

## Quality of Life in Patients Undergoing Emergency Surgery for Complex Colorectal Cancer: Protocol and Piloting of the Surgical Utilization and Recovery Patterns for Advanced Stage Colorectal Cancer Study

Cezar Ciubotaru<sup>1,2\*</sup>, Radu Cristian Poenaru<sup>2</sup>, Mircea Beuran<sup>1,2</sup>, Traian Pătrașcu<sup>1,3</sup>, Claudiu Ștefan Turculeț<sup>1,2</sup>, Gabriel Constantinescu<sup>1,2</sup>, Sorin Hostiuc<sup>2</sup>, Alin Moldoveanu<sup>4</sup>, Ionuț Negoii<sup>1,2\*</sup>

<sup>1</sup>Carol Davila University of Medicine and Pharmacy Bucharest, Romania

<sup>2</sup>Emergency Hospital of Bucharest, Bucharest, Romania

<sup>3</sup>Department of Surgery, Dr. I. Cantacuzino Clinical Hospital, Bucharest, Romania

<sup>4</sup>National University of Science and Technology Politehnica of Bucharest, Bucharest, Romania

\*Corresponding authors:

Ionuț Negoii, M.D. Ph.D.

Associate Professor of Surgery  
Carol Davila University of Medicine  
and Pharmacy Bucharest, Romania  
Consultant General Surgeon  
Emergency Hospital of Bucharest  
No 8 Floreasca Street, District 1  
014461, Bucharest, Romania  
E-mail: negoiiionut@gmail.com

Cezar Ciubotaru, M.D.

Ph.D. student, Carol Davila  
University of Medicine and Pharmacy  
Bucharest, Romania  
E-mail: caesar\_cnc@yahoo.com

### Rezumat

*Calitatea vieții pentru pacienții cu cancer colorectal complex operați în urgență: protocolul și studiul pilot pentru "Surgical Utilization and Recovery Patterns for Advanced Stage Colorectal Cancer Study"*

*Introducere:* La nivel global, cancerul reprezintă principala cauză de mortalitate, neoplazia colorectală (CCR) situându-se pe locul trei în ceea ce privește incidența și mortalitatea. Calitatea vieții (QoL) pacienților cu CCR este semnificativ influențată atât de boala nou diagnosticată cât și de morbiditatea tratamentului necesar. Scop: Acest studiu își propune să propună un protocol pentru măsurarea QoL, atât la momentul diagnosticului cât și pe termen lung, la pacienții cu CCR complicat.

*Material și Metodă:* studiu de cohortă observațional prospectiv multicentric.

*Rezultate:* QoL este un concept multidimensional, care include criterii pentru funcționalitatea fizică, mentală, emoțională și socială, așa cum este percepută de pacient. Evaluarea periodică a QoL oferă instrumente măsurabile și obiective pentru a interveni la momentul potrivit, diminuând astfel anii de viață pierduți și anii trăiți cu dizabilitate pentru pacienții cu CRC. Cu toate acestea, un sistem structurat și funcțional necesită eforturi instituționale dedicate și comune. Un studiu pilot folosind protocolul de studiu propus a inclus 69 de pacienți, cu vârsta de  $65,12 \pm 10,92$ , raport B:F = 56,5:43,5%. Procedura chirurgicală a fost hemicolecomie

Received: 20.03.2024

Accepted: 25.04.2024

dreaptă, colectomie stângă, colectomie transversală, sigmoidectomie, colectomie totală, rezecție rectală și rezecție colorectală cu stomă (ileostomie sau colostomie) în 21,7%, 11,6%, 2,9%, 11,6%, 1,4%, 23,2% și 27,5% din cazuri, respectiv. Valoarea medie a Global Health Status Score, Symptom Score și Functional Score a fost de 82,36±18,60, 11,89±10,27 și respectiv 86,27, 74,50-94,11.

*Concluzii:* CCR are impact major asupra stării fizice și psihologice a pacienților. Eforturi concentrate trebuie făcute, atât de către echipa medicală multidisciplinară implicată, cât și de către sistemele de sănătate, pentru a îmbunătăți QoL pacienților pe tot parcursul tratamentului.

**Cuvinte cheie:** calitatea vieții, cancer colorectal, rezecție chirurgicală, boală complexă

## Abstract

*Introduction:* Globally, cancer is the leading cause of mortality, with colorectal neoplasia ranking third in terms of incidence and mortality worldwide. Patients face disease- and treatment-specific impacts, which can significantly influence their quality of life (QoL). Aim: This study aimed to propose a protocol to measure in-hospital and long-term QoL in patients with complicated colorectal cancer (CRC).

*Material and Methods:* multicenter prospective observational cohort study.

*Results:* QoL is a multidimensional concept that includes criteria for physical, mental, emotional, and social functionality as perceived by the patient. Periodically evaluating QoL offers measurable and objective tools to intervene at the appropriate time to decrease the Years of Life Lost and Years Lived with Disabilities for CRC patients. However, a structured and functional system requires dedicated and common institutional effort. A pilot study using this protocol included 69 patients, 65.12±10.92 years, M:F ratio = 56.5:43.5%. Surgical procedure was right hemicolectomy, left colectomy, transverse colectomy, sigmoidectomy, total colectomy, rectal resection, and colorectal resection with stoma (ileostomy or colostomy) in 21.7%, 11.6%, 2.9%, 11.6%, 1.4%, 23.2%, and 27.5% of the cases, respectively. The mean Global Health Status Score, Symptom Score, and Functional Score was 82.36±18.60, 11.89±10.27, and 86.27, 74.50-94.11, respectively.

*Conclusions:* CRC diagnosis has major effects on patients' physical and psychological status, and concentrated efforts should be made by the involved medical team and healthcare systems to improve QoL throughout the treatment pathway.

**Key words:** quality of life, colorectal cancer, surgical resection, complex disease

## Introduction

Globally, cancer is the leading cause of mortality, and colorectal neoplasia ranks third in terms of incidence and mortality worldwide as well as in Europe (1,2). Improvements in early detection methods and treatments have resulted in a significant increase in survival in most developed countries (3). Despite this increase in survival, long-term physical and psychological effects should not be overlooked

(4). Survivors of this type of cancer face a specific treatment impact, such as the presence of a stoma or changes in bowel, sexual, or other functional habits, which can significantly influence their quality of life (5).

Quality of life (QoL) is widely discussed in the medical literature, but it is difficult to measure and understand objectively in daily clinical practice (6). The World Health Organization defines QoL as the patient's own feelings and perceptions, according to hers or

his “culture and value systems in which he lives and in relation to his goals expectations, standards and concerns” (7).

Regardless of the presence or absence of a stoma, these patients present with adverse effects in terms of social activity, functionality, work, family relationships, or with friends through the presence of intestinal transit disorders, flatulence, chronic fatigue, diet, and sexual disorders (8).

QoL in relation to the state of health has become a quantifiable criterion along with survival and disease-free periods (9). QoL is a multidimensional concept that includes criteria for physical, mental, emotional, and social functionality as perceived by the patient (10). Understanding these aspects and how they are influenced by the disease and treatment helps in the development of personalized complex therapeutic strategies adapted to each patient, depending on their needs (11).

Quality of life is influenced by colorectal cancer and correlates with tumor stage, age, location, presence or absence of metastatic disease, sex, and socioeconomic status (12-16). In addition, colorectal cancer monitoring is usually performed at six-month intervals over a period of five years, according to national or international guidelines, and consists of monitoring the combination of tumor markers, endoscopy, and imaging studies, which can create a state of anxiety or financial difficulties (17). On the other hand, it has been shown that lifestyle measures for the oncological patient under treatment are correlated with their QoL (18,19,20,21).

The aim of this study is to measure in-hospital and long-term QoL in patients with complicated CRC, and to compare with that of non-complicated patients.

