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CHAPTER 1

Introduction and outline of this thesis

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GENERAL INTRODUCTION

As healthcare expenditures keep rising and technological advances in healthcare continue, guiding and canalizing efforts aiming at improvement of effectiveness and efficiency of care remains high on the political agenda throughout the Western world. Particularly, the field of oncological care becomes more and more complex, with an increasingly multidisciplinary approach to cancer treatment, advances in staging methods, surgical- and multimodality treatment, and an ongoing centralization of care towards referral centers for many types of cancer treatment. One of the major challenges is the ageing population, leading to a higher proportion of cancer patients that is susceptible for complications secondary to cancer treatment, as a result of prevalent comorbid illnesses^{1,2}.

High-risk surgery

A successful treatment for a patient consists of a right diagnosis, followed by a proper and adequately performed treatment, and the avoidance of adverse events associated with the treatment. Perhaps, the processes and outcomes of surgical treatment are the most straightforward to measure among oncological treatments. Postoperative clinical outcomes are important for both patients and caregivers, and adverse events like postoperative complications and mortality remain a major concern in intestinal oncological procedures. Of all intestinal surgical oncological procedures, colorectal resections are performed most commonly. They account for a disproportionate share (24%) of all adverse events within the spectrum of general surgery³. For instance, anastomotic leakage after low anterior resection is reported in literature to be approximately 9%⁴ and 30-day postoperative mortality after colorectal cancer surgery is reported to be between 3-6% in larger series⁵⁻⁸. Oesophageal cancer surgery is a

classic example of high-complex, low-volume surgery with reported postoperative mortality rates as high as 9%⁹. In esophageal cancer surgery, there is compelling evidence of better results and lower morbidity and mortality rates when surgery is performed in high-volume referral centres^{10,11}. Although esophageal cancer care is now centralized in the Netherlands¹², postoperative morbidity and mortality (4.5%) is still high and esophageal cancer patients still have an unfavorable prognosis¹³.

Hospital variation

With this background, hospital variation regarding quality of care received much attention in recent years. In the Netherlands, the 2010 'Quality of Cancer Care' report^{14,15} by the Signaling Committee of the Dutch Cancer Society described the marked presence of variability of treatment patterns, as well as outcomes, between hospitals in the treatment of bladder-, lung-, colorectal- and breast cancer. A major theme was the volume-outcome relationship. Centralization of highly complex, low volume care- treating patients in centers that are experienced in a certain treatments, with a high annual number of procedures, has been shown to improve outcomes and reduce adverse events^{13,16,17}. However, according to the report, a higher annual number of patients receiving a certain treatment per caregiver proved to be only a part of the explanation of variation in outcomes between hospitals. Several studies showed that centralization based on outcomes is more effective than volume-based referral^{13,18,19}. The report highlighted the need for further defining quality of care and focusing research on the observed differences between hospitals, thereby appealing to the increasing demand of patients, policy makers and payers for transparency of treatment and outcome information. This paved the way for various Dutch clinical audits after international examples^{20,21}. Not surprisingly, gastrointestinal cancers

surgeons, especially colorectal surgeons, were among the first to embrace clinical registries in the Netherlands.

Clinical registry

The Dutch Surgical Colorectal Audit (DSCA) was initiated in 2009 as a nationwide continuous quality improvement program, registering all patients undergoing resections for primary colorectal cancer in the Netherlands. One of its main focus points is reduction of adverse event rates through feedback to participants of results with the national average as a benchmark²². The Association of Surgeons of the Netherlands agreed on a process in which outcomes of the DSCA will become publicly available in a stepwise fashion throughout the years. With a high rate of case-ascertainment and participation of all Dutch hospitals performing colorectal cancer resections, it is a valuable source of information on outcomes of everyday practice of colorectal cancer surgery in the Netherlands. Risk factors for adverse outcomes can be identified, with inclusion of patients that are usually not enrolled in clinical trials because of advanced age or comorbidity. The DSCA dataset forms the basis for most chapters in this thesis.

OUTLINE OF THIS THESIS

In this thesis, hospital variation concerning various outcomes is illustrated, thereby exploring the usability of these outcomes for hospital comparisons, both from a clinical and methodological point of view. Moreover, the studies provide insight in risk factors for adverse events in colorectal and oesophageal cancer surgery, focusing on the mechanism behind postoperative complications leading to mortality or not.

