Volume Standards and Value based Network Structures:
Reconfiguring Medical Care in Private Hospital Networks

A Thesis Submitted for the
Degree of Doctor of Business Administration

Daniel Liedtke D.O., PT, Exec. MHSA

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<th>Student</th>
<th>Daniel Liedtke</th>
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<tr>
<td>ID</td>
<td>11389170</td>
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<tr>
<td>Supervisor</td>
<td>Prof. Dr. Hans Schmid †, Prof. Dr. L. Buerki, Prof. Denise Jarratt</td>
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<td>Date:</td>
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I ABSTRACT

Research Objectives: The objective of this research is to enhance hospital quality and efficiency of a complex hospital network organisation in Switzerland. The goal of this research, as derived from the healthcare as well the medical scientific literature, is to identify minimum case volume standards per complex medical condition in Switzerland as well as value drivers regarding the pooling of case volume per complex medical condition and per hospital in order to maximise hospital as well as hospital network performance. The value drivers to achieve this goal are represented through the patients’, doctors’ and hospital executives’ behavioural expectations regarding a) medical outcome, i.e. improving the quality of medical care, b) economic efficiency and c) patient satisfaction in a hospital network organisation. The development of a preliminary model incorporating value drivers regarding the concentration of case volume of complex medical conditions in a for-profit (private) hospital network organisation is the overall goal of this thesis.

Research Questions: As derived from the business problem and the research objective, the overall research question is: “How can pooling of case volume per complex medical condition and per hospital maximise medical outcomes, economic efficiency and patient satisfaction in a hospital network organisation?” Due to the lack of a minimum case volume definition per complex medical condition in Switzerland, sub-question I of the thesis is: “What are the required minimum case volumes for complex medical conditions in Switzerland”? Addressing this question required the examination of the National Swiss inpatient data set with regard to the relationship between hospital case numbers and medical outcome as measured by post-treatment mortality rates.
Due to the lack of scientific literature-based propositions about the value drivers regarding pooling of hospital case volume the following further sub-questions were developed: “Which value drivers lead patients to be treated in high volume hospitals in a Swiss private hospital network?” (II); “Which value drivers lead doctors to treat patients in high volume hospitals in a Swiss private hospital network?” (III); “Which value drivers lead hospital executives to treat patients in high volume hospitals in a Swiss private hospital network?” (IV).

**Research Method:** The project employed both qualitative as well as quantitative techniques. The quantitative analysis investigated the pooling of cases of relevant complex medical conditions and determined for the first time for Switzerland minimum case volume standards per complex medical condition according to a standard statistical method. A case study of the largest private hospital network in Switzerland formed the qualitative component of the research. Thirty-one interviews were conducted and analysed to identify the value drivers of pooling case volume per complex medical condition from the perspectives of patients, doctors and hospital managers. The research project was approved and monitored by the Charles Sturt University, Ethics in Human Research Committee, in 2009.

**Results:** The thesis presents a preliminary model of value drivers impacting on the concentration of case volume of complex medical conditions in a for-profit (private) hospital network organisation. This model makes an important contribution to hospital executive decision-making as executives seek to maximise effectiveness and efficiency of medical services. The main purpose of hospital management is “the improvement of hospital quality as well as economic efficiency”. One important aspect for consideration
in achieving medical service effectiveness and efficiency is the implementation of minimum case volume requirements per complex medical condition as this applies across a hospital network. There is evidence that case volume contributes positively to medical outcomes of severely ill patients with complex medical conditions as well as contributing to economies of scale effects. As part of this research, case volume standards per complex medical condition were calculated.

The qualitative research component of the project revealed that the value drivers for patients for the pooling of case volume for complex medical conditions were a) the reputation of surgeons, b) a positive hospital reputation with regard to the management of complex medical conditions and c) recommendations by primary care providers and friends of patients.

For doctors, the value drivers for pooling case volume were found to be a) the qualifications and experience of hospital surgeons/hospital teams in treating the complex medical conditions, b) the speed of access to high-end technologies and linked disciplines and c) good relationships between hospital surgeons and general physicians/referrers.

For hospital executives, key drivers were specialisation of service lines and reputation with regard to complex medical conditions. These findings, when combined with case volume information, form important inputs to reconfiguring network structure to maximise effectiveness and efficiency of private hospital groups.
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GLOSSARY AND LIST OF ABBREVIATIONS

Ambulatory Care: Outpatient treatment.

BFS: Bundesamt für Statistik, Swiss authority for national statistics.

Canton (also Kanton): A regional unit of government in Switzerland.

Charlson Score: The number of coexisting conditions, weighted according to their relative effects on mortality.

Complex Medical Condition: A “complex” medical condition in a patient is defined either as a severe, potentially life-threatening disease with or without further concomitant diseases (e.g. a patient with brain tumor, but also suffering from severe diabetes mellitus complications, or additional infection) or the condition of a patient who has to undergo an operation/treatment which requires high-end technology and an elevated level of medical expert (e.g. surgeon) skill.

Disease Management: Programs, which coordinate interventions for patients with complex medical conditions. The aim is to provide more effective and efficient care.

DRG: A system to classify hospital cases into one of several hundreds of groups expected to have similar hospital resource use and developed for a payment system. DRG classification numbers are assigned to a case by a “grouper” program based on ICD diagnoses, procedures, age, sex, discharge status, and the presence of complications or comorbidities.
**Economic Efficiency:** Usage of resources in such a way as to maximise the production of goods and services. Economic efficiency describes a situation where the total value of the end uses, to which the resources are put, is maximised. A consequence is that all resources will be put to their highest value uses.

**Full Cycle of Care:** An integrated overall view of a medical condition that encompasses the entire trajectory of care, from monitoring/preventing, to diagnosing, preparing, intervening, recovering/rehabilitating, and monitoring/managing (Porter & Teisberg, 2006, pp. 398 - 400).

**Free Agent:** See independent physicians.

**Hospital Executives:** Hospital managing directors and chief operating and executive officers of hospitals.

**Hospital Experience:** See hospital satisfaction.

**Hospital Group:** See hospital network.

**Hospital Network:** A hospital network is a network or group of hospitals that work together to coordinate and deliver a broad spectrum of services to their community. A hospital system or health care system owns more than one hospital, sponsored, or contract managed by a central organisation.
**Hospital Performance:** According to the suggestions of the WHO regarding hospital performance, there exist various models to measure hospital performance, but no generally applicable definition. Hospital performance measurement should hence not be restricted on clinical effectiveness, but also embrace issues such as patient, staff and community orientation. In the context of the thesis, hospital performance summarises the three main hospital output indicators as medical outcome, patient satisfaction and economic efficiency from the perspectives of patients, doctors and hospital executives (Groene, 2006, pp. 226 - 233).

**Hospital Satisfaction:** It describes hospital client satisfaction especially regarding patients, doctors and referrers. Satisfaction is an attitude – a person’s general orientation towards a total experience of health care services. Satisfaction comprises both cognitive and emotional facets and relates to previous experiences, expectations and social networks. Satisfaction is achieved when the client’s (patient/referrer/independent physician) perception of the quality of care and services that they receive in healthcare setting has been positive, satisfying, and meets their expectations (Crow et al., 2002, pp. 1366 - 5278).

**Hospital Stakeholders:** Health care stakeholders include patients, physicians, health care managers and other care providers (e.g. nurses, pharmacists, therapists, etc.).

**HV:** High-volume

**ICD:** International Classification of Diseases.
**Independent Physicians:** Physicians who are not employed by a care facility, plan or organisation; usually, they contract as individual practitioners or groups of practitioners and provide care as a self-supporting business.

**Integrated Practice Units (IPUs):** A patient-centric way to organise the delivery of health care. Care is delivered by a multi-disciplinary team of physicians, nurses and therapists organised by service line respectively medical condition (Porter & Teisberg, 2006, pp. 169 - 170).

**LV:** Low-volume (LV)

**Managed Care:** An effort on the organisational level to control the costs of care. Types of managed care include HMOs (Health Maintenance Organisations) which assume responsibility for all enrolled persons within a geographic area (the enrolled members are restricted to the HMO for care), and preferred provider organisations (PPOs), which structure care reimbursements to encourage members to consult a restricted group of providers (who accept lower payment in exchange for market share).

**Mandatory Health Insurance:** In Switzerland, a package of basic health insurance coverage, defined under Federal Law that all individuals must purchase.

**Medical Condition:** A set of interrelated diagnoses and medical circumstances.

**Medical Outcomes:** The results of medical care. It includes for example mortality rates, pain, indices, range of movement, occurrence of infections or complications, number of re-hospitalisations, length of stay and time until return to work or normal activities.
**OECD:** Organisation for Economic Co-operation and Development. OECD brings together the governments of countries committed to democracy and the market economy from around the world to support sustainable economic growth, boost employment, raise living standards, maintain financial stability, assist other countries’ economic development and contribute to growth in world trade. The Organisation provides a setting where governments compare policy experiences, seek answers to common problems, identify good practice and coordinate domestic and international policies.

**Patient Satisfaction:** Patient satisfaction is an attitude – a person’s general orientation towards a total experience of health care services. Satisfaction comprises both cognitive and emotional facets and relates to previous experiences, expectations and social networks. Satisfaction is achieved when the patients’ perception of the quality of care and services that they receive in healthcare setting has been positive, satisfying, and meets their expectations (Crow et al., 2002, pp. 1366 - 5278).

**Quality:** Quality is the degree to which an assessed action produces beneficial results. The benefits must be appropriate and effective and as well as efficient.

**Risk-adjusted Mortality:** This risk-adjusted mortality ratio compares a hospitals’ actual mortality rate to the risk-adjusted (age, gender, comorbidity) expected mortality rate.

**Service Lines:** Service lines in health care are defined as a family of organisational arrangements based on an organisation’s outputs rather than on its inputs. It is a patient-centric way of thinking about how a physician or team serves the patient. It suggests
coordinating and integrating medical specialties and staff across the traditional disciplines or departmental boundaries, and organising the delivery of care by medical condition as experienced by the patient.

**Threshold Effect:** The threshold regarding case volume to achieve beneficial medical and economic results needs be high, and will vary by procedure. The outcomes are poorer before that level of experience is attained.


**Value Driver:** Something that is an important factor in the determination a company’s profitability and value. In the thesis context, it means the main customer’s motives (patients, doctors and hospital executives) on pooling case volume per medical condition and hospital in regard to maximise hospital performance. The term “drivers” reflects the positive correlation of the mentioned values (medical outcome, economic efficiency, patient satisfaction) with the pooling of case volume.

**Value for Patients:** Value (outcomes per unit of cost) as experienced by individual patients: from a patient’s perspective, increased value does not mean more treatment or more health care; it does mean more health or better medical outcomes. Frequently in health care, better results actually reduce costs, so value for patients often increases with
simultaneous improvement in outcomes and efficiency (Porter & Teisberg, 2006, pp. 107 - 111).

**WHO:** World Health Organization is the directing and coordinating authority for health within the United Nations system. The WHO is responsible for providing leadership on global health matters, shaping the health research agenda, setting norms and standards, articulating evidence-based policy options, providing technical support to countries and monitoring and assessing health trends.
VI STATEMENT OF AUTHORSHIP

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the award of any other degree or diploma at Charles Sturt University or any other educational institution, except where due acknowledgement is made in the thesis. Any contribution made to the research by colleagues with whom I have worked at Charles Sturt University or elsewhere during my candidature is fully acknowledged.

I agree that this thesis be accessible for the purpose of study and research in accordance with the normal conditions established by the Executive Director, Library Services or nominee, for the care, loan and reproduction of theses.

Daniel Liedtke

July 2010
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INTRODUCTION

1 INTRODUCTION

1.1 BACKGROUND OF THE RESEARCH

1.1.1 Introduction

This chapter describes the hospital industry in Switzerland as well as the business problem of the Swiss hospital industry.

1.1.2 Hospital Industry in Switzerland

The Swiss health care system is characterised by liberalism and federalism. Switzerland has an extremely well developed health care system (Herzlinger & Parsa-Parsi, 2004, pp. 1213 - 1220). Swiss spending on health care is relatively high (Kocher, G., Oggier, W., 2007, pp. 1 - 422). The Swiss health care market, measured on a per capita basis, is the third most expensive care in the OECD, behind only the United States and Luxembourg (OECD). There is no governmental cap on total expenditure. Decentralisation of political power is marked in the Swiss Confederation, with the 23 cantons, three of which are split into demi-cantons, acting autonomously in the organisation of healthcare in their area. More specifically, cantons are charged with regulation, hospital accreditation and finance along with disease prevention and health education. Local supervision of health care is the responsibility of cantonal health ministers (Gesundheitsdirektoren).

The new Law on Health Insurance of 1994 injects a degree of competition into the health care system. In theory there are three markets. Both insurers and providers compete for patients as customers. Insurers may also selectively contract with primary care providers. Swiss health care insurance combines public, subsidised private and fully private health care. For planning and funding purposes, secondary care can be
divided into two parts. The Federal government has no planning authority for outpatient care and does not provide subsidies for it. Inpatient care on the other hand is subject to state planning and receives for basic insured patients public subsidies.

Hospitals are operated by public (cantons, local authorities or associations of local authorities, or independent foundations) or private institutions, which can be managed either on a profit-making or not-for-profit basis. Most inpatient treatment (approximately 80%) is provided in cantonal or regional hospitals. Cantons must plan hospital care according to local needs and generate a list of accredited hospitals that are entitled to reimbursement under the compulsory insurance. Private hospitals, which are included in the canton’s hospital list, can receive reimbursement for services under compulsory health insurance. Hospital accommodation is of three types: ward (allgemein), semi-private (halb-privat), and private (privat). In general, the wards dispose of four beds; semi-private rooms have two beds, while private rooms have only one bed. All city and canton hospitals have all three types. Basic insurance entitles patients to treatment in a ward of a public or non-profit hospital in their canton of residency. Supplementary insurance policies provide the gateway to greater privacy, the for-profit private sector, and to hospitals in other cantons (Kocher, G., Oggier, W. (2007, pp. 1 - 422).

A Swiss government survey found that 54% of the Swiss population agreed that Swiss medical services are adequate, and in an earlier survey, two-thirds of respondents expressed overall satisfaction with the way the system functions (OECD, 2006). The OECD and WHO’s report, Reviews of Health Systems Switzerland, summarises and identifies some of the possible components of this satisfaction. Long waits for care are
uncommon (OECD 2006). Switzerland currently has 3.6 physicians and 10.7 practicing nurses per 1000 citizens, above the OECD averages of 2.9 and 8.0, respectively (OECD 2006). Switzerland has 3.9 acute care beds per 1000 people, slightly below the OECD average of 4.1, but its rate of 14.2 Magnet Resonance Instrument (MRI) units per million people almost doubles the OECD average of 7.7 MRI units per million. An additional factor in Swiss satisfaction is the free choice of provider: 72% of the people surveyed classified this choice as either “important” or “very important” (OECD 2006).

Data on the quality of care in Switzerland is scarce, however, as it is in most countries (OECD 2006). The combination of a lack of quality information and confidence in one’s chosen physician tends to create an impression of high quality that may not be borne out when the quality of care is measured. One survey, for example, found that 95% of the Swiss believe that quality is “rather good”, “good”, or “excellent” (Longchamp, Aebersold, Bösch, Tschöpe & Ratelband-Pally, 2006).

Teisberg (2007, p. 18 - 22) suggests that Switzerland is not immune from the problems of variations and errors in care that plague most countries. There is a trend in Switzerland to focus more and more on the issue of quality. The Comparis data (a Swiss Internet comparison service) for example, although only a beginning, nevertheless shows that attention is turning towards improving quality.

Hospital finance provides a good example of the diversity in Swiss healthcare organisation. Cantons and local authorities finance the better part of hospital capital investment – but also cover approximately 50% of the operating costs of “their” public and not-for-profit hospitals. Health insurers cover roughly 50% of operating costs,
INTRODUCTION

usually on the basis of a daily flat rate – negotiated annually on a canton-wide level between the sickness insurance fund association and service provider organisations. Price tariffs vary tremendously from one canton to another. This payment system is regarded as inefficient. Therefore, Switzerland is aiming to improve cost control in 2012 with a switch to a flat rate per case financing system based on patient diagnosis-related groups (Swiss DRGs). Hospital doctors are employed by hospitals or working as independent free agents in public as well as private hospitals. Additional payments are received when treating patients with supplementary insurance.

The Swiss benefit from a generous hospital infrastructure (Bundesamt für Statistik – Einrichtungen und Betten 2010). There are about 129 acute hospitals, with average of about 186 beds per hospital. About 60% of beds provide public hospitals and 40% beds are delivered by private hospitals in Switzerland. Private hospitals provided 1.56 million hospital days in 2007, which was 20% of the total amount of acute hospital days in 2007. Hirslanden – the largest private hospital network organisation provides 28% of the private hospital days in Switzerland. There are several single private hospitals and other small for-profit hospital groups as for example, Sonnenhof AG (three hospitals) and Grenolier (five hospitals), which provide the balance of the 1.56 million private hospital days (BFS – Einrichtungen und Betten 2008).

1.1.3 The Business Problem of the Swiss Hospital Industry

Improving value-based competitiveness is a challenge for every hospital organisation around the world and of international importance (Grove, 2005, pp. 490 - 492). Hospital leaders are responsible for the improvement of value for patients in terms of better medical outcome, higher patient satisfaction and increased economic efficiency
regarding in-patient treatments (Güntert, B. J., 2006, pp. 5 - 11). Teisberg (2007, p. 8) recommends health care providers in Switzerland that competitiveness will only be achieved if it is focused at the level where value for patients is created. Teisberg points out that the centre of attention should be a results-driven business model which is patient-centric, and physician-led. The concept of Porter & Teisberg (2006) articulated in the book “Redefining Competition in Health Care” implies that improving value for patients means improving outcome per unit of cost (pp. 155 - 156). Outcome reflects the results of medical care by a team, or of a particular medical intervention or treatment. Results of medical care include for example mortality, extent of recovery and as well as level of physical or mental functioning (Porter & Teisberg, 2006, pp. 13 - 15; Porter & Teisberg 2007, pp. 1103 - 1111). Also Herzlinger (1997) reports that patients want convenience and mastery through visible results, because treatments should be firstly understandable (convenience) and secondly the patient will be able to decide (mastery) in which hospital, as well as by whom he or she would like to be treated (pp. 47 - 83). Thus, although a number of independent recommendations have been made regarding factors influencing value for patients, improving quality and services of care as well as decreasing the rising costs per patient, (for example, Bohmer, 2010, p. 65) to date addressing these aspects in a holistic manner is yet to be attempted.

New patient value research indicates that patients are more and more likely to base their hospital choice also on non-medical aspects of a hospital visit, such as convenience (Grote, Newman, & Sutaria, 2007, pp. 1 - 9). Several scientific articles investigate these non-medical needs under the terms “patient experiences/satisfaction” and “hospital experience/satisfaction” (Jah, Orav, Zheng, & Epstein, 2008, pp.1921 - 1931; Grote et al., 2007, pp. 1 - 9; Hekkert, Ciahangir, Kleefstra, van den Berg, & Kool, 2009, pp. 68 -
The findings of these studies are that patients want to have fast access to a health care provider, close relationship to a health care provider, individual doctor confidence, and to be well informed. However, already in 1996 the National Health Scheme (NHS) - the Centre for Reviews and Dissemination - pointed out (1996, pp. 1 - 16) that hospital quality and hospital performance are more comprehensively measured by medical outcomes, patient satisfaction and economic efficiency.

There is some evidence that these three dimensions of hospital performance are related to each other. From a scientific perspective, the factor case volume per medical condition seems to be crucial in this context at least regarding better medical outcome and higher economic efficiency as shown by two different research disciplines, the research by medical professionals (Birkmeyer et al., 2004, pp. 2117 - 2127) as well as the research by general health care business and economists (Gandjour & Weyler, 2006, pp. 359 - 369). There is an agreement between medical literature and health care business literature that the threshold regarding case volume to achieve beneficial medical and economic results needs to be high and will vary by procedure (Porter & Teisberg, 2006, pp. 114 - 117). It has also been found that hospital size is significantly associated with lower patient satisfaction scores (Young, Meterko, & Desai, 2000, pp. 325 - 334).

A Swiss Internet comparison service (Comparis, 2010) provides patient satisfaction scores together with medical outcome parameters per Swiss hospital. The Comparis data are methodologically questionable because they are based on patient feedback, but
nevertheless show that patient satisfaction and medical outcome are more and more topics of public comment.

Hospital executives as well as government organisations realise more and more the relevance that case volumes below a specific minimal threshold of a medical condition in a specific hospital will decrease medical outcome significantly and influence economic efficiency negatively. The Swiss government extensively debated the topic of minimum case volume requirements for high-specialised medicine as well as for hospitals in general (GDK, Hochspezialisierte Medizin, 2010). As a result, there is considerable debate among health care executives and politicians concerning approaches and models about how pooling of case volume per complex medical condition and maximising hospital performance can be supported. Specifically, hospital network organisations have the advantage to organise their health care delivery regarding pooling of case volumes per complex medical condition, because in a hospital network a group of hospitals is potentially able to work closely together and to coordinate the delivery between the various hospitals in the network.

But, pooling of case volume has to be planned carefully, because hospitals and even more so, hospital networks, are complex organisations due to the nature of medicine in general, medical technology improvements, the role of various ethical aspects as well as the broad spectrum of patient well-being. Furthermore, the relevant internal stakeholders are highly educated people (for example physicians, nurses and medical engineers), and therefore need to be managed carefully. The motivation of most internal stakeholders is essentially related to their professional aspects and not so much on business and economic aspects. Therefore, hospital organisations are very health-
professional oriented and strongly focused on medical issues striving to improve medical outcomes. In contrast, the most important external stakeholder, the patient, acts more and more as a customer. Non-medical criteria as for example services, 24 hours access and information management are more and more important regarding patient satisfaction and for choosing a hospital (Grote et al., 2007, pp. 1 - 9). Several articles, especially from the German literature (Siess & Siewert, 2005, pp. 503 - 507), have investigated the impact of implementing minimum case thresholds in certain medical conditions and concluded that obligatory referral of patients in defined medical conditions to high-volume hospitals would result in a substantial reduction of the local availability of service offerings in a large area of Germany (up to 70% of the country would lose services). It is argued that such reductions of medical health service may not be acceptable to the population. The same experience has been observed by the government of Switzerland as a result of its intention to close some public hospitals in rural areas when the population residing around these hospitals voted successfully against this government goal (Beck, 2009, p. 17; Osswald, 2009, p. 25). In this context, the strategy of pooling case volume per medical condition – because of better medical outcome and higher economic efficiency – appears to be in conflict with the need of positive patient satisfaction, since treatment in high-volume hospitals is expected to coincide with reduced patient satisfaction. Nevertheless, there are some investigations (Tai et al., 2004, pp. 1904 - 1922; Adams et al., 1991, pp. 583 - 612) which show that the more the illness is complex the less patients focus on non-medical service quality. Therefore, pooling of case volume seems to be accomplished more easily for complex medical cases.

The business challenges today of hospital network organisations in Switzerland have therefore two main aspects: Firstly, because of medical outcome and economic reasons,
the determination, establishment and implementation of standards of a minimum case volume per complex medical condition in the Swiss health care system and the subsequent adoption of minimum case volume standards in the hospitals of a for-profit hospital group is of primary importance. Secondly, pooling of case volume per complex medical condition will change the portfolio of particular hospitals as well as referrer patterns and is therefore in a certain conflict with the need of the above mentioned stakeholders: patients, doctors and hospital executives. In order to support this change process, value drivers regarding the motivation of patients, doctors and hospital executives need to be understood. Therefore, in order to identify the criteria of value drivers in relation to the pooling of case volume per complex medical condition and per hospital, a theory building process has to be initialised to guide this project. As mentioned above (Glossary), a value driver is defined as something that is an important factor in the determination a company’s profitability and value (Porter & Teisberg, 2006, pp. 107 - 111). The term “value” from a hospital performance point of view can be related to the parameters medical outcome, economic efficiency and patient satisfaction. The term “drivers” reflects the positive correlation of the mentioned parameters/values (medical outcome, economic efficiency and patient satisfaction) with the pooling of case volume from the perspectives of patients, doctors and hospital executives.

1.1.4 Conclusion

It can be concluded that two research areas, research by medical professionals and research by health care economics professionals, both point to the importance of value for patients and in that context pooling case volume per complex medical condition per hospital. Nevertheless, the current scientific literature neither identifies which complex
medical conditions nor what minimum case volume standards regarding mortality rates for patients are relevant in Switzerland. The definition of standards of minimum case volume per medical condition was done – among other countries – in the US and in Germany but not in Switzerland. The quantitative research aspect of this project investigates this aspect and aims to provide quantitatively derived standards regarding minimum case volumes in Switzerland. Pooling of case volume of complex medical conditions requires specific health care delivery structures and adapted hospital network processes, based on an understanding of key value drivers with respect to the motivation of patients, doctors and hospital executives that support these changing processes and structures. The new knowledge generated through this research project will be useful for strategic decision makers in hospital network organisations.

1.2 RESEARCH QUESTIONS AND HYPOTHESES

The overall research question that emerges from this specific challenge is: “How can pooling of case volume per complex medical condition and per hospital maximise medical outcomes (i.e. saving further lives and improving the quality of medical care), economic efficiency and patient satisfaction in a hospital network organisation?” This question is embedded in the title of the thesis: “Volume standards and value based network structures: reconfiguring medical care in private hospital networks”. From the formulated research question, the subsequently described sub-questions, hypotheses and propositions are derived and related to the individual research steps. The following figure (Figure 1.1) shows the research question and related sub-questions.
Due to the lack of a minimum case volume definition per complex medical condition in Switzerland, sub-question I of the thesis addresses quantitatively the relationship between case volume and medical outcome in Switzerland.

I) What are the required minimum case volumes for complex medical conditions in Switzerland based on the examination of the National Swiss inpatient data set with regard to the relationship between hospital case numbers and medical outcome as measured by post-treatment mortality rates?

Due to the lack of scientific literature-based knowledge about the value drivers regarding pooling of hospital case volume, the following sub-questions of the thesis address the qualitative investigation of the value drivers on pooling case volume from the perspectives of patients, doctors and hospital executives of a for-profit (private) hospital network in Switzerland for those complex medical conditions which show a statistically significant correlation between case volume and medical outcome in Switzerland:
II) Which value drivers lead patients to be treated in high-volume hospitals in a Swiss private hospital network?

III) Which value drivers lead doctors to treat patients in high-volume hospitals in a Swiss private hospital network?

IV) Which value drivers lead hospital executives to treat patients in high-volume hospitals in a Swiss private hospital network?

1.2.1 Hypotheses and Propositions

The development of the hypothesis and the proposition model on improved hospital network performance is based on business as well as medical literature reviews in Chapter 2.

Quantitative Analysis

Investigations from the US and Germany support the implementation of minimum case volume standards per medical condition and per hospital with the argument of better treatment outcomes for patients with severe illnesses (Birkmeyer et al., 2002, pp. 1128 - 1137; 2003, 2004a, pp. 569 - 577, 2004b, pp. 2117 - 2127; 2006, pp. 2476 - 2486; 2007, pp.777 - 783). Therefore, Hypothesis I is formulated as follows:

HI: The hypothesis is that A) minimum case volume requirements per complex medical condition can be determined in Switzerland, and B) hospitals in a large for-profit (private) hospital network organisation can be subsequently classified as high- and low-volume hospitals regarding treatment of complex medical conditions in order to improve medical service quality outcome in terms of mortality reduction and economic efficiency of the entire hospital network.
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Qualitative Analysis

On the basis of the results derived from sub-question I, the propositions presented below focus on the value drivers on pooling case volume from the main hospital stakeholders’ perspectives.

Investigations about patient satisfaction support, that the reputation of the hospital staff, especially the surgeons, is decisive for the selection of a hospital by the patient (Geraedts et al., 2007, pp.1 - 6; Miller et al., 2006, pp. 354 - 364; Liu et al., 2007, pp. 17 - 24; Luft et al., 1990, pp. 2899 - 2906). Furthermore, non-medical factors appear to become more and more important for patients too (Grote, Newman, & Sutaria, 2007, pp. 1 - 9). The current literature is unclear about the minimum case volume requirements per complex medical condition and hospitals need to understand how value is understood. Therefore, the propositions regarding the patient’s value drivers were derived:

P1: Establishment of a minimum case volume requirement per complex medical condition in hospital networks will positively influence the mortality of severely ill patients with complex medical conditions and consequently influence patient value.

P2: A strong, positive hospital image and high reputation surgeons/treatment teams regarding the management of complex medical conditions will positively influence patient value.

P3: Short travelling time to specialised hospitals will positively influence patient value.

Investigations about criteria regarding the selection of a hospital show that referrers prefer hospitals with highly competent treatment teams (Geraedts et al., 2007, pp.1 - 6).
Referrers favour hospitals which put emphasis on a relationship with the referrers (Liu et al., 2008, pp. 124 - 130; Grote, Newman, & Sutaria, 2007, pp. 1 - 9; Rhön Klinikum AG – Strategie, 2010). Furthermore, surgeons appreciate hospitals with high-end technology for specific treatments (Rhön Klinikum AG – Strategie, 2010). It is not proven in the current literature whether doctors accept minimum case volume requirements per complex medical condition. Therefore, the propositions regarding the doctors’ value drivers are as follows:

P1: Establishment of a minimum case volume requirement per complex medical condition in hospital networks will positively influence the mortality of severely ill patients with complex medical conditions and consequently influence patient value.

P4: Highly qualified and experienced hospital surgeons with a high reputation for complex medical cases will positively influence doctor’s perception of value.

P5: The nature of the relationships between hospital surgeons and general physicians/referrers will positively influence doctor’s perception of value.

P6: Quick access to high-end technologies and linked disciplines will positively influence doctor’s perception of value.

The health care business literature and a web-based analysis (see Chapter 2) on the value drivers on pooling case volume of for-profit (private) hospital networks support the implementation of a service line organisation (Gee, 2004, pp. 60 - 65, Porter & Teisberg, 2006, pp. 65 - 76, Baghai et al., 2008, pp. 1 - 9; Goetzel, Ozminkowski, Villagra, & Duffy, 2005, pp.1 - 19) as well as the adoption of minimum case volume requirements (Geraedts et al., 2007, pp.1 - 6).
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P1: Establishment of a minimum case volume requirement per complex medical condition in hospital networks will positively influence the mortality of severely ill patients with complex medical conditions and consequently influence patient value.

P7: Specialisation on service lines with regard to complex medical conditions will positively influence hospital executive’s perception of value.

**1.3 JUSTIFICATION OF THE RESEARCH**

As derived from the business and scientific research problem as well as the literature review, the aim of this theory-building process was the development of a preliminary provider model which identifies the key value drivers from patients’, doctors’ and hospital executives’ perspectives on pooling case volume per complex medical condition in the largest private hospital network organisation in Switzerland. As mentioned above, the term “value” from a hospital performance point of view can be categorised by the items medical outcome, economic efficiency and patient satisfaction. The term “drivers” reflects the positive correlation of the mentioned values (medical outcome, economic efficiency, patient satisfaction) with the pooling of case volume.

Through the literature engagement process, the following six questions were addressed:

- “What are the scientific recommendations of network theory and stakeholder influences regarding the development of a complex network structure?”
- “What is the scientific knowledge from the health care business literature regarding pooling case volume and maximising medical outcome, economic efficiency and patient satisfaction?”
- “How do international hospital networks regard pooling case volume per complex medical condition as a mechanism to maximise economic efficiency, medical outcomes and patient satisfaction?”
- “What is the evidence of a relationship between increased hospital or physician case volume per complex medical condition and medical outcome?”
- “What is the relationship between case volume regarding a complex medical condition and economic efficiency?”
- “To what extent does concentration and centralisation of health care delivery facilities affect the patients/physician value assessment of a hospital?”

The underlying thesis of this research is firstly that pooling of case volume has to be limited to those complex medical conditions which show a relationship between case volume and mortality, and secondly that the implementation of minimum case volume standards as well as the definition of key value drivers from the perspectives of the patients, doctors and hospital executives will support the necessary centralisation and concentration process in hospital networks in Switzerland to deliver effective and efficient medical services.

From a scientific as well as a practical perspective, there are several problems with respect to the general applicability of the findings from previous research.

- Analysis of minimum case volume per medical condition and hospital:
  - In the American literature in particular there is significant evidence supporting a relationship between case volume and outcome within complex medical conditions. Although minimum case volume standards are defined in many countries, the thresholds vary from country to
country for a complex medical condition. Therefore the application of minimum case volume standards from other countries – like the US or Germany – to Switzerland is inappropriate. Furthermore, the differentiation between high- and low-volume hospitals in Switzerland, and also in a Swiss hospital network organisation, is not possible without the determination of minimum hospital volume standards.

- Drivers of pooling case volume:
  
  - Health care business literature as well as medical literature recommends pooling of case volume per medical condition in high-volume hospitals. Whether stakeholders interpret minimum case volume standards per medical condition as a general driver of pooling of case volume in a hospital network organisation will be determined through this research.
  
  - Literature on patient satisfaction recommends, in general, a short travelling time from the patient’s home to the hospital. Whether the assumption that a short travelling time is decisive for patients with complex diseases will be addressed through this research. Whether hospital and surgeon reputation is a driver of patients’ travelling long distances to a particular high-volume hospital will be addressed through this research.
  
  - From practice experience and some evidence from the health care business literature, it is argued that highly qualified and experienced hospital surgeons with a high reputation, as well a positive relationship between hospital surgeons and general physicians, will positively influence referring doctors’ perceptions of value. Nevertheless, whether reputation is really an important motivational factor for
referrers/surgeons to send patients to a high-volume centre far from their homes will be addressed through this research. Also, quick access to high-end technologies and linked disciplines will be assessed as a factor influencing patient referral to a high-volume hospital.

- The health care business literature as well as the current practice of international hospital networks clearly advocates the specialisation and the implementation of service line organisation per complex medical condition. Whether the management decisions and opinions of Swiss hospital executives are consistent with such a strategy will be investigated in this research.

1.4 RESEARCH METHODOLOGY

Following Carson, Gilmore, Perry & Gronhaug (2005, pp. 96 - 99) the theory-building process employed a combination of induction and deduction. This approach adapted from Carlson et al. (2005, p. 92 - 112) followed a logical process from the initial concept of the “proposition model” to the “preliminary model on value drivers regarding the concentration of case volume per medical condition and hospital” in the largest private hospital network organisation in Switzerland (Figures 1.2 and 1.3).
Figure 1.2: Theory building approach adapted from Carlson et al., (2005, p. 97)
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**Theory Building Process**

<table>
<thead>
<tr>
<th>Introduction</th>
<th>Research question</th>
<th>Complex medical conditions</th>
<th>Patients’ value drivers</th>
<th>Doctors’ value drivers</th>
<th>Hospital executives’ value drivers</th>
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<tr>
<td></td>
<td>How can pooling of case volume per complex medical condition and per hospital maximise medical outcome, economic efficiency and patient satisfaction in a hospital network organisation?</td>
<td>What are the required minimum case volumes for complex medical conditions in Switzerland?</td>
<td>Which value drivers lead patients to be treated in high-volume hospitals in a Swiss hospital network?</td>
<td>Which value drivers lead doctors to treat patients in high-volume hospitals in a Swiss hospital network?</td>
<td>Which value drivers lead hospital executives to support high-volume hospitals in a Swiss hospital network?</td>
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<tr>
<th>Health care business literature review</th>
<th>Network theory of stakeholder influences</th>
<th>New models on pooling of case volume and maximising hospital performance</th>
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<tr>
<th>Review on international hospital networks</th>
<th>Pooling case volume and maximising hospital performance</th>
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<tr>
<th>Medical literature review</th>
<th>Relationship between case volume and medical outcome</th>
<th>Relationship between case volume and patient satisfaction</th>
<th>Relationship between case volume and economic efficiency</th>
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<tr>
<th>Proposition matrix</th>
<th>Value drivers regarding the concentration of case volume of complex medical conditions in a hospital network organisation</th>
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<tr>
<th>Quantitative analysis</th>
<th>Analysis of the Swiss inpatient data set between 2003 and 2007</th>
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<td></td>
<td>What are the required minimum case volumes for definite medical conditions in Switzerland based on the examination of the Swiss inpatient data set (Bundesamt für Statistik, BFS, data) with regard to the relationship between case numbers and medical outcome as measured by postoperative mortality rates?</td>
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<tr>
<th>Qualitative analysis</th>
<th>In-depth interviews Pooling case volume and the patients’ value drivers</th>
<th>In-depth interviews Pooling case volume and the doctors’ value drivers</th>
<th>In-depth interviews Pooling case volume and the managers’ value drivers</th>
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<tr>
<th>Final theory</th>
<th>Preliminary model on value drivers regarding the concentration of case volume of complex medical conditions in a hospital network organisation</th>
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Figure 1.3: Theory building process. Own illustration.
The approach was determined by the research objective, the demands of validity, objectivity and reliability and prior research approaches identified from the various literature reviews. A positivist paradigm was applied to the quantitative investigation and a critical realist paradigm was used to analyse the qualitative sub-questions. This research and many previous investigations focus on two areas of a differing nature: “minimum hospital case volume requirements per medical condition” deals with exact and measurable numbers whereas the research area of “value drivers on pooling case volume per stakeholder (patients, doctors, hospital executives)” deals with perceived values of individuals. The research methods to tackle these questions are therefore different and this is the reason why there are two sub-projects within the research.

