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**Author:** Govaert, J.A.
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DISCUSSION AND FURTHER PERSPECTIVES
DISCUSSION

Ever since the publication of Michael Porters’ book ‘redefining healthcare: creating value based competition on results’ 1, health care providers have been developing frameworks for realigning the delivery of health care around value for patients. Since challenges for obtaining a sustainable healthcare system in the future include dealing with advances in technology, availability of expensive medications, chronic illness and ageing, it seems unavoidable to re-evaluate the way we have been providing care to our patients.

Surgical auditing and hospital costs

With the continuous rise of healthcare costs, healthcare providers, insurance companies, governments, and patients demand for information and transparency on performance of hospitals. Surgical audits are primarily initiated to monitor outcomes in order to reduce variation between institutions and improve quality of care 2,3. Although frequently assumed, evidence of surgical auditing as a tool to reduce hospital costs remains scarce. In chapter 2 4 we describe the results of a systematic review: of more than 3600 investigated manuscripts on effects of surgical auditing, only six manuscripts reported a relationship between surgical auditing and hospital costs. All six showed a positive effect of surgical auditing on reducing costs. The biggest reduction was seen for the more complex procedures, probably because prevention of adverse events in these procedures might be of greater clinical 5 and therefore financial importance. Since auditing is a time consuming effort 6, the question remains how auditing will effect outcomes—and costs—of ‘high-volume low-complex’ procedures, like procedures related to inguinal hernia and hip fractures. Also a general note of caution should be made regarding publication bias when performing a review of the literature: studies showing negative outcomes, in our case of surgical auditing, might be less likely submitted for publication by the authors. Conclusions of our systematic review were supported by the findings from the DVHBC-study. In chapter 3 7 we describe the relationship between severe complications and hospital costs for 29 hospitals participating in the Dutch Surgical
Colorectal Audit (DSCA). Between 2010 and 2012, the participating hospitals reduced their severe complications by 20%, their mortality rate by 29% and simultaneously hospital costs by eight percent. Moreover, an inverse relation between severe complication rate and hospital costs was identified and hospitals with the strongest improvement in three years had the strongest cost reduction. The total estimated cost reduction in the three consecutive years was more than €5 million for the participating hospitals. Even more, by combining clinical and financial outcomes we identified ‘best practice’ hospitals, and therefore providing a realistic goal for all other hospitals. If between 2010 and 2012 all other hospitals in our study performed on the level of the best practice hospitals, the additional savings in this three-year-study would have been more than €20 million (Figure 3 chapter 3). When comparing this to the overall Dutch hospitals budget of €23 billion a year, the savings might seem less impressive. However, these results should be interpreted in the light that we analyzed only the surgical part of one clinical diagnosis, leaving room for more savings, for example when the full potency of other registries is revealed as well. One might argue that ascribing improved quality of care (and cost reduction) to surgical auditing might be related to other factors: for example possible occurrences of secular trends not registered in the audit or increased rate of laparoscopic surgery. However, when comparing mortality of other oncologic diagnosis in the Netherlands, like gastric cancer, no reduction in post-operative mortality was found until the introduction of the Dutch Upper Gastrointestinal Cancer Audit. Moreover, a reduction of mortality and/ or complications can only be achieved when key data regarding clinical outcomes is available: without this data, health care organizations are flying blind in deciding what should be targets for quality improvement initiatives or in deciding which ‘peer-hospitals’ could serve as best practice hospitals.

Since registering and data verification is a cost and time consuming exercise, we presented a business case in chapter 4. Despite the additional time -and therefore costs- of data registration and data verification, we show that participating in the DSCA resulted in overall cost reduction of € 80,393 in three years (for a hospital yearly volume of 100 procedures, supplemental table 2, chapter 4). Moreover, we describe in this chapter the tremendous impact of severe complications after
colorectal cancer surgery on hospital costs: the top five percent most expensive patients were responsible for 23% of the total cost and additional costs of patients with complications was more than 30% of the total budget (figure 1, chapter 4). However, assuming direct relationships between single complications and costs may not be appropriate since some costs are not likely to be affected by a reduction in complications in the short term. For example overhead costs of the intensive care unit will more or less still exist, regardless of the number of patients admitted to such unit. Also costs of staffing will not change on the short term by a decrease in complications, since most of the staff is employed by the hospital based on long-term contracts.

