White Paper

Digital health
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IT value model

Slovakian hospital reduces patient's length of stay during mobile point of care pilot

Košice Children's Teaching Hospital

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Greater clinician efficiency reduces patient's length of stay

Wireless enabled workflows deliver a 632 per cent return on investment while freeing clinicians from time consuming paper processes, which in turn leads to shorter hospital stays for patients

The Košice Children's Teaching Hospital is widely regarded as a centre of excellence for Eastern and Central Slovakia. Children with serious and debilitating conditions such as leukemia, cancer and malignant tumors receive first-class healthcare, delivered through extensive and detailed treatment programmes.

The hospital was keen to explore whether a mobile point of care solution (MPoC) and tablet PCs, used in the Oncology department, would improve workflow and whether this would also influence levels of care.

The pilot substantially reduced some workflow areas, enabling physicians to spend more time with patients and improve the quality of care. Significantly this also led to a reduction in the length of time a patient stayed in hospital. Though this was not the aim of the pilot it revealed how the benefits of healthcare IT, if applied thoughtfully and with clear objectives, can cascade through an organisation.

A brief overview

A Cisco wireless network, five tablet PCs from Fujitsu Siemens Computers, two server-based applications and a tablet PC-based application replaced the traditional paper-based processes used for haematology test results, medication interaction and psychological testing. The tablet PCs were given to four paediatric oncologists and a paediatric psychologist.

The clinicians used the tablet PCs to monitor haematology test results and access directly a Hospital Information System and Evidence Based Medicine application, to verify whether there are interactions between prescribed medicines, and to carry out important psychological tests to establish the condition of patients.

However, when assessing the results of the MPoC trial it became clear that five tablet PCs were actually too many. Three was the optimal configuration. As a result, all the benefits of the MPoC pilot, including financial and productivity gains, were calculated based on the use of three tablet PCs and data gathered during the trial.

The MPoC pilot led to two hours saving each day for the paediatric oncologists, resulting in a nine per cent productivity increase, and a saving of one hour each week for the psychologist, resulting in a two per cent productivity increase.

However, the deeper value of the MPoC pilot was also evident in increased patient safety, greater patient and staff satisfaction, and improved quality of care. For example, keeping parents informed about the condition and treatment of their children is an important psychological factor. The clinicians not only had more time to spend with the patients but they were also able to provide more accurate information to parents. Significantly, this enhanced quality of care led to a reduction in the average length of stay from 7.5 days to seven days.

From an economic perspective, the MPoC pilot proved a net present value (NPV) of EUR 46,743, a breakeven within six months and a return on investment of 632 per cent. While the NPV may be relatively low, the benefits must be viewed in the context of much lower wage and cost structures in Slovakia compared to Western European countries.

In turn, by using the same measures the MPoC start up costs could be viewed as relatively high. However, the MPoC pilot established that even greater value

could be gained by loading more applications onto the tablet PCs and utilising the unused wireless network capacity.

The pilot demonstrably revealed that MPoC solutions can have a positive and far-reaching role in improving clinician workflows which in turn not only modernises the delivery of health care but enhances the quality of care. The MPoC pilot also clearly revealed how the Intel® healthcare IT value model can help healthcare organisations establish benchmarks, evaluate the value of their IT investments and gain a clear understanding of how technology can help improve the delivery of care.

Košice Children's Teaching Hospital

The Košice Children's Teaching Hospital was founded in 1924 as a children's department at what was then known as the Teaching Hospital. In 1948 it was brought under the wing of the Košice Medical University as a children's clinic and since 1958 has been widely regarded as a centre of excellence.

Today it adjoins the Teaching Hospital of Louis Pasteur and provides clinical departments across a number of areas of medical practice including infectious diseases, neurology and surgery. It has a total of 240 beds and a staff headcount of approximately 400.

The Oncology department has 15 beds staffed by a permanent roster of five doctors and the department deals with around 50 to 60 new cases every year. Each patient stays for an average period of 7.5 days for in–patient haemotherapy treatment.

Information technology is used within the hospital for administrative and record keeping purposes. Servers run a number of applications including a Hospital Information System, which is managed remotely by LCS Electronics. However, the IT systems are relatively basic, for example, in some departments employees transfer information between computers using diskettes.

