Chapter 9

Focusing on desired outcomes of care after colon cancer resections; hospital variations in 'textbook outcome'

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Abstract

Aims

We propose a summarizing measure for outcome indicators, representing the proportion of patients for whom all desired short-term outcomes of care (a 'textbook outcome') is realized. The aim of this study was to investigate hospital variation in the proportion of patients with a 'textbook outcome' after colon cancer resections in the Netherlands.

Methods

Patients who underwent a colon cancer resection in 2010 in the Netherlands were included in the Dutch Surgical Colorectal Audit. A textbook outcome was defined as hospital survival, radical resection, no reintervention, no ostomy, no adverse outcome and a hospital stay < 14 days. We calculated the number of hospitals with a significantly higher (positive outlier) or lower (negative outlier) Observed/Expected (O/E) textbook outcome than average. As quality measures may be more discriminative in a low-risk population, analyses were repeated for low-risk patients only.

Results

A total of 5582 patients, treated in 82 hospitals were included. Average textbook outcome was 49% (range 26 to 71%). Eight hospitals were identified as negative outliers. In these hospitals a 'textbook outcome' was realized in 35% vs. 52% in average hospitals ($p<0.01$). In a sub-analysis for low-risk patients, only one additional negative outlier was identified.

Conclusions

The textbook outcome, representing the proportion of patients with a perfect hospitalization, gives a simple comprehensive summary of hospital performance, while preventing indicator driven practice. Therewith the 'textbook outcome' is meaningful for patients, providers, insurance companies and healthcare inspectorate.

Introduction

Society increasingly demands information on hospitals' quality of care, and wants to know which hospitals deliver 'Exemplary Care and Outcome'[1]. Quality of health care is defined as "the degree to which health services ... increase the likelihood of desired health outcomes."[112] This implicates that quality of care would be best represented by the proportion of patients for whom all desired health outcomes are realized, in other words: the proportion of patients with a 'textbook outcome'. Although such measure has been suggested,[3,4] it was never presented for outcome after colon cancer resections.

Previous studies have reported on hospital variations in outcome after colon cancer resections.[4-6] Although information on individual outcome indicators are useful for targeted quality improvement programs, it is difficult to compare hospital performance by means of individual indicators: a hospital may have a high score on one indicator, but a low score on another. This is especially true for outcome indicators as they can be interrelated: a high ostomy rate may result in a low reintervention rate. Therefore, a summarizing measure could give an additional, comprehensible, overview of hospital quality of care for patients, payers and providers.

Information on hospital performance, including outcome indicators, is increasingly available within the public domain. However, Marshall et al showed that patients rarely searched for this information and did not understand or trust it.[7] New evidence suggests that patients would be more likely to use information on differences in quality of care when presented as a summary measure, for example as the percentage of patients with a 'textbook outcome'.[3,8] Hospital rates of 'textbook outcome' may however be largely affected by preoperative patient and tumor characteristics. Therefore, hospital performances on outcome indicators should be adjusted for case-mix. Moreover, Coory at al. showed that the systematic variation in hospital mortality after acute myocardial infarction was largest in a low-risk patient group,[9] while for high-risk patients, outcome was more likely determined by other factors than hospital quality of care. They concluded that therefore, hospital performances should be assessed on results in low-risk patients.

The aim of this study was to investigate hospital variation in the number and proportion of patients with a 'textbook outcome' after colon cancer resections in the Netherlands. In addition, we investigated if hospital variation in 'textbook outcome' differed when only low-risk patients were included.

