Evaluation of Oesophagus and Gastric Cancer Care within the Managed Clinical Network in the Northeast Region of the Netherlands

Retrospective study about variation in treatment and survival of patients with oesophagus or gastric cancer and the impact of supra-regional multidisciplinary team meetings.

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Abstract

Introduction

Prior studies describe a large variation in oesophageal and gastric cancer care. Over the past few years, many oncology networks have been established to ensure the quality, accessibility and affordability of cancer care regardless of the hospital of diagnosis. This study aimed to evaluate variation in treatment and survival among hospitals within the Managed Clinical Network (MCN) oesophagogastric cancer in the northeast region of the Netherlands in recent years. Moreover, the impact of a pilot of supra-regional multidisciplinary team (SMDT) meetings was examined.

Methods

Patients with oesophageal or gastric cancer diagnosed from 2016 until 2021 were selected from the Netherlands Cancer Registry (NCR). Differences in treatment strategies and lead times to the start of treatment between hospital clusters and individual hospitals were analysed and compared to a national benchmark. In addition, differences in referrals to hospitals outside the MCN and survival were analysed among the clusters. Data of patients discussed at the SMDT meetings were selected from the medical records of the Top Clinical Hospital Group Twente. Outcomes of patients discussed at the SMDT meetings were compared to a matched control group of patients treated in the MCN selected from the NCR. Moreover, deviations between the treatment advice of the SMDT meeting, the treatment advice of the regional MDT meeting and the received treatment were analysed.

Results

A total of 4206 patients, receiving treatment within the MCN, were included. Potentially curable patients diagnosed in the MCN in 2020-2021 equally received treatment with curative intent, regardless of the hospital cluster (range: 69-73%, p=0.342). The odds ratios on the probability of receiving treatment with curative intent ranged between 0.87 (p=0.693) and 1.96 (p=0.026) per hospital of diagnosis. The median lead time from diagnosis to the start of treatment with curative intent varied significantly among the clusters (range: 38-49 days, p<0.001) and individual hospitals (OR 0.38, p<0.001 and OR 2.72, p<0.001). The survival of patients did not vary among the clusters.

Patients discussed at the SMDT meetings had no delay in the lead time to the start of treatment compared to a matched control group (p=0.3466). For about half of the patients, the treatment advice of the SMDT meeting deviated from the advice of the regional MDT meeting. The treatment recommended at the SMDT meeting was received by the majority of patients.

Conclusion

This study demonstrated that oncology networks can contribute to uniformity in treatment decisions and equal survival among hospitals. Differences in lead time to treatment appear to remain. The SMDT meetings can contribute to uniformity in treatment decisions for complex cases, without impacting the lead time to the start of treatment.

Keywords

Oncology network, variation, supra-regional MDT meetings

1. Introduction

In 2020 about 1.1 million new cases of gastric cancer (GC) and about 0.6 million new cases of oesophageal cancer (EC) were detected globally [1]. The Netherlands had the highest incidence per number of inhabitants in Europe in 2020 [2]. Due to common late-stage diagnosis and the aggressive behaviour of the tumours, the prognosis of EC and GC is poor. With a global mortality to incidence ratio greater than 0.75, EC and GC can be categorised to the group of highly fatal cancers [3].

The most common curative treatment strategy is surgery (esophagectomy and gastrectomy) combined with neoadjuvant chemo(radio)therapy (C(R)T) for EC and perioperative CRT for GC [2,4,5]. Esophagectomy and gastrectomy are complex surgical procedures associated with high morbidity and mortality rates [6,7]. Other curative treatment strategies include endoscopic resection for early stage tumours and definitive CRT for patients with an unresectable tumour or who are too frail to undergo surgery [2,4,5].

Previous studies have shown that variation in treatment and survival of patients with EC or GC exist [8–10]. Multiple studies describe that the probability of receiving treatment with curative intent for patients with EC or GC largely depends on the hospital of diagnosis in the Netherlands [11–13]. This variation among hospitals is likely to be caused by a variety of factors, such as hospital volume, the availability of resources and the extent to which the guidelines are based on expert consensus or a high level of evidence [11–14]. Regionalisation and centralisation of esophagectomies and gastrectomies to increase the hospital volume may contribute to a decrease in postoperative mortality and practice variation [11,13,15–18]. Additionally, the complexity and costs of (oesophagogastric) cancer care are rising due to for example the increasing incidence, survival and availability of innovative technologies for diagnostics and treatment [1,19–21]. Therefore, oncology networks have been established over the past few years to ensure the quality, accessibility and affordability of cancer care regardless of the hospital of diagnosis [22–26].

Networks can be defined as “strategic alliances forged around common agendas of mutual advantage through collective action” [27, p.12]. In this context, networking involves the collaboration of individual healthcare organisations through knowledge- and resource sharing and the integration of healthcare services with the aim to offer the optimal treatment to patients diagnosed with cancer. Within oncology networks, regional MultiDisciplinary Team (MDT) meetings are commonly implemented. In the Netherlands, many oncology networks have been established over the past few years [26]. In 2008, seventeen hospitals in the northeast region of the Netherlands founded a Managed Clinical Network (MCN) for EC and GC. Within this network, multidisciplinary and regional agreements about diagnostics and treatment were formalised. Moreover, regional MDT meetings were established within three clusters of the MCN, each divided based on the availability of a surgical centre and geographical location. Ten years after the foundation of the MCN a study was performed which showed that the introduction of the MCN resulted in a reduction of variation in treatment, lead time and survival between clusters of hospitals in the northeast region of the Netherlands [16]. Furthermore, a national study identified that the implementation of regional MDT meetings for EC was associated with more curative resections and improved overall survival [28].

However, the MCN for EC and GC in the northeast region of the Netherlands experienced that for complex cases frequently no uniform agreement about the treatment advice is reached within the regional MDT meetings [29]. Moreover, the board of this MCN aims to strengthen the collaboration between the hospital clusters. The relevance of investing more in collaborations between healthcare organisations was emphasised by the Dutch government through the introduction of the ‘Integral Care Agreement’ in September 2022 [30,31]. Therefore, in addition to the regional MDT meetings, this MCN introduced supra-regional MDT (SMDT) meetings for EC and GC as a pilot in February 2022. In the SMDT meetings healthcare professionals of three surgical centres, one of each

cluster of the MCN, meet twice a month via videoconferencing to discuss complex cases. During the regional MDT meetings it is determined which cases should be discussed at the SMDT meetings. Cases are defined as complex when no treatment strategy could be established based on the current guidelines for EC or GC [32]. Hence, the SMDT meetings provide a platform to share knowledge and expertise, strengthen collaboration and minimise variation in care among hospitals in the MCN.

The United Kingdom is the frontrunner in practising SMDT meetings. One study identified that SMDT meetings allow in particular smaller centres to improve outcomes for germ cell cancer [33]. Another study found that the SMDT meetings enabled accurate and consistent diagnostic and treatment decisions for a complex multi-system fibro-inflammatory disorder [34]. The findings of both studies indicate that SMDT meetings may improve decision-making and reduce variation between hospitals. To date, no scientific literature is available about supra-regional collaborations in other countries.

Accordingly, this study aimed to examine the variation in treatment and survival between hospitals within the MCN in recent years and the added value of the pilot SMDT meetings. The results may provide guidance for the continuation of the SMDT meetings within the MCN and the implementation of regional and supra-regional collaborations outside the northeast region of the Netherlands.

2. Methods

2.1. Study design

A retrospective research design consisting of two phases was used: 1) variation in treatment and survival in the MCN and 2) the impact of the SMDT meetings. First, data of patients diagnosed with an invasive oesophageal or gastric tumour from 2016 until 2021 within the MCN (including patients discussed at the SMDT meetings) were analysed to identify differences and trends in treatment and survival among hospital clusters and individual hospitals over time, and compared to a national benchmark. Second, data of patients discussed at the SMDT meetings from February 2022 until May 2023 were analysed and compared to a control group of patients treated in the MCN with matching patient- and tumour characteristics, who were only discussed in a regional MDT meeting. Healthcare professionals involved in the SMDT meetings helped to determine whether the treatment advice established in the supra- and regional MDT meetings deviated from each other and the actual received treatment.

2.2. Indicators

To measure variation in treatment and survival and the impact of the pilot SMDT meetings, twelve indicators were developed based on the Donabedian model (Appendix A) [35]. Seven indicators were formulated to define treatment and survival, and five indicators were added to operationalise the impact of the pilot SMDT meetings (Table 1). The board members of the MCN and the previous evaluation of the MCN by Van Hoeve et al. [16] provided input for the development of the indicators.