The hospital has very high clinical standards and levels of expertise but capital funding is sometimes hard to come by. US Steel Košice, the city's largest company employing approximately 16,000 people from a population close to 300,000, recognises its role as a partner in the community and is a leading contributor to the economic and social development of Kosice and Eastern Slovakia.

It often helps fund medical equipment purchases for the Teaching Hospital of Louis Pasteur and the Košice Children's Teaching Hospital. It is also the largest sponsor of a charity fund for the Košice Children's Teaching Hospital's haematology department. Keen to help the hospital understand how IT can add value, US Steel co-funded the MPoC trial.

Understanding business value: Intel® mobile point of care value model

The Intel® healthcare IT value model provides Košice Children's Teaching Hospital with a truly informed understanding of how IT can enhance daily working practices as well as delivering financial benefits

Košice Children's Teaching Hospital wanted to establish whether a mobile point of care (MPoC) solution in the Oncology department had any business value. Specifically it focused on workflow optimisation, cost of care and quality of care values.

By engaging in the project the hospital recognised that it would gain expertise in understanding whether a business value model would support IT implementations. In turn, if the outcome was positive the experience could be used to inform the implementation of other IT projects within the hospital.

To help healthcare IT professionals assess the business value of MPoC investments, Intel®'s Digital Health Group (DHeG) and IT Innovation Centres have developed the Intel® MPoC value model.

Intel's core belief is that all IT investments are business investments that should support strategic priorities and deliver a sustainable advantage to an organisation. The MPoC value model helps organisations evaluate how IT can help them.

The MPoC value model is based on the use of value dials – broad categories of benefits through which an IT investment may deliver strategic value. Establishing which value dials are relevant to an investment can help focus attention and achieve agreement on core organisational objectives. These discussions can also influence project planning and improve the success of an implementation.

The aim of the pilot at Košice Children's Teaching Hospital was to determine the business value of a MPoC solution for optimising workflows by giving doctors tablet PCs and then evaluating any benefits compared to doctors who were not using PCs. The doctors would use the tablet PCs on their daily rounds, to monitor the result of haematology tests, assess the impact of medicine interaction and also carry out psychological testing.

Value dials were established following a workshop which introduced the concept of business value, value dials and metrics to the Košice team.

MPoC value dials, key performance indicators and Košice Children's Teaching Hospital

MPoC value dials have a single important goal – to measure the impact of healthcare IT.

Within the healthcare industry, there are typical value drivers, for example, quality of care, staff productivity, staff satisfaction, revenue enhancement, cost optimisation and patient access.

However, while there is a large degree of commonality in many healthcare organisations, each also has unique needs. Therefore, the value dials and assigned KPIs are specific and won't necessarily apply to each and every organisation.

Košice Children's Teaching Hospital, for example, focused, among others on the following value dials: patient safety, staff productivity and quality of care.

Under the patient safety value dial, the KPIs included reduced transcription errors, more effective treatment and improved medication decisions. Another organisation may have the same value dial but entirely different KPIs.

As such the value dials provide a broad perspective while the KPIs deliver very specific measurements relevant to that organisation.

Potential value dials were examined during the workshop and follow-up interviews carried out with the goal of:

- Defining business value in the language of Košice and make data-driven investment decisions
- Identifying Košice's core value drivers; understanding and evaluating the impact of healthcare IT-enabled initiatives
- Accelerating progress in achieving the benefits of healthcare IT

Once the value dials were established, the next step was to associate each value dial with a set of observable, quantifiable, operational metrics – key performance indicators (KPIs). Benefits are typically measured as improvements over a current baseline and the focus is on quantifiable benefits that produce a financial impact.

Some of the most significant benefits from using the MPoC value model arise in the discussions of what performance indicators are most relevant to specific projects, as well as to organisational goals and culture.

The Intel MPoC value model emphasises quantifiable benefits for which a financial impact can be determined, but full understanding of IT investments also acknowledges the many intangible gains that are produced. Each KPI is usually derived from an underlying calculation. That calculation generally has multiple variables that are built on data that hospitals typically collect to track performance, such as basic operational data, financial metrics and clinical metrics. Figure 1 summarises the value dials and KPIs Intel focused on for the Košice Children's Hospital pilot.

