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Quality indicators of colorectal cancer care in southern Switzerland: results from a population-based study

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Summary

AIM OF THE STUDY: Assessing the quality of cancer care (QoCC) has become increasingly relevant to providers, regulators and purchasers of healthcare worldwide. The aim of this study was to assess adherence to validated quality indicators (QIs) for colorectal cancer (CRC) in a population-based setting, and to compare results with the available literature.

METHODS: All colorectal cancers diagnosed between 1 January 2011 and 31 December 2012 were identified from the files of the population-based Ticino Cancer Registry, southern Switzerland. We computed 12 core QIs, approved by use of the validated Delphi methodology and for which all the necessary medical documentation was available or only minor data collection was still needed to complete the analysis: three for diagnosis, two for pathology and seven for treatment (surgery, oncology and radiotherapy). Each QI was analysed as proportion (%) with 95% confidence interval, following the approach "available case analysis".

RESULTS: A total of 474 colorectal cancers were identified: 86.9% patients were diagnosed after they reported symptoms, 90.2% had preoperative colonoscopy, 8.7% underwent emergency surgery, 97.2% had a surgical resection with tumour-free margins, and for 86.6% at least 12 lymph nodes were examined. The overall 30-day post-operative mortality was 3.6% and 66.7% of locally advanced rectal cancers benefited of neoadjuvant radiotherapy ± chemotherapy.

CONCLUSIONS: Our study showed the feasibility of assessing QoCC using Cancer Registry population-based data. Results according to the clinical domain of pathology, surgery, oncology and radio-oncology in southern Switzerland are generally positive and encouraging, sometimes more favourable in comparison with other international studies, except the very low proportion of patients with a diagnosis based on opportunistic screening (8.6%). Considering the lack in the literature of population-based studies, further national and international reports are urgently needed for comparative analysis as well as

standardisation of QI definition is absolutely necessary for inter-regional comparative goals.

Key words: *quality of cancer care, colorectal cancer, quality indicators, cancer registry, population-based study*

Introduction

Research on Quality of Cancer Care (QoCC) performed during the last decade has demonstrated that the increase in the knowledge on treatments with proven efficacy does not directly translate into optimal delivery of such treatments to patients. Moreover, accumulating evidence suggests that there may be both underuse and overuse of care for patients with cancer [1, 2]. In addition to survival analysis, the assessment of QoCC has become more and more important to providers, regulators and purchasers of care in order to evaluate and compare quality of care at the population-based level, and to respond to the growing demand for services, rising costs, constrained resources and evidence of variation in clinical practice [3]. Although the international guidelines for each type of cancer are reviewed annually, there is still the need to evaluate the real conditions of care in the community. Population-based cancer registry data are therefore essential to describe and reflect the real world and routine care, as well as to provide regular feedback to healthcare workers and decision makers about management of a disease in daily practice and about treatments that are routinely prescribed and/or effective in all patient groups. Moreover, cancer registries represent an independent data source, thus assuring a fair evaluation service and avoiding any conflicts of interest. We, therefore, implemented the QC₃ project (Quality indicators of Clinical Cancer Care project), focusing on QoCC related to the diagnosis and treatment process in colorectal cancers in Canton Ticino (southern Switzerland). The oncological healthcare system in Canton Ticino includes five public hospitals, three private clinics with oncology and radiotherapy units and private oncological practices where colorectal cancer patients undergo surgery and/or chemotherapy (ChT) and/or radiotherapy. All these are connected with the Ticino Cancer Registry, allowing direct access to the medical documentation necessary for the evaluation of

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quality indicators and a complete coverage of the region in terms of data collection.

Colorectal cancer (CRC) is an important health issue worldwide. It is the most common malignancy in Europe (excluding non-melanoma skin cancers) and the second most common in terms of cancer-related mortality [4–6]. In Switzerland, CRC is the second and third most frequent tumour in women and men, respectively. About 4100 CRC cases are diagnosed annually, corresponding to a European age-standardised incidence rate of 46.5 and 29.6 cases per 100 000 inhabitants in men and women, respectively, and representing 11% of all tumours. CRC is the third leading cancer cause of death in Switzerland, with approximately 1600 deaths/year, corresponding to a European age-standardised mortality rate of 17.6 and 10.1 cases per 100 000 inhabitants in men and women, respectively. With a 5-year survival probability of 65%, Switzerland is the country with the most favourable prognosis in Europe [7–10].

The aims of the present study were to evaluate, by means of a set of specific indicators, quality of care of patients treated for CRC diagnosed in 2011–2012 in southern Switzerland, and to compare results with the available literature and studies at the population-based level. The evaluation was performed by means of quality indicators (QI) related to the diagnostic and treatment process, selected from a previously published comprehensive list of QIs derived from different guidelines [11].

