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FACTORS AFFECTING THE DECISION MAKING PROCESS IN HEALTHCARE INSTITUTIONS

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ABSTRACT

In health care organizations, decision making is very complicated and could be of both clinical and nonclinical nature. Decision towards patients is usually associated with multiple factors including economic ones, in addition to several treatment options. Leaders and managers in healthcare organizations have to adapt significant pressure to make difficult operational and budgetary decisions by maximizing operational efficiency and reducing unnecessary costs while improving and maintaining high quality. Several factors influence decision making in healthcare organizations. Because of that it is imperative to identify and understand factors that positively or negatively influence the decision making process in such critical and sensitive forms.

The purpose of this study is to determine and examine factors that affect decision making process in Healthcare Organizations. A meta-analytic study was done to identify the most cited factors affecting the decision making process in the last five year throughout searching and screening the literature using Ankara University Electronic Library, The Pub Med, SAGEM Library, Google Scholar. Time period for scanning was between October 2014 and February 2015. First, all of the articles were tabulated according to the year of publication, the Author and the resulted factors influencing the decision making process in health care organizations. A lot of studies were found related to our key words of interests but many of them were talking about the factors affecting the decision making process from a clinical perspective and only articles talking about the process from a managerial point of view were included in our study. As a result 48 articles were included as they met our research criteria. Articles of interest were collected, gathered and tabulated according to the resulted factors affecting the decision making process in health care organizations. The following keywords were helpful in articles pickup process (Healthcare organizations, Decision Making, Process, Impact and Factors).

During the last five years Knowledge based decision making, Informative decision making and training effect on decision making were the most cited factors 14/48 studies. Followed by 11 studies mentioned the organizational and institutional factor, 7 studies considered the using of specific models for decision making and decision supporting tool a great and a helpful factor in the decision making process. The characteristic of the decision maker as an influencing factor took a part in three studies and was equal to the financial resources which were also taken in consideration in 3 studies also. The timelines of decisions, the delegation of decisions, and shared decision making factors came to play in one to two studies.

Decision making in health care organizations is a complicated process because it is of both clinical and non-clinical nature. According to findings, knowledge and evidence

informed decision making (EBDM) was the most cited factor to influence the decision making process in health care organizations. However, "the most cited" doesn't mean "the most important". Beside this the use of information and communication technologies and decision support tools, the environmental and institutional factors, the financial factors and the delegation of decisions were also important factors to discuss in this context.

INTRODUCTION

Making and implementing decisions are central functions of management (Ozcan, 2005). Decision making is the process of analyzing alternatives to reduce uncertainty about achieving a desired outcome, with the best effect on the organization. Timelines, methodological considerations, interpretations of value for money, explication of social values, stakeholder engagement and accountability for reasonableness are main issues surrounding the decision making process (Stafinski et al., 2011). Consideration of social and organizational dimensions of context is critical in optimizing the quality decision making (Smith, Higgs & Ellis, 2015). The decision makers' thinking processes included: vision, political astuteness, being tactical, being strategic, due diligence, and risk management; and the ethical processes included: respect for diverse opinions, integrity and trust, democracy, impact of policies, passion for public service, and intuition about doing the right thing. Strong face validity and trust worthiness of the data was achieved to inform future research (Jiwani, 2011).

Healthcare managers, administrators, physicians and other health care professionals have a great pressure to make the best use of available resources to get excellent results from limited resources. In addition to ensure providing high quality of care at a lower and competitive cost, because of today's highly complicate, technologic and competitive healthcare arena (Hanson et al., 2011). Decisions towards patients are usually associated with multiple factors including economic ones, in addition to several treatment options**.** In health care organizations, managers have to make decisions frequently based on collected information, they must decide how to direct and organize others, how to control processes within the system plus helping others to reach their own decisions. As a result, decision making can be quite stressful in today's dynamic and complex health care industry (Ozcan, 2005). Healthcare decision making is complex and requires access to a wide array of high- quality information and success depends on whether or not enough right decisions are both made and implemented (Bansal, 2005). Decisions can be described in terms of decision characteristics and attributes (e.g. complexity, urgency etc), nature of the task, the characteristics of the decision maker (e.g. demographics, diversity, tenure), and in which context the decision will take place, in addition to the availability of information required for making decisions, the economic and financial factors and to what extent the government is involved in decision making regarding to politics and regulations. Many factors may lead to more evidence based decision making such as the developed personal skills, the use of data and analytic tools, plus the suitable and favorable organizational climate. Knowledge and leadership are factors that influence the managers' decision. Although most people understand this concept, a relatively small number had substantial expertise and experience with its practice. Factors associated with use of EBDM included strong leadership; workforce capacity (number and skills); resources; funding and program mandates; political support; and access to data and program models suitable to community conditions (Sosnowy et al., 2013).

METHODOLOGY

The aim of this study was to identify the most cited factors affecting the decision making process in the last five years throughout searching and screening the literature using Ankara University Electronic library, The Pubmed, SAGEM library, Google scholar. Scanning process was carried in the time period between October 2014 and February 2015. First, all of the articles were tabulated according to the year of publication, the Author and the resulted factors influencing the decision making process in health care organizations. A lot of studies were found related to our key words of interests but many of them were talking about the factors affecting the decision making process from a clinical perspective and only articles talking about the process from a managerial point of view were included in our study. As a result 48 articles were included as they met our research criteria. Articles of interest were collected, gathered and tabulated according to the resulted factors affecting the decision making process in health care organizations. The following keywords were helpful in articles pick up process (Healthcare organizations, Decision Making, Process, Impact and Factors).

Table 1
MAJOR FINDINGS OF THE SELECTED ARTICLES

Publication	Findings
Purwanto, Eswaran & Logeaswaran, 2012	Dual hybrid model is useful for generating appropriate decisions which will be helpful for the healthcare managers. Special generated models for taking decisions
Adeyemi, Demir & Chaussalet, 2013	The transferable skills; the health outcomes, understanding of how the accesses, uses health service and information in making strategic decisions; and Practical involvement in how information informs commissioning decisions. Knowledge and information effect
Yuen, 2014	This study identified the need for having a receptive climate that supports the use of research in decision making. institutional and organizational factor
Solans-Domènech et al., 2013	The relationships between managers. Shared decision making
Nutley, Powell & Davies, 2013	Decision support tool play a vital role in health decision making. Using decision support tools and models
Zeng, Li & Yang, 2013	Considering VIKOR for use as a decision support tool for future study. Using decision support tools and models
Tromp & Baltussen, 2012	Recommended the use of conceptual mapping criteria by decision makers. Using decision support tools and models (mapping criteria)
Stipp & Kapp, 2012	Directors inform their decision making with streams of information. Organizational knowledge and value for local practice effectiveness.
Simonen et al., 2009	Manager's professional background and activity sector are associated with the kind of knowledge that affects their decision making.
Tourigny & Pulich, 2006	The role of delegation in improving the decision making process.
Kotalik et al., 2014	Ethical decision-making as well as advance the ethical atmosphere of the institution.
Bai et al., 2014	Task based and employee based sequential-decision approach, extensive computational analysis of a clinical workflow process

Table 1
MAJOR FINDINGS OF THE SELECTED ARTICLES

Publication	Findings
Williams et al., 2013	Decision-maker characteristics and processes that may influence the decision, including operations, readiness, attitudes, barriers, and facilitators.
Wills, 2014	The effect of data analytics in health care on decisions
Yousefi – Nooraie, Dobbins	Implying a positive atmosphere towards implementation of evidence-informed decision making in this public health organization.
Legare et al., 2014	Health professionals and managers attitude are barriers that influence decision making.
Sosnowy et al., 2013	Strong leadership; knowledge, workforce capacity (number and skills); resources; funding and program mandates; political support.
Villa et al., 2013	One's workforce and board of health were also influential in making decisions regarding resource allocations
Hoflund, 2013	Health care decision makers identified timeliness as a key factor.
Koon et al., 2013	The principles that are representative of the larger environment.
Poulin et al., 2013	Our findings suggest that four qualities influence decision: reputation, capacity, quality of connections to decision-makers, and quantity of connections to decision-makers and others. In addition to this, the policy strongly influences up take.
Hamrock et al., 2013	The effect of introducing new technologies on the decision making process.
De Graaf - Ruziendaal & De	Shared Decision making effect
Mendez et al., 2013	Conceptually, the hospital self-management policy is based on financial autonomy, and implementation is affected by persistent capacity gaps in policy design.
Fache, 2013	The mission, vision, and values statements of these organizations have been successfully translated into a set of shared values--a moral compass that guides behavior and decision making**.**
Mc Cormack et al., 2011	Levels of knowledge and actual levels of involvement in decision making
Lee et al., 2013	The effect of implementation qualitative analysis for past decision making results on developing appraisal guidelines and enhance the objectivity of decision-making processes.
Mc Caughey & Bruning, 2010	Cognitive information processing as a key factor in the decision-making process.
Shoemaker, Kazley & White, 2010	Financial considerations were a factor in decision making.

Table 1
MAJOR FINDINGS OF THE SELECTED ARTICLES

Publication	Findings
Tso et al., 2011	Decision aid is intended to help public sector health policy decision makers.
Jack et al., 2011	Experiential knowledge. Individual and organizational facilitators and
Khoumbati et al., 2008	MAESTRO identifies a set of factors that influence decision
Champagne et al., 2014	The impact of training. Individual, organizational and program design factors that facilitated and/or impeded the dissemination of the attitudes and skills gained by trainees to other organizational members
Hubbeling, 2014	The underlying psychological processes of normal decision-making are not well known and one cannot differentiate between unwise decisions caused by an illness or other factors.
Williams & Brown, 2014	Factors influence decisions impacting on quality and costs
François, Louise & Duranceau, 2014	Knowledge

FINDINGS

During the last five years Knowledge based decision making, Informative decision making and training effect on decision making was the most cited factor 14/48 studies. Followed by 11 studies mentioned the organizational and institutional factor, 7 studies considered the using of specific models for decision making and decision supporting tool a great and a helpful factor in the decision making process. The characteristic of the decision maker as an influencing factor took a part in three studies and was equal to the financial resources which were also taken in consideration in 3 studies also. The timelines of decisions, the delegation of decisions, and shared decision making factors came to play in one to two studies. These findings are showed in Tables 2 and 3 respectively from the most cited factor to the least cited factor. The most cited factor doesn't mean the most important factor.

Table 2
MOST CITED FACTORS THAT AFFECT DECISION MAKING IN HEALTH CARE ORGANIZATIONS

Knowledge based decision making	Organizational and institutional enviroment	The use of technology and analytic tools
Adeyemi, Demir & Chaussalet, 2013	Yuen, 2014	Wills et al., 2014
Sosnowy et al., 2013	Stipp & Kapp, 2012	Poulin et al., 2013
Simonen et al., 2009	Kotalik et al., 2014	Hamrock et al., 2013
Hamrock et al., 2013	Bai et al., 2014	De Graaf – Ruziendaal & De Bakker, 2013
Wilby & Al-Siyabi, 2013	Yousefi – Nooraie, Dobbins & Marin 2014	Stafinski et al., 2011
Mc Cormack et al., 2011	Hoflund, 2013	Yang et al., 2013
Lee et al., 2013	Fache, 2013	Lugtenberg et al., 2014
McCaughey & Bruning, 2010	Jack et al., 2011	Glover, Webb & Evison, 2010
Jack et al., 2011	Gildiner, 2007	Qureshi et al., 2014
Champagne et al., 2014	Ellen et al., 2014	
Ellen et al., 2014	Noriega Bravo & Pría Barros, 2011	
Foshay & Kuziemsky, 2014		
Solans-Domènech et al., 2013		
Simonen et al., 2012		

Table 3
THE LEAST CITED FACTORS AFFECTING THE DECISION MAKING PROCESS IN HEALTH CARE ORGANIZATIONS

Decision supporting tools and models	Shared decision making	Financial resources	Time and delegation
Zeng, Li & Yang, 2013	Williams et al., 2013	Bekemeier et al.,2013	Villa et al., 2013
Tromp & Baltussen, 2012	Legare et al., 2014	Mendez et al., 2013	Tourigny & Pulich, 2006
Tso et al., 2011	Koon et al., 2013	Shoemaker, Kazley & White, 2010	
Koumaditis,Themistocls & Da Cunha, 2013			
Kudyba et al., 2005			

DISCUSSION

Several factors influence decision making in healthcare organization. Because of that it is imperative to identify and understand factors that positively or negatively influence decision making process in health care organizations. Decisions based on scientific evidence are useful for both long and short term demands of health care organizations and helps improve the acceptability of decisions (Ross, 1999; Stafinski et al., 2015). Evidence informed decision making process is a complex, multi- disciplinary process that occurs within dynamic and ever changing community. It is not easy to translate research evidence into practice ,as a result, staff and managers succeed to implement evidence informed/based practice are considered experts and information sources (Yousefi – Nooraie, Dobbins & Marin, 2014). Many factors are needed to implement evidence based decision making and these factors include the strong leadership characteristics of the decision maker, the workforce capacity (number and skills); resources; funding and program mandates; political support; and access to data and program models suitable to community conditions (Sosnowy et al., 2013). The future decision-makers have to be capable of making comprehensive decisions affecting the entire organization in addition to that they should be able to identify versatile knowledge areas taking the cultural barriers in their consideration (Simonen et al., 2009). Sources of evidence range from online medical literature databases such as PubMed, to international organizations offering evidence summaries and appraisals of published studies (Wilby & Al-Siyabi, 2013). The level of knowledge is important at actual levels of involvement in decision making (Mc Cormack et al., 2011). Developing guidelines help decision makers to enhance objectivity of decision making process especially in terms of safety and effectiveness (Lee et al., 2013) increasing the adoption of evidence-based healthcare models, the rational choice, utility maximizing assumptions in EBDM and EBPM, must be critically evaluated to ensure effective and high-quality health policy decisions (McCaughey & Bruning, 2010). Decision makers need to inform practice-related decisions at different levels using research evidence and all factors that may influence the evidence informed decision making process. Information for decision-making is accessed from a range of sources, including web-based resources and experts in the field (Jack et al., 2011). Support must be given at different administrative levels to integrating EIDM, transfer and exchange strategies should be focused towards program managers and administrators and include capacity building for locating, appraising and using research evidence, knowledge brokering, and for partnering with universities. Resources are required to maintain web-based databases of searchable evidence to facilitate access to research evidence (Jack et al., 2011). Training can influence the extent of skills and knowledge transfer by the dissemination of the attitudes and skills gained by trainees to other organizational members (Champagne et al., 2014). Barriers to implementing EIDM include limited resources, time constraints, and negative attitudes toward change, on the other hand knowledge translating culture over time in health care organizations is considered a facilitator in implementing evidence based decision making (Ellen et al., 2014). Implementing accessible and efficient systems to support the use of research in decision-making (e.g., documentation and reporting tools, communication tools, and decision support tools) and developing and implementing an infrastructure or position where the accountability for encouraging knowledge use lies (Ellen et al., 2014). Changes in health services are highly correlated with the results of research and the channels used to transfer new knowledge (Solans- Domenech et al., 2013). It is not easy to translate and to transfer new knew knowledge into practice

especially in health care organizations because the channels of translation are very complex, the relationships between managers and research teams and the mutual knowledge of their activity have shown to be effective in applying research funding to practice and decision- making (Solans-Domenech et al., 2013). Managers would cultivate the use of effectiveness data by improving its accessibility, usability and visibility for effective use in decision process in health care organizations, the use of effectiveness data in management can be influenced by enhancing organizational patterns of action and supporting managerial decision-making (Simonen et al., 2009). Core competencies for public health require proficiency in evidence informed decision making (EIDM). However, decision makers often lack access to information, many workers lack knowledge and skills to conduct systematic literature reviews, and public health settings typically lack infrastructure to support EIDM activities, the critical factors and dynamics for building EIDM capacity at an organizational level included: clear vision and strong leadership, workforce and skills development, ability to access research (library services), fiscal investments, acquisition and development of technological resources, a knowledge management strategy, effective communication, a receptive organizational culture, and a focus on change management (Peirson et al., 2012).

Two critical challenges face healthcare organizations: significant personnel shortages and mandates to safeguard patient safety and information security, quality care delivery, cost reduction, and patient privacy (Bai et al., 2014). Ethical decision making is ascertained by understanding the mission, vision, and values of each health care organization (Kotalik et al., 2014). The mission, vision, and values statements of these organizations have been successfully translated into a set of shared values and moral compass that guides behavior and decision making (Fache, 2013). In order to create a decision-making process for a network administrative organization that is balanced and inclusive of diverse interests a leader must consider and incorporate principles that are representative of the larger environment and institutional factors, such as federalism and financial policies and the medical profession, or to economic indicators such as change in expenditures (Hoflund, 2013). Welfare-policy sectors are organized with respect to their decision-making contributes to politics of policy drift. Such organization is framed by two factors. The first is the set of rules by which the public–private boundary is drawn, and the second is the structuring of public institutions that set legislation and regulation, and organize the policy networks attendant on them, around these boundaries. Is a factor in the politics and dynamics of drift (Gildiner, 2007). The communication network between organizational divisions and the positive organizational atmosphere has a great impact on the implementation of evidence decision making in public health organizations (Yousefi – Nooraie, Dobbins & Marin 2014). More scientific evidence on the work of the departments and more management for the working process results in more control for decisions and allows determining the organizational and functional elements of departments, which could have an effect on the quality of work and the effectiveness of the decision-making (Noriega Bravo & Pria Barros, 2011). Directors should inform their decision making with streams of information, which they manage and generate to build organizational knowledge and value for local practice effectiveness (Stipp & Kapp, 2012). Additional factors impacting on organizational decisions include: Size and service mix, resource levels, location, governance structures, participation and connectedness, culture and strategic orientation, and absorptive capacity (Williams & Brown, 2014). Technological advancements have accelerated the deployment of healthcare information systems (HIS) with the potential to enhance

productivity, lower costs, reduce medication errors, and ease the manpower strain on the healthcare industry (Yang et al., 2013). The amount of data in healthcare is increasing at an astonishing rate. Healthcare executives face the risk of being overwhelmed by a flood of unusable data. In order to extract actionable information, leaders must take advantage of the promise of data analytics. Small data, predictive modeling expansion, and real-time analytics are three forms of data analytics, these three assist in the collection, management, and analysis of raw data to improve the quality of care and decrease costs (Wills, 2014).The increasing pressure of business environment of the information age is forcing the organizations of the entire world to adopt and use Information and communication technologies (ICTs) in decision making. Private sector organizations are using information system for achieving strategic advantages and gaining financial and business benefits more than its public counterpart (Qureshi et al., 2014). Decision making should be systematic, consistent, and transparent. It should involve translating and integrating scientific evidence, such as health technology assessment (HTA) reports, with context-sensitive evidence to develop recommendations on whether and under what conditions a new technology will be introduced. However, the development of a program to support such decision making can require considerable time and resources. An alternative is to adapt a preexisting program to the new setting. Adaptation of a preexisting program may reduce duplication of effort, save resources, raise the health care providers' awareness of HTA, and foster constructive stakeholder engagement, which enhances the legitimacy of evidence-informed recommendations for introducing new health technologies (Poulin et al., 2013). The challenge of determining which of many technologies to fund is one of the difficulties that healthcare systems face (Stafinski et al., 2015). It would be useful for organizations to engage data mining strategies for executive information systems and information policy issues (Glover, Webb & Evison, 2010). For the appropriate provision of local healthcare services to the healthcare needs of local populations to increase health status and decrease healthcare costs, the construction of a decision tool which enables healthcare planners to analyze local supply and demand is an another issue missed by many organizations (DeGraaf – Ruizendaal, 2013). Decision making process and enabling technologies are significantly positively related with effective decision making with enabling technologies as significant factor (Qureshi et al., 2014). The decision aid tools can facilitate the mission for health care policy makers in population based health policy decisions (Zeng, Li & Yang, 2013). Discrete event simulation (DES), a computerized method of imitating the operation of a real-world system (e.g., healthcare delivery facility) over time, can provide decision makers with an evidence-based tool to develop and objectively vet operational solutions prior to implementation. DES in healthcare commonly focuses on (1) improving patient flow, (2) managing bed capacity, (3) scheduling staff, (4) managing patient admission and scheduling procedures, and (5) using ancillary resources (e.g., labs, pharmacies). An original DES model developed to examine crowding and patient flow for staffing decision making at an urban academic emergency department serves as a practical example (Hamrock et al., 2013). Service oriented architecture (SOA) is increasingly adopted by many sectors, including healthcare. Due to the nature of healthcare systems, there is a need to increase SOA adoption success rates as the non-integrated nature of healthcare systems is responsible for medical errors that cause the loss of tens of thousands of patients per year. This model also helps health organizations to successfully implement an SOA based solutions (Koumaditis et al., 2013). Also the use of predictive modeling and continuous research with predictive models has great outcomes throughout early identifications and intervention (Kudyba et al., 2005). In

rationing decisions in health**,** many criteria like costs, effectiveness, equity and feasibility concerns play a role. Conceptual mapping of criteria, based on well-established health system frameworks like the World Health Organization's Health Systems Performance and Health Systems Building Blocks frameworks, will further develop the field of priority setting by assisting decision makers in the identification of multiple criteria for selection of health interventions. these criteria include the improvement of health, fair distribution of health, responsiveness, social and financial risk protection and efficiency, leadership and governance that reflects the feasibility based on the health system building blocks (service delivery, health care workforce, information, medical products, vaccines and technologies, financing) (Tromp & Baltussen, 2012). Analytic Hierarchy Process (AHP) is increasingly applied to healthcare and medical research and applications could be a promising decision tool to replace AHP to share information among patients or/and doctors, and to evaluate therapies, medical treatments, health care technologies, medical resources, and healthcare policies (Yuen, 2014).

Both the individual (individual level, race, gender, attitudes towards EBPs) and organizational characteristics (organizational level, organizational climate) have a great impact on the decision to adopt evidence based practice. Organizational barriers to implementing EBPs and use of reading materials and treatment manuals were related to directors' decision to adopt. Type of organization and staff attributes were associated with staff's decision to adopt (Williams et al., 2013). Shared decision making is a process that can be used to guide decisions about screening, investigations and treatments. Various tools are now found to facilitate the shared decision making (Picone, 2014). Four qualities influence embeddedness: reputation, capacity, quality of connections to decision-makers, and quantity of connections to decision-makers and others. In addition to this, the policy environment (e.g. the presence of legislation governing the use of HPSR, presence of strong civil society, etc.) strongly influences uptake raises several important considerations for decision-makers and researchers about the arrangement and interaction of evidence-generating organizations in health systems (Koon et al., 2013). Financial considerations and the transformational leadership style among the organizations administrators are important factors that affect decision making (Shoemaker, Kazley & White, 2010). Local decision-making authority is restricted by what public health activities are legally mandated and the categorical nature of funding source and health workforce and board of health are influential in making decisions regarding the available and allowed resource allocations. Financial information used as data and research evidence for decision making such as Programmatic mandates, funding restrictions, local stakeholders, and workforce capacity (Bekemeier et al., 2013). The concept of self- management is determined by autonomy in decision making about resource allocation and the financing of health service delivery in the hospitals. Human resources and financing polices should be included to improve the implementation stage of the decision. Weakness usually is related to the lack of organizational capabilities and managerial skills in the health teams. The hospital self-management policy is based on financial autonomy (Mendez et al., 2013).

