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IT EXPENDITURE IN A DUTCH HOSPITAL

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Abstract
Information Technology (IT) is an important enabler in supporting the growing demand for healthcare services and the growing complexity of healthcare services. IT is also a cost driver of importance in healthcare services; hospitals spend an estimated 3% of their annual revenues on IT. These factors make that IT expenditure is of strategic importance to local and national healthcare policy makers.

This paper addresses the question often raised by hospital management; how much do we spend on IT and on what do we spend it? An analysis of the expenditure of IT of a Dutch hospital (1996-2005) gives an insight usable as a reference for other hospital management and Information System researchers on how to approach IT expenditure evaluation. The discussion generates important issues for further research in IT expenditure in healthcare services.

Keywords
Healthcare Services, Hospitals, Information Technology, Expenditure, Strategy

Introduction

Demand for healthcare services
An important indicator for measuring a country’s efforts in their healthcare system is the total healthcare expenditure per capita in USD according to the power purchasing parity method. The healthcare expenditure per capita of European countries ranges between USD 2,250 for Italy and USD 3,800 for Norway. Annual growth rates of total healthcare expenditure in real terms (adjusted for inflation) from 1997 to 2003 vary between 2 percent and 4 percent annually for most European countries. European countries on average spend 9% of their GDP on healthcare. Europe’s GDP is 10,000 billion Euro. With a population of 450 million, an average expenditure per capita of 2,600 Euro annually. With an employment rate of 60%, 1 out of 10, roughly 25 million or more Europeans work in healthcare service related jobs (OECD, 2007).

The future growth of total health expenditures rates depend on factors such as country policy towards health economics, new technologies, cultural factors, the ageing of a countries population et cetera. In general, the expected higher life expectancy and lower birth rates in Europe will have a rising effect on the healthcare expenditure per capita. Additionally, contemporary afflictions are related to tobacco use or obesity, both having a rising effect on the healthcare expenditure per capita.
Complexity of healthcare services
Healthcare services, and more specific, hospital services are complex on a stakeholder and product level. The external stakeholder structure of healthcare services, usually in mix of private and public setting, has embedded conflicts of interest. The healthcare consumer pays a premium for healthcare insurance. A healthcare insurance company exercises their purchasing power on the healthcare providers. The healthcare service provider delivers healthcare service to the healthcare consumer and, the government defines and enforces the national healthcare policy.

On a product level, healthcare services have an unparalleled complexity. In a hospital, a physician may be able to order one of 2,500 medications, 1,100 clinical laboratory tests, 300 radiology procedures and large numbers of other test and procedures. The sequence and time relationship of the above along with patient condition and co morbidity (the presence of one or more diseases in addition to a primary disease) determine the relative utility of a particular approach to treatment. The variability within a pathway or guideline is compounded by the diversity of diseases and complications. There are 1,000 diseases, each of which, in theory, has a different pathway. This variability, or opportunity for variability, is unparalleled by any other manufacturing process. No carmaker produces 1,000 different models of cars or provides for each model 2,500 different types of paint, 300 different arrangements of wheels, or 1,100 different locations for the drivers seat. (Glaser and Hsu., 1999).

In a way the complexity of healthcare services reflects the complexity and uniqueness of the human body. This plays an important role in the way hospital processes are structured. Although many healthcare service processes are regulated by protocols and guidelines, at almost every process level there is room for deviation in the interest of the individual patient and healthcare professional.

The complexity is also reflected by the number of errors that occur in healthcare service processes. The To Err is Human report stated that “health care in the United States is not as safe as it should be - and can be. At least 44,000 people, and perhaps as many as 98,000 people, die in hospitals each year as a result of medical errors that could have been prevented. Even using the lower estimate, preventable medical errors in hospitals exceed attributable deaths to such feared threats as motor-vehicle wrecks, breast cancer, and AIDS. One oft-cited problem arises from the decentralized and fragmented nature of the healthcare service system or “non-system,” to some observers. When patients see multiple providers in different settings, none of whom has access to complete information, it becomes easier for things to go wrong.” (Kohn et al. 1999).