Patients and Methods

Patients

The dataset was retrieved from the Dutch Surgical Colorectal Audit (DSCA), a prospective national database, in which patient-, tumor-, diagnostic- and treatment characteristics as well as pathology and outcome data are registered for patients that undergo a resection

of a primary colorectal carcinoma in the Netherlands. Details of this dataset regarding data collection and methodology have been published previously.[10] Aim of the DSCA is to improve quality of care for colorectal cancer patients in the Netherlands by providing reliable feedback and benchmark information for all Dutch hospitals. The dataset and outcome indicators were based on Dutch evidence-based guidelines (www.oncoline.nl). Estimated completeness in the year 2010 compared to the Netherlands Cancer registry (NCR) was 93%,[11,12] all Dutch hospitals participated. (www.dsca.nl)

Inclusion and exclusion criteria

All colon cancer patients with a date of surgery between the January 1st 2010 and December 31st 2010 treated in one of the 92 Dutch Hospitals who were included in the DSCA before March 15th 2011 were evaluated. For this study, no ethical approval was required. As rectal cancer treatment involves different outcome indicators, this study was limited to colon cancer. Patients who were treated for recurrent colon cancer or multiple synchronous colorectal tumors were excluded.

Hospitals that failed to register all patients in 2010 were excluded (2 hospitals, 2 patients). Hospitals that failed to register all outcome parameters for more than 15% of patients were excluded (7 hospitals, 551 patients). Furthermore, as case-mix correction is imperative for evaluating outcome of care, and clustering of absent case-mix information makes risk-adjustment unreliable, hospitals that failed to fill in the required case-mix factors for more than 15% of patients were excluded (1 additional hospital, 28 patients). A total of 5582 patients, treated in 82 hospitals were included in the analyses.

Definitions

Outcome was registered at discharge or 30 days after the resection. 'Textbook outcome' was assessed by 6 separate 'desired outcome' measures: hospital survival, radical resection, no reintervention, no ostomy placement, no adverse outcomes and a hospital stay of 14 days or less. Postoperative mortality was defined as mortality within the hospitalization or 30 days after resection. Radical resection was defined as a microscopic radical resection. A reintervention was defined as an adverse outcome requiring a reoperation or percutaneous reintervention. Adverse outcomes were defined as any adverse outcome occurring within 30 days after resection. A 'textbook' hospital stay was set at the 75th percentile of the population: a hospital stay of 14 days or less. When all 6 desired health outcomes were realized, a 'textbook outcome', was achieved.

Available case-mix factors were age, gender, Body Mass Index (BMI), comorbidity (Charlson-score)[13], previous abdominal surgery, American Society of Anaesthesiologists (ASA) classifications, tumor stage, urgency, tumor complications, operative procedures and additional resections for tumor invasion and/or metastasis. All case-mix factors were categorized into discrete categories. Missing case-mix factors were analyzed in a separate category.

Analysis

First, we calculated the number and proportion of patients for whom each outcome indicator was realized. We then calculated the number and proportion of patients for whom each consecutive outcome indicators was realized; conditional to that the previous had succeeded. Outcome indicators were ranked in decreasing order of importance, with hospital survival as most important, and hospital stay as least important outcome indicator. This resulted in the number and proportion of patients for whom all desired health outcomes were realized and thereby a 'textbook outcome' was achieved. For each hospital, the proportion of patients with a 'textbook outcome' was calculated. Hospitals' unadjusted 'textbook outcome' rates were compared in a funnel plot.[14]

Secondly, as differences in case-mix may explain a large part of the hospital variation in 'textbook outcome' rates,[4,13] hospital performances were adjusted for case-mix by calculating Observed/Expected (O/E) outcome ratios.[15,16] For this calculation, the observed outcome was the number of patients with a 'textbook outcome' in a hospital and the expected outcome is the sum of all patients' estimated probabilities for a textbook outcome. Patients' probability estimates were derived from a backwards-stepwise multivariate logistic regression model, fitted on the data of all included hospitals, and using all case-mix factors mentioned above. For an average performing hospital, the observed outcome will be equal to the expected outcome, resulting in an O/E outcome ratio of 1. Hospitals that perform better than average have an O/E outcome ratio higher than 1, hospitals that perform worse than average have an O/E ratio lower than 1. For each hospital the exact Poisson 95% confidence interval for its O/E outcome ratio was calculated.[17] When the lower limit of the 95% confidence interval is above 1, the hospitals' O/E outcome is 'significantly better than average', and the hospital was considered a positive outlier. When the upper limit of the 95% confidence interval is below 1, O/E outcome is significantly worse than average and the hospitals was a negative outlier.