Figure 1. Laparoscopy vs open colorectal cancer resection (unpublished figure)
All elective T1-4N0-2M0-2 stage colorectal cancer patients were included. Laparoscopic resection (n=4237) was associated with longer operation time (A) and higher operation costs (B) as compared to open resection (n=3937). Total costs were lower for laparoscopic resection as compared to open resection (C). Arrow represents relative difference of unadjusted outcomes. Abbreviations: LR, laparoscopic resection; OR, open resection. * Time and costs of primary operation only.

Laparoscopic techniques and hospital costs
During the last two decades, laparoscopic resection has developed as a commonly accepted surgical procedure for colorectal cancer. Existing literature showed that laparoscopy for colorectal cancer is associated with faster postoperative recovery, similar long-term oncological outcome and similar or better long-term surgical outcome (risk of adhesion related small bowel obstruction and incisional hernia).
as compared to open resection\textsuperscript{10-13}, although two recent RCTs question its routine use for rectal cancer\textsuperscript{14,15}. Surprisingly, its effect on hospital costs is less thoroughly investigated. Most of the cost-studies were based on randomized controlled trials (RCTs)\textsuperscript{16}, which are known to describe outcomes of a selected group of patients operated in specialized (referral) centers\textsuperscript{17} and their limitations should be acknowledged, especially regarding external validity\textsuperscript{18}. Population-based studies analyzing actual hospital costs after laparoscopic and open colorectal cancer resections are scarce. One of the problems is a lack of uniformity and transparency in registration between different institutions and therefore proxies of actual costs are used, like DRG’s or insurance claim data (see cost calculations)\textsuperscript{19}.

In order to analyze the effect of a laparoscopic approach on hospital costs, our first attempt was to analyze a pooled group of all elective T1-4N0-2M0-2 stage colorectal cancer patients. In this first study, differences in patient characteristics were taken into account by performing multivariate analysis (Figure 1). However, after discussing our data with experts in the field\textsuperscript{20}, we believed that multivariate analyses would not correct for all (unknown) factors, which may have influenced the decision to perform open or laparoscopic surgery. As recently published by our group, sub-group analyses might provide better insight in clinically relevant subgroups and be of more interest for health care providers and/or payers\textsuperscript{21}. Therefore, we reviewed our data using sub-group analyses based on tumor location (colon vs rectum) and operative risk (age <75 years vs >75 years and ASA I-II vs ASA III-IV). Also, we selected T1-3N0-2M0 stage patients operated in an elective setting only. As shown in chapter 5\textsuperscript{22}, elective laparoscopic resection in all colon cancer subgroups resulted in lower hospital costs due to less severe complications and lower length of hospital stay. For all rectal cancer subgroups, laparoscopy resulted in higher hospital costs. This was probably due to the high rate of stoma construction in rectal cancer surgery (approximately 80%, Table 1 chapter 5\textsuperscript{22}) and therefore eliminating advantages seen after laparoscopic colon resections, like early discharge. Surprising was the tremendous variation in average total hospital costs between the clinical subgroups, ranging from €10,474 (≥75 year ASA I-II laparoscopic colon cancer patients) to €20,865 (<75 year ASA III-IV laparoscopic rectal
cancer patients), which is a 99% difference. This significant variation between the subgroups should be an incentive for Dutch payers and/or healthcare providers to evaluate current reimbursement systems (see chapter 9). Earlier studies analyzing differences in costs between open and laparoscopic procedures showed univocal outcomes. An important determinant in these studies might be that often no distinction between colon and rectal procedures was made. Probably this might be due to lower number of patients included in these studies making pooled analyses necessary. However, interpretation of those conclusions is difficult, because colon and rectal cancer are different disease entities in several aspects, and overall analysis does not give any insight into clinically relevant risk groups.