People cannot respond to situations and make decisions in a timely manner. As a result decision timeliness is a critical factor that influence the decision making process in health care organizations, in this case if people have the information and the access for what they need at a timely base the job will become easier and more efficient (Foshay & Kuziemsky, 2014). Health care decision makers identified timeliness as a key factor for facilitating the use of reviews and guides in hospitals and managed care organizations. To facilitate the integration into the decision-making process, it is imperative that key stakeholders

have access to comprehensive and timely information (Villa et al., 2013).

Delegation is the process of granting authority to make decisions to employees, thus increasing their decision-making autonomy. It involves giving subordinates the requisite authority to take action without obtaining prior approval. In essence, it refers to the locus of authority in decision making (Tourigny & Pulich, 2006). The globalized knowledge economy, the challenge of translating knowledge into policy and practice is universal. At the dawn of the 21st century, the clinicians, leaders, and managers of health care organizations are increasingly required to bridge the research-practice gap. Many clinicians still resist to the implementation of evidence-based clinical practice, asking themselves why their current practice should be changed or expanded. On the other hand, many leaders and managers of health care organizations are searching how to keep pace with the demand of actionable knowledge (Lapaige, 2009).

CONCLUSION

Decision making in health care organizations is a complicated process because it is of both clinical and non- clinical nature. Leaders and managers in health care organizations are continuously asked to make critical operational and budgetary decisions, with an objective to achieve efficient operations, competitive costs, with high quality of services. Many factors influence the coverage and commissioning of decisions in health care system around the world. According to our findings, knowledge and Evidence informed decision making was the most cited factor to influence the decision making process in health care organization. However, the most cited doesn't mean the most important.

Having the knowledge means having the power in making decisions for both short and long term demands of the health reforms. Nowadays, many sources of information are available and accessible whether as online medical literature or from the international health organizations publications. Health care organizations are being asked to implement accessible and effective web-based database of searchable evidence to facilitate the access to research evidence. Translating the research evidence into practice is not an easy job. On the other hand health care organizations could improve their employees in translating information in their decision making practice throughout continuous education and training. Having the information and all required data for making decision on a timely base facilitate the decision making process, because that the timeliness of decision is a sensitive factor to make the right decision on the right time. In our study the timeliness of decision was from the least cited factors. The institutional and the Environmental factors were a key factors and were from the most cited factors that influence the decision making process in our study. The mission, vision and values statements guide the behavior and the decision making process.

The amount of data in health care reforms are increasing in an astonishing rate, make it impossible to evaluate the status and making a decision in according to. But the introduction of information and communication technologies helped in extracting actionable information that leaders and managers could take advantage of in their decisions. Many constructed decision tools are now available on the internet that the organizations could benefit from. The use of a decision aid tool can facilitate the mission to make appropriate decisions as some of these methods could imitate the operations in the real world system over time and could be a suitable predictor before implementing any decision.

The Financial side must not be absent in any decision making process in any organization and is considered to be a vital factor in the financing of health services delivery

and in hospitals self-management policies. Because of the specific nature of health reforms, the shared decision making is a critical factor especially in investigation, screening and treatments decision making. Granting and delegating the authority for employees to make decisions, increase the decision making autonomy in the organization, although in our study these factors were from the least cited factors.

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ACTIVITY-BASED COSTING AND MANAGEMENT IN A HOSPITAL-BASED ENDOSCOPIC SURGERY UNIT

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ABSTRACT

The main purpose of this study is to develop a practical activity-based costing model to estimate the cost price of a gastrointestinal diagnostic and therapeutic endoscopic procedure in a secondary care private hospital in Balkan Region of Turkey. The model allows for accurate documentation of resource consumption and costs in order to facilitate objective decision-making. The costs of endoscopy diagnostic and therapeutic procedures calculated in this model are strictly related to resources consumed. The model aims at improving allocation of indirect costs and calculation of direct costs.

Keywords: *Activity Based Costing, Gastrointestinal Endoscopy, Cost Drivers, Turkey*

INTRODUCTION

Resource management and utilization in hospitals are extremely important in today's global economy. Traditional accounting systems are not adequate for managing hospital resources and costs (Hada, Chakravarty, & Mukherjee 2014). Activity Based Costing (ABC) is an established costing methodology developed by Cooper and Kaplan (1988) in United States (USA) during the 1980's that calculates cost price of product or service by determining the usage of resources in accounting sciences.

Some researchers admit that ABC has several pitfalls (Anderson and Young, 1999). ABC accumulates overheads for each organizational activity in the company. During the end of 1990's due to implementation of new technologies and progresses in health care services, the application of ABC was common in United Kingdom (UK) and US. According to Innes et al. (2000**)**, the usage of ABC in non-manufacturing and finance such as services industries were more than 21% in 1994.

Although research on the cost performance of the ABC of health care organization does not clearly improve firm value, it has crucial influence for accountants in the managerial function. Health management accountants can play a key role in the design of an ABC system suitable for health care services.

Based on their skills and training in health management, they can help identify what is appropriate for analysis in hospitals or primary care centers like service product, customer, process, etc. They can also help health care executives diagnose probable causes of an existing cost system's deficiencies. Successful implementation of ABC is not the same in every organization. There is no one defined way for reaching the same path in ABC methodology.

The significant and relevant literature suggests that the implementation process of an ABC system includes four steps (Wegmann and Stephen 2009):

(1) Cost system evaluation, (2) ABC design,
(3) ABC implementation, and
(4) System evaluation and validation.

With the use of ABC method, unused capacity can be detected and decreased in hospitals. Calculation of the cost price based on hospital level and sustaining costs of Iran's hospitals was studied by Rajabi and Dabiri's research in 2012. Several studies have been conducted on the use of the ABC method in emerging economies like Turkey (Nassar et al., 2009) in recent years.

The purpose of this research was to estimate the cost price of a gastrointestinal diagnostic and therapeutic endoscopic procedure in a secondary care private hospital in Balkan Region of Turkey. Turkish Government requires that all citizens get a mandatory health insurance policy with the Turkish Social Security Institution (SGK) that enables them to have coverage for endoscopic procedures.

Endoscopy is a flexible instrument that is introduced into the body through mouth or anus most commonly for examination of esophagus, stomach, and portions of the intestine. There are several types of endoscopy. In this research, esophagogastroduodenoscopy gastroscopy, endoscopy procedures were used.

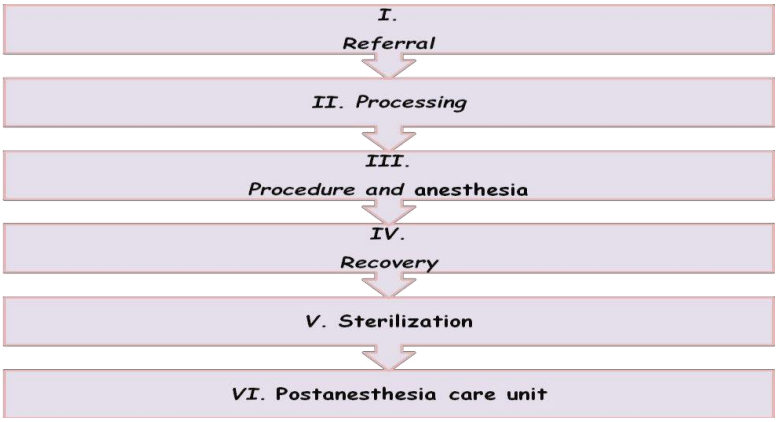
METHODS

Activity based costing is an approach for allocating overhead costs. An activity is an event that incurs costs. A cost driver is any factor or activity that has a direct cause and effect relationship with the resources consumed.

The two key cost drivers used in this research were employee costs (measured in time and material costs (measured in number of items used).

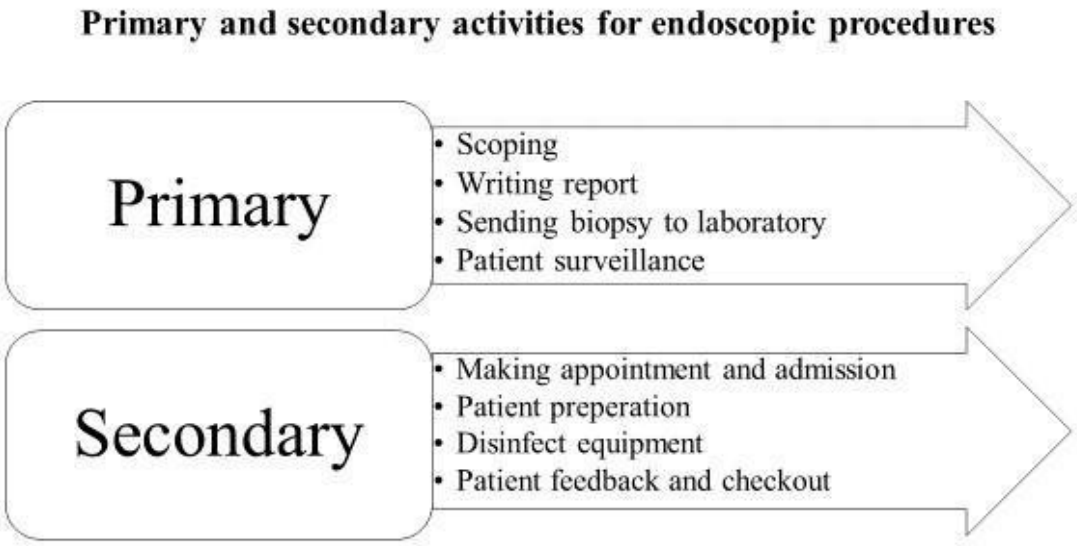
Endoscopic unit was divided into six main units based on the procedures shown in Figure 1 Activity centers were defined by the activity analysis method. Costs of administrative activity centers were allocated into diagnostic and operational departments based on the cost driver. Finally, with regard to the usage of cost objectives from services of activity centers, the cost price of endoscopic unit services was calculated.

Figure 1
ACTIVITY CENTERS



In order to manage costing exercises of endoscopic procedures, it is crucial to make a distinction among primary and secondary clinical activities that are shown in figure 2.

Figure 2
PRIMARY AND SECONDARY ACTIVITIES FOR ENDOSCOPIC PROCEDURES



The resources used for each procedure in Figure 2 were collected and divided in four sections such as labor time, equipment, maintenance and repair, and supplies. All patients were sedated for this procedure. Health care personnel get paid according to their performance from their private hospital. In calculations of the direct costs, all these amounts were considered as costs of the hospital in endoscopic unit. The direct working hours for the endoscopic procedures were collected from the time studies. Procedures were calculated according to endoscopic staff information. During all endoscopic activities nurse and physicians make contribution to the process. Their working hours were calculated. These include endoscopy's physicians, nurses, anesthesia technician, nurses of anesthesia, and physician of anesthesia.

The cost of anesthesia was calculated based on the quantity of anesthetics utilized during procedure. Various records were used for ascertaining specific input costs. For example, staff salary slips were used for estimation of salary and wages and departmental and hospital inventory books were used for estimation of the inventory. The Municipal Corporation water rates and State Electricity Boards tariff rates were used for estimation of water and electricity usage rates. The rental value of the building was also calculated.

Straight-line depreciation was utilized to estimate the depreciated value of equipment, whereas comprehensive annual maintenance contract rates were used in calculation of costs for equipment maintenance. The costs of various supplies and consumables were estimated for the study.

RESULTS

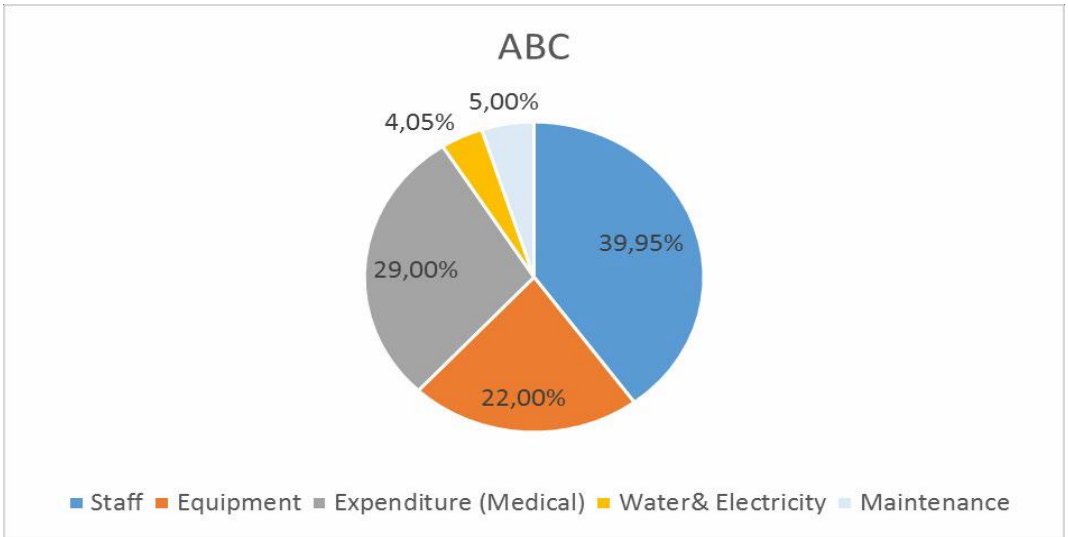
In calculation of the cost price with the ABC method, the high level of indirect costs in the hospital endoscopic unit indicates that capacities of resources are not used correctly in referral and processing units.

The daily patient costs in endoscopic unit were calculated to be 466 TL for gastrointestinal endoscopy without medical materials and medications. In Turkey, for those who have mandatory health insurance coverage, their health insurance provider pays only 177. 97 TL for endoscopic diagnostic or therapeutic procedures (http://www.ttb.org.tr). The extra cost is 288.03 TL.

The overall cost for referral was 30.31 TL. The cost per processing unit is estimated at 29.39 TL; Procedure and Anesthesia *78.01 TL;* Recovery *52 TL,* Sterilization 90.20 TL; Post anesthesia care unit 38.64 TL, respectively. The three major cost drivers were physician fees, disposable equipment, and nursing costs. The intraoperative phase contributed to 94.5% of the overall cost.

The costs for endoscopy are presented in Figure 4. The greatest contributions to overall costs are medical personnel fees and medical expenditures.

Figure 4
THE COSTS FOR ENDOSCOPY



CONCLUSION

The ABC method calculates cost price by applying suitable measures. In addition, this method provides useful information about the amount and combination of cost price services. This study estimated the overall cost of the endoscopic surgery unit services to be 739 TL per case.

Information obtained on the basis of the ABC model can be used in endoscopic unit in accurately determining procedure costs and prices. The analysis of ABC can work with more effective implementation of the activities by identifying those that create the greatest value for the health care organization (Cinquini, Miolo Vitali, Pitzalis, and Campanale, 2009).

There is a need to improve hospital accounting systems in Turkey to more accurately allocate hospital costs to specific medical departments and units, and ultimately to individual procedures. This study serves as a pilot study and highlights the importance of conducting similar replication studies in other departments and units.

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EFFECT OF INTELLECTUAL CAPITAL ON COMPANY INNOVATION: A RESEARCH FOR HEALTH ADMINISTRATION

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ABSTRACT

The main purpose of this study is to determine the effect of intellectual capital accumulation on innovative practices in today's health care businesses.

Answers have been searched for the questions of "Is there any relationship between intellectual capital accumulation and innovative practices in health care businesses?" and "If so, what is the direction of this relationship and interaction?"

245 employees from two hospitals operating in Istanbul have constituted the sample mass of this research, which has been performed with a combination of qualitative and quantitative research methods, and the opinion of the respondents has been measured by means of a conceptual model.

As a result of the research, it has been concluded that the sub-dimensions of intellectual capital as human capital, relationship capital and organizational capital in health care businesses positively impact innovation activities.

INTRODUCTION

Today, the dizzying developments in entire production processes, especially in communication and information technologies, have transformed the industry-based economies which have been established to transform goods or services into knowledge economies.

Especially in today's information society, people have begun to widely prefer people oriented, competitive, innovative businesses which hold extremely high brand value and produce high quality health care services. Therefore, intellectual capital accumulation in healthcare sector has become the most important factor affecting innovative initiatives (Kanter, 2006:79).

In fact, the concept of intellectual capital was first introduced at the end of 1960s, and at that time it was defined as "a mental movement beyond static and intangible value" (Harrison and Sullivan, 2000:33). In the coming years, intellectual capital concept has begun to be defined in the meaning used today with the development of knowledge economy (Ross et al., 1998).

Stewart has defined the intellectual capital in the vernacular of the day as "obtained experimented knowledge" and evaluated every kind of intellectual input, information, intellectual property and experience which would be used to create wealth in this concept (Stewart, 1997). Similarly, Youndt stated that intellectual capital actually comprises of all kinds of information inside or outside the business, and businesses should effectively manage their intellectual capital in the globalizing world to get competitive advantage (Youndt, 2004:337).

In the literature, intellectual capital is handled and measured in three dimensions as "human capital", "organizational capital" and "relationship capital" (Sveiby, 1997; Stewart, 1997; Tsang et al., 2005; Ross and Ross, 1997; Ross et al., 1998; Chu et al., 2006).

Human capital dimension of intellectual capital is defined as the sum of knowledge, skills, abilities, experiences and all other information stocks of employees in organization (Brooking, 1996; Edvinsson and Malone 1997; Stewart, 1997; Huang et al., 2002). This kind of intellectual capital consists of genetic inheritance, vocational education, job experiences, ideas and attitudes towards workplace of employees in a business (Bontis and Fitzenz, 2002).

The second dimension of intellectual capital is the organizational capital, and in the simplest way, it can be defined as all kind of knowledge, organizational processes and technological infrastructure which belong to an organization. (Narvekar and Jain, 2006). In a broader meaning, organizational capital consists of organizational vision, culture, mission, management philosophy, processes, information technologies/systems, patents, copyright ts, trademarks/secrets, logos, databases, R&D and innovation facilities of a business (Hsu et Fang 2009; Solitand and Tidström, 2010).

Relationship capital, the third sub-dimension of intellectual capital, includes relations between all parties who are capable to create added value for production processes, internal and external customer satisfaction of a business (Das et al., 2003). In fact, relationship capital which has a perceptual process feature in a sense is defined by linking the brand value of businesses in the literature. Such capital accumulation is shaped with mutual relationship of a business with external and internal customers (Stewart, 1997).

The concept of business innovativeness is defined as all activities which contribute added value in technological infrastructure, production processes and presentation of new goods and services of businesses aiming to create or develop a new idea or product in the literature (Dess and Lumpkin, 1997; Knight, 1997).

Indeed, a company must discover new marketing methods, create new products, acquire new supplier sources, create new forms of production or become open to innovation to be known as innovative today. (Thakur et al, 2012:565). An innovative company is starting to be mentioned with the intensification of continuous innovative investments and efforts in knowledge economy (Chang and Tseng, 2005).

Finally, it should be noted that innovation practices are classified in various ways according to occurrence frequency, innovation degree of company and level of meeting customer expectations in literature (Damanpour et al., 2009). However, innovation is grouped in a simple manner as product and process innovation (Burgelmann et al., 1995; Kanter, 2006).

Some researchers separate innovation into two groups as technological and product-market innovation (Miller and Friesen, 1978). On the other hand, other researchers define it as radical (revolutionary, discontinuous) or gradual (evolutionary, incremental, continuous) according to its occurrence (Tidd et al., 1997:24).

LITERATURE REVIEW

When the literature is examined, it is seen that lots of research have been done in recent times about knowledge management, intellectual capital and innovation practices in health care businesses (Bontis, 2002; Gallup, 2002; Van Beveren, 2003; Habersam and Piber, 2003; Hermansson et al., 2004; Chen et al., 2005; Lee et al., 2007; Peng et al., 2007; Bontis and Serenko, 2009).

For instance, Bontis (2002) has studied knowledge management differences affecting health care businesses, and Van Beveren (2003) has concluded that knowledge management requires privileged and special techniques specific to general and healthcare public businesses. Both of these studies declare that organizational performance of healthcare businesses focusing on effective management of intellectual capital could be increased with innovativeness (Thakur et al., 2012: 564).

Habersam and Piber (2003) have compared brand values and effectiveness in serving healthcare services of two hospitals in Italy and Austria according to their intellectual capital capacity. As a result of this research; they have made several suggestions concerning the relationship between intellectual capital and innovative practices. Hermansson et al. (2004) have contributed to the literature by modeling intellectual capital in healthcare businesses.

Likewise, Lee et al. (2007) have completed their research by aiming to make intellectual capital measurable from an uncertain state of annual activity report which is prepared to minimize the uncertainty of intellectual capital in healthcare businesses. In this context, researchers have categorized intellectual capital as human capital, patient capital, information technology capital, process capital, innovation capital and strategic capital (Lev et al., 2007).

Chen et al., (2005) have inspected the intellectual capital structures and the advantages of those structures for 35 healthcare companies with their special measurement method, and concluded innovation, customer and human capital to be more valuable for healthcare businesses in creating intellectual capital.

Bontis and Serenko (2009) have outlined that healthcare businesses supply significant benefits to intellectual capital on knowledge management, and stated healthcare employees are actually the best examples for "knowledge workers". About this point, Fitzgerald, (2002) who has given a new perspective of innovation particularly in health, states that innovativeness which spread all processes of a healthcare organization would be more successful when healthcare employees believe the interaction among themselves.

In the light of this literature review, it is possible to say that employing talented workers, becoming a learning organization, and successfully managing the intellectual capital in today's knowledge economies are the main sources of becoming innovative, creating value and making difference in competition in healthcare businesses (Bontis, 2002; Huang and Liu, 2005; Guthrie et al. 2002; Hsu and Fang, 2009). Thus, all sub-dimensions of intellectual capital, mainly human capital that consists of talent and knowledge accumulation of employees, have a positive contribution to innovation practices of companies (Subramaniam and Youndt, 2005).

Also, literature review findings show that the research which focuses on the relationship between intellectual capital and company innovativeness implicated the relationship of those concepts according to the measurement of three sub-dimensions of intellectual capital into

research models (Covin and Slevin, 1991; Bontis, 1998; McAdam, 2000; Nonaka and Treece, 2001; Youndt et al., 2004; Subramaniam and Youndt, 2005; Bosworth and Webster, 2006).

For example, McAdam, who has inspected the effects of human capital, a sub dimension of intellectual capital, on company innovativeness in empirical aspects has concluded in his research that effective and systematic knowledge management affects innovativeness in key fields for increasing employee benefits (McAdam, 2000). Similarly, Covin and Slevin (1991) Bontis (1998), Nonaka and Treece (2001), Youndt, et al., (2004), Subramaniam and Youndt, (2005) and Bosworth and Webster (2006) have concluded that human capital increases company innovativeness.

According to the literature, it is possible to claim there is positive and obvious interaction between organizational capital and firm innovativeness according to the studies which examine and explain the relationship between these two concepts in empirical aspects (Covin and Slevin, 1991; Nonaka and Takeuchi, 1995; Bontis, 1998; Youndt et al., 2004; Youndt and Subramaniam, 2005).

For instance, Nonaka and Takeuchi (1995) have concluded that the innovations in knowledge production and business infrastructure provide competitive advantages to firms; and Bontis (1998) has argued in his research that organizational capital contributes to the innovation performance of business. Also, Youndt et al. (2004) and Subramaniam and Youndt (2005) proved that organizational capital has positive effects on innovative performance of business.