A predominantly positivist research paradigm was applied to investigate minimum case volume requirements per complex medical condition for hospitals in Switzerland. The researcher and the respondents were not directly linked and reality was considered to be understandable and of a value-free nature. The research instrument was the Swiss nationwide (BFS, Bundesamt für Statistik) collection of patient records of hospitalised patients in all Swiss hospitals over a period of five years (2003 - 2007). A quantitative method was considered appropriate since the data reflected the individual variables of patients and did not require an in-depth, interactive level of engagement.

The critical realist paradigm was more appropriate to the theory building process of value drivers on pooling case volume per stakeholder and was implemented through interviews. The qualitative method facilitated interaction between researcher and interviewees. This approach was determined to be appropriate as the investigated area was assumed to be complex and required further in-depth explanations or questions.
regarding the concentration of case volume per medical condition, to build new knowledge on hospital network performance. The proposition model about the value drivers on pooling case volume as derived from the academic literature as well as the statistical results about minimum case volume requirements for Swiss hospitals have to be interpreted, critically reflected and tested in a hospital network environment, because the research issue requires specific consensus between the key stakeholders of a hospital network organisation. The research was carried out in the experiential and human context of the largest private hospital network organisation in Switzerland. An interview guide was designed to facilitate the in-depth interviews.

The quantitative analysis to determine minimum case volumes regarding complex medical conditions for hospitals in Switzerland included the patient records of all hospitalised patients over a five-year period from the Bundesamt für Statistik (BFS, Swiss National Statistics Office). Data variables per patient record included administrative data like age, gender, and area of residence of the patient, location of the treating hospital, length of the hospital stay of the patient, major diagnosis, secondary diagnoses of concomitant diseases or complications, major treatment intervention, additional treatment interventions, as well as further data per patient hospitalisation. Following the methodological description of Birkmeyer et al., (2002, pp. 1128 - 1137), all Swiss patients’ cases with complex medical conditions were assigned to defined groups of complex medical conditions (e.g. heart surgery, brain surgery, etc.). Five-year hospital volumes per complex medical condition and hospital were determined and patient cases then evenly distributed as high- and low-volume groups per complex medical condition. Mortality, i.e. the percentage of death cases in relation to all cases of a complex medical condition, was determined per hospital. The mortality data per
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complex medical condition and hospital were adjusted for age and comorbidity of the patient cases was assessed using a standard comorbidity score. Regression analyses of patient data per complex medical condition as well as further non-parametric statistical analyses were used in the analysis of the medical patient records.

The qualitative investigation, i.e. the theory building process, consisted of 12 convergent interviews with patients, 13 convergent interviews with doctors and 6 convergent interviews with hospital executives. The cases were selected from low and high-volume hospitals in a large for-profit (private) hospital network organisation in Switzerland. Convergent interviews were used as data collection method. According to Carson et al. (2005, p. 85), each interview went through a complete process of design, data collection, interpretation and redesign in order to test the defined research proposition in combination with gathering new information to enhance the findings with the objective of defining a final provider model about key value drivers of pooling of case volume per complex medical condition and maximising hospital performance in a for-profit hospital network organisation in Switzerland.

In summary the theory building approach consisted of two parts:

**Part One:**

The literature review comprised a health care business literature review, a web-based analysis about international network organisations and pooling case volume as well as a systematic literature review in order to develop firstly a hypothesis about minimum case volumes for definite medical conditions in Switzerland and secondly a proposition model about the value drivers on pooling case volume per medical condition and hospital from patient, doctors and hospital executives in
order to maximise medical outcome, economic efficiency as well as patient satisfaction in a for-profit (private) hospital network organisation in Switzerland.

**Part Two:**
The testing of the derived propositions as well as the development of the preliminary model on value drivers regarding the concentration of case volume per medical condition and hospital was done by a quantitative as well as qualitative analysis. A predominantly positivist paradigm was used for the quantitative analysis whereas a critical realist paradigm was used for the qualitative investigation.

In testing the research propositions, against those generated from the data analysis, a specifically developed matrix linked statements from the perspectives of patients, referrers/surgeons and hospital executives to the hospital performance dimensions of medical outcome, economic efficiency and patient satisfaction.

**1.4.1  Quantitative Research**
Based on nationwide collected Swiss patient records (BFS, Bundesamt für Statistik) of hospitalised patients in all Swiss hospitals over a period of five years (2003 - 2007), statistical methods are used to define hospital volume standards (total number of procedures performed per year) with view to statistically significant differences in mortality (mortality within 90 days of treatment start). The study of Birkmeyer et al. (2002, pp. 1128 - 1137) has clearly demonstrated that the treatment of patients in hospitals with yearly hospital case volumes above the defined minimum case volume standards was associated with significantly less mortality in complex medical conditions in the US.
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The nationwide Swiss patient record dataset, BFS data, contains hospital-discharge data for the acute care hospitalisations of all Swiss patients treated in acute care hospitals in Switzerland. Hospital patients undergoing each of the selected procedures were identified with the use of appropriate procedure codes from the International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM, respectively its Swiss extension, CHOP, Schweizerische Operationsklassifikation). The procedures were selected because they have already been investigated by other authors in other countries (for example Birkmeyer et al., 2002, pp. 1128 - 1137) are relatively complex, and are associated with a non-trivial risk of operative mortality. To determine total hospital case volumes in the defined medical conditions, pooled data from the years 2003 to 2007, BFS data was examined. Hospital volume, expressed as the number of procedures per period, was first evaluated as a continuous variable. To simplify the presentation of results, categorical variables defining two categories of hospital volume: low and high were created. For each procedure, the hospitals were ranked in order of increasing total hospital volume, and then two volume groups were defined by the selection of whole-number cutoff points for annual volume that most closely sorted the patients into two groups of equal size. The cutoff points were established before mortality was examined in order to avoid selecting cutoff points that could maximise the associations between volume and outcome.

The primary outcome measure was post-operative mortality, defined as the rate of deaths before hospital discharge or within 90 days after treatment start. For the statistical analysis, regression analyses were used in order to examine the relations between hospital volume and post-treatment mortality. Several statistical methods (Kruskal Wallis, Mann-Whitney, Kolmogorov-Smirnov, Analysis of Variance) were used
for testing the statistical significance in post-treatment mortality between high- and low-volume hospitals. For the purposes of risk adjustment, coexisting conditions (identified by their appropriate classification codes) were compiled into a Charlson score (the number of coexisting conditions, weighted according to their relative effects on mortality) (Charlson, Pompei, Ales, MacKenzie, 1987, pp. 373 - 383; Iezzoni et al., 1992, pp. 2197 - 2203; Jencks et al., 1988, pp. 2240 - 2246). The first part of the quantitative investigation led to the definition of minimum volume standards for defined medical conditions in Switzerland.

Based on the results of the described research, the individual hospitals of a Swiss for-profit hospital network was investigated as to whether delivered treatments in complex medical conditions meet the defined minimum case volume standards, therefore defining low and high-volume hospitals in the investigated for-profit hospital network in Switzerland.

1.4.2 Qualitative Research

The construction of a preliminary model regarding the pooling of case volumes required a qualitative research technique with “open questions” (Dey, 2004, p. 23). To develop a new knowledge the convergent interview is a recommended technique (Carson et al., 2005, p. 85). The convergent interview is a dialectical process, since the method attempts to disprove the emerging explanations of the data after each interview. After each interview, the findings were subjected to analysis, resulting in a redesign of the interview process. Based on the convergent interview method, adjustments were made to the interview questions during data collection. Therefore, the interaction between the research activities of data collection and data analysis allowed for the adaptation and
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improvement of the interview questions. According to Carson, the advantages of convergent interviews lie in the unstructured content of topics but at the same time the structured process, “because its data collection and analysis is rigorous and very similar but not as complex or common as the grounded theory” (Carson et al., 2005, p. 86).

The selection of experts was derived from the results of sub-question I (see Chapter 1.2), and the interview process in this research consisted of the following three main parts:

- Introduction about the relevance of case volume per medical condition, the challenge of how to pool case volume in the context of a hospital network organisation and the presentation of the standard case volume per medical condition for Swiss hospitals.
- Carrying out the convergent interview.
- Planning of further contacts, conclusion and thanking the participant for spending the time and sharing their knowledge.

The definition of the sample size of interviews followed the guidelines of Carlson et al. (2005, p. 104). Between six and twelve interviews are necessary per case project to reach valid and reliable results. In the context of the research question the involved stakeholders or experts were patients, surgeons and hospital managers. Therefore, the estimated sample of interviews was approximately 30 interviews.

Regarding the data analysis, summaries and cognitive maps were created around the statements of each of the interviewees. Through continuing analysis of the summaries and maps, each further interview was refined systematically during the research period.
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Therefore, the unstructured interview form passed into a more and more structured form with each interviewee. With regard to the posed research questions, the opinions, beliefs, and the knowledge of the interviewed experts were grouped into a matrix and analysed across the cases. The results of the data analysis are shown in tables as well as discussed in the text.

1.4.3 Time Schedule of the Research Process

The quantitative part of the thesis was finished by the end of January 2010. The qualitative part was finalised at the end of April 2010 and the construction of the preliminary model on value drivers regarding the concentration of case volume per medical condition and hospital respectively was completed by mid-July 2010.

1.5 CONTRIBUTION TO MANAGEMENT PRACTICE

The demonstrated dependency between case volume, economic efficiency and outcome quality and the determination of standards of minimum case volume per medical condition was previously investigated in the US, Germany as well as in other countries, but not in Switzerland. The quantitative component of the research addressed this issue and provided quantitatively derived standards regarding minimum hospital case volumes in Switzerland for defined complex medical conditions.

Pooling of case volume requires specific health care delivery structures and adapted hospital network processes. In contrast to the demonstrated dependency between case volume, economic efficiency and outcome quality, there was no prior research guiding the construction of a business model designed to satisfy patients, surgeons and hospital managers in the context of pooling case volume per medical condition in a hospital.
network organisation. This research has developed a preliminary provider model of pooling case volume per medical condition for Swiss hospitals in order to maximise medical outcome, economic efficiency and patient satisfaction in a for-profit hospital network organisation in Switzerland. The new knowledge will be useful for political executives as well as strategic decision makers of hospital network organisations. The implementation and adaptation of the presented health care provider model is not part of the research.

1.6 STRUCTURE OF THE THESIS

1.6.1 Macro Structure of the Thesis

In his book “Authoring a PHD”, Patrick Dunleavy has delineated several proposals on the macro-structure of scientific publications. According to the models presented, this thesis uses the “compromise” model, whose primary parts are:

- Focused literature review with the derivation of the research question.
- A core part with only one chapter about methodology (if not as appendix) and the results presentation.
- Analysis of the findings.
- Comprehensive conclusion.

1.6.2 Outline of the Report

This thesis comprises five main chapters:

1 INTRODUCTION
2 LITERATURE REVIEW
3 RESEARCH DESIGN
4 ANALYSIS OF DATA
5 CONCLUSIONS AND IMPLICATIONS

The structure is based on Perry and Coote (1994). A brief overview explains the topics addressed in each chapter:

Chapter One – INTRODUCTION

In chapter one, the reader is introduced to the research topic, the research question and the sub-questions, with reference to relevant literature and gaps in previous research. This chapter also contains general background information, a justification of the research, definitions and an overview of the applied research methodology as well as a discussion of how this dissertation contributes to professional practice.

Chapter Two – LITERATURE REVIEW

A critical review of academic literature will aid the identification of existing knowledge and practice gaps that are relevant to the formulation of the research question. The review is divided in three main parts, the first of which contains an analysis of the health care management literature. The main focus here is on network theory and the strategies and models about the pooling of case volume in order to maximise hospital network performance. The second part, an investigation on international hospital network organisations, focuses on the strategies of international hospital networks regarding the research questions, in particular pooling of hospital case volume. The third part investigates the available medical literature on pooling case volume in relation to medical outcome quality, economic efficiency and patient satisfaction.
Chapter Three – RESEARCH DESIGN

The Research Design chapter contains a justification of the research paradigms and provides an overview of the applied methodology. The reader is introduced to the theory building process, the research instruments and their strengths and weaknesses, the sampling and the criteria for hypothesis testing. Furthermore, topics of objectivity, validity, and reliability are described.

Chapter Four – ANALYSIS OF DATA

The Chapter provides a detailed presentation of the results of the quantitative as well as the qualitative research. Minimum hospital case volumes for Swiss hospitals are presented and high- and low-volume hospitals in a large hospital network identified. A new provider model on value drivers to maximise hospital network performance is developed and presented.

Chapter Five – CONCLUSIONS AND IMPLICATIONS

The final chapter contains the conclusions developed in relation to each formulated hypothesis/proposition and a response to the research question posed. In this chapter, the implications of the findings for theory and practice are also discussed. The chapter reflects the limitations of this research and summarises recommendations for further research.

1.7 DELIMITATIONS OF SCOPE

The goal of the thesis is to provide a preliminary business model, which maximises hospital network performance by focusing on key value drivers (medical outcome, economic efficiency and patient satisfaction) with regard to pooling of hospital case
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volume. However, the scope of the research work did not include the question of how the findings should be implemented in practice. The investigation focused on the Swiss market and considered Swiss hospitals. Whereas the quantitative part of the research allows for an analytical generalisation regarding Swiss hospitals in general, the qualitative part relates essentially to private hospital networks in Switzerland only. Both research methods and sample sizes were defined to gather reliable, objective and valid data that allowed the formulation of findings for the Swiss hospital market.

The quantitative studies carried out in the research dealt with medical outcome quality of defined complex medical conditions in Switzerland. The investigated data set does not include economic or patient satisfaction data and these aspects were therefore not investigated on a large-scale quantitative basis. The BFS data set is a retrospective data set and delivered by self-declaration from individual hospitals in Switzerland at the end of a calendar year to the Federal Statistical Office in Switzerland (BFS). Incidental coding errors regarding the medical classification of cases could not be excluded. However, systematic coding errors should not be present in the BFS data since data undergo a defined validation process.

The qualitative research component of the project investigated expert experience (patients, surgeons, hospital executives) in a large for-profit hospital network organisation in Switzerland, but did not explore the topics with patients/experts in public hospital network organisations.
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1.8 CONCLUSION

In this chapter the research background was explained and a business problem was defined through a research question and research propositions. A brief review of previous work undertaken in similar areas identified weaknesses and gaps, and justified the research that was undertaken. The research methodology, including an overview of the quantitative as well as qualitative analyses, was followed by a description of the delimitations of the scope of this research. Particular definitions explain terms frequently used in this dissertation. An outline of the thesis was included in order to explain the structure and illustrate the main elements and results of each chapter. Finally, the contribution to professional practice was explained.
2 LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter, a theoretical framework to inform the research question is developed in the form of propositions that will be tested to build a theoretical framework that hospital executives in practice can use to positively influence pooling on case volume and maximising hospital performance. This chapter will provide the reader with an overview of the existing literature relating to relevant areas and an explanation of how this research contributes to professional practice. The chapter consists of three main sections on pooling case volume: a review of health care business literature, a web-based review about international hospital networks and a systematic review of medical literature. The three sections have led to the formulation of a hypothesis (H1) and the propositions (P1 - P7). The structure of the literature review is shown in the subsequent Figure 2.1:

![Figure 2.1: The structure of the literature review. Own illustration.](image)

The section at the end of the review contains a proposition matrix regarding the pooling of hospital case volume per complex medical condition for Swiss hospitals in order to
maximise medical outcome (thereby saving additional lives of severely ill patients with complex medical conditions), economic efficiency and patient satisfaction in hospital network organisations.

2.2 SCOPE OF LITERATURE, REVIEW PROCEDURE AND DEFINITIONS

Research that investigates the value drivers on pooling case volume from the stakeholders’ perspectives requires a clear understanding of both current models on pooling case volume per medical conditions and the main drivers of hospital performance. The structure of the hospital industry in Switzerland is described in Chapter 1.1, and the terms “value drivers” and “hospital performance” are defined in the glossary. The health care business literature review provided additional models, strategies and variants on pooling case volume and consists of two parts:

- The first part about network theory and stakeholder influences gave a foundation for the formulation of value drivers.
- The second part provided literature-based strategies and models on pooling case volume.

The web-based analysis provides information on international hospital networks and their strategies on pooling hospital case volume and value drivers respectively propositions regarding the research sub-questions.

The medical literature review was directed towards understanding the relationship between pooling of case volume and hospital performance. The first section focused on medical outcomes. The second section analysed the context of pooling of case volume
and economic efficiency, and the third section investigated patient satisfaction in that context. A critical review in both areas offered an overview of the existing knowledge and an understanding of coherences and common models and variables, as well as identified strengths and weaknesses in previous research, which were used to establish clear pathways through which key value drivers influenced the pooling of hospital case volume per complex medical conditions in hospital network organisations. These pathways formed the basis of a preliminary model on value drivers regarding the concentration of case volume per medical condition and hospital. One hypothesis regarding the quantitative investigation and, in total, seven propositions emerged from the analysis of relevant literature and are embedded in a framework presented for investigation.

2.3 HEALTH CARE BUSINESS LITERATURE

2.3.1 Introduction

The health care sector is large, complex and health-professional oriented. Porter and Teisberg 2006a, p. 1-16 issue the following statement: “The literature on strategy for health care organizations is virtually nonexistent.” Therefore this narrative literature review identifies best practice approaches, develops research propositions and informs the research question particularly in the area of concentration and centralization of case volume per medical condition and maximizing hospital performance. The research instruments in this chapter are scientific literature in the field of health care management and administration. The sources for the research were scientific books, official databases from Harvard Business Review, Mckinsey, Medline and databases of the Charles Sturt University. The identification of articles has been done by searching for key relevant information in the mentioned databases and in the bibilotheca of
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Charles Sturt University. Any relevant article concerning the research objective were analysed and narrative described.

The first section of this chapter gives a short overview about network theory and stakeholder influences in the context of hospital networks. The goal is to learn which factors are important for a network organization specifically with respect to stakeholder conflict resolution.

The goal of the second section of the health care business literature review is to identify new strategies and models about the pooling of case volume and maximising hospital performance based on health-economic specific literature from Europe as well as from the US.
2.3.2 Network Theory of Stakeholder Influences

Network Theory and Organisational Inquiries


Hospital Network Challenges in regard to Stakeholder Interests

Hospital networks are complex organisations due to the nature of medicine in general as well as the impact of the various stakeholder interests in particular. As mentioned in the chapter above (Introduction), the strategy of pooling case volume per medical condition in a hospital network organisation – because of better hospital performance – appears to be in conflict with the various needs of the various stakeholders of the hospital network organisation (Siess & Siewert, 2005, pp. 503 - 507).

The motivation of hospital doctors and hospital staff is essentially related to their professional area of expertise and not to customer services, business and economic aspects (Porter and Teisberg (2006, pp. 1 - 16). In contrast, the patients as well as
medical referrers are exhibiting customer behavioural attributes. Non-medical criteria, for example customer services, 24-hour access and information management is becoming increasingly important regarding patient and medical referrer satisfaction and for choosing a hospital (Grote et al., 2007, pp. 1 - 9).

Furthermore, pooling of case volume per complex medical condition will reduce the medical portfolio of particular low-volume hospitals for the benefit of high-volume hospitals. Collaboration between high- and low-volume hospitals in regard to the management of patients with severe medical conditions is currently non-existent in Switzerland, not even in private hospital networks (pers. comm.). Therefore, pooling of case volume will be an important driver of a network organisation structure in which high-volume hospitals act as focal organisations where patients with complex medical conditions will be referred from low-volume hospitals. How efficiently and effectively this network development process can be achieved will be also related to the constraints of the key stakeholders, patients, doctors and hospital executives of hospitals in the network designated as low-volume.

**Stakeholder Influences on Network Organisation**

Institutional and resource dependence theories emphasise that organisations face a variety of external pressures and that these demands must be managed for the organisation to survive (Scott, 1992). This view is shared by the stakeholder theories, which argue that management choice and organisational survival are functions of how well the organisation satisfies its stakeholders (Brenner & Cochran, 1991, pp. 453; Carroll, 1989, p. 61). The external pressures come from “those who shape and enforce institutional rules and beliefs” and “those who control scarce resources” (Oliver, 1991,
Therefore, the source of these external pressures is the organisations’ set of stakeholders. The degree of external pressure as well as the structure of a given network can be described by network “density” and network “centrality” (Rowley, 1997, p. 896).

Density is a characteristic of the whole network: it measures the relative number of ties in the network that link actors together and is calculated as a ratio of the number of relationships that exist in the network (stakeholder environment), compared with the total number of possible ties if each network member were tied to every other member. A complete network is one in which all possible ties exist. Network Y in the Figure 2.2 has a high density because all actors have direct ties to one another whereas Network X in Figure 2.2 illustrates a network with a lower density.

![Network structure](image)

**Figure 2.2: Network structure.** Adapted from Rowley (1997).
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High network density provides institutionalised norms that mean stakeholders have established:

- Efficient communication.

As a result, a focal organisation planning to resist pressures from its stakeholders will have difficulty playing one group against another or finding a sympathetic group of stakeholders with whom it can form an alliance. In conclusion, densely tied networks produce strong constraints on the focal organisations’ actions (Rowley, 1997, pp. 896 - 898). According Rowley (1997, p. 897): “As a network density increases, the ability of a focal organisation’s stakeholders to constrain the organisations’ actions increases.”

Whereas density characterizes a network as a whole, “centrality” refers to an individual actor’s position in the network relative to others. Similar to formal power, which among many conceptualisations may be defined by a hierarchical position, network centrality implies a position of status. “The key difference between formally and informally (network) derived power is that the latter comes from actors’ positions in the actual patterns of interactions that define a social network” (Ibarra, 1993, p. 476). Centrality refers to power obtained through the network’s structure, as opposed to power gained through individual attributes.

One can define an actor’s power or degree of centrality by the number of ties he or she has with other actors in the network. The intuition behind power centrality is that players “well connected” – in terms of having many relations in their local environment – will have access to many alternative sources of information, resources, and so forth.
Network X in Figure 2.2 shows the focal organisation in a highly central position, where it has access to all other actors. Closeness centrality defines an actor’s ability to access independently all other members of the network (Freeman, 1979). An actor possessing low closeness centrality is highly dependent on other actors (intermediaries) to access other regions of the network. Accordingly, closeness centrality measures an actor’s independent access to different points in the network. When an actor is “close” to all the others, he or she can spread information quickly throughout the network. Freeman associates closeness centrality with efficient communication, stating that closeness “means fewer message transmissions, shorter times and lower costs” (1979, p. 225).

According to (Rowley, 1997, p. 900) if the focal organisation is in a central position, it is able to influence behavioural expectations and manage information flows so that its actions either go unnoticed or are presented in a self-serving fashion. The focal organisation’s centrality is a significant factor impacting its ability to resist stakeholder pressures. In other words as the focal organisation’s centrality increases, its ability to resist stakeholder pressures increases.

Therefore, the stakeholder network is a source of power for both stakeholders and the focal organisation. By examining the “interaction” of density and centrality, Rowley describes the relative power balance inherent in different types of network configurations and the roles focal firms adopt in these different network structures descriptively as:

- Under conditions of high density and high centrality, the focal organisation will adopt a compromiser role, attempting to negotiate with its stakeholders.
- Under conditions of low density and high centrality, the focal organisation will adopt a commander role, attempting to control stakeholder behaviours and expectations.

- Under conditions of high density and low centrality, the focal organisation will adopt a subordinate role, attempting to comply with stakeholder expectations.

- Under conditions of low density and low centrality, the focal organisation will adopt a solitaire role, attempting to avoid stakeholder pressures (1997, pp. 900 - 910).

In addition Rowley, Behrens and Krackhardt (2000, pp. 369-386) investigated empirically the mentioned propositions in the form of defined hypotheses of the network theory of stakeholder influences. Two networks were analysed: a network constructed for the steel-producing industry and another for the semiconductor manufacturing industry. The study confirmed, that the density of a stakeholder network and the focal organisation’s position in the network affect the behaviour of the stakeholders. The empirical data suggest that density negatively affects the focal organisation’s use of commander behaviours. Firms operating in dense stakeholder networks are less likely to manage their stakeholders by controlling and dominating the relationship than firms in sparsely connected networks. The findings suggest that centrality negatively affects compromiser and subordinate behaviours. In addition the findings suggest that density is strongly related to financial performance, measured as return on assets. Centrality was not significantly related to financial performance.
In conclusion, stakeholder influences the network structure significantly. The structure of a given network can be described by density and centrality. On the one hand density describes how efficiently communication and the establishment of shared behavioural expectations are developed in the network. Centrality on the other hand describes the actor’s position in the network relative to others. However, the role of the focal organisation in a network depends on the balance between density and centrality of a network organisation.

**Network Theory of Stakeholder Influences – Implication for this Research**

From the perspective of the network theory of stakeholder influences, the particular hospital – including its doctors – in which patients with complex medical conditions will be pooled will be designated as “focal hospitals”, whereas the low-volume hospitals (including its doctors), which should refer patients to the particular focal organisation, figure as stakeholders around this focal hospital. As mentioned above the role of the focal hospital depends therefore on the balance between density and centrality of the particular hospital network structure.

From a quality point of view the argument addressing mortality through pooling case volume in a focal hospital is already a strong value driver and increases the power of the particular high-volume hospital against the low-volume ones. Therefore, the position respectively the degree of centrality of a focal hospital in a hospital network is in general high. Nevertheless, there are potential risks that the density of the low-volume hospitals around this focal hospital is higher than the power of the focal hospital. In other words, under conditions of high density and low centrality, the focal organisation will adopt a subordinate role, attempting to comply with stakeholder expectations.
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(Rowley, 1997, pp. 900 - 910). However, the density of the network of high-volume hospitals has to be well developed too because efficient communication and the establishment of shared behavioural expectations inside the hospital network organisation are important too.

In conclusion, from the perspective of the network theory of stakeholder influences, the achievement of high density and high centrality in the hospital network structure are important regarding the establishment of a minimum case volume requirement per complex medical condition in the hospital network. Dense structures support communication and relationship development, which is critical to make sure that a comprehensive portfolio of services can be delivered by the network. Furthermore, it is important that stakeholders’ expectations and network contributions of low-volume hospitals are understood by the more central, high-volume network focal hospitals.

2.3.3 Strategies and Models about the Pooling of Case Volume and Maximising Hospital Performance

Introduction

Health economic experts and hospital executives around the world (also in Switzerland) deliberate about new health care delivery structures for public and private health care providers (Davis, 2007; European Observatory on Health Care Systems, 2000). Many countries try to concentrate and centralise their hospitals in order to improve hospital performances (Salfeld, Hehner, Wichels, p. 23 & pp. 211 - 212). In spite of the controversial discussion about the evidence of minimum case volume standards (Glance, Osler, Mukamel & Dick, 2007, pp. 195 - 202), the experts agree that experience with a particular medical procedure improves quality and economic
efficiency for both the surgeons and the hospital organisation. This literature review investigated the following question:

- What is the focus of health care business literature regarding pooling of hospital case volume per complex medical condition and per hospital in order to maximise economic efficiency, medical outcome and patient satisfaction in a hospital network organisation?

In general the investigated health care business literature shows, that under the conditions of increasing political regulations, pressure in economic and quality competition, and especially case volume requirements, everything points to a shift towards industrial process organisations per medical condition respectively special forms of service line organisations for health care providers. Therefore this section gives an overview about a number of aspects of service line organisations for health care providers and presents related organisation structures regarding pooling of case volume and maximising hospital performance based on the health-economic literature from Europe as well as from the US.

**Service Line Organisation in Health Care and Hospital Performance**

An important goal of service line organisations from an industrial point of view is to reach economy of scale effects. Economy of scale describes the behaviour of long-run costs as the scale of production changes, the long run being a period sufficiently long to permit all parameters (even the number of beds) to be variable. For a firm producing a single homogeneous product, economies (diseconomies) of scale are said to exist over a range of output if long-run average cost falls (rises) throughout the relevant range following an increase in the scale of production. If long-run average cost remains
invariant, neither economies nor diseconomies operate. Neoclassical theory often assumes a U-shaped relationship between long-run average cost and facility size. As facility size (and production) increases of long-run average cost is thought to decrease (economies) reach a minimum, and then increase (diseconomies) (Abplanalp, P. A., Lombriser, R., (2005, p. 256).

Charns and Tewksbury (1993) define medical service lines in health care as a family of organisational arrangements based on an organisation’s outputs rather than on its inputs. A “service line” signifies in the context of health care delivery that it refers to a non-traditional, patient-centric way of thinking about how a physician or team serves the patient. The concept suggests coordinating and integrating medical specialties and staff across the traditional disciplines or departmental boundaries, and organising the delivery of care by medical condition as experienced by the patient (Roeder et al., 2003, pp. 124 - 130). A medical cabinet or institution may provide care along multiple service lines, depending on their facilities, resources, and the staff’s level of experience. Indeed, most clinicians have multiple service lines, sometimes dozens. Alternatively, individual physicians may focus on a small number of service lines, thus acquiring depth of experience in one medical condition, and breadth of experience by treating the common co-morbidities of the disease (Porter & Teisberg, 2006, pp. 167 - 169; Porter & Teisberg, 2007, p. 1107).

An emphasis around clinical service lines delivers an improved focus on planning and decision-making, improved communication and accountability, reduced costs and improvement in clinical outcomes (Parker, 2001). However, differing stakeholder expectations and political manoeuvring can negatively impact on organisational

“When a health care provider makes a strategic choice of medical conditions and service lines, it feeds the ‘virtuous circle’ of value in care delivery in its favour. Deeper penetration in areas of excellence triggers a cascade of benefits” (Figure 2.3). For Porter and Teisberg (2006, pp. 65 - 76) the relevant entity in health care delivery is a medical condition, focusing on the full cycle of care. Medical conditions are patient-centred and not discipline-centred. For example a medical condition is not orthopaedic surgery, but distinct conditions like knee disorders or spine disorders. Thus, service lines should be strongly focused on medical conditions. The advantages of such single service lines in contrast to broad-line strategies are the focus on economies of scale, concentration of effort, experience and high-volume effects (Goetzel, Ozminkowski, Villagra, & Duffy, 2005, pp.1 - 19).

Building a business model around service lines requires hospital executives to define the set of medical conditions for which they have the competencies and capabilities to deliver health care. Furthermore, the providers have to define where their service lines fit in the full cycle of care (Holm & Schroeder, 2000, pp. 147 - 150). Porter & Teisberg (2006a, p. 204) define the full cycle of care as “the care delivery value chain”. It consists of the following parameters: monitoring/preventing, diagnosing, preparing, intervening, recovering/rehabilitating and monitoring/managing. The service line concept focuses on the measurement of results and the factors that influence them.
In regard to better medical outcomes of health care providers, valid and reliable medical outcome parameters measure service line performance in order to improve for example mortality rates, pain reduction, improvement in the range of movement and functional ability, complications, error and failed treatments, diagnostic accuracy, patient attributes and patient feedback (Porter and Teisberg 2006). Experience and the annual volume of treatments per medical condition, applied methods and patient attributes help the provider to move to the concept of value based competition with the concept of service line organisation in health care (Porter & Teisberg, 2006, pp. 181 - 184). The detailed list of the imperatives for hospital providers is given in Figure 2.4.

![Virtuous circle in health care delivery](image)

Figure 2.3: Virtuous circle in health care delivery (Porter and Teisberg, 2006, p. 161).
Moving to value – based competition: 
Imperatives for providers

- Redefine the business around medical conditions
- Choose the range and types of services provided
- Organize around medically integrated practice units
- Create a distinctive strategy in each practice unit
- Measure results, experience, methods and patient attributes by practice unit
- Move to single bills and new approaches to pricing
- Market services based on excellence, uniqueness and results
- Grow locally and geographically in areas of strength

Figure 2.4: The imperatives for providers (Porter and Teisberg, 2006, p. 157).

However, Enthoven (2007, pp. 1366 - 1372) expresses concern that Porter’s concept of service lines is too theoretical and remains unproven. But the concept of medical service lines is not new and health care providers in the USA have implemented this approach (Gee, 2004, pp. 60 – 65; Porter & Teisberg, 2006, pp. 65 – 76; Baghai et al. 2008, pp. 1 - 9).

In regard to better economic efficiency of health care providers, the efficacy of a service line organisation in health care business has been investigated by Baghai, et al. (2008, pp. 1 - 9). These authors present three case studies of service lines as organised in US hospitals. The findings are similar for all three hospitals – a full general hospital, a small hospital and an urban community hospital. The implemented service line structure resulted in significantly higher competitiveness as measured by economic efficiency and growth in their market “through the right choice of where to compete with the right decisions of strategic and non-strategic service lines”. This survey
confirms the theoretical findings of Abplanalp, P. A., Lombriser, R. (2005, p. 256) which show that, in general, strategies on high specialisations generate better economic results on the average than broad-line units, because of economies of scale effects. The referenced literature about service line organisations in health care confirms that the specialisation on service lines per medical condition will positively influence the establishment of a minimum case volume requirement per medical condition and consequently improve economic efficiency. Therefore the implementation of service line organisations will positively influence the hospital executive’s perception of value.

In regard to hospital reputation and doctor as well as patient satisfaction improvements, a service line organisation includes highly qualified and experienced hospital doctors and surgeons with a high reputation for a specific medical condition in specialised interdisciplinary teams with quick access to high-end technologies and linked disciplines around a single medical condition and focuses therefore on patient’s and doctor’s perception of value (Porter & Teisberg, 2006, pp. 169 - 189).

**Special Service Line Structures within the Hospital Systems designed around Economic Efficiency**

From an economic point of view the consequent implementation of the service line organisation structure supports three clearly defined hospital types: hospitals of maximum care, small general hospitals (also-called portal hospitals), and small highly specialised hospitals (Salfeld et al., 2008, pp. 119 - 125). To guarantee medical care, especially in rural areas, smaller general hospitals will continue to exist, but small and midsize hospitals in metropolitan areas are exposed to increasing pressure. For maximum care hospitals, there will continue to be a solid demand in metropolitan areas.
Their already high case numbers and high degree of specialisation should allow them to participate in the trend of larger medical departments. (Salfeld et al., 2008, pp. 119 - 125).

According to Salfeld et al. (2008, pp. 133 - 134), the implementation of service line organisations in maximum care hospital opens the big chance to restructure their department structures and to reduce their bed numbers in order to reach profitability. In the opinion of the authors, with the structure of service line organisations, such hospitals would not need more than 600 beds to treat 30,000 to 40,000 patients a year. Maximum care hospitals in metropolitan regions with 300 to 600 beds will be the access point for patients with more complex clinical pictures in the future. According to the authors, such defined service lines will pool case volume per medical condition inside the maximum care hospital to specialised teams and facilities and therefore lead to concentration and consolidation of the internal clinical services. These more efficient processes will decrease the duration of patient stay and possibly result in higher economic efficiency.