Mobile technology drives greater efficiency, saves time, improves staff morale and enhances patient care by ensuring real-time access to test results and important medication assessment systems

Value dials	Key performance indicators
Staff productivity	More efficient patient rounds
	Increased communications and decreased resource dependency
Patient safety	Reduced transcription errors
	Improved medication procedure
	Improved clinical decisions
Patient satis-faction	More professional caring service
	Reduced length of stay
	More patient engagement
Staff satisfaction	Improved care delivery
	Increased confidence in decision making
	Support through modern working methods
Quality of care	Effective education-based decision making
	More accurate test results
	More effective treatment
	Compliance with standards

Figure one: Value dials and KPIs for Košice Children's Teaching Hospital

Transforming clinicians' workflow

The mobile point of care solution supports clinician decision making and reduces scope for error by providing accurate information on medication interactions

The mobile point of care (MPoC) pilot began in April 2007 with the implementation of a Cisco wireless network, the selection of end-user devices and the commissioning of the system.

The implementation and commissioning of the WiFi network was achieved in a remarkably short time – approximately one week. This also included the installation of 15 bedside wireless internet access points, one for each of the beds in the Oncology department.

It was recognised that the internet access points could be used by the patients when the MPoC trial was completed and regardless of the results.

The overarching aim of the implementation was to determine whether the MPoC solution would improve workflows in three areas:

Haematology test results:
The effect of medication to the blood is central to the treatment of patients and they are subject to constant haematology testing. The results of these tests are used by the physician to assess whether the medication has been successful or not, enabling them to modify the medication in response to the progress of the patient.

Medication interaction:
The physician has to monitor the potential danger of a negative reaction between the various medications being prescribed to the patient as part of the oncology treatment or the effect if the patient suffers from other conditions, for example, asthma.

Psychological testing:
The psychologist monitors the psychology of patients undergoing oncology treatment. Each new patient undergoes a set of exams examining four areas of the psyche: intelligence, personality, emotion and psychomotor (movement of muscular activity associated with mental processes).

The pilot involved five physicians; four paediatric oncologists and one paediatric psychologist. The paediatric oncologists were each given a Fujitsu Siemens Computers' LIFEBOOK T4215* tablet PC powered by Intel® Core™ 2 processors. The paediatric psychologist was given a Fujitsu Siemens Computers' LIFEBOOK P1610* tablet PC also powered by the Intel® Core™ 2 processor.

Three applications were made available to the tablet PCs:

- A server-based application enabling the paediatricians to remotely access and examine the latest haematology test results
- A server-based application allowing the paediatricians to examine the potential interactions between medications prescribed to patients
- A PC-based application enabling the psychologist to carry out four different types of psychology tests and calculate the results of those tests

Haematology test results

Haematology tests are typically taken early morning, usually about 6am. The test samples are then brought to the laboratory where they are analysed. Approximately three hours later, the paediatric oncologist calls the laboratory to get the test results. However, sometimes the results are not available so the physician has to call the laboratory at a later time, often more than once.

The tablet PC enabled the physicians to directly monitor the results of the haematology tests cutting out the need to call the laboratory and transcribe by hand the results. Direct access to the results via the tablet PC positively impacts on patient safety by giving the physician immediate access, enabling quick responses if necessary. It also improves employee satisfaction through greater support in decision making and permits faster decision making by the physician.

In short, two potential main benefits were clearly identified; time saved in having the data provided directly to the physician and greater accuracy in the data the physician receives.

Medication interaction

Assessing whether medicines interact with each other has two phases; the paediatric oncologist uses a combination of paper-based and web-based information sources to check the level of interactions within medications prescribed for a patient. If an interaction is found, the oncologist proposes an alternative medication regime.

This can be a time consuming process, requiring the physician to interrupt their patient rounds by going to the nurses' station to check online whether specific medicines interact.

The tablet PC, however, allowed the physician to access a server-based system and a specialised Evidence Based Medicine application in the ward. It was anticipated that this facility would save the physician time as well as reducing the potential for errors due to better decision-making support.

Psychological testing

Psychological testing is important to assess the condition of the patient prior to and during treatment. The tests also establish whether the treatment is having an adverse effect on the patient, for example, whether the patient may be suffering from depression.

The psychologist performs a paper-based test and either completes the forms and exercises on behalf of the patient by asking questions or if the patient is old enough they complete the exercises themselves. The test results are then evaluated by the psychologist using a paper-based scoring mechanism.