Therefore, besides quality improvement, the availability of large number of patients in clinical registries underlines their importance as a robust source of data for research. The availability of large number of patients enables sub-group analyses, which - depending on the research question- might reveal better clinical insights as compared to multivariate analyses. Moreover, detailed data from nationwide covered clinical registries include information of patients often excluded from RCT’s, and therefore can address new research questions regarding patient care, new treatment modalities and the way it is financed.

Nowadays, more than 70% of all colon and 85% of all rectum cancer resections in the Netherlands are performed through laparoscopy. The vast majority of these laparoscopic procedures are performed using conventional laparoscopic techniques. A relatively new approach for operating colorectal cancer is the single-port laparoscopy (SPL). In 2010 the gastrointestinal surgeons of the Jeroen Bosch Hospital started with the introduction of SPL for less-complex abdominal procedures, resulting in the first SPL colorectal cancer resections in 2011. Since little is known about the costs of applying SPL, we performed a single-center cost-analysis of SPL in 2011 and 2012 (chapter 6). Although average costs of SPL over two years were higher as compared to conventional laparoscopy, a 35% decrease in hospital costs was seen for single port procedures after the introduction year resulting in comparable costs as conventional laparoscopy. Moreover, although SPL
is a relatively new technique, this study showed that implementation of SPL could be save since there were no significant differences in mortality and/or severe complications as compared to conventional laparoscopy. Advantages of single-port surgery include the use of a single incision. This single incision is larger than the incision of a conventional port (5 or 12mm), and one of the concerns after for example cholecystectomies might be an increased rate of port side hernias. In the case of a colectomy, the affected bowel cannot be removed through a 12mm port and needs to be removed through a larger incision. Therefore during conventional procedures the 12mm sub-umbilical incision has to be extended (an alternative is the use of a Pfannenstiel incision). In SPL procedures the larger incision for the single port could be used for the removal of the bowel, minimizing the disadvantage of this initial bigger incision.

This chapter used single center data, and the number of SPL procedures was relative small (analyzing 78 SPL procedures versus 189 conventional procedures). Therefore, conclusions of superiority and inferiority between the two procedures cannot be made. However, part of the evaluation of new surgical techniques is assessing its costs, and therefore this chapter should be seen as an impetus for further research in the field of laparoscopic advancements.

**High-risk patients and hospital costs**

In order to facilitate the discussion of increasing healthcare costs when operating high-risk patients we analyzed the impact on hospitals costs of two specific subgroups suffering from high complications rates. In chapter 7 we describe that obesity is associated with a significant increase in hospital costs, up to a 22% increase for obesity class ≥2 patients. Earlier studies describing such relationship were conducted in either the relatively obese populations of the United States and New Zealand or the relatively none-obese population of Japan. Our report is the first to describe this relationship for an European country with an intermediate BMI distribution, and our findings should therefore be of use for other countries with an intermediate BMI distribution, like Sweden and France (Figure 2). Moreover, we show that pre-obesity is associated with a significant lower mortality rate after colorectal cancer.
procedures. This so-called ‘obesity paradox’ was also identified in general surgery however has never been identified for surgical colorectal cancer patients.

In conclusion, obese colorectal cancer patients have an increased risk for both minor and major complications, which highlight the need for targeted quality programs for these patients. Moreover, since obesity is becoming pandemic, obesity-related increase of healthcare costs could be expected worldwide when treating colorectal cancer patients.