Small general hospitals in rural areas with one single service line will guarantee area-wide general care in the future, especially in rural areas. With roughly 80 to 200 beds they allow for a determined coverage of “primary care and a first treatment”. Consequently these hospitals are only equipped with a general surgical, a general internal and as well as an intensive medical care competence. The central diagnostics unit allows triaging the patients in order to treat the patient locally respectively refer the patients quickly to a particular, specialised hospital in the network. (Salfeld et al. (2008, pp. 133 - 134).
Service lines in small, highly specialised hospitals in metropolitan regions are described in the concept of Herzlinger (1997) of medical service-focused factories for example the Shouldice Hospital (pp. 159 - 172). Quality criteria and minimum case numbers are the basic parameters of these specialised inpatient-centres (Grote et al., 2007, p. 1 - 3). Hospitals with 50 to 300 beds could form a clinic with only one service line as a “specialty clinic”, or multiple service lines as a “multi-speciality clinic” (Salfeld et al., 2008, p. 129 - 133).

In conclusion there is much theoretical evidence that special service line structures will positively influence economic efficiency of any kind of hospital or hospital network organisations.

Special Structures within the Hospital Systems designed around Patients’, Doctors’ and Hospital Executives’ Perception of Value

Porter and Teisberg’s concept of the integrated practice unit (IPU) (2006, pp. 169- 189) is an idea of a kind of service line organisation too. It bundles physicians in freestanding IPUs, which specialise on a single medical condition and focus on patient value (Porter & Teisberg, 2006, pp. 169-189). Patient value is measured in medical results, experience (as for example the number of cases per IPU), methods and patient attributes. An IPU is fully integrated in the treatment chain of a particular medical condition (Figure 2.3 and 2.4). In this way the IPU concept will establish increasing case volumes per complex medical conditions and therefore positively influence the mortality of patients with and consequently influence patient value.
An IPU does not necessarily require a leading physician, but a team effort and case management. Nurses, therapists, operating and recovery facilities are co-located in a dedicated ward or even entire dedicated buildings (Porter & Teisberg, 2006, pp. 169 - 173). An IPU benefits from freestanding feeders and certain health professionals can provide care in more than one IPU. Enthoven (2007, pp.1366 - 1372) argues that IPUs are too focused on medical condition and too mono-disciplinary, describing them as an island in an archipelago. He prefers integrated delivery systems (IDS), which provide full services in broad medical homes. He argues that 75% of patients have more than three chronic diseases and therefore these patients need to walk from one IPU to another two IPUs. However, from a critical point of view and according to the literature, the differences between IDS and IPU are maybe not as big as Enthoven described, as the main difference between IPU and IDS is only the degree of specialisation on a certain medical condition. In case a patient has more than one disease, then other medical disciplines will be - for a limited time - integrated in the IPU (Porter & Teisberg, 2006, p. 170). Enthoven’s criticism about Porter and Teisberg’s concept is nevertheless useful, because it shows the difficulty of sub-specialisation. However the IPU concept integrates the sub-specialisation trend in the field of highly specialised medicine and influences positively the doctor’s perception of value, because it supports highly qualified and experienced hospital teams/surgeons with a high reputation for complex medical cases.

From the perspective of hospital executives in Switzerland who are working with the free agent system (“Belegarztsystem”), the relevant difference between IPU and IDS is that IDS require fully integrated and employed multidisciplinary physicians. In contrast, IPUs allow small and flexible freestanding specialised medical units similar to a “big
free agent”. In this case the hospital management has the option to offer these freestanding specialised units (IPUs) not only infrastructure and nursing but also an entire system of basic medical services including emergency staff, hospitalists and even anaesthesiologists and radiologists who are required in order to support the treatment of complex medical conditions in IPUs (Hirslanden Jahresbericht 2005, Lindenauer, et al., 2007, pp. 2589 - 2600). Therefore, specialisation on service lines with regard to medical conditions as for example the IPU concept will positively influence hospital executive’s perception of value.

2.3.4 Summarised Findings of Health Care Business Literature

From the first section of the health care business literature review about network theory of stakeholder influences, it can be concluded that the achievement of high density and high centrality in the hospital network structure are important regarding the establishment of a minimum case volume requirement per complex medical condition in the hospital network. Facilitating communication and relationship development is significant to achieve more effective team and hospital performance. Furthermore, the stakeholders’ expectations of low-volume hospitals have to be understood by focal hospitals. The focal hospitals act therefore in a negotiation role, attempting to effectively collaborate with its stakeholders.

The findings of health care business and health economic relevant literature state that providers, which are able to organise delivery structures regarding high case volume per medical condition efficiently will be competitive in the future. The health care management literature provides many logical reasons why hospital executives should
focus on pooling case volume through specialisation with specific medical service lines structures.

Service line organisation is a logical step forward in the specialisation process of medicine. The relevance of any kind of service line organisations is founded in the argument that a clinical service line supports the pooling of treatments regarding one specific leading medical condition. An organisation with focus around medical conditions instead of a hospital organisation with focus around medical disciplines makes medical treatment concepts more understandable to patients as well as to referring doctors. The performance of service lines structures would be measurable and comparable in terms of economic efficiency, medical outcome, and patient satisfaction.

In conclusion there is evidence that hospitals can improve economic efficiency with specialisation respectively the implementation of a service line organisation. The determinations of medical conditions, which are case volume critical, as well as the definition of their minimum case volumes are necessary as an essential basis of system organisation. Thus, the determination of minimum hospital case volumes per complex medial condition in Swiss hospitals (H1) is a key requirement for this research project. The literature review confirms that service line organisations support the pooling of case volume per medical condition. The review however provides no evidence whether the establishment of a minimum case volume requirement per complex medical condition in hospital networks will positively influence the mortality of severely ill patients with complex medical conditions and consequently influence patient value (P1). Nevertheless, the review confirms that the specialisation on service lines with regard to complex medical conditions will support the patient perceptions of value (P2: A strong,
positive hospital image and high reputation surgeons/treatment teams regarding the management of complex medical conditions will positively influence patient value). In addition, service line organisations influence doctor’s perception of value (P4: Highly qualified and experienced hospital surgeons with a high reputation for complex medical cases will support the doctor’s perception of value; P6: Quick access to high-end technologies and linked disciplines will support the doctor’s perception of value.) Finally, the specialisation on service lines with regard to complex medical conditions will positively influence the hospital executive’s perception of value (P7).

2.4 POOLING CASE VOLUME AND MAXIMISING HOSPITAL PERFORMANCE IN INTERNATIONAL HOSPITAL NETWORKS

2.4.1 Introduction

The overall goal of this review of hospital network practice is to explore the relevance of case volume per medical condition regarding the performance of international for-profit (private) hospital groups. Competitiveness in this context means economic efficiency, outcome quality, and patient satisfaction. The literature review investigates the hypothesis whether pooling of case volume per medical condition is an indicator for higher performance of a hospital group. Therefore, the author examines the current strategies of hospital groups in relation to their success. This systematic analysis investigates the freely available World Wide Web information about value drivers on pooling case volume per complex medical conditions of for-profit (private) international hospital network organisations. The analysis investigated the following question:

- What is the focus of international hospital networks regarding pooling of hospital case volume per complex medical condition in order to maximise economic efficiency, medical outcome and patient satisfaction?
2.4.2 Review Procedure

Search Design

A search strategy was designed to identify the maximum amount of relevant information and to develop a bibliography of relevant papers concerning strategies and concepts of for-profit hospital network organisations in the USA and Europe. The keywords of the systematic web-based search were derived from the introductory literature review as mentioned above. The used databases for information were PubMed Central, Medline, NHS EED and Elsevier. Databases were searched using a systematic search mask with key words and MeSH headings (Appendix 1 – Example of search masks). Any type of collected data from the search mask was categorised by the name of the particular hospital network, the general data variable profile (total revenue, EBIT, beds and employees) for the years 2007, 2008 and 2009, the strategy and concepts regarding case management approach inside the hospital network and the hospital performance indicators. The hospital performance indicators were defined according to the initial literature review as economic efficiency, medical outcome and patient satisfaction (i.e. Porter & Teisberg, 2004). Furthermore, hand searching of key relevant bank information, homepages, press releases and references of identified articles was done too. Data were referenced by author, title, source, and year.

Three categories of for-profit hospital network organisations were classified in order to categorise the hospital networks:

A) For-profit hospital network organisations with single-country strategy in Europe.

B) For-profit hospital network organisations with single-country strategy in the United States of America.

C) Multinational for-profit hospital network organisations.
The analysis has put emphasis on the following outcomes of interest:
- Focus on case volume policy
- Focus on the specialisation and technology
- Focus on substantial medical results regarding case volume and quality scores
- Strategic focus on patient satisfaction regarding regionally organised delivery system and/or focus on treatment facilities near the patient’s home base and/or focus on additional services for patients as example guest relation concepts
- Strategic focus on physician and referrer satisfaction regarding the implementation of special physician and referrer programs
- Market capitalisation
- EBIT

Data Collection and Analysis
A wide search was necessary to identify as much evidence as possible and it produced thousands of hints. After previewing these references, approximately 500 articles and websites were obtained and screened against inclusion criteria of relevance and outcome. The majority were rejected because few actually attempted to describe any of the case management approaches inside the hospital network and the related impact on hospital performance. This left about 27 references and websites to be included in the analyses, which provided evidence relevant to the relationship between pooling case volume and maximising hospital performance. The information was gained from the homepages of the hospital groups, out of press releases, from bank information and out of journal articles. The results from the web-based analysis were listed in a matrix and
grouped according of the dimensions of the major stakeholders: patients, doctors and hospital executives.

There is wide access to financial information from bank information or annual reports of the hospital groups. Also the structures of the hospital groups are well described in annual reports and on the homepages of the hospital groups. It is more difficult to find information about the particular strategies regarding hospital performance and pooling case volume of these hospital groups. With bank financial information it is possible to compare the financial situation of the hospital group but these sources do not contain information about the method of case management and the detailed strategies. There are only a few investigations about the strategies of hospital groups (Schmidt, 2003, pp. 1090 - 1095; Schmidt, Gabbert, Engler & Möller, 2003, pp. 294 - 299). In general the homepages and annual journals of the hospital groups are the only source that contained up-to-date information about strategies and concepts. There is a risk that the hospital groups do not publish the important information about their strategies and concepts. Furthermore, data from homepages are self-declared and therefore the reliability and validity of data is limited. An overview about the reviewed hospital network organisations is given in Appendix 2.

2.4.3 Summarized Findings of International Hospital Networks

Because of the differing degree of details available from the webpages, only limited value could be derived from this investigation and the collection of data regarding all variables defined in the search mask was not possible in all cases due to a lack of information on the webpages or annual reports. For this reason a thorough quantitative analysis of the collected data could not be carried out. However, the analysis revealed
that the current international for-profit hospital networks offer their patients an individual, entire health care delivery chain at least in the acute medical care sector. Therefore, patients will be treated with regard to their medical condition in different specialised inpatient and outpatient units at different geographical locations in the network. It appears that hospital networks plan to offer treatments near the home base of patients in outpatient centres, outpatient emergencies and in a wide range of outpatient services and daily surgeries too. Specialised facilities equipped with standard technologies treat patients with less complex and less severe medical conditions with standard medicine and surgery. Central hospitals with appropriate high-end technologies and specialised staff treat complex-disease patients with complex co-morbidities. By adopting such a strategy, especially the most economically successful hospital network organisation, Rhön Klinikum AG, tries to achieve higher hospital volume per medical condition per unit and furthermore better economies of scale, better cost performance, better medical outcomes and higher patient satisfaction.

Although, there is no consistent difference between medical outcome, patient satisfaction and economic efficiency, the focus on “specialisation and service lines” stands mainly for economic efficiency whereas “treatment near patient home” concentrates more on patient satisfaction. Secondly, it seems that “focus on referrer and doctor programs” regarding the relationship between surgeons and referrers, and satisfied doctors are relevant too. Finally, the analysis shows that only a few of the analysed hospital networks focus explicitly on “visible medical results regarding case volume and quality scores”.

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Table 2.1 presents consolidated strategic statements regarding the thesis’ propositions addressing value drivers on pooling hospital case volume and maximising hospital performance of international for-profit (private) hospital network organisations (fiscal year 2009). There are a few hospital networks which focus explicitly on “minimum case volume requirements per complex medical conditions and visible results” (P1). From a hospital executives’ perspective, most groups focus on the “specialisation on service lines focused on complex medical conditions respectively medical disciplines” (P7). From the referrers’ as well as the surgeons’ perspectives some of the evaluated hospital groups focus on the “relationships between hospital surgeons and general physicians” (P5). From the patients’ perspectives most hospital networks focus on “treatment near the patient home, respectively with regard to a short travelling time to specialised hospitals” (P3).

Rhön Klinikum AG as one of the most successful hospital groups in terms of market capitalisation puts emphasis on all the topics described in the seven thesis propositions. From the perspective of Rhön Klinikum AG, patients receive better visible medical results on the basis of higher hospital case volumes and quality scores per hospital, very experienced surgeons and due to short travelling times to a specialised hospital. Referrers prefer highly qualified and experienced hospital surgeons and need a good working relationship with the surgeons, because of patient streams aspects and information management. Surgeons estimate the access to high-end technologies and linked disciplines and finally, hospital executives build hospital reputation through the specialisation along treatment chains with appropriate technologies and treatment teams.
2.4.4 Conclusion

From the web-based analysis it can be concluded that the value drivers of the most successful hospital group in Europe (Rhôn) focuses on all the seven thesis propositions:

P1: Establishment of a minimum case volume requirement per complex medical condition in hospital networks will positively influence the mortality of severely ill patients with complex medical conditions and consequently influence patient value.

P2: A strong, positive hospital image and high reputation surgeons/treatment teams regarding the management of complex medical conditions will positively influence patient value.

P3: Short travelling time to specialised hospitals will positively influence patient value.

P4: Highly qualified and experienced hospital surgeons with a high reputation for complex medical cases will positively influence doctor’s perception of value.

P5: The nature of the relationships between hospital surgeons and general physicians/referrers will positively influence doctor’s perception of value.

P6: Quick access to high-end technologies and linked disciplines will positively influence doctor’s perception of value.

P7: Specialisation on service lines with regard to complex medical conditions will positively influence hospital executive’s perception of value.
<table>
<thead>
<tr>
<th>Hospital Networks</th>
<th>Economic Efficiency</th>
<th>Medical Outcome</th>
<th>Hospital / Patient Satisfaction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Market Capitalisation (in mio. Euro)</td>
<td>EBIT FY 2009 (in mio. Euro)</td>
<td>Specialisation and reputation on service lines and technology (P2, 4, 6 &amp; 7)</td>
</tr>
<tr>
<td>Rhön Klinikum AG</td>
<td>2,646</td>
<td>182</td>
<td>X</td>
</tr>
<tr>
<td>Mediclin AG</td>
<td>197</td>
<td>17</td>
<td>X</td>
</tr>
<tr>
<td>Sana Kliniken AG</td>
<td>n.k.</td>
<td>67</td>
<td>X</td>
</tr>
<tr>
<td>Helios Kliniken GmbH</td>
<td>n.k.</td>
<td>208</td>
<td>X</td>
</tr>
<tr>
<td>Générale de Santé</td>
<td>655</td>
<td>131</td>
<td>X</td>
</tr>
<tr>
<td>BMI Healthcare</td>
<td>n.k.</td>
<td>n.k.</td>
<td>X</td>
</tr>
<tr>
<td>Hospital Corporation of America (HCA)</td>
<td>n.k.</td>
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<td>X</td>
</tr>
<tr>
<td>Tenet Healthcare Corporation</td>
<td>1,612</td>
<td>419</td>
<td>X</td>
</tr>
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<td>Universal Health Services Inc. (UHS)</td>
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<tr>
<td>Community Health Systems Inc. (CHS)</td>
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<tr>
<td>Lifepoint Hospitals Inc.</td>
<td>1,291</td>
<td>253</td>
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<tr>
<td>IASIS</td>
<td>n.k.</td>
<td>103</td>
<td>X</td>
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<td>Vanguard Health Systems</td>
<td>n.k.</td>
<td>121</td>
<td>X</td>
</tr>
<tr>
<td>Capio</td>
<td>n.k.</td>
<td>n.k.</td>
<td>X</td>
</tr>
<tr>
<td>Parkway Holdings Limited</td>
<td>2,491</td>
<td>130</td>
<td>X</td>
</tr>
<tr>
<td>Bangkok Dusit Medical Services</td>
<td>850</td>
<td>70</td>
<td>X</td>
</tr>
<tr>
<td>Ramsay Health Care (RHC)</td>
<td>2,056</td>
<td>239</td>
<td>X</td>
</tr>
<tr>
<td>Healthscope</td>
<td>1,311</td>
<td>136</td>
<td>X</td>
</tr>
<tr>
<td>Netcare</td>
<td>1,997</td>
<td>383</td>
<td>X</td>
</tr>
<tr>
<td>Medi-clinic</td>
<td>1,473</td>
<td>326</td>
<td>X</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>19</strong></td>
<td><strong>3</strong></td>
<td><strong>14</strong></td>
</tr>
</tbody>
</table>

Source data: Bloomberg (July 23, 2010); Source foreign currency exchange rates: Oanda (July 23, 2010); P1-P7 = Propositions of the thesis; n.k. = Not known

Table 2.1: Summary of the analysed hospital network organisations. Own data.
2.5 MEDICAL LITERATURE

2.5.1 Introduction

The analyses on the relationship between pooling of case volume and hospital performance in terms of medical outcome, patient satisfaction and economic efficiency were – from a methodological point of view – based on the investigation of the NHS Centre for Reviews and Dissemination (1996, pp. 1 - 62). The three following sections describe the results of systematic reviews (following the methodology developed at the University of York, NHS 1996) in order to investigate the relationship between volume of clinical activity in hospitals and the quality of health care outcomes, hospital costs and patient access.

2.5.2 Pooling Case Volume and Medical Outcome Quality

Literature Process

In regard to the relationship between medical outcome and case volume, the literature search had to answer the following question:

- What is the evidence of a relationship between increased hospital or physician volume per complex medical condition and medical outcome?

A systematic query in Pubmed was carried out to assess the evidence on the relationship between medical outcome and hospital case volume. Studies in English, French, German and Italian and of any research design were included in the analysis. According to the investigation of Michael Place (1997), the developed systematic search strategy was designed to identify the maximum amount of relevant studies between 1996 and 2010. Databases were searched by using a systematic search mask with key words and MeSH (Medical Subject Headings) terms. Furthermore, hand searching of key relevant
journals was done, the references of identified studies were checked and experts in the field of outcome research were contacted. The relevance and quality of a study was assessed and data were extracted from web resources. Details of individual studies are given in table form (Appendix 3).

The following inclusion and exclusion criteria were defined: Studies have been included if they had empirical data and satisfied the following criteria: Studies on a comparison of medical outcomes of patients treated in a) hospitals/centres with different case volume levels or b) actual mortality rates in specialised units of high- or low-volume were compared with expected death rates derived from reliable data from units of another volume or c) studies where data are compared before and after concentration of services. Only studies with designs as meta-analyses and systematic reviews were included. Articles, which did not show empirical results, were not included in the analyses. Investigations using the same data sets for the same period of time were excluded. Also, studies where process rather than outcome measures were the main focus were excluded.

A wide search was necessary to identify as much evidence as possible and it produced over 340 titles on case volume and medical outcome. The majority of papers were rejected because few actually attempted to measure any of the aspects of the outcomes on interest. This left 26 papers, which covered the relationship between case volume and medical outcome.

Almost all studies were cross sectional. These are particularly vulnerable to confounding and therefore of relatively low quality even where attempts have been
made to adjust for potential confounding factors. The scientific articles, which form the
basis of this review, are summarised in tabular form in Appendix 3.

The Evidence of the Relationship between Minimum Case Volumes per Complex
Medical Condition and Medical Outcome

In the American literature in particular there is a lot of evidence of a relationship
between case volume and outcome in the treatment of complex medical conditions (see
Appendix 3). Significantly lower mortality rates with treatment in high-volume centres
have been shown especially in cases of patients undergoing surgery in complex disease
conditions. The Leapfrog Study Group defined standards for hospital volumes for a
number of medical conditions founded on a large evidence base in the US. It was
concluded that a full implementation of the Leapfrog standards would have averted

Furthermore, numerous studies have demonstrated very strong evidence about the
difference in outcomes after cancer resections, cardiovascular intervention as well as hip
and knee replacement. The reviewed literature in Appendix 3 clearly demonstrates that
higher hospital volume is associated with lower perioperative mortality, recurrence, and
complication rates, as well as higher long-term survival rates (Barocas et al., 2010, pp.
243 – 250; Bilimoria et al., 2009, pp. 1799-1808; Mayer et al., 2008, pp. 341 – 349;
Birkmeyer et al., 2007, pp. 777 – 783; Birkmeyer et al., 2006, pp. 2476 – 2481; Chang
& Birkmeyer, 2006, pp. 87 – 94; Birkmeyer, Stukel, Siewers, Goodney, Wennberg &
Lucas, 2004c, pp. 2117 - 2127). Despite the fact that a number of the mentioned articles
report a correlation between both hospital and individual surgeon volume on outcome parameters (most importantly, mortality), the relative importance of hospital vs. surgeon volume on outcome was not specifically investigated in most studies.

Specialised surgeons with high yearly case volumes had significantly better medical outcomes than general surgeons (Bilimoria et al., 2009, pp. 1799 – 1808; Dimick, Osborne, Nicholas & Birkmeyer, 2009, pp. 702 – 706; Du Bois et al., 2008, pp. 422 – 436; Wilt et al., 2008, pp. 820 – 828; Chowdhury, Dagash & Pierro, 2007, pp. 145 – 161). It can be concluded from the cited studies that for many procedures, the observed associations between hospital volume and operative mortality are largely influenced by surgeon volume and that patients can often improve their chances of survival substantially, even at high-volume hospitals, by selecting surgeons who perform the operations frequently.

Minimum case volume requirements per complex medical conditions in various countries (USA, Germany) are primarily defined by health care authorities and there is no scientific reference of a purely quantitative, statistical derivation of minimum case volume thresholds for specific medical conditions. Birkmeyer et al. (2002) provides an academically accepted statistical approach to compare the mortality rates of treatment in certain medical conditions in relation to hospital case volume. With regard to oesophagectomies - for instance - several other authors concluded that only with the experience of more than 10 esophagectomies per year can a significant reduction of mortality be achieved (Metzger et al., 2004, pp. 310 – 314; Wouters et al. 2009, pp. 481 – 487).
The scientific articles referenced in Appendix 2 reveal a relationship between case volume and medical outcome quality regarding the following medical conditions:

- Oesophagectomy for oesophagus cancer treatment
- Pancreatectomy for pancreas cancer treatment
- Coronary artery bypass surgery for coronary heart disease
- Carotid endarterectomy for carotid artery thrombosis (i.e. thrombus removal in an artery supplying the brain)
- Radical prostatectomy for prostate cancer treatment
- Pneumonia therapy
- Hip replacement surgery
- Knee replacement surgery
- Neurosurgery for brain tumor excision

The evidence from the scientific medical literature supports the hypothesis that minimum case volumes per medical condition should be determined for hospitals in Switzerland. Birkmeyer et al. (2002) provide an academically accepted statistical approach to compare the mortality rates of treatment in certain medical conditions in relation to hospital case volume. In addition, the exact mechanism of the impact of hospital or surgeon volume on outcome should be subjected to further study, and also the question of how hospital case volume and surgeon case volume interrelate to each other needs elucidation. However it can be stated that hospital volume is generally at least as important as doctor volume regarding the impact on outcome.
From an ethical as well as from a quality point of view, the strong evidence and knowledge about the relationship between case volume and medical outcome must be considered a main value driver of the implementation of minimum case volume requirements in hospital network organisations, because this means that mortality issues in the treatment of complex medical conditions can be addressed. Therefore - on the basis of the quantitative approach of Birkmeyer et al. (2002) - it is important to define the hypothesis (H1) that minimum case volume requirements per complex medical conditions for hospitals in Switzerland can be determined quantitatively: A) Minimum case volume requirements per complex medical condition can be determined in Switzerland. B) Hospitals in a large for-profit (private) hospital network organisation can be subsequently classified as high- and low-volume hospitals regarding treatment of complex medical conditions in order to improve medical service quality outcome in terms of mortality reduction and economic efficiency of the entire hospital network. The mentioned literature indicates that the “establishment of a minimum case volume requirement per complex medical condition in hospital networks will positively influence the mortality of severely ill patients with complex medical conditions and consequently increase patient value”. The review shows that this proposition will be supported by patients, doctors as well as hospital executives.

2.5.3 Pooling Case Volume and Economic Efficiency

Literature Process

In order to investigate the relationship between economic efficiency and case volume, a literature search was designed to address the following question:

- What is the relationship between case volume regarding a complex medical condition and economic efficiency?
A systematic query in Pubmed was carried out to assess the evidence of the relationship between economic efficiency and hospital case volume. The outcomes of interest were mainly the effects of medical treatment centralisation on economic efficiency. The search strategy was similar to that of pooling case volume and medical outcome, as mentioned in the section above. A wide range of study designs (from cross-sectional to randomised controlled trials) were accepted for inclusion. The search produced over 90 titles on case volume and economic efficiency. The majority of papers were rejected because few actually attempted to measure any of the aspects of the outcomes of interest. This left 14 papers which covered the relationship between case volume and economic efficiency. Almost all studies were cross-sectional. These were of relatively low quality even where attempts had been made to adjust for potential confounding factors. Details of individual studies are presented in tabular form in Appendix 4.

The Evidence of the Relationship between Minimum Case Volumes per Complex Medical Condition and Economic Efficiency

The availability of scientific literature regarding the question of the relation between case volume and economic efficiency in certain medical conditions appeared rather limited. There were only a few studies dealing with cost-benefit considerations, hospital or surgeon volume and economic efficiency and the studies did not show a clear-cut trend considering the results. Economic efficiency is generally investigated in the general business literature but has not been specifically studied in systematic reviews and prospective studies with large sample sizes for the treatment of certain medical conditions.

Studies with no clear cut trend of differences in hospital costs between high volume and low volume hospitals were presented in the field of intensive care costs in general (Kuo et al. (2001, pp. 1118 – 1124), the field of coronary artery bypass grafting (Shahian et al., 2001, pp. 53 – 64); and in craniotomy (Long et al. (2003, pp. 1056 – 1063).

Medical conditions for which a relationship between case volume and economic efficiency has been found (see literature summarised in Appendix 4) are:

- Carotid endarterectomy
- Coronary angioplasty
- Esophagectomies
- Abdominal aortic aneurysm repair
- Pneumonectomy
- Hip fracture and knee surgery
- Colonectomy
The literature review supports the hypothesis that minimum case volume requirements regarding treatment of several complex medical conditions are in relationship with economic efficiency. The exact determination of the impact of hospital case volumes on economic efficiency should be subjected to further study.

**Conclusion**

The relationship between pooling of case volume and economic efficiency correlates with the relationship between pooling of case volume and medical outcome. Therefore the “establishment of a minimum case volume requirement per complex medical condition in hospital networks will also positively influence the treatment costs of severely ill patients with complex medical conditions and consequently influence patient value” (P1). Concerning the hospital executive’s perception of value “the specialisation on service lines (pooling case volume) with regard to complex medical conditions will positively influence the economic efficiency of a particular hospital (P7).

### 2.5.4 Pooling Case Volume and Patient Satisfaction

**Literature review process**

The relationship between patient satisfaction and case volume was assessed through investigating the following question:

- To what extent does concentration and centralisation of health care delivery facilities affect the patients’/physicians’ satisfaction with the hospital?
- What are the influencing factors on patients’/physicians’ hospital choice?
- What aspects of the hospital have an impact on patients’/physicians’ satisfaction with the hospital?
The search strategy was similar to that of pooling case volume and economic efficiency as mentioned in the previous section. The outcomes of interest were the effects of centralisation on patient/physician satisfaction with the hospital. The majority of the analysed papers were rejected because few actually attempted to measure any of the aspects of the outcomes of interest. Almost all studies were cross sectional. These were of relatively low quality even where attempts had been made to adjust for potential confounding factors.

Details of individual studies are given in tabular form in Appendix 5.

The Evidence of the Relationship between Minimum Case Volumes per Complex Medical Condition and Patient Satisfaction

The availability of scientific literature regarding the question of the relation between case volume and patient satisfaction in certain medical conditions appeared rather limited. Patient satisfaction is generally investigated in the general quality literature but has not been specifically studied in systematic reviews respectively prospective studies with large sample sizes for certain medical conditions. It can therefore be concluded that this area should be examined closer in future research.

There is evidence that satisfaction scores are mainly determined at the patient level as for example age and health status, and to a lower extent at the department or the hospital level (Hekkert et al., 2009, pp. 68 – 75; Miller et al., 2006, pp. 354 – 364; Young et al., 2000, pp. 325 - 345). Furthermore patient satisfaction is strongly negatively associated with high-volume procedures (Rogut et al., 1996, pp. 314 - 344).
Nevertheless, the findings about the relationship between pooling of case volume and patient satisfaction show that aged patients prefer hospitals close to their homes (Tai et al., 2004, pp. 1903 – 1922; Adams et al.1991, pp. 583 – 612; Gozu et al., 2009, pp. 195 – 200; Luft et al., 1990, pp. 2899 – 2906). Furthermore, the attractiveness of high-volume centres is based on the large scope of services and the volume of specialised surgical procedures as well as the relationship between patients and general physicians (Liu et al., 2008, pp. 124 – 130; Katz et al., 2003, pp. 560 – 568). Moreover the quality/reputation of local surgeons/doctors seems to be very important for patient satisfaction (Geraedts et al., 2007, pp.1 – 6; Liu et al., 2007, pp. 17 - 24). Patients with complex medical conditions were more likely to bypass their closest rural hospitals (Tai et al., 2004, pp. 1904 – 1922; Adams et al., 1991, pp. 583 – 612).

It can be concluded the attractiveness of high-volume centres is based on the large scope of services, the volume of specialised surgical procedures and the reputation/quality of the hospital surgeons/doctors. Nevertheless, centralised high-volume hospitals are attractive only for patients with complex diseases, because patient satisfaction is generally negatively associated with high-volume procedures and the travelling time to the hospital especially for aged patients.

**Conclusion**

It can be concluded that in general an improvement of patient satisfaction with a strategy addressing pooling of case volume will be difficult. Nevertheless, the establishment of a minimum case volume requirement per complex medical condition in hospital networks will positively influence the mortality of severely ill patients with complex medical conditions and consequently influence patient value (P1).
Furthermore, a strong, positive hospital image and high reputation of surgeons/treatment teams regarding the management of complex medical conditions will positively influence patient value too (P2). Moreover short travel times to specialised hospitals will positively influence patient value (P3). In addition the review confirms that highly qualified and experienced hospital surgeons with a high reputation for complex medical cases will positively influence doctor’s/referrer’s perception of value (P4). Finally the nature of the relationships between hospital surgeons and general physicians/referrers will positively influence doctors’ as well as indirectly the patients’ perception of value (P5).

2.5.5 Conclusion of the Medical Literature Review

The medical literature reviews were undertaken to analyse the relationships between pooling of case volume and medical outcome, economic efficiency, and hospital performance. Except for the findings regarding the relationship between case volume and medical outcome, the available academic literature is limited. Prospective studies with large sample sizes for certain medical conditions are not available. It can therefore be concluded that these areas should be examined in future research.

From the health care business literature including a web-based analysis of for-profit (private) international hospital networks as well as the medical literature, there emerged the proposition model on pooling case volume and maximising hospital performance, as illustrated in Figure 2.5 below. This model describes the value drivers from the patients’, doctors’ and hospital executives’ perspectives. The value drivers are based on business experience and scientific findings as mentioned in the sections above. Following evidence in the literature providing support for these propositions, the overall
LITERATURE REVIEW

model requires testing within a specific context, where evidence may be found to support an extension of the model. The context in which the model will be tested is a hospital network organisation in Switzerland. According to the theory building process, two further research steps will be undertaken, firstly a quantitative analysis of the whole BFS (Swiss National Statistics Institute) national inpatient data set of medical patient records from 2003 to 2007 about the relationship between case volume per medical condition and morbidity- and age-adjusted mortality rates in Switzerland, including the definition of minimum case volume standards, and secondly the qualitative analysis about the beliefs, opinions and knowledge from patients, doctors and hospital executives on pooling case volume in the largest private hospital group in Switzerland.
<table>
<thead>
<tr>
<th>Quality</th>
<th>Saving Lives</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1: Establishment of a minimum case volume requirement per complex medical condition in hospital networks will positively influence the mortality of severely ill patients with complex medical conditions and consequently influence patient value.</td>
<td></td>
</tr>
<tr>
<td>P2: A strong, positive hospital image and high reputation surgeons/treatment teams regarding the management of complex medical conditions will positively influence patient value.</td>
<td></td>
</tr>
<tr>
<td>P3: Short travelling time to specialised hospitals will positively influence patient value.</td>
<td></td>
</tr>
<tr>
<td>P4: Highly qualified and experienced hospital surgeons with a high reputation for complex medical cases will positively influence doctor’s perception of value.</td>
<td></td>
</tr>
<tr>
<td>P5: The nature of the relationships between hospital surgeons and general physicians/referrers will positively influence doctor’s perception of value.</td>
<td></td>
</tr>
<tr>
<td>P6: Quick access to high-end technologies and linked disciplines will positively influence doctor’s perception of value.</td>
<td></td>
</tr>
<tr>
<td>P7: Specialisation on service lines with regard to complex medical conditions will positively influence hospital executive’s perception of value.</td>
<td></td>
</tr>
</tbody>
</table>

**Hospital Performance**

Medical Outcome, Patient Satisfaction and Economical Efficiency

Figure 2.5: Proposition matrix. Own illustration.
3  RESEARCH DESIGN

3.1  INTRODUCTION

As derived from the business and academic research problem described in the preceding chapters, the overall research question of the thesis is: “How can pooling of case volume per complex medical condition and per hospital maximise medical outcome, economic efficiency and patient satisfaction in a hospital network organisation?” The path to address this question is the development of a preliminary provider model which describes the value drivers from the patients’, doctors’ as well as hospital executives’ perspectives on pooling case volume per complex medical conditions in the largest private hospital network organisation in Switzerland. The theory building process embraces a mixture of induction and deduction phases and required qualitative as well as quantitative techniques (Figures 3.1 and 3.2). Therefore, a logical process from the “idea” then the “proposition matrix” to the “preliminary provider model on pooling case volume of complex medical conditions” could be developed (see Chapter 4, Analysis of Data). This chapter presents the quantitative as well as qualitative research approach in the context of the theory building process of this thesis.
<table>
<thead>
<tr>
<th>Introduction</th>
<th>Research question</th>
<th>Research sub-questions</th>
<th>Health care business literature review</th>
<th>Literature review</th>
<th>Medical literature review</th>
<th>Proposition matrix</th>
<th>Quantitative analysis</th>
<th>Qualitative analysis</th>
<th>Testing and development of the final theory</th>
<th>Final theory</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>How can pooling of case volume per complex medical condition and per hospital maximise medical outcome, economic efficiency and patient satisfaction in a hospital network organisation? Value based hospital network organisation / maximisation of hospital performance.</td>
<td>What are the required minimum case volumes for complex medical conditions in Switzerland?</td>
<td>Network theory of stakeholder influences</td>
<td>Pooling case volume and maximising hospital performance</td>
<td>Relationship between case volume and medical outcome</td>
<td>New models on pooling of case volume and maximising hospital performance</td>
<td>Analysis of the Swiss inpatient data set between 2003 and 2007. What are the required minimum case volumes for definite medical conditions in Switzerland based on the examination of the Swiss inpatient data set (Bundesamt für Statistik, BFS, data) with regard to the relationship between case numbers and medical outcome as measured by postoperative mortality rates?</td>
<td>In-depth interviews Pooling case volume and the patients’ value drivers</td>
<td>In-depth interviews Pooling case volume and the doctors’ value drivers</td>
<td>In-depth interviews Pooling case volume and the managers’ value drivers</td>
</tr>
</tbody>
</table>

Figure 3.1: Theory building process. Own illustration.
3.2 THEORY BUILDING PROCESS

The theory building process developed the business problem about maximising hospital performance and pooling of case volume and the overall research question was formulated as “How can pooling of case volume per complex medical condition and per hospital maximise medical outcomes, economic efficiency and patient satisfaction in a hospital network organisation?”