Materials and methods

Data sources and case selection

The study included all the resident population of the Canton Ticino (341 652 inhabitants, reference year 2012), the southern Italian-speaking region of Switzerland. Participants were considered eligible for this study if they had a diagnosis of CRC between 1 January 2011 and 31 December 2012 and were incident cases in the population-based Ticino Cancer Registry.

The Registry was founded in 1995 by the local government through a cantonal law, on the basis of a popular initiative; however, data collection started in 1996. It is closely connected to, and is part of, the regional Institute of Pathology, which has been serving the entire region since 1978 and notifies the Registry of the majority of tumour cases. Additional cases are actively retrieved from public and private hospitals (discharge letters), radiotherapy and oncology centres, oncologists, general practitioners (gastroenterologists for the present study) and other Swiss cancer registries [7]. Data are recorded prospectively. All information is actively collected and registered by the registry staff according to the International Agency for Research on Cancer (IARC) guidelines and the European Network of Cancer Registries recommendations [12, 13]. The first quality inspection and plausibility tests are automatically performed by the computer during the data entry phase. In addition, quality controls on multiple primaries, comparability, and validity and consistency of data are carried out by means of the IARC check programme and the Joint Research Centre - European Network Cancer Registries quality check software [12, 14–16]. Case completeness is assessed with the method reported by Bullard and colleagues and standard QIs [7, 8, 17]. Tumour sites and histological types are classified according to the International Classifi-

cation of Diseases for Oncology (ICD-O-3) and the WHO Classification of Gastrointestinal Tumours [18, 19]. Tumour stage is classified according to the 7th edition of the American Joint Committee on Cancer (AJCC) Staging Manual [20].

Locally advanced rectal cancers were defined as tumours either T3–T4 and/or with lymph node involvement (N1/N2), and with no distant metastasis (M0). Lymphomas and carcinoids were excluded.

For the present study, each single CRC patient's data were checked and reviewed in the database of the Ticino Cancer Registry. We collected all needed information in cooperation with the local public and private hospitals and clinicians. The original reports of pathology (biopsy and/or surgical resection), surgery, radiotherapy and oncological medical treatment were collected and consulted in order to extract all necessary data to be imported in the database of the Ticino Cancer Registry.

List of quality indicators and analysis

The Ticino Cancer Registry has published in 2013 the initial part of the QC₃ project, a prospective, descriptive study that aimed to identify QIs to be used to assess the quality of clinical cancer care of CRC patients in southern Switzerland, at the population-based cancer registration and data collection level [11]. The entire process used to define the QIs, encompassing the whole diagnostic-treatment process of CRC, is described in depth in Bianchi et al. [11]. Briefly, a comprehensive evidence-based literature search was performed to identify the initial list of QIs, which were then selected and approved by use of validated Delphi methodology involving two multidisciplinary expert panels (a local working group and an international advisory board) with expertise in CRC care, quality of care and epidemiology. QIs reaching more than 70% agreement, confirming their scientific and clinical value, and evaluated by all the involved experts as "feasible to be collected at the population-based level", were definitely retained. The complete list of the definitely validated 25 CRC QIs concerning the three clinical domains of diagnosis, pathology and treatment is exhaustively reported in Bianchi et al. [11].

For the present study, we selected half of the above mentioned validated QIs – a core of 12 QIs – for which either all the necessary medical documentation for the extrapolation of data needed for the QI measurement was available at the Ticino Cancer Registry, or only minor additional data collection was still needed to complete the analysis. The 12 selected QIs are reported in detail in table 1: three QIs were for diagnosis, two for pathology and seven for treatment (surgery, oncology and radiotherapy) were analysed for CRCs diagnosed in southern Switzerland in 2011 to 2012.

QIs were reported as the proportion (%) of patients who fulfilled the specific criteria with the corresponding 95% confidence interval (95% CI), based on the binomial distribution: the numerator was defined as the number of patients fulfilling the criteria, whereas the denominator was the total number of eligible patients. The approach "available case analysis" was followed for the calculation of each QI. Thus, cases with missing information (not retrieved in the consulted medical documentation) were excluded from the numerator and the denominator of the QI,

Table 1: Quality indicators (QI) for patients diagnosed with colorectal cancer in southern Switzerland between 2011 and 2012.