Operating oldest old colorectal cancer patients (≥85 year) has always been part of discussion between health care providers. A recent Dutch study showed a 12% excess mortality for the oldest old colorectal cancer patients in the first year after surgery, which is also seen after other major procedures like aorta aneurysm repair. In combination with an increased risk of post-operative complications, one might argue that operating the oldest old for colorectal cancer might result in an impermissible misbalance in hospitals’ resource utilization. In chapter 8, we describe that oldest old (≥85 year) suffered from higher complication and mortality rates as compared to their younger counterparts (Table 2, chapter 8). Although in the other chapters of this thesis higher complication rates were associated with higher costs, post-surgery hospital costs of the oldest old did not increase. These
lower costs were probably due to faster deterioration or less aggressive treatment when complications occur (Table 3, chapter 8). This was indicated by less resource utilization and a higher failure to rescue rate when severe complications occur in the oldest old as compared to patients under 85 years. Since cases registered in the DSCA reflect ‘real world’ surgical selection, conclusions based on this study emphasizes that (short-term) financial arguments should not play a role in clinical decision making whether to operate the oldest old or not.

Reimbursement and hospital costs
The current Dutch reimbursement system is far from adding ‘value’ in colorectal cancer surgery. No differences in reimbursement for colorectal cancer surgery exist between tumor location, ASA classification or age. At the moment, differences in reimbursement are mainly based on length of hospitalization (up to 28 days vs more than 28 days, see Table 1) or the use of hyperthermic intraperitoneal chemoperfusion (HIPEC), which is an intra-operative treatment with chemotherapy after cytoreduction of peritoneal metastases in a selected group of patients. It seems fair that hospitals will financially be compensated for longer hospital admissions. Although unlikely, since it might affect the integrity of healthcare providers, this higher reward for longer admissions may also provide a strong perverse stimulus. This more or less applies for the United States of America as well, were Eappen et al. reported that some hospitals have the potential for adverse near-time financial consequences when reducing their post-surgical complications (depending on payer mix).

In chapter 9 we make a suggestion for a first step to a more sophisticated reimbursement system. The idea arose following the publication of chapter 5, where actual costs of patients in the different colorectal cancer subgroups differed up to 99%. These differences were based on differences in tumor location, ASA classification, age and operation technique (Figure 1, chapter 5). This means that healthcare providers serving relatively high number of frail colorectal cancer patients should be aware of the accompanying increased hospital costs without receiving a proper financially compensation (Table 1, chapter 9). The substantial differences in actual costs between the different risk groups, something a healthcare provider cannot influence, highlight the need for a better and fairer reimbursement system.
A new reimbursement system should not be introduced with a ‘big bang’. Instead, we propose in chapter 9 as a first step that colorectal cancer payments should be adjusted for patient and tumor characteristics (for example based on ASA classification, age and tumor location). Hospitals serving low-risk patients will receive a lower reward, therefore discouraging ‘cherry picking’ and pushing those hospitals to become more efficient. Hospitals serving high-risk patients will receive a higher reward, therefore giving those hospitals the opportunity to develop quality improvement initiatives in order to reduce complication rates. A better distribution of the reimbursement will give all hospitals the opportunity to deliver profitable care, regardless of their patients case-mix. A reasonable (and necessary) next step could be coupling the reward to outcomes of care, such as those available in the DSCA, in order to increase value of delivered care. This is also what the Dutch minister of Healthcare has in mind, proposing implementation of outcome reimbursement in 2020.

Analyzing hospital costs
Understanding hospital finances is complex and articles describing accurate translation of resource utilization into costs are scarce. In research, mostly proxies of costs are used, like insurance claim data or costs of drugs related diagnosis to indicate expenditures. One of the best methods to determine actual costs might be activity-based costing at patient level. As outlined by Kaplan, even better is using time-driven activity-based costing (TD-ABC), which is a bottom-up micro-costing method that consists of calculating two parameters per activity: the costs per time unit to perform each activity and the overall time units spent performing the activity. Compared with top-down costing methods, the TD-ABC is superior in terms of revealing patient-level resource-use variations and the prevention of cross-subsidizations.