Therefore, the sub-questions focused firstly on quality in general and secondly on the perspectives of patients, doctors and hospital executives in order to evaluate:

I) What are the required minimum case volumes for definite complex medical conditions in Switzerland based on the examination of the Swiss inpatient data set with regard to the relationship between case numbers and medical outcome as measured by post-treatment mortality rates?

II) Which value drivers motivated patients to be treated in high-volume hospitals in a Swiss private hospital network?

III) Which value drivers lead doctors to treat patients in high-volume hospitals in a Swiss private hospital network?

IV) Which value drivers lead hospital executives to treat patients in high-volume hospitals in a Swiss private hospital network?

Because there was only limited literature informing a provider model of hospital network performance improvement and the main value drivers, and no empirical data, the literature review was used to generate systematic searches in order to develop the research proposition matrix.
The development of the proposition matrix on value drivers regarding the concentration of case volume of complex medical conditions in a hospital network organisation was the second part of the thesis theory building process (Figure 3.1). The literature review investigated the following topics: A) network theory and service quality, B) new models on pooling of case volume and maximising hospital performance in the healthcare business literature, C) international hospital networks and their strategies on pooling case volume and maximising hospital performance, D) the relationship between case volume and medical outcome quality, E) analysis of the relationship between pooling of case volume and economic hospital efficiency, and F) the relationship between pooling of case volume and patient satisfaction.

The development of the research proposition matrix was brought about by a matrix of statements from various literature resources. The developed matrix linked the statements from the perspectives of patients, referrers/surgeons as well as hospital executives to the hospital performance drivers: medical outcome, economic efficiency and patient satisfaction (Figure 2.5).

The matrix of propositions warranted both quantitative as well as qualitative research methods. Literature-based recommendations were developed about minimum case volume requirements per medical condition in the US as well as the value drivers regarding the pooling of case volumes from the patients’’, doctors’ and hospital executives’ perspectives (Figure 3.2 as an example).
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<table>
<thead>
<tr>
<th>Relevant medical conditions</th>
<th>Value drivers: Patients</th>
<th>Value drivers: Referrers / Surgeons</th>
<th>Value drivers: Hospital executives</th>
<th>Hospital performance:</th>
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<td></td>
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<td>Medical outcome</td>
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<td>Hospital satisfaction</td>
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</table>

Figure 3.2: Example: Value matrix for theory building. Own illustration.

The usage of quantitative research methods was necessary to investigate the relationship between case volume and treatment outcome quality as measured by morbidity-adjusted mortalities per complex medical condition. The quantitative examination included all inpatient data from Switzerland between 2003 and 2007 (Bundesamt für Statistik, BFS) and aimed to establish minimum case volume standards in Switzerland as well as to identify low respectively high-volume hospitals per complex medical conditions in the largest private hospital network organisation in order to select patients, referrers/surgeons and hospital executives for the qualitative investigation on the basis of in-depth interviews. The qualitative investigation included 32 in-depth expert interviews focusing on the opinion and knowledge of the most relevant hospital stakeholders (patients, referrers/doctors and hospital executives) regarding their value drivers, to support the centralisation process of complex medical conditions in the largest private hospital network organisation in Switzerland. Finally, from the quantitative as well as qualitative investigation, the finally emerging preliminary provider model regarding value drivers on pooling case volume of complex medical conditions in a for-profit (private) hospital network organisation in Switzerland was developed.
3.3 JUSTIFICATION OF RESEARCH PARADIGMS

The aim of the research is to attain a more coherent understanding of the idea – as described above – of case volume pooling per complex medical condition and maximising hospital performance in for-profit hospital network organisations. The theory building and testing process reflected a Critical Realism paradigm (Fleetwood, 2005, pp. 197 - 222). Critical Realism seeks both an alternative to the constructivist ontologies of postmodernism and a method of linking emancipatory research to structural analysis. It is a relatively new theory (Archer, 1988, 1995, 2000, 2003, pp. 11 - 20), with academics in economics (Downward, 2003), management and organisation studies (Reed, 2005, pp. 1621 - 1644) and healthcare (Clarke et al., 2007, pp. 513 - 539) contributing to and applying a Critical Realism paradigm.

For the quantitative analysis a predominantly positivist paradigm was chosen. Positivists believe that the world can be objectively and completely measured while both the investigator and the phenomenon are assumed to be independent from each other. The observation of the given situation takes place through a “one-way mirror” (Guba and Lincoln, 1994, pp. 105 - 117). There was no relationship between the researcher and the respondents in an epistemological sense. Reality was considered to be understandable and the researcher’s standpoint on the statistical factors investigated was value-free. The positivist paradigm applied strived to measure and analyse the relationship between case volume per complex medical condition and risk-adjusted mortality rate through secondary data analysis.

However, the statistical results required interpretation, and the framework developed from the literature was subjected to critical reflection and tested in a hospital network
environment using a qualitative research method. The subjective truth regarding this research question may lie in a specific consensus between the key players of the particular hospital network organisation investigated. The quantitatively derived minimum case volumes per medical conditions as well as the literature-based propositions about the factors, which support pooling of case volume in hospital networks, represent “only” theoretical results, if they do not fit with the reality of a hospital network organisation in Switzerland. This was the reason why the research was extended to include the qualitative investigation in an experiential and human context within the largest private hospital network organisation in Switzerland. The qualitative approach can be justified because connections were assumed to be complex and required further in-depth explanations or questions. The researcher was a “participant” in the fieldwork and linked to respondents. In order to achieve the most reliable and valid data, the interview guide was designed with open-ended questions that could be applied to all cases. Furthermore, the questions concept of in-depth interviews went – after each interview – through a complete process of design, data collection, interpretation and redesign. The convergent interview technique (Carson et al., 2005, p. 86) is described in the Chapter 3.6 Qualitative Analysis.

3.4 JUSTIFICATION OF THE RESEARCH METHOD

Regarding the definition of the research question, the selection of the appropriate research method as well as the requirements concerning validity, objectivity and reliability, the most important variable to be investigated in this research on the value drivers for the improvement of hospital network performance was medical outcome quality, i.e. the reduction in mortality in the treatment of complex medical conditions, which means – in other words – the increase of the number of patient lives saved. The
stakeholders’ (patients, doctors, hospital executives) value drivers regarding medical quality, patient satisfaction and economic efficiency are regarded as accelerators in order to reach the goal of reducing mortality rates through pooling of hospital case volume in a for-profit (private) hospital network organisation in Switzerland. The value drivers as derived from the academic and practice literature, from the stakeholders’ perspectives, were linked with the hospital performance factors and defined as proposition matrix.

For Punch (2005, p. 239) the main question is “what, exactly, are we trying to find out?”. This leads to the conclusion that different underlying questions require different methods. Medical patient record routine data (BFS data set) and the opinion as well as the knowledge of involved stakeholders were brought together and required an investigation in a real-life hospital context and justified the combination of a quantitative as well as a qualitative research approach. While quantitative data are information about the world in numerical form, necessarily structured in terms of the number system by the researcher, qualitative data are information in the form of words (Punch, 2005). Different methods allow a triangulation that strengthens a study in terms of reliability and validity since every method has its limitations (Patton, 2002).

The sample size in a quantitative analysis is an important factor in research and is directly linked to the question of objectivity. In order to contribute to generalisability and because the research was not aimed at understanding one particular case, the investigation used the BFS data set for the quantitative analysis which represents all hospitalised medical patients records in Switzerland between 2003 and 2007 and can therefore considered to be objective. In order to identify low- and high-volume hospitals
in the largest private hospital group in Switzerland and to remain reliable and valid, the same data were used to study the hospitals of the investigated hospital network.

The results from the qualitative investigation have only limited generalisability, but are valid for the specifically investigated hospital network in Switzerland. Nevertheless, using a multiple-case scenario lead to a better understanding of value drivers regarding the pooling of case volume among several stakeholders in hospital network organisations. Yin (1994, p. 45) noted “Every case should serve a specific purpose within the overall scope of inquiry”. One goal of the qualitative design was to identify certain relationships between key value drivers on pooling case volume and hospital performance factors from the perspectives of patients, doctors and hospital executives. In the fields of brain, heart and viseral surgery 13 surgeons, 6 hospital executives and 13 patients – as selected from high- and low-volume hospitals of the investigated hospital network – were interviewed.

3.5 QUANTITATIVE ANALYSIS

3.5.1 Research Process

Switzerland maintains a national set of medical patient records of hospitalised patients since 1998, which belongs to the responsibility of the Bundesamt für Statistik (BFS, i.e. the Federal Statistical Office). At the end of each calendar year, each Swiss hospital or health care institute has to deliver to the BFS the anonymised data regarding each hospitalised patient case following a defined data model, which comprises over 100 fields for administrative as well as medical information related to the patient case. Following the methodological approach of Birkmeyer et al. (2002), national patient record data are used to identify the subsets of patients with defined complex medical
conditions. A “complex” medical condition in a patient is defined either as a severe, potentially life-threatening disease with or without further concomitant diseases (e.g. a patient with brain tumor, but also suffering from severe diabetes mellitus complications, or additional infection) or the condition of a patient who has to undergo an operation/treatment which requires high-end technology and an elevated level of medical expert (e.g. surgeon) skill. The list of investigated complex medical conditions (see Chapter 4, Analysis of Data) was derived from the literature (Birkmeyer et al., 2002), where mortality differences with the treatment of medical conditions between high- and low-volume hospitals have been investigated. The mortality rates for the defined medical conditions per Swiss acute care hospital care were determined quantitatively as described in detail below.

Upon application by for the usage of the Swiss national dataset of patient records, the Swiss Bundesamt für Statistik formally accepted the investigation of the recorded Swiss patient data.

3.5.2 Selection of Data and Sample Size

The chosen methodology investigated all available cases with a defined complex medical condition, not just subsamples of the overall dataset of patient records. Patient cases to be assigned to a complex medical condition were identified by searching specific sets of search statements for diagnoses as well as interventions in the BFS medical record collection. All cases matching the search strategy for a complex medical condition where included in the analysis. For each case of a complex medical condition group, treatment outcome in terms of mortality within 90 days of treatment was analysed. 344,599 medical patient records for all investigated medical conditions from
all Swiss hospitals over a 5-year period (2003 - 2007) were included in the quantitative analysis.

Cases with complex medical conditions in those hospitals, which did not report any death cases during the study period (pooled data from 2003 - 2007), were excluded from the analysis.

The search statements for the selection of patients to the defined groups of complex medical conditions are available upon request and were based on diagnosis codes from the ICD-10 disease classification list as well as the ICD-CM-9 classification of procedures – more specifically from its Swiss derivative CHOP, Swiss classification of medical procedures.

Data from hospitals with only a few cases per complex medical condition during the 5-year pooling period showed partly obvious ICD classification coding errors and were consequently discarded from the analysis. In addition, hospitals, which did not report any mortality cases in the treatment of the investigated medical conditions over a 5-year period were not further analysed regarding the determination of minimum case volume definitions.

Patient condition was taken account of - at least in part and what could be exploited from the Swiss BFS data - by calculating the Charlson comorbidity score (Charlson et al., 1987, pp. 373 - 383) for each analysed patient. The Charlon comorbidity score takes account of the patient’s age as well as of major concomitant impairments and diseases.
3.5.3 Variables

Data variables per patient record included administrative data like age, gender and area of residence of the patient, location of the treating hospital, length of the hospital stay of the patient, major diagnosis, up to nine secondary diagnoses of concomitant diseases or complications, major treatment intervention, up to nine additional treatment interventions, hospital stay entry variables (e.g. type of hospital admission, stay before hospital admission, decision for hospital admission), hospital stay discharge variables (type of hospital discharge, e.g. as death case, stay after hospital discharge, decision of hospital discharge), number of days between subsequent hospital stays (either in the same hospital or in an other hospital) of the patient, DRG (diagnosis-related group with the cost weight as a measure of hospital resource usage) of the case, as well as further data per patient hospitalisation (> 100 fields per patient care record).

Mortality is defined as the relation of the comorbidity-adjusted (Charlson score) number of deaths per investigated medical condition within 90 days of hospital treatment to the number of all treated patients with this condition in a hospital (compare the definition of Birkmeyer et al., 2002).

3.5.4 Data Analysis

The quantitative data analysis consists of two parts. The first part investigated the determination of minimum hospital volumes concerning severe medical entities in Switzerland and the second part the definition of high- and low-volume hospitals of a large for-profit hospital network in Switzerland (Figures 2.5 and 3.1).
In order to identify minimum hospital case volumes for Switzerland, the following steps were performed: firstly pooling of all Swiss inpatient medical case records data from 2003 to 2007 from the BFS files, and secondly the definition of the complex medical conditions to be investigated for the determination of a minimum hospital volume. The following complex medical conditions (diagnoses, procedures) derived from the literature as well as from the author’s own experience as a hospital executive are investigated:

- Brain tumor removal surgery
- Brain vascular surgery
- Spinal cord surgery
- Heart valve and septum interventions
- Aortic valve replacement
- Mitral valve replacement
- Coronary artery bypass grafting (including myocardial revascularisation)
- Percutaneous coronary artery intervention (stenting, angioplasty)
- Percutaneous coronary artery intervention during acute myocardial infarction
- Elective abdominal aorta aneurysm repair
- Carotid artery endarterectomy
- Lower extremity bypass surgery
- Stroke
- Major thorax surgery
- Pneumonectomy
- Lung lobectomy
- Oesophagectomy
- Pancreatectomy
- Major intestine/colon surgery
- Rectum resection
- Hepatectomy
- Nephrectomy
- Radical prostatectomy
- Radical hysterectomy
- Vertebral column stabilisation procedures
- Total hip replacement
- Total knee replacement

The determination of the hospital volume of cases per medical entity investigated of each Swiss hospital derived from the BFS data set. The determination of treatment mortality of each of the medical entities was investigated per Swiss hospital. Patients from hospitals which did not report any death case occurrence during a five-year period (2003 - 2007) regarding treatment of a complex medical entity, were excluded from the analysis. Comorbidity (i.e. medical diseases coexisting to the main treatment indication) was calculated using the Charlson comorbidity score (Charlson et al., 1987, pp. 373 - 383; Birkmeyer et al., 2002, pp. 1128 - 1137). The formation of two groups of patients per medical entity was based on a distribution as evenly as possible between a high-volume (HV) and a low-volume (LV) group by selecting patients from high-volume and low-volume hospitals (according to the volume rankings of Swiss hospitals regarding a complex medical entity). The statistical comparison of adjusted mortality between high- and low-volume groups per complex medical condition was analysed by regression analyses were performed using the SPSS Statistics package (IBM). Descriptive statistics, tests regarding the type of data distribution, and statistical significance tests
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(analysis of variance, Kruskal Wallis, Mann Whitney, Kolomogorov Smirnov) were performed using the ALGLIB Statistics package (open source software, available from www.alglib.net, distributed under a GPL license) and the commercially available Total Access Statistics package (from FMS, Inc., 8150 Leesburg Pike, Suite 600, Vienna, Virginia 22182-2721, USA).

In order to determine the minimum hospital volume of medical entities, the differences in adjusted mortality rates of high- (HV) and low-volume (LV) groups per medical entity were investigated for statistical significance (at least p < .05), based on analysis of variance (ANOVA) statistics.

The “null hypothesis” for this quantitative investigation is formulated as follows: there is no significant difference between treatment outcome (mortality) between high and low volume groups in defined medical conditions. The "null hypothesis" will be rejected when a statistically significant difference between mortality in high volume vs. low volume hospitals can be demonstrated.

A minimum hospital case volume of a medical entity was defined as the number of hospital cases of the hospital with the lowest volume in the HV group, provided a statistically significant difference in adjusted mortality between HV and LV groups could be observed. In order to test whether the minimum hospital case volume of a medical entity could lie even lower than as defined on the basis of HV and LV groups with fairly equal numbers of patients (see above), the following procedure was performed: the patients from the hospital in the LV group of a complex medical entity
with the highest hospital volume were assigned to the HV group, thereby increasing the number of patients in the HV group and decreasing the number of patients in the LV group. Tests for statistical significance between the adjusted mortalities of these redefined HV and LV groups were then performed. This procedure was repeated five times and then stopped because the redistribution of patients from the LV to the HV group led to increasingly higher differences in the number of patients of the HV and LV groups, therefore increasingly reducing the possibilities of statistical significance testing. Chapter 4.2.1, “Determination of Swiss Minimum Hospital Volumes”, presents the results the first quantitative research step of the thesis.

3.5.5 Hypothesis Testing

On the basis of the determined Swiss minimum case volumes (Chapter 4.2.1), the hospitals of a for-profit hospital network were investigated whether they met the defined minimum case volume requirements. Consequently the investigated hospitals were classified as high- and low-volume hospitals regarding the medical entities for which a Swiss minimum yearly case volume could be established. Chapter 4.2.2, “Determination of High-Volume and Low-Volume Hospitals in a large Network Organisation in Switzerland”, presents the results of the testing of the defined Swiss minimum case volumes for the hospitals of a Swiss private hospital network.

3.5.6 Limitations, Strengths and Weaknesses

The determined minimum case volume requirements relate only to the Swiss hospital acute care market. Since this market is relatively small in relation to that of other countries, data from several years (2003 - 2007) had to be pooled. It has to be taken into
account that the data quality of the nationally secured medical patient records has undergone a process of improvement in the past 10 years, and therefore the reporting of mortality as well as the comorbidities and the completeness of the reports of all interventional procedures per hospitalised case in Switzerland improved over time. As a consequence, the accuracy of the established minimum case volumes may be improved by extending the analysis to the years 2008/2009 by future research.

3.5.7 Scientific Criteria: Objectivity, Validity and Reliability

The quantitative investigation tried objectively and purely by quantitative methods to determine Swiss minimum case volumes for complex medical conditions. The decision to discard the cases with complex medical conditions of those hospitals, which did not report any death cases during the study period (pooled data from 2003 - 2007), was taken in order to avoid confounding the mortality analyses.

The quantitative investigation analysed all patient data assigned to the defined groups of complex medical conditions from the 5-year study period, not just sub-samples of the overall universe, and therefore the results of the investigation can be considered as valid, objective and reliable.

3.5.8 Ethical Considerations

The research project was approved by Charles Sturt University, Ethics in Human Research Committee, for use of Human Participants or Materials in Research in 2009.
3.6 QUALITATIVE ANALYSIS

3.6.1 Interview Research Procedure

After the quantitative investigation, the qualitative testing of the key value drivers for case volume pooling to foster hospital network performance was undertaken. The aim of this qualitative part of the research was to test the literature-based propositions and to develop a preliminary model on value drivers regarding the concentration and centralisation of case volume of complex medical conditions in the largest for-profit (private) hospital network organisation in Switzerland. Therefore, it was necessary to choose an appropriate qualitative method, which allowed for the combination of these two tasks.

The construction of a preliminary model regarding the value drivers on pooling case volumes required a qualitative research technique with “open questions” (Dey, 2004, p. 23), because the key elements of such a new framework are not apparent in the literature. There are some important indications about the views of practice experts to be interviewed and some theoretical models in the literature, but the opinions and beliefs of the involved stakeholders are unknown.

According to Dey (2004, p. 22) and Silverman (2006) qualitative research methods are used for “theory-building”. As mentioned above the chosen concept of Carson et al. (2005, p. 97) presents a well-established qualitative research process aimed at the goal of discovering the truth about a theory (see also Figures 2.5 and 3.1). Although there is no general agreement in social science about the definition of expert interviews, it can be stated that expert interviews are interviews with people who have a particular knowledge in a certain field because of their professional position (Gläser, Laudel,
2006, p. 11). As mentioned above, the experts regarding the research question are “patients”, “doctors” (GP’s, referrers and surgeons) and “hospital executives” from low-volume hospitals and as well as from high-volume hospitals.

The research participants - i.e. the hospital key stakeholders as mentioned above - were invited to participate in an interview. The collection of data was achieved via personal interviewing, a two-way face-to-face discussion designed to elicit detailed responses from the interviewee. The interviewees were informed about the research objectives in advance. Doctors, patients and hospital managers from the hospital network were approached to determine their willingness to participate in the study. Patients were only included in the study on their doctors’ recommendation. The research followed the principles of “Informed Consent” and “Privacy and Confidentiality” for all participants (patients, surgeons, hospital managers). Furthermore, the hospital CEO of the investigated hospital network organisation approved the commencement of the investigation. The pre-description encouraged participants to reflect on case volume data for the complex medical condition at the specific hospital location (i.e. the yearly number of treatments) per medical condition regarding medical outcome (i.e. quality of treatment), and asked to consider alternatives to meet the challenge of how case volume might be pooled in the context of a hospital network organisation and to meet the standard minimum case volume per medical condition per individual hospital in the hospital network. The literature-based propositions were not especially emphasised, only if the interviewee did not give statements regarding these topics, the interviewee was asked about it directly. The average duration of the interviews was one hour. Patient participants were encouraged to reflect on criteria how they selected their hospital as well as the doctor, and were asked about their views on possible treatments
in alternative locations regarding the delivery of a specific medical service. Because of ethical reasons, special emphasis was laid on the patient selection and the patient interview process:

- Doctors of patients with medical conditions (as defined in the quantitative part of the investigation) already treated by low-volume respectively high-volume hospitals within the hospital network were contacted by the investigator to determine their willingness for patients who have recovered from complex medical conditions to be invited to be involved in the study. The doctors were informed by the investigator about the purpose of the research. Doctors were asked whether they would be willing to cooperate with the investigator and to identify specific patients who could be invited to participate in the study.

- The doctor provided the patient with information about the goal of the research and asked whether the patient would be interested and willing to participate in the study.

- If the patient agreed to participate, the investigator explained to the patient the purpose of the study and the context of the patient interview. After providing information to the patient about the study, the consent forms to participate in the study were signed. The patient was asked to deliberate again about his/her willingness to participate and to take the decision to sign the consent form at convenience, and confirming there were no negative consequences for non-participation.

- The investigator invited the patient to meet with the investigator for the interview (approximately one hour duration) in a comfortable environment (e.g. in a nice room in the hospital).

- The investigator posed questions to the patient following the structure of the
attached questionnaire (see Appendix 9, Questionnaires). The interview was recorded by tape. After each interview and in listening to the tape recordings, the author made a summary, including the coding of the words and phrases of the interviewees.

- After completion of the interview, the interviewer evaluated the interview.
- The patients were encouraged to discuss the process of the interview with their doctor.
- The treating doctor of the participating patient was provided with feedback about the interview process, not the interview content, which remained confidential.

### 3.6.2 Applied Interview Technique

The literature classifies the expert interview as unstructured interview, and it is considered as a type of an in-depth interview (Gläser, Laudel, 2006, p. 39; Carson et al., 2005, p. 85). One of the recommended interview techniques is the convergent interview also-called “Leitfaden” interview. The convergent interview guides the researcher through the interview and allows refining of the question after each interview. According to Carson et al., (2005, p. 85), the convergent interview is a technique for collecting, analysing and interpreting qualitative data about people’s attitudes, beliefs, knowledge and opinions by the use of only a small number of expert interviews. It is based on the questions concept of in-depth interviews but each interview goes through a complete process of design, data collection, interpretation and redesign. The convergent interview is very similar to the grounded theory, but not as complex or common (Carson et al., 2005, p. 86). According to the same authors, the advantages of convergent interviews are the unstructured content of topics but at the same time the structured
process, because its data collection and analysis is rigorous. Furthermore, the convergent interview is a dialectical process, because the method tries to disprove the emerging explanations of the data after each interview. Carson et al., (2005, p. 86), argue the convergent interview can be used for qualitative research about a topic, which has no established theoretical base or methodology. Therefore, the chosen technique was the “convergent interview”, because the research topic had no established theoretical base. The chosen technique allowed testing the literature-based developed proposition matrix in combination with gathering new information in order to develop a final provider model about key value drivers on pooling of case volume of complex medical conditions in the largest for-profit (private) hospital network organisation in Switzerland.

### 3.6.3 Sample Size and Selection of Interviewees

The definition of the sample size of interviews followed the recommendations of Perry (1998, pp. 76 - 85): between 6 and 12 interviews are necessary per project to reach valid and reliable results. In the context of the thesis topic, the involved stakeholders or experts were patients, surgeons and hospital executives. Dick (1990, p. 25) suggested that the sample size should be data driven and that it should contain at least 12 interviewees. In contrast Carson et al. 2005, p. 87, had mentioned that six interviews are sufficient, because beyond this number of six interviews increases in understanding are small and not worth the cost of the time spent in further interviewing. Therefore, in accordance with these recommendations 13 patients and their individual doctors (13) were interviewed. These doctors were working in 6 different hospitals, thus encouraging the inclusion of the directors of these 6 hospitals in the study. As illustrated in the tables in Chapter 4, Data Analysis, in total 32 in-depth interviews, were performed. Those 32
in-depth interviews formed the sample for this investigation. The cases investigated for this project were as follows: In the fields of brain, heart and visceral surgery, the following stakeholders were interviewed: 13 surgeons, 6 hospital executives and 13 patients as selected from high- and low-volume hospitals in the largest private hospital network organisation in Switzerland.

As described in many social science studies, the selection of interviewees followed the principles of maximum variation and the use of a small collection of relevant people (Dick, 1990, p. 44 - 55; Gorden, 1975, p. 196 - 197). Therefore, patients with different complex medical conditions, doctors from different surgery fields and hospital executives from different low- and high-volume hospitals were selected (see Chapter 4, Analysis of Data).

After each interview, the answers were subject to analysis and resulted in a redesign of the interview process. Based on the convergent interview, the author adapted the interview questions during the research. Therefore, the interaction between the research activities of data collection and data analysis allows for the adaptation and improvement of the defined interview questions.

3.6.4 Data Analysis and Proposition Testing

In principle, the author followed the recommended process of data analysis of Dey (2004, p. 26) illustrated in Figure 3.3. In contrast to Dey’s model with “steps” a “spiral-form” model of data analysis was employed, as illustrated in Figure 3.4. The reason for this decision was that the process of convergent interviewing is like a spiral, which includes a sequence of refined in-depth interviews. This process contains repetitive and
simultaneous data collecting, analysis and redesigning as described above and documented by Carson et al (2005, p. 87). As already mentioned, after each interview, the author wrote a summary/protocol. Through continuing analysis of these summaries, each further probe could be refined systematically during the research period. The more unstructured interview in the first interview moved into a more and more structured form with each interviewee. The author coded each interview “axially” and categorised it according the “propositions” and where necessary added new “items” in an MS Excel file. The new additional items, which were gathered from the interviews, were added to the matrix. In the “selective” phase of coding the author compared the statements from the interviews with the different perspectives of patients, doctors and surgeons. With regard to the posed research questions, the opinions, beliefs, and the knowledge of the interviewees were compared with the defined proposition matrix and classified as “agrees”, “disagrees” and “uncertain” (see Chapter 4, Analysis of Data). Three such matrices were developed in order to include the three perspectives of patients, doctors and hospital executives (see Chapter 4, Analysis of Data). Thereby the propositions could be tested and furthermore extended with new issues from the interviewees. The extension of the propositions, i.e the additional issues, were only be added if there was unanimous agreement across stakeholder groups.
Figure 3.3: Process of data analysis (Dey, 2004, p. 26).

Figure 3.4: Spiral of data analysis. Own illustration.
3.6.5 Limitations, Strengths and Weaknesses

Complex and comprehensive situations - where in-depth interactions between the researcher and the participant are unavoidable - both justify the application of qualitative research approaches and underline the strength of the methods. Advantages such as responding in one’s own words, expressing personal perspectives or providing additional information to answers that explain the logic of thinking made the interview technique an indispensable instrument for discovering complex facts (Patton, 2002).

To address the potential limitations of distorted responses due to personal bias, anger, politics and lack of awareness due to the emotional state of the interviewee, interview data were scrutinised for comparability and consistency (Patton, 2002). All interviews were documented and the analyses were compared with the predefined proposition matrix.

The general atmosphere during the meetings, the environment and the relationships between the interviewer and the interviewees were friendly and comfortable. There were no negative impacts on data quality because of particular circumstances under which interview data were collected.

3.6.6 Scientific Criteria: Objectivity, Validity and Reliability

Objectivity

Several checkpoints mentioned in Patton (2002) and Scholz and Tietje (2002) were considered in the research design phase to improve the objectivity of findings. The following criteria were considered:

- The researcher did understand the research topics prior to the investigation.
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- The method competence was learned and practised at Charles Sturt University prior to the field research and the research instruments were pre-tested to become familiar with the convergent interviews.

- The number of interviewees involved allowed for the investigation by a single researcher on the one hand while on the other hand a multiple case approach involved stakeholders with differing values.

- High motivation since findings were expected to contribute to professional practice by offering a preliminary model on value drivers regarding the concentration of case volume for complex medical conditions in a hospital network organisation.

- The intention of the interview research was designed prior to the beginning of the investigation.

- Credibility of researcher: the researcher holds a medical degree in osteopathic medicine, as well as in Physiotherapy, an MBA, acts as CEO of the major hospital in an international hospital network organisation and has more than 10 years experience in different management positions.

- The researcher’s personal experience is that an in-depth understanding of complex circumstances requires qualitative as well as quantitative instruments and he has proposed the application of both elements for the dissertation.

Validity and Reliability

A set of criteria relating to quality assurance was considered in the interview process. Data collection was conducted following Patton (2002) as presented below:

- The questionnaire outline was complete and the researcher strictly adhered to the minimum content without skipping any topics.
- The answers were documented as they were given to the interviewer.
- The relationships between the researcher and the interviewees were stated clearly.
- The requirements of comparability and consistency in terms of interview results were realistic as the same researcher carried out all interviews.
- Therefore, the skill-set and the interview procedure were the same in each interview.
- The summary/protocol of each interview with doctors and hospital executives were discussed before the data analysis in order to guarantee validity.
- The statements about the posed research questions were strictly compared with the defined proposition matrix and classified as “agrees”, “disagrees” and “uncertain” in order to guarantee reliability.

3.6.7 Ethical Considerations

Dealing with ethical dimensions is an important topic in conducting research since the domain of the researcher is often the real world where individuals live and work and because investigations may open up what is inside people (Patton, 2002). The rights of research participants are affected and it is of primary importance to protect people and organisations from any adverse consequences (Kvale, 1996; Newman & Brown, 1996). Three key topics were identified and addressed during the investigation. Firstly, all participants were informed as to the purpose of the research. They were free to decide on their participation. Participants could withdraw at any time without any consequences, and this was clearly outlined in advance. All individuals were treated in a respectful manner. Secondly, the data collected were handled confidentially and
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remained anonymous. No linkage between the informants and research data is possible. Only tape recording was used and tapes will be destroyed after five years.

The key issue about ethical aspects was the qualitative research work, especially the dependency of the relationship between doctor and patient. Therefore, it was important that the patient was assured that there were no negative consequences of non-participation in the study. Further, the confidentiality of the information provided by the patients during the interview was assured. The interview data were treated confidentially and de-personalized for usage and storage. Secured archiving in the hospital archive in the Hirslanden Hospital Zurich was given. Five years after the thesis has been submitted, all data will be deleted.

The research project was approved and monitored by the Charles Sturt University, Ethics in Human Research Committee for use of Human Participants or Materials in Research in 2009.

3.7 CONCLUSIONS

The theory building, testing and extension process covered a combination of induction and deduction phases and required qualitative as well as quantitative techniques. Therefore, a logical process from the “idea” over the “proposition matrix” to the “preliminary provider model on pooling case volume of complex medical conditions” could be developed. Medical case record routine data (BFS data set) and the opinion as well as the knowledge of involved stakeholders were brought together and required an investigation in a real-life hospital context and justified the combination of a quantitative as well as a qualitative research approach.
During the theory building process the paradigm of Critical Realism was generally employed. For the quantitative analysis a more positivist paradigm was chosen. However, the literature analysis as well as the statistical results required interpretation, critical reflection and to be tested in a real hospital network environment by using – additionally – a qualitative research method, because the subjective truth regarding this research question may lie in a specific consensus between the key stakeholders of hospital network organisation.

Regarding the definition of the research question, the selection of the appropriate research method as well as the requirements concerning validity, objectivity and reliability, the most important variable to be investigated in this thesis on the value drivers for the improvement of hospital network performance was medical outcome quality, i.e. the reduction in mortality in the treatment of complex medical conditions, which means – in other words – the increase of the number of patient lives saved. The stakeholders’ value drivers regarding medical quality, patient satisfaction and economic efficiency were regarded as accelerators in order to reach the goal of reducing mortality rates through pooling of case volume. The literature-based value drivers from the stakeholders’ perspectives were linked with the hospital performance factors in a specific proposition matrix.

The quantitative analysis is aimed to define minimum standards in Switzerland and to adopt the found minimum hospital case numbers for the investigated complex medical conditions to classify the hospitals of a big private hospital network in Switzerland as high- and low-volume hospitals. The described quantitative research process is objective, valid and reliable because the whole set of available data (2003 - 2007) as
reported from all Swiss hospitals to the National Statistics Authority was used for the quantitative investigation.

On the basis of the minimum case volume standards and the identification of low- and high-volume hospitals, the qualitative research of this thesis analysed – by using the technique of convergent interviews – the opinions, beliefs, and the knowledge of patients, doctors and hospital executives in comparison with the predefined proposition matrix. 32 interviews with different stakeholders selected from low- and high-volume hospitals were investigated. The interview research process was designed in order to reach objective, valid and reliable results. Nevertheless, and because of the nature of qualitative investigations in general, the generalisability of the results is limited to private hospital network organisations in Switzerland.

Finally the combination of quantitative and qualitative results allowed for the development of a value driver matrix called “Preliminary model on value drivers regarding the concentration of case volume of complex medical conditions in the largest private hospital network organisation in Switzerland”.

Ethical considerations were of great importance. Three strategies were employed: providing thorough information to participants prior to the research, upholding confidentiality with regard to data management and the application of the codes of ethics from the Charles Sturt University.
4 ANALYSIS OF DATA

4.1 INTRODUCTION

Chapter 4 contains a comprehensive analysis of the quantitative as well as qualitative research data to address the research question: “How can pooling of case volume per complex medical conditions and per hospital maximise medical outcome, economic efficiency and patient experience in a hospital network organisation?” Figure 4.1 shows the various parts of the research analyses.

Table: Quantitative and Qualitative Analysis

<table>
<thead>
<tr>
<th>Testing and development of the final theory</th>
<th>Quantitative analysis</th>
<th>Qualitative analysis</th>
<th>Final theory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analysis of the Swiss inpatient data set between 2003 and 2007</td>
<td>In-depth interviews Pooling case volume and the patients’ value drivers</td>
<td>In-depth interviews Pooling case volume and the doctors’ value drivers</td>
<td>Preliminary model on value drivers regarding the concentration of case volume of complex medical conditions in a hospital network organisation</td>
</tr>
</tbody>
</table>

What are the required minimum case volumes for complex medical conditions in Switzerland based on the examination of the Swiss inpatient data set (Bundesamt für Statistik, BFS, data) with regard to the relationship between case numbers and medical outcome as measured by postoperative mortality rates?

Figure 4.1: Quantitative and qualitative analyses. Own illustration.

The results related to sub-question I about the identification of minimum case volume standards per complex medical cases and the identification of low- and high-volume hospitals are presented in the section “Quantitative Analysis”. As mentioned above, the qualitative investigation is following the quantitative analysis because it has to be considered that the main value driver i.e. the key variable in the context of pooling case volume of complex medical conditions is the mortality rate, or “saving lives” per medical condition. With the quantitative analysis, minimum case volume standards per
ANALYSIS OF DATA

complex medical condition will be defined and low- and high-volume hospitals in Switzerland identified.

The results related to the research sub-questions II - IV, i.e. the testing and extension of the related propositions, are described in the section Analysis of Qualitative Data. The narrative description of the collected data provides an overview of the opinions and values of patients, doctors and hospital executives about the concentration and centralisation of complex medical condition treatment in the largest private hospital group in Switzerland. Furthermore, each sub-question will be specifically examined.

Following this analysis, the final value matrix will be developed as a preliminary model on value drivers regarding the concentration of case volume per medical condition and per hospital in a hospital network organisation.