“Tens of billions of dollars have gone into IT systems in healthcare, but patients and care providers have very little to show for it. Despite the investment, most of healthcare remains decades behind other industries in sophistication and deployment of modern IT. For example, coding of the identity of a drug in IT-friendly formats is not standard in this country. If a patient sees a doctor in the office and was treated in a hospital last month in a different town, healthcare in most cases lacks even agreed-upon coding systems to store that information. If healthcare has an IT system comparable to those now common in industry, it would have a constant memory of the problem list and the drug list of a patient. It would alert patients and clinicians to a dangerous interaction if two incompatible drugs were ordered. In would integrate care and shore up safety.” (Berwick et al. 2002).

There statements underline the importance of information and IT as an enabler in reducing complexity.

IT as cost driver of importance in healthcare services
Hospitals implement IT’s such as enterprise resource and planning systems, digital imaging and storage facilities to cope with the increasing complexity. However, healthcare service is, in terms of IT expenditure as a percentage of revenue, more close to the low complex agricultural industry than banking and finance. With a at the least equal or higher complexity healthcare services spend 2.3% versus 7.5% in banking and finance. The relative lower complexity of banking and finance processes generates a relative higher expenditure of IT as percentage of revenue. This might be a result of the high number of transactions in banking with a relatively low complexity, relying heavily on the IT infrastructure. In addition, the hospital expenditure structure, where labor, medical equipment and medical supplies are dominant factors, differs from banking where labor and data processing equipment and office supplies are dominant factors (Info–Tech research group 2005, n = 1,400, n US healthcare services = 196, n US hospitals = 80) (Weil and Broadbent 1998)

HIMSS Analytics (2005, n = 4,000, US hospitals) report a hospital IT expenditure between 2.5 and 3%. In their report average hospital IT expenditure as a percentage of revenue does not exceed 3% for any bed size range or any segment of hospitals based on region (e.g. urban or rural) or function (e.g. academic, non-academic, general medical, not general medical). Recent data captured in a joint study conducted by The Scottsdale Institute, HIMSS Analytics, and Lawson Software found that hospitals with effective IT governance structures and industry leading IT environments spend more than 3% of their annual revenue in IT. Average IT expenditure increases relative to the bed size of the organization. Urban, academic/teaching, and non general medical hospitals have the highest average IT expenditure (Sheldon et al 2005) IT expenditure as percentage of total revenue is a measure for efforts an organization is putting into IT. More important is the return on IT expenditures; to understand under what conditions one can expect to find a measurable return from IT expenditure (Lucas 1999, Deckers 2000). Currently, there is a consensus among academics that IT expenditure has a positive effect on individual firm's productivity. To the extent that there is disagreement about the returns to IT, it can be explained by
the difficulties in conceptualizing and measuring IT and the relevant business outcomes. The problem is that IT expenditure has most likely a cumulative effect over time, which can be only captured through repeated observations. In addition, there are many organizational issues that can interfere with the direct translation of IT investment in IT capabilities. For this reason, most empirical research has agreed on IT usage as the appropriate measure and unequivocally finds a positive impact on a firm's performance (Brynjolfson and Hitt 2000, Stratopoulos and Dehning 2000).

Looking at the current state of the literature, the ambivalent results regarding the benefits of IT are predominantly at the macro level. For example, Jorgenson (2001) documents a rising contribution of IT to economic growth in the U.S., while Gordon (2002) only finds a robust effect for the durable manufacturing sector.

Traditionally, healthcare service organizations focus on non-strategic IT investments in information processing, mostly for well-structured operational world processes (such as data management systems for streamlining patient administration). In a hospital, physicians indirectly control approximately 70% to 80% of all hospital costs. A problem arises when the objectives of physicians and hospital management are at odds; while the hospital is willing to provide care up to the point where marginal benefits may equal marginal costs, physicians face other incentives and may wish to provide more care. In this case, a classic moral hazard (the possibility that the redistribution of risk changes physicians' behavior) situation exists and the hospital may invest in IT to serve as monitoring technology (Jydstrup and Gross 1966). Such applications are concerned primarily with improving efficiency of operational tasks, rather than the effectiveness of strategic and integrative decision processes.

**IT expenditure is of strategic importance in healthcare services**

To reduce complexity, IT strategy should focus on the information requirements of ad hoc and poorly structured decision tasks (Raghupathi and Tan 2002). A difficult choice for hospital management, since the IT investment opportunities matrix has a wide variety of investment types, where the transformational IT and strategic applications are amongst those with the lowest probability of return (Lucas 1999).