Quality indicator [11]	Numerator		Denominator		%* (95% CI)	Medical documenta-tion	Rationale
	Description	n	Description	n			
QI1 Proportion of patients with colorectal cancer and diagnosis based on symptoms vs opportunistic screening vs accidental finding	Number of patients with colorectal cancer whose diagnosis is based on symptoms, defined as appearance or persistence of clinical events and signs, such as rectal bleeding, occult blood in stool, weight loss with no apparent cause, general abdominal discomfort, bowel obstruction, change in bowel habits, constant tiredness, anaemia	372	Number of pa-tients with colorectal cancer	474, of which 428 with available information	86.9% (83.7–90.1%)	Request form for endo-scopic examination Endoscopic and surgical pathology reports Reports/discharge letters from all hospital de-partments (i.e., surgery, medicine, radiotherapy, medical oncology)	Assessment of the pa-tient's care
	Number of patients with colorectal cancer whose diagnosis is based on op-portunistic screening, de-fined as examination, such as faecal occult blood test or colonoscopy in asymptomatic patients	37			8.6% (6.0–11.3%)		
	Number of patients with colorectal cancer whose diagnosis is an accidental finding following examina-tions or therapies for other diseases (e.g., hospital admission for other caus-es...)	19			4.4% (2.5–6.4%)		
	(46 missing: information not retrieved)						
QI2 Proportion of patients with colorectal cancer undergoing preoperative colonoscopy	Number of patients with colorectal cancer who have been evaluated in a preoperative colonoscopy	349	Number of pa-tients with colorectal cancer under-going surgery [†]	392, of which 387 with available information	90.2% (87.2–93.1%)	Endoscopy report Request form for pathol-ogy examination Endoscopy pathology report	Planning of further diag-nostic procedures and treatments Comprehensiveness of diagnostic and staging evalua-tion
	(5 missing: information not retrieved)						
QI3 Proportion of patients with rectal cancer and description of the tu-mour localisation (dis-tance ab ano) in the endoscopy pathology report	Number of patients with rectal cancer having de-scription of the tumour lo-calisation, in terms of dis-tance ab ano, in the endoscopy pathology doc-u-mentation	113	Number of pa-tients with rectal cancer undergoing endoscopy	144, of which 136 with available information	83.1% (76.8–89.4%)	Endoscopy report Request form for pathol-ogy examination Endoscopy pathology report	Planning of further diag-nostic procedures and treatments Comprehensiveness of diagnostic and staging evalua-tion
	(8 missing: information not retrieved)						
QI4 Proportion of patients with locally advanced rectal cancer (T3–4 and/or any T, N+, M0) for which the pathology re-port includes informa-tion about neo-adjuvant RT±ChT	Number of patients with lo-ally advanced rectal can-cer (T3–4 and/or any T, N+, M0) for which the re-quest for pathological ex-amina-tion includes infor-mation about neo-adjuvant RT±ChT	40	Number of pa-tients with locally advanced rectal cancer (T3–4 and/or any T, N+, M0) undergoing neo-adjuvant RT±ChT and surgery [†]	47, all with available infor-mation	85.1% (74.9–95.3%)	Request form for pathol-ogy examination Surgical pathology re-port	Providing the necessary information for a comprehensive pathological ex-amina-tion Assessment of the quality of the flow of clinical infor-mation
	(0 missing)						
QI5 Proportion of patients with rectal cancer for which the pathology report includes information about radial mar-gins	Number of patients with rectal cancer for which the pathology report includes information about radial margins	78	Number of pa-tients with rectal cancer undergoing surgery [†]	104, of which 101 with available information	77.2% (69.1–85.4%)	Surgical pathology re-port	Comprehensiveness and standardisa-tion of surgical pathology report Comprehensiveness of stag-ing evalua-tion Planning of further treat-ments
	(3 missing: information not retrieved)						
QI6 Proportion of patients with colorectal cancer undergoing emergency surgery [‡]	Number of patients with colorectal cancer undergo-ing emergency surgery [‡]	34	Number of pa-tients with colorectal cancer under-going surgery [†]	392, of which 390 with available information	8.7% (5.9–11.5%)	Radiology and surgery report / discharge letter Surgical pathology re-port	Assessment of the pa-tient's care
	(2 missing: information not retrieved)						
QI7 Proportion of patients with colorectal cancer who died within 30 days after surgery (postope-rative mortality)	Number of patients with colorectal cancer who died within 30 days after surgery [†]	14	Number of pa-tients with colorectal cancer under-going surgery [†]	392, all with available infor-mation	3.6% (1.7–5.4%)	Surgery report / dis-chARGE letter Surgical pathology re-port Access to regional Of-fice of Population Regis-try Rosters for assess-ment of the patient's vital status	Assessment of the quality of the surgical procedure
	(0 missing)						