When hospital-specific outcomes are made available for the public, explicit ranking of hospitals based on specific outcomes may be attempted to compare quality of care, as is rather popular in the lay press²³⁻²⁵. Postoperative mortality may be considered one of the most delicate outcomes, and unjustly stigmatizing a hospital as having a high mortality rate may have great impact on its reputation. In rankings, besides differences in casemix, chance variation may play a role. The study described in **chapter 2** aims to determine to what extent chance variation and differences in casemix between hospitals have an impact on rankings; and whether postoperative mortality is an appropriate outcome to be used for hospital rankings in colorectal cancer surgery.

When comparing hospitals on outcomes, there is an important role for risk-adjustment, as observed variation between hospitals may be influenced by differences in patient- and tumor characteristics (casemix) between hospitals. It has been shown, for instance, that patients at high risk for postoperative mortality after colorectal cancer resections are not evenly distributed among hospitals²⁶. It may be valuable to identify outcomes that accurately reflect actual differences in quality of care, but are not much influenced by patient characteristics. In **chapter 3**, it is explored to which extent hospital variation in anastomotic leak rates can be attributed to differences in casemix, in comparison with postoperative mortality.

Another well-known outcome measure in colorectal surgery is ‘unplanned reoperations’. In the Netherlands, it has long been a compulsory quality indicator for hospitals, traditionally collected by the Dutch Healthcare Inspectorate. On a patient level, reoperations are obviously associated with adverse outcomes such as complications, a prolonged length of hospital stay and postoperative mortality^{7,27,28}.

Less is known, however, about the correlation between reoperation rates and other outcomes on a hospital level. In fact, a low threshold for a reoperation in case of a suspected surgical complication may be part of an effective strategy to reduce postoperative mortality²⁹. **Chapter 4** studies the value of reoperation rate as a marker for quality of care in elective colorectal cancer surgery.

As postoperative mortality is usually preceded by postoperative complications, hospitals with high postoperative mortality rates will intuitively have higher complication rates. However, there is increasing evidence that high postoperative mortality rates in certain centres is better explained by the way they recognize and rescue patients from postoperative complications once they emerge^{6,30} - reflected by the 'failure to rescue' rate: the postoperative mortality rate among patients with a postoperative complication³¹. The study described in **chapter 5** investigates whether high-mortality centers are characterized by higher complication rates or by higher failure to rescue rates and explores its value for quality improvement programs.

Hospital type (e.g., academic or non-academic hospital) and annual hospital caseload (volume) are well-known proxies for surgical experience, perioperative care, and availability of resources. The environment in which a surgical team works may influence the ability of the team to keep patients alive when severe complications occur. Another seemingly important hospital characteristic, the level Intensive Care facilities available in a hospital, was not studied before in this context. **Chapter 6** studies the association between these three hospital characteristics and failure to rescue rates after colorectal cancer resections.

The study presented in **chapter 7** of this thesis concerns oesophageal cancer resections. As mentioned above, there is a clear volume-

outcome relationship in oesophageal cancer surgery and minimum volume standards are now introduced in various countries. In literature, usually arbitrary volume categories are compared and as a result, these minimums vary from country to country. In this study, the relationship between hospital volume and 6-month and 2-year mortality following oesophagectomy in a non-categorical, non-linear fashion was determined, exploring how far centralization should go to be most effective. The discussion in **chapter 7**, as well as the general discussion of this thesis elaborates whether this should be achieved through a higher volume standard or through another process.

In order to reduce morbidity and mortality, it is important to understand the mechanisms behind the development of complications and the way they lead to fatal outcomes. **Chapter 8** studied rates of anastomotic leak and associated mortality in left-sided and right-sided colectomies, assessing the burden and impact of leaks in various types of colon cancer resections. Besides anastomotic leak, associated non-surgical complications may be an important determinant of postoperative mortality. The impact of these may be more related to patient factors. In the DSCA as well as the British National Bowel Cancer Audit Program³², postoperative complication- and reoperation rates appear to be higher after rectal cancer resections than after colon cancer resections. However, postoperative mortality rates are higher in the latter²². This suggests the risk of dying once a postoperative complication has emerged is higher for patients undergoing a colon cancer resection. **Chapter 9** investigates differences in failure to rescue associated with major complications between elective colon- and rectal cancer resections, adjusting for differences in patient- and tumour- characteristics.

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