Table 1
Indicators to measure the variation in treatment and survival in the MCN and the impact of the SMDT meetings per component of the Donabedian model

	Component	Indicator
Variation in treatment and survival in the MCN	Process	1) Percentage of potentially curable patients receiving treatment with curative intent (only surgery, CRT without surgery, surgery after neoadjuvant C(R)T with or without adjuvant therapy, ER).
	Process	2) Percentage of potentially curable patients receiving treatment without curative intent (other treatment strategies than the strategies mentioned as curative and no treatment).
	Process	3) Median lead time from diagnosis (date diagnosis confirmed by pathology) to the start of primary treatment with curative intent.
	Process	4) Median lead time from MDT meeting to the start of primary treatment with curative intent.
	Process	5) Percentage of patients referred to a hospital outside the MCN.
	Outcome	6) One-year survival
	Outcome	7) Two-year survival
Impact of the SMDT meetings	Structure	8) Presence of at least one surgeon, one medical oncologist and one radiation oncologist from each participating centre at the SMDT meeting.
	Structure	9) Presence of the referring medical specialist at the SMDT meeting.
	Process	10) Median lead time from regional MDT meeting to SMDT meeting.
	Process	11) Percentage of patients for whom the treatment advice of the regional MDT meeting deviated from the treatment advice of the SMDT meeting.
	Process	12) Percentage of patients for whom the actual received treatment deviated from the treatment advice of the SMDT meeting.

2.3. Data sources and selection

To analyse variation in treatment and survival in the MCN and for the comparison with a national benchmark (phase 1), all patients registered in the Netherlands Cancer Registry (NCR) with invasive EC or GC from 2016 until 2021 were selected (including patients discussed at the SMDT meetings). Additionally, to examine the impact of the pilot SMDT meetings (phase 2), data of patients discussed at the SMDT meetings were selected from the medical records of the Top Clinical Hospital Group Twente (ZGT). This hospital administratively supported the SMDT meetings from February 2022 until May 2023 and has therefore registered data of the patients discussed. The specific inclusion and exclusion criteria per indicator can be found in Appendix A.

2.4. Statistical analysis

2.4.1. Analysis of variation in treatment and survival in the MCN

Differences in patient characteristics and treatment between time periods and hospital clusters were examined using the chi-squared test for nominal data and the Mann-Whitney U test for median lead times. First, statistical differences in the outcomes of indicators 1 to 5 were analysed between three time periods: 2016-2017 (T1), 2018-2019 (T2) and 2020-2021 (T3). Second, statistical differences in the outcomes were tested between three hospital clusters of the MCN which were distinguished based on the existing regional MDT meetings and the availability of a surgical treatment centre. Additionally, the probability of patients receiving treatment with curative intent and the probability of receiving this treatment within six weeks after diagnosis were analysed per hospital of diagnosis with multivariable logistic regression. Gender, age and cT classification were added to adjust for case mix differences. Third, Kaplan-Meier curves were generated to analyse the survival and log-rank tests were used to compare the curves of the hospital clusters. Lastly, the outcomes of patients treated within the MCN were compared with the outcomes of patients treated in other hospitals in the Netherlands (outside the MCN) with the chi-squared test and the Mann-Whitney U test.

2.4.2. Analysis of the impact of SMDT meetings

To analyse and compare the treatment of patients discussed in a SMDT meeting with patients who were only discussed in a regional MDT meeting, an intervention- and control group were formed. The intervention group consisted of patients discussed at the SMDT meetings. Case-control 1:n matching was applied to form a control group of patients treated in the MCN selected from the NCR, but not discussed at a SMDT meeting. Statistically significant predictors were used as matching variables. In this way, 22 cases were matched to 65 controls. Multivariable logistic regression was used to determine clinically relevant predictors for discussion at the SMDT meetings. Subsequently, statistical differences between the intervention- and control group were examined for indicators 1 to 5 with the Fisher's Exact test and Mann-Whiney U test. In addition, multivariable logistic regression was used to identify determinants for deviation between the treatment advice of the SMDT meeting and the regional MDT meeting and determinants for deviation between the treatment advice of the SMDT meeting and the actual received treatment. Finally, the association between the presence of the medical specialists (indicators 8 and 9) and the outcome of the SMDT meetings (indicators 11 and 12) were analysed using the Fisher's Exact test.

All analyses were performed in R 4.2.2. For all analyses $p<0.05$ was considered statistically significant.

3. Results

In total 4206 patients diagnosed with EC or GC in 2016 to 2021 and treated in the MCN were included. No clinically relevant differences in patient and tumour characteristics were observed between the time periods (Table 2).

Table 2
Patient and tumour characteristics by year of diagnosis for EC and GC.

	MCN 2016–2017 (T1) (n = 1356)	**MCN 2018–2019 (T2) (n = 1436)**	**MCN 2020-2021 (T3) (n = 1414)**	***p***
Hospital of primary treatment				*0.071*
Cluster A	448 (33%)	491 (34%)	482 (34%)	
Cluster B	533 (49%)	603 (42%)	606 (43%)	
Cluster C	375 (28%)	342 (24%)	326 (23%)	
Age				*0.620*
<60 years	215 (16%)	236 (16%)	219 (15%)	
60-75 years	668 (49%)	687 (48%)	664 (47%)	
>75 years	473 (35%)	513 (36%)	531 (38%)	
Gender				*0.795*
Male	994 (73%)	1049 (73%)	1019 (72%)	
Female	362 (27%)	387 (27%)	395 (28%)	
Clinical stage				*0.757*
Early (cT1, cN0/X & cM0)	39 (3%)	31 (2%)	36 (3%)	
Potentially curable (cT1-4a & cM0)	764 (56%)	831 (58%)	802 (57%)	
Non-curable (cT4b or cM1)	553 (41%)	574 (40%)	576 (41%)	
Histology				
Oesophagus	870 (64%)	905 (63%)	906 (64%)	*0.064*
Adenocarcinoma	636 (47%)	623 (43%)	626 (44%)	
Squamous cell carcinoma	200 (15%)	224 (16%)	221 (16%)	
Other	34 (3%)	58 (4%)	59 (4%)	
Gastric	486 (36%)	531 (37%)	508 (36%)	*0.131*
Adenocarcinoma	459 (34%)	490 (34%)	463 (33%)	
Other	27 (2%)	41 (3%)	45 (3%)	

3.1. Variation in treatment and survival in the MCN

3.1.1. Trends in treatment over time

Of the 4206 patients treated in the MCN, 2503 (60%) patients were diagnosed with early stage or potentially curable EC or GC (Table 2). In T3, 73% of patients diagnosed with potentially curable EC and 71% of patients diagnosed with potentially curable GC received treatment with a curative intent (Table 3). The most common curative treatment strategies in T3 were CRT without surgery (31%) and surgery combined with neoadjuvant C(R)T (24%) for EC and surgery combined with neoadjuvant C(R)T or perioperative C(R)T for GC (41%). For both EC and GC, the percentage of patients receiving CRT without surgery increased over time (respectively +9%, $p<0.001$ and +7%, $p=0.029$). Additionally, the percentage of patients with EC receiving endoscopic resection increased significantly by +9% from T1 to T3 ($p<0.001$). However, the increase in endoscopic resections declined from T2 to T3 (+4%, $p=0.056$). For GC, the percentage of patients receiving perioperative C(R)T significantly increased by +8% from T1 to T3 ($p=0.016$), but this increase also declined from T2 to T3 (+3%, $p=0.428$). For both EC and GC, the percentage of patients receiving neoadjuvant C(R)T decreased from T2 to T3 (respectively -14% ($p<0.0001$) and -10% ($p=0.011$)).

Most patients diagnosed with potentially curable EC or GC in T3 who were treated without curative intent received treatment for symptom relief. For GC, the percentage of patients receiving no treatment significantly decreased from T1 to T2 (-9%, p=0.020), but remained stable from T2 to T3 (p=0.964).

Table 3
Treatment modalities by year of diagnosis for potentially curable EC and GC.

	MCN 2016–2017 (T1)	**MCN 2018–2019 (T2)**	**MCN 2020-2021 (T3)**	***T1 vs. T3 p***	***T2 vs. T3 p***
Treatment oesophagus cancer	n = 540	n = 584	n = 577		
Treatment with curative intent	387 (72%)	426 (73%)	422 (73%)	*0.630*	*0.994*
Surgery only	20 (4%)	7 (1%)	8 (1%)	*0.022*	*0.981*
CRT[a] without surgery	117 (22%)	148 (25%)	184 (31%)	*<0.001*	*0.016*
Neoadjuvant C(R)T[a] & surgery with/without adjuvant therapy	233 (43%)	222 (38%)	161 (28%)	*<0.001*	*<0.001*
Neoadjuvant C(R)T[a] & surgery	233 (43%)	221 (38%)	139 (24%)	*<0.001*	*<0.001*
Neoadjuvant C(R)T[a], surgery & adjuvant therapy	0 (0%)	1 (0%)	22 (4%)	*<0.001*	*<0.001*
Endoscopic resection	17 (3%)	49 (8%)	69 (12%)	*<0.001*	*0.056*
Treatment without curative intent	153 (28%)	158 (27%)	155 (27%)	*0.630*	*0.994*
Other treatment	92 (17%)	92 (16%)	97 (17%)	*0.983*	*0.683*
No treatment	61 (11%)	66 (11%)	58 (10%)	*0.564*	*0.552*
Treatment gastric cancer	n = 263	n = 278	n = 261		
Treatment with curative intent	169 (64%)	208 (75%)	186 (71%)	*0.105*	*0.405*
Surgery only	63 (24%)	58 (21%)	53 (20%)	*0.368*	*0.958*
CRT[a] without surgery	3 (1%)	10 (4%)	22 (8%)	*<0.001*	*0.029*
Neoadjuvant C(R)T[a] & surgery with/without adjuvant therapy	99 (38%)	132 (47%)	106 (41%)	*0.544*	*0.129*
Neoadjuvant C(R)T[a] & surgery	67 (25%)	84 (30%)	53 (20%)	*0.192*	*0.011*
Neoadjuvant C(R)T[a], surgery & adjuvant therapy	32 (12%)	48 (17%)	53 (20%)	*0.016*	*0.428*
Endoscopic resection	4 (1%)	8 (3%)	5 (2%)	*0.751*	*0.656*
Treatment without curative intent	94 (36%)	70 (25%)	75 (29%)	*0.105*	*0.405*
Other treatment	35 (13%)	32 (11%)	38 (15%)	*0.774*	*0.356*
No treatment	59 (23%)	38 (14%)	37 (14%)	*0.020*	*0.964*

[a] Chemo(radio)therapy: C(R)T

No significant differences in the lead time from diagnosis to the start of treatment with curative intent and the referrals to a hospital outside the MCN were identified over time (Table 4). The lead time from the MDT meeting to the start of treatment with curative intent decreased significantly from T1 to T3 by six days (p<0.001).