Lastly, as previous studies suggested that, as for high risk patients outcomes are largely determined by other factors than hospital quality of care, differences in hospital performances are best assessed in a low-risk population,[9] hospital variation in 'textbook outcome' was also assessed in a selection of 'low-risk' patients. Risk stratification was based on the patients estimated probability for 'textbook outcome' as derived from logistic regression analysis (i.e. low risk patients were patients with a high probability for a 'textbook outcome'). Patients with a predicted probability of more than the 75th percentile of 'textbook outcome' were classified as low-risk patients. We investigated hospital variation in O/E 'textbook outcome' rates for low-risk patients and identified outlier hospitals.

All statistics were performed in PASW Statistics for Mac, Rel 18.0.2009. Chicago: SPSS inc. and Microsoft Excel.

Results

Average number of colon cancer resections per hospital was 67 patients (range 7 to 144). Table 1 shows the number and proportion of patients for whom each desired health outcome was realized. Next, performances on each outcome indicator were calculated conditionally to that the previous outcome indicator was met, in decreasing order of importance of outcomes. For each outcome indicator added, the percentage of patients for whom that specific outcome and all previous outcome indicators were realized, was reduced

Table 1. Outcome after colon cancer resections, population average on individual outcome indicators, and on outcome indicators, each conditional to the previous indicator being fulfilled.

	Population		Conditional	
	N	%	N	%
Patients	5582			
Hospital survival	5312	95%	5312	95%
Radical resection	4965	89%	4735	85%
No reintervention	4716	85%	4076	73%
No ostomy	4747	85%	3544	64%
No adverse outcome	3731	67%	2918	52%
Hospital stay <14 days	4319	77%	2721	49%
Textbook outcome			2721	49%

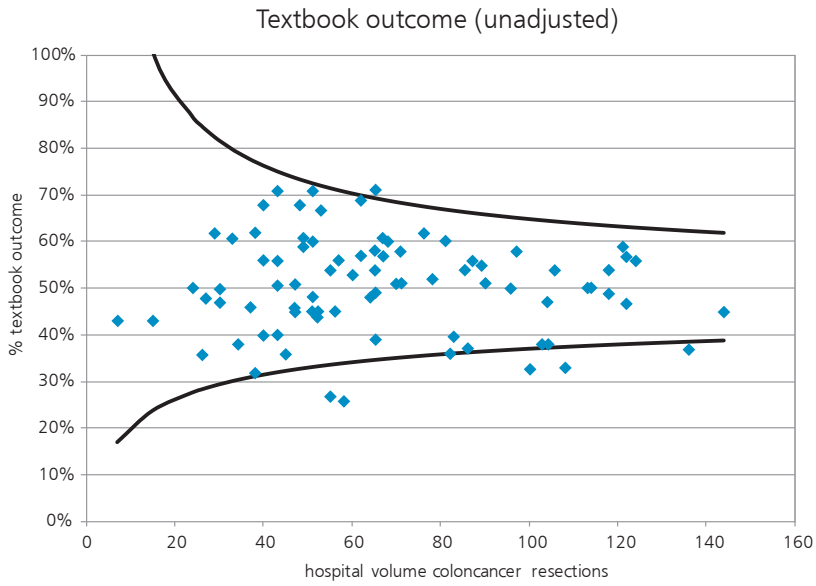

Figure 1. Hospital variation in percentage of patients with 'textbook outcome', unadjusted. Black lines represent the 95% confidence interval of population average. Gray thin line represents population average 'textbook outcome'.

with approximately 10%, except for the last outcome indicator, a hospital stay of 14 days or less. For only 49% of all patients, a 'textbook outcome' was realized.

Hospital differences in 'textbook outcome'

Figure 1 shows the hospital variation in percentage of patients with 'textbook outcome'. Unadjusted hospital 'textbook outcome' rates varied from 26 to 71%. Five hospitals performed significantly worse than average, based on unadjusted outcome. One hospital was significantly better than average.