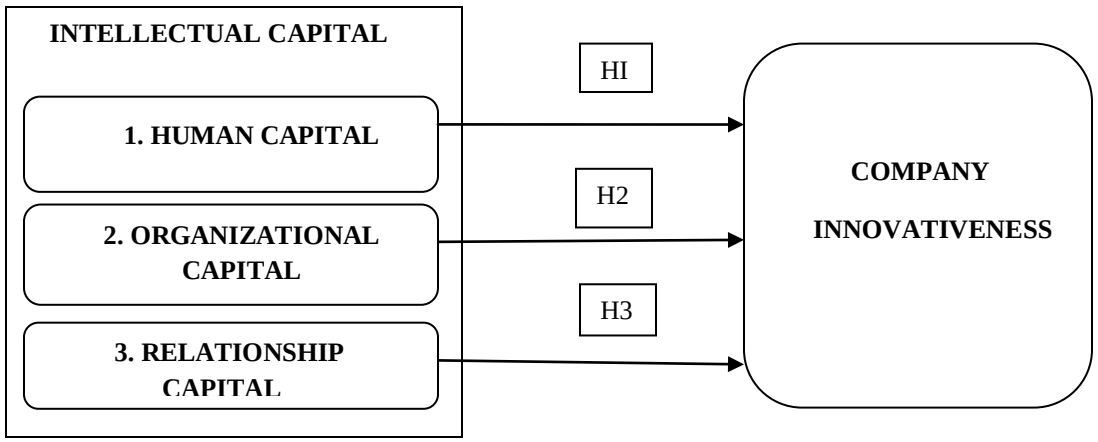
When the studies conducted on the relationship between company innovativeness and relationship capital, the most strategic component of intellectual capital, is examined, a positive and mutual interaction between these two concepts is observed (Bontis, 1998; Phillips, 1999; Gray et al., 2000; Agarwal et al., 2003, Youndt and Snell, 2004; and Youndt Subramaniam, 2005; Ottenbacher and Gnoth, 2005).

METHODOLOGY

Participants from two leading hospitals in Turkey who have been selected with the of convenience sampling constitute the population of this research. 245 health workers in various positions such as doctor, nurse, emergency medical technician, hospital manager, hospital logistic, and quality, human resources and patient consultant from the mentioned healthcare businesses have been included in the study.

The main mass of employees surveyed corresponds to 25% of the total employees. The following research model has been developed for measuring the effect of intellectual capital which consists of three sub-components on company innovativeness on the basis of proposed research hypothesis in the concept of this research, which has been carried out with both qualitative and quantitative research methods.

Figure 1
MODEL OF THE RESEARCH



Arrows shown in the figure above indicate the relationship between basic concepts of this research, direction of the interactions and research hypotheses. The research hypotheses indicated with arrows are those below:

H_1 *There is a positive relationship between company innovativeness and human resources of companies.*

H_2 *There is a positive relationship between company innovativeness and organizational capital of companies.*

H_3 *There is a positive relationship between company innovativeness and relationship capital of companies.*

Furthermore, the subscales of "human capital", "organizational capital" and "relationship capital" defining intellectual capital in parallel with the hypothesis of this research have been taken from the studies of Bontis (1998), Subramaniam and Youndt (2005), Hsu and Fang (2009), Ling (2011), Longo and Mura (2011) and Hsu and Sabherwal (2011); and "Business Innovativeness Scale" has been taken from the studies of Subramaniam and Youndt (2005), Ling (2011), Hsu and Sabherwal (2011).

Eventually, it should be noted that SPSS 20.0 and AMOS 4 computer programs have been used for the analysis of data gathered through survey forms in scope of this research. The consistency of the hypotheses shown in the research model has been investigated with reliability and validity analysis, then correlation analysis and lastly regression analysis.

First of all, demographic features of participants have been examined in the context of research. Demographic features such as company name, professional title, gender, age range, education and job duration have been collected and shown on the table below:

Table 1
DEMOGRAPHIC PROFILES OF THE RESPONDENTS

		Frequency	Percentile	Cumulative P
Business	Public	133	54.2	54.2
	Private	112	45.8	100
	TOTAL	245	100	
Title	Administrative Personnel	103	42	42
	Medical Personnel	142	58	100
	TOTAL	245	100,0	
Gender	Female	141	57.5	57.5
	Male	104	42.5	100
	TOTAL	245	100,0	
Educational Status	High school Graduate	59	24.1	24.1
	Associate Degree	55	22.4	46.5
	Bachelor	85	34.7	81.2
	Post-graduation	46	18.8	100
	TOTAL	245	100	
Age Range	20-25 years	63	25.71	25.71
	26-35 years	110	44.90	70.61
	36-40 years	46	18.78	89.39
	More than 40 years	26	10.61	100.00
	TOTAL	245	100	
Job Duration	0-5 years	143	58.37	58.37
	06-10 years	75	30.61	88.98
	11-15 years	19	7.76	96.73
	More than 16 years	8	3.27	100.00
	TOTAL	245	100	

As an overall evaluation of demographics of participants shown in the figure, both physiological features of participants such as gender and age, and vocational education, professional title and experience levels of participants illustrate a wide sample of overall health sector. In other words, the demographic findings have been found sufficient enough to reach meaningful results in the scope of the survey.

Secondly, reliability and validity analysis have been conducted for data set variables in the context of the research. Primarily, average value of proficiency has been calculated with Kaiser- Meyer-Olkin (KMO) sample test. KMO sample proficiency value (0.90) has been observed to be higher than the proposed value (0.50) in the literature (Stoel and Muhanna, 2009).

Then, Bartlett Sphericity Test have been conducted and the findings of this test has shown to be statistically significant at 5% ($X^2(153) = 840.26$, $p < 0.5$). Therefore, it has been concluded each statement (communalities) in the survey is above 0.30 and each indicator has common variance with other indicators (Field, 2005).

"Explanatory Factors" test has been conducted in the third stage of the reliability and validity analysis and findings have been shown in the table below.

Table 2
FACTOR LOADINGS

	Human Capital	Relationship Capital	Organization Capital	Innovativeness	Coefficient of Communalities
HC2	0.88				0.83
HC3	0.84				0.79
HC1	0.84				0.77
HC5	0.83				0.79
HC4	0.81				0.73
HC6	0.79				0.73
HC8	0.79				0.69
HC7	0.78				0.71
RC2		0.76			0.71
RC4		0.75			0.72
RC3		0.74			0.67
RC5		0.67			0.64
RC6		0.67			0.66
RC1		0.57			0.52
OC4			0.80		0.74
OC5			0.80		0.76
OC2			0.59		0.61
OC3			0.58		0.59
Inno.4				0.79	0.77
Inno.2				0.78	0.72
Inno.1				0.77	0.76
Inno.5				0.76	0.71
Inno.6				0.63	0.58

*Principle Component Analysis and Varimax Rotation are used. Total Variance Explained: 68.80%

As observed in the table above, a total of 3 indicators have been eliminated on account of not attaching to a factor and not fulfilling the criteria of being equal or higher than 0.50 or attaching to more than one factor (factor load in another factors-cross load) equals or more than 0.40 (Stoel and Muhanna, 2009). Thus, the number of questionnaires has been reduced to 32 from 35 questions.

All statements in the data set have been subjected to "Confirmatory Factor Analysis" in order to realize that the scales are reliable and valid; and the findings of this analysis have shown that AVE value correlation coefficients of each factor are smaller than squares.

In the final step, Cronbach Alfa reliability coefficient and composite reliability coefficients of all indicators in survey form have been determined to be higher than standard threshold value (0.70). This finding has proved the reliability of the scales applied in survey to be high.

Correlation and regression analysis have been used to test the research hypothesis in the third and last stage of the study and the correlation analysis findings are shown in the table below:

Table 3
CORRELATION COEFFICIENTS AND DESCRIPTIVE STATISTICS

Variables	Average	Standard Deviation	1	2	3	4	5
1.Human Capital	3.66	0.94	-				
2. Relationship Capital	3.64	0.91	0.63**	-			
3.Organization Capital	3.53	0.87	0.57**	0.58**	-		
4. Innovativeness	3.18	0.88	0.21**	0.37**	0.38**	-	
Cronbach Alfa Reliability Coefficient			0.95	0.88	0.83	0.89	0.92
Composite Reliability(CR)			0.95	0.88	0.81	0.89	0.92
Average Variance Extracted(AVE)			0.69	0.56	0.51	0.61	0.57

(*) p<0.05, (**) p<0.01

As seen in the table, the correlation coefficients which show the linear relationships between variables indicate a relationship between some variables at 0.05 significance level (p<0, 05), but 0.01 significance level between others.

Then, multiple regression analysis has been conducted in order to test the hypothesis in research model. In this context, firm innovativeness as dependent variable, and human capital, relationship capital and organizational capital, sub dimensions of intellectual capital, as independent variables have been subjected to regression analysis.

The findings of the regression analysis held with SPSS 20.0 program have been illustrated and reviewed below in terms of research hypothesis:

Table 4
REGRESSION ANALYSIS RESULTS RELATED TO FIRM INNOVATIVENESS (FOR H_1, H_2, H_3 HYPOTHESES)

	Dependent Variable			
	Company Innovativeness			
Independent Variables	Standard Beta (β)	t value	p-value	VIF value
1.Human Capital	.298**	4.448	.000	1.418
2.Organizational Capital	.097	1.312	.191	1.744
3.Relationship Capital	.196 **	2.809	.005	1.548
	R^2= 0,239			
	F = 25.185			
	p-value = 0.000			

* p < 0.05; ** p<0.01

According to the regression analysis findings shown in the figure, the relationship between company innovativeness and human capital, a sub dimension of intellectual capital, is statistically significant and this sub dimension of intellectual capital has positive impact on company innovativeness (β= 0.298, p <0.01). In addition, these findings support the hypothesis (H_1), which assumes human capital positively effects company innovativeness.

In contrast, organizational capital does not have a statistically significant effect

on company innovativeness in terms of regression analysis findings of the hypothesis (H_2), which assumes that organizational capital positively affects company innovativeness (β= 0.097 p> 0.01).

This result does not positively affect H_2 hypothesis which assumes organizational capital has positive effects on company innovativeness.

Finally, the H_3 hypothesis, which is based on the assumption that relationship capital, a sub dimension of intellectual capital, has a positive effect on company innovativeness, has been tested. There is a positive and significant interaction between relationship capital and company innovativeness according to the regression analysis findings held for this purpose (β = 0.196 p <0.01). This result supports the hypothesis (H_3) which assumes relationship capital positively effects company innovativeness.

Table 5
RESEARCH HYPOTHESIS TEST RESULTS

Hypothesis	Suggestion of the Hypothesis	Consequence
H1	There is a positive relationship between company innovativeness and human resources of the companies.	APPROVED
H2	There is a positive relationship between company innovativeness and organizational capital of companies.	REJECTED
H3	There is a positive relationship between company innovativeness and relationship capital of companies.	APPROVED

CONCLUSION AND DISCUSSION

As a result of the research, the human capital and relationship capital as sub dimensions of intellectual capital of healthcare businesses have been evaluated to have positive effects on company innovativeness.

McAdam's results from a 2000 research support the results of this research; that is, the effective and systematic knowledge management increases employee benefits and have positive effect at innovation in critical areas. Similarly, Youndt, et al., (2004), Youndt and Subramaniam (2005), and Bosworth and Webster (2006) concluded that human capital increases the innovation of the firm. Youndt and Snell, (2004), Subramaniam ve Youndt, (2005); and Ottenbacher ve Gnoth, (2005) have done research on the relationship between the relationship capital and firm innovation. When examined, the research findings show that there is a positive and mutual relationship between the two concepts.

It is possible to say the investments in both these two dimensions of intellectual capital and successful practices would provide significant contributions to the ongoing innovative practices in businesses according to these findings. Interestingly, the survey results have not justified the assumption that the organizational capital sub dimension of intellectual capital does not have positive impact on company innovativeness. However, many research findings on this subject in the literature have reached the conclusion which confirms this assumption. For example Nonaka and Takeuchi (1995)'s research results concludedthat knowledge creation and innovation in business infrastructure provides a competitive advantage to firms. Similarly, results of Bontis (1998)'s research showed that the innovation performance of the company has positive effects on organizational capital.

Furthermore, when looked from the perspective of daily business life, the new investments of organizational capital accumulation and new practices in this context are generally thought to be the most concrete indicators of company innovativeness by healthcare employees.

Thus, this finding of the research could be explained as mismanagement of the organizational capital in healthcare businesses or the failure in the measurement of correlation and regression relationship between these two concepts.

As a result of the research, it has been concluded that the managers in healthcare businesses should effectively manage all three dimensions of intellectual capital, while increasing the efforts to enrich the intellectual capital in healthcare businesses. Moreover, only organizational or technological investments would be insufficient to provide high company performance, the basic production of which is human factor, so the investments on human capital and relationship capital must be increased in parallel with those investments.

Particularly, the complexity in healthcare services, overuse of technology and the entity of human interaction make the adaptation of healthcare businesses to external environment difficult and cause administrative problems. At this point, it has been observed that healthcare businesses could be successful only by training the staff with leadership skills, including them in management processes, and creating a new organization culture and climate suitable for innovation and creativity.

Eventually, it must be said with regard to future research, detection of the effects of the mentioned factor on intellectual capital will be possible if the "company innovativeness factor" held as independent variable in this research is examined as a "moderator variable" with its sub- scales in a similar model with this research.

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MEASURING PROCESS PERFORMANCE WITHIN HEALTHCARE LOGISTICS - A DECISION TOOL FOR SELECTING TRACK AND TRACE TECHNOLOGIES

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ABSTRACT

Monitoring tasks and ascertaining quality of work is difficult in a logistical healthcare process due to cleaning personnel being dispersed throughout the hospital. Performance measurement can support the organization in improving the efficiency and effectiveness of processes and in ensuring quality of work. Data validity is essential for enabling performance measurement, and selecting the right technologies is important to achieve this. A case study of the hospital cleaning process was conducted at a public Danish hospital to develop a framework for assessing technologies in healthcare logistics. A set of decision indicators was identified in the case study to assess technologies based on expected process performance. Two aspects of performance measurement were investigated for the hospital cleaning process: what to measure and how to measure it.

INTRODUCTION

Logistical processes are essential for a hospital to function and in providing services for patients. Improving the efficiency and effectiveness of healthcare processes not only economizes on resources but also provides supports in reaching organizational goals (Gleason & Barnum, 1982; Mentzer & Konrad, 1991). Measuring the efficiency and effectiveness of a process can motivate employees and induce learning in order to improve processes (Neely, Gregory, & Platts, 2005). In a healthcare logistics context, employees will often perform tasks in various parts of a hospital without close management control. The lack of control and the dispersion of employees make it difficult to assess individual and process performance. Thus, from a principal-agent point of view, there is a need to measure and monitor the process (Kathleen M. Eisenhardt, 1989; Melnyk, Stewart, & Swink, 2004). Technologies such as RFID, barcodes and portable job agents can capture data in a process and enable process measurement (Ferrer, Dew, & Apte, 2010; Sarac, Absi, & Dauzère-Pérès, 2010). When measuring several performance indicators, one technology may not fit all, and a range of different technologies may be needed to enable performance measurement. Selecting the appropriate technologies for capturing data is important to ensure data validity and enable performance measurement.

A hospital is a complex system where a network of organizational units interact to perform various processes (Kannampallil, Schauer, Cohen, & Patel, 2011; Plsek & Wilson, 2001). The level of complexity can be determined by the interrelatedness between parts of a system and the uniqueness of those relations (Kannampallil et al., 2011; Simon & Cilliers, 2005). The uniqueness of healthcare processes stems from the unpredictable hospital environment as the course of treatment differs for each patient (Jarrett, 1998). The uniqueness of the hospital processes means that certain conditions are intrinsic to a hospital context.

Furthermore, the important role of the patient in the outcome of health services differs from other industries with a more production oriented focus (Lillrank, Groop, & Venesmaa, 2011). Thus, the decision criteria that are valid in other industries may not apply in a hospital setting.

The decision criteria for assessing technologies to measure process performance within healthcare logistics are investigated in this paper. This study aims to develop a framework that serves as a decision support tool for logistics management within healthcare. The purpose of the tool is to assess technologies that enable performance measurement. The framework is developed by answering the following research question (RQ): How can decision indicators identified in a hospital cleaning case be used to assess technologies for measuring process performance in a logistical healthcare process?

A REVIEW OF THE LITERATURE

Literature within the field of healthcare logistics is reviewed to understand what healthcare logistics involves. The technologies used in healthcare logistics are then found in literature and the need for assessment methods is identified.

Understanding Healthcare Logistics

In one of the early definitions of logistics, the change in form and location of inventory was viewed as the main value-added process in materials logistics management (Bowersox, Carter, & Monczka, 1985). The term logistics has evolved over time from a narrow definition focusing on the reduction of inventories to a more broad definition (Cooper, Lambert, & Pagh, 1997). Several and more elaborate definitions of logistics have since been proposed. One of the widely used definitions of logistics is that of the Council of Supply Chain Management Professionals who defines logistics as 'that part of the supply chain process that plans, implements, and controls the efficient flow and storage of goods, services, and related information from the point of origin to the point of consumption in order to meet customers' requirements'(Council of Supply Chain Management Professionals, 2015). Lummus and colleagues provide a similar definition of logistics as 'planning, implementing and controlling efficient, effective flow and storage of goods and services from the beginning point of external origin to the company and from the company to the point of consumption for the purpose of conforming to customer requirements. Logistics is generally viewed as within one company, although it manages flows between the company and its suppliers and customers' (Lummus, Krumwiede, & Vokurka, 2001). Controlling the flow of goods from point of origin to point of consumption in order to meet customer requirements seems to be recurring elements for the latter definitions. For this paper, logistics will be defined as by the Council of Supply Chain Management Professionals, and healthcare logistics is then logistics within a healthcare context.

The cost of providing healthcare has been rising and the pressure to provide healthcare services at lower costs has increased (OECD, 2013). The logistical costs in a hospital account for more than 30% of hospital expenditure (Poulin, 2003). Reducing costs related to healthcare logistics therefore provides an opportunity for addressing the challenge of increasing healthcare costs. Studies have investigated how the logistical activities in a hospital are performed and the opportunities for improving processes to reduce costs by implementing improvement initiatives such as just-in-time systems (Aptel & Pourjalali, 2001; Jarrett, 1998, 2006; A. Kumar, Ozdamar, & Ning Zhang, 2008; S. Kumar, DeGroot, & Choe, 2008), innovation processes (Lee, Lee, &

Schniederjans, 2011; Su, Gammelgaard, & Yang, 2011), Lean (Hicks, McGovern, Prior, & Smith, 2015; Joosten, Bongers, & Janssen, 2009; Kollberg, Dahlgaard, & Brehmer, 2007; Poksinska, 2010; Souza, 2009), TQM (Chen, Chen, Wu, & Lin, 2004; Chow-Chua & Goh, 2000; Pinna, Carrus, & Marras, 2015), Six Sigma (Jin, Switzer, & Agirbas, 2008; Lifvergren, Gremyr, Hellström, Chakhunashvili, & Bergman, 2010) , and Business Process Reengineering (A. Kumar et al., 2008; A. Kumar & Rahman, 2014). These improvement initiatives are all process oriented. Healthcare logistics processes have been investigated to some extent in literature, including medical supply (A. Kumar et al., 2008), pharmaceutical supply (Mustaffa & Potter, 2009; Romero & Lefebvre, 2015), patient flow logistics (Kriegel, Jehle, Dieck, & Tuttle-weidinger, 2015; Lillrank et al., 2011; van Lent, Sanders, & van Harten, 2012; Villa, Barbieri, & Lega, 2008; Villa, Prenestini, & Giusepi, 2014), sample transports (Al-Riyami et al., 2014; Jørgensen, Jacobsen, & Poulsen, 2013), and bed logistics (Feibert & Jacobsen, 2015; Schmidt, Geisler, & Spreckelsen, 2013; Utley et al., 2003). However, other logistical processes exist in a hospital such as laundry management, waste management, catering, mail service, security, cleaning, and managing surgical tools (Aptel & Pourjalali, 2001; Granlund & Wiktorsson, 2013; Jørgensen, 2013; A. Kumar & Rahman, 2014; Pan & Pokharel, 2007). Many of these hospital logistics services will often be outsourced, especially cleaning, security and catering (Moschuris & Kondylis, 2006). The literature survey shows that several logistical healthcare processes have not been explored in literature. Patient flow logistics has been studied more extensively, whereas the study of other logistical healthcare processes is limited.

The process improvement methods mentioned above can reduce waste in healthcare processes. However, healthcare processes face variability in demand and should not only look to lean process strategies but also agile process strategies (Rahimnia & Moghadasian, 2010). Aronsson and colleagues therefore contend the need for a supply chain management perspective that utilizes lean to reduce waste, and uses agility to cope with uncertainty (Aronsson, Abrahamsson, & Spens, 2011). To provide a supply chain management perspective, a number of studies have focused on logistical processes for the entire supply chain (Aronsson et al., 2011; de Vries & Huijsman, 2011; A. Kumar et al., 2008; Lillrank et al., 2011).

The cost of supplying a hospital can be divided into the cost of supplied goods, administration, overhead, and logistics (Neumann, 2003). The cost of goods itself can be expensive, especially pharmaceutical products. The cost of supply can be reduced by negotiating the price of the product but also by procuring refurbished products (Ross & Jayaraman, 2009). Another way to reduce the cost of supply is by reducing stock levels through inventory management. Additionally, purchasing decisions will directly affect inventory levels (S. Kumar et al., 2008). One of the challenges in procurement and inventory management is handling variability in demand, making it difficult to achieve low or no stock levels. By collaborating and sharing information in the supply chain, uncertainty in demand can be reduced, leading to improved customer service levels or reduced inventory levels. Collaborative solutions such as Planning, Forecasting and Replenishment (CPFR), JIT and VMI use information sharing through information systems to create transparent and visible demand patterns (Holweg, Disney, Holmström, & Småros, 2005). Studies have assessed different collaborative solutions for healthcare supply chains. Both VMI solutions and JIT solutions have been found suitable for healthcare logistics. E.g. Mustaffa and Potter assessed vendor managed inventory (VMI) and JIT for Malaysian hospitals and found that VMI was preferable due to poor infrastructure, the distance between clinics, and the high number of delivery points (Mustaffa & Potter, 2009).

Others have found JIT to be a viable solution for hospitals (Jarrett, 1998; Pan & Pokharel, 2007). This paper focuses on process management rather than purchasing and inventory management.

Use and Assessment of Technologies in Healthcare Logistics

In addition to information systems, the use of track and trace technologies can also improve purchasing decisions and reduce costs by lowering inventory (S. Kumar et al., 2008). Thus, technologies can be a means to achieve more efficient processes (Hammer, 1990; Jimenez et al., 2012; C. A. Voss, 1988). Different types of technologies have been implemented in healthcare logistics; these technologies include RFID (Chan, Choi, & Hui, 2012; Ferrer et al., 2010; Fosso Wamba, Anand, & Carter, 2013; Gastaldi, Mangiaracina, Miragliotta, Perego, & Tumino, 2015; A. Kumar & Rahman, 2014; S. Kumar et al., 2008; Qu, Simpson, & Stanfield, 2011; Romero & Lefebvre, 2015; Wang, Chen, Ong, Liu, & Chuang, 2006; Yao, Chu, & Li, 2012), barcodes (S. Kumar et al., 2008; Romero & Lefebvre, 2015), mobile devices (Granlund & Wiktorsson, 2013; Siau & Shen, 2006), ERP-systems (Jenkins & Christenson, 2001; Stefanou & Revanoglou, 2006; Woodside, 2007), MRP-systems (Steinberg, Khumawala, & Scamell, 1982), CPFR (S. Kumar et al., 2008; Lin & Ho, 2014), EDI (Spinardi, Graham, & Williams, 1997; Woodside, 2007), pneumatic tube systems (Al-Riyami et al., 2014; Bakken, 2012; Granlund & Wiktorsson, 2013; Jørgensen et al., 2013), Automated Guided Vehicles (AGVs) (Bakken, 2012; Granlund & Wiktorsson, 2013; A. Kumar & Rahman, 2014; Landry & Philippe, 2004), robotics (Takahashi, Suzuki, Shitamoto, Moriguchi, & Yoshida, 2010), conveyor systems (A. Kumar & Rahman, 2014; Markin, 1994), and automated inventory systems (Bakken, 2012). Overall, the identified technologies can be divided into three groups: 1) track and trace technologies, 2) planning and forecasting technologies, and 3) transport technologies. The technologies considered in this paper are the track and trace technologies.