The tablet PC allowed the psychologist to carry out the tests using a PC-based programme which also included graphical components. Children who took these tests felt they were playing a video-game which generated greater interest and greater willingness to participate in the tests. In turn it also meant the psychologist could carry out much faster and more efficient compilation and diagnosis of test results while obviating the need to constantly move between the patients' bedside and the nurses' station to interpret and compile the results.

The optimised MPoC-based 'connected prescription' workflow puts the patient at the centre of the care process

The business value of mobile point of care – significant quantifiable improvements

Clinician productivity improvements lead to many benefits including enhanced quality of care, which in turn reduces the length of time a patient stays in hospital by seven per cent

Between June 2007 and February 2008, the physicians made use of the tablet PCs during their daily rounds. Workflows were observed and measured by trailing the physicians to understand the work task and to establish the challenges and opportunities during the workflow process.

However, because the business value assessment started after the technology implementation it was not possible to gather baseline data from before the mobile point of care (MPoC) trial started. The baseline data relating to workflows before the implementation had to be deduced from user evidence.

Overall, the pilot highlighted that a MPoC solution would clearly optimise workflow. This had a direct and positive impact on productivity and efficiency in the three areas that were monitored: haematology test results, medical interactions and psychological testing.

Strikingly, this led to benefits in several quality of care indicators which had a further positive influence. For example, increased confidence in decision making led to more effective decision making which in turn resulted in a decreased length of stay in the ward from 7.5 days to seven days. In the 15-bed ward this equated to freeing up one bed for one week.

The following provides detailed insight into the Košice Children's Teaching Hospital value dials and how the MPoC solution was measured against the key performance indicators and the resultant benefits:

Staff productivity

The paediatric oncologists saved 1.6 hours a day in accessing test results and 1.8 hours a week in assessing medication interactions. The psychologist saved approximately one hour a week in compiling the results of the psychology tests.

In turn this improved overall efficiency. Because the physicians could immediately access the test results electronically there was no need to find and wait for other personnel to retrieve results. It also reduced the amount of time travelling between patients' beds and the nurses' station. Less time was spent on administrative tasks and more time on clinical work. Furthermore, the tablet PCs reduced competition and queues among staff for the Oncology department's PCs.

Dr Igor Jenčo, paediatric oncologist, said: "Before we had to call the laboratory to collect the haematology test results. Sometimes they weren't ready and they would have to call back. Using a tablet PC is much better; it speeds up the work process as well as ensuring greater accuracy."

Patient safety

Direct access to test results via the tablet PC eliminated the possibility of errors when assessing medication interactions and transcribing blood results over the phone. However, due to the unavailable baseline data, the trial was unable to quantify the reduction in transcription and medication errors.

That said, physicians were able to make medication changes on the spot by accessing test results at the bedside. It also enabled the physicians to keep parents more informed about the use of 'off-label' drugs, that is, those drugs used by adults but still requiring certification for children's use.

Direct access to the Evidence-Based Medicine (EBM) application also supported the prescription decision making process by reducing the scope for errors. EBM is very important for the paediatric oncologists because it enables them to accurately and reliably record treatment information.

Patient satisfaction

Because blood test results, medication interaction data and psychological testing information could be accessed at the bedside, the oncologists and psychologist could spend more time with the patient enabling a more professional and caring service. Children were also more engaged and responsive to the tablet PC-based psychological tests than paper-based tests.

Staff satisfaction

Because the physicians can complete their rounds without having to go to the nurses' station to use a PC there is a greater feeling of satisfaction. The EBM-based medication application helped deliver greater compliance with prescription procedures and greater test result accuracy increased personal performance.

From the psychologists perspective the automatic compilation of test results also removed the drudgery of manual inputting. The physicians also felt more supported through the availability of modern working tools and methods.

Quality of care

The use of the EBM-based application reinforced the physician's decision making, which in turn supported compliance with best-practice guidelines. For example, clinical decisions were considered to be more effective because they were based on information that was at the physician's fingertips rather than that held in the memory. Further, the increased confidence in the accuracy of the test results from the laboratory ensured the oncologists were more satisfied with their diagnoses.

The initial goal of the MPoC solution in the context of this value dial was to establish whether a workflow reduction would improve quality of care. It achieved this through the combination of direct access to test results and more readily available medication interaction information, enabling the physician to put patients on a more effective course of medication earlier in the patient stay.