Quality indicator [11]		Numerator		Denominator		%* (95% CI)	Medical documenta-tion	Rationale
		Description	n	Description	n			
QI8	Proportion of patients with colorectal cancer undergoing surgery and with tumour-free margins (R0) [§]	Number of patients with colorectal cancer undergoing surgery and with tumour-free margins (R0) [§]	375	Number of patients with colorectal cancer undergoing surgery [†]	392, of which 386 with available information	97.2% (95.5–98.8%)	Surgical pathology report Surgery report / discharge letter	Assessment of the quality of the surgical procedure
		(6 missing: information not retrieved)						
QI9	Proportion of patients with colorectal cancer and number of resected lymph nodes ≥12	Number of patients with colorectal cancer and number of resected lymph nodes ≥12	285	Number of patients with colorectal cancer undergoing surgery [†] but no neo-adjuvant therapy	333, of which 329 with available information	86.6% (82.9–90.3%)	Surgical pathology report Surgery report / discharge letter	Assessment of the quality of the surgical procedure and pathology examination
		(4 missing: information not retrieved)						
QI10	Proportion of patients with locally advanced rectal cancer (T3–4 and/or any T, N+, M0) receiving neo-adjuvant RT±ChT	Number of patients with locally advanced rectal cancer (T3–4 and/or any T, N+, M0) receiving neo-adjuvant RT±ChT	50	Number of patients with locally advanced rectal cancer (T3–4 and/or any T, N+, M0) undergoing surgery [†]	75, all with available information	66.7% (56.0–77.1%)	Endoscopy pathology report Radiology report Radiotherapy and oncology reports / discharge letters	Assessment of the quality of oncology treatment and radiotherapy
		(0 missing)						
QI11	Proportion of patients with locally advanced rectal cancer (T3–4 and/or any T, N+, M0) receiving neo-adjuvant RT±ChT and operated on within 6–8 weeks after the end of neo-adjuvant RT±ChT	Number of patients with locally advanced rectal cancer (T3–4 and/or any T, N+, M0) receiving neo-adjuvant RT±ChT and operated on within 6–8 weeks after the end of neo-adjuvant RT±ChT	37	Number of patients with locally advanced rectal cancer (T3–4 and/or any T, N+, M0) receiving neo-adjuvant RT±ChT followed by surgery [†]	50, all with available information	74.0% (61.8–86.2%)	Endoscopy pathology report Radiology report Surgery and oncology reports / discharge letters Surgical pathology report	Assessment of the quality of oncology treatment and radiotherapy
		(0 missing)						
QI12	Proportion of patients with colon cancer and AJCC TNM stage II (T3N0M0, T4N0M0) and at high risk (presence of at least one of: LN<12, G3, lymph vessel or perineural invasion, tumour obstruction, tumour perforation, pT4) or stage III, receiving adjuvant ChT	Number of patients with colon cancer and AJCC TNM stage II (T3N0M0, T4N0M0) high-risk (presence of at least one of: LN<12, G3, lymph vessel or perineural invasion, tumour obstruction, tumour perforation, pT4) or stage III, receiving adjuvant ChT	55	Number of patients with colon cancer and AJCC TNM stage II high-risk or stage III, undergoing surgery	122, of which 117 with available information	47% (38.0–56.1%)	Radiology report Surgical pathology report Surgery and oncology reports / discharge letter	Assessment of the quality of oncology treatment
		(5 missing: information not retrieved)						

AJCC= American Joint Committee on Cancer; ChT= chemotherapy; CI = confidence interval; LN = lymph node; G = grade; RT= radiotherapy (short or standard course) * The proportion is calculated on the basis of available/retrieved information (missing cases are excluded). † Surgery: intestinal resection with anastomosis within 6 months from the diagnosis; endoscopic resection and/or colostomy alone were excluded. ‡ emergency: within 24 hours from the onset of symptoms § R0: free margins, at least 1 mm tissue without cancer cells was available [21]

whereas the corresponding raw number was reported in [table 1](#) for information purpose only.

For QIs concerning CRC patients who were operated on, surgery was defined as intestinal resection with anastomosis within 6 months from the diagnosis; endoscopic resection and/or colostomy alone were not considered for the calculation of the specific QI concerning surgery.

For comparative goals, publications on QIs were identified and selected by means of a literature search in PubMed/MEDLINE, using initially general or specific keywords/expressions and a combination of them, such as the following: “population-based study”, “quality indicators”, “quality of care or quality of cancer care”, “colon cancer”, “rectal cancer”, “colorectal cancer”, “locally advanced rectal cancer”, “stage III”, “stage II high risk”, “stage II/III or stage II and -III”, “preoperative colonoscopy or endoscopy”, “quality of diagnostic assessment”, “pathology or pathological”, “surgery or surgical”, “neo-adjuvant or neoadjuvant or preoperative”, “adjuvant or postoperative”, “radiation oncology or radiotherapy”, “chemotherapy”, “chemoradiotherapy or radiochemotherapy”, “30-day mortality”, “emergency or elective”, “lymph node evaluation or examination”. We included all the peer-reviewed articles, but case reports, letters, abstracts or editorials.