The technologies used in health logistics as identified in literature are mainly assessed by identifying the benefits of the technology, e.g. (Anand & Wamba, 2013; Ferrer et al., 2010; Gastaldi et al., 2015). Ferrer studied the benefits of RFID across several industries and identified four benefits that were valid for all cases in the study. Thus, some of the identified benefits are industry specific. Literature tends to focus on the evaluation of a single technology, e.g. (Fosso Wamba et al., 2013; Yao et al., 2012), although some studies evaluate two technologies, e.g. (Chan et al., 2012; Romero & Lefebvre, 2015). This paper seeks to identify the decision criteria that are specific to healthcare logistics and that enable the assessment of several technologies.

Other decision criteria than the benefits of a technology may be relevant for assessing a technology. Healthcare logistics should not only be viewed as a means for achieving savings for logistical processes but also as having a more strategic role by supporting the clinical organization to achieve more productive clinical processes (Landry & Philippe, 2004). Decisions in healthcare logistics such as technology assessment should therefore not only be based on financial criteria but also strategic considerations. Furthermore, technologies will often be introduced to improve process performance (Hammer, 1990; Jimenez et al., 2012; C. Voss, Tsikriktsis, & Frohlich, 2002), thus expected process performance should influence the assessment of technologies (Gastaldi et al., 2015), in order to reflect the goals and strategy of the organization (Brewer & Speh, 2000). Due to the multidimensional nature of logistics, it is necessary to measure more than one performance indicator when measuring the performance of a logistical process (Chow, Heaver, & Henriksson, 1994). Thus technologies should be

assessed based on several criteria, including benefits of a technology and expected performance.

Performance measurement can provide a platform for improving process performance (Neely et al., 2005). A principal-agent problem occurs when a) goals differ between the principal and agent and b) information and verification of behavior is difficult (Kathleen M. Eisenhardt, 1989). Performance measurement can provide information that reduces information asymmetry between the principal and the agent. Principal-agent theory is used in this study to assess how different technologies affect data validity in the data capturing process.

Multiple criteria decision methods can include criteria that are both quantitative and qualitative in nature (T. L. Saaty, 2004a). There are several multiple criteria decision methods that can be used to assess alternative scenarios. Health Technology Assessment (HTA) is a widely used assessment method within healthcare. However, HTA focuses on solving a health problem and on improving the quality of life (WHO, 2015). Therefore, the HTA is not relevant for assessing track and trace technologies in healthcare logistics, where the aim is to provide more efficient and effective logistical processes. A simple multiple decision criteria method is weighted factor analysis, which has been used for assessing technologies in healthcare logistics (Jørgensen, 2013). A more sophisticated method is Analytic Network Process (ANP), which allows for a quantitative comparison of different solutions based on individual judgment or measurement of identified decision criteria. A special case of ANP is the Analytic Hierarchy Process (AHP), where the decision criteria are independent of each other (T. L. Saaty, 2004a, 2004b; T. Saaty & Vargas, 2006). AHP has been used to assess logistics performance (Korpela & Tuominen, 1996) and to identify critical success factors for introducing CPFR in healthcare (Lin & Ho, 2014). This paper does not focus on a specific quantitative method, but provides a set of decision indicators to which the quantitative methods can be applied.

METHODOLOGY

In this section, the research objectives, research design, collection of data, data analysis, and research quality are described for the study.

Aims and Objectives

The aim of this study is to develop a decision support tool based on an investigation of the overall RQ, which focuses on logistical healthcare processes. In this study, a hospital cleaning process will represent a logistical healthcare process. The overall RQ is answered through a set of sub questions (SQs) which all investigate the hospital cleaning process. The SQs will address different aspects of the decision indicators to be defined for the overall RQ. Management of the hospital logistics department in the case study hospital seeks to improve the performance of the hospital cleaning process, and technologies are a means to achieving this (Hammer, 1990; Jimenez et al., 2012; C. A. Voss, 1988). Which technology to choose will therefore depend on the expected performance of the process. The decision indicators for assessing technologies in healthcare logistics should reflect the performance indicators used to assess performance. Process performance consists of an efficiency and effectiveness aspect; effectiveness relates to reaching a goal, whereas efficiency relates to the economic use of resources (Gleason & Barnum, 1982; Mentzer & Konrad, 1991). Aiming to reach organizational goals will therefore improve process effectiveness and consequently process performance. Studies show that setting clear, specific and particularly challenging goals leads to increased performance. Thus, challenges and goals are closely related, and the more challenging a goal is,

the higher the level of performance will be (Locke & Latham, 2002; VandeWalle, Cron, & Slocum Jr., 2001). Challenges and goals are therefore addressed in SQ1 because addressing challenges and setting goals will lead to improved process performance. Similarly, performance indicators are addressed in SQ2 because they reflect performance of a process. Lastly, risk factors affecting data validity are addressed in SQ3 to include the purpose of the technology in the decision process, i.e. to provide valid data. These risk factors relate to informational risks, e.g. capturing and use of data as well as access to key information (Cavinato, 2004), or system risks, e.g. information system breakdowns (Tummala & Schoenherr, 2011). The results from SQ1-SQ3 lead to SQ4 where the final decision indicators used for assessing technologies to measure process performance are identified. The SQs investigated in this study are as follows:

SQ1: What are the challenges and management goals for a hospital cleaning process?

SQ2: How can performance indicators measure process performance of a hospital cleaning process to address challenges and help achieve management goals?

SQ3: What are the risk factors affecting data validity for technologies capturing performance data in the hospital cleaning process?

SQ4: Which decision indicators should be used to assess technologies capturing performance data in a hospital cleaning process?

Research Design and Data Collection

This study is a qualitative study within the field of operations management. A single case study design was chosen because it provides an in-depth understanding of a problem and is well suited for answering "how" questions (K. M. Eisenhardt, 1989; Yin, 1994). Furthermore, case studies are suitable for investigating research questions within the theoretical field of operations management (McCutcheon & Meredith, 1993; C. Voss et al., 2002). The case study method has also been widely used within healthcare logistics, e.g. (Granlund & Wiktorsson, 2013; A. Kumar et al., 2008; Pan & Pokharel, 2007; Wang et al., 2006). The case study investigated in this paper is a study of the hospital cleaning process at a public Danish hospital. The hospital cleaning process has mostly been treated in literature to investigate the methods for cleaning as well as methods and indicators for assessing cleanliness (Al-Hamad & Maxwell, 2008; Dancer, 2004; Griffith, Cooper, Gilmore, Davies, & Lewis, 2000; White, Dancer, & Robertson, 2007). This paper takes a slightly different approach. The study investigates how the hospital cleaning case can be used to identify decision indicators for assessing technologies that capture performance data. Although cleaning at a hospital is not considered a traditional logistical process, it was identified in the literature review as a logistical process less treated in literature. The process contains some logistical elements. First, the service of cleaning is distributed across the hospital. Secondly, the technologies investigated are technologies commonly used within supply chain management and logistics, such as RFID and barcodes (Ramanathan, Ramanathan, & Ko, 2014).

The case study hospital is a public Danish hospital in the greater Copenhagen area with room for approximately 700 inpatients at a time. The hospital covers many medical areas but specializes in cancer treatments and also holds a large mother and child facility. Furthermore, the hospital treats almost 500,000 outpatients a year and has an emergency department that treats around 70,000 patients a year. The case study hospital was chosen because of 1) the accessibility to data and 2) the relatively large size of the hospital, which accentuates the challenge of overseeing a large number of cleaning personnel within an extensive area.

Data for the hospital cleaning case was collected over a five month period from October 2014 to February 2015 following a case study protocol. During the case study, 20 interviews were carried out, the cleaning process was observed, and several documents were collected. Interviews were carried out with managers and supervisors of the logistics and cleaning department at the primary case study hospital. Interview persons from another hospital were interviewed to get insight into how the hospital cleaning process was conducted elsewhere. Furthermore, managers from the central IT department for Danish healthcare and the central Strategy department for hospitals in the region were interviewed to learn about the more strategic aspects of technologies and about performance measurement. The interview persons were selected based on their involvement and knowledge about the hospital cleaning process or about data and performance measurement within the Danish healthcare system. Toward the end of the study, case study results were presented to management of hospital logistics at the primary hospital for respondent validation (Bryman, 2012; Yin, 1994). An overview of the interviews and observations for this case study can be found in Table 1.

The conducted interviews were semi-structured interviews that lasted between ½-1hours depending on the questions that were covered. The interview questions discussed with the interview persons are listed in Table 2 and are linked to the SQs. The interviews were conducted based on more elaborate interview guides that included more questions.

Table 1
OVERVIEW OF INTERVIEWS

Organization	***Roles of persons interviewed***	***Interviews / observations***
(A) Primary case hospital	Head of hospital logistics	2 interview
	Manager of Cleaning department	3 interviews
	2 supervisors in Cleaning department	2 interviews
	Planning coordinator for cleaning	2 interview
	OR logistical services coordinator	2 interviews
	2 head nurses (Urological and Medical departments)	2 interviews
	Hygiene nurse (Hygiene department)	1 interview
	Observation of cleaning process	1 observation
(B) Other hospital	Manager of Cleaning department	1 interview
	Lean consultant	1 interview
(C) Central Lean and Strategy unit for the hospital region	Lean consultant	1 interview
(D) Central IT department for Danish healthcare	2 heads of IT architecture	2 interviews
	IT platform project manager	1 interview

Table 2
THE RELATION BETWEEN MAIN INTERVIEW QUESTIONS AND RESEARCH SUB QUESTIONS

SQs	*Interview questions*
SQ1	What are the main challenges in the hospital cleaning process?
	What are the main goals for the hospital cleaning process?
SQ2	How could capturing data help solve challenges in the hospital cleaning process?
	How could measuring process performance help solve challenges in the cleaning process?
	What should potential performance indicators measure?
SQ3	How could technology help solve the challenges in the hospital cleaning process?
	Which technologies do you use in the hospital cleaning process?
	Which technologies have you considered to use in the hospital cleaning process?
	What are the risk factors that could affect data validity when capturing data?
SQ4	Which decision parameters would be relevant for assessing technologies to be implemented in the hospital cleaning process?

Analyzing Data to Investigate the Research Questions

Each SQ is addressed in turn to answer the overall RQ. For SQ1, challenges and management goals for the hospital cleaning process were identified by mapping and analyzing the hospital cleaning process. Furthermore, challenges and goals were identified through interviews and discussions with logistics management. In SQ2, performance indicators were developed together with management. The performance indicators were based on the strategy and goals of the organization (Brewer & Speh, 2000). In addition, challenges were included as a basis for the performance indicators because of the close relation between challenges and goals, i.e. overcoming challenges to reach goals (Locke & Latham, 2002; VandeWalle et al., 2001). SQ3 was then investigated to ensure data validity. The process of capturing performance data was analyzed to identify risk factors that affect data validity. The analysis was conducted by assessing the risk factors for different types of technologies. These technologies were identified based on literature and interviews in the case study and included the following: iBeacon, tablet, RFID, barcode, and a portable job agent. Lastly, a set of decision indicators were identified in SQ4 based on findings from SQ1-SQ3. The identified decision indicators in SQ4 therefore relate to challenges and goals (SQ1), performance indicators (SQ2), and data validity (SQ3). The implications for management were then summarized based on the results.

Validity and Reliability

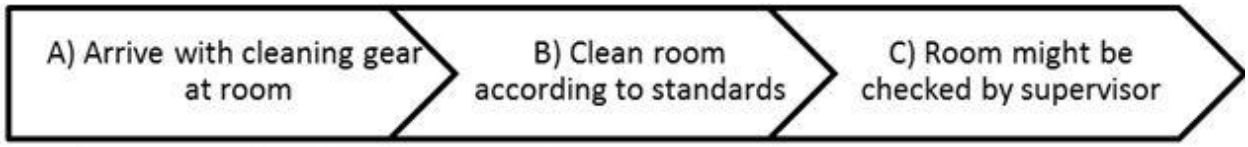
A case study protocol was developed to plan and guide the research activities. The different strategies adopted for collecting data were interviews and observations, and data from several sources were gathered and analyzed. To validate the findings, respondent validation was carried out by interviewing key informants to ensure construct validity (Bryman, 2012; Denzin & Lincoln, 1994; Yin, 1994). To generalize the findings beyond a context within Danish healthcare

logistics, a similar study should be conducted outside of Denmark. The case study does not aim to generalize universally but to find out under which conditions certain outcomes can be predicted (Yin, 1994). Lastly, the reliability of the findings was ensured through colleague review and triangulation (Miles, Huberman, & Saldaña, 2014).

SQ1: IDENTIFYING CHALLENGES AND GOALS

Challenges and goals for the hospital cleaning process are identified in this section. First, the hospital cleaning process is mapped, and each process step is then analyzed in turn to identify challenges and goals in the process. The current hospital cleaning process is fairly simple and can be seen in Figure 1

Figure 1
SIMPLE MAPPING OF THE CURRENT HOSPITAL CLEANING PROCESS



Step A: Arrive With Cleaning Gear at Room

The first process step is the arrival of resources at the place to be cleaned. It is the responsibility of management in the Cleaning department that enough resources are available for the needed cleaning tasks, i.e. *security of supply*. Furthermore, the employees must have the right competences to perform the cleaning tasks satisfactory. One of the challenges experienced by the clinical departments was that the knowledge and quality of cleaning demonstrated by the cleaning personnel during the weekends did not live up to the same standards as on weekdays. This quality issue is related to *employee competences* and translates into *output quality* of the performed tasks.

Step B: Clean Room According To Standards

The cleaning department faces a huge communication and information management challenge. It is a challenge to convince people that a room has been cleaned and that it has been done satisfactory. As cleaning personnel will often clean the rooms when no one is in the room, people often mistakenly think that the room has not been cleaned. Only certain cleaning tasks are documented, and for these tasks, only end time and employee ID is registered. There is no traceability in the cleaning process and it is not registered nor communicated how much time was spent cleaning, who cleaned it or if it lived up to the necessary quality standards. For those tasks not documented, it is difficult to communicate and convince clinical staff, patients and visitors that the room has indeed been cleaned. Furthermore, the expectations of the clinical departments to the level of cleaning have not been aligned with the quality requirements for cleaning. I.e. even when the Cleaning department lives up to the required quality standards, they are still not satisfied with the result. There is a lack of understanding from the clinical departments as to what level of cleaning is required and what level of cleaning can be expected within a given timeframe. It is therefore difficult for the Cleaning department to communicate

that they actually do a good job, and the work of the cleaning personnel is often not recognized.

One part of the communication challenge is to communicate what is already known, i.e. what the Cleaning department already documents. Another part of the challenge is to provide valid data for tasks that are currently not documented. Agreements have been made between the Cleaning department and the clinical departments about the cleaning tasks to be performed. However, it has been difficult to outline these contracts because it is not known how much time is actually spent per room. Part of this problem is that personnel often perform more tasks than written in the agreement. Creating transparency about which tasks have been performed and how much time is spent on them would make it easier to outline contracts and would also help create more trust in the Cleaning department. Creating transparency about tasks would enable better planning and coordination of resources and provide the necessary information for determining process performance. Furthermore, transparency would ensure that the Cleaning department allows enough time for the employee to perform the cleaning task.

Another challenge in the hospital cleaning process is that resources are hard pressed for time. This is partly due to the way resources are planned as only just enough time is scheduled for the employees to clean the rooms. The schedule is based on best practice and past experiences, but no time studies have been carried out. In addition, the cleaning organization faces high sickness absenteeism and difficulties retaining staff, which adds pressure on available resources. The high sickness rates and the issue related to retaining staff can partly be explained by the employee work conditions and employee motivation. Cleaning is hard work and improving work conditions is in the interest of management and employees to ensure a viable solution for both. Tools, technologies and knowledge about correct ways to perform tasks can alleviate the employees. Another work condition concern is that of monitoring the employees, which could lead to some privacy issues (Chao, Yang, & Jen, 2007; Fisher & Monahan, 2008; Reyes, Li, & Visich, 2012) and the risk of micro management. This concern was expressed by the manager of the Cleaning department:

"I would not want to perform micro management and control the individual; I would prefer focusing on the human being and on leading people."

The work conditions together with the lack of recognition of employee efforts do not provide an environment that encourages employee motivation. The organization has subsequently experienced high rates of employee absence, which has added to the pressure on available resources. Management in hospital cleaning is therefore interested in alleviating resources by eliminating any unnecessary processes.

Step C: Check Quality of Work

The quality of cleaning is important for the hospital as a step to contain any infections and avoid infections from spreading throughout the hospital. One of the goals for the hospital cleaning process is therefore to ensure that the rooms are cleaned sufficiently to help avoid infections from spreading. Thus, the *impact on related processes*, in this case the patient care, is of high importance to the cleaning process.

Summary of Identified Challenges and Goals for the Hospital Cleaning Process

The findings relating to SQ1 have been summarized in Table 3, providing an overview of the challenges and goals in the hospital cleaning process. The identified challenges and goals

have been bundled based on similarities. These bundles serve as decision indicators for assessing technologies in a healthcare logistics setting.

SQ2: DEFINING THE PERFORMANCE INDICATORS

Measuring process performance for the hospital cleaning process is an important issue for logistics management at a hospital. Cleaning personnel disperse into all parts of the hospital to clean their designated areas, and it is currently not possible to monitor and check the work of all employees. As the head of logistics pointed out in an interview:

"My main concern is that I let all these people [cleaning personnel] loose [in the hospital] and I don't know what they're doing all day… if they're doing what they're supposed to do and if what they are supposed to do is actually the right amount of work… measuring what people do should also be done to ensure they are not overworked and have enough time to perform their tasks."

Providing information through performance measurement could create transparency about employee performance and the quality of their work (Neely et al., 2005). However, the statement by the head of logistics indicates that creating transparency about performance is not only for the benefit of management and the hospital but also for the employees.

Table 3
CHALLENGES AND GOALS BUNDLED INTO DECISION INDICATORS

Decision indicators	*Challenges*	*Goals*
Security of supply	Scarce resources and difficulties in retaining the resources they have.	Ensuring enough resources to perform cleaning tasks.
Output quality	Cleaning quality differs between weekdays, weekends, and seasons (cleaning quality).	Ensuring quality of work (cleaning quality).
	Valid data not available for performance indicators (data quality).	Ensuring valid data (data quality).
Employee work conditions	Cleaning is hard work. Enough time should be allowed to perform tasks.	Avoiding micro management.
Competence match	Competences are not the same in weekends as on weekdays.	Ensuring same quality of work regardless the day of the week.
Information management	Lacking use of technologies to capture data.	Ensuring enough time is allowed for employees to perform tasks according to cleaning standards.
	Challenges faced with coordinating and prioritizing resources and tasks across teams.	
	Lacking overview of continuous progress in tasks performed.	Being able to determine whether a process is efficient.
	Being unable to show what has actually been done. There is a challenge in assessing and communicating performance, and in aligning expectations with clinical departments.	Being able to verify and communicate which tasks have been performed and to what quality level.
Traceability	Not knowing where employees are and what they are doing.	Being able to assess individual performance.

Employee motivation	Cleaning is hard work and efforts are often not recognized. This has led to lack of motivation and high absenteeism.	Making the job physically easier for employees and ensuring that their efforts are recognized.
Unnecessary process	Resources are hard pressed for time and no unauthorized breaks are allowed. This issue is enhanced by high absenteeism.	Eliminating any unnecessary processes in order to alleviate hard pressed resources.
Impact on related processes	Hospital infections spreading in the hospital.	Provide high quality cleaning and avoid infections from spreading.

Performance indicators should reflect the strategy of the organization and help achieve organizational goals (Brewer & Speh, 2000). To align organizational behavior with strategic goals, central management covering all hospitals in the region had defined the following five performance aspects to be measured: (1) quality, (2) resources, (3) productivity, (4) satisfaction, and (5) service delivery. These aspects of performance measurement are based on the overall strategy of the hospital region and should be traceable down to the individual employee. Based on the five aspects to be measured, a set of performance indicators were developed together with management. These indicators can be seen in Table 4. The performance indicators have been bundled into decision indicators that are aligned with the decision indicators found for SQ1.

In measuring quality (1) of the hospital cleaning process, it is only possible to check the quality of a random sample of rooms. The random sample of rooms is checked according to two quality standards and the share of rooms that passes the quality standards is then used as a quality measure, i.e. % rooms passed quality check. Additionally, to provide some quality assurance for the rooms not checked, supporting performance measures were developed. Case study interviews showed that quality and time spent on cleaning are closely related. Software is used to estimate the amount of time needed to clean each room. These norm times are adjusted on a regular basis to best reflect the amount of time needed to clean a specific room. Planning of resources is based on these norm times and the aim of management has been to allocate just enough time for an employee to clean a room at a satisfactory level. Thus, it is estimated that all the allocated time should be used for cleaning the room in order to achieve a satisfactory result. Demonstrating that a certain amount of time has been spent in a room could therefore provide supporting evidence of the level of quality. The suggested performance indicator norm time/time spent cleaning is therefore both a productivity measure and a supporting quality measure. Resources (2) are reflected in the performance indicators by measuring % sick leave and #employees on leave. As mentioned in the section identifying challenges and goals for the hospital cleaning process, one of the major challenges is that employee absenteeism is high for the department and that employees are hard pressed for time. Management is therefore interested in closely monitoring the availability of resources.

Productivity indicators (3) were developed to reflect how much time was spent on value-adding processes by measuring norm time/time spent cleaning. Norm time/time spent cleaning can also be viewed as value-added time. To measure the efficiency of the individual employee, #planned cleanings/employee was chosen as an indicator.

Satisfaction (4) was already assessed in a yearly report though a survey sent out to all departments in the hospital. This report was a qualitative study and not a quantitative measure as such, and management wished to keep it that way.

Finally, for service delivery (5), two indicators were selected. To make it easier to outline contracts with clinical departments and communicate about performed tasks, % delivered of planned was chosen as an indicator. % delivered of planned indicates how many of the promised tasks were actually finished. Another aspect of service delivery interesting to management was the lead time for acute tasks. Compared to the planned tasks, these tasks were time sensitive and timely delivery imperative.

Table 4
PERFORMANCE INDICATORS BUNDLED INTO TOPICS

Decision indicators	***Performance indicators***
Output quality	% rooms passed quality check Norm time/time spent cleaning (supporting indicator) Experienced service report
Value-added time	Norm time/time spent cleaning (primary indicator)
Security of supply	# finished tasks / promised % delivered of planned
Lead time	Lead time
Unnecessary process	# planned cleanings / employee % sick leave # employees on leave
Traceability	All performance indicators should be traceable to the individual person.

SQ3: TECHNOLOGIES, RISK FACTORS, AND DATA VALIDITY

SQ3 investigates the process of capturing data within hospital cleaning. To measure the performance indicators identified in the previous section, it is necessary to capture different types of data in the process. In the following, each step of the data capturing process within hospital cleaning is analyzed to identify risk factors affecting data validity. The risk factors are summarized in Table 5 and bundled into decision indicators.