Factors which reduce chances at a 'textbook outcome' are: older age, male gender, previous abdominal surgery, ASA score of III or more, urgent resection, tumor complications, left hemicolectomy, low anterior resection or 'other resection' (e.g. subtotal colectomy or panproctocolectomy), a higher tumor stage and additional resections for local tumor invasiveness. Charlson co-morbidity score and Body Mass Index (BMI did not remain statistically significant in the logistic regression model. The C-statistic was 0.75 (0.74-0.76), indicating a moderately good prediction model.[18] (Table 2)

Table 2. Case-mix factors predictive for 'textbook outcome'.

Case-mix Factor		N	%	OR	(95% CI)
Age (years)	>70	2403	45%	1.00 (ref)	
	70-79	1769	33%	0.66	(0.57-0.75)
	80+	1212	22%	0.49	(0.41-0.57)
Gender	Female	2562	52%	1.51	(1.34-1.71)
Abdominal history		1856	34%	0.82	(0.72-0.93)
ASA score	III+	1388	26%	0.52	(0.46-0.60)
Urgency	Urgent/acute	1014	19%	0.44	(0.35-0.56)
Tumor	None	4092	76%	1.00 (ref)	
complication	Perforation	125	2%	0.40	(0.23-0.69)
	Obstruction	671	13%	0.66	(0.51-0.86)
	Else	454	8%	0.94	(0.75-1.17)
Procedure	Right hemicolectomy	2527	47%	1.00 (ref)	
	Left hemicolectomy	715	13%	0.77	(0.64-0.92)
	Sigmoid resection	1263	23%	1.08	(0.92-1.25)
	(L)AR	715	13%	0.46	(0.38-0.55)
	Else	173	4%	0.29	(0.20-0.43)
Stage	I	949	18%	1.00 (ref)	
	II	1932	36%	0.74	(0.62-0.88)
	III	1626	30%	0.74	(0.62-0.88)
	IV	819	15%	0.21	(0.16-0.25)
	X	65	1%	0.59	(0.34-2.01)
Additional resection	Local tumor invasion	507	9%	0.44	(0.36-0.55)
C-statistic				0.75	(0.74-0.76)

ASA: American society of Anaesthesiologists
LAR: Low anterior resection
OR: Odds Ration
CI: Confidence interval

Table 3. Case-mix and Outcome parameters for Low-risk and High-risk patients

Case-mix		Low-risk (4041)	High –risk (1541)	p
Age (years)	<70	48%	35%	
	70-79	33%	34%	
	80+	19%	31%	
Gender	Female	51%	37%	<0.01
Abdominal history		34%	37%	<0.05
ASA score	III+	19%	45%	<0.01
Urgency	Urgent/acute	7%	55%	<0.01
Tumor complication	None	87%	43%	<0.01
	Perforation	1%	9%	
	Obstruction	5%	36%	
	Else	7%	12%	
Procedure	Right hemicolectomy	47%	35%	<0.01
	Left hemicolectomy	12%	15%	
	Sigmoid resection	26%	16%	
	(L)AR	9%	25%	
	Else	2%	9%	
Stage	I	22%	3%	<0.01
	II	39%	26%	
	III	33%	23%	
	IV	5%	47%	
	X	1%	1%	
Additional resection	Local tumor invasion	5%	23%	<0.01
Outcome				
Hospital survival		97%	91%	<0.01
Radical resection		96%	73%	<0.01
No reintervention		86%	81%	<0.01
No ostomy		93%	67%	<0.01
No adverse outcome		71%	56%	<0.01
Hospital stay <14 days		83%	66%	<0.01
Textbook outcome		**60%**	**21%**	<0.01

ASA: American society of Anaesthesiologists
LAR: Low anterior resection
Low-risk patients: Predicted probability for 'textbook outcome'> 35%.