4.2 QUANTITATIVE ANALYSIS

4.2.1 Determination of Swiss Minimum Hospital Case Volumes

The quantitative analysis included data from 344,599 patient cases from the years 2003 to 2007 from the national collection of medical case records of hospitalised patients with complex medical conditions, which were investigated in this study (as listed further below in this chapter) in order to define minimum case volume standards for Switzerland (research proposition P1). The Swiss Bundesamt für Statistik (BFS, National Institute of Statistics) formally accepted the analysis undertaken in this thesis and has been approved for publishing by Patrick Schwab and Jacques Huguenin of the Federal Statistical Office in 2010.
The 344,599 investigated patient cases were first assigned to each of the studied medical conditions (see Table 4.1) on the basis of defined search strategies using diagnosis and medical procedure codes from the internationally accepted ICD (International Classification of Diseases) catalogue of diseases (originally defined by the WHO), which is in widespread use in many countries of the world. The selected BFS data were extracted from the overall data collection of BFS patient records of the years 2003 - 2007 which amount in total to 7,307,433 medical patient records, and were transferred to a specifically designed and implemented MS Access Database for the purpose of the quantitative investigation.

<table>
<thead>
<tr>
<th>Complex Medical Condition</th>
<th>Number of cases (5 years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DBAItem001 - Brain Tumor Removal</td>
<td>5'997</td>
</tr>
<tr>
<td>DBAItem002 - Brain Vascular Surgery</td>
<td>1'830</td>
</tr>
<tr>
<td>DBAItem003 - Heart Valve / Septum Interventions</td>
<td>13'402</td>
</tr>
<tr>
<td>DBAItem004 - CABG / Myoc Revasc</td>
<td>15'834</td>
</tr>
<tr>
<td>DBAItem005 - PTCA / Stenting</td>
<td>52'010</td>
</tr>
<tr>
<td>DBAItem006 - Radical Prostatectomy</td>
<td>10'266</td>
</tr>
<tr>
<td>DBAItem007 - Pancreatectomy</td>
<td>2'229</td>
</tr>
<tr>
<td>DBAItem008 - Oesophagectomy</td>
<td>832</td>
</tr>
<tr>
<td>DBAItem009 - Total Hip Replacement</td>
<td>64'587</td>
</tr>
<tr>
<td>DBAItem010 - Total Knee Replacement</td>
<td>44'940</td>
</tr>
<tr>
<td>DBAItem011 - Vertebral Column Stabilization Surgery</td>
<td>27'440</td>
</tr>
<tr>
<td>DBAItem012 - Temporary Tracheostoma</td>
<td>3'801</td>
</tr>
<tr>
<td>DBAItem013 - Major Thoracic Surgery</td>
<td>5'201</td>
</tr>
<tr>
<td>DBAItem014 - Spinal Cord Surgery</td>
<td>1'118</td>
</tr>
<tr>
<td>DBAItem015 - Percutaneous Intervention with AMI</td>
<td>14'477</td>
</tr>
<tr>
<td>DBAItem016 - Rectum Resection</td>
<td>6'084</td>
</tr>
<tr>
<td>DBAItem017 - Major Intestine / Colon Surgery</td>
<td>33'522</td>
</tr>
<tr>
<td>DBAItem018 - Radical Hysterectomy</td>
<td>1'281</td>
</tr>
<tr>
<td>DBAItem019 - Stroke</td>
<td>10'436</td>
</tr>
<tr>
<td>DBAItem020 - Abdominal Aortic Aneurysm Repair</td>
<td>1'591</td>
</tr>
<tr>
<td>DBAItem021 - Carotid Endarterectomy</td>
<td>3'037</td>
</tr>
<tr>
<td>DBAItem022 - Nephrectomy</td>
<td>4'747</td>
</tr>
<tr>
<td>DBAItem023 - Lobectomy</td>
<td>3'042</td>
</tr>
<tr>
<td>DBAItem024 - Pneumonectomy</td>
<td>815</td>
</tr>
<tr>
<td>DBAItem025 - Aortic Valve Replacement</td>
<td>7'481</td>
</tr>
<tr>
<td>DBAItem026 - Mitral Valve Replacement</td>
<td>1'349</td>
</tr>
<tr>
<td>DBAItem027 - Lower Extremity Bypass</td>
<td>7'250</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>344'599</strong></td>
</tr>
</tbody>
</table>

Table 4.1: Number of patient records per complex medical condition investigated.
ANALYSIS OF DATA

The SQL search statements in order to select cases per complex medical condition from the BFS medical data records 2003 - 2007 are available upon request.

The data model of the MS Access database used for the quantitative analysis of the thesis contained 30 data fields with administrative as well as medical patient case data (as described in Chapter 3.5.3 Variables).

In the next step of the quantitative analysis, by means of the described MS Access database and in order to define minimum case volumes standards for Switzerland, the number of cases per complex medical condition per Swiss hospital was established. Appendix 6 presents a sample of the investigated medical patient records per complex medical condition and Swiss hospital (anonymised by non-significant hospital identification numbers, Hospital ID).

Then the investigated hospitals were distributed per medical condition to a high-volume (HV) or a low-volume (LV) group of hospitals per complex medical condition as described in Chapter 3.5.4 Data Analysis. Low-volume hospitals with obvious coding errors of diseases or procedures, and those hospitals which did not report mortality in the investigated 5-year period, were discarded from further analysis. Appendix 7 shows a sample of the classification of hospitals as HV or LV hospitals per complex medical condition in Switzerland.

The results of statistical significance testing of differences in adjusted mortality between high- and low-volume groups per complex medical condition is stored in the MS Access database of the quantitative investigation results of this research. A sample of the
statistical output is provided in Appendix 8. Detailed results of the statistics tests can be obtained upon request.

Linear regression analysis (using the SPSS statistics package) showed discernible correlations between the number of cases with a complex medical condition and risk-adjusted mortality of the investigated hospitals (Figures 4.1 to 4.7), i.e. that hospitals with smaller case volumes showed higher mortality compared to hospitals with higher case volumes.

Figure 4.2: Simple Linear Regression Analysis: Brain tumor excision
ANALYSIS OF DATA

○ Mortality and 5-year number of cases per hospital
- Linear Regression

Figure 4.3 Simple Linear Regression Analysis: Oesophagectomy
Figure 4.4 Simple Linear Regression Analysis: Pancreatectomy
Mortality and 5-year number of cases per hospital

- Linear Regression

Figure 4.5: Simple Linear Regression Analysis: Temporary tracheostomy
Mortality and 5-year number of cases per hospital

Linear Regression

Figure 4.6: Simple Linear Regression Analysis: Percutaneous coronary interventions with acute myocardial infarction
According to the described procedure for the determination of a minimum case volume in Switzerland (Chapter 3.5), the following results were obtained as shown in the Table 4.2:
ANALYSIS OF DATA

<table>
<thead>
<tr>
<th>DBAItem</th>
<th>HV Cases</th>
<th>HV Deaths Adj</th>
<th>HV Mortality</th>
<th>LV Cases</th>
<th>LV Deaths Adj</th>
<th>LV Mortality</th>
<th>Min Volume 1Y</th>
<th>HV/LV Diff</th>
</tr>
</thead>
<tbody>
<tr>
<td>DBAItem001 - Brain Tumor Removal</td>
<td>2296</td>
<td>86.9</td>
<td>3.76%</td>
<td>3436</td>
<td>196.79</td>
<td>5.73%</td>
<td>167</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>DBAItem002 - Brain Vascular Surgery</td>
<td>1267</td>
<td>133.5</td>
<td>10.50%</td>
<td>415</td>
<td>67.61</td>
<td>16.30%</td>
<td>2</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>DBAItem003 - Heart Valve / Septum Interventions</td>
<td>6728</td>
<td>311.9</td>
<td>4.60%</td>
<td>6425</td>
<td>352.19</td>
<td>5.50%</td>
<td>24</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>DBAItem004 - CABG / Myocardial Revascularisation</td>
<td>12626</td>
<td>430.3</td>
<td>3.40%</td>
<td>3093</td>
<td>143.6</td>
<td>4.60%</td>
<td>142</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>DBAItem005 - PTCA / Stenting</td>
<td>23184</td>
<td>570.7</td>
<td>2.46%</td>
<td>27866</td>
<td>590.47</td>
<td>2.12%</td>
<td>48</td>
<td>p &lt; 0.05</td>
</tr>
<tr>
<td>DBAItem006 - Radical Prostatectomy</td>
<td>1490</td>
<td>4.8</td>
<td>0.32%</td>
<td>1571</td>
<td>13.77</td>
<td>0.88%</td>
<td>12</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>DBAItem007 - Pancreatectomy</td>
<td>1280</td>
<td>81.0</td>
<td>6.30%</td>
<td>701</td>
<td>69.5</td>
<td>9.90%</td>
<td>12</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>DBAItem008 - Oesophagectomy</td>
<td>43</td>
<td>39.4</td>
<td>9.10%</td>
<td>201</td>
<td>39.94</td>
<td>19.90%</td>
<td>48</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>DBAItem009 - Total Hip Replacement</td>
<td>29827</td>
<td>197.0</td>
<td>0.66%</td>
<td>31215</td>
<td>215.21</td>
<td>0.69%</td>
<td>105</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>DBAItem10 - Total Knee Replacement</td>
<td>18692</td>
<td>36.6</td>
<td>0.20%</td>
<td>12707</td>
<td>67.51</td>
<td>0.50%</td>
<td>105</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>DBAItem011 - Vertebral Column Stabilization Surgery</td>
<td>11462</td>
<td>111.1</td>
<td>0.97%</td>
<td>12616</td>
<td>116.14</td>
<td>0.92%</td>
<td>15</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>DBAItem012 - Temporary Tracheostoma</td>
<td>2433</td>
<td>549.5</td>
<td>22.60%</td>
<td>1223</td>
<td>421.2</td>
<td>33.70%</td>
<td>15</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>DBAItem013 - Major Thoracic Surgery</td>
<td>2169</td>
<td>103.9</td>
<td>4.79%</td>
<td>2597</td>
<td>105.39</td>
<td>4.06%</td>
<td>12</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>DBAItem014 - Spinal Cord Surgery</td>
<td>378</td>
<td>14.5</td>
<td>3.82%</td>
<td>506</td>
<td>20.16</td>
<td>3.98%</td>
<td>12</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>DBAItem015 - Percutaneous Intervention with AMI</td>
<td>10416</td>
<td>121.4</td>
<td>12.0%</td>
<td>3345</td>
<td>54.26</td>
<td>1.60%</td>
<td>105</td>
<td>p &lt; 0.05</td>
</tr>
<tr>
<td>DBAItem016 - Rectum Resection</td>
<td>2871</td>
<td>38.1</td>
<td>1.30%</td>
<td>1897</td>
<td>45.17</td>
<td>2.70%</td>
<td>25</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>DBAItem017 - Major Intestine / Colon Surgery</td>
<td>16106</td>
<td>539.3</td>
<td>3.35%</td>
<td>16155</td>
<td>557.71</td>
<td>3.45%</td>
<td>12</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>DBAItem018 - Radical Hysterectomy</td>
<td>318</td>
<td>9.3</td>
<td>2.90%</td>
<td>23</td>
<td>3.55</td>
<td>15.40%</td>
<td>5</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>DBAItem019 - Stroke</td>
<td>4889</td>
<td>652.2</td>
<td>13.34%</td>
<td>5125</td>
<td>886.14</td>
<td>16.85%</td>
<td>35</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>DBAItem020 - Abdominal Aortic Aneurysm Repair</td>
<td>563</td>
<td>22.0</td>
<td>3.90%</td>
<td>666</td>
<td>38.93</td>
<td>5.85%</td>
<td>16</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>DBAItem021 - Carotid Endarterectomy</td>
<td>1641</td>
<td>15.4</td>
<td>0.90%</td>
<td>177</td>
<td>7.78</td>
<td>4.40%</td>
<td>15</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>DBAItem022 - Nephrectomy</td>
<td>1580</td>
<td>36.3</td>
<td>2.42%</td>
<td>2001</td>
<td>56.01</td>
<td>2.90%</td>
<td>35</td>
<td>p &lt; 0.06</td>
</tr>
<tr>
<td>DBAItem023 - Lobectomy</td>
<td>1215</td>
<td>49.6</td>
<td>4.08%</td>
<td>1350</td>
<td>52.35</td>
<td>3.88%</td>
<td>12</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>DBAItem024 - Pneumonectomy</td>
<td>515</td>
<td>44.7</td>
<td>8.70%</td>
<td>156</td>
<td>22.91</td>
<td>14.70%</td>
<td>12</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>DBAItem025 - Aortic Valve Replacement</td>
<td>3199</td>
<td>135.6</td>
<td>4.24%</td>
<td>4080</td>
<td>237.8</td>
<td>5.83%</td>
<td>15</td>
<td>p &lt; 0.01</td>
</tr>
<tr>
<td>DBAItem026 - Mitral Valve Replacement</td>
<td>575</td>
<td>47.3</td>
<td>8.22%</td>
<td>752</td>
<td>68.87</td>
<td>9.16%</td>
<td>5</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>DBAItem027 - Lower Extremity Bypass</td>
<td>3133</td>
<td>154.0</td>
<td>4.92%</td>
<td>3523</td>
<td>164.55</td>
<td>4.67%</td>
<td>105</td>
<td>p &lt; 0.001</td>
</tr>
</tbody>
</table>

Legend: DBAItem = Investigated medial entity; HV = High-volume hospitals; DeathsAdj = Charlson Score adjusted number of deaths; LV = Low-volume hospitals; Mortality = Mortality rate in %; Minimum Volume1Y = Statistically required minimum case volume per year and per hospital; HV/LV Diff = Level of statistically significant difference between HV and LV hospitals.

Table 4.2: Minimum case volumes for treatment of complex medical conditions in Switzerland. Own data.
The variables presented in the table above include the number of cases of high-volume hospitals per complex medical condition (HV Cases), the risk-adjusted number of deaths per complex medical condition in high-volume hospitals (HV Deaths Adj), the risk-adjusted mortality of high-volume hospitals (HV Mortality), the number of cases of low-volume hospitals per complex medical condition (LV Cases), the risk-adjusted number of deaths per complex medical condition in low-volume hospitals (LV Deaths Adj), the risk-adjusted mortality of low-volume hospitals (LV Mortality), the yearly minimum case volume per medical condition (Min Volume 1Y), the statistical significance test result of mortality differences between high- and low-volume groups (HV/LV Diff).

For the complex medical conditions marked in grey in the above table, a statistically significant difference in adjusted mortality between high- and low-volume groups could be established. Statistical significance testing was based on the analysis of variance (ANOVA) test, which emerged as the strongest test in the investigation showing the highest discriminative power between high- and low-volume groups in comparison to other statistical test methods used (Kruskal Wallis, Mann Whitney, Kolmogorov Smirnov).

4.2.2 Determination of High-Volume and Low-Volume Hospitals in a Large Hospital Network Organisation in Switzerland

On the basis of the defined minimum hospital volume standards the high- and low-volume hospitals within the investigated for-profit hospital network were identified (Table 4.3):
### ANALYSIS OF DATA

<table>
<thead>
<tr>
<th>5YMinVolume</th>
<th>5YVolumeHospital</th>
<th>VolReq</th>
<th>Hospital</th>
<th>DBA Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>1'215</td>
<td>1'224</td>
<td>ok</td>
<td>A</td>
<td>DBAItem003 - Heart Valve / Septum Interventions</td>
</tr>
<tr>
<td>715</td>
<td>1'237</td>
<td>ok</td>
<td>I</td>
<td>DBAItem004 - CABG / Myocardial Revascularisation</td>
</tr>
<tr>
<td>715</td>
<td>720</td>
<td>ok</td>
<td>C</td>
<td>DBAItem004 - CABG / Myocardial Revascularisation</td>
</tr>
<tr>
<td>715</td>
<td>1'757</td>
<td>ok</td>
<td>A</td>
<td>DBAItem004 - CABG / Myocardial Revascularisation</td>
</tr>
<tr>
<td>240</td>
<td>715</td>
<td>ok</td>
<td>I</td>
<td>DBAItem004 - CABG / Myocardial Revascularisation</td>
</tr>
<tr>
<td>240</td>
<td>246</td>
<td>ok</td>
<td>L</td>
<td>DBAItem006 - Radical Prostatectomy</td>
</tr>
<tr>
<td>240</td>
<td>410</td>
<td>ok</td>
<td>A</td>
<td>DBAItem006 - Radical Prostatectomy</td>
</tr>
<tr>
<td>240</td>
<td>305</td>
<td>ok</td>
<td>E</td>
<td>DBAItem006 - Radical Prostatectomy</td>
</tr>
<tr>
<td>60</td>
<td>60</td>
<td>ok</td>
<td>A</td>
<td>DBAItem007 - Pancreatectomy</td>
</tr>
<tr>
<td>60</td>
<td>79</td>
<td>ok</td>
<td>I</td>
<td>DBAItem007 - Pancreatectomy</td>
</tr>
<tr>
<td>525</td>
<td>561</td>
<td>ok</td>
<td>C</td>
<td>DBAItem010 - Total Knee Replacement</td>
</tr>
<tr>
<td>525</td>
<td>911</td>
<td>ok</td>
<td>A</td>
<td>DBAItem010 - Total Knee Replacement</td>
</tr>
<tr>
<td>525</td>
<td>572</td>
<td>ok</td>
<td>G</td>
<td>DBAItem010 - Total Knee Replacement</td>
</tr>
<tr>
<td>525</td>
<td>1'470</td>
<td>ok</td>
<td>J</td>
<td>DBAItem010 - Total Knee Replacement</td>
</tr>
<tr>
<td>525</td>
<td>804</td>
<td>ok</td>
<td>E</td>
<td>DBAItem010 - Total Knee Replacement</td>
</tr>
<tr>
<td>125</td>
<td>424</td>
<td>ok</td>
<td>I</td>
<td>DBAItem016 - Rectum Resection</td>
</tr>
<tr>
<td>125</td>
<td>147</td>
<td>ok</td>
<td>B</td>
<td>DBAItem016 - Rectum Resection</td>
</tr>
<tr>
<td>125</td>
<td>213</td>
<td>ok</td>
<td>E</td>
<td>DBAItem016 - Rectum Resection</td>
</tr>
<tr>
<td>25</td>
<td>25</td>
<td>ok</td>
<td>D</td>
<td>DBAItem018 - Radical Hysterectomy</td>
</tr>
<tr>
<td>25</td>
<td>32</td>
<td>ok</td>
<td>A</td>
<td>DBAItem018 - Radical Hysterectomy</td>
</tr>
<tr>
<td>25</td>
<td>38</td>
<td>ok</td>
<td>J</td>
<td>DBAItem018 - Radical Hysterectomy</td>
</tr>
<tr>
<td>80</td>
<td>173</td>
<td>ok</td>
<td>A</td>
<td>DBAItem021 - Carotid Endarterectomy</td>
</tr>
<tr>
<td>780</td>
<td>782</td>
<td>ok</td>
<td>A</td>
<td>DBAItem025 - Aortic Valve Replacement</td>
</tr>
</tbody>
</table>

Legend: 5YMinVolume = Statistically required minimum case volume per five years and per hospital; 5YVolumeHospital = Five year case volume of the particular hospital; VolReq = Required case volume per five years achieved; Hospital = Particular hospital inside the hospital network; DBA Item = Investigated medical entity.

Table 4.3: List of hospitals of the investigated for-profit hospital network, which met the minimum case volume requirements in defined complex medical conditions.
The obtained results serve as basis for the selection of interviewees (patients, doctors, hospital executives) from high- and low-volume hospitals of the investigated private hospital network in Switzerland (Chapter 4.3 Qualitative Analysis).

The complete list of results of the investigated for-profit hospital network regarding minimum Swiss volume requirements is available on request.

### 4.2.3 Limitations of the Quantitative Analysis

The number of cases with the studied complex medical conditions in Switzerland is not very high, as compared with the number of cases in countries in which similar analyses had been done (e.g. USA, Germany). Therefore, the whole study population per complex medical condition could not be distributed into five groups with approximately even numbers of patient cases, as did Birkmeyer et al. (2002) in the US. In Switzerland, only two groups (a high- and a low-volume group) per complex medical condition could be established on which the quantitative investigation in order to define minimum case volumes was based.

Only patient records with complex medical conditions (Table 4.1) have been investigated for differences in mortality as major medical outcome measure.

### 4.2.4 Summarized Findings and Implications

Based on the data set of the Swiss Bundesamt of Statistik (Federal Statistical Office), medical patient records with defined complex medical conditions were included for the investigation of the relation between the number of cases treated in a hospital and risk-adjusted mortality. The investigation defined highly significant statistical differences in
mortality between high- and low-volume Swiss hospitals in complex medical conditions as for instance brain surgery, heart surgery, oesophagectomy, pancreatectomy, percutaneous coronary interventions with acute myocardial infarction and further complex medical conditions.

The obtained results of the quantitative investigation served as basis for the selection of interviewees (patients, doctors, hospital executives) from high- and low-volume hospitals of the investigated private hospital network in Switzerland.

4.3 QUALITATIVE ANALYSIS

4.3.1 Introduction

This section describes the results of the qualitative analysis about the beliefs, opinions and knowledge of patients, doctors and hospital executives on pooling case volume and maximisation of hospital performance in the largest private hospital group in Switzerland.

The objective of this qualitative analysis was to test and extend the value drivers from the stakeholders’ perspectives which have an influence in the process of pooling case volume and implementing minimum case volume standards to facilitate high acceptance in a hospital network environment (Figure 4.8). Each sub-question is specifically examined. The narrative description of the collected data gives an overview about the collected data. Each interview is compared with the predefined literature-based propositions with a matrix by “agrees”, “disagrees” and “uncertain”. Three such matrices were developed in order to include the three perspectives of patients, doctors and hospital executives. The tested proposition and the value drivers that were supported in all interviews will be discussed and finalised as a value driver matrix from
ANALYSIS OF DATA

the stakeholder’s perspective on pooling case volume of complex medical conditions in a private hospital network organisation in Switzerland.
### Figure 4.8: Proposition Matrix. Own illustration.

| Value drivers regarding the concentration of case volume of complex medical conditions in a hospital network organisation | Hospital Performance  
Medical Outcome, Patient Satisfaction and Economical Efficiency |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality Saving Lives</td>
<td>P1: Establishment of a minimum case volume requirement per complex medical condition in hospital networks will positively influence the mortality of severely ill patients with complex medical conditions and consequently influence patient value.</td>
</tr>
<tr>
<td>Patient Trust &amp; Service</td>
<td>P2: A strong, positive hospital image and high reputation surgeons/treatment teams regarding the management of complex medical conditions will positively influence patient value.</td>
</tr>
<tr>
<td>Patient Trust &amp; Service</td>
<td>P3: Short travelling time to specialised hospitals will positively influence patient value.</td>
</tr>
<tr>
<td>Doctors Competence &amp; Attention</td>
<td>P4: Highly qualified and experienced hospital surgeons with a high reputation for complex medical cases will positively influence doctor’s perception of value.</td>
</tr>
<tr>
<td>Doctors Competence &amp; Attention</td>
<td>P5: The nature of the relationships between hospital surgeons and general physicians/referrers will positively influence doctor’s perception of value.</td>
</tr>
<tr>
<td>Hospital Executives Specialisation &amp; Reputation</td>
<td>P6: Quick access to high-end technologies and linked disciplines will positively influence doctor’s perception of value.</td>
</tr>
<tr>
<td>Hospital Executives Specialisation &amp; Reputation</td>
<td>P7: Specialisation on service lines with regard to complex medical conditions will positively influence hospital executive’s perception of value.</td>
</tr>
</tbody>
</table>
4.3.2 Pooling Case Volume and the Patients’ Value Drivers – In-depth Interviews

Introduction

This section investigates the sub-question “Which value drivers lead patients to be treated in high-volume hospitals in a Swiss private hospital network?” The literature-based propositions of value drivers from the patients’ perspectives are illustrated in the matrix below (Figure 4.9).

Table 4.4 describes the characteristics of the 13 interviewed patients as selected from low- and high-volume hospitals of the investigated hospital network. Furthermore, this section describes the collected data narratively as well as quantitatively for the stakeholder group “patient”. The patients’ statements per proposition were summarised from the transcripts of each interview and compared with the literature based predefined propositions. New ideas, which were supported by all interviewees, were included as a new value driver.

| Value drivers on pooling case volume | Hospital performance | Patients’ Trust & Service | Saving Lives
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>P1: Establishment of a minimum case volume requirement per complex medical condition in hospital networks will positively influence the mortality of severely ill patients with complex medical conditions and consequently influence patient value.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P2: A strong, positive hospital image and high reputation surgeons/treatment teams regarding the management of complex medical conditions will positively influence patient value.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P3: Short travelling time to specialised hospitals will positively influence patient value.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 4.9: Proposition matrix from patients’ perspective. Own illustration.
Table 4.4: Characteristics of interviewed patients. Own data.

<table>
<thead>
<tr>
<th>Patients</th>
<th>Sex</th>
<th>Age</th>
<th>Special Field</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M</td>
<td>74</td>
<td>Visceral Surgery</td>
</tr>
<tr>
<td>2</td>
<td>F</td>
<td>74</td>
<td>Visceral Surgery</td>
</tr>
<tr>
<td>3</td>
<td>F</td>
<td>59</td>
<td>Visceral Surgery</td>
</tr>
<tr>
<td>4</td>
<td>M</td>
<td>67</td>
<td>Visceral Surgery</td>
</tr>
<tr>
<td>5</td>
<td>M</td>
<td>77</td>
<td>Visceral Surgery</td>
</tr>
<tr>
<td>6</td>
<td>F</td>
<td>79</td>
<td>Visceral Surgery</td>
</tr>
<tr>
<td>7</td>
<td>M</td>
<td>48</td>
<td>Cardiac Surgery</td>
</tr>
<tr>
<td>8</td>
<td>F</td>
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</tr>
<tr>
<td>9</td>
<td>M</td>
<td>73</td>
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</tr>
<tr>
<td>10</td>
<td>F</td>
<td>56</td>
<td>Visceral Surgery</td>
</tr>
<tr>
<td>11</td>
<td>F</td>
<td>84</td>
<td>Cardiac Surgery</td>
</tr>
<tr>
<td>12</td>
<td>F</td>
<td>66</td>
<td>Neurosurgery</td>
</tr>
<tr>
<td>13</td>
<td>F</td>
<td>65</td>
<td>Neurosurgery</td>
</tr>
</tbody>
</table>

Narrative Description of the Patients’ Interviews

As mentioned in the chapter Research Design, only patients from Switzerland were selected and the interview language was German. Therefore, the statements were translated into English and back into German to assure accuracy of translation.

The Relevance of Primary Care Providers and Friends (an additional value driver)

The interviewed patients with complex medical conditions in the field of brain cancer, visceral cancer or severe heart diseases mention that they usually have first contact with a general physician in an outpatient unit or in an emergency station. Therefore, the process of choosing a hospital is influenced usually by a primary care provider. They recommend patients after first primary care to contact specialised surgeons in specific hospitals. Some of the interviewed patients, who had the time, energy and the appropriate insurance status to select the hospital on their own, asked their primary care provider for a preliminary advice on the selection of a surgeon. All of the interviewed
patients state, that this recommendation and the dialogue with the involved physicians is
decisive regarding the selection of their surgeon and hospital.

The patient apparently needs the advice from his or her primary care doctor about his or
her medical situation and which hospital or medical specialist might provide the best
help to improve/cure the patient’s medical condition. The value driver is the
recommendation of the involved primary care doctor and also of those who are close to
the patient. Patients tend to follow the recommendations of their doctors. This decision
for the selection of a surgeon is also influenced by the reputation of the surgeon.

**The Relevance of High Experienced Surgeons and the Reputation of the Hospital**
*(propositions P1 and P2)*

The process of selecting special further treatment focuses firstly on the quality and
reputation of surgeons, and secondly patients seek information about the hospital where
the doctor works. Therefore, from a patient point of view, a highly qualified surgeon is
identified by recommendations from other physicians, the surgeon’s experience in terms
of his reputation as well as recommendations from the patients environment and the
reputation and location of the hospital. Although case volume of a surgeon is relevant,
patients do not specifically challenge this or ask about this. The valuation of the selected
surgeon’s experience can better be judged by the patients by asking other involved
physicians and people close to them. It seems that patients prefer a close relationship
and a dialogue between their primary care providers i.e. involved physicians. Patients
responded as follows:

“My doctor told me that he knew his colleague very well, doctor X, who is an
expert for …” (Patient 14)
“Doctors who have investigated my health state have always stated that with a condition like the one I have people always go to doctor Y” (Patient 10)

“Dr. V. has said that the specialist surgeon has already performed more than 400 to 500 interventions. This gave me a lot of confidence.” (Patient 12)

“Dr. T. is working in a hospital in Zurich, therefore, I will travel to this clinic Z” (Patient 11)

Patients in Switzerland do not appear to be informed about the relevance of hospital case volume regarding treatment of complex diseases and the relationship between hospital volume per medical condition and mortality rates for specific medical conditions and treatments. However, if explicitly asked for the relevance of hospital reputation they mentioned it as an important factor in choosing a hospital.

Patients also consider hospital quality and hospital convenience during their selection process of the appropriate surgeon. Although patients feel safer if the recommended hospital has a good reputation, an experienced intensive care unit, access to linked medical disciplines and emergency centre, these criteria are not decisive in choosing a hospital. Nevertheless, they ask friends and family as well as other involved physicians about their experience with the hospitals where the potential surgeons are working.

Hospital reputation seems to matter whereas hospital’s case volume is not of importance when considering the opinions of patients. If patients are explicitly asked about hospital case volume, they are uncertain about the relevance of this hospital quality parameter and do not know much about the relationship between hospital case volume and medical
outcome. A more relevant aspect for patients is the experience of the surgeon. Therefore, after selection of the surgeon, the patients will go to the hospital where the surgeon works, even if the recommended hospital is a low-volume hospital for the specific medical condition of the patient.

The Relevance of the Distance between the Patients’ Residence and the Hospital (proposition P3)

Surprisingly, the distance and travelling time does not appear to be relevant for the interviewed patients, because the statements of the reviewed patients with complex medical conditions do not confirm in any case that distance in Switzerland is an obstacle for choosing an appropriate surgeon. Even interviewed patients, who were treated locally, did not indicate it would be difficult to travel if there were a better surgeon far from home. Many responded as follows:

“This (distance between Zurich and Lucerne) was no problem at all. My husband had taken me to the hospital; this was no problem.” (Patient 8)

“In case of an intervention with a low risk, I would select a local hospital.” (Patient 4)

However, the surgeons and hospital executives interviewed were uncertain about the relevance of hospital distance from a patient’s perspective as they made decisions about medical treatment. It was evident from the data that the distance from hospital for patients with severe diseases was not a major issue, as their focus was to acquire the best medical treatment possible in Switzerland.
Value Driver Matrix

The value drivers as well as the quantitative accounts of the interviewees’ statements from low- as well as high-volume hospitals per each predefined proposition are presented in Table 4.5.
### Analysis of Data

**Patients**

<table>
<thead>
<tr>
<th>Patients</th>
<th>Trust &amp; Safety</th>
<th>Additional Value</th>
<th>Driver:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P1***: Establishment of a minimum case volume requirement per complex medical condition in hospital networks will positively influence the mortality of severely ill patients with complex medical conditions and consequently influence patient value.</td>
<td>P2: A strong, positive hospital image and high reputation surgeons/treatment teams regarding the management of complex medical conditions will positively influence patient value.</td>
<td>P3: Short travelling time to specialised hospitals will positively influence patient value.</td>
</tr>
<tr>
<td></td>
<td><strong>A</strong></td>
<td><strong>D</strong></td>
<td><strong>U</strong></td>
</tr>
<tr>
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<td>3</td>
<td></td>
<td>2</td>
</tr>
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</tr>
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<td>14</td>
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<td></td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>0</td>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>

Legend: A = Agree; D = Disagree; U = Uncertain; P1-P.. = Propositions; *** Defined medical conditions by quantitative analysis (see above).

Table 4.5: Qualitative analysis: patients’ perspective. Own data.
Proposition P1: “Establishment of a minimum case volume requirement per complex medical condition in hospital networks will positively influence the mortality of severely ill patients with complex medical conditions and consequently influence patient value” was a new concept for patients and was not well understood. None of the interviewed patients used the expression “minimum case volume standards”, as indicated in the table above. However, patients said that they would prefer experienced surgeons and hospitals with a high reputation regarding the management of complex medical conditions as described above and illustrated in Table 4.5, column 2.

“A strong, positive hospital image and high reputation of surgeons/treatment teams regarding the management of complex medical conditions will positively influence patient value” is the most relevant driver and decisive for pooling case volume per medical condition and per hospital from the patients’ perspectives (Table 4.5, column 2). The surgeon has to be experienced in the required field, he has to be very well known by primary care providers and has to have an excellent reputation in the local area where the patients lives, because patients choose surgeons on the basis of recommendations from primary care providers, friends and other relevant people.

It is surprising that from a patient’s perspective the proposition P3 “short travelling time to specialised hospitals will positively influence patient value” is not relevant (Table 4.5, column 3). The evaluation of doctors’ and hospital executives’ statements in this regard was performed to triangulate these results (Table 4.7 and Table 4.9). Even from the perspectives of the hospital stakeholders, proposition P3 was not supported. Therefore, proposition P3 is rejected.
Patients indicated that the decision of choosing a surgeon located at a hospital is mainly affected by the “recommendations of primary care providers and friends regarding a specific surgeon respectively hospital” (Table 4.5, column 4). The indirect triangulation to support this conclusion is undertaken in testing proposition P5 from a doctor’s and a hospital executive’s point of view (Table 4.7 and Table 4.9). The relationships between hospital surgeons and general physicians/referrers seem to be very important for doctors and therefore support this patients’ value driver “recommendations of primary care providers and friends”.

**Conclusion**

The interviewed Swiss patients are motivated to travel to high-volume hospitals within a for-profit hospital network. The patient’s main value drivers in choosing a hospital are:

- “A strong, positive hospital image and high reputation of surgeons/treatment teams regarding the management of complex medical conditions will positively influence patient value” and
- “Recommendations of primary care providers and friends regarding a specific surgeon or hospital”

**4.3.3 Pooling Case Volume and the Referrers’/Surgeons’ Value Drivers – In-depth Interviews**

**Introduction**

This section investigates the sub-question: “Which value drivers lead doctors to treat patients in high-volume hospitals in a Swiss private hospital network?” The literature-based propositions of value drivers from the doctors’ perspectives are illustrated in the
ANALYSIS OF DATA

matrix below (Figure 4.10). Table 4.6 describes the characteristics of the 13 interviewed surgeons/referrers, selected from low- and high-volume hospitals. Furthermore, this section describes the collected data for the stakeholder group “doctors” narratively. The surgeons’ and referrers’ statements per proposition were consolidated from the transcripts of each interview and compared with the literature-based predefined propositions. New ideas, which were supported by all interviewees, were identified as additional value drivers

<table>
<thead>
<tr>
<th>Value drivers on pooling case volume</th>
<th>Hospital performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality</td>
<td>Saving Lives</td>
</tr>
<tr>
<td>Medical Outcome, Patient Satisfaction and Economical Efficiency</td>
<td></td>
</tr>
<tr>
<td>P1: Establishment of a minimum case volume requirement per complex medical condition in hospital networks will positively influence the mortality of severely ill patients with complex medical conditions and consequently influence patient value.</td>
<td></td>
</tr>
<tr>
<td>P4: Highly qualified and experienced hospital surgeons with a high reputation for complex medical cases will positively influence doctor’s perception of value.</td>
<td></td>
</tr>
<tr>
<td>P5: The nature of the relationships between hospital surgeons and general physicians/referrers will positively influence doctor’s perception of value.</td>
<td></td>
</tr>
<tr>
<td>P6: Quick access to high-end technologies and linked disciplines will positively influence doctor’s perception of value.</td>
<td></td>
</tr>
</tbody>
</table>

Figure 4.10: Proposition matrix from doctors’ perspectives. Own illustration.
Table 4.6: Characteristics of interviewed surgeons. Own data.