In turn, more effective treatment resulted in a reduction in the average length of stay for each patient from 7.5 days to 7 days. Given that there are 15 beds in the ward, this is the equivalent of one bed being free for one week.

Cost optimisation

The business value assessment also highlighted compelling financial advantages. The trial clearly showed that the wireless network and tablet PCs saved the paediatric oncologists 2 hours each day while the psychologist saved one hour a week. This led to a nine per cent productivity improvement for the paediatric oncologists and a two per cent productivity improvement for the psychologist.

Analysis of the three workflows revealed that the tablet PCs were only used during the main day shift which starts at 9am and ends at 6pm. As a result the tablet PCs were only used for approximately 50 per cent of the shift. Based on these results it was established that an optimal configuration for the Oncology department would be three tablet PCs (rather than the five used in the pilot) pooled between the two to three paediatric oncologists and the psychologist. Further the trial only used 20 per cent of the wireless network at any one time and will be used in the future to support other applications in the ward.

Based on this data, that is 20 per cent usage of the wireless network and three tablet PCs shared between three to four clinicians, a financial model was established which showed that the trial had a net present value of EUR 46,743, a return on investment of 632 per cent and breakeven within less than six months.

Figure 2 shows how this was calculated. For example, the equipment costs totalled EUR 7,218 and the maintenance costs over three years, EUR 1,044. These combined costs are EUR 8,262.

The annualised financial benefits from the staff productivity gains are EUR 3,789 and over three years, EUR 11,367. The annualised savings arising from the reduced length of stay is EUR 16,382 and over three years EUR 49,146.

To place the financial benefits in context it's important to point out that Slovakian salaries are quite low compared to Western European countries. For example, a physician at the Košice Children's Teaching Hospital receives an average monthly salary of EUR 860.

While the standards of clinical care are high, this relative low salary reflects the low cost of living in Slovakia. As a result, cost productivity gains would be much higher in a Western European country.

IT Costs Euro				Maintenance Euro		
Item	**Cost**	**Qty**	**Initial Investment**	**Year 1**	**Year 2**	**Year 3**
Tablet PCs	€ 1,648	3	€ 4,944	€ 450		
WiFi Net	€ 9,888	20%	€ 1,978	€ 99	€ 99	€ 99
Medication Software	€ 99	3	€ 297	€ 99	€ 99	€ 99
Total Cost			**€ 7,218**	**€ 648**	**€ 198**	**€ 198**
Staff Productivity Benefit				€ 3,789	€ 3,789	€ 3,789
Quality of Care – Length of Stay Benefit				€ 16,382	€ 16,382	€ 16,382
Net Benefit			€ -7,218	€ 19,522	€ 19,972	€ 19,972
3yr Project NPV 5% discount			€ 46,743			
			$ 72,779			
Return on Investment			632%			

Figure two

Figure 3 illustrates the breakdown in costs and savings based on 3 tablet PCs using 20 per cent of the wireless network capacity. For example, total productivity savings on a daily basis were 48 per cent. Before the MPoC trial the workflow costs were EUR 21.49. During the MPoC trial this fell to EUR 11.08, resulting in a daily cost saving of EUR 10.41.

It should also be pointed out that these cost savings are actually conservative estimates. To ensure nothing was overstated and to stay within a very conservative remit, the cost savings in the table are approximately half of the cost savings that were originally captured.

Per Day Wage Costs on Result/Med check					Per Day Hours on Result/Med check		
Oncologist - Heamatology	**Before MPOC**	**With MPOC**	**Savings**		**Before MPOC**	**With MPOC**	**Savings**
Result confirmation	€ 16.71	€ 8.36	€ 8.36	50%	3.3	1.6	1.6
Medication Interaction	€ 3.31	€ 1.98	€ 1.32	40%	0.6	0.4	0.3
Daily Total	€ 20.02	€ 10.34	€ 9.68	48%	3.9	2.0	1.9
Annual	€ 7,285.87	€ 3,763.25	€ 3,522.62		1417	732	685

Per Day Wage Costs on Results check					Per Day Hours on Results check		
Psychologist	**Before MPOC**	**With MPOC**	**Savings**		**Before MPOC**	**With MPOC**	**Savings**
Calculating Results	€ 1.47	€ 0.74	€ 0.73	50%	0.3	0.1	0.1
Annual	€ 534.74	€ 268.71	€ 266.03		104	52	52