Earlier studies analyzing cost reduction of surgical auditing (chapter 2) were hampered by their use of ‘fixed’ costs of complications. In those studies a decline in complication rate was multiplied by a fixed price of those complications. Only Hollenbeak et al. used patient-level cost-calculations based on a standard ratio of cost-to-charges methodology. For the cost-to-charges methodology, costs are estimated as a percentage of hospital charges. Since each hospital department estimated a
cost-to-charges on a yearly basis, the authors admitted that this approach is certainly imperfect for estimating hospital costs. Also multi-center studies analyzing cost differences between open or laparoscopic colorectal resections had their limitations, mainly because of a lack of uniform cost calculations between the individual centers. Populations-based studies analyzing differences between open and laparoscopic colorectal procedures were performed in the United States of America and based on claim data from payers and therefore not reflecting actual hospital costs.

In this thesis, translation of resource utilisation into costs was performed by Performation, a healthcare consultancy firm providing patient level costing and benchmarking services for more than 100 hospitals across Europe. Performation uses the activity-based costing methodology and where possible TD-ABC to determine actual hospital costs and benchmark products. All in-hospital resources used by the care of a patient (and therefore costs of those patients) are being tracked in the hospital information system and linked to the patients’ unique identification number. Since both the DSCA and Performation measure outcomes at patient level, combining these databases at patient level reveals detailed cost information of colorectal cancer treatment leading to compelling steering information (Figure 3).

**Figure 3.** Illustrative picture: hospital costs of a patient with a complicated course

Hospital costs of a 79-year, ASA III, female patient with a caecum cancer undergoing a laparoscopic ileo-cecal resection (day 1) followed by an anastomotic leakage (day 8). Cost of primary admission (day 1 till day 41) were €42,274. Cost during Q1 (first 90 days after discharge) were €216. Data retrieved from the DVBHC-study.
FURTHER PERSPECTIVES

Payment systems

From a macro-economic perspective healthcare has a bad track record when it comes to reducing costs. One of the future challenges will be determining through which system we are going to pay for our healthcare delivery in the next decades. Experts in the field agree that the current Dutch leading system with ‘fixed annual budgets’ for providers is outdated since budgets are disconnected from the actual patient need that arises during the year. This system also leads to waiting lists and creates pressure on both healthcare providers and payers at the end of the year when predetermined budgets are exceeded. Also the system in the United States, ‘fee for service’, is far from perfect. It fosters ‘eat what you kill’ mentality thereby fueling waste by rewarding quantity and not quality of care.

None of the healthcare innovations during the last decades have led to considerable costs reductions, and therefore skepticism remains why a value based system will. For example, what if we are able to decrease failure to rescue rate for colorectal cancer patients by 50 percent? Although one might consider this as improvement in quality, this implies that more patients suffering from severe complications will survive and therefore generate more hospital costs. Eventually these patients will die from the same (or other diseases) in the future and therefore shifting present costs to costs in the future. This underlines that not all improvement in healthcare automatically leads to a reduction in costs, however when focused on the right outcomes it will, as seen in chapter 3 and 4.

Two recent publications in the Harvard Business Review described two leading payment systems that might catalyze development of high-quality care: capitation or bundled payments. Suggested by Michael Porter, ‘bundled payments’ might realign delivery of healthcare even more around value for patients. Bundled payments cover the full care cycle for acute medical conditions, the overall care for chronic conditions for a defined period, or primary and preventive care for a defined patient population. Besides case-mix correction they also have care guarantees that hold providers responsible for avoidable (long-term) complications.
As seen for hip and knee replacements in Sweden, bundled payments improved efficiency while improving outcomes for patients \(^{55}\). Also incorporating the whole chain of care in the reimbursement could lead to more efficiencies while maintaining quality, as seen in the Dutch ParkinsonNet \(^{56}\). Although existing literature sounds promising, further studies are needed to identify if bundled payments will catalyze also further improvement of value in colorectal cancer care. For example, the construction of a defunctioning stoma in rectal cancer surgery might be seen as a risk adverse strategy. However, a recent study showed that a high tendency towards stoma construction did not result in lower overall anastomotic leakage or mortality rates \(^{57}\). Since construction of a defunctioning stoma introduces extra costs in the future (e.g. purchase of stoma bags, costs of treating stoma related complications, costs of a re-operation for removing the stoma), rewarding long-term outcomes in colorectal cancer surgery might provide more awareness whether to construct a stoma in the first place.