<table>
<thead>
<tr>
<th>Doctors</th>
<th>Special Field</th>
<th>Hospital Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Visceral Surgery</td>
<td>High Volume Hospital</td>
</tr>
<tr>
<td>2</td>
<td>Visceral Surgery</td>
<td>Low Volume Hospital</td>
</tr>
<tr>
<td>3</td>
<td>Neurosurgery</td>
<td>High Volume Hospital</td>
</tr>
<tr>
<td>4</td>
<td>Neurosurgery</td>
<td>Low Volume Hospital</td>
</tr>
<tr>
<td>5</td>
<td>Visceral Surgery</td>
<td>High Volume Hospital</td>
</tr>
<tr>
<td>6</td>
<td>Visceral Surgery</td>
<td>Low Volume Hospital</td>
</tr>
<tr>
<td>7</td>
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<td>High Volume Hospital</td>
</tr>
<tr>
<td>8</td>
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<td>Low Volume Hospital</td>
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<tr>
<td>9</td>
<td>Cardiac Surgery</td>
<td>High Volume Hospital</td>
</tr>
<tr>
<td>10</td>
<td>Visceral Surgery</td>
<td>Low Volume Hospital</td>
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</tr>
<tr>
<td>13</td>
<td>Cardiology</td>
<td>Low Volume Hospital</td>
</tr>
</tbody>
</table>

Narrative Description of the Doctors’ Interviews

As mentioned in Chapter 3, Research Design, only doctors from Switzerland were selected and the interview language was German. Therefore, the statements were translated into English and then back translated to assure accuracy of translation.

The Relevance of the Establishment of Minimum Case Volume Requirements per Complex Medical Condition for Hospitals in Hospital Networks (Proposition P1)

Necessary case volumes per complex medical treatments are required for surgeons, but are equally important with respect to other hospital staff because complex surgery requires teamwork and therefore sufficient training is required for all those involved. There was agreement among the interviewed hospital surgeons that minimum case volume requirements per hospital are decisive drivers, and a motivation to concentrate surgeons and also to pool case volume per medical condition and per hospital. Even surgeons who are working currently in low-volume hospitals agree with minimum case volume requirements for complex medical conditions and treatments per hospital. They
were of the view that medical outcomes and reputations of surgeons as well as of the whole hospital network organisation would significantly increase with the adoption of minimum case volume standards. Surgeons were of the view that the Swiss population and also the referrer generally were generally uninformed about the relationship between hospital case volume and hospital mortality rates. However, they indicated that hospital case volume requirements would be a major concern in the next decade in Switzerland’s public health care debate. Nevertheless, the topic of minimum case volume standards was sometimes critically commented on by surgeons. Surgeons do not entirely believe in the accuracy of the statistical analyses of the BFS data set, because of coding confounders. Furthermore, they believe that hospital executives would use minimum case volume requirements as a political measure against some doctors in certain situations.

“Case volume is not only important from the perspective of the surgeon but also the perspective of the care team. There is a clear inverse correlation between case volume and complication rates. One has to distinguish between individual surgeon volume and hospital volume. Individual surgeon case volume is apparently not as critical as hospital volume. In other countries, minimum case volume standards are already established for quite some time. However, sometimes health authorities there have just decided on the implementation of these standards without much further foundation.”

The Relevance of Highly Qualified and Experienced Hospital Surgeons/Treatment Teams with a High Reputation (Proposition P4)

From the hospital surgeons’ perspective as well as from the referrers’ perspective, experienced surgeons are the basis of the treatment process of complex medical cases.
Furthermore, in the opinion of referrers, highly specialised surgeons have to invest much more effort on the specific reputation for complex surgery. The surgeon has to be experienced in the required field; he or her has to be very well known by primary care providers and has to have an excellent reputation. They believe that the hospital and the surgeons in the field of complex medical treatments have to act as one treatment entity and therefore, they should build reputation together for complex surgery. Doctors agree on the importance of concentrating their complex medical cases in specific specialised hospitals in a hospital network organisation. Some of the highly specialised surgeons mentioned that outpatient centres, as satellites of specialised high-volume hospital in the areas of interest, would be an innovation: firstly because of the referral of patients to a specific hospital in the network organisation, and secondly because of brand building in the areas of interest. Nevertheless, experts are not sure if the commitment of local primary care providers can be accomplished with such an organisation.

“A convenience package of the hotel services of the hospital may be of certain importance.” (Doctor 5) “However, the quality of treatment of complex medical cases is more important.” (Doctor 6)

“Medical treatment quality is not just related to the doctor’s skills but the quality of the whole medical team respectively in the whole hospital.” (Doctor 8)

“One should have the opportunity to treat patients with defined complex medical conditions after hospitalisation locally in an outpatient setting for consultations, for instance in Lucerne.” (Doctor 9)
The Relevance of the Relationships between Hospital Surgeons and General Physicians/Referrer (Proposition P5)

Patients who suffer from complex diseases have usually first contact with a general physician in an outpatient unit or in an emergency station as mentioned above. Therefore, the process of choosing a surgeon is influenced by this primary care provider. Highly specialised surgeons are aware about this fact and therefore they emphasise the relevance of good relationships with referrers. Hospital surgeons as well as hospital executives agree that referrers choose the surgeon according to the personal relationship and experience between referrer and surgeon, the feedback from patients after surgery and as well the surgeon’s case volume of the required treatment. They recommend the implementation of specific network platforms to expand and support relationship management between referrer and surgeon easier.

“We know that referrers judge the surgeons based on their knowledge of the surgeon’s expertise, from the personal relationship between referrer and surgeon, and the patients’ feedback after treatment.” (Doctor 7)

The Relevance of High-End Technologies and linked Disciplines regarding the Management of Complex Medical Conditions (Proposition P6)

Hospital surgeons in for-profit (private) hospital network organisations in Switzerland are mostly working across a number of hospitals. Although working in various hospitals, the interviewed surgeons treat complex medical conditions usually in one particular local hospital. Nevertheless, some of them are working also far from their clinics and outside of their canton in specific hospitals. The reason why they take patients to a specific hospital outside of their canton and far from their clinics is because the necessary high-end technology is available only in specific high-volume hospitals.
Highly specialised surgeons prefer an environment with an intensive care unit, linked experienced disciplines in the required medical conditions. Even if they do not need these facilities for each case, they prefer that these highly experienced units are available in case of increased treatment risks or complications. All of the interviewed surgeons who treat complex medical conditions agree that access to high-end facilities, technology and specialised treatment teams of nurses and technicians is a decisive driver for the concentration process of the pooling of case volume per hospital.

“The major criterion is the equipment of the surgery theatre. In neurosurgery it is key to dispose of stereotactic navigation or intra-operative neurophysiology. In our local hospital we do not have sufficient access to the required state-of-the-art technology; therefore we have to travel to Zurich.” (Doctor 8)

**Value Driver Matrix**

The value drivers as well as the consolidation of the interviewees’ statements from low-as well as high-volume hospitals per each predefined proposition are given in Table 4.7.
Competence & Attention

<table>
<thead>
<tr>
<th>Doctors (Referrers and Surgeons)</th>
<th>P1***: Establishment of a minimum case volume requirement per complex medical condition in hospital networks will positively influence the mortality of severely ill patients with complex medical conditions and consequently influence patient value.</th>
<th>P4: Highly qualified and experienced hospital surgeons with a high reputation for complex medical cases will positively influence doctor's perception of value.</th>
<th>P5: The nature of the relationships between hospital surgeons and general physicians/referrers will positively influence doctor's perception of value.</th>
<th>P6: Quick access to high-end technologies and linked disciplines will positively influence doctor's perception of value.</th>
<th>Statements to P3: Short travelling time to specialised hospitals will positively influence patient value.</th>
<th>Additional Idea: Satellites for pre- and post operative treatments.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>D</td>
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<td>A</td>
<td>D</td>
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</tr>
</tbody>
</table>

Legend: A = Agree; D = Disagree; U = Uncertain; P1-P... = Propositions. *** Defined medical conditions by quantitative analysis (see above).

Table 4.7: Qualitative analysis: surgeons’ perspective. Own data.
The interviewed doctors agree strongly that the “Establishment of a minimum case volume requirement per complex medical condition in hospital networks will positively influence the mortality of severely ill patients with complex medical conditions and consequently influence patient value” is a decisive value driver to concentrate surgeons and to pool case volume per medical condition (Proposition P1 in column 1, Table 4.7).

“Highly qualified and experienced hospital surgeons with a high reputation for complex medical cases will positively influence doctor’s perception of value (Proposition P2 in column 2, Table 4.7) is an important value driver from the perspectives of doctors. They believe that the effort regarding the building of reputation for complex surgery is effective and a driver for pooling case volume in a specific hospital or in a hospital network organisation. This statement is indirectly supported also by statements from the patients (see column 2, Table 4.5, proposition P2).

Some of the highly specialised surgeons recommend the positioning of hospital outpatient satellites in areas of interest in order to manage pre- and post-operative treatments near the patient’s home (additional idea, in column 6, Table 4.7).

An additional value driver for pooling case volume per complex medical condition from the doctors’ point of view is “the nature of the relationships between hospital surgeons and general physicians/referrers will positively influence doctor’s perception of value” (P5), because highly specialised surgeons in Switzerland receive their patients usually on the recommendation of primary care providers as for example GPs (see proposition P2, column 3, Table 4.5). The indirect triangulation to prove this finding is given by the
additional value driver from this perspective of the patients: “Recommendations of primary care providers and friends.”

All of the interviewed surgeons who treat complex medical conditions agree with the statements that “quick access to high-end technologies and linked disciplines will positively influence the doctor’s perception of value (proposition P6, in column 4, Table 4.7).

Column 5 in Table 4.7 is used for indirect triangulation of the patients’ proposition P3 (“short travelling time to specialised hospitals will positively influence patient value”) as mentioned above in the previous sections.

**Conclusion**

With regard to the final provider model, the interviewed Swiss doctors/surgeons who treat or refer complex medical conditions agree strongly with the following value drivers on pooling case volume in specific hospitals inside a hospital network organisation:

- Establishment of a minimum case volume requirement per complex medical condition in hospital networks will positively influence the mortality of severely ill patients with complex medical conditions and consequently influence patient value.
- Highly qualified and experienced hospital surgeons with a high reputation for complex medical cases will positively influence doctor’s perception of value.
- The nature of the relationships between hospital surgeons and general physicians/referrers will positively influence doctor’s perception of value.
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- Quick access to high-end technologies and linked disciplines will positively influence doctor’s perception of value

4.3.4 Pooling Case Volume and the Hospital Executives’ Value Drivers – In-depth Interviews

Introduction

This section investigates the sub-question: “Which value drivers lead hospital executives to treat patients in high-volume hospitals in a Swiss private hospital network?”. The literature based propositions of value drivers from the perspectives of hospital executives are illustrated in the matrix below (Figure 4.11). Furthermore, this section describes the collected data narratively as well as quantitatively for the stakeholder group “hospital executives”. Hospital executives’ statements per proposition were consolidated from the transcripts of each interview and compared with the literature based predefined propositions. New ideas, which were supported by all interviewees, were included as additional value drivers.

<table>
<thead>
<tr>
<th>Value drivers on pooling case volume</th>
<th>Hospital performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality Saving Lives</td>
<td>P1: Establishment of a minimum case volume requirement per complex medical condition in hospital networks will positively influence the mortality of severely ill patients with complex medical conditions and consequently influence patient value.</td>
</tr>
<tr>
<td>Hospital Executives Specialisation &amp; Reputation</td>
<td>P7: Specialisation on service lines with regard to complex medical conditions will positively influence hospital executive’s perception of value.</td>
</tr>
</tbody>
</table>

Figure 4.11: Proposition matrix from hospital executives’ perspectives. Own illustration.
The hospital executives within the investigated Swiss for-profit hospital network are each responsible as managing director for one hospital in the network. They are in charge for the strategic portfolio planning per hospital as well as for the operation of the business. Furthermore, some of the interviewed hospital executives are additionally in charge for synergy achievements and best practice identifications between the hospitals in the network. All are members of the management board of the group. The interviewed hospital executives develop their hospitals with regard to hospital performance factors: economic efficiency, patient satisfaction and medical outcomes.

Currently there are no minimum case volume requirements in Switzerland in place and little patient flow between the hospitals inside the investigated network. The hospitals in the investigated network are the market leaders regarding treatment of privately insured patients in the catchment area of the particular hospital. Table 4.8 describes the case volume type characteristics (High-Volume Hospital, Low-Volume Hospital) of the hospitals of the six interviewed managing directors.

<table>
<thead>
<tr>
<th>Directors</th>
<th>Hospital Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Low Volume Hospital</td>
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<td>2</td>
<td>Low Volume Hospital</td>
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<td>5</td>
<td>Low Volume Hospital</td>
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<td>6</td>
<td>High Volume Hospital</td>
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</tbody>
</table>

Table 4.8: Characteristics of interviewed hospital executives. Own data.
Narrative Description of the Hospital Executives’ Interviews

As mentioned in Chapter 3, Research Design, only hospital executives from Switzerland were selected and the interview language was German. Therefore, the statements had to be translated into English and then back translated to assure translation accuracy.

The interviewed hospital executives are very interested in the topic of pooling case volume per medical condition and hospital. They believe in the concentration process of particular complex medical treatments, because they support economy of scale effects. However, the motivation to pool case volume per medical conditions is firstly driven by economic reasons, secondly medically driven, because of sub-specialisation trends in the fields of medicine, and thirdly patient driven for the reason that patients require more and more direct access to specialists (which is allowed in Switzerland).

On the one hand hospital managers know that pooling of case volume is important for economic reasons and on the other hand that big hospitals with many beds achieve normally less patient satisfaction scores in general. They support building service lines within small units in the hospital and to avoid “industrial” depersonalised high-volume treatment experiences by patients. However, in the field of certain complex medical conditions, there are very limited numbers of cases in Switzerland and the hospital executives are aware of the relationship between hospital case volume per medical treatments and mortality rates. Nevertheless, the hospital executives expressed support for the implementation of minimum case volume requirements per complex medical condition inside a hospital network. They mentioned that minimum case volume requirements are especially relevant for the surgeons and they expressed some support for limiting the medical portfolio per hospital, because they do not believe that the
surgeon will be happy without such a structure in a hospital network. Although there is a basic motivation regarding the concentration of complex cases in particular hospitals in the network, they do not want to force that issue with the surgeons because surgeons’ satisfaction is one of the most relevant general drivers for hospital performance and reputation.

“Minimum case standards may be difficult to be implemented in the setting of a private for-profit hospital network simply because in certain medical conditions there are not enough cases available for the concentration inside the network and there is a danger of losing these patients to other hospitals outside the network.” (Hospital Executive 2)

Hospital executives are already experienced with service line strategies in particular disciplines as for example specialised orthopaedic centres (e.g. foot and ankle centres).

“I think that economic profitability can only be achieved with sufficient case numbers for a specific treatment chain. The driving force towards specialisation is primarily the patient and the primary care provider, because they require that care is provided only on one site and not several at the same time.” (Hospital Executive 1)

Hospital executives agree that specialisation in particular service lines in their hospital accelerates pooling of case volume, the quality standard of specialised facilities and the implementation of new technology. As a consequence, they believe they would be highly attractive to excellent physicians, as first movers regarding the newest technology, and also highly attractive to patients. In the opinion of the interviewed experts the allocation of resources is better managed through a service line structured
organisation. Furthermore, they hope that this specialisation process prevents hospitals doing “a little bit of everything”. In the view of hospital executives, service line organisations integrate patient requirements in terms of single points of access, provide access to primary providers as well as specialised units, establish the relationship between health care specialists in the service lines and, as well, provide technology allocation.

“We have to make sure that we are on top regarding medical technical equipment and therapy methods. As a consequence, we are then more attractive to excellent physicians, we will have earlier access to the newest technology, we are more attractive to patients, we achieve a higher overall quality, also regarding our employees in the hospital – for instance in the technical sector.”

(Hospital Executive 3)

Hospital executives agree that building high reputation for the treatment of complex cases in one or two defined hospitals in the network could be the way to concentrate complex cases in the network. They agree with the views of patients and surgeons that high reputation is mainly linked to highly qualified hospital surgeons with a high reputation for complex case treatment. However, clear portfolio guidance in order to build “brands” per hospital in the hospital network is required by the hospital executives. Furthermore, they agree with the views of surgeons that reputation platforms for highly specialised surgeons are important in order to build a brand for the treatment of complex cases in a particular hospital inside the network.

“The most important criterion for a referrer is the competence of the surgeon.”

(Hospital Executive 2)
“With regard to politicians as well as political health care committees, it is important that we are perceived in the public as a hospital group with very competent doctors, with tremendous experience in the treatment of complex medical conditions.” (Hospital Executive 1)

Value Driver Matrix

The value drivers as well as the quantitative assessment of the interviewees’ statements from low- as well as high-volume hospitals per each predefined proposition are presented in Table 4.9.
## Specialisation & Reputation

<table>
<thead>
<tr>
<th>Directors (Hospital Executives)</th>
<th>P1***: Establishment of a minimum case volume requirement per complex medical condition in hospital networks will positively influence the mortality of severely ill patients with complex medical conditions and consequently influence patient value.</th>
<th>P7: Specialisation on service lines with regard to complex medical conditions will positively influence hospital executive’s perception of value.</th>
<th>Statements to P3: Short travelling time to specialised hospitals will positively influence patient value.</th>
<th>Statements to P4: Highly qualified and experienced hospital surgeons with a high reputation for complex medical cases will positively influence doctor’s perception of value.</th>
<th>Statements to P5: The nature of the relationships between hospital surgeons and general physicians/referrers will positively influence doctor’s perception of value.</th>
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<td></td>
<td>A</td>
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<td>U</td>
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</tbody>
</table>

Legend: A = Agree; D = Disagree; U = Uncertain; P1-P.. = Propositions, *** Defined medical conditions by quantitative analysis (see above).

Table 4.9: Qualitative analysis: hospital executives’ perspective. Own data.
The interviewed hospital executives do agree in general with the literature-based proposition “Establishment of a minimum case volume requirement per complex medical condition in hospital networks will positively influence the mortality of severely ill patients with complex medical conditions and consequently influence patient value” (proposition P1 in column 1, Table 4.9). They agree that the implementation of minimum case volume standards per complex medical condition and per hospital is per se important. Nevertheless, they are not sure if these standards will be accepted by their highly specialised surgeons. There is strong concern among hospital executives about the implementation of a case volume organisational structure. It seems that hospital executives do not discuss this issue with their doctors, since the interviewed doctors support strongly the implementation of minimum case volume requirements per complex medical condition for hospitals in hospital networks (proposition P1 in column 1, Table 4.7).

From the hospital executives’ perspectives it can be concluded that the setting of a for-profit Swiss hospital network organisation supports the literature-based proposition of “specialisation on service lines with regard to complex medical conditions will positively influence hospital executive’s perception of value” (P7). All of the interviewed managers agree with the statement that service line organisations are valuable regarding the pooling of case volume, the allocation of technology and resources and that there is potential for economy of scale effects (proposition P7 in column 2, Table 4.9).

Columns 3 and 4 in Table 4.9 are used for indirect triangulation of the patients’ proposition P3 (“Short travelling time to specialised hospitals will positively influence
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patient value”) and doctors’ propositions P4 and P5 (“Highly qualified and experienced hospital surgeons with a high reputation for complex medical cases will positively influence doctor’s perception of value” and “The nature of the relationships between hospital surgeons and general physicians/referrers will positively influence doctor’s perception of value”) as mentioned above in the previous sections.

Conclusion

With regard to the final form of a provider model, the interviewed Swiss hospital executives agree with the following value drivers on pooling case volume in specific hospitals inside a hospital network organisation:

- Establishment of a minimum case volume requirement per complex medical condition in hospital networks will positively influence the mortality of severely ill patients with complex medical conditions and consequently influence patient value.
- Specialisation on service lines with regard to complex medical conditions will positively influence hospital executive’s perception of value.

4.3.5 Preliminary Model on Value Drivers regarding the Concentration of Case Volume of Complex Medical Conditions in a Hospital Network Organisation

The final form of the model describes the key value drivers, which are relevant regarding the pooling of case volume per complex medical condition and maximising medical outcome, economic efficiency and patient satisfaction from all stakeholder perspectives of the largest private hospital network organisation in Switzerland developed through convergent interviews. Compared to the proposition matrix derived
from the literature, the value driver “short travelling time to the hospital” was removed as a consequence of the triangulation for patients (see Chapter 4.3.2 Pooling Case Volume and the Patients’ Value Drivers – In-depth Interviews), surgeons (see Chapter 4.3.3 Pooling Case Volume and the Referrers’/Surgeons’ Value Drivers – In-depth Interviews), and hospital executives (see Chapter 4.3.4 Pooling Case Volume and the Hospital Executives’ Value Drivers – In-depth Interviews). However, a new value driver emerged from the qualitative analysis, namely “Recommendations of primary care providers and friends” from the patient perspective (see Chapter 4.3.2 Pooling Case Volume and the Patients’ Value Drivers – In-depth Interviews) and was included in the model.

Figure 4.12 presents the final model of value drivers regarding the concentration of case volume of complex medical conditions in a hospital network organisation.
### Hospital Performance
Medical Outcome, Patient Satisfaction and Economical Efficiency

<table>
<thead>
<tr>
<th>Quality Saving Lives</th>
<th>Establishment of a minimum case volume requirement per complex medical condition in hospital networks will positively influence the mortality of severely ill patients with complex medical conditions and consequently influence patient value.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient Trust &amp; Safety</td>
<td>A strong, positive hospital image and high reputation surgeons/treatment teams regarding the management of complex medical conditions will positively influence patient value.</td>
</tr>
<tr>
<td>Recommendations of primary care providers and friends regarding specific surgeon’s respectively hospital.</td>
<td></td>
</tr>
<tr>
<td>Doctors Competence &amp; Attention</td>
<td>Highly qualified and experienced hospital surgeons with a high reputation for complex medical cases will positively influence doctor’s perception of value.</td>
</tr>
<tr>
<td>The nature of the relationships between hospital surgeons and general physicians/referrers will positively influence doctor’s perception of value.</td>
<td></td>
</tr>
<tr>
<td>Quick access to high-end technologies and linked disciplines will positively influence doctor’s perception of value.</td>
<td></td>
</tr>
<tr>
<td>Hospital Executives Specialisation &amp; Reputation</td>
<td>Specialisation on service lines with regard to complex medical conditions will positively influence hospital executive’s perception of value.</td>
</tr>
</tbody>
</table>

Figure 4.12: Preliminary provider model. Own illustration.
5 CONCLUSIONS AND IMPLICATIONS

5.1 INTRODUCTION

The objective of this research was to advance professional practice in the management of a network hospital environment in Switzerland. Specifically, the objective was to focus on aspects of quality medical outcomes, performance and patient satisfaction. Swiss national legislation requires a concentration of hospitals as a general condition across the various stakeholders in the healthcare system (e.g. health care authority officials, hospital executives). The goal of this research, as derived from the network, healthcare and the medical academic literature, was to identify minimum case volume standards per complex medical condition in Switzerland as well as value drivers affecting the operationalisation of pooling of case volume per complex medical condition and per hospital in order to maximise hospital as well as network performance in a hospital network. The value drivers in order to achieve this goal represent the patients’, doctors’ and hospital executives’ behavioural expectations regarding maximising hospital performance in terms of medical outcomes, i.e. positively influencing the mortality rate and improving the quality of medical care, economic efficiency and patient satisfaction in a hospital network organisation. These value drivers from each of the stakeholders’ perspectives were identified as influencers in the process of pooling case volume and implementing minimum case volume standards and achieving high acceptance in a hospital network environment.

Firstly, it is important to confirm that the quantitatively analysed minimum case volume standards per complex medical condition reflect prescriptive levels for Switzerland and cannot be transferred to other contexts. Secondly, it is also noteworthy to mention that the qualitatively analysed propositions presented – in terms of stakeholders’ value
CONCLUSIONS AND IMPLICATIONS

drivers – are descriptive rather than prescriptive: the model is not prescribing a model that leads to significantly superior performance but rather describes the values (patterns of behaviours) which motivate hospital stakeholders to support the process of pooling case volume in the largest private hospital network organisation in Switzerland.

In Chapter one, the research background was outlined and the research problem identified. In this chapter, the need for further investigations into the impact of pooling case volume on hospital performance is highlighted and the research agenda was justified.

In Chapter two, the research was placed in the context of existing knowledge and previous research. The research question was derived as: “How can pooling of case volume per complex medical condition and per hospital maximise medical outcomes (i.e. saving further lives and improving the quality of medical care), economic efficiency and patient satisfaction in a hospital network organisation?”

In Chapter three the research framework was developed, and the research methods, the data sample and specific Swiss data sets that could be used for hypothesis and proposition testing defined.

Chapter four contained an analysis of the quantitative as well as qualitative data gathered and concluded with a discussion confirming which hypotheses and propositions were supported by the data.
This final chapter contains a summary of the conclusions and implications for theory of the research findings, a discussion of implications for professional practice, an outline of the limitations of the research and recommendations for further research.

5.2 THE RESEARCH QUESTION

The following section summarises the conclusions drawn from the research. The first objective of the research was to test the hypotheses generated from the literature that A) minimum case volume requirements per complex medical condition can be determined in Switzerland, and B) hospitals in a large for-profit (private) hospital network organisation can subsequently be classified as high- and low-volume hospitals regarding treatment of complex medical conditions in order to improve medical service quality outcomes in terms of mortality reduction and economic efficiency of the entire hospital network. The second objective was to test and extend propositions gathered from the literature relating to value drivers which support the process of pooling case volume from the stakeholders’ (patients, doctors, hospital executives) perspectives. The following sections present these results.

5.2.1 Which are the Required Minimum Case Volumes for Complex Medical Conditions in Switzerland with regard to the Relationship between Hospital Case Numbers and Medical Outcome as measured by post-treatment Mortality Rates?

Based on the data set of the Swiss Bundesamt of Statistik (Federal Statistical Office), medical patient records with defined complex medical conditions were included for the investigation of the relation between the number of cases treated in a hospital and risk-adjusted mortality. The investigation defined highly significant statistical differences in
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mortality between high- and low-volume Swiss hospitals in certain complex medical conditions as for instance brain surgery, heart surgery, oesophagectomy, pancreatectomy, percutaneous coronary interventions with acute myocardial infarction and further complex medical conditions (Table 4.2). For complex medical conditions a statistically significant difference in adjusted mortality between high- and low-volume groups was established. Statistical significance testing was based on analysis of variance (ANOVA) tests, which emerged as the strongest test in the investigation showing the highest discriminative power between high- and low-volume groups in comparison to other statistical test methods used (Kruskal Wallis, Mann Whitney, Kolmogorov Smirnov). The obtained results of the quantitative investigation served as basis for the selection of interviewees (patients, doctors, hospital executives) from high- and low-volume hospitals of the investigated private hospital network in Switzerland.

5.2.2 Which Value Drivers lead Patients to be treated in High-volume Hospitals in a Swiss Private Hospital Network?

The interviewed Swiss patients were motivated to travel to high-volume hospitals inside a for-profit hospital network. The patients’ main value drivers in choosing a hospital identified through the research were (see Table 4.5):

- “High reputation of the hospital surgeons as well as a high hospital image regarding the management of complex medical conditions.”
- “Recommendations of primary care providers and friends regarding a specific surgeon or hospital.”

Prior research (Tai et al., 2004, pp. 1903 – 1922; Adams et al.1991, pp. 583 – 612; Gozu et al., 2009, pp. 195 – 200; Luft et al., 1990, pp. 2899 – 2906) had established the
importance of travelling time to a health care provider. This is indirect contrast to the findings of this research. It is especially surprising that from a patient’s perspective the travelling time to a specialised hospital in order to get surgery for a complex medical condition was not a priority for patients. Even from the perspectives of doctors and hospital executives proposition P3 (“Short travelling time to specialised hospitals”) was not supported (see Tables 4.5, 4.7 & 4.9). Therefore, this proposition was rejected. The result that travelling time was not a priority in decision-making about treatment for complex medical conditions in specialised distant hospitals may be explained by the special situation of Switzerland where the distances from a patient’s home to the major cities of the country with high-end medicine clinics are comparatively short (1 to 2 hours) as well as by the fact that transportation infrastructure in Switzerland is generally good and therefore patients can travel conveniently and safely.

Further, the findings support the proposition that patients’ choice of surgeon and hospital is mainly affected by the “recommendations of primary care providers and friends”. The relationships between hospital surgeons and general physicians/referrers was found to be very important for doctors too and provides additional support for consideration of the value driver “recommendations of primary care providers and friends”.

5.2.3 Which Value Drivers lead Doctors to treat Patients in High-volume Hospitals in a Swiss Private Hospital Network?

The interviewed Swiss doctors/surgeons who treat or refer complex medical conditions agree strongly with the following value drivers on pooling case volume in specific hospitals within a hospital network organisation (see table 4.7):

- Establishment of a minimum case volume requirement per complex medical condition in hospital networks as an important measure to positively influence mortality rates.
- Highly qualified and experienced hospital surgeons/hospital team with a high reputation for complex medical cases.
- Relationships between hospital surgeons and general physicians/referrers.
- Quick access to high-end technologies and linked disciplines.

These findings are in agreement with the scientific literature on the health care business - as for example Herzlinger (1997) - and the strategies of successful hospital groups as for example Rhön Klinikum AG, as well as with the medical literature, as for example Dimick, Osborne, Nicholas & Birkmeyer (2009). Some of the highly specialised surgeons recommend the positioning of hospital outpatient satellite facilities locally in order to manage pre- and post-operative treatments near the patient’s home. Nevertheless, this idea found only a partial support.
5.2.4 Which Value Drivers lead Hospital Executives to treat Patients in High-volume Hospitals in a Swiss Private Hospital Network?

The interviewed Swiss hospital executives agree with the following value drivers on pooling case volume in specific hospitals inside a hospital network organisation (see Table 4.9):

- Establishment of minimum case volume requirements per complex medical condition in hospital networks as an important measure to save additional lives of severely ill patients with complex medical conditions.

- Specialisation on service lines with regard to complex medical conditions.

It was apparent from the data that hospital executives do not discuss alternative strategies for enhancing medical service efficacy and efficiency with their doctors, as they seemed unaware that doctors support strongly the implementation of minimum case volume requirements per complex medical condition within hospital networks.

5.2.5 Summary: Preliminary Model on Value Drivers regarding the Concentration of Case Volume per Complex Medical Condition and Hospital

Hospital operation as part of the health care market is different in many countries (OECD, 2006). Concentrations of medical services within hospital networks, as non-profit or for-profit organisations, are rapidly increasing (Kocher, G., Oggier, W., 2007). In order to maximise hospital medical and economic performance, the integration of hospitals into hospital network structures is expanding in Switzerland (Bundesamt für Statistik – Einrichtungen und Betten 2010) and Germany (OECD, 2006). From both a medical service and economic points of view, the concentration of case volume per
CONCLUSIONS AND IMPLICATIONS

medical condition and per hospital in a hospital network organisation seems to have
great performance potential (scientific publications summarised in Appendix 3 and
Appendix 4). Existing academic literature however does not provide hospital networks
with guidance on how they might address this issue (Enthoven (2007; Siess & Siewert,
2005). The findings of this current research provide hospital executives with a way
forward for restructuring a hospital network around operationalising a case volume
methodology.

Prior research from the disciplines of management, medicine and economics was drawn
on to develop a framework for investigating this business problem as the challenge of
restructuring the delivery of medical services within a network context to enhance
efficacy and effectiveness is not discipline specific. The lack of a comprehensive model
to guide the decision-making of network hospital executives as they seek to address the
often conflicting objectives of political and financial stakeholders underpinned the need
for this current research (Beck, 2009; Osswald; 2009; GDK, Hochspezialisierte
Medizin, 2010).

Few researchers had previously addressed components of this challenge. Porter and
Teisberg (2006) stated: “The literature on strategy for health care organisations is
virtually non-existent” (pp. 1 - 16). Porter and Teisberg certainly supported the notion
of value-based competition in health care delivery. In their view the relevant entity in
health care delivery is a medical condition, focusing on the full cycle of care and
managed by competitive integrated medical practices in order to generate highest value
for patients (Porter and Teisberg, 2006, pp. 65 - 76). Focusing on medical conditions
instead of discipline-orientation provides a strong patient-centred approach. This
encourages the re-definition of medical services away from terminology, orthopaedic surgery, towards specific medical conditions, which might embrace surgery and prosthetics services. Also several other not-medical authors emphasise the relevance of service line approaches in health care delivery however, mainly citing economic reasons as drivers of change (e.g. Baghai, Levine & Sutaria, 2008, pp. 1 - 9). The current research has broadened this emphasis through including multiple performance indicators: medical outcomes, patient satisfaction and economic performance.

Nevertheless, none of the known research groups in health care administration nor academic researchers have recommended an effective business model around medical outcome, economic efficiency and patient satisfaction. The approach of this research based on case volume effects per medical condition in service line hospital organisations has provided an effective business model that meets each of these important performance measures. But the concept of medical service lines is not new and health care providers in the USA are increasingly adopting this model (Gee, 2004, pp. 60 – 65; Porter, Teisberg, 2006, pp. 65 – 76; Baghai, Levine and Sutaria, (2008, pp. 1 - 9). This research has built on this approach and provided a case volume methodology for implementing this approach in Switzerland.

The current research developed a new model on pooling case volume for hospital network performance improvement designed to enhance hospital competitiveness. The final model that emerged from the data describes the key value drivers which are relevant for implementing the process of pooling of case volume per complex medical condition and maximising medical outcomes, economic efficiency and patient satisfaction from key stakeholder perspectives drawn from the largest private hospital network organisation in Switzerland. Compared to the apriori proposition matrix, the
value driver “short travelling time to the hospital” was not supported through triangulation of patients’, surgeons’ and hospital executives’ data. However, a new value driver emerged from the qualitative analysis, namely “recommendations of primary care providers and friends” from the patient perspective.

The literature on network theory including stakeholder influences on network organisations indicates that the primordial properties of complex networks, network density and network centrality (Rowley, 1997; 2000), should be carefully considered in order to further optimise the functioning of a complex hospital network under a potential new business model derived from pooling case volume in order to improve hospital network medical quality as well as economic efficiency. A network theory model of high density (i.e. direct network connections of each network member with many other network members) and high centrality (i.e. the individual actor's position in the network relative to others) is important in meeting key value drivers derived through the research of team based performance and relationship development between surgeons and referring practitioners.

5.3 RESEARCH CONTRIBUTIONS AND IMPLICATIONS

The thesis presents a model of network restructuring based around value drivers related to concentration of case volume per medical condition and per hospital to address hospital network performance improvement in medical outcomes and treatment quality, economic performance and patient satisfaction. The model supports the premise that hospital group performance in terms of these key performance parameters is positively affected by the pooling of case volume in high-volume hospitals of a hospital network. Those medical conditions where a statistically significant difference in comorbidity-
CONCLUSIONS AND IMPLICATIONS

adjusted mortality was apparent formed the basis of re-aligning medical services with the Swiss hospital network, thereby providing a significantly better medical treatment outcome.

The thesis presents a preliminary model on value drivers regarding the concentration of case volume of complex medical conditions in a for-profit (private) hospital network organisation as a potentially important basis of hospital executive decision-making. Regarding the main purpose of hospital management, “the improvement of hospital quality and patient satisfaction as well as economic efficiency”, the hospital executive is encouraged to focus on the establishment of a minimum case volume requirement per complex medical condition in hospital networks. There is significant evidence that case volume is an important measure that has the potential to save lives of severely ill patients with complex medical conditions as well as to gain economies of scale effects.

In order to accelerate pooling of case volume in focal hospitals in a hospital network organisation the following value drivers are important:

Key drivers of patient value were found to be:

- High reputation of the hospital surgeons as well as a strong positive hospital image regarding the management of specific complex medical conditions. The recommendations of primary care providers and friends regarding a specific surgeon or hospital.

Key drivers of doctor/surgeon value were found to be:
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- Highly qualified and experienced hospital surgeons/hospital teams with a high reputation for the treatment of complex medical cases:
- Fast access to high-end technologies and linked disciplines; and
- Good relationships between hospital surgeons and general physicians/referrers.

Key driver of hospital executive value was:
- Specialisation of service lines and reputation with regard to complex medical conditions.

These key drivers form the foundation of a business model for implementing performance driven hospital network restructuring.