Table 4
Lead times and referrals to hospitals outside the MCN by year of diagnosis for potentially curable EC and GC.

	MCN 2016–2017 (T1)	**MCN 2018–2019 (T2)**	**MCN 2020-2021 (T3)**	***T1 vs. T3 p***	***T2 vs. T3 p***
Median lead time from diagnosis to start treatment with curative intent	(n = 556[a]) 43 (IQR:20)	(n = 634[a]) 45 (IQR:24)	(n = 608[a]) 44 (IQR:23)	*0.723*	*0.084*
Median lead time from MDT meeting to start treatment with curative intent	(n = 542[b]) 27 (IQR:16)	(n = 612[b]) 24 (IQR:16)	(n = 551[b]) 21 (IQR:16)	*<0.001*	*<0.001*
Referrals to hospitals outside MCN	n = 1376[c]	n = 1460[c]	n = 1413[c]		
Potentially curable	40 (5%)	40 (5%)	30 (4%)	*0.220*	*0.363*
Non-curable	17 (3%)	11 (2%)	9 (2%)	*0.149*	*0.849*

[a] Patients treated with curative intent.
[b] Patients discussed at a MDT meeting before the start of primary treatment with curative intent.
[c] All patients diagnosed within the MCN.

3.1.2. Variation between hospital clusters

The percentage of patients diagnosed with potentially curable EC or GC receiving treatment with curative intent did not significantly differ in T3 between the three clusters of the MCN (Table 5). In T1, fewer patients were treated with curative intent in cluster C compared to cluster A (72% versus 63%, p=0.039). Yet, in T2 more patients were treated with curative intent in cluster C in comparison to cluster B (79% versus 69%, p=0.020).

Over the total measurement period, the lead times differed significantly between the MCN clusters (Table 5). The median lead time from diagnosis to the start of treatment with curative intent was significantly longer for patients diagnosed in cluster B and changed minimally over the years (48 days in T1 and 49 days in T3). In T3 the median lead time from diagnosis to the start of treatment with curative intent was 8 days shorter for patients diagnosed in cluster A (p<0.001) and 11 days shorter for patients diagnosed in cluster C (p<0.001) compared to cluster B.

The median lead time from MDT meeting to the start of treatment with curative intent was significantly shorter for patients diagnosed in cluster C in comparison to clusters A and B (Table 5). Patients diagnosed in cluster A had the longest median lead time from MDT meeting to the start of treatment with curative intent (-6 days at cluster B and -10 days at cluster C in T3, p<0.001).

Additionally, over the total measurement period, more patients diagnosed in cluster A and C were referred to a hospital outside the MCN compared to patients diagnosed in cluster B (+5% at cluster A, p=0.03 and +4% at cluster C, p=0.016).

Table 5
Treatment with or without curative intent, lead times and referrals to hospitals outside the MCN by year of diagnosis for potentially curable EC and GC per hospital cluster of diagnosis.

	2016–2017 (T1)	2018–2019 (T2)	2020-2021 (T3)	Variation between clusters		
				T1 *p*	T2 *p*	T3 *p*
Treatment with curative intent[a]						
Cluster A	(n = 263) 189 (72%)	(n = 284) 210 (74%)	(n = 270) 197 (73%)	*A-B:* *0.874*	*A-B:* *0.243*	*A-B:* *1.000*
Cluster B	(n = 292) 207 (71%)	(n = 343) 238 (69%)	(n = 347) 253 (73%)	*B-C:* *0.060*	*B-C:* *0.020*	*B-C:* *0.342*
Cluster C	(n = 225) 141 (63%)	(n = 216) 170 (79%)	(n = 209) 136 (69%)	*A-C:* *0.039*	*A-C:* *0.259*	*A-C:* *0.365*
Treatment without curative intent[a]						
Cluster A	(n = 263) 74 (28%)	(n = 284) 74 (26%)	(n = 270) 73 (27%)	*A-B:* *0.874*	*A-B:* *0.243*	*A-B:* *1.000*
Cluster B	(n = 292) 56 (29%)	(n = 343) 46 (31%)	(n = 347) 94 (27%)	*B-C:* *0.060*	*B-C:* *0.020*	*B-C:* *0.342*
Cluster C	(n = 225) 122 (37%)	(n = 216) 46 (21%)	(n = 209) 73 (31%)	*A-C:* *0.039*	*A-C:* *0.259*	*A-C:* *0.365*
Median lead time from diagnosis to start treatment with curative intent[b]						
Cluster A	(n = 189) 40 (IQR:17)	(n = 210) 43 (IQR:20)	(n = 197) 41 (IQR:15)	*A-B:* *<0.001*	*A-B:* *<0.001*	*A-B:* *<0.001*
Cluster B	(n =207) 48 (IQR:26)	(n = 238) 50 (IQR:28)	(n = 253) 49 (IQR:33)	*B-C:* *0.074*	*B-C:* *<0.001*	*B-C:* *<0.001*
Cluster C	(n = 141) 43 (IQR:20)	(n = 170) 41 (IQR:25)	(n = 136) 38 (IQR:23)	*A-C:* *0.001*	*A-C:* *0.432*	*A-C:* *0.194*
Median lead time from MDT meeting to start treatment with curative intent[c]						
Cluster A	(n = 179) 28 (IQR:15)	(n = 206) 27 (IQR:20)	(n = 194) 26 (IQR:14)	*A-B:* *0.024*	*A-B:* *0.422*	*A-B:* *<0.001*
Cluster B	(n = 204) 26 (IQR:17)	(n = 221) 26 (IQR:14)	(n = 211) 20 (IQR:14)	*B-C:* *<0.001*	*B-C:* *<0.001*	*B-C:* *<0.001*
Cluster C	(n = 140) 21 (IQR:19)	(n = 169) 19 (IQR:14)	(n = 124) 16 (IQR:11)	*A-C:* *<0.001*	*A-C:* *<0.001*	*A-C:* *<0.001*
Referrals to hospitals outside MCN[d]						
Cluster A	(n = 284) 21 (7%)	(n = 307) 23 (7%)	(n = 286) 16 (6%)	*A-B:* *0.002*	*A-B:* <0.001	*A-B:* *0.003*
Cluster B	(n = 297) 5 (2%)	(n = 346) 3 (1%)	(n = 351) 4 (1%)	*B-C:* 0.018	*B-C:* <0.001	*B-C:* *0.016*
Cluster C	(n = 239) 14 (6%)	(n = 230) 14 (6%)	(n = 208) 10 (5%)	*A-C:* 0.600	*A-C:* 0.643	*A-C:* 0.855

[a] n = patients diagnosed with potentially curable cancer and treated within the MCN.
[b] n = patients treated with curative intent within the MCN.
[c] n = patients discussed at a MDT meeting before the start of primary treatment with curative intent within the MCN.
[d] n = patients diagnosed with potentially curable cancer within the MCN.

3.1.1. Hospital variation

Multivariable logistic regression analysis showed that the odds ratio (OR) to receive treatment with a curative intent in the MCN ranged between 0.87 (p=0.693) and 1.96 (p=0.026) per hospital of diagnosis (Figure 1). At none of the hospitals, the probability to receive treatment with a curative intent was significantly lower in comparison to the other hospitals. Patients diagnosed at one hospital of cluster B had a significantly higher probability of receiving treatment with a curative intent (OR 1.96, p=0.026).

More variation was observed in the probability of receiving primary treatment with curative intent within six weeks after diagnosis (Figure 2). At two hospitals, one of cluster A and one of cluster C, the probability of receiving treatment within six weeks was significantly higher (OR 2.72, p<0.001 and OR 1.88, p=0.008). At three hospitals of cluster B, the probability of receiving treatment within six weeks was significantly lower (OR 0.28, p<0.001; OR 0.41, p=0.005 and OR 0.37, p<0.001).

Figure 1
Odds ratios on the probability of receiving treatment with curative intent for potentially curable EC and GC by the hospital of diagnosis on a logarithmic scale (N=2503). Adjusted for: age, sex and cT classification.