Total Productivity Savings	**Before MPOC**	**With MPOC**	**Savings**		**Before MPOC**	**With MPOC**	**Savings**
Daily	€ 21.49	€ 11.08	€ 10.41	48%	4.2	2.2	2.0
Annual	€ 7,820.62	€ 4,031.96	€ 3,788.65		1521	784	737

Length of Stay Reduction	**Before MPOC**	**With MPOC**	**Savings**	
Daily cost during recovery*	€ 1,350.13	€ 1,305.12	€ 45.00	3%
Annual	€ 491,447.00	€ 475,065.43	€ 16,381.57	

**using average hospital cost / day during period after chemotherapy*

Total Annual Savings**	**€ 20,170.22**

***All savings are Gross; prior to implementation costs*

Portion of Savings captured (typically advise 50% for larger scale implementations)
50% LOS savings assume all costs are variable OR re-assignable (example: at 100% capacity, shift to another ward)

Figure three

Mobile point of care into the future

The mobile point of care (MPoC) trial and use of mobile clinical assistants at the Košice Children's Teaching Hospital met its initial objectives by demonstrating clear and measurable benefits in workflow optimisation and quality of care.

Improvements in these areas also led to a reduction in the length of patient stay from 7.5 days to 7 days. This represented a seven per cent saving or one week in the 15 bed ward. This clearly has considerable positive implications for Košice Children's Teaching Hospital.

For example, extended across the hospital these savings could result in much improved capacity management, greater funding and revenue enhancement, among other benefits.

This significant benefit arose from improvements in three workflow areas: haematology test results, medication interaction and psychological testing with clinicians using tablet PCs connected to a wireless network and running applications relevant to their tasks.

The MPoC pilot led to greater accuracy for test result analysis and diagnosis, improved staff productivity and patient safety, increased patient and staff satisfaction and enhanced quality of care. In summary, outside of the reduction in length of stay, the MPoC solution resulted in:

- Net present value of EUR 46,743 and breakeven in less than six months
- Oncologist time saving of 2 hours every day
- Psychologist time saving of one hour a week

Cost optimisation was significant within the framework of far lower labour costs in Eastern Europe when compared to Western Europe and North America. As a result, the cost benefits need to be considered within this context. For example, a physician in the Oncology ward can expect to earn an average monthly salary of EUR 860.

MPoC benefits could also be increased by extending the use of the tablet PCs, which were only used 50 per cent of the time. This, for example, could be achieved by:

- Configuring the tablet PCs so they print out on the ward's printers
- Integrating the tablet PCs with the hospital medication management system

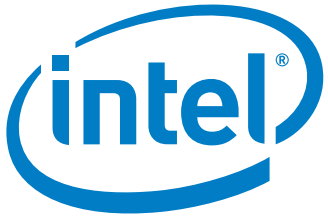
In terms of the clinician's response to the MPoC trial, a survey revealed a very encouraging response. All the main indicators were positive. For example, when asked about the tablet PCs, Dr Igor Jenčo, paediatric oncologist said: "They help us to communicate faster and more efficiently with the labs, patients and parents of the patients. They also helped deliver a significant improvement in the decision-making related to medication."

In fact, the results of the physicians' survey revealed:

- A 100 per cent increase in the clinicians' rating of the importance of IT tools to their work after the trial
- A 33 per cent increase in overall clinician satisfaction after the trial

Like many regions in Eastern Europe, the capital to invest in healthcare is often lacking. However, the Košice Children's Teaching Hospital has clearly seen positive benefits from the MPOC trial and is now formulating plans to introduce a second phase into the Oncology departement. This will include making the medication management system available on the tablet PCs as well as the introduction of Voice and Video over IP for patient's families and internal monitoring.

The success of the pilot fuels the drive for extended MPoC use in the Oncology department



For more about the Intel® healthcare IT value model, talk to your Intel® Digital Health representative or download the paper, The value of healthcare IT: http://www.intel.com/healthcare/hit/providers/hit_value_model_whitepaper.pdf

For more about the business value of IT, see the whitepaper, Measuring IT success at the bottom line, at: http://www.intel.com/it/pdf/measuring-it-success-at-the-bottom-line.pdf

and David Sward's Measuring the business value of information technology (Intel Press, 2006): http://www.intel.com/intelpress/sum_bvm.htm