Knowledge informing the research was derived from various analyses of Internet-based information including a comparison of the most important hospital networks in the US, Europe, Asia and other regions of the world regarding key financial figures and group strategic planning concerning main value drivers on pooling case volume (Appendix 2). In addition, systematic analyses of existing knowledge on the principal value drivers on pooling case volume per medical condition in order to maximise medical outcome, economic efficiency and patient satisfaction in the field of business health care administration, medicine and economy were investigated (Appendices 3, 4, and 5).

The literature on health care management, in particular hospital group management is limited, specifically on the strategic management of health care delivery models. However, medical literature (Appendix 3; for example Birkmeyer & Dimick, 2004) has established that there are statistically significant differences in mortality between high-
and low-case volume hospitals in defined medical conditions. The relationship between yearly hospital case volume and medical outcome in terms of perioperative mortality is significant in several major medical illnesses. This research has established case volume values to support the restructuring of services lines within a hospital network.

Prior research (Appendix 4; for example Bardach et al., 2004) supports that disease treatment of severe medical conditions in high-volume centres aligns with improved economic efficiency of the hospital. Patient satisfaction however – as a major indicator of hospital performance – appeared to have a negative impact on hospital performance in high-volume hospitals as compared to low-volume hospitals at least for “not complex cases” (Appendix 5; for example Rogut et al., 1996). The current research indicated that patient satisfaction is an important performance outcome parameter for a network hospital and that patient value drivers of surgeon competency and hospital reputation with regard to specific medical conditions, relationships between surgeons and referring doctors ensuring quality referrals are closely aligned with patient satisfaction.

The research confirmed through quantitative analysis the case pooling relevant medical conditions in Switzerland and determined for the first time in Switzerland minimum case volume standards per complex medical condition by standard statistical methods including regression analysis, non-parametric comparison tests and tests for statistical significance, partly following the methodology of Birkmeyer et al. (2002, pp. 1128 - 1137). The subsequent qualitative analysis confirmed the value drivers on pooling case volume per complex medical conditions from the perspectives of patients, doctors and hospital managers in the largest private hospital network organisation in Switzerland.
CONCLUSIONS AND IMPLICATIONS

5.4 LIMITATIONS

The proposed preliminary model on value drivers in the hospital network sector was developed in a setting in Switzerland and was not investigated in other countries. Nevertheless, the investigated complex medial conditions and their minimum case volume requirements for Switzerland are representative for Switzerland because all patients from Switzerland on the basis of the medical record data from the BFS between 2003 and 2007 were included in the analysis. Minimum case volume figures for specific medical conditions might be different in other countries, partly because of other methodological approaches but also due to the fact that minimum case volume standards are sometimes also politically defined.

The research findings have shown that despite the fact that in high-volume hospitals one could expect more patients with more complex and severe conditions of a certain disease, medical outcome was nevertheless better than in low volume hospitals. Differences in medical outcome between private and public hospitals have not been investigated in this study and should be subject to further analysis.

The relative importance of surgeon volume versus hospital volume was not investigated. Literature confirms that both, individual surgeon volumes, as well as hospital volumes play significant roles regarding treatment outcome (Appendix 3; for example Birkmeyer et al., 2004c). The magnitude of the hospital volume appears – in most medical conditions – to be more important compared to the surgeon volume. The major reason for this is that in severe medical conditions not only the experience and technical skills of the surgeon are important but also the experience of the whole hospital team dealing with a severe medical entity.
Economic efficiency with pooling hospital case volume was qualitatively, but not quantitatively investigated in this research. However, existing literature and the in-depth interviews indicate that economic efficiency is as a rule associated with pooling case volume. Furthermore, patient satisfaction in association with pooling case volume, i.e. whether patients treated in low-volume hospitals expressed more satisfaction compared to patients treated in high-volume hospitals, was not quantitatively investigated in this research. Nevertheless, the systematic analysis of current knowledge and the 13 in-depth interviews with patients provided some confirmation that high-volume hospitals are attractive for patients who suffer from complex illnesses.

The model developed through this research has developed new knowledge in the strategic management of hospital networks in Switzerland, but specific implementation issues may emerge in the operationalisation of the model. The model generated through the research is comprehensible, however effective implementation will require training and experience.

5.5 FUTURE RESEARCH
The preliminary model on value drivers and complex medical conditions regarding pooling of case volume and maximising hospital performance is based on quantitative analysis, network, economic and medical theories and the collected interview data. From a critical realism point of view, the model generated from the research is yet to be tested in a business context and will be enhanced further through an action research method. Only one hospital network organisation (Rhön, Germany) places emphasis on a hospital network structure that adopts the principles of pooling case volume so far.
The implementation of the model has to be controlled by common financial, medical and hospital satisfaction instruments and compared with past data. Nevertheless, the implementation of the presented model in a Swiss hospital network setting is likely to result in the need to address unforeseen complex, practical problems. For example the implementation of the value driver “work with highly qualified and experienced hospital surgeons with a high reputation for the treatment of complex medical cases” raises the question about the best approach to effectively and efficiently manage and enhance medical team performance in the setting of a hospital network organisation. Other problems in the implementation phase will certainly arise and the method of problem identification circles may be helpful. Therefore, it is recommended that the implementation of the preliminary model in a Swiss hospital network organisation should be supported by action research, because this method supports longitudinal research, emphasises gradual learning and improvements and allows the interaction between the problem owners (hospital stakeholders) and the researcher (Argyris, 1983, pp. 115 - 140).

After the model is implemented, a quantitative investigation to analyse retrospectively the relationship between case volume and economic efficiency as well as the relationship between pooling of case volume and patient satisfaction with past and real data of the particular hospital network would be important.

The question whether there is a lower limit of case volume below which decreases efficiency and quality could not be investigated in this study due to resource limitations. Future research should prospectively investigate this topic.
The question of whether the expectation of the benefits of high case volumes cause untoward side effects, e.g. that assigning specific procedures to specific centres in order to increase case volume may cause physicians to increase indications for a specific medical treatment, was not analysed in this investigation and may be subject to analysis in future studies.

The implementation of minimum case volume requirements could lead to overtreatment in certain medical conditions and therefore result in the generation of higher case volumes for high volume clinics when patients with defined medical conditions might be treated at earlier phases of the disease. The impact of treatment at earlier disease states as a consequence of the adoption of minimum case volume standards on overall outcome will have to be investigated in the future.

Despite a large body of evidence from the scientific literature that minimum case volume requirements are significantly related to improvements in medical outcome quality (e.g. Birkmeyer et al., 2002), it is highly probable that high case volume is not the only factor which favourably influences treatment outcome in complex medical conditions. Tiret et al. (1986) have shown that the existence of post-operative recovery rooms was directly related to better treatment outcome. Further studies should investigate the relative impact of all potential factors, which improve medical outcome in the treatment of severe and complex medical conditions.
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5.6 CONCLUSION

The thesis presents a preliminary model for value based hospital network performance improvement with emphasis on the major value drivers regarding the concentration of case volume per complex medical condition and hospital in a hospital network organisation.

The model implies that hospital group performance in terms of medical outcome quality, economic efficiency and patient satisfaction is positively affected by the pooling of case volume in high-volume hospitals of a hospital network on complex medical conditions where a statistically significant difference in comorbidity-adjusted mortality could be detected between high- and low-volume hospitals in Switzerland. The adoption of the presented preliminary model should result in improved medical treatment outcomes (i.e. a decrease in mortality), better economic performance in a hospital network group while maintaining patient satisfaction. The research provides recommendations to hospital managers about which actions should be taken in order to increase hospital performance regarding the treatment of complex medical conditions inside a hospital network organisation including:

1. The implementation of minimum case volume standards per hospital and per complex medical condition inside the hospital network organisation will enhance medical outcomes.

2. Building relationships and reputation between medical service teams, including highly specialised surgeons, and referring doctors will enhance patient satisfaction.

3. Economic efficiency will be developed through hospital specialisation and implementing specific service lines including specialised treatment teams, high-
end technology and intensive care units with regard to particular complex medical conditions.

The comparative analysis of the big multinational and national hospital networks in the US, Europe and other parts of the world was based on information available from the Internet homepages, from annual reports of the investigated hospital groups and Bloomberg financial data. Because of the differing degree of details available from the webpages, only limited value could be derived from this investigation and the collection of data regarding all variables defined in the search was not possible in all cases due to a lack of information on the webpages or annual reports. For this reason a thorough quantitative analysis of the collected data could not be carried out. However, the analysis revealed that one of the companies investigated, namely Rhön Klinikum AG, Germany, which is one of the most profitable and biggest hospital networks in Germany, provided detailed information on its treatment system as well as its focus on case volume pooling strategies. From this example it appears that pooling of case volume as done in practice by Rhön Klinikum AG presents an important strategic and successful example of service policy implementation. A future case study of Rhön Klinikum AG could examine the validity of the model derived through this research directed towards hospital network performance improvement.

The definition of minimum case volume requirements regarding treatment of several complex medical conditions would qualify Swiss hospitals to provide treatment and therefore is anticipated to lead to improved medical outcome and economic efficiency of the hospital network. The results of this study on the definition of minimum case volume requirements are generally in agreement with the defined case volume standards.
CONCLUSIONS AND IMPLICATIONS

in the US, Germany and other countries. The data from the Swiss health care market show a trend towards slightly lower, but nevertheless statistically significant differences between case volumes of high- and low-volume centres for complex medical condition treatment. Definitions of minimum case volumes in the mentioned countries were mostly brought about by health authority decisions based on recommendations from health care professionals and also statistical analyses of the available patient data. The method of determination of the minimum case volume requirements in defined medical conditions presented in this study was derived by the quantitative analysis and might serve as a model for future determinations of minimum case volume standards also in other countries.

The results of this research apply primarily to the private health care market and hospital service provision in Switzerland. Similar studies to be undertaken in other countries with a similar health care market and hospital organisation structure should help to verify the general applicability of the presented business model for hospital network performance improvement.


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## APPENDICES

### 7.1 Appendix 1: Systematic search masks, example Rhön Klinikum

<table>
<thead>
<tr>
<th>Concept 1 (or)</th>
<th>Concept 2 (or)</th>
<th>Concept 3 (or)</th>
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<th>Concept 5 (or)</th>
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<th>Concept 7(or)</th>
<th>Concept 8 (or)</th>
<th>Concept 9 (or)</th>
<th>Concept 10 (or)</th>
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</thead>
<tbody>
<tr>
<td>Röhn Klinikum AG</td>
<td>1) for-profit</td>
<td>19) pooling of case volume</td>
<td>29) patient experience</td>
<td>37) medical condition</td>
<td>41) referrer requirements</td>
<td>51) health care delivery system</td>
<td>60) portal clinics</td>
<td>67) quality report</td>
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<td></td>
<td>9) strategy</td>
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<td>Röhn Gruppe</td>
<td>2) profit</td>
<td>20) management of pooling of case volumes</td>
<td>30) patient satisfaction</td>
<td>38) economical efficiency</td>
<td>42) referrer issues</td>
<td>52) health care delivery</td>
<td>61) outpatient centers</td>
<td>68) quality management</td>
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<td></td>
<td>10) management practice</td>
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<tr>
<td>Rhön Kliniken</td>
<td>3) total revenue</td>
<td>21) distribution of case volumes</td>
<td>31) patient requirements</td>
<td>39) medical outcome</td>
<td>43) referrer interests</td>
<td>53) service line organisation</td>
<td>62) portal hospitals</td>
<td>69) total quality management</td>
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<td>11) management tactic</td>
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<td></td>
<td>4) EBIT</td>
<td>22) allocation of case volumes</td>
<td>32) patient interests</td>
<td>40) managed care</td>
<td>44) referrer needs</td>
<td>54) medical service focused factory</td>
<td>63) MVZ</td>
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<td>12) management policy</td>
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<td></td>
<td>5) performance</td>
<td>23) dispersion of case volumes</td>
<td>33) patient matters</td>
<td>45) referrer satisfaction</td>
<td>55) integrated practice units</td>
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<td>64) ambulatory</td>
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<td>13) organisation</td>
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<td>6) earnings</td>
<td>24) spreading of case volumes</td>
<td>34) patient needs</td>
<td>46) referrer services</td>
<td>56) virtuous cycle in health care delivery</td>
<td>65) maximum care hospital</td>
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<td></td>
<td>14 clinic profile</td>
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<td>7) employees</td>
<td>25) case management</td>
<td>35) patient service</td>
<td>47) referrer integration</td>
<td>57) integrated delivery systems</td>
<td>66) highly specialised hospital</td>
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<td>15) concentration structure</td>
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<td></td>
<td>8) beds</td>
<td>26) disease management</td>
<td>36) hospital experience</td>
<td>48) referrer incentives</td>
<td>58) system provider model</td>
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<td>16) cooperation structure</td>
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<td>17) group structure</td>
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<td>8) organisation structure</td>
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</table>

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### 7.2 Appendix 2. Pooling case volume and maximising hospital performance in international hospital networks

<table>
<thead>
<tr>
<th>A</th>
<th>Profile</th>
<th>Total revenue 2008 (in Mio. EUR)</th>
<th>EBIT 2008 (in Mio. EUR)</th>
<th>Beds 2008</th>
<th>Employees 2008</th>
<th>Main drivers regarding pooling medical conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rhön Klinikum AG</td>
<td>Private German clinic group, 53 hospitals and 29 MVZs, offers everything from primary health care to maximum medical care</td>
<td>2,130</td>
<td>172</td>
<td>14,828</td>
<td>33,679</td>
<td>Medical condition, visible results, service lines near the patient’s home base and referrer programs</td>
</tr>
<tr>
<td>Mediclin AG</td>
<td>Private German clinic group with 33 general &amp; specialised hospitals (acute clinics), 7 post acute clinics and 9 medical care units (MVZ)</td>
<td>456</td>
<td>15</td>
<td>7,900</td>
<td>5,816</td>
<td>Medical disciplines, service lines near the patient’s home base and referrer programs</td>
</tr>
<tr>
<td>Sana Kliniken GmbH</td>
<td>Private German hospital group with 40 hospitals at all care levels, 6 rehabilitation clinics and 7 nursing homes</td>
<td>1,063</td>
<td>60</td>
<td>8,200</td>
<td>16,500</td>
<td>Medical disciplines, service lines near the patient’s home base</td>
</tr>
<tr>
<td>Helios</td>
<td>German publicly traded company with 42 acute clinics, 24 MVZs, 1 “Poliklinik”, 4 nursing homes and 19 rehabilitation clinics</td>
<td>2,123</td>
<td>173</td>
<td>13,733</td>
<td>23,533</td>
<td>Medical disciplines, service lines and visible results</td>
</tr>
<tr>
<td>Générale de Santé</td>
<td>Publicly traded French corporation with a full range of hospital services and a complete spectrum of acute care services, more than 200 facilities</td>
<td>1,983</td>
<td>114</td>
<td>16,136</td>
<td>21,500</td>
<td>Medical disciplines and service lines</td>
</tr>
<tr>
<td>BMI Healthcare</td>
<td>Publicly traded British corporation, 67 hospitals and treatment centres</td>
<td>887</td>
<td>n.a.</td>
<td>2,840</td>
<td>9,203</td>
<td>GPs, service lines near the patient’s home base</td>
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<tr>
<td>Hospital corporation of America (HCA)</td>
<td>Publicly-traded American health care service with 160 acute care hospitals, 5 psychiatric hospitals, 1 rehabilitation centre and 105 freestanding surgery centres</td>
<td>20,691</td>
<td>853</td>
<td>38,504</td>
<td>191,000</td>
<td>Medical conditions, medical disciplines, service line near the patients’ home base and referrer programs</td>
</tr>
<tr>
<td>Tenet Healthcare Corporation</td>
<td>Investor-owned health care delivery system with 49 acute care hospitals and 57 outpatient centres</td>
<td>6,329</td>
<td>219</td>
<td>14,352</td>
<td>60,297</td>
<td>Medical conditions, medical disciplines, service lines near the patients’ home base and referrer programs</td>
</tr>
<tr>
<td>Universal Health Services (UHS)</td>
<td>Publicly-traded American Healthcare Organisation with 26 acute care hospitals, 101 behavioural health centres and 9 outpatient centres</td>
<td>3,649</td>
<td>298</td>
<td>13,110</td>
<td>39,500</td>
<td>Expansion of their hospital network</td>
</tr>
<tr>
<td>Community Health Systems (CHS)</td>
<td>Publicly-traded hospital company with 118 hospitals</td>
<td>7,885</td>
<td>715</td>
<td>17,245</td>
<td>n.k.</td>
<td>Maximised health care and specialised medical disciplines near the patients’ home base</td>
</tr>
<tr>
<td>Lifepoint Hospitals Inc.</td>
<td>Publicly-traded hospital company with 48 hospitals</td>
<td>1,966</td>
<td>166</td>
<td>5,686</td>
<td>Ca. 21,000</td>
<td>Medical conditions, disciplines, service lines near the patients’ home base.</td>
</tr>
<tr>
<td>IASIS Healthcare</td>
<td>For-profit hospital operator with 15 general acute-care hospitals and 1 behavioural hospital</td>
<td>1,523</td>
<td>123</td>
<td>2,644</td>
<td>10,775</td>
<td>Medical disciplines, service lines near the patients’ home base and referrer programs</td>
</tr>
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<td>Vanguard Health Systems</td>
<td>For-profit hospital operator with 15 general acute-care hospitals</td>
<td>2,050</td>
<td>97</td>
<td>4,181</td>
<td>18,500</td>
<td>Medical disciplines, visible results, service line and medical nurses trainings</td>
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</tr>
<tr>
<td>Capio</td>
<td>A leading health care provider in Europe with about 100 ambulatory, stationary and diagnostic facilities</td>
<td>1,238</td>
<td>n.k.</td>
<td>n.k.</td>
<td>14,500</td>
<td>Medical disciplines, service lines near the patients’ home base</td>
</tr>
<tr>
<td>Parkway Holdings Ltd.</td>
<td>A leading health care provider in Asia with 16 hospitals, 49 medical centres, 9 radiologic centres and 4 laboratories</td>
<td>491</td>
<td>62</td>
<td>2,891</td>
<td>n.a.</td>
<td>Medical disciplines, service lines near the patients’ home base</td>
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<tr>
<td>Bangkok Dusit Medical Services</td>
<td>Largest hospital operator in Thailand with 17 hospitals in Thailand and Cambodia</td>
<td>483</td>
<td>66</td>
<td>4,026</td>
<td>2,468</td>
<td>Medical disciplines</td>
</tr>
<tr>
<td>Ramsay Health Care</td>
<td>Global hospital group with 108 facilities in Australia, Indonesia and the UK</td>
<td>1,964</td>
<td>188</td>
<td>8,437</td>
<td>25,000</td>
<td>Medical disciplines</td>
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<tr>
<td>Netcare</td>
<td>Global health care provider in South Africa and the UK with 113 hospitals</td>
<td>2,072</td>
<td>90</td>
<td>8,679</td>
<td>28,884</td>
<td>Medical disciplines</td>
</tr>
<tr>
<td>Healthscope</td>
<td>Leading private health operator with 43 hospitals, 45 medical centres, a pathology business and a diagnostic imaging division in Australia, New Zealand, Singapore and Malaysia</td>
<td>1,488</td>
<td>154</td>
<td>n.k.</td>
<td>n.a.</td>
<td>Medical disciplines and near patient home</td>
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<tr>
<td>Medi-Clinic</td>
<td>Private hospital group with hospitals in South Africa, Namibia, Switzerland and the United Arab Emirates</td>
<td>912</td>
<td>103</td>
<td>6,776</td>
<td>12,554</td>
<td>Medical disciplines and referrer programs</td>
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</table>
## Appendix 3. Scientific literature on pooling of cases with relevant medical conditions regarding medical outcome in the USA and Europe

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<tr>
<th>Study</th>
<th>Setting, dates, patient numbers, study design</th>
<th>Aim of the study/Hypothesis</th>
<th>Method</th>
<th>Results</th>
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<tr>
<td>Birkmeyer &amp; Dimick (2004a &amp; b)</td>
<td>Data from the 2000 Nationwide Inpatient Sample</td>
<td>Estimation of the potential benefits of expanded 2003 standards of the Leapfrog group – a large coalition of employers and health care purchasers aiming with their knowledge to improve hospital safety.</td>
<td>The authors used data from the 2000 Nationwide Inpatient Sample to determine eligible surgical populations, volume-outcome associations, and risk-adjusted hospital mortality rates for the 5 operations (esophagectomy, pancreatectomy, abdominal aortic aneurysm repair, coronary artery bypass grafting [CABG] and percutaneous coronary intervention [PCI]).</td>
<td>Approximately 23,790 patients died in 2000 in the United States undergoing 1 of the 5 procedures. The authors estimated that full implementation of the Leapfrog standards would have averted 7818 of these deaths: CABG (4089), PCI (3016), elective abdominal aortic aneurysm repair (356), esophageal resection (180), and pancreatic resection (177). For CABG and PCI, standards based on risk-adjusted mortality rates would save at least 5 times more lives than those based on volume criteria alone.</td>
<td>It was concluded that widespread implementation of the 2003 Leapfrog standards for evidence-based referral could avert a large number of surgical deaths and that for some procedures, standards comprised of process of care or direct outcome measures would be more effective than those based on volume alone.</td>
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<td>Birkmeyer et al. (2004c)</td>
<td>National Medicare claims database for 1998 through 1999.</td>
<td>Study of the relationship between surgeon volume and operative mortality in the United States among all 474,108 patients who underwent one of eight cardiovascular procedures or cancer resections</td>
<td>The relations between operative mortality and surgeon volume and hospital volume (each in terms of total procedures performed per year), with adjustment for characteristics of the patients and other characteristics of the providers were analysed</td>
<td>Surgeon volume was inversely related to operative mortality for all eight procedures. The adjusted odds ratio for operative death. Surgeon volume accounted for a large proportion of the apparent effect of the hospital volume, to an extent that varied according to the procedure: it accounted for 100% of the effect for aortic-valve replacement, 57% for elective repair of an abdominal aortic aneurysm, 55% for pancreatic resection, 49% for coronary-artery bypass grafting, 46% for esophagectomy, 39% for cystectomy, and 24% for lung resection. For most procedures, the mortality rate was higher among patients of low-volume surgeons than among those of high-volume surgeons, regardless of the surgical volume of the hospital in which they practiced.</td>
<td>For many procedures, the observed associations between hospital volume and operative mortality are largely mediated by surgeon volume. Patients can often improve their chances of survival substantially, even at high-volume hospitals, by selecting surgeons who perform the operations frequently.</td>
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<td>Chowdhury et al. (2007)</td>
<td>The search identified 55'391 articles published between 1957 and 2002. 1075 were relevant to the study, of which 163 fulfilled the entry criteria.</td>
<td>Articles examining the effects of one or more of three variables (hospital volume of surgery, surgeon volume and specialization) on outcome (measured by length of hospital stay, mortality and complication rate) were analysed.</td>
<td>The methodological quality of each study was assessed, a correlation between the variables analysed and the outcome accepted if it was significant.</td>
<td>163 studies examined 42 different surgical procedures, spanning 13 surgical specialities. Hospital volume was reported in 127 studies; <em>high-volume hospitals had significantly better outcomes in 74% of studies</em>, but this effect was limited in prospective studies. Surgeon volume was reported in 58 studies; <em>high-volume surgeons had significantly better outcomes in 74% of studies</em>. Specialization was reported in 22 studies; <em>specialist surgeons had significantly better outcomes than general surgeons in 91% of studies</em>. The benefit of high surgeon volume and specialization varied in magnitude between specialities.</td>
<td>High surgeon volume and specialization benefit medical outcome. The benefit of high hospital volume is less clear and varies between procedures. Where high hospital volume has been shown to be beneficial, the data come predominantly from retrospective studies.</td>
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<td>Dimick, Osborne, Nicholas &amp; Birkmeyer (2009)</td>
<td>Identification of all patients who underwent gastric bypass in the New York State Inpatient database (n = 32,381 patients, n = 105 hospitals).</td>
<td>Determination whether risk-adjusted outcomes or hospital volume were better at predicting future hospital morbidity with bariatric surgery.</td>
<td>Morbidity was ascertained using a previously validated combination of diagnostic and procedure codes. First the risk-adjusted morbidity was calculated and volume at each hospital during a 2-year period (2003 to 2004). Then the proportion of hospital-level variation explained by each measure was ascertained using hierarchical modelling techniques. Finally the ability of each measure to predict future performance was compared, as assessed with risk-adjusted morbidity, in the next 2 years (2005 to 2006).</td>
<td>Risk-adjusted morbidity explained 83% of future hospital-level variation in morbidity compared with only 21% for hospital volume. When comparing the “best” with the “worst” hospital quartiles, risk-adjusted morbidity predicted a more than fourfold difference in future performance (1.7% versus 7.2%; odds ratio [OR]: 4.5; 95% CI, 3.5 to 5.9). Hospital volume predicted only a twofold difference (2.5% versus 4.5%; OR: 1.9; 95% CI, 1.5 to 2.4) from the best to worst quartile.</td>
<td>Risk-adjusted morbidity is much better than hospital volume at predicting future performance with bariatric surgery. Rather than focusing on volume, accreditation and centers of excellence programs should focus more on directly measuring outcomes.</td>
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<td>Bilimori a et al. (2009)</td>
<td>29 studies were reviewed.</td>
<td>The objective of this study was to assess studies examining the effect of surgeon training and experience on outcomes in surgical oncology.</td>
<td>A systematic review of the literature was performed to assess articles examining the impact of surgeon training, certification, and experience on outcomes. Studies were included if they examined cancer resections and performed multivariable analyses adjusting for relevant confounding variables.</td>
<td>27 examined surgeon training/specialization, 1 assessed surgeon certification, and 4 evaluated surgeon experience. Of the 27 studies examining training/specialization, 25 found that specialized surgeons had better outcomes than nonspecialized surgeons. Of the four studies that examined experience, three studies found that increasing surgeon experience was associated with improved outcomes.</td>
<td>Although numerous studies have examined the impact of surgeon factors on outcomes, only a few cancers have been examined, and outcome measures are inconsistent.</td>
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<td>Birkmeyer et al. (2006)</td>
<td>Medicare claims database (2000 - 2002), all patients undergoing major resections for lung, esophageal, gastric, liver, or pancreatic cancer (n = 71,558).</td>
<td>Examination of the relations between hospital volume, process of care, and operative mortality in cancer surgery.</td>
<td>Relative to those at low-volume centers (lowest 20th by volume), patients at high-volume hospitals (highest 20th) were significantly more likely to undergo stress tests, but not other preoperative imaging tests. They were more likely to see medical or radiation oncologists, but not other specialists, preoperatively. Although blood transfusions and use of epidural pain management did not vary significantly by volume, patients at high-volume hospitals had significantly longer operations and were more likely to receive perioperative invasive monitoring. Differences in measurable processes of care did not explain volume-related differences in operative mortality to any significant degree.</td>
<td>Although high-volume and low-volume hospitals differ with regard to many aspects of perioperative care, mechanisms underlying volume-outcome relations in high-risk cancer surgery remain to be identified.</td>
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<td>Birkmeyer et al. (2007)</td>
<td>National Surveillance Epidemiology and End Results (SEER)-Medicare linked database (1992 - 2002)</td>
<td>Study of the relationships between hospital volume and late survival after different types of cancer resections.</td>
<td>The authors identified all patients undergoing major resections for lung, esophageal, gastric, pancreatic, colon, and bladder cancer (n = 64,047).</td>
<td>Absolute differences in 5-year survival probabilities rates between low-volume and high-volume hospitals ranged from 17% for esophageal cancer resection (17% vs. 34%, respectively) to only 3% for colon cancer resection (45% vs. 48%). Absolute differences in 5-year survival between low-volume and high-volume hospitals fell between these ranges for lung (6%), gastric (6%), pancreatic (5%), and bladder cancer (4%). Volume-related differences in late survival could not be attributed to differences in rates of adjuvant therapy.</td>
<td>Along with lower operative mortality, high-volume hospitals have better late survival rates with selected cancer resections than their lower-volume counterparts.</td>
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<td>Chang &amp; Birkmeyer (2006)</td>
<td>Review article including 12 studies.</td>
<td>Study of the relationships between surgical volume and medical outcomes after esophageal resection, including operative mortality, complication rates, and late survival.</td>
<td>11 of 12 studies noted a statistically significant volume–outcome relationship with this procedure. Hospital and surgeon volume are inversely related to operative mortality for esophageal resection. Given the heterogeneity of the volume–outcome literature, it is difficult to identify minimum volume thresholds at which satisfactory performance is achieved.</td>
<td>Both volume-based hospital referral and process improvement provide compelling and sometimes competing strategies for translating evidence about volume–outcome relationships into policy. Each approach has significant limitations that preclude uniform implementation nationwide.</td>
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<td>Du Bois et al. (2008)</td>
<td>44 studies.</td>
<td>Systematic review summarises the available data evaluating the impact of different physician and hospital characteristics on outcome in ovarian cancer patients. Selected studies assessed the relationship between physician and/or hospital specialty or volume and at least one of the outcomes of interest. The primary outcome was survival. Additional parameters included surgical outcome, completeness of staging, and quality of chemotherapy.</td>
<td>The authors independently reviewed each article and applied the inclusion/exclusion criteria. The quality of each study was assessed by focusing on strategies to control for important prognostic factors.</td>
<td>Discipline and sub-specialization of the primary treating physician were identified as the most important variable associated with superior outcome. Evidence showing a beneficial impact of institutional factors was weaker, but followed the same trend. Hospital volume was hardly related to any outcome parameter.</td>
<td>The limited evidence available showed considerable heterogeneity and has to be interpreted cautiously. Better utilization of knowledge about institutional factors and well-established board certifications may improve outcome in ovarian cancer. Patients and primary-care physicians should select gynaecologic oncologists for primary treatment in countries with established sub-specialty training.</td>
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<td>Study</td>
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<td>Mayer et al. (2008)</td>
<td>22 studies.</td>
<td>Systematically assessment of the quality of evidence for the volume-outcome relationship in uro-oncology.</td>
<td>Studies were assessed for their methodological quality using a previously validated rating system. Where possible, meta-analytical methods were used to calculate overall differences in outcome measures between low- and high-volume healthcare providers.</td>
<td>Only 4 studies appropriately explored the effect of both the institution and surgeon volume on outcome measures. Mortality and length of stay were the most frequently measured outcomes. The median total quality scores within each of the operation types were 8.5, 9 and 8 for cystectomy, prostatectomy and nephrectomy, respectively (possible maximum score 18). Random-effects modelling showed a higher risk of mortality in low-volume institutions than in higher volume institutions for both cystectomy and nephrectomy.</td>
<td>The methodological quality of volume outcome research as applied to cystectomy, prostatectomy and nephrectomy is only modest at best. Accepting several limitations, pooled analysis confirms a higher-volume, lower mortality relationship for cystectomy and nephrectomy.</td>
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<td>Study</td>
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<td>Metzger et al. (2004)</td>
<td>Review of the last 10 years, 13 papers on esophageal cancer.</td>
<td>Aimed at reducing surgical deaths, several initiatives have attempted to establish volume-based referral strategies in high-risk surgery.</td>
<td>Meta-analysis. A random effects model was used.</td>
<td>Clear reduction in postoperative mortality with increasing case volumes per year. Single papers have analysed the main reasons for this phenomenon and showed that postoperative complication rates are lower in high-volume hospitals and management of complications is more successful. Long-term prognosis is also correlated to case volume. In conclusion, the analysis shows that only with the experience of more than 20 esophagectomies per year can a significant reduction of the mortality, down to 4.9%, be achieved.</td>
<td>Surgery of esophageal cancer is a task for high-volume hospitals because of decreased postoperative mortality and improved long-term prognosis compared with low-volume hospitals.</td>
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<td>Study</td>
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<tr>
<td>Pennathur &amp; Luketich (2008)</td>
<td>Literature review.</td>
<td>To give the reader an overview of the important factors that may have an impact on the outcomes after esophagectomy.</td>
<td>The authors reviewed their experience and the medical literature on the various factors that may have an impact on the outcomes after esophagectomy. These include patient selection, staging strategies, the surgical approach, extent of resection, and the role of multimodality therapy for the treatment of esophageal cancer.</td>
<td>Surgical resection is the primary curative modality in patients with resectable esophageal neoplasm. Strategies to optimize surgical outcomes include optimal patient selection, accurate staging, and stage-directed therapies that include a multimodality approach in localized advanced esophageal cancer. The type of surgical approach is typically based on surgeon preference, and in some centers, a minimally invasive approach is used. Other important factors are hospital and surgeon volume.</td>
<td>Further prospective studies are required to clearly define the role of neoadjuvant or adjuvant therapies.</td>
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APPENDICES
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<tr>
<td>Salz &amp; Sandler (2008)</td>
<td>23 articles.</td>
<td>Systematic review of studies evaluating the association between hospital or surgeon volume and rectal cancer outcomes.</td>
<td>Description of each study and report of outcomes in terms of the effect of hospital or surgeon volume on the type of surgery performed, surgical complications, postoperative mortality, survival, and recurrence.</td>
<td>Hospitals and surgeons with higher caseloads appear to perform more sphincter preserving surgeries and have lower postoperative mortality rates. Hospital and surgeon volume appear to have no effect or a small beneficial effect on the rate of leaks, complication rates, local recurrence, overall survival, and cancer specific survival. For rectal cancer, the effects of hospital volume may be stronger for more short-term outcomes.</td>
<td>Beyond the immediate recovery period, the effect of hospital and surgeon volume may be minimal.</td>
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<td>Wilt et al. (2008)</td>
<td>17 articles.</td>
<td>Association between hospital and surgeon volume, and medical outcomes after radical prostatectomy.</td>
<td>Information on study design, hospital and surgeon annual radical prostatectomy volume, hospital status and medical outcome rates were abstracted using a standardised protocol. Data were pooled with random effects models.</td>
<td>Hospitals with volumes above the mean had lower surgery related mortality and morbidity (rate difference. Teaching hospitals had an 18% lower rate of surgery related complications. Surgeon volume was not significantly associated with surgery related mortality or positive surgical margins. The rate of late urinary complications was 2.4% lower and the rate of long-term incontinence was 1.2% lower for each 10 additional radical prostatectomies performed by the surgeon annually. Length of stay was lower, corresponding to surgeon volume.</td>
<td>Higher provider volumes are associated with better outcomes after radical prostatectomy. Greater understanding of factors leading to this volume-outcome relationship, and the potential benefits and harms of increased regionalisation is needed.</td>
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<td>Barocas et al. (2010)</td>
<td>Literature review.</td>
<td>Relationship between case volume and outcomes after radical prostatectomy (RP) was analysed.</td>
<td>Literature search of the English language studies available through PubMed. Thirteen original studies and a meta-analysis were found, which focus on the impact of hospital RP volume on surgical outcomes. Eight studies were identified that interrogated the relationship between individual surgeon case volume and outcomes.</td>
<td>Across multiple outcome metrics, there is a pervasive association between higher hospital RP case volume and improved outcomes. Increasing individual surgeon volume may also portend better outcomes, not only perioperatively, but even with respect to long-term cancer control and urinary function. While most data arise from retrospective cohort studies, these studies, for the most part, are of sound design, show an impressive magnitude of effect, and demonstrate an impact on outcome that is proportional to surgical volume.</td>
<td>To address differences in outcome between low volume and high-volume surgeons, some have proposed and implemented subspecialisation within practice groups, while others have looked toward subspecialty certification for urologic oncologists. With regard to differences in hospital volume, regionalisation of care has been proposed as a solution, but is fraught with pitfalls. It may be more pragmatic and, ultimately more beneficial to patients, However, to identify processes of care that are already in place at high-volume hospitals and implement them at lower volume centers.</td>
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<td>Wouters et al. (2009)</td>
<td>21 articles where included in the review.</td>
<td>In The Netherlands esophageal resections for cancer are banned from hospitals with an annual volume less than 10. In this study the validity of this specific volume cut-off is evaluated. In addition, the expected benefits of volume-based referral to the results of a regional centralisation process based on differences in outcome are compared.</td>
<td>A search of the medical literature was performed in Medline for the period 1998–2008. The search was limited to publications in the English language and original articles.</td>
<td>Hospitals with an annual volume between 10 and 20 resections a year on average do not perform better than lower volume hospitals (less than 10 resections a year).</td>
<td>Expectations about quality improvements as a result of high-volume standard of 10 resections a year have to be moderate. Between studies, the choice of volume categories differs widely, with the lowest volume categories varying from less than 1 to less than 30 resections a year.</td>
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## Appendix 4. Scientific literature on pooling case volume and economic efficiency