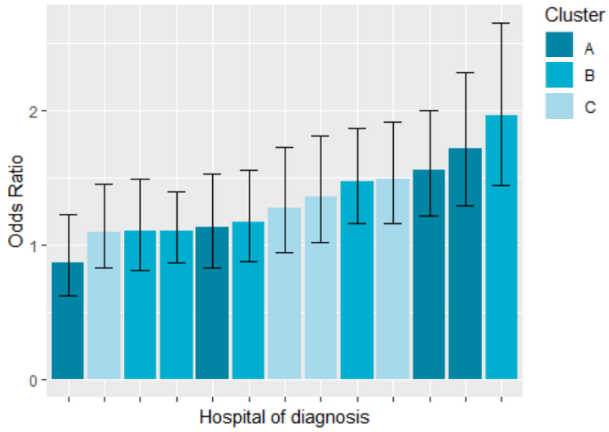
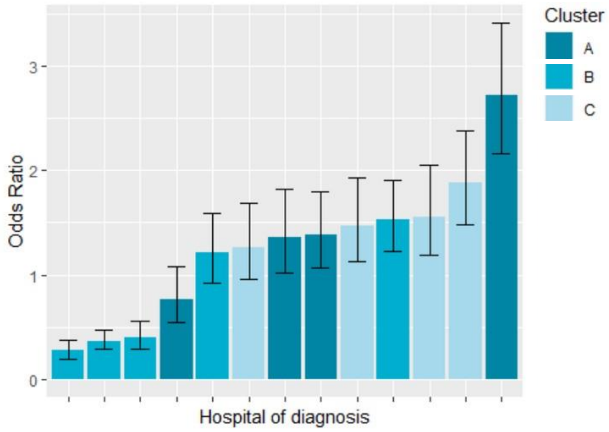


Figure 2
Odds ratios on the probability of receiving treatment with curative intent within six weeks after diagnosis for potentially curable EC and GC by the hospital of diagnosis on a logarithmic scale (N= 1798). Adjusted for: age, sex and cT classification.



3.1.2. Survival

For patients diagnosed with potentially curable EC or GC in T2 and treated with curative intent, the one-year survival was 84% at cluster A and 83% at clusters B and C (Appendix B). Of these patients, 63-68% was still alive two years after the diagnosis. No significant differences in the survival of patients treated with curative intent were observed among the hospital clusters (Figure 3). The same applies for the survival of patients treated without curative intent (Figure 4).

Figure 3
Survival curve of patients diagnosed in 2016-2019 (T1 and T2) with potentially curable EC or GC treated with curative intent per hospital of treatment.

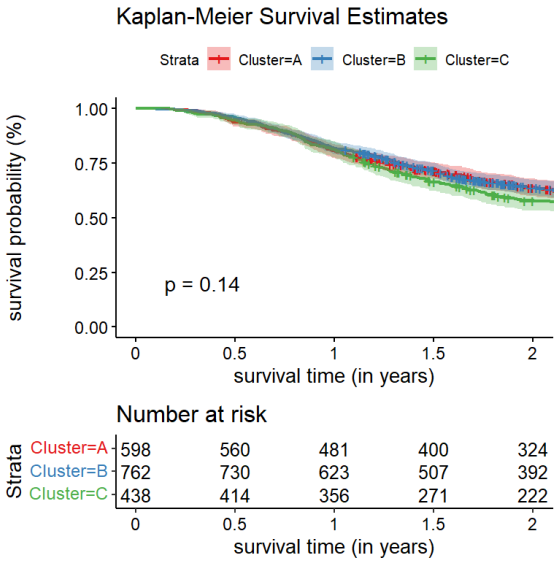
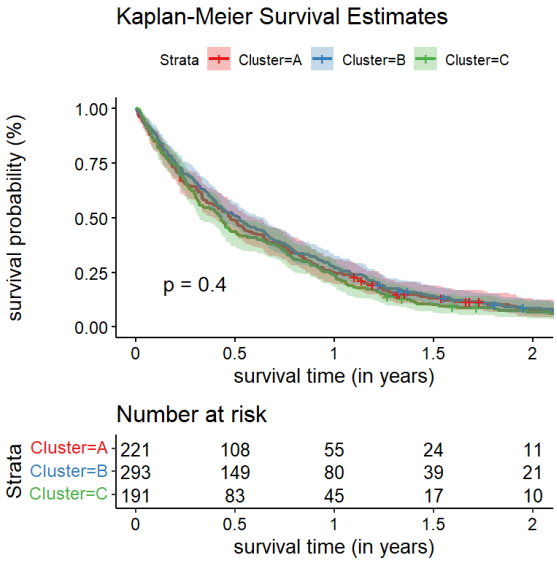


Figure 4
Survival curve of patients diagnosed in 2016-2019 (T1 and T2 with potentially curable EC or GC treated without curative intent per hospital of treatment.



3.1.3. Comparison with national benchmark

The proportion of patients receiving treatment with curative intent versus without curative intent did not differ between patients treated in the MCN or in other hospitals in the Netherlands (Table 6). For EC, relatively more patients were treated with endoscopic resection in the MCN (12% versus 7%, p <0.001) and less with neoadjuvant C(R)T and surgery (28% versus 33%, p=0.031). For GC, relatively more patients received CRT without surgery in the MCN (8% versus 5%, p=0.020).

The median lead time from diagnosis to the start of treatment with curative intent was five days longer for patients treated in the MCN in comparison to patients treated outside the MCN in T3 (p<0.001). The median lead time from MDT meeting to the start of treatment with curative intent of patients treated in the MCN did not differ from patients treated outside the MCN in T3.

In addition, the overall survival of patients treated with or without curative intent in the MCN did not differ from patients treated in other hospitals in the Netherlands (Figures 5 and 6). The one-year survival of patients diagnosed in T2 with potentially curable EC or GC treated with curative intent in the MCN was 83% and outside the MCN 84%. The two-year survival was 65% for patients treated with curative intent in the MCN and 66% for patients treated with curative intent outside the MCN.

Table 6
Comparison of treatment modalities and lead times in the MCN with other hospitals in the Netherlands (outside the MCN) for patients diagnosed with potentially curable EC or GC in 2020-2021 (T3).

	Treatment in the MCN	**Treatment outside the MCN**	***p***
Treatment EC	n = 577	n = 2375	
Treatment with curative intent	422 (73%)	1724 (73%)	*0.832*
Surgery only	8 (1%)	39 (2%)	*0.799*
CRT[a] without surgery	184 (32%)	737 (31%)	*0.727*
Neoadjuvant C(R)T[a] & surgery with/without adjuvant therapy	161 (28%)	776 (33%)	*0.031*
Neoadjuvant C(R)T[a] & surgery	139 (24%)	661 (28%)	*0.078*
Neoadjuvant C(R)T[a], surgery & adjuvant therapy	22 (4%)	115 (5%)	*0.345*
Endoscopic resection	69 (12%)	172 (7%)	*<0.001*
Treatment without curative intent	155 (27%)	651 (27%)	*0.832*
Other treatment	97 (17%)	408 (17%)	*0.882*
No treatment	58 (10%)	243 (10%)	*0.959*
Treatment gastric cancer	n = 261	n = 1384	
Treatment with curative intent	186 (71%)	934 (67%)	*0.259*
Surgery only	53 (20%)	238 (17%)	*0.263*
CRT[a] without surgery	22 (8%)	65 (5%)	*0.020*
Neoadjuvant C(R)T[a] & surgery with/without adjuvant therapy	106 (40%)	568 (41%)	*0.952*
Neoadjuvant C(R)T[a] & surgery	53 (20%)	280 (20%)	*1.000*
Neoadjuvant C(R)T[a], surgery & adjuvant therapy	53 (20%)	288 (21%)	*0.920*
Endoscopic resection	5 (2%)	63 (5%)	*0.073*
Treatment without curative intent	75 (29%)	450 (32%)	*0.259*
Other treatment	38 (15%)	195 (14%)	*0.918*
No treatment	37 (14%)	255 (18%)	*0.119*
Median lead time from diagnosis to start treatment with curative intent	(n = 608[b]) 44 (IQR:23)	(n = 2658[b]) 39 (IQR:19)	*<0.001*
Median lead time from MDT meeting to start treatment with curative intent	(n = 551[c]) 21 (IQR:16)	(n = 2373[c]) 20 (IQR 11)	*0.338*

[a] Chemo(radio)therapy: C(R)T
[b] Patients treated with curative intent.
[c] Patients discussed at an MDT meeting before the start of primary treatment with curative intent within the MCN.

Figure 5
Survival curve of patients diagnosed in 2018-2019 (T2) with potentially curable EC or GC treated with curative intent within the MCN compared to other hospitals in the Netherlands (outside MCN).