Figure 2 shows hospital adjusted O/E 'textbook outcome' ratios and the concomitant 95% confidence intervals. O/E 'textbook outcome' ranged from 0.52 to 1.40. Eight hospitals were identified as negative outliers, with a significantly worse O/E textbook outcome than average. No positive outliers were identified. Negative outlier hospitals realized a 'textbook outcome' of in 35 vs. 52% of patients in hospitals with average performance (p<0.01). Patients treated in a negative outlier hospital had a lower chance at the desired health outcomes of 'no reintervention' (78 vs 86%, p<0.01), 'no adverse outcome' (53 vs. 69%, p<0.01) and a hospital stay <14 days (75 vs. 79%, p<0.01).

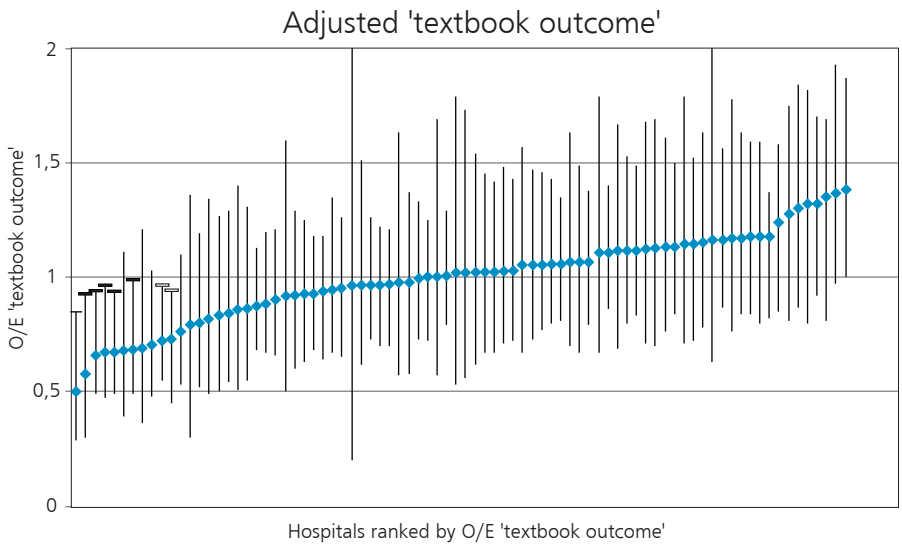

Figure 2. Hospitals ranked by risk-adjusted, i.e. observed/expected (O/E) 'Textbook outcome'.
Hospitals with an O/E 'textbook outcome' of less than 1 have less patients with a textbook outcome than expected based on their case-mix and thus perform worse than average. Hospitals with an O/E 'textbook outcome' of more than 1 have more patients with a textbook outcome than expected based on their case-mix and thus perform better than average.
Hospitals marked with a – are negative outliers, and had significantly less patients with a 'textbook outcome' than average.