### List of publications on pooling of case volume and economic efficiency

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<td>Bellal et al. (2009)</td>
<td>Two-part study reviewed publicly available hospital information from the Leapfrog Group, HealthGrades, and hospital websites. Hospitals were evaluated for Leapfrog ICU staffing criteria and Safe Practice Score; HealthGrades five-star rating for complex gastrointestinal procedures and operations; and presence of a general surgery residency, gastroenterology fellowship, and interventional radiology.</td>
<td>Study whether associations exist between hospital volume and hospital clinical resources and between both of these factors to mortality to help explain this relationship.</td>
<td>Evaluation used trend analysis and multiple logistic regression analysis. The second part determined the mortality rate for pancreaticoduodenectomy using inpatient mortality data from the National Inpatient Sample and Leapfrog. Hospitals were categorised by low-volume (≤ 10/year), high-volume (≥ 11/year), strong clinical support, and weak clinical support. Data were correlated by number of pancreatic resections per hospital, hospital system clinical resources, and operative mortality.</td>
<td>As hospital volume increased, statistically significant increases occurred in the frequency of hospitals meeting Leapfrog ICU staffing criteria, Leapfrog Safe Practice Score, HealthGrades 5-star rating, general surgery residency, gastroenterology fellowship, and interventional radiology services. No significant relationships were found between resection volume and any one of the clinical support factors and perioperative death. Presence of strong clinical support was associated with lower mortality.</td>
<td>System clinical resources were more influential in operative mortality for pancreatic resection. This might help explain why high-volume hospitals, low-volume surgeons in high-volume institutions, and some lower volume hospitals with excellent clinical resources have lower perioperative mortality rates for pancreatic resection.</td>
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<td>Birkmeyer et al. (2002b)</td>
<td>Data from a cross-section of New England hospitals.</td>
<td>Economic effects from three different perspectives were considered: (1) Hospital perspective: Surgery is a well-known profit centre at most hospitals. How would redistributing surgical caseload affect the bottom lines of high-volume hospitals gaining patients, and low-volume hospitals losing market share? (2) Payer perspective: Concentrating selected procedures among a smaller number of providers may reduce competition among hospitals. Will insurers have to pay more for surgery? (3) Societal perspective: Volume-based referral strategies could influence both the unit cost of providing a given surgical procedure and the total number of procedures performed. Will the net cost of delivering surgical care rise or fall?</td>
<td>To evaluate potential gains and losses from the hospital perspective, average hospital profits were estimated with four surgical procedures* (all targeted by the Leapfrog Group).</td>
<td>For each of the four procedures, average hospital reimbursements greatly exceed costs. Average profits ranged from USD 3,200 for elective abdominal aortic aneurysm repair to USD 6,840 for CABG surgery. Volume-based referral strategies may have several important economic effects. From the hospital perspective, these strategies will redistribute surgical revenue, creating financial winners (high-volume hospitals) and losers (lower volume centers). From the payer perspective, reduced competition among providers may result in increased prices in many, but not all, areas. Finally, volume-based referral strategies should not be expected to greatly reduce direct health care costs.</td>
<td>In the absence of quantitative information about different costs and savings, it is impossible to calculate a bottom line. However, by creating incentives for hospitals to do more cases and concentrating care in the hands of surgical “enthusiasts”, volume-based referral strategies could greatly increase the use of discretionary procedures. The economic implications of volume-based referral policies would depend on details of the specific strategy employed. Volume-based referral strategies may a good place to start in efforts to improve surgical quality.</td>
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<td>Dimick et al. (2001)</td>
<td>Statewide database was analysed for patients who underwent esophageal resection in Maryland (n = 1,136 patients) from 1984 to 1999.</td>
<td>Determination of the effect of hospital volume on outcomes of esophageal resection.</td>
<td>Multivariate regression was used to determine the association of hospital volume with in-hospital mortality, length of stay, and hospital charges after adjusting for case mix and time period.</td>
<td>Unadjusted in-hospital mortality rates were lower in high-volume hospitals (2.7%) than in medium (12.7%) and low (16%) volume hospitals. High hospital volume was associated with: (1) fivefold reduction in the risk of death; (2) a 6-day reduction in length of stay; and (3) USD 11,673 decrease in hospital charges.</td>
<td>Hospitals that perform high-volumes of esophageal resection have superior clinical and economic outcomes. By referring these patients to high-volume centers, quality improvement and cost reduction may be approved.</td>
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<td>Ho &amp; Aloia (2008)</td>
<td>Analysis of the administrative discharge data on patients receiving 1 of 6 cancer resections in Florida, New Jersey, and New York between 1989 and 2000.</td>
<td>Evaluation of the associations between hospital and surgeon volume and inpatient costs for 6 cancer resections.</td>
<td>After dividing hospital and surgeon volumes into tertiles, examination of the relations between the total cost of an inpatient stay and surgeon and hospital volume, adjusting for patient and hospital characteristics. Testing for differences in adjusted volume-cost relationships that persisted throughout the sample period, versus those that lasted for shorter periods.</td>
<td>For the entire sample period, relative to low-volume surgeons, high-volume surgeons were 5.5% less costly for pneumonectomy and 10.6% less costly for esophagectomy. High hospital volume was associated with lower costs only for colectomy.</td>
<td>High surgeon volume, rather than high hospital volume, is associated with lower inpatient cancer surgery costs, and the relationship has become significant in recent years for each cancer procedures examined.</td>
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<td>Kuo et al. (2001)</td>
<td>Massachusetts Health Data Consortium on discharge information for all acute care hospitals in Massachusetts regardless of payer from 1992 to 2000.</td>
<td>Several complex surgical procedures had a reduction in mortality when they were performed at high-volume centers. Hypothesis: esophagectomy procedures for cancer performed at high-volume hospitals in the state of Massachusetts would show a similar relationship.</td>
<td>The influence of hospital volume was related to days in the intensive care unit, length of stay, discharge disposition, hospital mortality, and total cost. Hospitals were stratified to low-volume hospitals (&lt; 6 cases per year) and high-volume hospitals (&gt; 6 cases per year).</td>
<td>High-volume hospitals were associated with a 2-day decrease in median length of stay, a 3-day reduction in median intensive care unit stay, an increased rate of home discharges, and a 3.7-fold decrease in hospital mortality. The odds ratio of death at a low-volume hospital was 4.3. The median cost was USD 755 greater at high-volume hospitals (not significant).</td>
<td>Hospitals that perform a high-volume of esophagectomies have better results with early clinical outcomes and marked reductions in mortality compared with low-volume hospitals.</td>
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<td>Losina et al. (2009)</td>
<td>Data from a national cohort of Medicare beneficiaries undergoing total knee arthroplasty (TKA) in 2000.</td>
<td>Investigation of the cost-effectiveness of TKA and the influences of hospital volume and patient risk on TKA cost-effectiveness in the United States.</td>
<td>Development of a Markov, state-transition, computer simulation model and population of it with Medicare claims data and cost and outcomes data from national and multinational sources. Projection of lifetime costs and quality-adjusted life expectancy (QALE) for different risk populations and varied TKA intervention and hospital volume. Cost-effectiveness of TKA was estimated across all patient risk and hospital volume permutations. Conduction of sensitivity analyses to determine various parameters’ influences on cost-effectiveness.</td>
<td>TKA was more costly and less effective in low-volume centers than in high-volume centers. The greatest variations were seen for the quality of life gain after TKA and the cost of TKA.</td>
<td>Total knee arthroplasty appears to be cost-effective in the US Medicare-aged population, as currently practiced across all risk groups. When a high-volume hospital is available, TKAs performed in a high-volume hospital confer even greater value per dollar spent than TKAs performed in low-volume centers.</td>
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<td>Malchau et al. (2008)</td>
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<td>The purpose of this study was to examine the impact of hospital volume on the cost-effectiveness of the computer navigation in order to determine its feasibility and the level of evidence that should be sought prior to its adoption.</td>
<td>A Markov decision model was used to evaluate the cost-effectiveness of computer-assisted knee arthroplasty, in relation to hospital volume. Transition probabilities were estimated from the arthroplasty literature, and costs were based on the average reimbursement for primary and revision knee arthroplasty at our institution. Outcomes were measured in quality adjusted life years.</td>
<td>Computer-assisted surgery becomes less cost-effective as the annual hospital volume decreases, as the cost of navigation increases, and as the impact on revision rates decreases. If a centre performs 250 cases per year, computer navigation will be cost-effective if the annual revision rate is reduced by 2% per year over a twenty-year period. If a centre performs 150 cases per year, computer navigation is cost-effective if it results in a 2.5% reduction in the annual revision rate over a twenty-year period. If a centre performs only 25 cases per year, the annual reduction in revision rates must be 13% for computer navigation to be cost-effective.</td>
<td>Computer navigation is not likely to be a cost-effective investment in health care improvement in low-volume joint replacement centers, where its benefit is most likely to be realised. It may be a cost-effective technology for higher volume joint replacement centers, where the decrease in the rate of knee revision needed to make the investment cost-effective is modest, if improvements in revisions rates with the use of this technology can be realised.</td>
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<td>Shahian et al. (2001)</td>
<td>12,774 patients who underwent isolated coronary bypass surgery at 12 Massachusetts hospitals during 1995 and 1996.</td>
<td>Study investigates the relationship between the cost of coronary artery bypass graft surgery and both hospital size and case volume.</td>
<td>Hospitals were stratified by number of operating beds into 3 groups. Total annual coronary bypass cases per hospital varied from 271 to 913. Univariate and multivariable analyses were used to study the relationship between the direct and total cost and a number of patient and hospital predictor variables. For each hospital, the relationship between changes in coronary bypass case volume and the corresponding changes in average cost from 1995 to 1996 were studied.</td>
<td>When annual cases were analysed as continuous variables, there was no linear relationship of case volume with direct or total cost of coronary bypass for any diagnosis related group or year. When hospital bed capacity and case volume were grouped into strata and studied by analysis of variance, there was no evidence of an inverse relationship between these variables and cost. In multivariable analysis, patient acuity class and diagnosis-related group were the most important predictors of cost.</td>
<td>Within the range of hospital size and case volume represented in this study, there is no evidence that either variable is related to the cost of performing coronary bypass surgery. Massachusetts hospitals appear to function on different segments of different average cost curves. It is not possible to predict the relative cost of coronary bypass grafting at a given hospital based primarily on volume.</td>
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7.5 Appendix 5. Scientific literature on pooling case volume and patient satisfaction

Scientific studies on the relationship between case volume and patient satisfaction.

<table>
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<tr>
<th>Observed variables</th>
<th>Evidence</th>
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<tr>
<td>Distance and A &amp; E*</td>
<td>The evidence shows a clear distance decay effect for self referral to A &amp; E departments.</td>
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<td>*Hospital-service patients can use without a referral</td>
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<td>Distance and clinics and day cases</td>
<td>The evidence can be interpreted as being consistent with the expectation that patients will drop out of attending clinics because of the distance involved if they do not see them as being important. On the other hand the evidence indicates that distance does not affect attendance where the clinic is related to cancer.</td>
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<td>Distance and inpatients</td>
<td>There is a conflicting evidence for inpatient services, although the majority of the studies present some evidence of a distance-decay effect. The evidence from North America is mixed, whilst from the UK finds evidence of distance-decay in each case. Although not conclusive, the weight of evidence therefore suggests that accessibility is likely to be adversely affected by the distance from the hospital.</td>
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<tr>
<td>Visitors</td>
<td>The evidence suggests that avoidance of excessive concentration may be a legitimate goal where families and stress are involved: easy accessibility for relatives can be important, for example in visiting babies and young children.</td>
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<td>Distance and screening</td>
<td>Screening may seem unimportant to the individual and therefore not worth making effort to attend, but the evidence (Bentham et al., 1995) indicates that positive systematic action such as a call and recall system may help to improve the rate of access to a screening service.</td>
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<tr>
<td>Distance and willingness to travel</td>
<td>Two studies provide evidence that patients are willing to travel some distance to overcome delays in accessing hospital services.</td>
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<td>Distance and outcome</td>
<td>There is mixed evidence about the association between outcome and the time taken to access the hospital services.</td>
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The quality of evidence in this area is generally poor, with a lack of properly controlled studies. The evidence of (mostly) cross-sectional studies suggests that in some cases increasing the distance between the patient and the hospital service may result in reduced access and possibly worse outcomes.
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<tr>
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<tr>
<td>Adams et al. (1991)</td>
<td>12,000 Medicare discharges in three overlapping rural market areas during 1986. MEDPAR files available from the Health Care Financing Administration (HCFA).</td>
<td>Examination of the hospital choice of rural Medicare beneficiaries, explicitly accounting for the existence and characteristics of their alternative choices. Effect of a patient’s complexity of illness on the choice of hospital.</td>
<td>Development of a model to predict where Medicare inpatients would go if the rural hospital that they had previously chosen were to close. The independent variables used in the analysis comprise three types: hospital characteristics (or attributes) that do not vary across patients, patient characteristics that do not vary across hospitals, and distance variables that vary with both individuals and hospitals.</td>
<td>Results indicate that rural Medicare beneficiaries tend to choose hospitals with a large scope of service and with teaching activity over those with a lower scope of service and no teaching activity, holding other factors constant. Distance is a deterrent to hospital choice, especially for older Medicare beneficiaries. The more complex cases tend to choose larger urban and rural hospitals over small rural hospitals more often than less complex cases do.</td>
<td>The implications of this study are concentrating on factors that are retaining patients from bypass their local hospital.</td>
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<td>Geraedts et al. (2007)</td>
<td>Starting 2005. Germany’s health law required reports to be published every two years by all acute care hospitals. The reports were intended to help patients and physicians make informed choices of hospitals. 50 patients and 50 physicians.</td>
<td>Patients and physicians were asked to rate the understandability (pat.), suitability (phys.) and relevance (both) of a set of 29 quality indicators.</td>
<td>The differences in patient and physician ratings of relevance of all indicators were analysed by applying descriptive statistics, t-tests and Wilcoxon tests.</td>
<td>The most relevant indicator for the patients was ‘qualification of doctors’ and for the physicians ‘volume of specified surgical procedures’.</td>
<td>Most of the content of Germany’s hospital quality reports seems to be useful for patients and physicians and influence their choice of hospital.</td>
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<td>Gozu et al. (2009)</td>
<td>8 months after closure of a practice in Dundalk, Maryland. Random selection of 140 patients older than 60 years from each of the following groups: those who followed their primary care provider (PCP) and those who transferred to a closer clinic.</td>
<td>Questionnaire with demographic characteristics, self-reported medical conditions, duration of PCP-relationship, driving proficiency and patient perceptions about distance and travel time. Hypothesis: more frail patients and those with barriers to travel would not follow their PCP to the distant site.</td>
<td>$\chi^2$-tests and logistic regression analyses were used to determine differences between the groups.</td>
<td>Older patients who live alone and are weaker seem to be more likely to forgo continuity with their PCP for the sake of convenience when a barrier to access occurs, such as relocation of the physician to a more distant office.</td>
<td>Self-report study. Study included older patients affected by the closure of a single clinic in a specific area. Therefore, these findings may not be generalisable to other populations.</td>
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<td>Hekkertert et al. (2009)</td>
<td>2005. 8 academic and 14 (out of 88) general hospitals participated. Response rate: 55.7% for academic hospitals (n = 16,904) &amp; 47.7% for general hospitals (n = 11,015)</td>
<td>Core questionnaire. Patient Satisfaction (COPS) with 6 dimensions on patient satisfaction: admission procedures, nursing care, medical care, information, patient autonomy, and discharge and aftercare.</td>
<td>Multilevel analyses were conducted to evaluate which part of the variance in patient satisfaction is related to the hospital/department/patient level.</td>
<td>The differences in satisfaction scores are mainly determined at the patient level and to a lower extent at the department and the hospital levels. 0 - 4% of the variance in patient satisfaction scores was on the hospital and department levels. The patient and hospital characteristics explained 3 - 5% of the variance. Especially age, health status and education have a substantial impact on the outcome of satisfaction research.</td>
<td>Unsatisfied patients are more likely to return the questionnaire, which might be a response bias. Satisfaction scores were generally quite high; this artefact can be a result of the survey design but it’s also likely to be a valid reflection of patient views.</td>
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Katz et al. (2003)

Ohio, Pennsylvania, Colorado.
1995 (THR), survey 3 years later.
926 patient (undergoing THR in 1995).
Population-based cohort study.

Is hospital volume and surgeon volume of total hip replacements (THRs) associated with patient-reported functional status and satisfaction with surgery 3 years postoperatively?

Harris hip and satisfaction score, dichotomisation of outcomes.
Bivariate analyses (identification of patients characteristics associated with hospital volume).
Multivariate modelling. Therefore, hospital volume as primary predictor.

Hospital and surgeon volume have little effect on 3-year functional outcome following THR, after adjusting for patient sociodemographic and select clinical characteristics. Patients who underwent primary THR in the lowest-volume hospitals were somewhat more likely to have a Harris hip score in the lowest 10% of the distribution. Patients who underwent primary THR in low-volume hospitals appeared to be less satisfied with the result of the surgery.

Higher hospital and surgeon volume have been associated with lower rates of adverse events following numerous surgical and medical procedures. The influence of hospital and surgeon volume on pain and physical functional status, which are critically important outcomes of THR from the patient’s point of view, has received little prior attention.

It is possible that patients in high-volume hospitals responded positively to the more sophisticated facilities in these centres when they answered the questions about their satisfaction with the result of the surgery. Adjustment abolished the volume effect, indicating that education, income and preoperative functional status confounded the association between volume and functional outcome.

Low response rates (39 & 51%).
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<td>Liu et al. (2007)</td>
<td>647 subjects aged 18 years and older, who had been admitted to a hospital for inpatient care in the past 12 months and lived within 15 - 20 miles of 25 randomly selected CAH*s, were surveyed by phone during 2005.</td>
<td>Survey questions included demographic characteristics, general health status, travel time/distance to health care, questions on satisfaction with local health services, bypass behaviour, and solicited suggestions on how local hospitals could retain patients locally.</td>
<td>Bivariate analyses were used to test for differences between patients who chose to bypass and those who intended to seek care locally. $\chi^2$ for categorical independent variables (e.g. gender, education, etc.) and t-test for continuous independent variables (e.g. driving times to hospitals, general health, satisfaction, etc.) were used to test for differences between patients who bypassed their CAH and those who used the local hospital, which was the dependent variable. A multiple logistic regression model was executed to assess factors associated with bypass pattern.</td>
<td>Bypass rates ranged from 16% to 70% across the sampled CAHs. Factors associated with bypass included age, income, satisfaction with the local hospital, and travelling distance/time. Lack of specialty care, limited services, and the quality/reputation of local services/doctors were most frequently mentioned as reasons why patients bypass local CAHs.</td>
<td>Not all patients had an equal opportunity to participate in this study. Factors retaining patients from bypassing their local hospital are studied. Therefore, implications cannot be used.</td>
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1) to assess the prevalence of bypass, a pattern of seeking health care outside the local community.  
2) to examine the impact of locally available primary care physicians (PCPs) and hospital size on the odds of bypass.  
3) to identify patient demographic & geographic factors associated with bypass. | Bivariate analyses: differences between local users & bypassers ($\chi^2$, t-test).  
Multiple logistic regression model to assess factors associated with bypass. | About 32% of sampled respondents usually bypass their local health care professionals for primary medical care. Hospital size and PCP density were strongly associated with bypass.  
Patients who bypassed their local primary care were significantly more likely to live in CAH areas where the hospital had fewer beds.  
Respondents living in areas with low PCP density (> 4,500 residents/PCP) were 58% more likely to bypass local care than those who lived in areas with at least 1 PCP/3,500 residents. | Consistent with other findings, results indicate that older age and greater satisfaction with local hospitals are associated with lower odds of bypassing local care.  
Respondents rate only 45% (telephone interviews).  
Medical diagnosis is unknown. Therefore, no possible impact of diagnosis and illness severity detectable. |
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<td>Luft et al.</td>
<td>Hospital discharge abstracts for 1983 from the California Health Facilities Commission.</td>
<td>Examination whether choice of hospital is related to hospital quality, charges, ownership, and distance for patients who underwent each of seven surgical procedures or had one of five medical conditions diagnosed.</td>
<td>Qualitative choice models.</td>
<td>Greater distance and public or proprietary ownership reduced the likelihood of selection while medical school affiliation increased the likelihood of selection.</td>
<td>Very complicated methodology.</td>
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<td>Miller et al. (2006)</td>
<td>2005. Patients in the UK needing an operation were offered a choice of 4/5 (NHS trusts, foundation trusts, treatment centres, private hospitals or practitioners).</td>
<td>Find out what the most important influencing factors are to people when making a choice of hospital. 1) How participants would rate the importance of clinical factors against facilities and factors (13 factors) 2) Which factors were more important to them?</td>
<td>Research was a phenomenological-based study.</td>
<td>Study found that what would influence people varied from person to person depending on their illness. All 23 focus groups placed more importance on the clinical factors against facilities factors. Participants wanted to know information on the success rates of their operations and the reputation of the consultant.</td>
<td>Very small sample size!</td>
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<td>Rogut et al. (1996)</td>
<td>3,423 randomly selected patients discharged from 15 New York City hospitals.</td>
<td>To learn whether disadvantaged patients were more likely to report problems with their care, and whether hospitals that serve large proportions of these patients were less likely to provide high-quality interpersonal care.</td>
<td>Telephone interviews. Bivariate analysis, multiple linear regression, and least square means were used to assess the effects of 5 hospital characteristics and 15 patient characteristics on reports about problems with care.</td>
<td>A multivariate model showed that patients in fair or poor health, those without a regular doctor and younger patients were more likely to report problems with aspects of their care. Medical volume was also a strong, significant predictor of problem scores.</td>
<td>Patient reports can be used to measure differences in quality of interpersonal care among hospitals. Only some of these differences can be explained by patient and hospital characteristics, indicating that other factors facilitate or inhibit the delivery of high-quality interpersonal care.</td>
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<td>Tai et al. (2004)</td>
<td>1994 &amp; 1995. 1702 hospitalisations of rural Medicare beneficiaries. 65 years of age or older.</td>
<td>Examination of hospital choices:  - Patient attributes (age, gender, marital status, education, income, health status, etc.).  - Hospital attributes (hospital bed size, distance, number of alternatives).</td>
<td>Mc Fadden’s* conditional logit model (including the independent variables to control patients’ and hospitals’ attributes and the distance to hospital alternatives).</td>
<td>Empirical results show strong preferences of aged patients for closer hospitals and those of greater scale and service capacity. Patients with complex acute medical conditions and those with more resources were more likely to bypass their closest rural hospitals. Beneficiaries were more likely to bypass their closest rural hospital if they had no regular physician, had a shorter patient-physician tie, were dissatisfied with the availability of health care, and had a longer travel time to their physician’s office.</td>
<td>Alleviation of the access to urban hospitals for the elderly (e.g. by carpool).</td>
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<td>Discussion</td>
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<tr>
<td>-----------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Woodsid e et al. (1987)</td>
<td>1984.</td>
<td>Global measure of affect, evaluation of specific services received during stay. Responsiveness for choosing Baptist Medical Centre for the stay.</td>
<td>Questionnaire: two-page structured and open-ended questionnaire.</td>
<td>Female patient satisfaction with hospital stays is likely to be influenced by whom they perceive to have made the hospital choice decision. Among adult male patients, no pos./neg. relationship was found between attribution of the hospital choice decision and satisfaction with the hospital stay. Internal attribution of the hospital choice decision is associated positively with evaluation of the physician seen in hospital.</td>
<td>Internal vs. external attribution of the hospital choice decision may increase overall satisfaction with hospital stays among female patients. The pos. impact of perceived participation in the decision process may be more substantial among women than men because female patients may have found such participation to be unique and fulfilling (such participation may not be perceived as unusual among male patients).</td>
</tr>
<tr>
<td>Study</td>
<td>Setting, dates, patient numbers, study design</td>
<td>Questions posed/Hypotheses</td>
<td>Method</td>
<td>Results</td>
<td>Discussion</td>
</tr>
<tr>
<td>------------------</td>
<td>----------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------</td>
<td>-------------------------------</td>
<td>-------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Young et al. (2000)</td>
<td>1997. Veterans Health Administration (VHA) patient survey (USA) N = 8,000 - 14,000.</td>
<td>Examination of the extent to which a patient’s satisfaction scores are related to his/her demographic characteristics and the institutional characteristics of the health care organisation where care was received.</td>
<td>Analysis of secondary data. Regression analysis.</td>
<td>Among demographic characteristics, age and health status had a significant effect on satisfaction scores: advancing age and better health status were significantly associated with higher satisfaction scores. Among the institutional characteristics, hospital size was significantly associated with lower satisfaction scores. Rural hospitals had significantly higher scores than did urban hospitals. Sample variation in satisfaction scores was mainly attributed to patient characteristics.</td>
<td>Not clear, whether these relationships (age/health status &amp; satisfaction) reflect differences in patient expectations and values or reflect actual differences in the way different patients are treated. Patients who perceive themselves to be healthier may be more satisfied with life generally.</td>
</tr>
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</table>
Appendix 6. Number of investigated medical patient records per complex medical condition and Swiss hospital (anonymised by non-significant hospital identification numbers, Hospital ID), part of the result list only.

<table>
<thead>
<tr>
<th>DBAItem</th>
<th>HospitalID</th>
<th>NumberOfCases</th>
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<td>1,511</td>
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<tr>
<td>DBAItem001 - Brain Tumor Removal</td>
<td>368</td>
<td>857</td>
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<tr>
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<td>599</td>
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<td>DBAItem001 - Brain Tumor Removal</td>
<td>3041</td>
<td>493</td>
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<td>2484</td>
<td>464</td>
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<td>447</td>
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<td>228</td>
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<td>139</td>
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Appendix 7. Distribution of case records to high-volume (HV) and low-volume (LV) groups per complex medical condition and hospital, part of the anonymized result list only

<table>
<thead>
<tr>
<th>DBAItem</th>
<th>Hospital ID</th>
<th>NrCases</th>
<th>AdjMortality</th>
<th>Volume Group</th>
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<tbody>
<tr>
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<tr>
<td>DBAItem001 - Brain Tumor Removal</td>
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</tr>
<tr>
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<td>463</td>
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<tr>
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<td>5.71%</td>
<td>LV</td>
</tr>
<tr>
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<td>422</td>
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<td>LV</td>
</tr>
<tr>
<td>DBAItem001 - Brain Tumor Removal</td>
<td>2864</td>
<td>329</td>
<td>4.99%</td>
<td>LV</td>
</tr>
<tr>
<td>DBAItem001 - Brain Tumor Removal</td>
<td>3245</td>
<td>218</td>
<td>7.02%</td>
<td>LV</td>
</tr>
<tr>
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<td>932</td>
<td>135</td>
<td>4.19%</td>
<td>LV</td>
</tr>
<tr>
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<tr>
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<tr>
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<td>70</td>
<td>7.09%</td>
<td>LV</td>
</tr>
<tr>
<td>DBAItem001 - Brain Tumor Removal</td>
<td>3092</td>
<td>60</td>
<td>1.67%</td>
<td>LV</td>
</tr>
<tr>
<td>DBAItem001 - Brain Tumor Removal</td>
<td>154</td>
<td>37</td>
<td>5.03%</td>
<td>LV</td>
</tr>
<tr>
<td>DBAItem001 - Brain Tumor Removal</td>
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<td>36</td>
<td>4.36%</td>
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<td>3</td>
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### 7.8 Appendix 8. Details of statistical results of the quantitative investigation (sample of the results)

<table>
<thead>
<tr>
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<th>DataField</th>
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<th>Source_of_Verification</th>
<th>Sum_of_Series</th>
<th>DP</th>
<th>Mean_Score</th>
<th>Score_Value</th>
<th>F-Value</th>
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<th>NEdit</th>
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<th>NMeta</th>
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<tbody>
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<td>MDA_YearlyReport</td>
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<td>1</td>
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<td>29-Apr-12</td>
<td>0</td>
<td>2.852</td>
<td>3</td>
<td>0.285</td>
<td>23.627</td>
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<td>2544</td>
<td>164.25</td>
<td>0.05608</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**APPENDICES**

260
7.9 Appendix 9. Questionnaires

A. Questionnaire with Patients (oral)
The following questions (and optional sub-questions) will be posed to the interviewed patient:

Main question I
Selection of your hospital and your surgeon: Which criteria were most important for you for the selection of this hospital or your surgeon to treat your complex medical condition?
- Possible additional sub-questions (in case the interviewee has not yet given the answer in replying to the main question):
  o Recommendation of your family doctor: If your family doctor has made a recommendation, what was the recommendation?
  o Selection of your surgeon: How did you select your surgeon?
  o Quality of the hospital: How do you estimate respectively value the quality of your hospital or the medical service quality of your hospital?
  o Distance of your hospital from your home: How long is the travel time to the hospital from your home?
  o Reputation of your hospital (as reflected in the media, Internet, newspapers, promotional material, etc.): which information was most relevant for you to make your decision to select your hospital?
  o Receiving visitors during the hospital stay: how important is it for you to receive visitors during your hospital stay?

Main question II
Treatment in a distant hospital: Based on which arguments would you consider receiving treatment of your medical condition in a distant hospital (travel time at least two hours from your home)?
- Possible additional questions (in case the interviewee has not yet given the answer in replying to the main question):
  o Criteria from information provided by your family doctor: Which criteria from information given by your family doctor would convince you to select a distant hospital for the treatment of your medical condition?
  o Criteria from information provided by your surgeon: Which criteria from information given by your surgeon would convince you to select a distant hospital for the treatment of your medical condition?
  o Would you follow your surgeon of your local hospital if he/she would treat you in a distant hospital and why?
  o Selection of the distant hospital: Which criteria from information from your relatives or friends would convince you to select a distant hospital for the treatment of your medical condition?
  o Information from the media, the Internet, etc.: Which criteria from information from the media, the Internet, etc., would convince you to select a distant hospital for the treatment of your medical condition?
o Quality reports of hospitals: Which criteria from information from hospital quality reports would convince you to select a distant hospital for the treatment of your medical condition?
o How relevant is the number of operations your surgeon has performed regarding your medical condition to your decision on treatment in a distant hospital?
o How relevant is the number of operations done in a hospital regarding your medical condition to your decision to receive treatment in a distant hospital instead in your local hospital?

B. Questionnaire for Interviews with Surgeons (oral)
The following questions (and optional sub-questions) will be posed to the interviewed surgeon:

Main question I
Selection of the hospital to treat the medical condition of your patient:
Which criteria were most important to you regarding the selection of the hospital for the treatment of complex medical conditions?
- Possible additional sub-questions (in case the interviewee has not yet given the answer in replying to the main question):
o Quality of the hospital: How do you value or judge the medical and service quality of the hospital where you will treat your patient?
o Experience of the hospital: How do you value or judge the experience of the hospital regarding the treatment of the medical condition of your patient?
o Available technology: Which technology the hospital has to dispose of do you define as indispensable for the treatment of the medical condition of your patient?
o Quality of the hospital employees’ work: How do you value or judge the quality of the hospital employees’ work regarding the treatment of the medical condition of your patient?
o Distance of the hospital from your surgery: How long is the travel time from your surgery to the local hospital?
o Reputation of the hospital as seen by the doctors, as reflected in the media, in the Internet, in newspapers, in promotional material, etc: What information is most relevant to you for your decision to treat your patient in the selected hospital?

Main question II
Treatment of your patient in a distant hospital: Based on which arguments would you consider treatment of your patient in a distant hospital (travel time at least two hours from your office)?
- Possible additional sub-questions (in case the interviewee has not yet given the answer in replying to the main question):
o Medical outcome criteria regarding the distant hospital: Which medical criteria (e.g. number of treated cases, mortality statistics, and patient satisfaction ratings) would convince you to consider treatment of your patient in a distant hospital?
o Special medical framework conditions in the distant hospital: Which highly developed special medical framework quality has to be available in the distant hospital (e.g. peri-operative assistance including post-operative care with complication management)?

o Financial aspects: Which general financial conditions have to be met that you consider treatment of your patient in the distant hospital (e.g. reimbursement of your travel expenses, etc.)?

o Case volume of the hospital: Is the number of operations performed in the distant hospital regarding the medical condition of your patient relevant to you to decide to possibly treat your patient in the distant hospital?

C. Questionnaire for Interviews with Hospital Managers (oral)
The following questions (and optional sub-questions) will be posed to the interviewed:

Main question 1
Criteria to provide treatment of the medical condition of the patient in your hospital: Which criteria were most important to you regarding the decision to provide treatment of complex medical conditions in your hospital?

- Possible additional sub-questions (in case the interviewee has not yet given the answer in replying to the main question):
  o Sub-specialisation of your hospital in the treatment of the complex medical condition of the patient: How do you value or judge the experience your hospital has in the treatment of the special medical condition of the patient?
  o Hospital volume of the treatment of the patient’s medical condition: How relevant is the hospital volume of treatments of the patient’s medical condition in your decision of the definition of the medical services offerings of your hospital?
  o Assessment of treatment quality of the patient’s medical condition in the hospital: How do you assess the medical treatment quality as well as the additional service quality regarding the patient’s medical condition in your hospital? How does this information affect hospital operations?
  o Available technology to treat the patient’s medical condition: Is the technology available in your hospital regarding the treatment of the patient’s medical condition sufficient? Who assesses the quality of the available required technology in your hospital?
  o General organisational conditions regarding the treatment of the patient’s medical condition: Which general organisational measures have to be set in order to support the treatment of the patient’s medical condition in your hospital (e.g. organisation of the journey of the patient to the hospital)?
  o General financial conditions: Which general financial conditions have to be regulated regarding the treatment of the patient’s medical condition in your hospital?
  o Quality of employees’ performance: How is the quality of the hospital employees’ work regarding the treatment of the patient’s medical condition assessed in your hospital?
O Reputation of the hospital to treat the patient’s medical condition: Which information from the public, from the doctors, the media, the Internet, newspapers, promotional material, etc., are most important to you concerning the reputation of the hospital to treat the patient’s medical condition? How did this information influence you in your decision to provide treatment in your hospital to the patient’s medical condition?

Main question II
Treatment of the patient in a distant hospital: Based on which arguments would you consider a referral of your hospital’s patient to a distant hospital within your hospital network (travel time at least two hours from your hospital)?
- Possible additional sub-questions (in case the interviewee has not yet given the answer in replying to the main question):
  - Sub-specialisation of the distant hospital in the treatment of the patient’s medical condition: How important do you value or judge the extent of sub-specialisation of the distant hospital in the treatment of the patient’s medical condition? How do you value the experience of the distant hospital in the treatment of the patient’s medical condition?
  - Distant hospital volume: How important for your decision to refer your hospital’s patient to the distant hospital is the distant hospital volume of treatment of the patient’s medical condition?
  - Outcome criteria of distant hospital treatment: Which treatment outcome criteria (e.g. distant hospital case volume in the treatment of the patient’s medical condition, mortality statistics, infection rate, and patient’s satisfaction) would convince you to accept referral of a patient from your hospital to a distant hospital in your hospital network?
  - General organisational conditions: Which general organisational conditions have to be set in order to accept referral of a patient from your hospital to a distant hospital of your hospital network (organisation of the journey from the patient’s home to the distant hospital)?
  - General financial conditions: Which general financial conditions have to be set regarding the referral of a patient from your hospital to a distant hospital of your hospital network?
  - Role of family doctors and surgeons: What is the impact of the opinion of family doctors and local hospital surgeons regarding treatment of the patient on your decision to refer the patient with a defined medical condition to the distant hospital?

Reputation of the distant hospital to treat the patient’s medical condition: Which information from the public, from the doctors, the media, the Internet, newspapers, promotional material, etc. are most important to you concerning the reputation of the distant hospital to treat the patient’s medical condition? How did this information influence you in your decision to refer the patient to the distant hospital.