One misconception is that IT expenditure drives successful healthcare operations. (Davidson and Chismar 1999, Davidson 2000). A higher intensity of IT usage may require a radical change in organization (Scott Morton 1991). In order to effectively use IT to create a competitive advantage a healthcare service organization needs to understand, with clarity, and integrate well, strategically and tactically, the organization’s strategic context, the organization’s environment, the IT strategy and the IT portfolio (Weil and Broadbent 1998, Willcocks and Lester 1999, Galbraith 2002). The focus should be on business outcome rather than on system output. (Parker et al. 1988, Remenyi et al. 1997). Hospitals may have varying strategies depending on their current operating environment; and their strategies may cover different time horizons (Paloova 2007).

Ask a hospital board their raison d’être or strategy and they proudly present their mission statement. The mission statement reflects the fundamental objectives of the business and the cultural contract between the organization and its constituents. A comparison of hospital mission statements worldwide (n=261) reveals the following mission statement of the ‘average’ hospital: is to provide quality healthcare to our patients that is compassionate, cost-effective and patient-oriented and doing that contribute to research and education of healthcare professionals.” (see Appendix A for details on this comparison). A mission statement is a strategic business management tool. The strategy of an organization has two major components: formulation and implementation. However, the nobility of the mission statement is not in the statement itself but in the translation of the mission statement to the organization’s environment (Glaser and Hsu 1999, O’Hallaron and O’Hallaron 2001).

Hospital management have a belief, often tenuous, that IT will provide some form of strategic advantage and will be a major contributor to the execution of their mission statement. 26% of the healthcare management (n = 53) in four different European countries describe the level of alignment between the business strategy and the IT strategy as high, the rest neither high nor low (45%) of low (16%). There is a clear gap between their business strategy and IT strategy (Van Dijk 2005).

Hospital IT management play a role in this of importance, their culture typically starts out with a strong bureaucratic culture, characterized by high values for standardization, security, centralism, order and individual avoidance (Ross and Rockart, 1999). Hospital IT management in its role as enabler is mostly technically oriented and interested in clearly defined requirements for their work. Generally, the hospital IT management formulates the information policy resulting in a weak link with the hospital strategy as a whole. When compared to all other industries, Hospitals have slightly lower proportions of Innovators and Housekeepers. Survivors are slightly higher than the average of other industries. A large budget and large staff does not automatically lead to gains – time is still critical. Very few Hospital IT managers are on top of things. Health services ranked last among all industries in time available to IT management. This lack of time negatively impacts the ability to fully leverage IT investments (Info-Tech research group 2005).

Healthcare professionals spend most of their time on patient-related work, so IT strategy should focus on this area. A composite view of the patient's healthcare wanderings and links to decision aids will improve healthcare decision-making, reduce errors and could improve patient outcomes and reduce costs. Electronic patient records are also valuable because

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healthcare professionals are in front of the computer, and information can be stored right there and then. However, to win time is critical for acceptance.

There is a hazard of increasing the average task completion time per patient encounter by introducing information technology such as electronic patient records leading to a negative total net savings, undermining the economic justification. Also, when the electronic patient file is widely introduced the risk of errors in that electronic communication can increase. Illustrating is the research by Nebeker et al (2005) reporting high rates of adverse drug events in a highly computerized hospital may continue to occur after implementation of a computerized physician order entry system and related computerized medication systems that lack decision support for drug selection, dosing, and monitoring.

Traditionally IT addresses patients and healthcare professionals within the walls of the hospital. Similar to e-banking, e-health allows moving the typical front desk activities in a service organization towards the customer; empowering, adding value, and reducing cost at the same time. Opportunities lie in the use of new IT that allow crossing these walls for example in providing patients the control and access over their health information (Tan 2005).

Case hospital
This case presents an analysis of the IT expenditure of a Dutch hospital (1996-2005). The principles of data collection are multiple sources of evidence such as interviews, minutes from meetings, periodic budget reports, human resource allocation tables and the IT inventory database. The data was collected in 2004-2006.

Case hospital: demand for healthcare services
The Dutch health expenditure per capita in 2003 is 3,000 USD, with a population of 16 million and an averaged growth of in real terms (1997-2003) of 3 percent. Dutch hospitals generate 30% of the national healthcare expenditure (13 billion Euro), more than 3% of the GNP, employing 230,000 fte (full time equivalent).