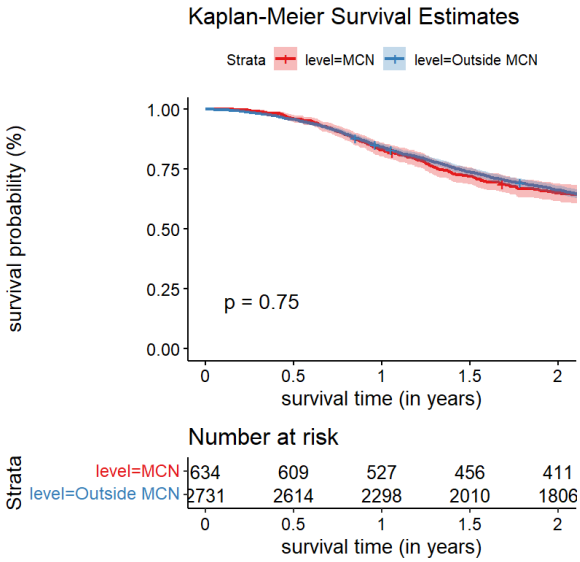
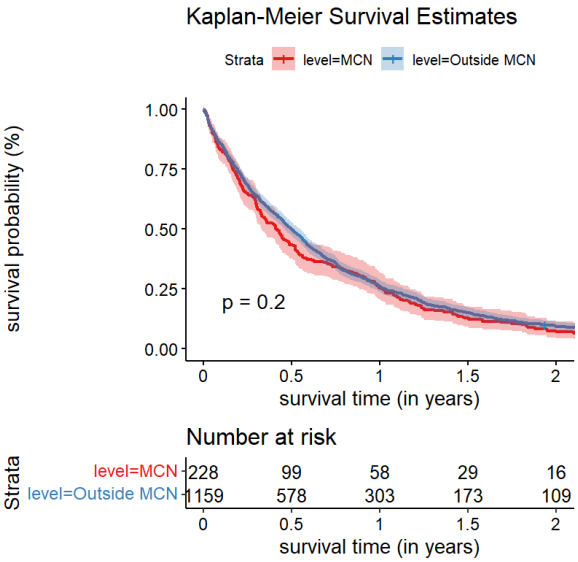


Figure 6
Survival curve of patients diagnosed in 2018-2019 (T2) with potentially curable EC or GC treated without curative intent within the MCN compared to other hospitals in the Netherlands (outside MCN).



3.2. Impact of the SMDT meetings

3.2.1. Characteristics of patients discussed at the SMDT meetings

From February 2022 until May 2023, 22 patients were discussed at the SMDT meetings. The characteristics of these patients are presented in Table 7. Most patients were signed up for discussion by hospital cluster A. About half of the patients (n=10) were discussed because of a progression or residual tumour.

A predictor with a lower likelihood of being discussed at a SMDT meeting was increased age (60-75 years: OR 0.315, p=0.001 and >75 years: OR 0.097, p=0.018). Predictors with a higher likelihood of being discussed at a SMDT meeting were other morphology (OR 7.250, p<0.001) and unknown comorbidities (OR 39.083, p<0.001).

3.2.2. Treatment, lead times and referrals (indicators 1 to 5)

All 12 patients who were diagnosed with potentially curable EC or GC, received treatment with curative intent after the discussion at the SMDT meeting (Table 8). Of the patients treated with curative intent, nine were treated for their primary tumour and two for a progression or residual tumour. No significant difference in the percentage of patients receiving primary treatment with a curative intent was identified in the comparison with the matched control group (p=0.554).

Table 7
Univariable and multivariable logistic regression analysis for determining predictors of being discussed in the SMDT meetings (N = 22 patients).

	n	Univariable analysis OR	*p*	Multivariable analysis OR	*p*
Hospital of application					
A	13 (59%)	1		1	
B	6 (27%)	0.350	0.034	0.326	0.033
C	3 (14%)	0.303	0.062	0.621	0.048
Age					
<60 years	10 (45%)	1		1	
60-75 years	9 (41%)	0.295	0.008	0.261	0.007
>75 years	3 (14%)	0.129	0.002	0.096	0.001
Gender					
Male	18 (82%)	1		1	
Female	4 (18%)	0.576	0.319	0.408	0.143
Clinical stage					
Potentially curable (cT1-4a & cM0)	12 (55%)	1		1	
Non-curable (cT4b or cM1)	10 (45%)	1.517	0.332	1.121	0.803
Tumour location					
Gastric	9 (41%)	1		1	
Oesophagus	13 (59%)	0.821	0.650	0.654	0.395
Morphology					
Adeno carcinoma	13 (59%)	1		1	
Squamous cell carcinoma	3 (14%)	1.177	0.799	1.979	0.334
Other	6 (27%)	5.944	<0.001	6.629	<0.001
Number of comorbidities by Charlson Comorbidity Index					
0 categories	7 (32%)	1		1	
1 category	5 (23%)	0.876	0.821	1.330	0.634
2 or more categories	3 (14%)	0.720	0.635	1.282	0.730
Unknown	7 (32%)	31.741	<0.001	42.734	<0.001

Table 8
Received treatment of patients after the SMDT meeting (N = 20 patients[a])

	n
Treatment with curative intent	12 (54%)
Patients diagnosed with potentially curable EC or GC	12 (100%)
Patients diagnosed with non-curable EC or GC	0 (0%)
Treatment without curative intent	8 (36%)
Patients diagnosed with potentially curable EC or GC	0 (0%)
Patients diagnosed with non-curable EC or GC	8 (100%)

[a] The received treatment of two patients is unknown.

The median lead time from diagnosis to the start of treatment with curative intent for the primary tumour varied largely for patients discussed at the SMDT meetings with a median of 41 days and an interquartile range of 56 days. The median lead time from the regional MDT meeting to the start of treatment with curative intent was 33 days. No significant difference in the lead time from diagnosis to the start of treatment with curative intent was identified in the comparison with the matched control group (p=0.347). The same applied for the lead time from the MDT meeting to the start of treatment with curative intent (p=0.253).

The median lead time from regional MDT meeting to SMDT meeting was four days, with an interquartile range of 20 days (Table 9). Half of the patients were discussed at both the regional MDT meeting and the SMDT meeting on the same day.

None of the patients discussed at the SMDT meetings was referred to a hospital outside the MCN. Two patients (9%) received a second opinion at a hospital outside the MCN.

Table 9
Median lead times of patients discussed at the SMDT meetings

	Days (Q1-Q3)
Diagnosis to start primary treatment with curative intent (n=9[a])	41 (27-83)
Regional MDT meeting to start treatment with curative intent (n=9[b])	33 (20-50)
Regional MDT meeting to SMDT meeting (n=18[b])	4 (0-20)

[a] Patients discussed because of a progression or residual tumour were excluded.
[b] Of four patients (one treated without curative intent) the date of the regional MDT meeting was unknown.

3.2.3. Presence of core disciplines and the referring specialist (indicators 8 and 9)

None of the SMDT meetings were attended by a surgeon, medical oncologist and radiation oncologist from all participating centres (Table 10). The referring medical specialist was present at half of the SMDT meetings. No association between the presence of the medical specialists and the outcome of the SMDT meetings (indicators 11 and 12) was identified (Appendix C).

Table 10
Presence of core disciplines (surgeon, medical oncologist and radiation oncologist) and referring medical specialist at the SMDT meetings (N = 22 SMDT meetings).

	n
Presence of core disciplines	
One or more core disciplines were absent	2 (9%)
Core disciplines were present irrespective of the centre	16 (73%)
Core disciplines of two centres were present	4 (18%)
Core disciplines of all participating centres were present	0 (0%)
Presence of referring medical specialist	
Absent	9 (41%)
Present	11 (50%)
Unknown	2 (9%)

3.2.4. Treatment advice of SMDT meeting versus regional MDT meeting (indicator 11)

For about half of the patients, the treatment advice that was established in the SMDT meeting deviated from the treatment advice established in the regional MDT meeting (Table 11). Deviations in treatment advice include adjustments in neoadjuvant or adjuvant treatment (n=2), an adjustment in primary treatment from surgery to definitive CRT (n=1), a difference in priority (n=1), an addition of treatment alternatives (n=1), an exclusion of trial treatment (n=1) and an exclusion of treatment for symptom relieve (n=1). For one patient the advice was revised from a curative to a palliative treatment strategy in case of no complete response to neoadjuvant treatment. Additionally, for two patients the treatment advice was adjusted because more clinical information was available at the time of the SMDT meeting.

The treatment advice of patients signed up by cluster B were less often revised compared to clusters A and C (OR=0.350, p=0.034). No other significant determinants for deviation of the treatment advices were identified (Appendix C).

3.2.5. Treatment advice of SMDT meeting versus received treatment (indicator 12)

In 65% (n=13) of the cases the received treatment was equal to the treatment advice of the SMDT meeting (Table 11). In 30% (n=6) of these cases the received treatment was also equal to the treatment advice of the regional MDT meeting. In one case the received treatment was equal to the advice of the regional MDT meeting which deviated from the advice of the SMDT meeting. In 30% (n=6) of the cases the received treatment was not equal to the advice of the regional MDT meeting or SMDT meeting. Of these cases, five were diagnosed with non-curable EC or GC and received treatment to relieve symptoms or no treatment instead of the recommended curative treatment. One patient did not receive the recommended neoadjuvant treatment.

Hence, a significant determinant for deviation between the treatment advice of the SMDT meeting and the received treatment is the clinical stage (Appendix C). Patients diagnosed with non-curable EC or GC have a higher likelihood of deviating from the recommended treatment strategy established in the SMDT meeting than patients diagnosed with potentially curable EC or GC (OR 18.083, p=0.040).