The other leading model to pay for healthcare is capitation \(^{54}\). With a population-based capitated payment healthcare providers are paid a fixed amount for each enrolled person assigned to them, per period of time, whether or not that person seeks care. It should be adjusted for each patient’s expected needs and also held providers accountable for high-quality outcomes. Supporters of this system claim that this approach is the only one that would encourage healthcare to improve quality since it fundamentally shifts the role of managing care from insurers to care providers. A major driver behind this is system is that it should reduce all kinds of waste, which is claimed to eat up at least 35% of the healthcare budget \(^{54}\). Since there is no robust nationwide evidence for either system yet, the big challenge for the future is to determine which system will support development of a high value care system the most.

**Dealing with expensive medication**

Another future challenge will be dealing with expensive medications. Recent developments in the field of oncology increased the number of indications for immunotherapy and so called ‘targeted therapies’. Immunotherapy is a type of
cancer treatment designed to boost the body’s natural defenses to fight the cancer. It uses substances either made by the body or in a laboratory (e.g. monoclonal antibodies, vaccines, T-cells) to improve or restore immune system function by stopping or slowing the growth and spread of cancer cells and help the immune system destroying cancer cells. Targeted therapies are either antibodies or drugs that work to inhibit specific proteins that are important for the growth and/or survival of cancer cells. Because targeted therapy agents do not directly interfere with rapidly dividing cells, they do not have the usual side effects of conventional chemotherapy (although they do have their own side effects) \(^{58}\). The major concern is the exorbitantly high costs of these immuno- and targeted therapies and that they are often prescribed for patients with an end-stage disease.

Back in 2006 the Dutch Council for Healthcare and Society proclaimed that the costs of an intervention per quality-adjusted life year should not exceed €80,000 \(^{59}\). Therefore questions rise whether innovative therapies undermine the development of a sustainable healthcare. For example, in 2012 Ipilimumab, an anti-CTLA4 antibody, came available in the Netherlands and initially it could be used as a second line treatment for patients with unresectable or metastatic melanoma. It is administered in a dosage of 3mg/kg and repeated three times (four treatments in total, regardless of the appearance of new lesions or growth of existing lesions) \(^{60}\). Costs of 50mg Ipilimumab are €4,505. For a 60kg patient this means that total costs for four treatments exceed €60,000 \(^{61}\). For metastatic colorectal cancer, Ramucirumab (an antibody targeting the VEGF receptor 2) can be added to chemotherapy (FOLFIRI) when there is still progression of the disease after failure of other targeted therapies (like Bevacizumab, Oxaliplatine and Fuoropyrimidine). For a patient of 60 kilograms, 480mg of Ramucirumab can be given every two weeks till progression of the disease or until unacceptable toxicity occurs \(^{60}\). Costs of 100mg Ramucirumab are €572.40, resulting in almost €5,500 on a monthly basis \(^{61}\). These striking high costs raise the question whether resources in healthcare are spend in the right manner and if these targeted therapies might even threat sustainability of healthcare in general.

In 2013 the Dutch Melanoma Treatment Registry was founded in order to track the performance of Ipilimumab and B-RAF inhibitors \(^{62}\). Perhaps for other targeted
therapies, and also for new surgical and/or radio-therapeutic therapies (like stapler material, implants, robotic surgery or proton therapy), implementation of clinical audits can fulfill an important role by tracking their performances in ‘real world’ clinical practice. As a result, such audits might identify patient groups that do benefit most from these expensive therapies and patient groups that do not, leading to more appropriate care and a more sustainable healthcare system.