The one-location case hospital has an annual total revenue of 213 million Euro, 2,244 fte (full time equivalent) employees (see Appendix B: Data on Case hospital). Case hospital is seen as one of the most productive hospitals in the Netherlands, compared with other hospitals in their class.

The mission statement of Case hospital is: “een patiëntgericht, innovatief, topklinisch opleidingsziekenhuis te zijn, dat aan hen die zich aan de zorg van het ziekenhuis toevertrouwen state of art medische behandeling, verzorging en begeleiding biedt”. Which roughly translates into: “an innovative and patient oriented teaching hospital, providing state of the art medical care to those that entrust themselves to the care of the hospital”.

Case hospital: complexity of healthcare services
The Dutch Ministry of Healthcare sees it as their task to bridge the barriers that keep healthcare service stakeholders from active use of IT. IT can help improve quality of care, effectiveness and access of care. For an electronic patient record an infrastructure for identification and authentication of patients and healthcare professionals, an authorization structure for access to this data, definitions of messages and interoperability of systems are necessary. A national institute and budget was allocated to facilitate these goals. (NICTIZ, 2006).

According to The Dutch Healthcare Inspection (DHI), between 1,500 and 6,000 Dutch patients die annually as a result of medical mistakes or accidents. An significant number of mistakes and accidents can be prevented through the use of an electronic patient file. DHI has set up a set of performance indicators for hospitals to score their IT (Healthcare Inspection, 2005).

In the past years, the concentration of Dutch healthcare insurance companies over-accelerates the concentration of hospitals, thus increasing the purchasing power of healthcare insurance companies (Zorgmonitor Vektis 2005). The hospitals’ customers have a clear view regarding the effective use of IT. In a research by the Dutch Consumers Platform Dutch patients put one mayor improvement on top of their list: “physicians that inform each other” (60%, n=30 hospitals, over 40,000 returned questionnaires patients)’ (Consumentenbond 2002).

In addition, growing transparency on medical results enforced by the DHI and growing customer awareness through Internet has changed health services into an unforgiving market. Healthcare service providers are subject to constant impulses from the patients, patients’ organizations, healthcare insurance companies and government to improve quality of their healthcare services.

Case hospital produces 350,000 ambulatory visits, 25,000 admissions, 170,000 nursing days, 20,000 short stay visits in 500 beds. The hospital strongly focuses on cardiovascular care and oncology care, housing heavy infrastructure such as 4 cath labs and 8 linear accelerators. As an alternative measure of productivity, in the Netherlands patient-units are used: in the Case
hospital the productivity is 750,000 patient units\(^1\). The population (calculated adherence) that served by the hospital is 215,000, about 200,000 DBC-product\(^2\) units are produced annually.

**Case hospital: IT as cost driver of importance**

The expenditure of IT in Dutch hospitals (n= 20) is reported to range from 2.5 to 4% depending on whether or not counting the expenditure on the Picture Archiving Communication System (Kingma 2004). Case hospital spends 7 to 8 million Euro annually on IT; roughly 3.5% of total revenue.

Case hospital has experienced a high growth rate in terms of revenue, almost doubling their revenue in a 10 years period (corrected for inflation). The investments in IT have kept up with this growth, only lagging in 2000 due to an arbitrary budget cut. The cost of IT lags temporarily in 2003 due to a hold on investments, waiting for the new hospital information system to implemented in 2004. The cost of and IT and IT staff have a similar growth path. In 2005 the IT staff growth exceeds the average hospital staff growth.

![Graph showing revenue, IT expenditure, and staff index for Case hospital from 1996 to 2005](image)

**Figure 1. Case hospital, Revenue, IT Expenditure (1996-2005) adjusted for inflation**

*CBS, HICP, 1.0000; 1.01019; 1.02819; 1.04819; 1.07119; 1.12219; 1.16119; 1.18319; 1.19719; 1.21219

The 15 million Euro’s IT infrastructure has a depreciation of 3 million Euro annually. To operate the IT infrastructure 4 million Euro annually is allocated. 2 million Euro of expenditure is related to personnel (32 fte) and 2 million Euro software and licences and maintenance contracts. Roughly 70% of the expenditure (1996-2005) is related to the technical infrastructure (50% depreciation, 20 hard- and software maintenance), 30% of the expenditure is related to personnel.