## Material and Method

### Study Design

The SURPASS study is planned to be a multi-center prospective observational cohort study. (Link for enrolling centers <https://forms.gle/onhg7SFQnm44si4y5>)

### Study Objectives

The primary objective of the current study is to measure the QoL in patients with complicated CRC, during in-hospital stay and in the long term.

The secondary objectives are: a) to compare they QoL with that of non-complicate patients treated in the corresponding centers; b) to find prognostic factors for an impaired QoL, related to the surgical approach; c) to find, through geostatistical analysis, clinical pathways associated with low QoL.

### Study Period and Data Collection

Patients admitted between 1<sup>st</sup> of June 2024 to 1<sup>st</sup> of April 2025 will be included. They follow-up will be at each six month, up to five years.

### Patients

Patients admitted to each center with colorectal cancer that required surgery. The EORTC QLQ-C30 (<https://qol.eortc.org/questionnaire/eortc-qlq-c30/>) (22) and QLQ-CR29 (<https://qol.eortc.org/questionnaire/qlq-cr29/>) (23) will be administered at 0, 3, 6, and 12 months.

According to the European Organization for Research and Treatment of Cancer (EORTC) methodology and manuals (<https://qol.eortc.org/manuals/>) (24) QLQ – C30 is a questionnaire that has five functional scales, three symptom scales, a global health status/QoL scale and six single items. It is calculated based on a formula adapted for each scale (functional, symptom and global health), with a score obtained for each. The higher the functional and global scores, the better the quality of life and the level of functioning. High symptom score means a high level of symptomatology or health problems.

QLQ – CR29 is complementary to QLQ – C30, and specific for those with colorectal cancer. The two forms are used together. CR29 incorporates four item scales and 19 single-term items, assessing a range of problems and symptoms common among these patients.

QLQ – C30 form has questions from 1 to 30 and QLQ – CR29, continues with 31 to 59. In all cases, the principle for scoring these scales is the same. First, we calculate the raw score by estimating the average of the items that contribute to the specific scale. Second, we use a linear transformation to standardize the raw score. In this way, the scores range from 0 to 100.

$$\text{Raw score} = \text{RS} = (I_1 + I_2 + \dots + I_n)/n$$

The linear transformation should be applied to 0-100 to obtain the score S.

$$\text{Functional scales: } S = \left\{ 1 - \frac{(RS-1)}{\text{range}} \right\} \times 100$$

$$\text{Symptom scales/ items: } S = \left\{ \frac{(RS-1)}{\text{range}} \right\} \times 100$$

Global health status / QoL.

$$S = \left\{ \frac{(RS-1)}{\text{range}} \right\} \times 100$$

Range is the difference between the maximum and minimum possible value of Raw Score. In QLQ – C30, all the items in any scale take the same range of value, except for the items contributing to the global health status or QoL, which has a range of 6 (22–24).

The questionnaires will be completed by the patients during their hospitalization (*Appendix 1* and *2*). The follow-up and application of the questionnaires at 3, 6, and 12 months will be completed via telephone.

The inclusion criteria were as follows: (1) age > 18 years; (2) colorectal cancer; and (3) emergency, postponed emergency, or elective surgical procedure.

Exclusion criteria: (1) age < 18 years; (2) patient's refusal to be included in the study; and (3) the patient's inability to complete the questionnaire.

The complicated colon cancer is defined as that with an acute complication (obstruction, hemorrhage, perforation), and / or locally advanced, and / or metastatic.

Informed consent will be obtained from each patient. In addition, a patient' withdrawal at any time from the study without needing

explanations or motivation for their decision, and the collected information will not be included in the statistical analysis. The time to complete the questionnaires will be on admission, and before the discharge, then, at every three months (25).

Each patient will be assigned a unique code so that personal data can only be accessed by the practicing physician who performs the recruitment (26). In addition to the 2 questionnaires, data will be collected regarding the type of complication presented to the hospital, age, sex, BMI on admission, at 3, 6 and 12 months, date of admission, date of surgery, date of discharge, smoking status, number of packs/year, alcohol consumption status, clinical TNM stage, ASA score, associated comorbidities, tumor location, type of surgery, surgical approach (laparoscopic, open, converted laparoscopy), admission of the patient to ICU, period of the patient's stay in ICU, postoperative complications according to Clavien-Dindo classification, the need for reintervention, the type of operation performed at the time of reintervention, the reason for reintervention, concordance with the ERAS guidelines (27), histopathological TNM stage, date of initiation of chemotherapy, date of initiation of radiotherapy, type of chemotherapy, type of radiotherapy, the period of chemotherapy treatment, the total dose of radiotherapy, the time of application of the questionnaires compared to the time of chemotherapy/radiotherapy (before/during the treatment/ how many months after completion of the treatment). For rectal neoplasia, neoadjuvant treatment, chemotherapy/radiotherapy, stoma formation before neoadjuvant treatment, and operative time after neoadjuvant treatment have been reported (28–31).

Follow-up will be carried out at 3, 6, and 12 months by applying the two questionnaires by telephone. Each patient will be given a QoL profile according to the scores obtained on the basis of the two questionnaires by dividing them into groups: the somatic score that will contain the following subgroups: physical, contributory functions, pain, intestinal transit disorders, urinary tract disorders, self-

perception of the body; psychological with subgroups: emotional, memory, and concentration; fatigue; social: family life, socialization, and financial status; and sexually (32-34).

Depending on the impairments of the QoL scores, will be given recommendations to improve the deficient scores. For patients with the treatment plan changes/recommendations based on QoL impairments, data will be collected regarding the type of recommendation made for each score, compliance with the recommendation, and the time when the recommendation was made (35). These will be made mainly according to the guidelines developed by The World Cancer Research Fund/American Institute for Cancer Research and various other international guidelines (20). The status of tobacco consumption (smoking, number of packs/year, period of abstinence) (36) and alcohol consumption (how many times per month/week/day, how many units of alcohol) will also be analyzed (37), and recommendations will be made accordingly. Physical activity status will be assessed in minutes per week at moderate sustained intensity (38-40). The diet followed by the patients, will be analyzed, with scores specifically developed (e.g. the Association of Official Analytical Collaboration, the Department of Health in Great Britain, etc.) (20,41,42-44). The evolution of BMI during the follow-up period of the patients will be analyzed, as obesity is known to be a risk factor for 13 types of cancer (45). The increasing prevalence of this type of comorbidity in developed or developing countries can have a significant impact on survival and quality of life, respectively (46-48).

### *Data Collection*

The principal investigator (PI) of each center has the responsibility to obtain the Ethical approval from the local committee. This study was approved by the Ethics Committee of the Clinical Emergency Hospital of Bucharest.

Data will be de-identified by investigators in the participating hospitals. The PI of each site has the entire responsibility to take all the

required measures concordant with the current NIS and General Data Protection Regulations (GDPR) legislation for de-identification of the transmitted data and for ensuring the data remains confidential. Each patient will receive a unique code associated with de-identified data, only the unique code will be transferred to the central team for analysis. All the de-identified data will be stored in a double protected database.

The patients' contact forms (*Appendix D*) will be stored in a double protected database on an external drive dedicated to that, connected periodically to a dedicated computer, different from the one with de-identified data, and will not be transferred from each investigating center.

### **Statistical Analysis**

The study will be compliant with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement (49). Data will be analyzed using Microsoft Excel, and statistical analysis will be performed using IBM SPSS statistics version 29, JAMOVI and JASP software. The data will be reported as mean  $\pm$  standard deviation, and median and IQR (25% – 75%). The data will be verified for homogeneity using Kolmogorov-Smirnov test. We will perform both frequentist and Bayesian analysis. We will use Independent Samples or Paired-Samples T-Test, ANOVA tests, Mann-Whitney U test, Chi-squared tests as appropriate. Multi-variable analysis will be conducted and will develop a three- and four-layer artificial neural network models. An alpha level of 0.05 will be used.