The Process of Capturing Data within Hospital Cleaning

Technologies would be needed to enable measurement of the developed performance indicators for the hospital cleaning process. The alternative would be to manually register the data points in the process, which would be time consuming. Figure 2 shows an example of how data could be captured in the hospital cleaning process, in this case by registering start and end time of the cleaning process.

Figure2
MAPPING EXAMPLE OF REGISTERING DATA IN THE HOSPITAL CLEANING PROCESS

Five technologies were assessed for the hospital cleaning process for capturing performance data. These technologies were RFID, barcodes, tablets/apps, iBeacons, and portable job agents. The hospital already uses some of these technologies such as barcodes, tablets and portable job agents, and the technology that the Cleaning department chooses could potentially be used by other departments. E.g. RFID could be used to track doctors, patients and medical equipment. Thus, taking into consideration that others may benefit from the technology suggests an element of future proofing. Future proofing means that the chosen technology is also likely to be used by the hospital in the future and that it will not become obsolete any time soon.

Step A: Arrive At the Room and Register Start Time

The first steps of the process would be for the employee to arrive at the room to be cleaned (step A1) and then register the starting time (step A2). This registration would be done electronically, but not necessarily automatically. For the RFID and iBeacon technologies, this registration would happen automatically. Data such as room number, time stamp, and personnel ID could be registered. However, for other technologies, some manual effort would be needed to register data. For barcodes, the employee would have to scan a barcode such as one on an ID card, which would then register room number, time stamp, and personnel ID. Lastly, using tablets and portable job agents means that the employee would have to identify the task, i.e. room to be cleaned, on the device. Upon identification on the device, time stamp and personnel ID would be registered.

The solutions with tablets and job agents differ from the other solutions in that the registration does not require or ascertain the presence of an employee in a given location at a given point in time. Thus, from an agency theory point of view, it is not possible to ascertain whether the employee was present at the location at the given point in time, which means there is information asymmetry. Traceability will therefore reduce information asymmetry. Furthermore, the registration requires an effort of the employee to actively make a registration. Risk of forgetting to register data means there is a risk that data validity will be impaired if data is not registered automatically. I.e. the degree of automation is important in ensuring data validity. In addition, if data is not registered automatically, it might not be registered in a consistent manner, which would also increase the risk of mistakes. If the employee has to actively make a registration, this may not happen at the same point in the process every time. However, if the registration is automated, the risk of mistakes would be reduced and consistency would be ensured. Therefore, the degree of automation is closely related to risk of mistakes and consistency. Conversely, a higher degree of automation also means that the ability to capture data is fully dependent on the technology and that any downtime and maintenance may disrupt data capturing and thereby affect data validity. Lastly, for the technology to capture data, the employees must be able to use the technology, i.e. the technology should be easy to use, and the

employees should possess the necessary competences.

The employee may not see it as in his or her interest to measure performance, especially personal performance. The goals of the employee may therefore differ from the goals of management. Viewing the registration task from an agency theory perspective; if the goals of management are not the same as those of the employee, and if it is difficult to obtain information about the employee's behavior, an agency problem occurs. Unless there is a motivation for the employee to make the registration, there is a risk that the employee may neglect or forget to do so. It is important to note that monitoring individual employee performance will not only enable management to address poor performance but also to recognize good performance.

Step B: Clean the Room and Register End Time

For step B2, the same risks affect data validity as identified for registering start time in step A2. Only step B1 will therefore be analyzed in the following. One of the challenges mentioned earlier is the differing level of quality between weekends and weekdays. The cleaning personnel during the weekends do not include experienced employees. Weekend personnel is often be people not working full time within the cleaning field. The less experienced employees are therefore not as knowledgeable and skilled as the more experienced employees. This lack of knowledge and skill has led to quality issues during the weekends. One way of addressing this challenge is to supply the employee with the correct knowledge when needed, thus helping the employees gain the needed competences. This could be done by providing videos and illustrations of how a certain task should be performed, e.g. using iBeacons or tablets.

Step C: Check Quality of Work

In the hospital cleaning case, a number of randomly selected rooms would be checked by a supervisor. The supervisor would follow a check list to assess the room according to two Danish quality standards (INSTA 800 and DS2451-10). The assessment would be noted on a physical template and later typed into a spreadsheet on the office computer. The extra process in documenting and re-documenting data is essentially an unnecessary process that increases the risk of mistakes and puts data validity at risk. Furthermore, the extra step also means there may be a shift in who performs the process, i.e. a competence shift.

Table 5
SUMMARY OF IDENTIFIED RISK FACTORS AFFECTING DATA VALIDITY

Decision indicators	Description of risk factors identified in the process analysis
Future proofing	Ensuring that the technological solution capturing data will persist in the hospital to provide valid data in the future.
Traceability	Ascertaining time and location of the employee that performed a task is necessary to enable to assure that the employee had been at the location.
Degree of automation	Automating the process of registering data reduces the risk of mistakes in the way data is captured. It also ensures that data is captured in the same way and prevents employees from neglecting or forgetting data registration.
Risk of mistakes	Degree of automation is closely related to the risk of mistakes in data capturing. Incorrect registrations lead to incorrect and invalid data.

Table 5 (continued)
SUMMARY OF IDENTIFIED RISK FACTORS AFFECTING DATA VALIDITY

Decision indicators	Description of risk factors identified in the process analysis
Consistency	Degree of automation and a reduced risk of mistakes lead to higher consistency in data. Inconsistency in data renders data incomparable.
Features and ease of use	If data is not captured automatically, one of the pre-requisites for enabling data registration is that employees are able to operate the technology. Ease of use makes it more likely that employees can operate the technology.
Competence match	Together with ease of use, ensuring that employees have the right competences will increase the likelihood of employees correctly operating the technology.
Employee motivation	Ensuring ease of use and the right competences are pre-requisites for enabling the use of technologies that are not automated. The next challenge is to ensure that the employee is then motivated to actively register data.
Unnecessary process	Unnecessary processes such as double entry of data increases the risk of incorrect data registration from one registration to another.
Competence shift	If double entry of data is handed over from one employee to another, the risk of incorrect data registration increases due to the risk of miscommunication.

SQ4: DEFINING THE DECISION INDICATORS

Defining Decision Indicators Based On the Case Study Analyses

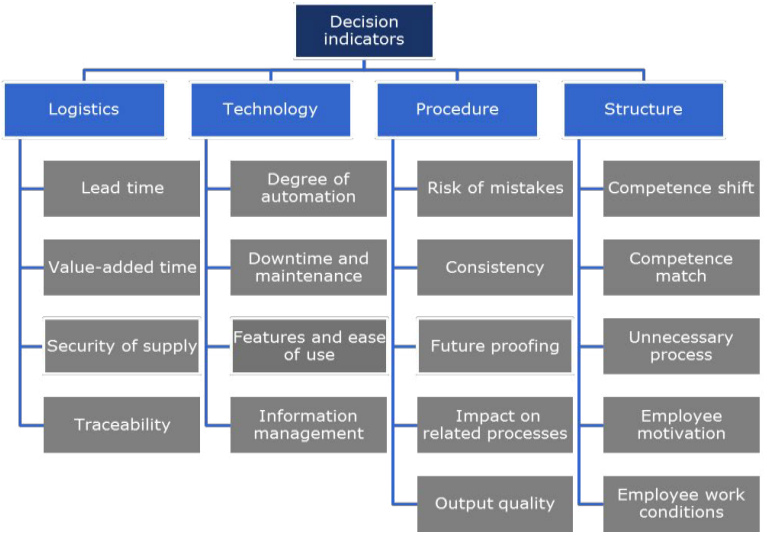
As a result of the analyses conducted for SQ1-3, 18 decision indicators (Table 6) have been identified based on the hospital cleaning case. The purpose of the decision indicators in the framework is to enable assessment of alternative solutions for a logistical healthcare process.

To make the list of indicators more coherent and transparent, the 18 decision indicators were structured into logical categories. Commonalities were identified between decision indicators, and the decision indicators were grouped into four categories: Logistics, Technology, Procedure and Structure. Logistics refers to logistical activities as defined in the literature review. Technology refers to the track and trace technologies as found in the literature and in discussions with management in the case study. Procedure refers to the formalized processes in healthcare logistics, e.g. standard operating procedures. Finally, Structure refers to the organizational structure in a healthcare setting. The 18 decision indicators structured into the four categories form the developed decision framework in this case study. The framework is illustrated in figure 3.

Table 6
OVERVIEW OF IDENTIFIED DECISION INDICATORS AND THE SQS THEY WERE IDENTIFIED FOR

Decision indicators	SQ1: Challenges/goals	SQ2: Performance	SQ3: Risks
Security of supply	Challenges and goals		
Output quality	Challenges and goals	Performance indicators	
Competence match	Challenges and goals		Risk factors
Information management	Challenges and goals		
Traceability	Challenges and goals	Performance indicators	Risk factors
Employee work conditions	Challenges and goals		
Employee motivation	Challenges and goals		Risk factors
Unnecessary process	Challenges and goals	Performance indicators	Risk factors
Impact on related processes	Challenges and goals		
Value-added time		Performance indicators	
Lead time		Performance indicators	
Future proofing			Risk factors
Degree of automation			Risk factors
Risk of mistakes			Risk factors
Consistency			Risk factors
Downtime & maintenance			Risk factors
Features and ease of use			Risk factors
Competence shifts			Risk factors

Figure 3
DECISION INDICATORS FOR ASSESSING TECHNOLOGIES IN HEALTHCARE LOGISTICS



Implications for Management When Assessing Track and Trace Technologies

The implications for management of the results in this paper are presented in the following. A list of decision steps is proposed for selecting track and trace technologies to measure performance indicators within healthcare logistics. In the section analyzing SQ1, a list of challenges and goals were identified. Subsequently, a set of performance indicators were developed in SQ2. This paper considered the selection of technologies to measure these performance indicators. The combination of technology and data point to be measured creates a certain level of data validity, i.e. some technologies produce more valid data than others. In the investigation of SQ3, the risk factors affecting data validity were identified.

The financial aspect of selecting a technology is not covered by the 18 identified decision indicators identified in this paper. The main part of the Danish healthcare system is public, and funds are limited. This means that funding for logistical investments is often scarce as clinical investments are prioritized. Most organizations would not invest a large amount of money without calculating a business case, and the financial aspect of investing in technologies should therefore be considered alongside the identified decision indicators in the framework. In the process of selecting a new technology to invest in, the organization will have to secure the funds for the investment. Financial considerations could have practical implications for the choice of performance indicators and track and trace technologies. The benefits of the investment should outweigh the costs, and one of the benefits is the amount of data that will be provided by the technology. A certain number of data registrations above a level of some critical mass would therefore be a prerequisite for a profitable business case. Another financial aspect to consider is that one technology may not fit all. Thus, it may be necessary to invest in more than one technology or reduce the number of indicators to be measured. Although performance measures should be governed by the overall strategy of the organization (Brewer & Speh, 2000), the economically feasible technologies may not enable measurement of the preferred performance indicators. Steps should therefore be taken to accommodate any financial limitations. Based on the analysis presented in this section, the following decision steps are proposed for selecting technologies to measure process performance in healthcare logistics:

1. Select performance indicators based on goals, challenges, and strategy
2. Ascertain critical mass for data registration
3. Compare the 18 decision indicators for each of the potential technological solutions
4. Assess data validity for data-technology combinations based on the identified risk factors
5. Compare data validity with the cost of investment in technology
6. Determine feasible technological solutions from a financial perspective
7. Adjust performance indicators if necessary

The third decision step comparing the 18 decision indicators is one of the most extensive steps in the decision process. The comparison could be done qualitatively or quantitatively by using quantitative methods such as AHP or ANP.

DISCUSSION

Most of the literature on assessing technologies in a logistics setting tends to focus on the benefits of a specific technology, e.g. (Anand & Wamba, 2013; Yao et al., 2012). Some

of the benefits identified in literature are generic across industries while others are specific to a particular industry (Ferrer et al., 2010). The developed framework focuses on decision indicators specific to a healthcare logistics context. In addition, the framework proposed in this study is suitable for assessing different types of track and trace technologies based on a set of decision indicators. The decision indictors can be evaluated for each technological solution and assesses the solution from a process performance perspective. Thus, the decision indicators in the framework do not only take the benefits of the specific technology into account, but provides a more context specific decision support tool. The context specificity is not only provided by assuming a process perspective, but also by considering effects outside of the process such as impact on related processes. Thus, a systems perspective is assumed, providing a more holistic view of the hospital. In addition, the type of hospital and the financial situation of the hospital may influence preferences of management. These preferences can then be expressed in the decision framework by letting management evaluate each decision indicator.

Some of the decision indicators resemble the benefits of technology adoption found in literature. E.g. Ferrer also identified automation as a benefit / decision criterion (Ferrer et al., 2010). The benefits identified by Ferrer relate to operations strategy objectives and are thus limited to the operations side of the hospital. Although the logistical processes considered in this paper are operations oriented, the decision criteria need not be limited to this. The strategy and organization of the hospital as a whole, especially the clinical departments, should also be taken into consideration (Landry & Philippe, 2004).

The main RQ was answered through four underlying SQs, which were each answered through three different analyses. Furthermore, implications for management were summarized in 7 decision steps proposed for assessing technologies in healthcare logistics. Findings in this paper are limited to a healthcare logistics context and should be validated for other contexts and settings outside of Denmark. The literature review revealed a lack of literature investigating specific healthcare logistics processes. This study is limited to a single case study of the hospital cleaning process, and similar studies of other healthcare logistics processes should be conducted. Based on the literature review, a gap in technology assessment for logistical healthcare was identified, and was subsequently investigated in this study. The developed framework showed similarities to existing literature while at the same time contributing with new knowledge on technology assessment.

CONCLUDING REMARKS

The framework proposed in this study has provided a set of decision indicators for assessing different types of track and trace technologies. The identified decision indicators were identified based on 1) challenges and goals, 2) performance indicators, and 3) risk factors affecting data validity. In addition to the decision indicators provided in this study, each of the three aspects are interesting in their own right and can be used separately. E.g. to identify main challenges and goals of a process for process improvement purposes, developing performance indicators for a process improvement initiative, and lastly assessing data validity for different technologies. The main challenges identified in the case study were related to information management. The challenge of information management included creating transparency about which tasks had been conducted as well as the performance on quality and productivity. Being able to measure performance indicators would support better communication to the clinical staff, patients, and visitors. A set of performance indicators was

proposed to enable communication of performance and to ensure that the cleaning tasks had been performed, and that they had been done satisfactory. To ensure quality of cleaning, productivity measures were developed to support the quality measures. This is to ensure that cleaning personnel has spent enough time in the room to clean it at a satisfactory level. This measure is especially important for rooms that have not been quality checked. Finally, risk factors affecting data validity were identified. The main risk factors relate to traceability, degree of automation, features and ease of use, and employee motivation. The technology used to capture data in the process will affect data validity, and data validity can be assessed for each technology by evaluating the identified risk factors. Furthermore, the feasible choice of performance indicators may be affected by the choice of technology.

This paper contributes with a set of decision indicators for assessing track and trace technologies in a healthcare logistics setting. The decision indicators form a framework that serves as a decision support tool for management in healthcare logistics. The framework is structured around four constructs: Logistics, Technology, Procedure, and Structure. In practice, the framework can be used either qualitatively by comparing each decision indicator for different scenarios and/or by applying a quantitative method such as AHP or ANP.

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DEVELOPMENT OF "MEDICAL DEVICE CALIBRATION GENERAL EVALUATION FORM" FOR MEDICAL DEVICE USERS

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ABSTRACT

Medical devices play a significant role in the diagnosis and treatment phase. To have accurate results on time, calibration of the devices has to be made. Attitude of users towards calibration is vitally important. On the other hand, how users handle the calibration process is in close relation with patient safety as well. The Purpose of the Study is to develop the medical device calibration general evaluation form for medical device users. Study group consists of medical and healthcare professional groups who use medical device. For this objective, an expression pool is formed with the help of literature and the experts of their subject. In line with the experts' knowledge and views the number of items is decreased to 59 by elimination. In the next step, the form has been applied to approximately 60 medical device users. "Kaiser Meyer Olkin (KMO) Test" has been used to measure if the sample size is adequate. KMO value has been found as 0.866, which is appropriate for the factor analysis of the sample size. For the accountability of the form Cronbach Alpha Internal Consistency Coefficient and for the validity "Scope Validity", "Scale Validity" and "Structure Validity" has been examined. Furthermore, factor analysis and experts views have been examined to set dimensions. Cronbach Alpha Internal Consistency Coefficient of the form was found as 0.913 which proves the form is accountable. For the validity "Scope Validity", "Scale Validity" and "Structure Validity" have been examined and found to be valid. Besides, 12 dimensions have been obtained by taking consideration of factor analysis and experts' opinions. This form demonstrate that it may be used in researches to measure how medical device users look at calibration and how serious they find it.

Keywords: Calibration, Medical Device, Medical Device Calibrations

INTRODUCTION

Medical devices, expert from pharmaceuticals, from very primitive tool to high- tech devices such as MR (Yerebakan ve Karakuş, 2007) are products which are used to improve health quality, diagnosis and treatment options of individuals (İzmir Ticaret Odası, 2012). More broadly, medical devices are not effective pharmacologically, immunologically, metabolically but supportive functionally on humans during;

1. The diagnosis, prevention, monitoring, treatment or alleviation of the disease, diagnosis, monitoring, treatment, alleviation or removing victimization of injury or disability,
2. Research of an anatomic and physiologic function, modifying or exchanging,

3. Defined as; produced for birth control or drug implementation, alone or together, backed by softwares when needed, including tissues of dead animals, all types of devices and accessories and other materials (93/43/EEC Konsey Direktifi, 1993; Sağlık Bakanlığı, 2011; Yerebakan and Karakuş, 2007).

1978 Alma-Ata Declaration and World Health Organization (WHO) define medical devices as the most efficient factor that affects human health. Health organizations and workers are responsible to take precautionary measures to protect human health and improve treatment process. According to National Patient Safety Foundation, patient safety is to prevent errors related to healthcare and decrease patient injuries caused by health services (NPSF, http://www.npsf.org). To clear these mistakes away or to keep them at the minimum level, studies are required to be done on a continuing basis. In the scope of these studies, medical device calibrations have to be done regularly to prevent undesired outcomes (Odacıoğlu, 2008).

Hospitals are organizations where most accurate researches for treatment and diagnosis of diseases are made. Calibration enables medical devices to produce accountable results. Considering this, medical calibration is vitally important for hospitals.

Calibration is finding the difference between the value that reference device shows and what the device being calibrated should demonstrate (Ulusal Metroloji Enstitüsü, http://www.ume.org). In more general sense, under certain conditions, it shows the relationship between the values that measurement system or measurement device demonstrates and its corresponding reference value (MEGEP, 2008). Calibration in the biomedical field is reporting the deviations, differences and accountability of the measurements of any medical device by comparing it with the calibrator, in other words reference measurement system or reference measurement device (Karagöz, 2013). Medical devices generally make measurement for chemical, biological and physical parameters (MEGEP, 2008). As a result of medical device calibration, tracking measurements of the medical devices and measurement chain is enabled. A certificate is given to devices if certain biomedical calibration conditions are met. By doing so the accuracy of the measurements is taken under guarentee (Güleç at all. 2009).

To consider a measurement as a calibration, "calibrators","trained staff", "environmental conditions" and "measurement uncertainty" are needed (Cıvdı, 2015; slideplayer.biz.tr).

Reasons why a device should be calibrated are as follows:

-To create traceability chain and maintain it,

-To guarantee that data coming from the system or the measuring device is consistent with other measurements,

-To determine the accuracy of the data coming from the system or measurement device.

Thus it is to provide measurement accountability (Howarth and Redgrave, 2008).

To summarize, medical calibration is controlling medical devices which are used for treatment and diagnosis according to standards on a regular basis.

METHOD

"Medical Device Calibration General Evaluation Form" has been developed in this study. Using an opinion funnel, "Candidate Calibration General Evaluation Form" which consists of 65 items and has been turned into "Expert Evaluation Form" and presented to the experts knowledge and evaluations. Form consisting of 59 items has been approved with staff working in clinics, laboratories, and physicians working in operating room, nurses and health technicians. Application: "Medical Device Calibration General Evaluation Form"

has been developed in many steps as follows;

1. Defining Evaluation Attribute: General knowledge of physicians, nurses and health technicians about calibration will be examined in this study.

2. Determining the Scope of the Evaluation Attribute: At this stage, literature and expert opinions have been used to determine the scope of the thema that will be evaluated and expressions related to the evaluation. Furthermore, 50 people consisting of physicians, nurses and health technicians that use medical devices have been asked four open ended questions and their opinions have been examined to determine evaluation attribute's scope.

3. Gathering of Expert Knowledge and Opinions: A group of 10 people consisting of 1 biomedical engineer instructor, 1 electronics engineer instructor, 2 health institutions management instructor, 1 psychometrics instructor, one manager from Ankara Gülhane Military Medical Academy Biomedical Engineering Center, two managers from Ankara Gülhane Military Medical Academy Calibration Center, 1 Turkish Standards Institution Calibration Manager and one manager from Yüksek Ihtisas Hospital Calibration Laboratory have expressed their opinions.

4. Generation of General Evaluation Form Expressions with Respect to The Scope (Expression Pool): With reference to the expressions above, and considering expert opinions and literature, an "Expression Pool" has been generated with 65 items. Generating both positive and negative expressions which contain actions, knowledge and sensual content is a top priority. On the other hand, high attention was paid to keep expressions away from more than one judgment. "Candidate Calibration General Evaluation Form" has been presented to experts to have their opinions about it (Table 1).