The patient data of Case hospital is (by law) recorded in paper files, 360,000 active on paper, 1.3 million on microfiche. All that data is also stored in the hospital information system. The IT infrastructure that is used to store and distribute the

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\(^1\) A patient unit is calculated as the sum of (Number of Admissions * 10) + (Number of Nursing Days * 0.52) + (Short Stay * 3.5) + (Number of Primary Ambulantory care * 1.27).

\(^2\) A DBC is Diagnose Behandeling Combinatie, the Dutch system of product definition introduced after a decade of preparation in 2005. The system is comparable to DRG, Diagnose Related Groups, but does not differentiate in health case severity. DBCs are not used in this analysis since there is no comparable data from 2000-2004.
information necessary to support the hospital processes consists of a main equipment room containing 100-125 file-servers, running 300 applications and a storage capacity of 250 terabytes. Over 30 satellite equipment rooms link the 2,300 personal computers and 500 printers to the main equipment room. The 250 terabyte stored information consists of 16 terabyte on the servers, 54 terabyte on the storage area network (an array of disk used by the servers as a storage pool), and a massive 170 terabyte tape storage, mainly for the storage of medical imaging. The number of personal computers has almost risen a factor 4 in the past 10 years (1996: 562, 2005: 2,210). From a ratio of 1 on every three employees (or one per bed) it has risen to almost one on one (or three per bed). This means that personal computers in Case hospital have become as common as desk telephones (good news for Niklas Zennström and Janus Friis!). The majority (44%) of the activities of a hospital IT department consist of operating the existing infrastructure. Beside that the development (28%) of hospital information system and data warehouse are time-consuming activities. Most (72%) of Case hospitals’ resources are allocated to ongoing operations, that is relatively high (average hospitals 65%, Info-Tech research group, 2005).

The 32 fte IT Staff is 1.4% of the hospital staff, or 1 fte per 70 fte hospital employees. This is comparable to hospitals with in the US with more than 2,000 employees (1.3%, 75, Info-Tech research group, 2005). The 32 fte annually work 46,500 hours at an average wage of 40 Euro an hour in three area’s: Service desk, Operations, Development. Some hospital departments such as Radiology, Radiotherapy, Laboratory and Pharmacy have additional personnel specialized in the user interface if their domain specific IT infrastructure (not included in the case). The Case hospital Service Desk (17%) typically handles 15,000 calls annually, roughly 1,500 per Service Desk fte, 60 per day, 5 per hospital fte per year. Most calls (25%) relate to the standard working environment (such as E-mail, Word-processing), second place is the hospital information system (15%). Case hospital IT department is expected to handle roughly 100 projects concurrently, a workload of 5 per IT employee (excluding Service desk activities).

In the past years Case hospital has implemented modern technologies such as a storage area network and picture archiving system (2002). Case hospital was forced to replace their self-developed hospital information system by one of the three market leaders systems, foreseeing not being able to comply tot the systems changes necessary to accommodate the new DRG-like billing system (2004). In addition, their obsolete Baan enterprise resource system was replaced by a more modern financial logistic system Oracle (2006) and a new human resource system was put in place (2003). Their first generation OLAP tool Gentia was replaced by Cognos to support flexible user access to their data warehouse (2005). In 2006 Case hospital introduced more externally oriented IT such as the electronic exchange of data with regional pharmacists to reduce prescription errors or the remote monitoring of post-sectio patients, reducing admission time, being cost-effective and patient friendly at the same time.

Case hospital: summarizing
Case hospital spends 3-4% of its annual expenditure on IT (7-8 million Euro). Case hospital has 1.4% of it’s workforce located at the IT department; 1 fte per every 70 fte hospital employee. Case hospital has as much access points as there are fte’s (2,210 versus 2,244) and stores 250 Terabyte. Case hospitals IT expenditure has grown with 60% (adjusted for inflation) since 1996, their revenues have grown 80% (adjusted for inflation) since 1996.