The SAS system version V9.3 (SAS Institute Inc., Cary, North Carolina, USA) was used for analysis.

Results

Overall, 474 patients with CRC were identified at the Ticino Cancer Registry between 1 January 2011 and 31 December 2012 (324 and 150 with colon and rectal cancers, respectively). The male:female ratio was 1.14 and median age at diagnosis was 73 years (range 26–99 years). A total of 392 patients underwent a surgical intervention within 6 months from the diagnosis.

[Table 1](#) reports the results for the 12 selected QIs, including the following data: QI general definition; numerator description, in terms of criteria for patients inclusion and corresponding number; denominator description, in terms of criteria for patients eligibility and corresponding number; QI results, percentage (%) and 95%CI; list of the necessary medical documentation that have been collected and examined by the Cancer Registry staff to extract the needed and relevant information to build up the QI; QI rationale.

The number of cases for which we could not retrieve the needed information for the QI calculation (reported as “missing” in [table 1](#)) was very low (under 5%) for most

QIs. The only exception is QI1: for 46 patients (9.7%), we could not retrieve the CRC detection method in the archives of the Cancer Registry.

Quality indicators for diagnosis

QI1–3 refer to the clinical domain of diagnosis and are essential to assess the care taken of the patient and the comprehensiveness of the diagnostic and staging evaluation, as well as to plan further diagnostic procedures and treatments (table 1). Overall, 372 CRC were diagnosed on the basis of symptoms (86.9%; 95% CI 83.7–90.1%), whereas less than 9% of CRC were detected after an opportunistic screening examination, such as the faecal occult blood test or colonoscopy (QI1). According to the examined medical documentation, 90.2% (95% CI 87.2–93.1%) of CRC patients undergoing surgery were evaluated in a preoperative colonoscopy (QI2). For 113 patients with rectal cancers undergoing endoscopy (83.1%, 95% CI 76.8–87.4%), the distance *ab ano* was systematically described in the endoscopic/pathological reports (QI3).

Quality indicators for pathology

QI4–5 refer to the pathology clinical domain and assess the quality of the flow of clinical information and the comprehensiveness of surgical pathological examinations and reports, including the staging evaluation necessary for an appropriate planning of further treatments (table 1). For 85.1% (95% CI 74.9–95.3%) of patients with locally advanced rectal cancer undergoing neo-adjuvant radiotherapy ± chemotherapy and surgery, the request for pathological examination of the surgical specimen included the information about the neo-adjuvant radiotherapy ± chemotherapy (QI4). Of the 101 patients with rectal cancers (all stages) undergoing surgery, information about the radial margins was included in the pathological report for 77.2% cases (95% CI 69.1–85.4%) (QI5).

Quality indicators for treatment

The last seven QIs refer to the clinical domain of treatment and assess the care taken of the patient, the quality of both surgical procedures (QI6–9) and oncology/radiotherapy (QI10–12) (table 1). Less than 9% of CRC patients undergoing surgery were operated on as an emergency (within 24 hours from the onset of symptoms) (QI6), whereas 3.6% (95% CI 1.7–5.4%) died within 30 days from the date of surgery (QI7, post-operative mortality). For almost all surgical CRC patients, the surgical specimen had free margins (QI8: 97.2%, 95% CI 95.5–98.8%). For 86.6% (95% CI 82.9–90.3%) of the 329 CRC patients undergoing surgery but not neo-adjuvant therapy, more than 12 lymph nodes were resected (QI9). Among the 75 patients with locally advanced rectal cancer (T3–T4 or any T, N+ and M0) undergoing surgery, 66.7% (95% CI 56.0–77.1%) received neo-adjuvant radiotherapy ± chemotherapy (QI10). Thirty-seven of the 50 patients with locally advanced rectal cancer were operated on within 6 to 8 weeks after the end of the neo-adjuvant radiotherapy ± chemotherapy (QI11: 74%, 95% CI 61.8–86.2%). The proportion of surgical patients with colon cancer and AJCC TNM stage II (T3–T4, N0, M0) at high risk (presence of at least one of the following factors: <12 lymph nodes resected, grade 3, lymph vessel or perineural invasion, tumour obstruction, tumour perforation, pT4) or AJCC TNM stage III (any T, N+, M0),

who underwent adjuvant chemotherapy, was 47% (95% CI 38.0–56.1%) (QI12).