**Improving clinical audits’ value**

Clinical audits traditionally cover clinical outcomes only and are most of the times focused on a single procedure or intervention\(^2,3,63\), rather than covering the full cycle of care. For colorectal cancer surgery, covering the full cycle of care would imply that also outcomes of colorectal cancer screening programs and related diagnostic procedures should be incorporated, as well as tracking long-term clinical and/or financial outcomes (e.g. 5-year survival rates). In the Netherlands, this for example means that the Dutch Gastrointestinal Endoscopy Audit \(^64\) should be merged with the Dutch Surgical Colorectal Audit \(^2\) in order to cover both diagnostic and treatment processes.

The Dutch Parkinson’s Insight Audit is a good example of a trans-mural audit: clinicians, paramedics and general physicians contribute in order to register and improve clinical outcomes and patient related outcome measures (PROMs) \(^65\). In 2015 the Dutch Society of Doctors for Lung Diseases and Tuberculosis, the Dutch Society for Radiotherapy and Oncology, the Dutch Association for Cardio-thoracic Surgeons and the Dutch Society for Lung Surgery have formed the Dutch Lung Cancer Audit \(^66\). This bundled audit covers the entire diagnostic and treatment program for all patients with lung cancer in the Netherlands. Currently it is further developed as a blue print for ‘whole care cycle’ audits in the Netherlands. Therefore, also the DSCA will be transformed in a patient-centered disease specific audit. After its multidisciplinary extension in 2017, this new audit will cover the full care cycle of colorectal cancer patients in the Netherlands (Dutch Colorectal Cancer Audit).

Doctors think about colorectal cancer surgery in terms of anastomotic leakage. The average patient does not. This is also shown in recent literature describing that
patient related outcome measures (PROMs) are not correlated with early preoperative events in bariatric surgery, therefore adding new information in treatment evaluation. A systematic review showed that overall PROMs intervention effect sizes were small-to-moderate, however the routine use of PROMs might lead to improved symptom control and patient satisfaction, leading to more discussions of patient outcomes during consultation. This is why future registries should incorporate PROMs in order to provide meaningful data for patients. Although there are some initiatives pioneering integration of PROMs into daily practice, only a few have adopted it into nationwide programs.

In 2012, a joint taskforce of the Karolinska Institute in Sweden, Harvard Business School and the Boston Consulting group initiated the International Consortium of Health Outcomes Measurement (ICHOM). The mission of ICHOM is to develop a new paradigm focused on health outcomes by defining global standard sets of outcome measures. Their aim is to have published standard sets covering more than half of the global disease burden by 2017. To make sure that outcomes that really matter to patients are measured, all their datasets cover besides clinical outcomes, PROMs as well. The ICHOM colorectal cancer standard set was developed in close cooperation with the Dutch Institution for Clinical Auditing (DICA) and includes for example outcomes regarding depression, pain, sexual dysfunction and health-related quality of life through validated questionnaires. DICA has started with synchronizing its datasets with the ICHOM standard sets with incorporation of PROMs, that are already available for several of its clinical audits.

Finally, embedding costs to an audit will tremendously increase the audit’s value as shown in this thesis. The DVBHC-study was the first Dutch Institute of Clinical Auditing (DICA) database-based study to be linked in such manner. Performation and DICA are now making steps to set up more (pilot) costs studies for other audits, like the Dutch Upper GI Cancer Audit (DUCA) and the Dutch Audit for Treatment of Obesity (DATO). Since accurate cost calculations are complex and should (nationwide) be performed in a uniformly manner, the question remains whether this is feasible. However, if healthcare providers can track down their expenses they can identify where their provided care is most costly and where it is not. This
might reveal the best opportunities for dedicated quality improvement programs leading to better outcomes for patients.

Implementation of undeveloped aspects of the ‘value agenda’

Several aspects of the ‘value agenda’ have not been addressed in this thesis. To enable the full power of the value agenda, health care providers should also embrace the other components as suggested by Michael Porter.

