44.54 %. Looking at this picture, management can question what has been done for these services and whether cost levels justify content and quality. Questions open up new discussions and new way of thinking where improvements can take place in the future. In fact, this is the essence of data analytics.

### 4.3.4 Service structure report

HUH Psychiatry’s existing report in excel form has been implemented as pivot chart in the application with graphical add-ons. The pivot has the same look and feel as in excel, however, instead of calculating data in flat excel table with functions, Qlikview allows to
calculate the fields in the load script or in the expressions without touching to data source. It is also possible to export the report from Qlikview in excel form.

Service Structure Report presents key indicators on patients, services, duration and cost. At the level of each cost center, service activity type and service activity, managers can monitor the following indicators:

- number of patients
- % of patients
- number of care services
- % of care service in overall and in own type
- sum and % of registered hours for service activities in overall and in own type
- sum and % of cost and bill again in overall and in own type

The graphs below the report present part of the pivot data in graphical form, collected again in a container for a clean look. These are namely patient and service volume, diagnostic groups, cost and bill per service activity.

Referring again to Pasila Youth Psychiatry Clinic, it was seen that, since start of the year, 617 patients received 41 different types of 4030 care services, at the cost of 964 970,65 €, which made 5.0 % of the total cost. Other interventions (INTM) occupied 61.9 % of the cost and 55.0 % of the service volume caused by depression (diagnostic code F32).
4.3.5 Resource analysis

In Resource Analysis sheet on the upper left graph, full time equivalent (FTE) resource capacity per cost center can be seen for four main professional groups: doctors, nurses, specialized care personnel and others. On the upper right, service activity types and service activities are shown according to by which service provider they are delivered. On the lower right, in which mode service types and activities are delivered can be seen. Next to it, the lower right graph shows the capacity distribution per patient and service volume.

Resource capacity information for professional groups was taken from second excel sheet provided by HUH Psychiatry separately. It was linked to the hospital data at the load phase of the application. As the data contained resource capacity on May 2015, it can be considered as static.

Once the data cover the information over a duration of time, it is possible to modify the views to reflect capacity in trend form. Additionally, utilization view per professional group can be generated by use of total registered duration and FTE figures.
4.3.6 Diagnosis and services

The view lists delivered services for diagnosed disorders including date and cost. It is used to relate service activity types and service activities with the diagnosis groups and codes. The report consolidates all the services provided to the patient with dates and costs.

This report can be used by the management or by the professional groups to track and compare which service activities are provided for which diagnostic groups. It can be utilized to make pattern analysis to interlink diagnosis with services. Coupled with the value outcome (when available), it can be instrumental to monitor effectiveness of delivered services to lower the costs.
4.3.7 Patient overview

Hospital data contained gender, age and home base information of the patient. In the load script, age data were categorized into 7 age groups: Under 16, 16-25, 26-35, 36-45, 46-55, 56-65 and 65-95. These age groups were defined according to the range of age data.

Patient Overview is designed to present demographics and diagnostics of the patient. On the upper left, patient and service volume are distributed per age groups and gender. On the lower left, patient home base distribution is seen. In the container on upper right, patient volume in diagnostic groups and service activity types are shown. Who has delivered service activities to how many patients can be seen in Trellis chart on lower left.

The data showed that, females in the age group of 16-25, living in Helsinki capital area received services for depression at most, at the cost of 1 692 538,10 €. The same characteristics are valid also for Pasila Youth Psychiatry Clinic, as their target customers are in the same age group.
4.3.8 Patient statistics

Patient statistics view reports patient identity (which was replaced by distinct pseudo code in the given data set), age, gender, home base, diagnosis, delivered service activity, service provider and duration of service, cost, bill and the difference in between.

Combined with the previous view of patient overview, this report can be used to get more details on patient level by management or professional groups. The report also shows the total cost of delivered services accumulated around the patient.
5 CONCLUSIONS

5.1 Outlook

Demographic, economic and social changes force healthcare industry to adapt itself in order to increase quality by decreasing the cost. Innovative developments in healthcare technology are capable to produce solutions to this challenging equation.

Technology integrates devices, systems and people in the digital world, where the common denominator is data. There are a massive amount of data production on a daily base from every connection point. However, data as such do not create any value, so long they are not translated into actionable insight. This is the reason why data analytics tools and processes are getting more important. They can simply help to create deeper understanding on the issues, situations, experiences out of collected data.

The thesis work aimed to develop a customized data analytic tool to visualize, interpret and make decisions by the use of HUH Psychiatry’s collected data set. Even though the starting point was different, it was quickly adapted to add value to their operational excellence project.

The application development work proceeded iteratively through-out three face to face meetings with HUH Psychiatry Development and Finance Managers. During March-May, 2015, the pilot application was developed by using two months data. The final five months data were received and inserted into the application at the end of May, 2015.

Quality of data was very good, even though certain parts such as registration of service delivery durations have been in the ramp-up phase. Data structure gave the possibility to create multiple views to cross compare departments, cost centers, patients, diagnosis, service types, service activities, service resource capacity per professional groups, costs and invoices.

By using Qlikview platform, a data analytic tool was developed to connect, visualize and analyse the data in eight different views. The intention was to produce an application
which can be utilized by the thesis commissioner, HUH Psychiatry for their daily analysis and reporting work later on. The last version of the application, which has been referred in this thesis, was shared with HUH Psychiatry for taking into use.

5.2 Recommendations

Qlikview is a practical, flexible and powerful tool to visualize any kind of data sets to analyse the content. There are a number of features which can be explored, such as developing an interactive map view for the HUS departments and cost centers.

The very next development area can be integrating service provider’s capacity trend information into the time window of the rest of the data. This would allow capturing and analysing resource utilization against the volume of patients and services in the same time frame.

It is also possible to connect the application to the data warehouse where data can be updated automatically. On the long run, when more users have access to the application, automatized views would ensure integrity in data management. More users may also mean defining specifications for authentication and requirements for security. These are more advanced topics for Qlikview applications, which can be explored per need. Yet, the current application is believed to provide a nice start to do that.
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APPENDICES

Appendix 1. Porter and Kaplan’s Time-Driven Activity-Based Costing

Porter and Kaplan introduced “time-driven activity-based costing” (TDABC) concept for healthcare that allow calculation of actualized costs according to the services provided to the patient. In their famous article (Porter and Kaplan 2011), they proposed creating a cost measurement system using the following steps:

1. Select the medical condition and/or patient population to be examined.
2. Define the care delivery value chain.
3. Develop process maps of each activity in patient care delivery, identify the resources involved and any supplies used for the patient at each process.
4. Obtain time estimates for each process step.
5. Estimate the cost of supplying each patient care resource.
6. Estimate the practical capacity of each resource provider and calculate the capacity cost rate.
7. Compute the total costs over each patient’s cycle of care.

Process maps encompass the paths patients follow as they move through their care cycle. They include all resources (personnel, facility, equipment and supplies) involved at each process along the path both those directly and indirectly used by the patient. In the article, cost calculation by using TDABC methodology was described with an example.

It takes time and effort to develop process maps. Porter and Kaplan estimated that, in their case study, for each segment of process map took approximately 40 hours of work by a large expert team. However, in addition to revealing the cost aspect, process maps are also useful in immediate opportunities for process improvement and cost reduction.