Discussion

The present population-based descriptive study showed by means of specific QIs that the process of CRC diagnosis and treatment in southern Switzerland reflects the various guidelines and has a good quality level in comparison with other countries. Specifically, the proportion of CRC patients benefiting from a preoperative colonoscopy was 92% (89% in France), the proportion of patients with locally advanced rectal cancer receiving preoperative radiotherapy ± chemotherapy was 67% (Germany 70%, US 57%), the proportion of CRC patients operated with an adequate number of resected lymph nodes was 86.6% (Spain 90%, US 72%) [22–25]. On the contrary, for other QIs there is still room for additional improvement, such as the proportion of CRC patients with the diagnosis based on opportunistic screening (8.6%), which was very low compared to other regions (Canada 16%, US 14%) [26, 27].

A strength of the present study is the procedure followed for QI definition and selection, which took into account the degree of relevance, validity, reliability and feasibility, and used the validated Delphi methodology including a literature review of the evidence and the integration of expert opinions from local clinicians and international experts, as described in depth previously [11]. An additional relevant strength of this study is the quality of data collection and data entry, which were performed by specifically trained data managers, followed by the in-the-field supervision of expert professional figures and medical doctors. The Ticino Cancer Registry staff had regular access to the oncological medical information from various public or private data sources, as above mentioned. All needed information was directly extracted from the original medical documentation, assuring homogeneous interpretation and coding of data in order to achieve the highest possible level of comparability and coherence. Moreover, data collection performed at the population-based level provided representative results, reducing the risk of a possible selection bias and representing the entire regional care system. This was confirmed by Lorez et al., who reported the highest level of CRC registration completeness in the Ticino Cancer Registry compared with the other Swiss regions (97.8% in Ticino vs 95.8% in the whole Switzerland) [28].

A major limit of the study concerns the comparisons with the available literature, particularly the possible differences in selection criteria, such as patients' age and comorbidities, disease stage distribution, different pathological protocols and surgical procedures, heterogeneous adhesion to specific/different national/international guidelines, as well as the lack of a standardised QI definition (i.e. numerator/denominator) in the literature. Furthermore, the literature research performed to select comparative studies according to the systematic process described above could have missed some relevant studies. Another limitation of the study could be the proportion of missing data for a few QIs. In spite of the high level of overall completeness of the CRC registration process reported by Lorez et al., reporting of some specific information could be improved. For QI1, measuring the percentage of patients undergoing opportunistic screening, we observed 9.7% missing data,

which has a questionable impact on the QI1 result for comparative purposes. Concerning the other QIs, the proportion of missing data ranged between 0 and 5.5%, which are considered as acceptable low proportions having no impact on the study results. Moreover, a small sample size was observed for two QIs (QI4 and QI11), consequently producing larger 95% CIs and probably affecting the statistical power of the specific analyses. This could be solved extending the observation period or the population at risk for future projects.

In the following paragraphs we comment on the results of each QI, comparing them, whenever feasible, with the available literature.

QI1 The primary prognostic factor for colorectal cancer is the stage at the time of the initial treatment. Diagnosis at an early stage and/or precancerous condition, the target of screening tests, could play an important role in curative treatment and outcome, particularly resulting in better survival. Despite the implementation of an opportunistic screening strategy for CRC in our country, the proportion of patients with CRC (no distinction was made between average- and high-risk patients) diagnosed through a screening test appear low (8.6%), and lower when compared with other population-based studies conducted in regions in which organised CRC screening programmes are implemented: Tuscany, Italy (11% for colon and 16% for rectum); Canada (16.5% for CRC); Florida, USA (14% for CRC) [26, 27, 29].

QI2 Preoperative endoscopic evaluation is recommended by different guidelines and has several advantages, particularly exact localisation of the lesion, the chance to perform a biopsy for determination of tumour characteristics, detection of synchronous precancerous or cancerous lesions and the removal of polyps, if any [30]. In the study period, 92% of patients underwent a preoperative colonoscopy, higher proportion than that reported in the south-east of France (89%) and in the Netherlands (72%) [22, 31]. Major factors that could influence the rate of preoperative colonoscopies are the number of CRC patients operated on as an emergency, for which colonoscopy is sometimes not performed, and the curative versus palliative intention of the scheduled surgical intervention.

QI3 The description of exact distance of rectal cancer *ab ano* in the endoscopy reports could be useful for planning additional diagnostic examinations (such as magnetic resonance imaging, which is mandatory for tumours in the lower rectum) or treatment that could be different for tumours in lower and higher rectum [32]. We could compare the value of 83.1% observed in southern Switzerland only with the result produced by Malin et al. in the US, where 77% of the evaluated medical documents described the exact distance *ab ano* of the detected cancers [1].