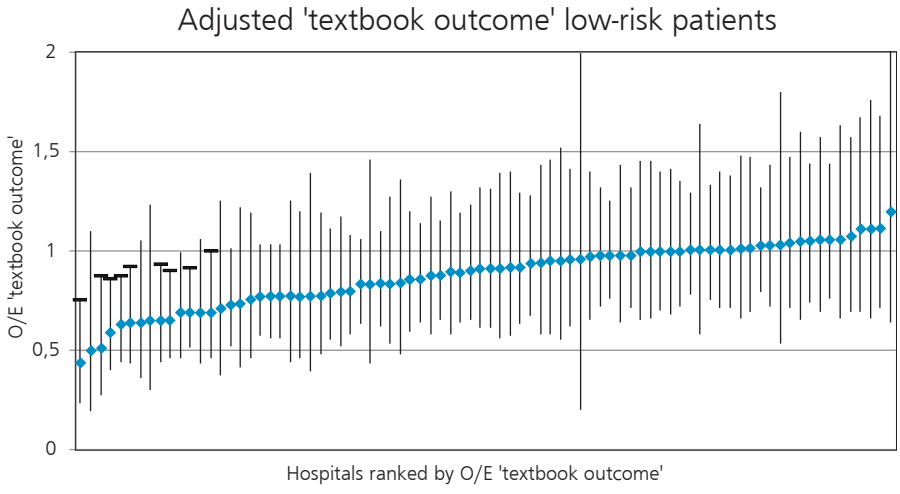

Figure 3. Risk-adjusted, i.e. observed/expected (O/E) 'textbook outcome' for low-risk patients.
Low risk patients: patients with a high probability for 'textbook outcome' (predicted probability > 35%).
Hospitals with an O/E 'textbook outcome' of less than 1 have less patients with a textbook outcome than expected based on their case-mix and thus perform worse than average. Hospitals with an O/E 'textbook outcome' of more than 1 have more patients with a textbook outcome than expected based on their case-mix and thus perform better than average.
Hospitals marked with a – are negative outliers, and had significantly less patients with a 'textbook outcome' than average.

Low-risk patients

Of all patients, 4041 (75%) were classified as 'low-risk' patients. Low risk patients were younger, more often female, had a lower ASA-score, mostly scheduled in an elective setting, more often had a right sided or sigmoid tumor and had a lower tumor stage (Table 3). Average 'textbook outcome' for low-risk patients was 60% vs. 21% for high-risk patients ($p<0.05$). Hospital volume for low-risk patients ranged from 4 to 102 patients. Hospitals' 'textbook outcome' rate for low-risk patients ranged from 31% to 82%, O/E 'textbook outcome' ranged from 0.44 to 1.20. Nine hospitals were negative outliers for 'textbook outcome' in low-risk patients. Amongst these nine hospitals were all eight hospitals, which were negative outliers in the whole population. (Figure 3) The newly identified outlier hospital also had a worse than average O/E textbook outcome in the full analysis, however this was not statistically significant.

Discussion

Major findings

The present study uses a composite outcome measure representing the percentage of patients with a 'textbook outcome', for the assessment of quality of care in colon cancer surgery. This composite measure illustrates how clinical audits can be used to provide case-mix adjusted outcome information, which is simple and meaningful for all involved parties. We showed that for only 49% of all colon cancer patients, all desired health outcomes were realized. Using this composite measure we were able to identify eight outlier hospitals, with a 'textbook outcome' rate significantly lower than expected based on their case-mix and the population average. When hospital performances were assessed based on low-risk patients only, one more outlier hospital was identified. This implies that hospital outlier status was hardly determined by an excess of high-risk patients, and moreover, that outlier hospitals also performed worse than average for their low-risk patients.

Previous studies have investigated different methods of constructing composite measures. Reeves at al. described five methods for combining indicators and they found different methods to be useful in different situations.[19] They found that the 'all or none' method (the percentage of patients in whom all indicators are met) is especially suitable when success depended on meeting all indicators. Habib et al. defined a composite outcome measure for colorectal cancer surgery in Australia, based on hospitals' performance relative to the national average, but did not account for hospital variations in case-mix or random variations.[20] O'Brien, tested four methods for combining indicators in adult cardiac surgery: an opportunity-based approach, (weighted) averaging of item-specific estimates, 'all or none' scoring, and latent trait analysis, and found the 'all or none' approach the most suitable for constructing a composite measure.[21] The 'all or none' method is simple and comprehensive, and can be adjusted for differences in case-mix, it sets a high benchmark for the ideal hospitalization and shows the largest inter-provider variability.

Strengths of the 'textbook outcome' measure

The composite 'all or none' measure 'textbook outcome', as presented in this study is a comprehensive score, which combines all relevant short-term outcome indicators for colon cancer resections. The 'textbook outcome' is simple and seems meaningful to all stakeholders (high face-validity). For patients, it represents their chances for the most favourable ('textbook') outcome in a specific hospital. For care-givers it gives information on how often treatment is successful and therewith may drive quality improvement. For insurance companies and hospitals, it may be useful in selective contracting as it summarizes indicators on patient safety, effectiveness and efficiency. For the healthcare inspectorate this score may guide surveillance-programs. By combining important outcomes of care in one comprehensive measure, the 'textbook outcome' prevents defensive, indicator driven practice. For example: the placement of an ostomy to prevent anastomotic leakage can be a good clinical decision, but a hospital policy to accept an excess ostomy rate to get a better score at the indicator 'no reintervention' may not be in the patients best interest. Good clinical decision-making will therefore result in an optimal score on 'textbook outcome'. Moreover, this measure seems discriminative, as we identified eight outlier hospitals, in which quality of care was worse than average, on several aspects.