Table 1
EXPERT EVALUATION AND SVR (SCOPE VALIDITY RATIO)

ITEMS	Expert Evaluation										SVR
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	
1. Medical device calibration means that it operates properly or not.	+	+	+	+	C	C	+	+	+	+	1
2. Calibration provides regular controls of medical devices and also measurement accuracy.	+	-	C	+	C	C	+	+	+	+	0,80
3. Implementation of calibration processes on time and regularly in a hospital indicates that there is a high quality healthcare service in that hospital.	C	+	+	+	C	C	C	+	+	+	1
4. I take care on the calibration period of the medical device that I use	+	+	+	+	C	+	C	+	+	+	1
5. I don't know the calibration frequency of the medical device that I use.	+	+	+	+	C	+	+	C	+	+	1
6. I can have the calibration of the medical device that I use done before the scheduled time when needed.	+	+	+	+	C	+	+	+	+	+	1
7. I don't know that the calibration frequency can differ depending on the device.	+	+	+	C	C	+	C	C	+	+	1
8. I can learn the calibration frequency of medical device that I use from user manual or calibration staff.	+	+	C	+	C	+	C	+	+	C	1
9. There is no need to calibration period for medical devices. The user can do or have the calibration done whenever he/she wants/desires/ needs.	+	-	-	C	C	+	+	C	+	+	0,60
10. I don't know who will do the calibration of the medical device that I use.	+	+	C	+	C	+	C	C	+	+	1
11. I do the calibration of medical devices on time that are under users 'calibration responsibility.	C	-	C	+	C	C	+	+	+	+	0,80

Table 1
EXPERT EVALUATION AND SVR (SCOPE VALIDITY RATIO)

ITEMS	Expert Evaluation										SVR
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	
12. I don't only trust the calibration of the medical device that I use, but I also observe and control the operation of the device.	+	-	C	C	C	+	+	+	+	+	0,80
13. Use of the medical device requires its calibration.	+	+	+	+	C	+	C	+	+	C	1
14. Proper operation of the medical devices that are used in diagnosis and treatment is not important for users.	+	+	+	+	+	C	C	C	+	+	1
15. I don't think that there will be any difference in its operation for a medical device when environmental and operational conditions change.	+	-	+	+	C	C	C	+	+	+	0,80
16. Having the calibrations of medical devices done in a healthcare organization gives confidence to both user and the patient.	+	+	+	+	C	+	+	+	+	+	1
17. The calibration of medical devices is not important for me.	+	+	+	+	+	C	+	C	+	+	1
18. It is unnecessary to do the calibrations of medical devices regularly in order to decrease the measurement errors of medical devices to a minimum level.	+	+	C	+	+	+	+	C	+	+	1
19. The calibration of medical devices is unnecessary because of its high costs.	+	+	C	+	+	+	C	C	+	+	1
20. I don't rely on the calibration of the medical device that I use completely.	+	-	C	+	C	C	C	C	+	+	0,80
21. The malfunction frequency of the medical device increases after a calibration process.	C	+	C	+	C	C	+	C	+	+	1
22. The opinions and suggestions of the users is not taken into account during calibration steps.	+	+	C	+	C	+	+	C	+	+	1
23. The calibrations of the medical devices must be done to be sure about the results produced.	+	+	C	+	+	+	+	+	+	+	1
24. The calibration of medical devices is not important for patients. Patients have to believe the results of the medical devices whether they are calibrated or not.	+	+	+	C	C	+	+	C	+	+	1
25. Users have to believe the results of the medical devices whether they are calibrated or not.	+	+	C	+	C	+	+	C	+	+	1
26. Proper implementation of calibration processes in a healthcare organization is not a criteria of quality.	+	+	+	+	+	C	+	C	+	+	1
27. That the medical devices are calibrated is not a crucial factor on the preference of a hospital by patients.	+	+	C	+	C	+	+	C	+	+	1
28. The medical device that I use is calibrated, gives me confidence.	+	+	+	+	C	C	+	+	+	+	1
29. I rely on the results of the calibrated medical device that I use.	+	+	C	+	C	+	+	+	+	+	1
30. I pay attention to the situation of its calibration for a medical device that I will use.	+	+	+	+	C	+	C	+	+	+	1
31. Calibration doesn't take place between the reasons that I first think about the working/operation inconsistency.	+	+	C	+	C	+	C	C	+	+	1
32. I don't know what medical device calibration means.	+	+	+	+	C	+	+	C	+	+	1
33. I believe calibration processes in our hospital are implemented realistic, correct and reliable.	+	+	C	+	+	+	+	C	+	+	1
34. I don't have any information about the situation of calibration of the medical devices. Somebody does when it is scheduled.	+	+	+	C	+	+	+	C	C	+	1

Table 1
EXPERT EVALUATION AND SVR (SCOPE VALIDITY RATIO)

ITEMS	Expert Evaluation										SVR
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	
35. That the medical devices are calibrated doesn't prevent negative situations in diagnosis and treatment.	+	+	C	+	C	+	+	C	+	+	1
36. It makes me happy that administration gives importance to medical device calibration.	+	+	+	+	+	+	+	+	+	+	1
37. There is no need to inform medical device users sufficiently about calibration.	C	+	+	+	+	+	+	C	+	+	1
38. It is mandatory to calibrate all medical devices that are to be calibrated.	+	+	C	+	+	C	C	+	+	+	1
39. It is enough to calibrate some of important medical devices in the hospital.	+	+	+	+	+	+	+	C	+	+	1
40. The medical device that I use is calibrated, doesn't make my work easy.	+	+	+	+	+	+	+	C	+	+	1
41. The medical device that I use is calibrated, doesn't decrease my repeated working frequency.	C	+	C	C	C	+	C	C	+	+	1
42. The medical devices in a TSE ISO certified hospitals are appropriate in means of calibration.	+	+	C	+	+	+	C	C	C	+	1
43. The medical device that I use is un calibrated to discompose me.	+	+	+	+	+	+	+	+	+	+	1
44. I behave with the consciousness of doing my practice with calibrated medical devices.	+	+	C	+	+	+	+	+	+	+	1
45. There is no relation between the calibration of medical device and accuracy in my practice.	+	+	C	+	+	+	+	C	+	+	1
46. I don't have any information about that, the medical device that I use must be calibrated in order not to face any negative legal situation.	+	+	C	C	C	+	C	C	+	+	1
47. It relieves my mind that the medical device that I use is calibrated to present a high quality healthcare service.	+	+	+	+	+	+	+	+	+	+	1
48. There is no benefit of medical device calibration processes except bringing extra work to users.	+	+	+	+	+	+	+	C	+	+	1
49. That the medical device is calibrated, doesn't remove the responsibility of users in means of reliability of results.	+	+	+	+	C	+	+	+	+	+	1
50. The calibration of medical devices is something that is faked-up within accreditation.	+	+	C	+	+	+	C	C	+	+	1
51. The processes that I made are reliable if the device that I use is calibrated.	+	+	+	+	C	+	+	+	+	C	1
52. I don't believe that the calibration of medical devices is done strictly.	-	+	+	+	C	+	+	C	+	+	0,80
53. Previously there was no such thing calibration is no need now.	+	+	+	+	+	+	+	C	+	+	1
54. I know that calibration of medical devices is done by using special kits, reference solutions and calibrators.	+	+	+	+	C	+	+	+	+	C	1
55. I apply specific procedures while calibrating the medical device that I	+	+	+	+	C	+	+	+	+	+	1
56. Considering that medical devices are used in diagnosis and treatment for human health, regular adjustments and calibration checks of medical devices must be done and certified certainly.	+	+	+	+	+	+	+	+	+	C	1
57. I am able to do the basic service adjustments and user calibration of the medical device that I use.	+	+	+	+	C	+	+	+	+	+	1

Table 1
EXPERT EVALUATION AND SVR (SCOPE VALIDITY RATIO)

ITEMS	Expert Evaluation										SVR
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	
58. The medical devices must be calibrated in order to achieve the accurate study in means of human health and quality of measurement.	-	+	+	+	C	+	+	+	+	+	0,80
59. The continuebility of quality of medical devices which are used intensely in diagnostic and treatment processes is provided by calibration.	+	+	C	+	C	+	+	+	+	+	1
60. The user problems and risks are decreased to minimum by medical device calibration.	+	+	+	+	+	+	C	+	+	+	1
61. The calibration of medical devices is not vital for treatment process.	+	+	+	+	+	+	+	C	+	+	1
62. The calibration of medical devices are not only done in scheduled periods, it is also done if; a. the device is never used b. is defected or mechanically harmed c. is not used according to instructions for use d. periodic maintenance is not done e. adjustment mechanisms are broken f. in case of suspicious results	+	-	+	C	C	+	C	+	+	+	0,80
63. I am aware that, the right diagnosis obtained by providing measurement reliability will have a positive effect on treatment process.	+	+	+	+	+	+	+	+	+	+	1
64. I don't know that patients will be under risk when the medical devices don't operate properly.	+	+	+	+	+	+	+	C	+	+	1
65. The calibration of medical devices is crucial and necessary for presenting a high quality healthcare service, patient safety and environmental safety.	+	+	+	+	+	+	C	+	+	+	1

C: Correction

5. Validity and Reliability of Calibration General Evaluation Form: A validity analysis has been made to find out if form is suitable for calibration attributes that will be evaluated and if form covers to topics that will be evaluated. Validity analysis covers the examination of the form in terms of "Scope Validity", "Surface Validity", "Criterion Validity" and "Structure Validity".

5.1 Validity of Scope: Validity of Scope decides if the expressions in the form represent the field that will be evaluated. At this stage, "Candidate Calibration General Evaluation Form" consisting from 65 items, has been modified to "Expert Evaluation Form" which is submitted to expert to have their opinions and comments. Form has been handed in to expert by the researcher. Experts graded each item as "Appropriate" or "Not Appropriate" and expressed their comments about rooms for improvements. "Scope Validity Ratio – SVR" is calculated for scope validity. Scope validity ratio is set by "Lawshe Technique" (Table 1). SVR (Scope Validity Ratio) form located calculated value of each item and the smallest values were 0.60. SVR value of each item must be a minimum of 0,62 (Lawshe, 1975; Yurdagül, 2005). Calculation of SVR is as follows;

$$SVR = \frac{NE - N/2}{N/2}$$

NE= Number of experts who grade the expression as "Appropriate"
N= Total number of experts

The experts mostly contributed to modifying expressions and asking for new, untouched topics. After SVR evaluation, number of items in the evaluation form has been decreased to 59.

5.2 Surace Validity (Logical Validity): Expression in the previous items of Calibration General Evaluation Form has been modified by the researcher in terms of "comprehensibility" and "accurateness of the expression" according to suggestions coming from experts. Calibration General Evaluation Form, consisting from 59 items, has been answered by 60 people who are physicians, nurses and health technicians of Ankara Gülhane Military Medical Academy. This form has been applied to staff which work in the relevant clinics with the medical devices. Expression in the form were evaluated from the perspectives of; "Propriety", "Meaningfulness", "Legibility", "Comprehensibility" and "Simplicity" and modified when needed. Meanwhile Cronbach Alpha Internal Consistency Coefficient has been calculated as 0.923 (Table 2). At this stage useless item is removed providing that disturbing the overall structure and finally the form consists of 40 items.

Table 2
MEDICAL DEVICE CALIBRATION GENERAL EVALUATION FORM ITEM ANALYSIS RESULTS.

Items (Expressions)	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
1	232,9833	478,254	,104	,926
2	232,8167	474,525	,233	,924
3	232,2000	474,264	,538	,922
4	232,4667	470,490	,576	,921
5	232,4167	474,315	,347	,922
6	232,1167	475,088	,520	,922
7	232,1500	474,774	,525	,922
8	232,3500	472,808	,492	,922
9	232,6333	463,728	,647	,920
10	232,7167	473,393	,323	,923
11	233,6667	477,175	,148	,925
12	233,5833	461,874	,454	,922

N:60; Number of Items 59; Cronbach Alpha Coefficient 0,923

5.3 Criterion Validity: Since "Medical Device Calibration General Evaluation Form" is no available, this analysis could not be made.

5.4 Structure Validity: Factor analysis is used for structure validity. Factor analysis helps related variables stay together. Factor analysis is used to find out how the structure that belongs to attributes which will be evaluated took place with the evaluation form that is to be developed (Tavşancıl, 2010). Last version of the form which contains 40 items is completed by 60 medical device users and the results were tested by "Kaiser Meyer Olkin (KMO) Test" to find out if sample size of the study satisfies the factor analysis which is used for structure validity. KMO value was found as 0.866 which satisfies the requirement needed to make factor analysis (Aydın, 2007). Since there is no related information in literature and it is

not known how many factors the topic has, "Principal Components Analysis" which is a sub technique of "Explanatory/Discovering Factor Analysis" is used to group the expressions in this form. In the Principal Components Analysis, Total Variance Explained Table and Component Matrix Table have been considered to set the structure of the variables. Since it is expected to have more than one factor (dimension), "Varimax Rotation", a sub method of "Right Angle Rotation Method" is used (Büyüköztürk, 2004). Considering both analysis made and expert views, factors has been renamed and 12 dimensions have been obtained. 1st factor; "Definition of Calibration", 2nd factor; "Benefits of Calibration",3rd factor; "Calibration Awareness", 4th factor; "Who is Doing the Calibration", 5th factor; "Responsibility of the User", 6th factor; "Calibration Period and Timing", 7th factor; "Problems in Calibration", 9th factor; "Calibration Training", 10th factor; "Psychological Relationship Between User and the Calibration", 11th factor; "Devices that are to be Calibrated", 12th factor; "Calibration Quality Correlation" are decided as factors (Table 3). 9th factor; "Calibration Training", 10th factor; "Psychological Relationship between User and the Calibration", 11th factor; "Devices that are to be Calibrated", 12th factor; "Calibration-Quality Correlation" are decided as factors (Table 3).

Table 3
MODIFIED SUB DIMENSIONS OF CALIBRATION GENERAL EVALUATION FORM

Factors	Number of Items (Expression)	Item (Expression) Text
1. Factor: Definition of Calibration	1	Calibration helps us to measure how approximate does the medical device measures considering the reference value.
	3	I know that calibration of medical devices is done by using special kits, reference solutions and calibrators.
2. Factor: Benefits of Calibration	2	Calibration provides regular controls of medical devices and also measurement accuracy.
	39	The user problems and risks are decreased to minimum by medical device calibration.
3. Factor:Calibration Awareness	4	Use of the medical device requires its calibration.
	20	Proper operation of the medical devices that are used in diagnosis and treatment is not important for users.
	27	Calibration takes place between the reasons that I first think about the working inconsistency.
	35	I am aware that, the right diagnosis obtained by providing measurement reliability will have a positive effect on treatment process.
	38	Management should pay importance to the medical device calibration.
	40	Since proceeding with uncalibrated medical devices will not have any meaning, using them mean time and financial loss.

4. Factor: Who is Doing the Calibration	5	I know that some devices do not require calibration, some of the calibrations are done by users, and some of them need to be calibrated by authorized staff.
	17	I know where to call in case of an emergency in terms of the calibration of the medical device I use.
5. Factor: Responsibility of the User	6	I am able to do the basic service adjustments and user calibration of the medical device that I use.
	13	I know that when calibration period comes I need to prepare my medical device and not use it until it is calibrated.
	14	I know how to read the calibration certificate that is prepared after calibration and understand what the written data means.
	15	I know that if there is change in the measured values after the calibration, I need to use it according to the new values.
	16	I know that I need to keep the calibration all certificates of the devices that are calibrated.
	25	I don't trust only medical device calibration I use, I check if the device is calibrated before I use.
	26	I pay attention to the situation of its calibration for a medical device that I will use.
	32	I know that it is necessary the medical device that I use must be calibrated in order not to face any negative legal situation.
	36	That the medical device is calibrated, doesn't remove the responsibility of users in means of reliability of results.
6. Factor: Calibration Period and Timing	7	I can learn the calibration frequency of medical device that I use from user manual or calibration staff or I set myself in my experience.
	8	Since I know the calibration period of medical devices I use, I take the calibration period serious.
	9	The calibration of medical devices are not only done in scheduled periods, it is also done if; a. the device is never used b. is defected or mechanically harmed c. is not used according to instructions for use d. periodic maintenance is not done e. adjustment mechanisms are broken f. in case of suspicious results
	10	When the conditions of the environment where medical device is being used changes, recalibration is needed.
	11	I can have the calibration of the medical device that I use done before the scheduled time when needed.
7. Factor: Problems in Calibration	12	I do not information about the calibration plans of the calibration laboratory or company responsible for it, for the medical device I use.
	21	User opinions and suggestions are not taken into consideration in the medical device calibration phase.

8. Factor: Importance of Calibration	18	The calibration of medical devices is vital for treatment process.
	19	The calibration of medical devices is crucial and necessary for presenting a high quality healthcare service, patient safety and environmental safety.
9. Factor: Calibration Training	22	All medical device users need to be trained enough on a continuous basis about calibration.
	23	I took enough level of training about the calibration of medical devices.
10. Factor: Psychological Relationship Between User and the Calibration	24	Medical device users feel safe when devices are calibrated.
	28	The malfunction frequency of the medical device increases after a calibration process.
	29	I do not feel that medical device calibrations are necessary since they are a part of a procedure.
	37	I do not wish to work in a hospital where there are medical devices which I have doubts about how accurate they work.
11. Factor: Devices that are to be Calibrated	30	It is mandatory to calibrate all medical devices that are to be calibrated
	31	It is enough to calibrate some important medical devices that are to be calibrated at the hospital.
12. **Factor: Calibration-Quality Correlation**	33	Calibration of the medical devices is mandatory if the hospital has a ISO certificate.
	34	Calibrations made on time and on a continuous basis is an indicator of a high quality and reliable healthcare service.

***12-19-20-26-29-30-31 number of ıtems encoded vice versa.**

6. Reliability of the Form: Cronbach Alpha Internal Consistency Coefficient has been calculated as 0.913 of the form which has 40 items (Table 4). Cronbach Alpha Internal Consistency is an important indicator for accountability. If Cronbach Alpha Internal Consistency Coefficient is higher than 0.70, evaluation form is held as accountable (Cornbach, 1951; Turan, 2012).

Table 4
LAST FORMAT OF CALIBRATION GENERAL EVALUATION FORM WITH 40 ITEMS

Items (Expressions)	Absolutely Agree 5	Agree 4	Neutral 3	Disagree 2	Completely Disagree 1
1. Calibration helps us to measure how approximate does the medical device measures considering the reference value.					
2. Calibration provides regular controls of medical devices and also measurement accuracy.					

3. I know that calibration of medical devices is done by using special kits, reference solutions and calibrators.					
4. Use of the medical device requires its calibration.					
5. I know that some devices do not require calibration, some of the calibrations are done by users, and some of them need to be calibrated by authorized staff.					
6. I am able to do the basic service adjustments and user calibration of the medical device that I use.					
7. I can learn the calibration frequency of medical device that I use from user manual or calibration staff or I set myself in my					
8. Since I know the calibration period of medical devices I use, I take the calibration period serious.					
9. The calibration of medical devices are not only done in scheduled periods, it is also done if; a. the device is never used b. is defected or mechanically harmed c. is not used according to instructions for use d. periodic maintenance is not done e. adjustment mechanisms are broken f. in case of suspicious results					
10. When the conditions of the environment where medical device is being used changes, recalibration is needed.					
11. I can have the calibration of the medical device that I use done before the scheduled time when needed.					
***12.** I do not information about the calibration plans of the calibration laboratory or company responsible for it, for the medical device I use.					
13. I know that when calibration period comes I need to prepare my medical device and not use it until it is calibrated.					
14. I know how to read the calibration certificate that is prepared after calibration and understand what the written data means.					
15.I know that if there is change in the measured values after the calibration, I need to use it according to the new values.					
16. I know that I need to keep the calibration all certificates of the devices that are calibrated.					

17. I know where to call in case of an emergency in terms of the calibration of the medical device I use.					
18. The calibration of medical devices is vital for treatment process.					
19. The calibration of medical devices is crucial and necessary for presenting a high quality healthcare service, patient safety					
***20.** Proper operation of the medical devices that are used in diagnosis and treatment is not important for users.					
***21.** User opinions and suggestions are not taken into consideration in the medical device calibration phase.					
22. All medical device users need to be trained enough on a continuous basis about calibration.					
23. I took enough level of training about the calibration of medical devices.					
24. Medical device users feel safe when devices are calibrated.					
25. I don't trust only medical device calibration I use, I check if the device is calibrated before I use.					
26. I check if the device is calibrated before I use					
27. Calibration takes place between the reasons that I first think about the working inconsistency.					
***28**. The malfunction frequency of the medical device increases after a					
***29**. I do not feel that medical device calibrations are necessary since they are a part of					
30. It is mandatory to calibrate all medical devices that are to be calibrated at the hospital.					
***31**. It is enough to calibrate some important medical devices that are to be calibrated at the hospital.					
32. I know that it is necessary the medical device that I use must be calibrated in order not to face any negative legal					
33. Calibration of the medical devices is mandatory if the hospital has a ISO certificate.					
34. Calibrations made on time and on a continuous basis is an indicator of a high quality and reliable healthcare service.					
35. I am aware that, the right diagnosis obtained by providing measurement reliability will have a positive effect on treatment process.					
36. That the medical device is calibrated, doesn't remove the responsibility of users in means of reliability of results.					

37. I do not wish to work in a hospital where there are medical devices which I have doubts about how accurate they work.					
38. Management should pay importance to the medical device calibration.					
39. The user problems and risks are decreased to minimum by medical device calibration.					
40. Since proceeding with uncalibrated medical devices will not have any meaning, using them mean time and financial loss.					

***12, 20, 21, 28, 29, 31 numbered of ıtems encoded vice versa.**

FINDINGS

"Calibration General Evaluation Form" has been developed containing 40 items as a result of this study. The form has been found to be valid and reliable. Cronbach Alpha Internal Consistency Coefficient has been found to be 0.913 and 5 point Likert Scale is used. Each user needs to choose either "Absolutely Agree=5", "Agree=4", "Neutral=3", "Disagree=2", or "Completely Disagree=1". Items numbered "12", "20", "21", "28", "31" will be evaluated vice versa. These ıtems will be evaluated as follows; "Absolutely Agree=1", "Agree=2", "Neutral=3", "Disagree=4", or "Completely Disagree=5". Forms filled by users will have a lowest grade of 40 and a highest grade of 200. Higher grades should be interpreted as positive (Table 4). Considering both analysis made and expert views, factors has been renamed and 12 dimensions has been obtained. 1st factor; "Definition of Calibration", 2nd factor; "Benefits of Calibration", 3rd factor; "Calibration Awareness", 4th factor; "Who is Doing the Calibration", 5th factor; "Responsibility of the User", 6th factor; "Calibration Period and Timing", 7th factor; "Problems in Calibration", 8th factor; "Importance of Calibration", 9th factor; "Calibration Training", 10th factor; "Psychological Relationship Between User and the Calibration", 11th factor; "Devices that are to be Calibrated", 12th factor; "Calibration-Quality Correlation" have been decided as factors (Surh, http://www.2.sas.com) (Table 3).

CONCLUSION

"Medical Device Calibration General Evaluation Form for Medical Device Users", a result of this study, may be used to judge if medical device users take calibration seriously and show necessary sensitivy or not.

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AN EVALUATION OF CALLS MADE TO MINISTRY OF HEALTH COMMUNICATION CENTER

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ABSTRACT

The Objective of the Study

The objective of this study was to analyze and evaluate the complaint calls made between the years of 2004 and 2009 to the Communication Center of The Ministry of Health that was founded within the framework of "The Transformation in Healthcare Project" and thus to make a contribution by providing an introducing general view of the functionality of the feedback mechanism.

The Method

The sample of the study consists of 686.397 appeal calls that were made to the Ministry of Health's Communication Center between the years 2004 and 2009. The complaints have been studied in relation to a range of factors like the months of the complaints, the hour of the day, the days of the week, the age groups of the complainers, gender, and type of the complaint and the reason of complaint.

Findings

By answering not only to health related appeals, but also to virtually any issue of interest for the citizens, SABIM achieved a plural involvement of the stakeholders and an "interactive administration". It realized feedback mechanisms that enabled the real-time assessment of services as they were being supplied, thus eliminating many problems that arise from lack of communication.

INTRODUCTION

As dynamic systems, healthcare systems are going through rapid fundamental changes globally (Effken, 2002). All national healthcare systems aim to improve the quality of their service by consistent administration of organizational and procedural changes. While healthcare systems are built basically on professional conventions of care providers, a medical expertise-only approach proved insufficient for successful patient oriented healthcare. (Jakubowska and Crossley, 1992:2). Healthcare public relations has to be understood as a two way symmetrical communication process of interdependent stakeholders where the service receiver is not considered as just a target for communication, but also one who is listened to (Grunig, 1992). Poor communication is still found as one of the most common reasons for health systems complaints. The lack of convenient feedback ways lets the patient and relatives in a state of deep discontent that can undermine the whole treatment process and turn into distrust to government institutions (Abraham, 2011). To maintain and foster public thrust on public health institutions, the health system has to establish openness and communication with its various stakeholders (Wise, 2001).