### *Pilot Study*

The above methodology of the study was tested in a pilot feasibility study of complicated CRC patients from the Emergency Hospital of Bucharest, managed during a time frame of one year, identified retrospectively and phone called for the questionnaire.

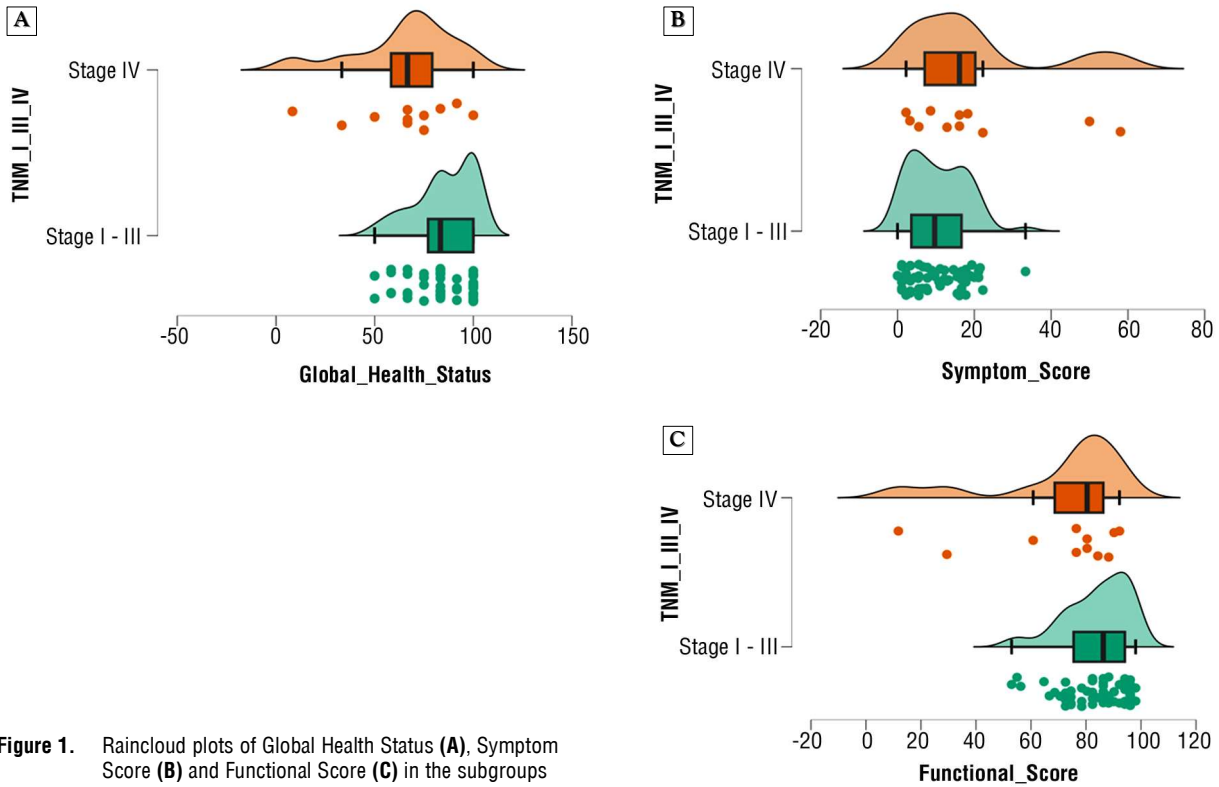
## Results

We selected 69 patients with complicated colon cancer, who filled the one-year questionnaire, with a mean age of  $65.12 \pm 10.92$  years, M:F ratio = 56.5:43.5% (Table 1). The surgical approach was open, and laparoscopic, in 88.4%, and 11.6% of cases, respectively. The surgical procedure was right hemicolectomy, left colectomy, transverse colectomy, sigmoidectomy, total colectomy, rectal resection, and colorectal resection with stoma (ileostomy or colostomy) in 21.7%, 11.6%, 2.9%, 11.6%,

1.4%, 23.2%, and 27.5% of cases respectively. The TNM stage was stage I (4.3%), stage II (18.8%), stage III (60.9%), and stage IV (15.9%) (Fig. 1). The main complication for which patients were admitted was hemorrhage (43.5%), intestinal obstruction (37.7%), generalized peritonitis in 5.8%, and localized peritonitis in 11.6%. Perforation was present in 1.4% of the cases; 87% of the patients had cardiac, pulmonary, or diabetes comorbidities. Grade I-V Clavien-Dindo postoperative complications were present in 40.6% of cases. The reintervention rate was 4.3%. The mean

**Table 1.** Patients characteristics.

		Count	Column N %	95.0% Lower Confidence Level (CL) for Column N %	95.0% Upper CL for Column N %	Standard Error of Column N %
Sex	Male	39	56.5%	44.8%	67.8%	6.0%
	Female	30	43.5%	32.2%	55.2%	6.0%
Pre-existing comorbidities	Yes	60	87.0%	77.5%	93.3%	4.1%
	No	9	13.0%	6.7%	22.5%	4.1%
TNM stage	Stage I	3	4.3%	1.2%	11.1%	2.5%
	Stage II	13	18.8%	11.0%	29.2%	4.7%
	Stage III	42	60.9%	49.1%	71.7%	5.9%
	Stage IV	11	15.9%	8.8%	25.9%	4.4%
Complication of CRC	Perforation	13	18.8%	11.0%	29.2%	4.7%
	Bleeding	30	43.5%	32.2%	55.2%	6.0%
	Obstruction	26	37.7%	26.9%	49.4%	5.8%
Complication of CRC	Perforation	1	1.4%	0.2%	6.6%	1.4%
	Hemorrhage	30	43.5%	32.2%	55.2%	6.0%
	Localized peritonitis	8	11.6%	5.6%	20.7%	3.9%
	Generalized peritonitis	4	5.8%	2.0%	13.2%	2.8%
	Intestinal obstruction	26	37.7%	26.9%	49.4%	5.8%
Surgical approach	Open	61	88.4%	79.3%	94.4%	3.9%
	Laparoscopy	8	11.6%	4.3%	26.0%	5.4%
Surgical procedure	Right colectomy	15	21.7%	13.3%	32.5%	5.0%
	Transverse colectomy	2	2.9%	0.6%	9.0%	2.0%
	Left colectomy	8	11.6%	5.6%	20.7%	3.9%
	Sigmoidectomy	8	11.6%	5.6%	20.7%	3.9%
	Total colectomy	1	1.4%	0.2%	6.6%	1.4%
	Others	16	23.2%	14.5%	34.1%	5.1%
	Colectomy + stoma (ileum or colon)	19	27.5%	18.1%	38.8%	5.4%
Multivisceral resection	Yes	14	20.3%	12.1%	30.9%	4.8%
	No	55	79.7%	69.1%	87.9%	4.8%
Postoperative Presence of Complications	No complications	41	59.4%	47.6%	70.4%	5.9%
	Complications	28	40.6%	29.6%	52.4%	5.9%
Postoperative complications	No	41	59.4%	47.6%	70.4%	5.9%
	Hemorrhage	2	2.9%	0.6%	9.0%	2.0%
	Anastomotic leakage	3	4.3%	1.2%	11.1%	2.5%
	Peritonitis	1	1.4%	0.2%	6.6%	1.4%
	Wound dehiscence	2	2.9%	0.6%	9.0%	2.0%
	Superficial SSIs	15	21.7%	13.3%	32.5%	5.0%
	Infection	5	7.2%	2.8%	15.2%	3.1%
Systemic complications	No	66	95.7%	88.9%	98.8%	2.5%
	Pulmonary embolism	1	1.4%	0.2%	6.6%	1.4%
	Myocardial infarction	0	0.0%	.	.	.
	Pneumonia	2	2.9%	0.6%	9.0%	2.0%
	Deep vein thrombosis	0	0.0%	.	.	.
Surgical reinterventions	Yes	3	4.3%	1.2%	11.1%	2.5%
	No	66	95.7%	88.9%	98.8%	2.5%



**Figure 1.** Raincloud plots of Global Health Status (A), Symptom Score (B) and Functional Score (C) in the subgroups of patients with TNM stage I-III versus IV.