Discussion and conclusion
As with all empirical research, questions of which variable are causal makes interpreting the results a challenge. IT expenditure in the Case hospital IT can be associated with the performance in terms of revenue. Did the investments cause improvements in the hospital revenue or did the hospital revenue allow higher investments in IT? Or, can the claim be made that without the growth in IT expenditure for Case hospital, the growth in revenue would have been considerably lower? It seems logical that when Case hospital revenues rise, hospital staff rises and IT staff and IT expenditure rises (Paloova 2007). Although almost parallel the growth of these variables are not likely to be adequate predictors for healthcare IT expenditure. Growth of revenue and IT expenditure have similar growth rates, but IT expenditure is lagging due to an arbitrary budget cut in 2000. Hospital IT expenditure as percentage of hospital revenue, as popular used to benchmark is clearly not an adequate reference, since it is only in remotely related to the output of hospitals. Hospital output measures such as patient units or population seem more relevant variables for policy makers since they neutralize local differences (Borzekowski 2002). Over a period, the inflation corrected indexed percentage of IT expenditure per capita for Case hospital remains stable over the years 2000/2004 (Appendix B). Assuming that this is persistent, a calculation of the lifetime hospital IT expenditure per capita can be made. With an inflation adjusted expenditure of around 30 Euro annually per capita and an average life
expectancy of 78 years (OECD 2007) this would mean a present value of 2,300 Euro (30 Euro times 78) or a future value of 5,500 Euro.1

Case hospital currently has a lifetime expenditure on hospital IT per citizen of 5,500 Euro that has been stable for the past 5 years. This is interesting; apparently, the increase of IT usage such as storage or infrastructure did not cause a higher IT expenditure per citizen. Mechanisms like Moores law (Moore 1965) might explain the increase of data storage and processing per citizen at equal costs.

At this moment in Dutch hospitals, management can locally decide on IT expenditure. The downside of this policy is that less IT oriented hospitals or smaller hospitals might not be able to allocate the funds to invest in new IT’s. Also, any organization utilizing IT must undergo an extensive learning curve as assets complementary to IT are developed and deployed. This may include new organizational procedures, training of employees, customization of software and other changes, all of which take time to implement. Thus, for less IT oriented hospitals, the expenditure of adoption are higher and revenues are reduced or delayed.

Some argue that hospital IT is of national importance and thus hospital IT expenditure should not depend on the local choices of hospitals. Others argue that hospital IT should not be on the national healthcare policy agenda where a government promotes competition in healthcare services. In a free market a hospital manager should decide on the use of IT based on the mission statement and business strategy and expected revenues.

Either way, for purposes of evaluating the development of healthcare IT expenditure it seems sensible for national policy makers and hospital managers to relate IT expenditure to output measures such as capita or patients served. IT expenditures between hospitals differ and overall seem low compared to other industries, further research is needed to understand why.

Limitations
The paper gives an insight in the IT expenditure in a Dutch teaching hospital and should be read as such. A mayor limitation is the grey area concerning the definition hospitals IT expenditure. In this case-study medical IT such as the computer in a MR scanner is not included, the cabling throughout the hospital is considered medical infrastructure, the Picture Archiving Communication System workstations and storage capacity is included in the expenditure, but the nurse with autodidact IT skills that solves operational problems isn’t. One could argue that the traditional paper archives and administration still in place by regulation should be taken into account as well. On the other hand, by now there is almost no data that is printed, that isn’t stored in the electronic patient record.

The primary reason for Dutch hospitals to differ from the general population of hospitals in the way their care model is organized differently. For example, in the Netherlands, a hospital is defined as a centre for curative medical care. In other nations, a general hospital also provides psychiatric long stay care for chronical diseases. Private hospitals in Great Britain, France and Germany provide elective forms of care such as surgery, gynecology, obstetrics, psychiatry and rehabilitation. These different care models have different revenue mechanisms that might lead to different IT expenditure.

Future research
The use of IT in healthcare services is still in its infancy. Given the potential in the support of the complexity of healthcare services and given the cost driver of importance, IT seems more and more of strategic importance for local and national healthcare policy makers.

Further research is needed to define a standardized dataset and calculation method for national or even international benchmarking on usage and expenditure of IT in hospitals, as an aid for policymakers and hospital management to regulate the costly process of our digitalizing healthcare.

The evaluation of hospital IT expenditure would certainly improve when related to output measures such as capita or patients served or even quality adjusted life years gained. In the end, not the hospitals revenue, but the positive contribution to the health of patient determines the success of IT in hospitals.

1 FV [ = PV . (1+ i) n ] where PV is the annual IT expenditure per citizen, n is the average life expectancy, and i stands for the inflation rate of 2% per period.
Appendix A: Elements of Hospital mission statements

To get a broad idea of what hospitals do for a living, 261 hospital mission statements were analyzed. On the average hospital management takes 46 words to formulate their mission statement; ranging from 6 words to 110.