SABIM, the Ministry of Health Communication Center is one of the e-health initiatives that The Ministry of Health has established with the aims of providing direct information in healthcare issues to patients and their relatives, receiving their complaints and views related to the healthcare system and practices and so establishing an elaborate feedback system. In accordance to the aims and goals of the system, teams of healthcare professionals who are well informed on the workings of the healthcare system, is answering and recording 24 hours and 7 days to any answer, problem, critic, suggestion, and request in relation to the healthcare system. In short, by establishing effective communication between planners/administrators and service providers and service receivers, SABIM aims to establish a cooperative platform that the nature of the healthcare system requires. Reaching the people would enable the instant detection of malfunctions that might emerge at any level of the system and thus would enable fast and conclusive solutions.

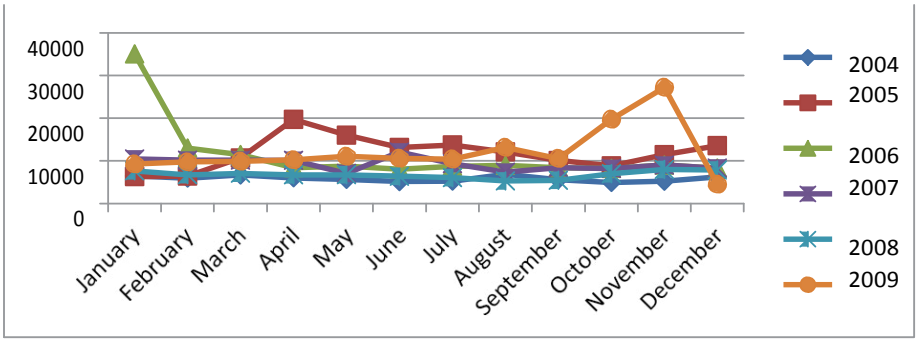
A fundamental goal is to ensure a plural involvement of the stakeholders and to lay the foundation for an "interactive administration". An ineffective public administration bureaucracy inevitably accumulates unsolved problems to a heritage of unsolvable problems, thus real-time feedback mechanisms that could monitor the services as they are being provided are of definitive importance for any system efficiency (Sağlık Bakanlığı, 2014).

THE STUDY

The study aims to provide an overall view of the functionality of the analysis, evaluation and feedback mechanism of the calls to SABIM Information Center as an important component of the Transformation in Healthcare Program and so to provide a critical contribution. A total of 686.397 calls for information between 2004 and 2009 have been subjected to frequency analysis.

FINDINGS

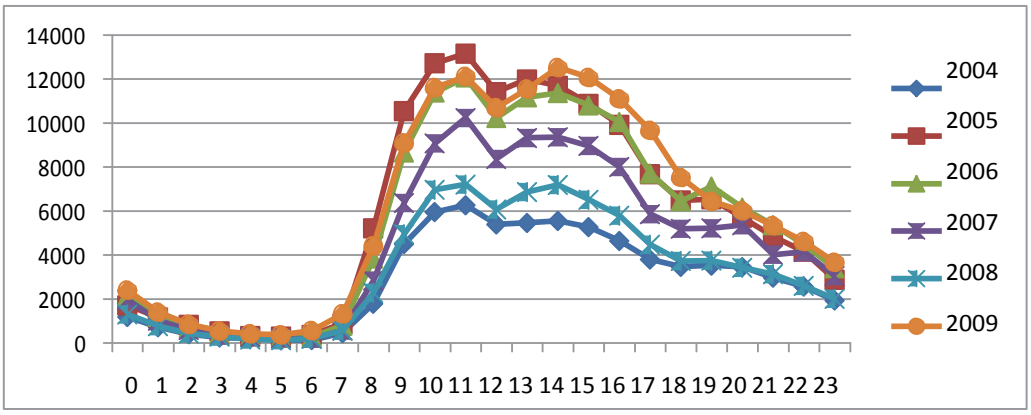
Figure1
DISTRIBUTION OF COMPLAINTS ACCORDING TO MONTHS



.

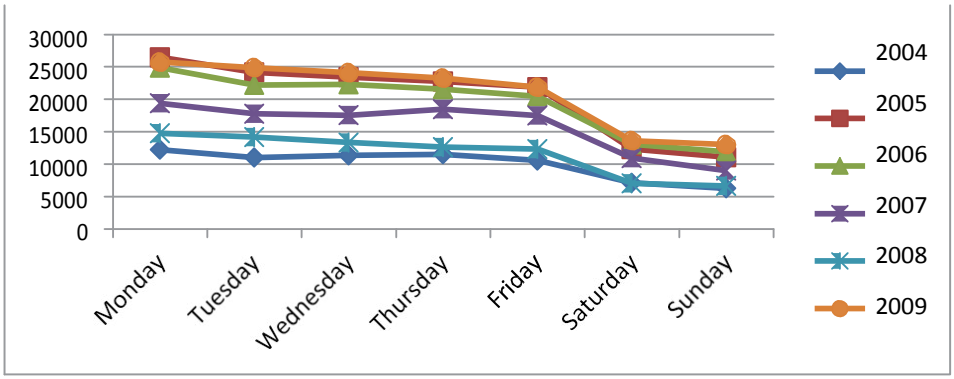
A complaint distribution in relation to months shows that in these years, most appeals were made during the month November with 10.3 %, followed by October with 10.1 % while least appeal was made in February with 6.5 %.

Figure 2
COMPLAINT DISTRIBUTION IN RELATION TO THE HOURS OF THE DAY



The calls increased with the beginning of the work hours and reached a peak at circa 11 a.m., decreased after the work day ended and fell to 0,2 % after 5-6 pm, all in a regular repetition.

Figure 3
CALL DISTRIBUTION ACCORDING TO THE DAYS OF THE WEEK



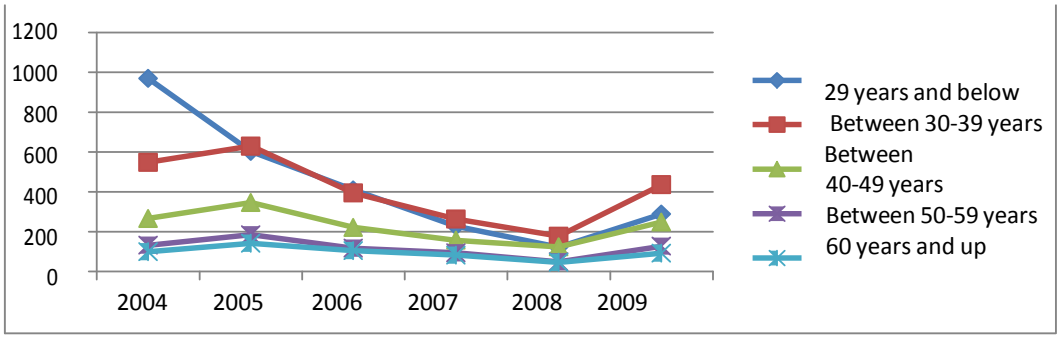
Most calls were made on Mondays and Tuesdays while the least calls were made on Sundays. Weekday calls were at 17-18 % and weekend calls were 5-6 %.

Table 1
CALL DISTRIBUTION IN RELATION TO GENDER

	2004	2005	2006	2007	2008	2009
Female	35441	69103	62560	36247	31222	42415
Male	31689	71179	69270	54171	43788	59839
Undefined	2947		4579	20206	5886	44133
Total	70077	142004	136409	110624	80896	146387

With unrecorded data included, men contacted to more units by 66.3 %.

Figure 4
CALL DISTRIBUTION IN RELATION TO AGE GROUPS



The age group of 30-39 made the most calls with 21 % and call frequency decreased with increasing age with only 3% of the age group of 60 years and beyond decided to appeal.

Table 2
DISTRIBUTION ACCORDING TO CALL TYPE

	2004	2005	2006	2007	2008	2008
Concept	43454	98278	86494	75340	50965	121792
Person	933	130	305	555	40	46
Organization	25690	43588	49580	34700	29845	24543
TOTAL	70077	142004	136409	110623	80896	146387

Information request in relation to a unit consisted 77,1 % of all calls, appeals related to persons amounted to 13.1 % and information requests about a health related concept were 7.9 %.

Table 3
CALL DISTRIBUTION ACCORDING TO APPEAL REASON

Subject	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Information request inlation to healthcare workers	393	9572	31682	15376	4865	3144
Information request about vaccination	1559	1292	539	258	305	1238
Information request about health problems	13114	20562	13823	7777	6974	7789
Information request about the functioning of the healthcare system	10259	49073	19576	16990	10823	12197
Information request about bird flu			7940	8065	142	9361

Table 3
CALL DISTRIBUTION ACCORDING TO APPEAL REASON

Subject	2004	2005	2006	2007	2008	2009
Information requests about KKK fever						961
UKM Information request about tissue-organ transplantation					764	382
Information request about contract personnel	1115	10059	4884	3961	1787	9655
Information request about revolving fund practices	3574	2395	5555	9806	10774	8731
Information request about Social Insurance protocols	438	405	467	870	60	3498
Drugstore phone number request		5569	10445	12190	5533	738
Healthcare phone number request	10796	16062	11500	7685	6870	7981
Information request about SABIM	14738	8581	15860	16184	21166	47984
Other phone number requests	11935	14821	9973	8783	8605	24813

The table above shows the information request topics of the SABIM line that gives not only information about health problems but it also gives us cues about the problems that emerged during the implementation of The Transformation in Healthcare program.

Figure 5
INFORMATION REQUEST ABOUT CHANGED PROCEDURES FOR CONTRACT STAFF EMPLOYMENT

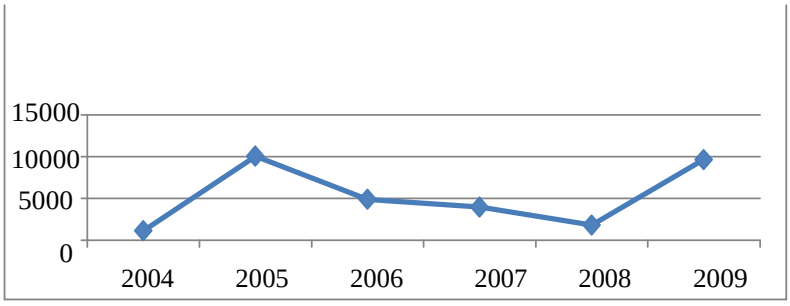


Figure 5 shows in 2005 a surging request wave to the SABİM line for information in relation to a change in the employment procedures of contract staff. Another wave in 2009 is also in relation to a change in relation to the above issue.

Figure 6
INFORMATION REQUEST ABOUT THE SABİM

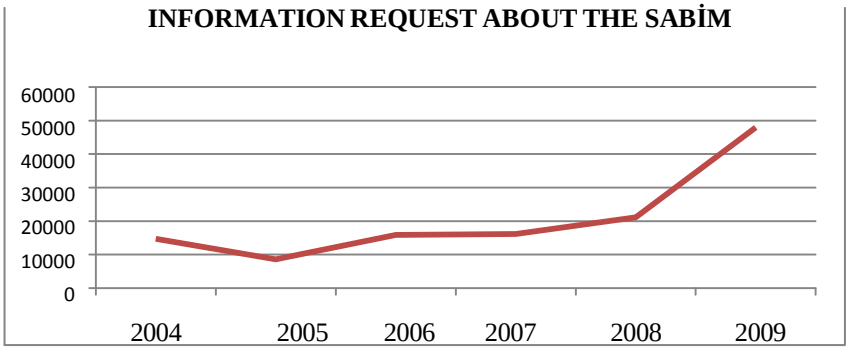


Figure 6 indicates that in the years 2008 and 2009, the most frequent issue of information request was also about the working of SABİM itself.

Figure 7
INFORMATION REQUESTS ABOUT THE CRIMEAN-CONGO HEMORRHAGIC FEVER

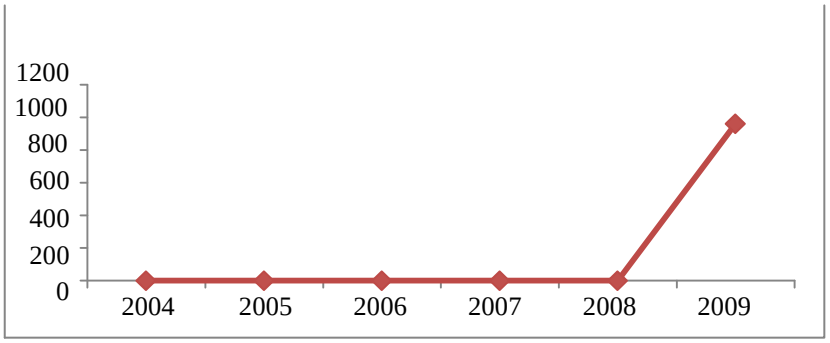
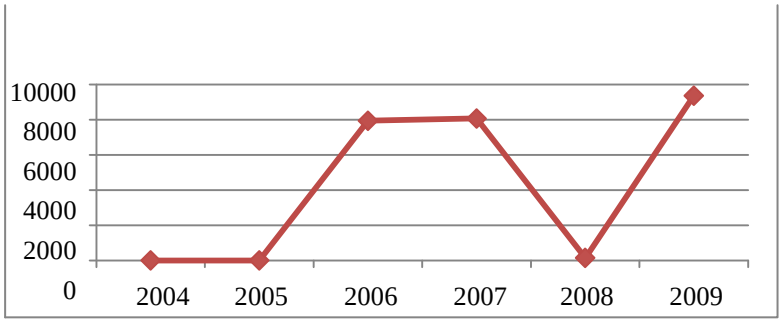


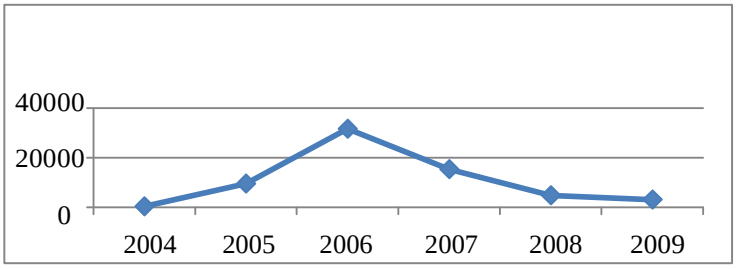
Figure 7 indicates a rising public concern about the Crimean-Congo hemorrhagic fever that had occupied the public agenda in 2009.

Figure 8
BIRD FLU RELATED INFORMATION REQUESTS



From 2006 on, public concern over Bird flu cases reflected itself on information requests to the SABİM line. Figure 9 indicates that with increase of cases, information requests surged to a high in 2009.

Figure 9
INFORMATION REQUESTS IN RELATION TO PROTEST ACTIONS OF HEALTH CARE STAFF



The beginning of the implementations of the transformation in healthcare program in 2004 triggered consequently protest actions of health care staff that reached its high in 2006 and abated to reach its lowest point in 2009. This timeline represented itself on Figure 10 by the information requests to the SABİM line about this issue. During this process, the SABİM line provided the administrators and planners valuable feedback over the implications of their implementations.

CONCLUSION AND DISCUSSION

SABIM (Ministry of Health Information and Communication Center) was founded in 2003; commenced work in 2004 and by 2010 it was established as a healthcare related citizen appeal point for information request on health related issues, making complaints, critics and requests, and also for thanking. The more than 6 million calls and 844.000 appeals that accumulate in the center during this period proved a most valuable feedback data-bank for guiding the reforms and implementations of the Ministry of Health.

In general, the appeals began with about 70.000 in the first year and stabilized above 100.000 the subsequent years, they showed no important difference according to the months of the year and also not for the days of the week. While Mondays peaked in health related appeals, the ratios stabilized at 15-18 % for the week days, to fall to weekend lows of 7-9 %. The calls started to increase with the beginning hours of the work day, reached its peak about 11 a.m. with 9 %, to decrease slowly during the afternoon, that trend continued until reaching the lowest point of 0.1 % at circa 4-6 o'clock in the morning.

From a gender related viewpoint -aside complaint appeals where men complained more- there was no meaningful difference between men and women in calls. As of age groups, the calls began increasing with the 29-and-below group, reached peak with the 30-39 age group, increased with further aging and fell to lowest point with 60 years and above.

Naturally, the metropolis of Istanbul is leading a place of call with great margin followed by the other big cities Ankara, Izmir and Bursa while the smallest cities like Ardahan, Artvin and Hakkari produced low call numbers.

Among the wide range of various informational call subjects, the general issue about the procedural functioning of the healthcare system is the most frequent requested information topic, followed by personal health issues, information about health institutions, about drugstores and other institutions, healthcare workers' actions, information about revolving fund practices.

At the present situation, SABIM has established itself both as a help and information request center for the citizens and also as an indispensable source of information for the Ministry of Health. While healthcare bureaucrats and requesting researchers have access to SABİM, the vast accumulated data should be of much interest to all researchers of healthcare management issues and of all aspects of healthcare researchers in general as well. A more research oriented approach in the organization of the data management of SABİM would facilitate a more productive harvesting of information that would certainly contribute to a more dynamic healthcare administration and continuous reforming. The most important need for the completion of this important service unit is perhaps an appropriate legal definition of the organizational framework. Another important suggestion might be a software application function that would output the input data directly to analysis-friendly statistical data. The challenge of managing data is an issue to be addressed for the effective usage of this information. The establishment of categories may be a way to go for the analysis of data as information (Krowinski and Steiber, 1996). In order to establish feedback as an effective practice for achieving change in healthcare practice, the usage procedures have to be systematized with view of the anticipated outcomes.

It is very important that the SABIM system is maintained by further enhancement and that this enormous data is exhaustively used through proper analysis at the decision mechanisms. Only so will SABIM be able to sustain it's positive contribution to the healthcare system and will guide administratrs and policy enactors.

From a view of healthcare public relations, the feedback that SABİM provides to the higher administration of the national healthcare system is indispensable.

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MUSHROOM MANAGEMENT THEORY; SAMPLE OF HEALTH SECTOR

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ABSTRACT

Keeping in the dark by senior management from their subordinates is referred as "Mushroom Management". Within the scope of the present study, Mushroom Management application and exposure levels of administers and employers in the health industry were tried to be determined.

The theoretical part of the study has been developed based on reviews of literature and in conjunction with conducted researches. Field research has been completed by using interview method, applied to 30 senior level health managers and 30 health workers from Gümüşhane city in Turkey. According to the obtained results, 84% of managers apply mushroom management style, and 87% of employees perceive mushroom management behaviors.

Key words: Mushroom Management, antipatern, keep in the dark

INTRUDUCTION

Mushroom management is a theory included in management sciences lately. The Theory name was called based on metaphor of cultivation "Mushrooms" such that mushrooms are provided manure and left in the dark for growth, and shortly yield is taken. According to this theory, Mushroom Manager gives his/her employees necessary job and tools, but does not inform them about what purpose they are working for. Also, Mushroom Managers attempts to control the all of decision making process (Mar, 2011). The Mushroom Managers do not share strategies, income, expense and risks included, and etc. with them. There is an information asymmetry between manager and employees. Communication channels mostly are closed and Mushroom manager may make solution decisions without consulting the team. Nevertheless, the mushroom managers only expects them performance and result (Kılıç, 2015).

Description of Mushroom Management Concept

Mushroom Management" is the term used to describe how we manage people like we grow mushrooms: keep them in the dark and throw plenty of manure on them (Herman,1997,66). When they grow enough, get them canned. A style of management where the personnel are not familiar with the ideas or the state of the company and are given work without knowing its purpose. The opposite is open-book management. Curiosity and self- expression of workers is not supported and employees often have no idea what the situation of the company is. Leaders tend to make all decisions on their own and without asking for anybody's opinion first (Mar, 2011). This problem can occur when the manager does not understand the work of their employees, e.g. programmers, and therefore cannot communicate effectively (Laplante and Neill, 2006).

This form of management applies to every situation where management is involved. Be it passing on critical information to employees, or informing people of policy change and company announcements. The entire purpose is to be as vague and unresponsive as possible. The ultimate culmination and success of this management style can be found when people draw comparisons to management and a black hole. Where resources and information go in and nothing comes out *(Baxter, 2005).*

Example of Mushroom Management:

Employee1: So you talked to management on our companies re-bid for the contract? Employee2: Yea, but didn't get much. Management said there's nothing to report. Employee3: How can that be? Our contract is up next month, how can they not know anything?
Employee1: Don't ask me dude. Man I feel like I'm constantly in the dark and fed full of shit. Kind of like a mushroom.

These characteristics often land the Mushroom Manager in trouble. When in trouble the Mushroom Manager is likely to (Mar, 2011):

1. make unreasonable demands of the team
2. blame the team

Why Do Some Managers Apply Mushroom Method?

a-) The main reason for this kind of philosophy to be applied in a company is that the managers fail their main purpose – to manage. They do not see themselves as someone leading others towards bigger success for everyone, but rather someone who knows everything and the ones below them are just a herd of sheep following blindly. Often unintentionally, the fear of their employees coming up with great new ideas instead of them drives them to make bad decisions, excluding workers from everything except for the actual work. As a result, the employees end up doing loads of work they were given just to do something and not contributing in any other way (www.changingminds.org).

b-) The information to be disclosed to employees is at strategic level. For instance, a well-known "soda/ cola company" does not share its formula with more than 3-5 person. The most important reason is that when this formula is disclosed, number of rival companies with the same taste can join the market. Similarly, when the ship Titanic hit the iceberg, only a few members of the crew knew that the ship would sink. The captain did not inform majority of the crewmen of the seriousness of the situation, which ended in chaos and disorganization. He acted on his own without incorporating his officers into the decision making (Smart, 2014). If this information was disclosed to everyone, there might have been different results (either positive or negative)

c-) Manager does not want employees to question and critique by holding the information and power at central point. Organization sometimes might be encountering a situation in which it experience serious economic or administrative crises. In such periods, information shared with subordinate levels might cause rumors within the organization,

which can decrease motivation level and increase potential burden of the crisis. Therefore, information is not disclosed. For example, if you disclose information to the employees of a factory that the business is about to bankrupt, number of personnel, who are loyal to the company, might quit the job. Or, if you tell employees that the factory is a dangerous place to work in terms of health and safety at work code, they might sue you. Managers do not reveal information to his employees because of such similar circumstances.

Benefits of Mushroom Management from the Employees' Perspective

Although this management type seems negative, it offers some benefits from different angles. For instance, when talking about blind development, the key feature is that employees have almost very limited responsibility. The amount of decisions they have to make is minimal, which reduces stress in the workplace (Laplante and Neill, 2006).

What Kind Of Organizations Apply Mushroom Management Style?

There are two basic types of organizations: low-access and high-access. Good communication is a hallmark of the high-retention work environment. At its heart, communication is all about access. In a low-access organization, the flow of communication is guarded and restricted-constipated, in fact. People find themselves kept in the dark, like mushrooms, stuffed in narrow confines based on job descriptions, ranking, and where they sit on the organizational chart. It's no surprise that low-access organizations-many of them hierarchical-have greater difficulty responding to change, fluctuating customer needs, and the fluidity of the modern workplace. In contrast, a high-access organization thrives on information and shares it to the maximum extent possible. The more information people have, the more quickly they can respond to the changing needs of customers and the environment. High-access companies are committed to open *(*Smith, 2002).

Consequences of Mushroom Management

Consequences of mushroom management can be devastating for everybody involved in any way. If the flow of information in a company, or in any other environment, is insufficient the people do not know how to react in situations that require quick assessment and prompt decision making (Smith, 2002). For example a company that makes and sells shoes does a research about their customer´s preferences and finds out that their preferences have changed. This piece of information is, however, not given to the sales manager of a shop selling the shoes. The shop will still display the "old" shoes and not catch attention of the customers. At the end, the blame is often put on the shop assistants, because they are in a direct contact with the customers (Laplante and Neill, 2006).