Global Health Status Score, Symptom Score, and Functional Score was  $82.36 \pm 18.60$ ,  $11.89 \pm 10.27$ , and  $86.27$ ,  $74.50-94.11$ , respectively (Table 2).

**Discussions**

The incidence and disease burden of CRC is

increasing in younger individuals, with a significant influence on their QoL and expected society impact (50,51). The psychosocial and emotional impacts are disproportionate between the two age categories of patients (52), with younger patients having a lower QoL, although being in better physical condition (Table 3). The chemotherapy/ radiotherapy,

**Table 2.** Correlation of the QoL scores with patients' characteristics.

	<b>Global Health Status Score</b>	<b>Symptom Score</b>	<b>Functional Score</b>	<b>Statistical Significance / Test used</b>
	Mean± Std. Dev $82.36 \pm 18.60$ Median, 27%-75% IRQ $83.33, 70.83 - 100.00$	Mean± Std. Dev $11.89 \pm 10.27$ Median, 27%-75% IRQ $10.75, 3.88-16.67$	Mean± Std. Dev $81.91 \pm 15.44$ Median, 27%-75% IRQ $86.27, 74.50-94.11$	$P < 0.001, P = 0.004,$ $P < 0.001 /$ One-Sample Kolmogorov-Smirnov Test The three scores are not normally distributed. We used non-parametric tests or bootstrapping.
Age (years)		$65.12 \pm 10.92$		$P = 0.063; P = 0.376; P = 0.733 /$ Pearson Correlation Age & Score
Sex (M/F)	$83.76 \pm 19.86$ vs. $80.55 \pm 16.99$ $P = 0.283$	$9.92 \pm 10.25$ vs. $14.44 \pm 9.89$ $P = 0.012$	$84.81 \pm 15.01$ vs. $78.14 \pm 15.42$ $P 0.027$	Mann-Whitney U test
Complications of the colorectal cancer (Perforation/Bleeding /Obstruction)	$83.33 \pm 20.69$ vs. $82.50 \pm 14.73$ vs. $81.73 \pm 21.98$ $P = 0.825$	$9.95 \pm 12.94$ vs. $12.26 \pm 8.07$ vs. $12.42 \pm 11.34$ $P = 0.211$	$85.36 \pm 12.51$ vs. $81.63 \pm 14.49$ vs. $80.51 \pm 17.93$ $P = 0.565$	Kruskal-Wallis H test

**Table 2.** Cont'd

	Global Health Status Score	Symptom Score	Functional Score	Statistical Significance / Test used
TNM stage (I/II / III / IV)	80.55±20.97 vs. 86.53±13.83 vs. 85.71±15.20 vs. 65.15±26.30 P = 0.047	14.40±9.74 vs. 10.12±7.80 vs. 10.29±7.16 vs. 19.39±18.35 P = 0.389	81.69±14.71 vs. 82.15±14.59 vs. 84.96±10.39 vs. 70.05±26.19 P = 0.269	Kruskal-Wallis H test Independent samples T-Test
Stage I-III versus IV	85.63±14.95 vs. 65.15±26.30 P < 0.001	10.46±7.34 vs. 19.39±18.35 P = 0.007	84.16±11.48 vs. 70.05±26.19 P = 0.005	
Surgical approach (Open / Laparoscopic)	81.42±18.84 vs. 89.58±15.90 P = 0.246	12.26±10.51 vs. 9.00±8.18 P = 0.402	80.96±15.81 vs. 89.21±10.21 P = 0.157	Independent samples T-Test
Surgical procedure (colectomy right / transverse / left / sigmoidectomy / total / others / colectomy with stoma – ileum or colon)	76.66±19.97 vs. 91.66±11.78 vs. 79.16±19.92 vs. 86.45±12.54 vs. 100.00±0.00 vs. 87.50±12.90 vs. 80.26±23.27 P = 0.573	14.00±11.81 vs. 12.77±13.35 vs. 11.37±7.45 vs. 8.73±7.98 vs. 17.77±0.00 vs. 10.33±8.75 vs. 12.67±12.53 P = 0.907	80.00±12.98 vs. 81.37±12.47 vs. 81.05±12.99 86.02±7.51 vs. 82.35±0.00 vs. 84.55±12.10 vs. 79.87± 23.02 P = 0.956	One-way ANOVA
Multivisceral resection (Yes / No)	76.78±20.45 vs. 83.78±18.03 P = 0.211	15.45±13.18 vs. 10.98±9.32 P = 0.074	77.59±18.94 vs. 83.01±14.42 P=0.243	Independent samples T-Test
Postoperative complication (Yes / No)	86.30±15.91 vs. 79.67±19.98 P = 0.14	10.13±6.95 vs. 13.08±11.96 P = 0.59	83.75±13.65 vs. 80.66±16.60 P = 0.49	Mann-Whitney U test

**Table 3.** Review of the literature of studies investigating quality of life in patients with colorectal cancer.

Author	Title	Nr. pts.	Year	Type of QoL questionnaire	Type of study	Surgical approach	Results	Statistical significance
M. Perrone et. al (4)	A prospective study evaluating health-related quality of life following a multimodal treatment for colorectal cancer	55	2023	EORTC QLQ – C30, QLQ – C38	Prospective, observational	NS	QoL worsened after diagnosis, and returned to baseline values after 5 years	NS
L. Wang et. al (5)	Quality of life among colorectal cancer survivors participating in a pilot randomized controlled trial of a web-based dietary intervention with text messages	50	2023	EORTC QLQ – C30, QLQ – CR29	Prospective, interventional	NS	The results of this study highlight the benefits of dietary intervention in patients with CRC in terms of QoL	At 24 weeks, the intervention group presented significant improvements in social functioning (between-group mean difference: 13.8; 95% CI: 2.1, 25.5) and in terms of fatigue (mean difference: -9.1, 95%CI: -17.1, -1.1)
F. Kennedy et. al (35)	Fatigue, quality of life and associations with adherence to the World Cancer Research Fund guidelines for health behaviors in 5835 adults living with and beyond breast, prostate and colorectal cancer in England: A cross-sectional study	5835	2023	FACIT Fatigue scale, version 4 EuroQoL – 5 Dimension (Eq-5D-5L) QoL FACT-G measure	Cross-sectional survey	NS	The results of this cross-sectional survey from Great Britain highlight de importance of dietary and physical behaviors in neoplastic patients, and the need to develop multimodal care for a good life after cancer diagnosis and treatment	Patients who followed the recommendations regarding physical activity, consumption of fruits, vegetables, sugar, fats and red meat, had reduced odds of severe fatigue of 12-35%, and smoking cessation decreased by up to 47%. The QoL of those who followed the recommendations regarding physical activity, fat consumption and smoking, they had lower odds of one or more QoL problems by 29, 18 and 33%.