Table 11
Deviations in treatment advice of the SMDT meeting, regional MDT meetings and the received treatment per hospital that signed the patient up for discussion.[a]

	Cluster A	**Cluster B**	**Cluster C**	**Total**
Treatment advice of SMDT meeting versus regional MDT meeting	(n = 12)	(n = 6)	(n = 3)	(N = 21[b])
Equal	6 (50%)	3 (50%)	2 (67%)	11 (52%)
Deviates	6 (50%)	3 (50%)	1 (33%)	10 (48%)
Treatment advice versus received treatment	(n = 13)	(n = 6)	(n = 1)	(N = 20[c])
Treatment is equal to advice of SMDT meeting	8 (61%)	4 (67%)	1 (33%)	13 (65%)
Treatment is equal to advice of both regional MDT meeting and SMDT meeting	5 (38%)	0 (0%)	1 (33%)	6 (30%)
Treatment is equal to advice SMDT meeting	3 (23%)	4 (67%)	0 (0%)	7 (35%)
Treatment is equal to advice regional MDT meeting	1 (8%)	0 (0%)	0 (0%)	1 (5%)
Treatment is not equal to advice of SMDT meeting or regional MDT meeting	4 (31%)	2 (33%)	0 (0%)	6 (30%)

[a] Healthcare professionals involved in the SMDT meetings helped to determine whether the treatment advices and the actual received treatment deviated or not.
[b] Of one patient documentation about the regional MDT meeting was missing.
[c] Of two patients documentation about the received treatment was missing.

4. Discussion

In this study, variation in treatment and survival in the MCN EC and GC in the North-East region of the Netherlands was assessed for three successive periods and the impact of the pilot SMDT meetings was evaluated.

Over the past few years, more patients received CRT without surgery, endoscopic resection and perioperative C(R)T. Potentially curable patients diagnosed in the MCN equally received treatment with curative intent, regardless of the hospital of diagnosis. The median lead time from diagnosis to the start of treatment with curative intent varied significantly among the hospital clusters and individual hospitals. The percentage of patients referred to a hospital outside the MCN differed between the hospital clusters. Patients treated within the MCN had equal chances to survive, regardless of the cluster they were treated.

All potentially curable patients discussed at the SMDT meetings received treatment with curative intent. Patients discussed at the SMDT meetings had no delay in lead time to the start of treatment compared to a matched control group. The treatment advice of the SMDT meeting deviated from the advice of the regional MDT meeting for about half of the patients. The treatment recommended at the SMDT meeting was received by the majority of patients.

4.1. Variation in treatment and survival in the MCN

The increase in endoscopic resection for EC and perioperative C(R)T for GC is conform the Dutch Guidelines [4,5]. A study of Luijten et al. showed that the implementation of regional MDT meetings was associated with more endoscopic resections [28]. In our study, more patients underwent an endoscopic resection in the MCN compared to other hospitals in the Netherlands, which may indicate a relatively strong regional multidisciplinary collaboration within the MCN. The increase in CRT without surgery may be attributed to the SANO trial [36] comparing active surveillance versus surgery for patients with a clinically complete response to neoadjuvant CRT. Patients included in this trial underwent surgery only when a residual tumour was found in the absence of distant metastases. Another plausible explanation for the increase in CRT without surgery might be the impact of the COVID-19 pandemic, in which patients with EC and GC were less likely to undergo surgery [37].

Although the proportion of potentially curable patients receiving treatment with curative intent versus without curative intent was equal among the hospital clusters of the MCN in T3, significant differences existed among the clusters in T1 and T2. This is in contrast with the previous evaluation of the MCN, in which no significant differences in the proportion of curative versus non-curative treatment were observed among the clusters for patients diagnosed with EC in 2015-2016 [16]. The inclusion of GC in the present study may partly explain the observed variation in T1 and T2 since the volume norms for gastrectomies were introduced later than the volume norms for oesophagectomies (2011 versus 2013). This can be supported by the study of Luijten et al. who found that differences among hospitals in the Netherlands in the proportion of curative versus non-curative treatment reduced from 2012-2014 to 2015-2017 for patients with EC while it remained stable for patients with GC [13]. In addition, the number of hospital clusters in the MCN was reduced in our study from five to three.

The median lead time from diagnosis to the start of treatment with curative intent is significantly longer in the MCN compared to other Dutch hospitals and exceeded the SONCOS norm of six weeks [38]. Patients diagnosed in cluster B encountered the longest waiting time for the start of their treatment. The long lead time may be a signal for improving the efficiency of care. Yet, the median lead time from the MDT meeting to the start of treatment with curative intent in the MCN decreased over time, suggesting that the MDT meetings shifted to a later moment in the diagnostic process without affecting the start of the treatment.

The impact of lead times on the survival of patients is currently controversial. In this study no significant differences were observed in the survival of patients among the hospital clusters, indicating that the identified variation in lead time from diagnosis to the start of treatment among the clusters did not affect the survival of patients. This is in line with the study of Visser et al. who demonstrated that the waiting time from diagnosis to treatment with curative intent did not impact the survival of patients with potentially curable EC [39]. However, other studies did find evidence that oncological treatment delay is associated with poor prognosis and increased mortality [40,41].

The MCN managed to treat most patients within the MCN over the past few years. The remaining referrals may partly be explained by geographical factors since the percentage of patients referred to a hospital outside the MCN in cluster B was lower compared to the other clusters. The 'Integral Care Agreement networking tool' developed by the Netherlands Comprehensive Cancer Organisation can be used to gain more insight into where patients were referred to [42].

The outcomes of the analysis of the individual hospitals may provide leads for targeted evaluation and improvement. The results showed that at none of the hospitals in the MCN patients with potentially curable EC or GC encountered a lower likelihood to receive treatment with curative intent. Patients diagnosed at one hospital of cluster B were more likely to be treated with curative intent. Differences in the probability to receive treatment with curative intent between hospitals in the same cluster may occur if not all patients are discussed at the regional MDT meetings to improve the efficiency [43,44]. Regarding the lead time, patients diagnosed at three hospitals of cluster B were less likely to receive treatment with curative intent within six weeks after diagnosis. Factors causing the long lead time and potential improvements could be elucidated through a comparison with hospitals demonstrating a significantly shorter lead time (one at cluster A and one at cluster C).

Hence, this study shows that oncology networks may contribute to uniformity in treatment decisions and equal survival among hospitals, ensuring the quality and accessibility of care regardless of the hospital of diagnosis. The insights gained by this evaluation of variation in EC and GC care provide a basis for the continuous learning process of the MCN.

4.2. Impact of the SMDT meetings

For about half of the complex cases of EC and GC discussed at the SMDT meetings the treatment advice was adjusted. Another study, evaluating the impact of SMDT meetings for patients with a suspected diagnosis of a complex multi-system fibro-inflammatory disorder (IgG4-RD), also found a substantial rate of treatment advice adjustments (74%) [34]. Hence, both studies underscore the potential added value of SMDT meetings for complex medical conditions where strong evidence or expert consensus on treatment guidelines is lacking. However, in our study, the adjustments in the treatment advice were minimal. For two patients the deviation could be attributed to differences in the available clinical information. Moreover, the follow-up period was too short to examine the effect of the adjustments on the prognosis.

Although the majority of patients received the treatment recommended at the SMDT meeting, the results showed that in cases of non-curable EC or GC, there was a higher likelihood to deviate from the recommended treatment. This suggests that the SMDT meetings are more likely to be of added value to patients with potentially curable cancer. Nevertheless, especially for patients diagnosed with non-curable cancer, confirmation of the proposed treatment may be valuable for healthcare professionals. Despite this, five patients received palliative or no treatment instead of the recommended curative treatment, which may indicate that more attention could be paid to the patient preferences at the SMDT meetings to ensure a tailored treatment plan [45].

Some studies found that the implementation of oncological MDT meetings led to a delay in the start of treatment [46,47]. While the impact of lead times on survival is controversial, lead times should be minimised since the waiting time for treatment is stressful for patients and negatively

impacts their quality of life [48]. Our study showed that the SMDT meetings did not have a significant impact on the lead time from diagnosis to the start of treatment with curative intent and the lead time from the MDT meeting to the start of treatment with curative intent.

Accordingly, it can be argued that the SMDT meetings may be a good instrument to pool and exchange expertise, potentially reducing variation for complex cases of EC and GC, without affecting the lead time to the start of treatment for patients.

4.3. Strengths and limitations

This study contributes to the scarce scientific literature that is available about the impact of SMDT meetings and oncology networks. The extensive dataset of the MCN made it possible to perform statistical analyses with large patient groups and to gain a comprehensive overview of the effects of networking on variation in treatment and survival among clusters and individual hospitals. Moreover, the results were compared with a national benchmark, which helped to interpret the results of the MCN more accurately. Hence, by analysing at the national, regional, cluster and hospital level, we were able to identify leads for targeted evaluation and improvement.

Nevertheless, this study has several limitations. First, the results of the analysis of the pilot SMDT meetings should be interpreted carefully due to the limited number of included patients (22). However, presenting the preliminary results may contribute to the motivation required for the continuation of the SMDT meetings. Second, the follow-up period was limited. A longer follow-up period would have enabled the examination of variation in survival for patients diagnosed in 2020-2021 in the MCN and the examination of survival of patients discussed at the SMDT meetings. Third, the generalisability of the results is restricted, due to differences in for example patient population, regional agreements and organisation of care processes.