How to Avoid Mushroom Management

Information has the power over the world. It is unavoidable to share the information with whom one works with. Yet, one of the most important things to do is to be able to differentiate between the information that can be shared with others and that cannot. Company should not give up all its secrets to its employees, because that could do even more harm. Managers should learn how to distribute information and how to communicate with the people they are responsible for (Mar, 2011).

METHODOLOGY

Within the scope of this research, interview questions were developed in order to measure Mushroom Management perception. These interviews were conducted with 30 managers and 30 (totally 60 health workers) employees through face-to-face method in health industry Gümüşhane City in Turkey. Obtained data were analyzed by means of the SPSS software program.

FINDINGS

Table 1
DEMOGRAPHICAL INFORMATION OF PARTICIPANTS

Variables		**Number**	**%**
Gender	Female	36	60.0
	Male	24	40.0
Education Status	High School	7	11.7
	College	20	33.3
	Bachelor	25	41.7
	Master and Ph.D	8	13.3
Organization	General Secretariat of Union Public Hospitals	12	20.0
	City Health Directorate	10	16.7
	Public Health Directorate	14	23.3
	Public Hospital	17	28.3
Title	Manager	30	50.0
	Employee	30	50.0
Work experience	0-1 Years	8	13.3
	1-5 Years	8	13.3
	6-10 Years	7	11.7
	11-15 Years	6	10.0
	16 and over	31	51.7
Total		60	100.0

Table 1 shows the demographic characteristics of the participants in the research. As it is shown at Table 1; 60% of participants were women, and 40% were man. Most of the participants (%41,7) Bachelor degree. Most of the participants (%28,3) from Public Hospital.

Table 2
ANSWERS GIVEN BY EMPLOYEES AND MANAGERS FOR THE QUESTION OF "WHAT TYPES OF INFORMATION ARE KEPT CONFIDENTIAL AT YOUR ORGANIZATION?"

According to Managers	%	According to Employees	%
Non-task information	27,5	Non-task information	28,5
Personnel rights / information	22,5	Board Decisions – Amendments	16,3
Investigations and discipline information	10	Human Resources	14,2
Administrative and legal decisions	10	Administrative information	12,2
Confidential documents	5	Meetings	10,2
Confidential correspondence	5	Investigations	8,1
Payments	5	Income – financials	6,1
Information that may cause panic	5	Official correspondence	2,0
Risk management	5	Confidential correspondence	2,0
Profit/ Savings/income	2,5		
Personal and organizational weaknesses	2,5		

Table 2 shows the answers given by employees and managers for the question of "what types of information are kept confidential at your organization?". As it is shown at Table 2; According to Managers; "Non-task information" the answer to the first place with 27.5% and the answers "Profit/ Savings/income" and "Personal and organizational weaknesses" last place with 2.5%. According to the answers given by the employees to the same question: "Non-task information" the answer to the first place with 28.5% and the answer "Confidential correspondence", last place with 2.0%.

Table 3
ANSWERS GIVEN BY EMPLOYEES AND MANAGERS FOR THE QUESTION OF "WHAT IS THE POINT OF KEEPING INFORMATION CONFIDENTIAL IN AN ORGANIZATION?"

According to Manager	%	According to Employees	%
Confidentiality	20,4	Rules	32,4
Eliminating conflicts among personnel	18,1	Does not concern us	13,5
Based on procedures	15,9	Unnecessary	10,8
Protection of organizational prestige and Order	13,6	Unwillingness for promotion	10,8

Table 3
ANSWERS GIVEN BY EMPLOYEES AND MANAGERS FOR THE QUESTION OF "WHAT IS THE POINT OF KEEPING INFORMATION CONFIDENTIAL IN AN ORGANIZATION?"

According to Manager	%	According to Employees	%
Preventing rumors	6,8	Egotistically	8,1
Preventing misleading comments	6,8	Lack of communication	5,4
Maintaining motivation	6,8	Future concerns	5,4
Due to the quality principles	4,5	Waste of time	5,4
Eliminating panic situations	2,2	Hierarchal order	2,7
Eliminating chaos	2,2	Information safety	2,7
Protecting peace at work	2,2	Rumors	2.7

Table 3 shows the answers given by employees and managers for the question of ""what is the point of keeping information confidential in an organization?". As it is shown at Table 3; According to Managers; "Confidentiality" the answer to the first place with 20.4% and the answers "Protecting peace at work" last place with 2.7%. According to the answers given by the employees to the same question: "Rules" the answer to the first place with 32.43% and the answer "Rumors", last place with 2.7%.

CONCLUSION

According to the results obtained through this study, 84% of managers apply mushroom management; 87% of employees are exposed to mushroom management. When these rates are considered, there is correlation between the mushroom management felt by employees and mushroom management applied. Similarly, in answers given by managers and employees for the question of "what is the purpose of hiding information?" were similar to each other. Likewise, equivalent answers were taken for the question of "what types of information are kept confidential?" According to these findings, it was determined that there is mushroom management applied in health industry.

On the other hand, managers, who stated that they share all information with their subordinates; create a joint vision and mission mutually with their subordinates; and their subordinates play efficient role in decision mechanism, and they consider satisfaction of both service receivers and givers while making decision; and they act in transparently, constitute 16% of the sampling group.

In the present study, some of employees stated that they are aware of information about management and organization; they can have access to any information they want; they can be effective on decisions; and they do not feel mushroom management. The rates of employees who share this opinion constitute 13% of the sampling group.

There is not similar study on the same subject in the existing literature. Therefore results could not be discussed comparatively.

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HIP REPLACEMENT IN AUSTRIA-MODELLING THE ECONOMIC BURDEN DUE TO OBESITY

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ABSTRACT

Introduction: Since low birth rates meet growing life expectancy the population in Austria is tending to overage, thereby causing increasing economic burden for the public healthcare system. For the planning of healthcare resources and decision making in health policy, comprehensive tools to evaluate the future demand for health services and expenditure in the healthcare sector are needed. A simulation model taking into account the demographic development to evaluate the future need for hip replacement was already published, but lacks of accounting for the increasing prevalence of obesity.

Research goal: Based on literature review it can be seen that there is a link between obesity and the need for hip arthroplasty. The aim of the presented model is to evaluate the additional burden for the healthcare system in the domain of hip replacement, which is caused by obesity.

Methods: Based on data from literature and Austria's national statistics service a system dynamics model was created, taking into account the influence of obesity on the frequency of indications for hip arthroplasty, the need for revision of implants and the length of stay in hospital.

Findings and results: The results indicate a 77% increase in the total costs until 2050 solely due to the demographic change. This growth might be doubled by the boosted need for hip replacement through obesity. Therefore comprehensive countermeasures and preventive actions to reduce obesity are needed. Through simulation of different scenarios of the BMI distribution within Austria's population the presented model offers a comprehensive view on the influence of obesity on the healthcare expenditure in the domain of hip implants. Thus it provides a basis for future decisions in health policy making.

INTRODUCTION

Austria's population is currently subject to a demographic change, caused by the so called 'double aging effect'. Low fertility rates meet growing life expectancy. Thus there is an inherent trend towards an over aged society, resulting in approximately 25% of the population being of age 60 years and above by 20 years from now (Statistics Austria, 2013). As a direct result the expenditures and the need for appropriate healthcare resources caused by age related diseases and injuries are an upcoming challenge for the Austrian healthcare system. Hence proper planning of the healthcare development is necessary to manage this situation.

Simulation models linking the demographic development to the expected healthcare expenditures have proven to be an indispensable support for health policy makers. As the major indications for hip replacement, namely arthrosis and fracture of the femur neck, are

clearly age-related a comprehensive model was built to link the current demographic trends to the need for hip arthroplasty (Siegl et al., 2014).

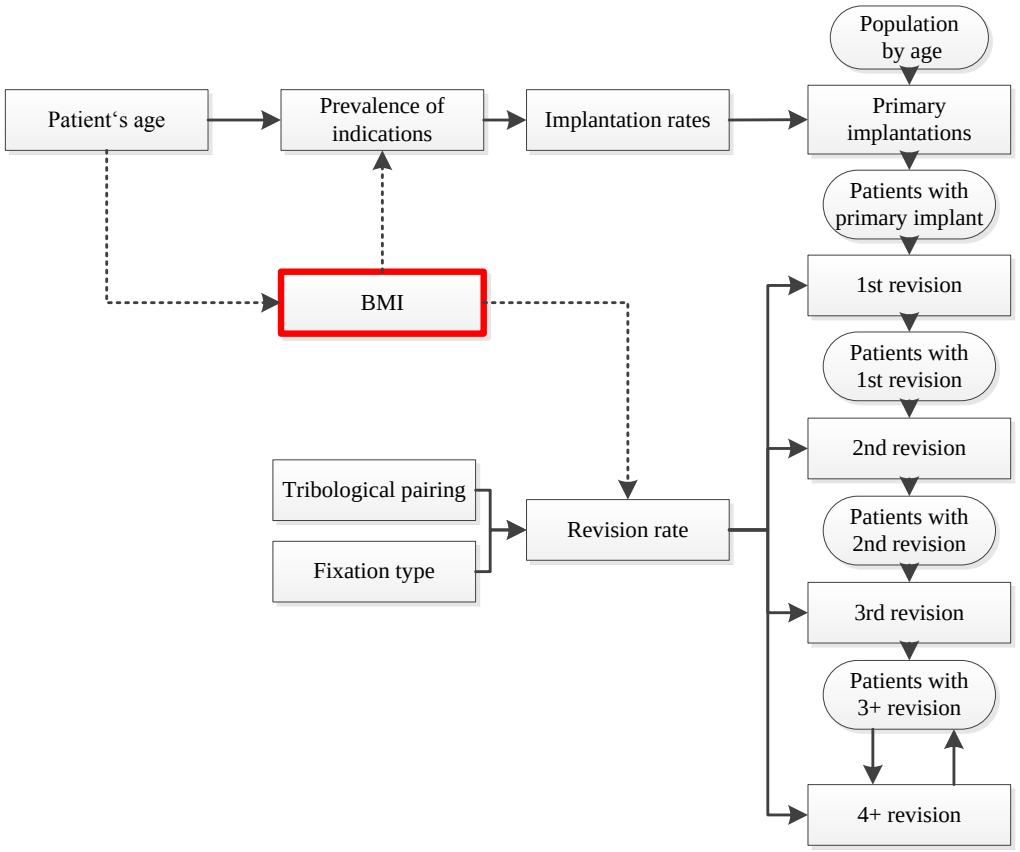
Since there are several studies concluding that there is a link between obesity and increased risk for hip replacement (Haverkamp et al., 2011; Karlson at al., 2003; Wendelboe et al., 2003) the presented work aims to extend the previously published baseline model (Siegl et al., 2014) to investigate the influence of obesity on the future need and expenses for hip replacement.

METHODS

The Baseline Model

The baseline model aims to estimate the future expenditure for artificial hip replacement, which is dependent of two main factors. Those are firstly, the total number of surgeries and secondly the awarded financial compensation per treatment.

Figure 1
SIMPLIFIED STRUCTURE OF THE BASELINE MODEL WITH EXTENSION FOR BODY-MASS-INDEX



The models working principle is illustrated in Figure 1. Its input parameters are the population size by age as well as the implantation and revision rates by age. It is primarily based on multiplying the implantation rate by the number of people at risk, thus determining the total number of primary implantations. In similar manner the number of revision surgeries is determined, by a multiplication of the patients that already received hip replacement with the revision rate. The latter is influenced by the tribological pairing and the fixation method used during implantation. The model includes cemented as well as cement less fixation and different materials for the tribological pairing. Theoretically an infinite number of revision surgeries is observed (cf. Figure 1), but the model does not further distinguish between patients that received three or more revisions, as data from the Australian joint replacement register (Australian Orthopaedic Association, 2012) shows that this fraction is negligible.

Corresponding data for the revision rates was obtained from the Swedish and the Australian joint replacement register (Australian Orthopaedic Association, 2012; Garellick et al., 2010), while data for the age specific implantation rates and population development was obtained from Statistics Austria (2013).

Finally, once given the number of implantations per year, the arising costs are evaluated on basis of the Austrian DRG (diagnosis related groups) based reimbursement system, which also takes into account the length of stay in hospital. The latter is implemented using the expected value drawn from the corresponding age specific distributions obtained from Statistics Austria (2013).

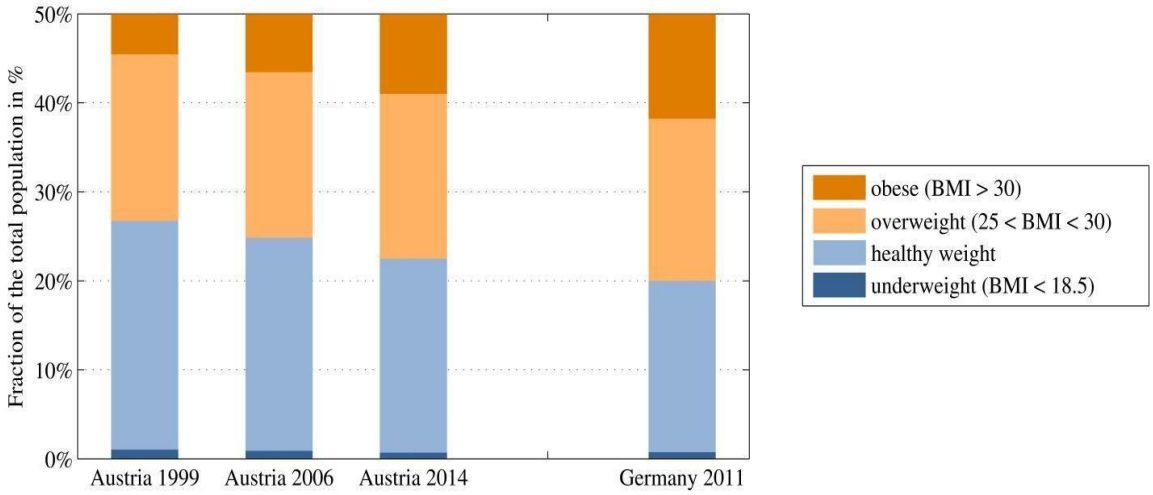
Model Building

The newly developed extension as well as the baseline model is implemented using the system dynamics modeling approach, for the reason that the characterization of the given task by stock and flow variables is convenient. Thereby stock variables, denoted by rounded edges in Figure 1, describe an accumulation of an entity over time while flow variables describe the change of those accumulations.

Obesity in Austria

Comprehensive studies about the distribution of the Body-Mass-Index (BMI) in Austria were conducted in 1999 and 2006 (Austrian Federal Ministry of Health, 2009). Figure 2 shows the BMI distribution for the overall population. The model itself uses BMI data dissected into five groups by age.

Figure 2
DISTRIBUTION OF THE POPULATION AMONGST BODY-MASS-INDEX FOR AUSTRIA AND GERMANY IN DIFFERENT YEARS AND EXTRAPOLATION FOR AUSTRIA 2014. (AUSTRIAN FEDERAL MINISTRY OF HEALTH, 2009; RKI, 2013A; RKI, 2013B)



As no recent data was available, the BMI distribution in 2014 was extrapolated by using linear extrapolation. To check for plausibility the results were compared to the most recent data available from Germany (RKI, 2013a; RKI, 2013b). Since the extrapolated BMI distribution for Austria 2014 tends to underestimate the prevalence of obesity in comparison to Germany, simulations were carried out with both distributions.

The BMI Model

According to literature obesity can influence the following three parameters related to artificial hip joints:

1. Prevalence of arthrosis2
2. Risk for revision surgery
3. Length of stay in hospital

Since the survey period for the baseline model data was 2002 to 2011 the BMI distribution for 2006 is used as a reference. It is assumed that the distribution in 2006 represents the average BMI distribution in the survey period, since 2006 is in the middle of the survey period and there is no other data available for this period. The prevalence and revision data from the survey period is then adjusted according to the change in the BMI distribution from 2006 to 2014 using the relative risk (RR) factors denoted in Table 1. For the calculation of the average relative risk from different studies the sample size was applied as a weighting factor. The data was categorized into three groups by BMI and normalized to BMI <25, as 25is considered to be the borderline between healthy weight and overweight. Furthermore, based on the findings of Sadr Azodi et al. (2006) and Foote et al. (2009), also an increase of the median length of stay by one day for obese people was integrated in the model.

Table 1
RELATIVE RISK FOR PRIMARY IMPLANTATION AND REVISION WITH 95% CONFIDENCE INTERVAL
(Sadr Azodi et al., 2008; Karlson at al., 2003; Wendelboe et al., 2003)

BMI	RR for primary implantation		RR for revision
	Males	Females	
< 25	1.0 (Ref.)	1.0 (Ref.)	1.0 (Ref.)
25 to 30	1.4 (1.2 – 1.6)	1.3 (1.2 – 1.5)	2.4 (1.1 – 5.2)
> 30	3.7 (2.4 – 5.6)	2.0 (1.8 – 2.2)	3.6 (1.4 – 8.9)

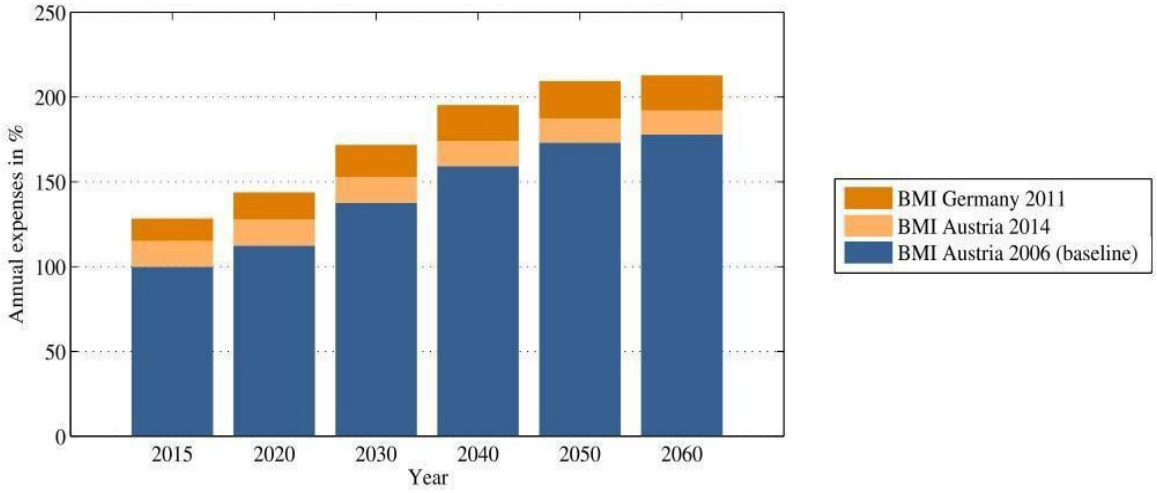
RESEARCH

Results

The model output is illustrated in Figure 3 as the annual costs arising from artificial hip replacement without inflation. The baseline scenario indicates a 77% increase in the total costs until 2050 solely due to the demographic development.

The scenario assuming the extrapolated BMI distribution for Austria shows an additional increase in the total annual costs of approximately 15% in 2015 due to obesity when compared to the baseline results for 2015. This 15% top-up can be observed in every single year of the simulation period. In contrast to this rather constant top-up the scenario assuming Germany's BMI distribution starts with a 28% increase in 2015 that constantly grows up to 34% in 2050.

Figure 3
FORECAST OF THE ANNUAL COSTS FOR HIP REPLACEMENT ASSUMING DIFFERENT BMI DISTRIBUTIONS IN THE AUSTRIAN POPULATION (2015 = 100%).



However the overall trend in the curve remains the same, as the expenses stabilize from 2050 onwards due to the underlying demographic development that also establishes a stable period for about ten years from 2050 onwards and starts to decline afterwards. A subsequent increase of the total costs in the preceding decades, varying between 77 and 90% amongst the three scenarios is evident. In the same time period the underlying number of surgeries increases by 68% in the baseline scenario, by 71% in the Austrian and by 76% in the German BMI scenario.

The main cause for this increase is that the age structure of the underlying population experiences a shift towards an 'over aged' society. In about 20 years from now already 25% of the population in Austria will be above the age of 60, thereby causing increased demand for hip replacement.

Discussion

The results point out a tightening financial burden for the Austrian public healthcare system (under the assumption that the health policy remains unchanged). Therefore the previously published forecast (Siegl et al., 2014) need to be revised to account for increasing prevalence of obesity.

The presented model allows simulating different scenarios for healthcare provision, since health policy is crucial for the future healthcare expenditures. Therefore all input parameters for the demographic development, the implantation and revision rate, as well as the BMI distribution can be varied to evaluate different scenarios.

Although there are other measures that are considered to be superior to BMI in describing linkage to potential health risks (e.g. Waist-to-height-ratio), BMI was used in this model for reasons of better availability of sufficient and current data. However the

current BMI distribution had to be extrapolated from historic data. To overcome these drawbacks, additional simulations were performed with BMI data from Germany (RKI, 2013a; RKI, 2013b), as in general satisfying transferability of data from Austria and Germany are assumed due to geographic and cultural proximity.

Since historic data shows that obesity was slightly more prevalent in Germany than in Austria (OECD, 2012) the result of this scenario can be interpreted as upper boundary for the true development, while the Austrian scenario might slightly underestimate the development by using simple linear extrapolation for lack of sufficient data.

The results show that the increase in the overall costs exceeds the increase in the total number of surgeries. In general this behavior can be reasoned by the growing life expectancy leading to more and more people living long enough to need at least one revision procedure. Therefore there is a growing demand for the more costly revision surgery.

But furthermore it can be noticed that the discrepancy is higher as prevalence of obesity rises. This behavior is a result of the relative risk factors given in Table 1. The risk for obese females to need hip replacement is only twice the risk for normal weighted females. But the number of revisions will grow disproportionately as the relative risk for revisions is 3.6. This causes increased costs as revisions are more expensive than primary implantations.

Given the high sensitivity towards a change in the populations BMI distribution and not to forget additional burden through other obesity related diseases, the results indicate a need for change in Austria's health care policy. Comprehensive prevention programs need to be established, following the "healthy individual in a healthy society" (Rose, 1993) idea. Treatment of obesity and the resulting risk factors can only be one brick in the health policy. Effective prevention needs a multilevel approach ranging from the individual level (e.g. healthy nutrition, sports), to local level (e.g. teaching healthy nutrition, ban junk food from schools, …) as well as national level (e.g. taxation of unhealthy food, support people with low socio-economic- status,…) (Müller et al., 2006).

However this paper does not intend to suggest a certain preventive strategy, but to present a comprehensive simulation model for the estimation of the future economic burden in the area of hip endoprosthesis. Thereby the baseline model already offered the possibility to simulate a wide variety of changes in health policy like new reimbursement plans, cost sharing, rationing and so on. The new model now also accounts for changes in the BMI distribution of the underlying population. Future work will be dedicated to account for the rehabilitation process following hip arthroplasty. However the presented model is yet a powerful tool for resource planning and health policy decision making.

CONCLUSION

The presented model is a novel tool that estimates the future need and expenditure in the domain of artificial hip joint replacement with regard to the ongoing demographic change and increasing prevalence of obesity. While the former causes an increase of total costs of approximately 77% until 2050, the latter tends to double this effect. The provision of sufficient healthcare infrastructure and its funding is therefore an upcoming challenge for the Austrian public healthcare system. Although the model is still undergoing future development towards the inclusion of the rehabilitation process, it already offers a widespread functionality to support decision making and health policy planning.

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