**Table 3.** Cont'd

Author	Title	Nr. pts.	Year	Type of QoL questionnaire	Type of study	Surgical approach	Results	Statistical significance
C. Georges et. al (64)	Comparison of quality of life, symptom and functional outcomes following surgical treatment for colorectal neoplasia	242	2023	International Consortium of Health Outcome Measures CRC PROMs	Retrospective study	NS	The best post-operative function, with reduced symptoms was significantly better in patients with right hemicolectomy, compared with those with ultra-low anterior resection	$p < 0.01$
C-M. Hung et. al (65)	Medium-term surgical outcomes and health-related quality of life after laparoscopic vs open colorectal cancer resection: SF-36 health survey questionnaire	567	2023	Modified version of the 36 -item Short Form (SF - 36)	Prospective	307 pts – Laparoscopic resection (LR) group 260 pts – Open resection (OR) group	LR group – mildly better in general health, moderately better in physical activity and significantly better in social function compared with OR group at 3-month PO No clinical difference at 12-month PO	$P = 0,045$ – general health $P = 0,006$ – physical activity $P = 0,0001$ – social function
Melissa. N. N. Arron et. al (66)	The association between anastomotic leakage and health-related quality of life after colorectal cancer surgery	1197	2023	EORTC QLQ – C30	Prospective	893 pts – LR group 263 pts – OR group	At the time of diagnosis, there were no significant differences in Sum Score (SumSc) in patients who developed anastomotic fistula, compared to those without fistula, but at 6 months those with anastomotic fistula had a significantly lower SumSc, but without clinical relevance, as in 2 years postoperatively the differences were insignificant	SumSc at diagnosis – AL vs. NonAL = $-2.81$ (95% CI = $-2.81$ ) SumSc at 6 months post-diagnosis – AL vs. NonAL = $-6.8, 1.18$ (95% CI = $3.46$ ) SumSc at 2 years post-diagnosis – AL vs. NonAL = $-0.8, 7.73$
M. Tarkowska et. al (32)	Prospective Evaluation of the Quality of Life of Patients after Surgical Treatment of Rectal Cancer: A 12-Month Cohort Observation	82	2022	EORTC QLQ – C30, QLQ – CR29	Prospective, three-stage, cohort, observational study	21 pts - LR 61 pts - OR	One year postoperatively, the QoL from the point of view of role functioning was better in the laparoscopic group. Regarding the presence of a stoma, one year postoperatively, a significant improvement in the social score was found, compared to the preoperative evaluation	$P = 0,043$ – role functioning
A. Diamantis et. al (12)	Quality of life deterioration and colorectal cancer staging in elderly patients. Which comes first?	80	2021	Age-adjusted Charlson (AAC) Comorbidity Score Edmonton Frail Scale (EFS) EORTC QLQ – C30	Prospective study	31 pts - LR 49 pts - OR	Statistically significant difference regarding the QoL and the TNM stage of the cancer at the time of diagnosis. After post-hoc analysis, significant difference between stage I and II, as well as between stage I and III, but insignificant between stage II and III.	$P = 0,002$ $P = 0,043$ (between stage I and II) $P = 0,01$ (between stage I and III) $P = 0,319$ (between stage II and III)
K. A. Miller et. al (56)	Time from Diagnosis and Correlates of Health-Related Quality of Life among Young Adult Colorectal Cancer Survivors	196	2021	Functional Assessment of Cancer Therapy-Colorectal (FACT-C) The Comprehensive Score for Financial Toxicity – Functional Assessment of Chronic Illness Therapy (COST-FACIT)	Cross-sectional study - online survey	NS	In this study, adolescents and young adults CRC survivors had overall a lower HRQoL score, both in terms of global and specific scores, regardless of the time elapsed since the time of diagnosis	$P = 0,38$
W. Siemens et. al (29)	Severe symptoms and very low quality-of-life among outpatients newly diagnosed with advanced cancer: data from a multicenter cohort study	481	2020	Palliative Outcome Scale (POS) Hospital Anxiety and Depression Scale (HADS) EORTC QLQ – C30	Cross-sectional study	NS	Approximately 2/3 of adults with advanced incurable cancer, newly diagnosed (preceding 8 weeks), reported at least one symptom of intense severity or a very low QoL in at least one domain.	Median number of severe intensity symptoms/very low QoL = 2.0 (IQR 0.0 to 4.0, range 0.0 to 16.0).
A. M. Couwenberg et. al (28)	The impact of postoperative complications on health-related quality of life in older patients with rectal cancer: a prospective cohort study	230 (<70 years) 115 ( $\geq 70$ years)	2018	EORTC QLQ – C30	Observational study	39/15 pts – OR 157/80 pts – LR 12/8 pts - Conversion	85.2% of patients over 70 years old and 93% of those under 70 years old completed the QoL questionnaires. Between the 2 analyzed groups, the baseline functioning score were similar, but the older patients had lower physical scores	MD – 9.6, $p < 0.001$ MD – 7.0, $p = 0.02$

**Table 3.** Cont'd

Author	Title	Nr. pts.	Year	Type of QoL questionnaire	Type of study	Surgical approach	Results	Statistical significance
J.H. Marks et. al (14)	Quality of Life and Functional Outcome After Transanal Abdominal Transanal Proctectomy for Low Rectal Cancer	90	2017	Fecal Incontinence Quality of Life Scale (FIQLS) EORTC QLQ – C30 EORTC QLQ – CR38 Metric regarding QoL and attitude toward colostomy (developed by the authors)	Cross-sectional study	Transanal abdominal transanal protosigmoidectomy – TATA 36 pts – OR 54 pts - LR	79% of the patients judged their QoL, after the operation, as good to excellent, compared to 88% before the operation. Regarding the preference of a colostomy vs the current operation (TATA), 98.7% answered little to none	$p = 0.11$
M. Akhondi-Meybodi et. al (13)	Quality of life in patients with colorectal cancer in Iran	120	2016	EORTC QLQ – C30	Descriptive analytic study	NS	No statistically significant difference was observed regarding average QoL score and gender	77.37 ± 8.7 in women 76.64 ± 8.7 in men
A. Downing et. al (55)	Health-related quality of life after colorectal cancer in England: a patient-reported outcomes study of individuals 12 to 36 months after diagnosis	21802	2015	EuroQoL-5D Functional Assessment of Cancer Therapy and Social Difficulties Inventory Items	Population level study	NS	34.5% of the respondents did not report any problem in any domain of the EQ-5D. 70.9% of patients with rectal cancer reported problems, compared to 63.8% and 63% of patients with rectosigmoid and colonic cancer.	$P < 0.001$
R.G. Orsini et. al (15)	Quality of life of older rectal cancer patients is not impaired by a permanent stoma	143	2013	Validated Dutch version of the Short Form – 36 (SF-36) questionnaire EORTC QLQ – CR38 Self-administered Comorbidity Questionnaire (SCQ)	Part of a long-term cancer survivorship study	Abdominal perineal resection = 56 pts Low anterior resection = 87 pts	After adjustment, no differences were found regarding the SF-36 subscales between patients with a stoma and those without a stoma. Older patients had a lower physical functioning score regardless of the presence or absence of a stoma.	54.2 ± 27.5 and 63.2 ± 27.3 vs. 76.2 ± 22.6 and 78.2 ± 21.5 $P = 0.0003$
D.N Son et. al (16)	Relationship between diversion colitis and quality of life in rectal cancer	30	2013		Prospective study	NS	An increased incidence of DC after performing an ileostomy compared with the data reported from western countries. A negative influence on QoL, including after closing the stoma, mainly due to diarrhea.	From 6% up 48% is the variability of DC symptom rates.
S. K. Chambers et. al (63)	A five-year prospective study of quality of life after colorectal cancer	763	2012	FACT-C BSI-18	Prospective survey	NS	Significant association between the increased baseline values of health-related and global QoL and the long-term values of these variables	$p < 0.001$
R.N. Whistance et. al (25)	Clinical and psychometric validation of the EORTC QLQ-CR29 questionnaire module to assess health-related quality of life in patients with colorectal cancer	351	2009	EORTC QLQ – C30 EORTC QLQ – CR29	Prospective international study	170 pts – OR 57 pts – LR 81 pts – unknown 43 pts – no surgery	EORTC QLQ – CR29 is a reliable and valid questionnaire that can be applied with EORTC QLQ – C30 in QoL analysis in patients with colorectal cancer	Because all the correlations between the QLQ-CR29 and QLQ – C30 were with $r < 0.40$ , it was demonstrated that the new module did not overlap unduly with the previous one.
V. Arndt et. al (62)	Restrictions in quality of life in colorectal cancer patients over three years after diagnosis: a population-based study	309	2006	EORTC QLQ – C30 EORTC QLQ – CR38	Population-based statewide cohort study	NS	Among the patients included in the study, 68 died between the first and the third year from the time of diagnosis. They reported a poorer QoL compared to the 241 patients who survived the follow-up	Mean score = 57.6 vs. 64.3 $p = 0.04$
V. Arndt et. al (34)	Quality of life in patients with colorectal cancer 1 year after diagnosis compared with the general population: a population-based study	309	2004	EORTC QLQ – C30	Population-based statewide cohort study	NS	Overall, QoL, and also physical functioning in patients with CRC, one year after diagnosis is comparable to the general population	Mean score: 79.5 vs. 82.6 62.8 vs. 63.6
I. Kopp et. al (31)	Relation between severe illness and non-completion of quality-of-life questionnaires by patients with rectal cancer	146 pts – 98 pts participated in QoL	2003	EORTC QLQ – C30 EORTC QLQ – CR38	Observational study	NS	At the time of discharge, the overall response rate to the questionnaire was 59%, and at the end of the follow-up only 36%. It should be mentioned that the post-operative mortality rate was 4% and 27% at 2 years.	Patients at risk of non-compliance (>75 years old, ASA score III or IV, palliative treatment intention) completed fewer questionnaires. The difference rates in completion were 30% vs. 53%, was significant. $p < 0.001$