For colorectal cancers we suggest the following items:

Organize into integrated practice units

Colorectal cancer surgeons might seek stronger collaboration with gastroenterologists, oncologist and radiotherapists and define their common goal: improving the outcomes for colorectal cancer patients. That means that, besides participation in weekly multidisciplinary meetings, each clinician should feel accountable for not only treating the disease, but also for treating the related complications and treating related circumstances that occur with it. For example, surgeons may choose to construct a diverting ileo-stoma (in order to protect the low anastomoses seen in rectal cancer), however they should be aware of the stoma related complications. For example, non-surgical stoma related complications are most of the times seen by the stoma care nurse (e.g. failure of appropriate stoma handling, superficial wound infections) and/or the internal medicine doctor (e.g. dehydration). Sharing information on long-term complications might also provide valuable insights for radiotherapist, since they are often not involved during the follow-up period and therefore not noticing the long-term toxicity of radiotherapy. Also sharing wards and/or out-clinic departments between surgeons and for example gastroenterologists might lead to a more direct treatment plan with fewer in-hospital referrals. Shared accountability might enhance direct feedback (short-loop communication) and stimulate relevant discussions between providers. In other hospitals where integrated practice units have been introduced, like the Martini Klinik in Hamburg and the Cleveland Clinic in Ohio, specialists are aligned around the care of a single diagnosis leading to more satisfaction for both patients and doctors.
Integrate care delivery across separate facilities

First colorectal cancer health care providers should define the scope of services for each hospital in a certain region. Community providers can usually work very effective, like shorter turnover times between surgeries or scheduling more out-clinic visits a day, and should ideally focus on less complex procedures/proceedings. Academic centers have traditionally more heavily resourced facilities, therefore facilitating the infrastructure for more complex surgeries, like surgery for frail ASA III-IV patients. Second, care should be integrated across the different locations. For example, after a complex procedure is performed in an academic hospital, post-operative physiotherapy or stoma care can be performed closer to home. Important note is that the IPU still manages the full cycle of care and should for example be responsible for developing uniform protocols between the facilities. The Leiden University Medical Center is now teaming up with Haaglanden Medical Center (HMC), a major hospital in The Hague with multiple locations, in order to create the University Cancer Center Leiden|The Hague. In the near future, surgeons of both institutions will perform surgeries in one of the HMC locations, which will entirely focus on treating cancer. In addition, complex colorectal cancer patients (e.g. ASA IV patients) of the greater Leiden – The Hague area will be redirected to the Leiden University Medical Center.

Build an enabling information technology platform

This component should powerfully enable all other components of the value agenda. Unfortunate information technology (IT) systems are lagging behind in most hospitals. In the greater Leiden area, almost all surrounding hospitals run on a different IT system, not even mentioning other health care providers like general practitioners or nursing facilities. Creating synergies between the different systems should catalyze efficient evaluation of treatments and optimize communication between different (located) health care providers. For example, treatment of colorectal cancer patients might improve when general physicians can easily reach out to specialist by leaving notes or pictures of wounds in the electronic patient record system in order to decide if a patient has to be redirected to the hospital again.
Also linking hospitals IT systems to audit IT systems (such as these of the DICA) could lead to easy accessible key information for healthcare providers on disease specific performances. Moreover, linking IT systems should enable data extraction for research and/or audits. Since data extraction and verification for auditing is a time and cost consuming exercise \(^{6,9}\) this certainly improve the usability of the audit. Although a lack of a perfect IT system is well recognized by most providers, there is no ideal IT system available in the market yet.

**CONCLUSION**

This thesis shows that quality of colorectal cancer care is irrevocably associated with hospital costs. Although surgical auditing is a cost and time-consuming exercise, it has a strong potential to improve outcomes in healthcare and simultaneously reduce hospital costs. Comparing hospital performances on both quality and costs makes identification of ‘best practice’ hospitals possible. Moreover, providing combined quality-cost outcomes of frail patients or operation techniques provides valuable insights where to start quality improvement initiatives. Finally, rewarding healthcare providers based on operative risk could be a first step in developing powerful reimbursement systems. This all might catalyze the continuous improvement of value leading to a more sustainable healthcare system in the future.
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