Coory at al. showed that the systematic variation in hospital mortality after acute myocardial infarction was largest in a low-risk patient group.[16] However, a large sample size (i.e 10 years) was required to prove an increased systematic variation in outcome in low-risk patients. The present study showed that outlier hospitals for low-risk patients were consistent with outlier hospitals in the whole population, and identified only one additional outlier in the low-risk sub-analysis. Possibly, when data of multiple years are combined, we may find an increased systematic variation in low-risk patients. Also, we may be able to identify positive outliers on 'textbook outcome', and the best practices leading to these outcomes.

Limitations and possible refinements to this measure

The major limitation of this study is the completeness of the database: although the dataset of the DSCA 2010 was more complete than several other national registries, the estimated completeness of the DSCA in 2011 was 93%. Data comparisons with the independently collected data of the NCR showed no overall differences in patient, tumour, procedural and outcome data. (www.clinicalaudit.nl) Therefore, it is unlikely that the results would have been influenced to a great extent by the missing 7% of patients.

The present study found that the percentage of patients for whom all desired health outcomes were realized is less than 50%. This percentage is higher for low-risk patients, who are more likely to be in the position to select their hospital of treatment as they are often treated in an elective setting and fit to seek and travel for better quality of care. However, the percentage of low-risk patients with 'textbook outcome' is still only 60%, indicating that the measure may be too strict. The outcome indicators with the lowest population average were 'no adverse outcomes' and 'hospital stay <14 days'. Adverse outcomes which do not result in a reintervention or permanent morbidity, may be considered 'minor morbidity', and

it could be argued that these should not be included in the definition of 'textbook outcome'. However, when we exclude 'no hospital stay > 14 days' and 'no adverse outcomes', still only 64% of all patients, had a textbook outcome. Moreover, we found that outlier hospitals had a 'worse than average' performance on several outcome indicators, indicating that outlier status was not explained by a high 'minor morbidity' rate only. Another limitation of this study is the absence of long-term follow-up results, which were unfortunately not available when this study was completed. Moreover, although long-term outcome, combining operative and oncologic outcome, may be a more valid outcome measure, it reflects the quality of care delivered one to five years earlier. Short-term outcome on the other hand, reflects the quality of recently delivered care, and is therefore commonly used for performance measurements.

Possibly the 'textbook outcome' measure could be refined by adding weights to different outcome measures, making one outcome more important than another. However, no clear data or rationale from which to derive these weights is available. Therefore, any weights added to the textbook outcome measure would be subjective and therefore would diminish its simplicity and usefulness.

Implications and directions for future research

Previous studies have shown that patients are willing to travel further for better quality of care,[22] and that they would like to use outcome information, summarized as 'textbook outcome' for their choice for a hospital of treatment.[3] However, in order to produce such outcome information, a uniform, complete and reliable clinical registry, in which at least case-mix, process and outcomes of care are registered, is required. In the Netherlands such a registry exists for a few disease entities, but many more registries are needed. Furthermore, the measure 'textbook outcome' is composed of clinical outcomes considered relevant by providers. Extensive literature has shown that doctors' preferences are inconsistent with patients' preferences, even when doctors are asked to imagine that they are patients.[23,24] A patients' survey, investigating outcomes of care considered relevant by patients would be of additional value.

Conclusions

The present study introduces a composite measure, which reflects the percentage of patients for whom all desired health outcomes are realized. Not only may this measure be helpful for patients to base their choice for a hospital of treatment on, it may also provide useful feedback information for care providers. For low-risk patients, overall chance at a 'textbook outcome' is 60%. This number can be used to inform patients during the preoperative clinical consult. However, improvement of quality of colon cancer care in the Netherlands is required. Using the 'textbook outcome' measure, in combination with the individual

outcome indicators, may facilitate such improvement of outcomes of colon cancer care in the Netherlands.

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