**Table 3.** Cont'd

Author	Title	Nr. pts.	Year	Type of QoL questionnaire	Type of study	Surgical approach	Results	Statistical significance
A.M. Stiggelbout et. al (17)	Follow-up of colorectal cancer patients: quality of life and attitudes towards follow-up	82	1997	Medical Outcomes Study short-form general health survey (MOS SF-20) Rotterdam Symptom Checklist (RSCL) Visual analogue scale - VAS	Cross-sectional study	NS	Overall QoL can be affected by physical limitations and there is a correlation between physical functioning and VAS score	p < 0.04

tumor recurrence, low socio-economic status, TNM stage at diagnosis, time since diagnosis, female gender and the presence of comorbidities are correlated with a lower QoL in these patients (53-56). Increasing occurrence in the most productive period of life, the social and financial impact is significant (57-60). Although the new technology in surgery, radiotherapy, and chemotherapy has significantly progressed, rectal cancer patients are facing many challenges (61). The minimally invasive surgical approach and major post-operative complications such as anastomotic leakage impacts 3- and 6- months QoL scores, with a lower impact on the one year QoL scores (62,63).

Sexual dysfunction is a known adverse effect of CRC and its treatment. The mechanism of this dysfunction is complex, involving physical factors and medical complications, but also the immense psychological stress to which these patients are subjected, which is determined by the diagnosis of cancer and its treatment (64). However, younger patients are more susceptible to look for and accept medical care for QoL improvements (65).

## Conclusions

CRC diagnosis has major effects on patients' physical and psychical status, and concentrated efforts should be made by the involved medical team and the healthcare systems to improve their QoL throughout the treatment pathway. Periodically evaluating the QoL offers measurable and objective tools to intervene at the appropriate time, to decrease Years of Life Lost and Years Lived with Disabilities for CRC patients. However, a structured implemented

and functional system requires dedicated and common institutional efforts.

## Author's Contributions

Conception/design of the research / Collection of data / Data analysis/interpretation: CC, IN, RCP, MB, TP, CST, GC, SH. Drafting the manuscript: CC, IN. All authors participated in contributing to text and the content of the manuscript, including revisions. All authors approve of the content of the manuscript and agree to held accountable for the work.

## Acknowledgement

This paper is part of the doctoral thesis at CDUMF of Cezar Ciubotaru PhD student.

## Reference

1. Cancer [Internet]. [cited 2023 Jun 11]. Available from: <https://www.who.int/news-room/fact-sheets/detail/cancer>
2. Cancer Today [Internet]. [cited 2023 Jun 11]. Available from: [https://gco.iarc.fr/today/online-analysis-dual-bars-2?v=2020&mode=cancer&mode\\_population=regions&population=908&populations=908&key=asr&sex=0&cancer=39&type=0&statistic=5&prevalence=0&population\\_group=0&ages\\_group%5B%5D=4&ages\\_group%5B%5D=17&nb\\_items=15&group\\_cancer=1&include\\_nmsc=0&include\\_nmsc\\_other=1&dual\\_distribution=1&population1=908&population2=642&show\\_values=false&type\\_multiple=%257B%2522inc%2522%253Atrue%252C%2522mort%2522%253Atrue%252C%2522prev%2522%253Afalse%257D&type\\_sort=0#collapse-group-0-4](https://gco.iarc.fr/today/online-analysis-dual-bars-2?v=2020&mode=cancer&mode_population=regions&population=908&populations=908&key=asr&sex=0&cancer=39&type=0&statistic=5&prevalence=0&population_group=0&ages_group%5B%5D=4&ages_group%5B%5D=17&nb_items=15&group_cancer=1&include_nmsc=0&include_nmsc_other=1&dual_distribution=1&population1=908&population2=642&show_values=false&type_multiple=%257B%2522inc%2522%253Atrue%252C%2522mort%2522%253Atrue%252C%2522prev%2522%253Afalse%257D&type_sort=0#collapse-group-0-4)
3. Anderson AS, Martin RM, Renehan AG, Cade J, Copson ER, Cross AJ, et al. Cancer survivorship, excess body fatness and weight-loss intervention—where are we in 2020? *Br J Cancer*. 2021;124(6):1057-1065.
4. Perrone M, Garufi C, Cosimelli M, Graziano F, Falcicchio C, Bonucci A, et al. A Prospective Study Evaluating Health-Related Quality of Life Following a Multimodal Treatment for Colorectal Cancer. *J Gastrointest Cancer*. 2023; 54(1):117-125.
5. Wang L, Langlais C, Kenfield SA, Van Loon K, Laffan A, Atreya CE, et al. Quality of life among colorectal cancer survivors participating in a pilot randomized controlled trial of a web-based dietary intervention with text messages. *Supportive Care in Cancer*. 2023;31(3):1-10.
6. Post MWM. Definitions of quality of life: what has happened and how to move on. *Top Spinal Cord Inj Rehabil*. 2014;20(3):167-80.