QI4 Communication among medical services could play an essential role in the quality of offered treatments. The information as to whether or not patients with locally advanced rectal cancer received neo-adjuvant radiotherapy before surgery is essential for the pathologist to provide a comprehensive examination and the histological tumour regression grade of such cancers. It is known that the regression grade is correlated to outcome, especially the local recurrence rate [33]. Although we did not find in the literature any data that could be compared with the observed

proportion of 86.8% in southern Switzerland, we believe that this value could be improved.

QI5 In rectal cancers, the circumferential or radial margins of surgical intervention should be systematically reported by pathologists, as it is an independent prognostic factor influencing local recurrence and survival rates [34]. It could be used to evaluate the quality of the pathological documentation: in the study period, 77.2% of reports included the exact information of radial margins, but we could not find any comparable population-based results in the literature.

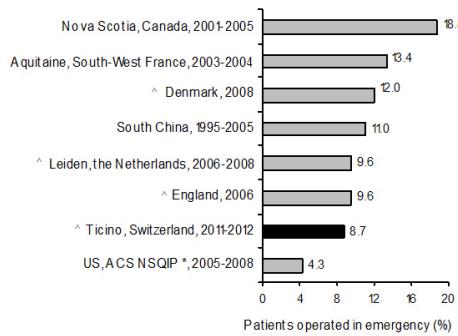
QI6 CRC emergency presentation as obstruction, perforation or intestinal bleeding is mostly due to the presence of advanced tumours and is associated with high mortality and morbidity following surgical treatment [35, 36]. **Figure 1** depicts some international comparisons: our result appears to be quite low, at 8.7%, although no CRC screening programme is implemented in southern Switzerland. We could expect a further improvement of this QI, if an organised screening programme were to be implemented [22, 35–42].

QI7 Postoperative mortality within 30 days after CRC surgery (emergency or elective surgical resection) is a well-known marker of the quality and safety of the whole healthcare service. As reported in **figure 2**, in southern Switzerland postoperative mortality is very low (3.6%), and comparable to that in the US and Canada and lower than in Denmark, the Netherlands and the UK [27, 37, 39–41, 43–47]. Since the type of surgery (emergency vs elective) could represent a significant factor affecting post-operative mortality, we stratified CRC patients accordingly. As expected, we found that patients operated on as an emergency surgery showed a significantly 10-fold higher 30-day postoperative mortality rate (20 vs 2%, $p < 0.001$).

QI8 Free margins (R0) in patients operated on for CRC represent a well-established prognostic factor and a QI of surgical procedures [21, 48, 49]. Although most of the patients included in our study had R0 surgery, we could not compare our results because of a lack of population-based data in the literature.

QI9 Maximising the number of lymph nodes resected by the surgeon and analysed by the pathologist enables reliable staging, which influences treatment decision making [50]. Different studies also suggested a better prognosis for

Figure 1: QI6. Proportion of patients with colorectal cancer undergoing emergency surgery: comparison between southern Switzerland and other countries.



* population-based study

* ACS NSQIP = American College of Surgeons National Surgical Quality Improvement Program

patients undergoing adequate resection of intestinal lymph nodes. Therefore, this QI combines the quality of both surgery and pathological evaluation [51]. According to the results reported in figure 3, the proportion of 86.6% observed in southern Switzerland was consistent with that observed in centres of excellence, but higher than that suggested in other population-based studies [22, 25–27, 29, 31, 52–56].

QI10 Preoperative radiotherapy ± chemotherapy is widely accepted as a standard procedure in the treatment of locally advanced rectal cancers, having an impact in terms of better local control and less toxicity, lower local recurrence rate and increased survival [57]. In a recent population-based analysis conducted in the south of Switzerland for the period 2002 to 2007, 61% of patients with locally advanced rectal cancer received neo-adjuvant treatments [58]. In the present study, for the same population, the percentage increased to 66.7%, representing one of the highest values reported in the available literature (fig. 4 [23, 24, 29, 59, 60]).

QI11 Several studies comparing short and longer delays to surgery for locally advanced rectal cancer after radiotherapy ± chemotherapy had some conflicting results in terms of local control and survival rates [57, 61, 62]. Since we could not distinguish between the two types of radiotherapy (short vs standard course), QI11 included all patients undergoing surgery within 6 to 8 weeks after the end

of such preoperative treatment. The lack of literature concerning the adherence to such recommendations in clinical practice made it impossible to compare our result (74%) at the population-based level.