“To improve the health of children.”

and

“Hospital … is dedicated to providing: medical care to infants, children, adolescents and burn victims of all ages, regardless of ability to pay multi-level professional education for residents and students of medicine, nursing, and the various allied health professionals basic and clinical research into the causes, treatment and cure of childhood illness and injury and burn injury community service intended to improve health status through lay education child and family advocacy efforts to improve the status of children and adolescents in our region of service continuing medical education to facilitate and encourage the process of life-long learning for physicians and other health care providers involved in the care of children.”

Typical elements of hospitals mission statements are: “hospital is to provide”, “hospital is committed to”, “quality and cost effective”, “health care needs of”, “health and well-being of”, “needs of our community”, “quality health care services”, “needs of our patients”.

<table>
<thead>
<tr>
<th>Keyword Co-occurrence</th>
<th>Co-Occurs</th>
<th>Do Not</th>
<th>Is Absent</th>
<th>Jaccard</th>
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<td>6</td>
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<td>37</td>
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<td>0.239</td>
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Table 1. Elements of Hospital mission statements
## Appendix B: Data on Case hospital

<table>
<thead>
<tr>
<th>Year</th>
<th><em>Hospital Revenues (x 1,000 Euro)</em></th>
<th><em>Cost of IT (x 1,000 Euro)</em></th>
<th>Hospital Employees (fte)</th>
<th>IT Employees (fte)</th>
<th>Personal Computers</th>
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<td>5,568</td>
<td>2.237</td>
<td>28</td>
<td>1,899</td>
</tr>
<tr>
<td>2005</td>
<td>175,956</td>
<td>5,981</td>
<td>2.244</td>
<td>32</td>
<td>2,210</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Patient units (average)</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case hospital</td>
<td>429,626</td>
<td>442,272</td>
<td>502,517</td>
<td>696,500</td>
<td>747,493</td>
</tr>
<tr>
<td>Reference group</td>
<td>514,671</td>
<td>491,640</td>
<td>552,319</td>
<td>566,842</td>
<td>600,080</td>
</tr>
<tr>
<td>Other general hospitals</td>
<td>271,678</td>
<td>287,858</td>
<td>306,683</td>
<td>319,866</td>
<td>355,997</td>
</tr>
<tr>
<td>Total Patient Units</td>
<td>336,194</td>
<td>345,184</td>
<td>373,319</td>
<td>390,775</td>
<td>426,198</td>
</tr>
</tbody>
</table>

### IT cost per Patient unit*

| Case study hospital (Euro) | 9.38 | 10.85 | 9.57 | 7.23 | 7.45 |

### Calculated Adherence (based on clinical and short stay patients, capita)

| Case study hospital | 183,515 | 191,158 | 206,490 | 208,855 | 214,649 |
| Reference group     | 4,308,208 | 4,306,378 | 4,293,144 | 4,333,720 | 4,380,480 |
| (University hospitals) | 1,956,740 | 1,984,984 | 1,998,959 | 2,006,077 | 2,046,223 |
| Other general hospitals | 9,415,487 | 9,504,554 | 9,606,691 | 9,643,920 | 9,616,680 |
| Total Dutch population | 15,863,950 | 15,987,075 | 16,105,285 | 16,192,572 | 16,258,032 |

### Total average Hospital Cost per Capita in Euro’s*

| Case study hospital | 595 | 644 | 667 | 710 | 751 |
| Reference group     | 495 | 517 | 533 | 553 | 579 |
| Other general hospitals | 408 | 434 | 451 | 465 | 486 |
| Total               | 510 | 534 | 555 | 576 | 603 |

### IT cost per Capita *

| Case study hospital (Euro) | 22 | 25 | 23 | 24 | 26 |
| Case study hospital (% of total) | 3.7% | 3.9% | 3.5% | 3.4% | 3.5% |

Table 2. Data on Case hospital

*Adjusted for inflation CBS, HICP. 1.0000; 1.01019; 1.02819; 1.04819; 1.07119; 1.12219; 1.16119; 1.18319; 1.19719; 1.21219

(Primant, Hospital database Netherlands, and hospital accounting and HRM system, 2006)
Ronald Spanjers, IT Expenditure in a Dutch Hospital

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Stratopoulos, T. and Dehning, B., “Does successful investment in information technology solve the productivity paradox?,” Information & Management, 28, 2000, p. 15


Ronald Spanjers, *IT Expenditure in a Dutch Hospital*


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