7. WHOQOL - Measuring Quality of Life The World Health Organization [Internet]. [cited 2023 Jun 17]. Available from: <https://www.who.int/tools/whoqol>
8. Sprangers MAG, Taal BG, Aaronson NK, te Velde A. Quality of life in colorectal cancer - Stoma vs. nonstoma patients. *Dis Colon Rectum*. 1995; 38(4):361-9.
9. Arndt V, Merx H, Stegmaier C, Ziegler H, Brenner H. Quality of life in patients with colorectal cancer 1 year after diagnosis compared with the general population: a population-based study. *J Clin Oncol*. 2004;22(23):4829-36.
10. Conroy T, Bleiberg H, Glimelius B. Quality of life in patients with advanced colorectal cancer: what has been learnt? *Eur J Cancer*. 2003;39(3):287-94.
11. Conroy T, Blazey JM. Health-related quality of life in colorectal cancer patients. *Expert Rev Anticancer Ther*. 2003;3(4):493-504.
12. Diamantis A, Tzouvaras G, Samara A, Magouliotis D, Baloyiannis I, Symeonidis D, et al. Quality of life deterioration and colorectal cancer staging in elderly patients. Which comes first? *JBUON*. 2021;26(4):1266-70.
13. Akhondi-Meybodi M, Akhondi-Meybodi S, Vakili M, Javaheri Z. Quality of life in patients with colorectal cancer in Iran. *Arab J Gastroenterology*. 2016; 17(3):127-30.
14. Marks JH, Salem JF, Valsdottir EB, Yarandi SS, Marks GJ. Quality of Life and Functional Outcome After Transanal Abdominal Transanal Proctectomy for Low Rectal Cancer. *Dis Colon Rectum*. 2017;60(3):258-265.
15. Orsini RG, Thong MSY, Van De Poll-Franse LV, Slooter GD, Nieuwenhuijzen GAP, Rutten HJT, et al. Quality of life of older rectal cancer patients is not impaired by a permanent stoma. *Eur J Surg Oncol*. 2013;39(2):164-70.
16. Son DN, Choi DJ, Woo SU, Kim J, Keom BR, Kim CH, et al. Relationship between diversion colitis and quality of life in rectal cancer. *World J Gastroenterol*. 2013;19(4):542-9.
17. Stiggelbout AM, De Haes J, Vree R, Bruijninx C, Van Groningen K, Kievit J. Follow-up of colorectal cancer patients: quality of life and attitudes towards follow-up. *Br J Cancer*. 1997;75(6):914-20.
18. Hidde MC, Lyden K, Henry K, Leach HJ. Reallocating Time to Physical Activity and Sleep: Associations with Body Mass Index in Cancer Survivors. *Int J Behav Med*. 2024;31(1):109-115.
19. Mehra K, Berkowitz A, Sanft T. Diet, Physical Activity, and Body Weight in Cancer Survivorship. *Med Clin North Am*. 2017;101(6):1151-65.
20. Clinton SK, Giovannucci EL, Hursting SD. The World Cancer Research Fund/American Institute for Cancer Research Third Expert Report on Diet, Nutrition, Physical Activity, and Cancer: Impact and Future Directions. *J Nutr*. 2020 Apr 1;150(4):663-71.
21. Clinton SK, Giovannucci EL, Hursting SD. The World Cancer Research Fund/American Institute for Cancer Research Third Expert Report on Diet, Nutrition, Physical Activity, and Cancer: Impact and Future Directions. *J Nutr*. 2020 Apr 1;150(4):663-71.
22. Quality of Life of Cancer Patients | EORTC - Quality of Life [Internet]. [cited 2024 Mar 18]. Available from: <https://qol.eortc.org/questionnaire/eortc-qlq-c30/>
23. Colorectal | EORTC - Quality of Life [Internet]. [cited 2024 Mar 18]. Available from: <https://qol.eortc.org/questionnaire/qlq-cr29/>
24. Manuals | EORTC - Quality of Life [Internet]. [cited 2024 Mar 18]. Available from: <https://qol.eortc.org/manuals/>
25. Whistance RN, Conroy T, Chie W, Costantini A, Sezer O, Koller M, et al. Clinical and psychometric validation of the EORTC QLQ-CR29 questionnaire module to assess health-related quality of life in patients with colorectal cancer. *Eur J Cancer*. 2009;45(17):3017-26.
26. Gujral S, Conroy T, Fleissner C, Sezer O, King PM, Avery KNL, et al. Assessing quality of life in patients with colorectal cancer: an update of the EORTC quality of life questionnaire. *Eur J Cancer*. 2007;43(10):1564-73.
27. Scott MJ, Aggarwal G, Aitken RJ, Anderson ID, Balfour A, Foss NB, et al. Consensus Guidelines for Perioperative Care for Emergency Laparotomy Enhanced Recovery After Surgery (ERAS®) Society Recommendations Part 2-Emergency Laparotomy: Intra- and Postoperative Care. *World J Surg*. 2023;47(8):1850-1880.
28. Couwenberg AM, de Beer FSA, Intven MPW, Burbach JPM, Smits AB, Consten ECJ, et al. The impact of postoperative complications on health-related quality of life in older patients with rectal cancer; a prospective cohort study. *J Geriatr Oncol*. 2018;9(2):102-9.
29. Siemens W, Schönsteiner SS, Orellana-Rios CL, Schaeckel U, Kessler J, Eschbach C, et al. Severe symptoms and very low quality-of-life among outpatients newly diagnosed with advanced cancer: data from a multicenter cohort study. *Supportive Care in Cancer*. 2020;28(11):5547-55.
30. Cabilan CJ, Hines S. The short-term impact of colorectal cancer treatment on physical activity, functional status and quality of life: A systematic review. *JBI Database System Rev Implement Rep*. 2017;15(2):517-66.
31. Kopp I, Lorenz W, Rothmund M, Koller M. Relation between severe illness and non-completion of quality-of-life questionnaires by patients with rectal cancer. *J R Soc Med*. 2003;96(9):442-8.
32. Tarkowska M, Głowacka-Mrotek I, Skonieczny B, Jankowski M, Nowikiewicz T, Jarzowski M, et al. Prospective Evaluation of the Quality of Life of Patients after Surgical Treatment of Rectal Cancer: A 12-Month Cohort Observation. *J Clin Med*. 2022;11(19):5912.
33. Kopp I, Bauhofer A, Koller M. Understanding quality of life in patients with colorectal cancer: Comparison of data from a randomised controlled trial, a population based cohort study and the norm reference population. *Inflamm Res*. 2004;53(Suppl 2):S130-5.
34. Arndt V, Merx H, Stegmaier C, Ziegler H, Brenner H. Quality of life in patients with colorectal cancer 1 year after diagnosis compared with the general population: a population-based study. *J Clin Oncol*. 2004;22(23):4777-84.
35. Kennedy F, Lally P, Ella Miller N, Conway RE, Roberts A, Croker H, et al. Fatigue, quality of life and associations with adherence to the World Cancer Research Fund guidelines for health behaviours in 5835 adults living with and beyond breast, prostate and colorectal cancer in England: A cross-sectional study. *Cancer Med*. 2023;12(11):12705-12716.
36. Health Survey for England - 2008: Physical activity and fitness - NHS Digital [Internet]. [cited 2023 Jun 17]. Available from: <https://digital.nhs.uk/data-and-information/publications/statistical/health-survey-for-england/health-survey-for-england-2008-physical-activity-and-fitness>.
37. Bush K, Kivlahan DR, McDonell MB, Fihn SD, Bradley KA. The AUDIT alcohol consumption questions (AUDIT-C): an effective brief screening test for problem drinking. Ambulatory Care Quality Improvement Project (ACQUIP). Alcohol Use Disorders Identification Test. *Arch Intern Med*. 1998; 158(16):1789-95.
38. Carroll AJ, Huffman MD, Wileyto EP, Khan SS, Fox E, Smith JD, et al. Change in cardiovascular health among adults with current or past major depressive disorder enrolled in intensive smoking cessation treatment. *J Affect Disord*. 2023;333:527-534.
39. Kurtze N, Rangul V, Hustvedt BE, Flanders WD. Reliability and validity of self-reported physical activity in the Nord-Trøndelag Health Study — HUNT 1. *Scand J Public Health*. 2008;36(1):52-61.
40. Lange-Drenth L, Schulz H, Endsin G, Bleich C. Association of the Extent of Internet Use by Patients With Cancer With Social Support Among Patients and Change in Patient-Reported Treatment Outcomes During Inpatient Rehabilitation: Cross-sectional and Longitudinal Study. *JMIR Cancer*. 2023 May 17;9:e39246.
41. SACN Carbohydrates and Health Report - GOV.UK [Internet]. [cited 2023 Jun 17]. Available from: <https://www.gov.uk/government/publications/sacn-carbohydrates-and-health-report>
42. Roberts C, Steer T, Maplethorpe N, Cox L, Meadows S, Nicholson S, et al. National Diet and Nutrition Survey: results from years 7 and 8 (combined) of the Rolling Programme (2014/2015 – 2015/2016). 2018;
43. Hmsol: Dietary Reference Values A Guide. 1991;
44. Cappuccio FP, Rink E, Perkins-Porras L, McKay C, Hilton S, Steptoe A. Estimation of fruit and vegetable intake using a two-item dietary questionnaire: a potential tool for primary health care workers. *Nutr Metab Cardiovasc Dis*. 2003;13(1):12-9.
45. Lauby-Secretan B, Scoccianti C, Loomis D, Grosse Y, Bianchini F, Straif K. Body Fatness and Cancer - Viewpoint of the IARC Working Group. *N Engl J Med*. 2016;375(8):794-8.
46. Pietrocola F, Pol J, Vaccelli E, Rao S, Enot DP, Baracco EE, et al. Caloric Restriction Mimetics Enhance Anticancer Immunosurveillance. *Cancer Cell*. 2016;30(1):147-160.
47. Quail DF, Dannenberg AJ. The obese adipose tissue microenvironment in cancer development and progression. *Nat Rev Endocrinol*. 2019;15(3): 139-154.