4.4. Recommendations for future research

To draw better-informed conclusions about the impact of the SMDT meetings, it is recommended to repeat this evaluation five years after the introduction of the SMDT meetings to ensure a larger study population and a follow-up period of at least two years. To gain more insight into the impact of the SMDT meetings on the prognosis of complex cases of EC or GC, other outcome indicators could be added such as complications after surgery or textbook outcome, a composite measure of parameters representing the (post)operative course [49]. Moreover, to gain further insight into the level of collaboration in the MCN, indicators about the percentage of patients participating in clinical studies or the performance of multi-centre studies could be added. Additionally, it may be valuable to perform a cost-benefit analysis of the SMDT meetings to determine whether the limited time of the healthcare professionals is optimally used. Furthermore, it might be valuable to implement pilot SMDT meetings in other oncology networks and perform the same evaluation to gain more generalisable insights into the impact of networking and SMDT meetings.

5. Conclusion

This evaluation demonstrated that the MCN contributed to uniformity in treatment decisions and equal survival for EC and GC among hospitals in the northeast region of the Netherlands. However, the MCN did not contribute to a reduction of variation in the lead time to the start of treatment. Based on the analysis at the national, regional, cluster and hospital level, targeted opportunities to further reduce variation were pointed out. The SMDT meetings can contribute to uniformity in treatment decisions for complex cases, without impacting the lead time to the start of treatment.

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Appendix A

Indicator 1

Name of the indicator	Percentage of potentially curable patients receiving treatment with curative intent
Numerator	Number of patients diagnosed with invasive potentially curable EC or GC that received a curative treatment strategy.
Denumerator	Total number of patients diagnosed with invasive potentially curable EC or GC.
Patient in and exclusion criteria	Inclusion: • Patients diagnosed with invasive potentially curable EC or GC (cT1-4a or cTx, cNany and cM0). • Patients treated within the MCN. Exclusion: • Patients diagnosed with non-invasive EC or GC. • Patients diagnosed with non-curable EC or GC (cT4B or cM1). • Patients who are not treated within the MCN.
Type of indicator	Process
Quality domain	Equity
Rationale	Previous studies have shown that variation in treatment and survival of patients with EC or GC exist [8–10]. Multiple studies describe that the probability of receiving treatment with curative intent for patients with EC or GC largely depends on the hospital of diagnosis in the Netherlands [11–13]. A prior evaluation showed that the introduction of the MCN EC and GC resulted in a reduction of variation in treatment between the hospitals in the northeast region of the Netherlands (period of measurement 2012-2016). Re-measuring this indicator helps to identify whether the supra- and regional collaborations contributed to a further reduction of variation in care for EC and GC within the MCN over the past few years.
Period of measurement	01-01-2016 until 31-12-2021 01-02-2022 until 31-05-2023
Definitions	cTNM = clinical classification of the malignant tumour before primary treatment; T = size and invasion of primary tumour; N = regional lymph nodes; M = distant metastasis; SMDT = supra-regional multidisciplinary team; MCN = managed clinical network; curative treatment strategies = only surgery, surgery with or without neoadjuvant C(R)T and with or without adjuvant therapy, CRT without surgery and endoscopic resection.

Indicator 2

Name of the indicator	Percentage of potentially curable patients receiving treatment without curative intent
Numerator	Number of patients diagnosed with invasive potentially curable EC or GC that did not receive a curative treatment strategy.
Denumerator	Total number of patients diagnosed with invasive potentially curable EC or GC.
Patient in and exclusion criteria	Inclusion: • Patients diagnosed with invasive potentially curable EC or GC (cT1-4a or cTx, cNany and cM0). • Patients diagnosed and treated within the MCN. Exclusion: • Patients diagnosed with a non-invasive EC or GC. • Patients diagnosed with non-curable EC or GC (cT4B or cM1). • Patients who are not treated within the MCN.
Type of indicator	Process
Quality domain	Equity
Rationale	Previous studies have shown that variation in treatment and survival of patients with EC or GC exist [8–10]. Multiple studies describe that the probability of receiving treatment with curative intent for patients with EC or GC largely depends on the hospital of diagnosis in the Netherlands [11–13]. A prior evaluation showed that the introduction of the MCN EC and GC resulted in a reduction of variation in treatment between the hospitals in the northeast region of the Netherlands [16]. Re-measuring this indicator helps to identify whether the supra- and regional collaborations contributed to a further reduction of variation in care for EC and GC within the MCN over the past few years.
Period of measurement	01-01-2016 until 31-12-2021 01-02-2022 until 31-05-2023
Definitions	cTNM = clinical classification of the malignant tumour before primary treatment; T = size and invasion of primary tumour; N = regional lymph nodes; M = distant metastasis; SMDT = supra-regional multidisciplinary team; MCN = managed clinical network; curative treatment strategies = only surgery, surgery with or without neoadjuvant C(R)T and with or without adjuvant therapy, CRT without surgery and endoscopic resection; treatment strategies without curative intent = other strategies than the ones defined as curative or no treatment.

Indicator 3

Name of the indicator	Median lead time from diagnosis (date diagnosis confirmed by pathology) to start of treatment with curative intent
Numerator	Median of the number of days between the date the diagnosis is confirmed by pathology and the date the patient received primary treatment with curative intent.
Denumerator	-
Patient in and exclusion criteria	Inclusion: • Patients diagnosed and treated for EC or GC within the MCN. • Patients receiving treatment with curative intent: only surgery, C(R)T without surgery, surgery after neoadjuvant C(R)T with or without adjuvant therapy, endoscopic resection. Exclusion: • Patients diagnosed with non-invasive EC or GC. • Patients who are not diagnosed and/or treated for EC or GC within the MCN. • Patients receiving treatment without curative intent. • Patients treated for a progression or residual tumour.
Type of indicator	Process
Quality domain	Timeliness
Rationale	The impact of lead times on the prognosis of patients is currently controversial. A study of Visser et al. demonstrated that the waiting time from diagnosis to treatment with curative intent did not impact the survival of patients with potentially curable EC [39]. However, other studies did find evidence that treatment delay is associated with poor prognosis and increased mortality [40,41]. In addition, the waiting time to treatment is stressful for patients and negatively impacts their quality of life [48]. Therefore, it is included in the Dutch SONCOS norms that healthcare organisations should ensure that patients receive primary treatment within 6 weeks after a malignant diagnosis [38]. Studies have shown that variation in treatment and lead time of patients with EC or GC exist [8–13]. A prior evaluation showed that the introduction of the MCN EC and GC resulted in a reduction of variation in lead time between the hospitals in the northeast region of the Netherlands (period of measurement 2012-2016) [16]. Re-measuring this indicator helps to identify whether the supra- and regional collaborations have resulted in a further reduction of variation in lead time and optimisation of EC and GC care in the MCN.
Period of measurement	01-01-2016 until 31-12-2021 01-02-2022 until 31-05-2023
Definitions	SMDT = supra-regional multidisciplinary team; MCN = managed clinical network.

Indicator 4

Name of the indicator	Median lead time from MDT meeting to the start of primary treatment with curative intent
Numerator	Median of the number of days between the date the patient is discussed at a MDT meeting and the date the patient received primary treatment with curative intent.
Denumerator	-
Patient in and exclusion criteria	Inclusion: • Patients diagnosed and treated for EC or GC within the MCN. • Patients discussed at a MDT meeting. • Patients receiving treatment with curative intent: only surgery, C(R)T without surgery, surgery after neoadjuvant C(R)T with or without adjuvant therapy, ER. Exclusion: • Patients diagnosed with non-invasive EC or GC. • Patients who are not diagnosed and/or treated for EC or GC within the MCN. • Patients who are not discussed at a regional MDT meeting. • Patients receiving treatment without curative intent.
Type of indicator	Process
Quality domain	Timeliness
Rationale	The impact of lead times on the prognosis of patients is currently controversial. A study of Visser et al. demonstrated that the waiting time from diagnosis to treatment with curative intent did not impact the survival of patients with potentially curable EC [39]. However, other studies did find evidence that treatment delay is associated with poor prognosis and increased mortality [40,41]. In addition, the waiting time to treatment is stressful for patients and negatively impacts their quality of life [48]. Therefore, it is included in the Dutch SONCOS norms that healthcare organisations should ensure that patients receive primary treatment within 6 weeks after a malignant diagnosis [38]. Hence, the median lead time for patients with EC or GC should be minimised, yet their should be sufficient time for accurate decision-making. Measuring this indicator helps to identify to what extent there is more time needed to discuss patients in both a SMDT meeting and (regional) MDT meeting compared to only a (regional) MDT meeting.
Period of measurement	01-01-2016 until 31-12-2021 01-02-2022 until 31-05-2023
Definitions	SMDT = supra-regional multidisciplinary team; MCN = managed clinical network

Indicator 5

Name of the indicator	Percentage of patients referred to a hospital outside the MCN.
Numerator	Number of patients that is referred to a healthcare organisation that is not connected to the MCN EC and GC in the northeast region of the Netherlands.
Denumerator	Total number of patients diagnosed with EC or GC within the MCN in the northeast region of the Netherlands.
Patient in and exclusion criteria	Inclusion: • Patients diagnosed with EC or GC within the MCN. Exclusion: • Patients diagnosed with non-invasive EC or GC. • Patients who are not diagnosed with EC or GC within the MCN.
Type of indicator	Process
Quality domain	Effectiveness
Rationale	Measuring this indicator helps to identify whether the supra- and regional collaborations within the MCN contributed to a decrease of referrals to hospitals outside the MCN. A decrease in the outcome of this indicator may indicate that the collaboration within the MCN is improved, enhancing the accessibility of the individual hospitals to expertise and (expensive) technologies required to manage the increasing complexity of EC and GC care.
Period of measurement	01-01-2016 until 31-12-2021 01-02-2022 until 31-05-2023
Definitions	SMDT = supra-regional multidisciplinary team; MCN = managed clinical network.