QI12 The use of adjuvant chemotherapy in patients with colon cancer AJCC TNM Stage II high-risk or AJCC TNM Stage III could be restricted by patient characteristics such as old age, short life expectancy, underlying co-morbidities and performance status and patient's refusal, as well as negative predictive factors of the disease such as microsatellite instability [48, 63]. In our study population, 47% of patients with colon cancer undergoing surgery received adjuvant chemotherapy. This result could be compared only with a population-based study conducted in Canada, which reported a similar proportion (53.3%, fig. 5) [64]. When we considered only AJCC TNM stage III colon cancers, the percentage increased to 58.9%, similar to that observed by other researchers in France, the Netherlands, Canada and the US [65–68]. A further increase was observed when we excluded patients over 74 years old, which resulted in a proportion of 85.7%, higher than that observed in Italy, confirming the crucial role of age as restricting factor for treatment delivery [29].

The present QC₃ report promotes the culture of evaluation of QoCC by healthcare providers, the short-term assessment of the diagnostic-therapeutic process "without waiting" for survival results or as a "complement" to interpretation of survival results, the continuous collaboration between cancer registries and clinicians, and the expertise and active involvement of local and international health-

Figure 2: QI7. Proportion of patients with colorectal cancer who died within 30 days after surgery: comparison of postoperative mortality between southern Switzerland and other countries.

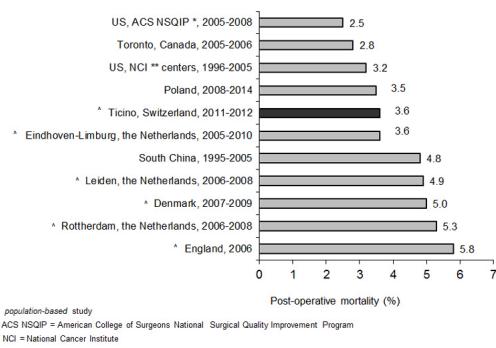


Figure 3: QI9. Proportion of patients with colorectal cancer who had ≥12 lymph nodes examined: comparison between southern Switzerland and other countries.

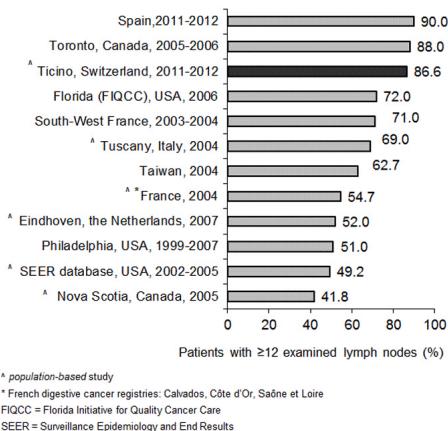


Figure 4: QI10. Proportion of patients with locally advanced rectal cancer (T3-T4 and/or any T, N+, M0) receiving neoadjuvant radiotherapy ± chemotherapy: comparison between southern Switzerland and other studies.

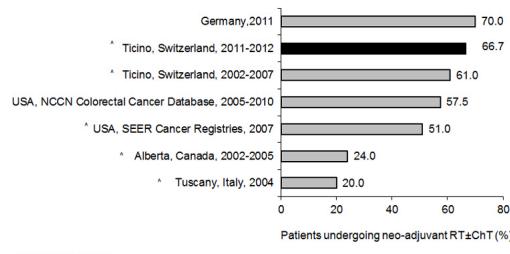
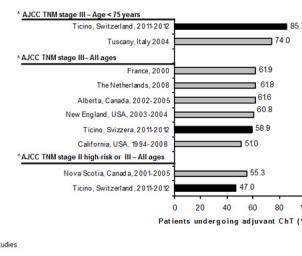


Figure 5: QI12. Proportion of patients with colon cancer and AJCC TNM stage II (T3-T4, N0, M0) high-risk or III (any T, N+, M0) receiving adjuvant chemotherapy: comparison between southern Switzerland and other studies.



care providers representing all major disciplines (epidemiologists/statisticians and clinical experts in pathology, radiology, surgery, radiotherapy, oncology). This can lead to increasing quality, acceptance and translation of results into daily clinical practice, and development of an evaluation system at the population-based level involving both public and private settings, ensuring a real description of a regional care system without selection bias.

Our study showed the feasibility of the assessment of QoCC using cancer registry population-based data. Although improvements are possible, CRC QI results in southern Switzerland are generally positive and encouraging, and sometimes favourable in comparison with other international studies. Few population cancer registries have published studies referring to QoCC in CRC, particularly in recent years. Collaboration with cancer registries could exploit the potential of population level data to assess the QoCC. Further national and international reports are urgently needed for comparative analysis, as well as the standardisation of QI definition and measurement that is absolutely necessary for inter-regional comparative goals.

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Competing interests

The authors have no conflict of interests.

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