48. Hopkins BD, Goncalves MD, Cantley LC. Obesity and Cancer Mechanisms: Cancer Metabolism. *J Clin Oncol*. 2016;34(35):4277-4283.
49. Elm E von, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP. Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *Internist (Berl)*. 2008;49(6):688-93. German
50. Hofseth LJ, Hebert JR, Chanda A, Chen H, Love BL, Pena MM, et al. Early-onset colorectal cancer: initial clues and current views. *Nat Rev Gastroenterol Hepatol*. 2020;17(6):352-64.
51. Zaborowski AM, Abdile A, Adamina M, Aigner F, D'Allens L, Allmer C, et al. Characteristics of Early-Onset vs Late-Onset Colorectal Cancer: A Review. *JAMA Surg*. 2021;156(9):865-74.
52. Waddell O, Mclauchlan J, McCombie A, Glyn T, Frizelle F. Quality of life in early-onset colorectal cancer patients: systematic review. *BJS Open*. 2023; 7(3):zrad030.
53. Downing A, Morris EJA, Richards M, Corner J, Wright P, Sebag-Montefiore D, et al. Health-related quality of life after colorectal cancer in England: A patient-reported outcomes study of individuals 12 to 36 months after diagnosis. *J Clin Oncol*. 2015;33(6):616-24.
54. Miller KA, Stal J, Gallagher P, Weng Z, Freyer DR, Kaslander JN, et al. Time from Diagnosis and Correlates of Health-Related Quality of Life among Young Adult Colorectal Cancer Survivors. *Cancers (Basel)*. 2021;13(16): 4045.
55. Perl G, Nordheimer S, Lando S, Benedict C, Brenner B, Perry S, et al. Young patients and gastrointestinal (GI) tract malignancies - are we addressing the unmet needs? *BMC Cancer*. 2016;16(1):630.
56. Mack JW, Cronin A, Fasciano K, Block SD, Keating NL. Cancer treatment decision-making among young adults with lung and colorectal cancer: A comparison with adults in middle age. *Psychooncology*. 2016;25(9):1085-91.
57. Blum-Barnett E, Madrid S, Burnett-Hartman A, Mueller SR, McMullen CK, Dwyer A, et al. Financial burden and quality of life among early-onset colorectal cancer survivors: A qualitative analysis. *Health Expect*. 2019; 22(5):1050-1057.
58. de Wind A, Tamminga SJ, Bony CAG, Diether M, Ludwig MA, Velthuis MJ, et al. Loss of paid employment up to 4 years after colorectal cancer diagnosis - a nationwide register-based study with a population-based reference group. *Cancers (Basel)*. 2021;13(12):2868.
59. Arndt V, Merx H, Stegmaier C, Ziegler H, Brenner H. Restrictions in quality of life in colorectal cancer patients over three years after diagnosis: a population based study. *Eur J Cancer*. 2006 Aug;42(12):1848-57.
60. Chambers SK, Meng X, Youl P, Aitken J, Dunn J, Baade P. A five-year prospective study of quality of life after colorectal cancer. *Qual Life Res*. 2012 Nov;21(9):1551-64.
61. Georges C, Yap R, Bell S, Farmer KC, Cohen LCL, Wilkins S, et al. Comparison of quality of life, symptom and functional outcomes following surgical treatment for colorectal neoplasia. *ANZ J Surg*. 2023;93(7-8): 1877-1884.
62. Hung CM, Hung KC, Shi HY, Su SB, Lee HM, Hsieh MC, et al. Medium-term surgical outcomes and health-related quality of life after laparoscopic vs open colorectal cancer resection: SF-36 health survey questionnaire. *World J Gastrointest Endosc*. 2023;15(3):163-176.
63. Arron MNN, Custers JAE, van Goor H, van Duijnhoven FJB, Kampman E, Kouwenhoven EA, et al. The association between anastomotic leakage and health-related quality of life after colorectal cancer surgery. *Colorectal Dis*. 2023;25(7):1381-1391.
64. Enzlin P, De Clippeleir I. The emerging field of "oncosexology": recognising the importance of addressing sexuality in oncology. *Belg J Med Oncol* 2011;5:44-9
65. Holla JFM, van de Poll-Franse LV, Huijgens PC, Mols F, Dekker J. Utilization of supportive care by survivors of colorectal cancer: results from the PROFILES registry. *Support Care Cancer*. 2016;24(7):2883-92

## Supplementary Material

### Appendix 1. Patients identification data

Surname, First Name:	
Telephone number:	
First grade relatives (wife, child, siblings, other):	
Surname / First Name / Telephone number:	
Unique registration code:	

Appendix 2. Printed Case Report Form at index admission At

Hospitalization data										
Age	Sex	Weight	Height							
Karnofsky index	ECOG	Colostomy	Date of colostomy							
Smoking	Current smoker (P/year)	ASA score	TNM stage							
	Ex. Smoker (≤ 6 weeks)			Date of discharge	Perforation	Hemorrhage	Localized peritonitis	Generalized peritonitis	Intestinal obstruction	
Date of admission	Nonsmoker	Date of surgery	Acute complication							
	Comorbidities			CHF	Type of surgical intervention	Right hemicolectomy				
Atrial fibrillation		Transvers colectomy								
Arterial hypertension		Hepatic flexure								
Diabetes		Transvers colon								
Chronic kidney failure		Splenic flexure								
COPD		Descendent								
Another neoplasia		Sigmoid								
Atherosclerosis		Upper rectum								
Liver failure		Medium rectum								
History of Chemo		Lower rectum								
Approach	History of RT	Nr. of days in ICU	Other							
	Open			Postoperative complications						
	Laparoscopic									
	Converted laparoscopic									
Type of postoperative complication	Hemorrhage	Reintervention	Clavien-Dindo							
	Anastomotic leakage			I						
	Peritonitis			II						
	Evisceration			III						
	Wound infection			IV						
	Other infections									
	Pulmonary TEP									
Heart attack										
Type surgical reintervention	Reason for reintervention	Applied ERAS	pTMM							
				pT						
				pN						
				LV						
				LN						
QLQ-C30	QLQ-CR29									
				G						

B) During follow-up

3-, 6-, 12 - months follow-up									
CHT	CHT initiation date	Number of cures of CHT		Last session of CHT					
RT	RT initiation date	Gy RT	Last session of RT						
QLQ-C30	QLQ-CR29	Smoke	Current smoker (P/year)		Alcohol	Daily			
			Ex. Smoker ( $\leq$ 6 weeks)			/Week			
Physical	Role	Pain	Nonsmoker			/Month			
Own perception	Emotional	Memory			Bowel movement	Urinating			
Family	Socialization	Financial			Concentration	Fatigue			
					Sexual life				
Physical activity	Fibers		Red meat		Fat	Precooked			
Sugar	Soft drinks	Fresh juices			Vegetables	Fruits			
Weight	Height								
Recommendations	Physical activity	Diet			Vices				