Indicator 6

Name of the indicator	One-year survival
Numerator	Number of patients that is alive one year after the patient was diagnosed with EC or GC within the MCN.
Denumerator	Total number of patients diagnosed and treated for EC or GC within the MCN.
Patient in and exclusion criteria	Inclusion: • Patients diagnosed and treated for EC or GC within the MCN. • Patients treated with curative intent. Exclusion: • Patients diagnosed with a non-invasive EC or GC. • Patients who were not diagnosed or treated within the MCN. • Patients who were treated without curative intent.
Type of indicator	Outcome
Quality domain	Equity
Rationale	Previous studies have shown that variation in treatment and survival of patients with EC or GC exist [8–10]. Multiple studies describe that the probability of receiving treatment with curative intent for patients with EC or GC largely depends on the hospital of diagnosis in the Netherlands [11–13]. A low probability of undergoing treatment with curative intent was associated with a worse overall survival. A previous evaluation showed that the introduction of the MCN for EC and GC resulted in a reduction of variation in survival between the hospitals in the northeast region of the Netherlands [16]. Re-measuring this indicator helps to identify whether the supra- and regional collaborations contributed to a further reduction of variation in care for EC and GC within the MCN over the past few years. Specifically, the one-year survival provides information about the initial response of patients after treatment.
Period of measurement	01-01-2016 until 31-12-2019
Definitions	cTNM = clinical classification of the malignant tumour before primary treatment; T = size and invasion of primary tumour; N = regional lymph nodes; M = distant metastasis; SMDT = supra-regional multidisciplinary team; MCN = managed clinical network; curative treatment strategies = only surgery, surgery with or without neoadjuvant C(R)T and with or without adjuvant therapy, CRT without surgery and endoscopic resection; treatment strategies without curative intent = other strategies than the ones defined as curative or no treatment.

Indicator 7

Name of the indicator	Two-year survival
Numerator	Number of patients that is alive two years after the patient was diagnosed with EC or GC within the MCN.
Denumerator	Total number of patients diagnosed and treated for EC or GC within the MCN.
Patient in and exclusion criteria	Inclusion: • Patients diagnosed and treated for EC or GC within the MCN. • Patients treated with curative intent. Exclusion: • Patients diagnosed with a non-invasive EC or GC. • Patients who are not diagnosed or treated within the MCN. • Patients who were treated without a curative intent.
Type of indicator	Outcome
Quality domain	Equity
Rationale	Previous studies have shown that variation in treatment and survival of patients with EC or GC exist [8–10]. Multiple studies describe that the probability of receiving treatment with curative intent for patients with EC or GC largely depends on the hospital of diagnosis in the Netherlands [11–13]. A low probability of undergoing treatment with curative intent was associated with a worse overall survival. A prior evaluation showed that the introduction of the MCN for EC and GC resulted in a reduction of variation in survival between the hospitals in the northeast region of the Netherlands [16].]. Re-measuring this indicator helps to identify whether the supra- and regional collaborations contributed to a further reduction of variation in care for EC and GC within the MCN over the past few years. Specifically, the one-year survival provides information about the initial response of patients after treatment. Specifically, the two-year survival provides information about the effectiveness of the treatment.
Period of measurement	01-01-2016 until 31-12-2019
Definitions	cTNM = clinical classification of the malignant tumour before primary treatment; T = size and invasion of primary tumour; N = regional lymph nodes; M = distant metastasis; SMDT = supra-regional multidisciplinary team; MCN = managed clinical network; curative treatment strategies = only surgery, surgery with or without neoadjuvant C(R)T and with or without adjuvant therapy, CRT without surgery and endoscopic resection; treatment strategies without curative intent = other strategies than the ones defined as curative or no treatment.

Indicator 8

Name of the indicator	Presence of at least one surgeon, one medical oncologist and one radiation oncologist from each participating centre to discuss the treatment advice of the patients at the SMDT meetings.
Numerator	-
Denumerator	-
Answer categories	0 = One or more core disciplines are absent. 1 = Core disciplines are present (irrespective of which centres). 2 = Core disciplines of two participating centres are present. 3 = Core disciplines of each participating centre are present.
Patient in and exclusion criteria	Inclusion: • Patients discussed in a SMDT meeting. Exclusion: • Patients who are not discussed in a SMDT meeting. • Patients with incomplete or missing documentation about the healthcare professionals present at the SMDT meeting.
Type of indicator	Structure
Quality domain	Effectiveness
Rationale	A high-quality MDT meeting can only be guaranteed if at least one member of each core discipline is present [50]. A previous study about the implementation of SMDT meetings for EC and GC identified that the core members of SMDT meetings are a surgeon, a medical oncologist and a radiation oncologist from each participating centre [51].
Period of measurement	01-02-2022 until 31-05-2023
Definitions	MDT = multidisciplinary team, SMDT = supra-regional multidisciplinary team, core disciplines = surgeon, medical oncologist and radiation oncologist.

Indicator 9

Name of the indicator	Presence of the healthcare professional that signed the patient up for discussion at the SMDT meeting.
Numerator	-
Denumerator	-
Answer categories	Yes/No
Patient in and exclusion criteria	Inclusion: • Patients discussed in a SMDT meeting. Exclusion: • Patients who are not discussed in a SMDT meeting. • Patients with incomplete or missing documentation about the healthcare professionals present at the SMDT meeting. • Patients with incomplete or missing documentation about the healthcare professional that signed up the patient for discussion at the SMDT meeting.
Type of indicator	Structure
Quality domain	Effectiveness
Rationale	The presence of the healthcare professional that signed up the patient for discussion is included as a quality criterium in the template for the performance of regional MDT meetings that was used for the setup of the SMDT meetings [29]. It is important that the referring healthcare professional is present to ensure that the treatment advice is established based on relevant medical and personal information of the patient. A tailored treatment plan and a patient-centered approach cannot be guaranteed if the referring healthcare professional is absent [45,52].
Period of measurement	01-02-2022 until 31-05-2023
Definitions	MDT = multidisciplinary team, SMDT = supra-regional multidisciplinary team.

Indicator 10

Name of the indicator	Median lead time from regional MDT meeting to SMDT meeting
Numerator	Median of the number of days between the date the patient is discussed at the regional MDT meeting and the date the patient is discussed at the SMDT meeting.
Denumerator	-
Patient in and exclusion criteria	Inclusion: • Patients discussed in both a SMDT meeting and a regional MDT meeting for EC and GC. Exclusion: • Patients who are not discussed in a SMDT meeting and/or regional MDT meeting for EC and GC.
Type of indicator	Process
Quality domain	Timeliness
Rationale	The impact of lead times on the prognosis of patients is currently controversial. A study of Visser et al. demonstrated that the waiting time from diagnosis to treatment with curative intent did not impact the survival of patients with potentially curable EC [39]. However, other studies did found evidence that treatment delay is associated with poor prognosis and increased mortality [40,41]. In addition, the waiting time to treatment is stressful for patients and negatively impacts their quality of life [48]. Therefore, it is included in the Dutch SONCOS norms that healthcare organisations should ensure that patients receive primary treatment within 6 weeks after a malignant diagnosis [38]. Hence, the median lead time for patients with EC and GC should be minimised, yet their should be sufficient time for accurate decision-making. Measuring this indicator helps to gain insight in the time that is needed to discuss a patient in both a supra- and regional MDT meeting.
Period of measurement	01-02-2022 until 31-05-2023
Definitions	MDT = multidisciplinary team; SMDT = supra-regional multidisciplinary team.

Indicator 11

Name of the indicator	Percentage of patients for whom the treatment advice of the regional MDT meeting deviated from the treatment advice of the SMDT meeting
Numerator	Number of patients with a treatment advice established in a SMDT meeting that deviated from the treatment advice established in a regional MDT meeting for EC and GC.
Denumerator	Total number of patients discussed at both a supra- and regional MDT meeting for EC and GC.
Patient in and exclusion criteria	Inclusion: • Patients discussed in both a supra- and regional MDT meeting for EC and GC. Exclusion: • Patients who are not discussed in a SMDT meeting and/or regional MDT meeting for EC and GC. • Patients with incomplete or missing documentation about the treatment advice of the SMDT meeting and/or regional MDT meeting.
Type of indicator	Process
Quality domain	Effectiveness
Rationale	The available evidence indicates that SMDT meetings may improve decision-making and clinical outcomes for complex, multidisciplinary diseases [33,34]. Measuring this indicator helps to identify whether the SMDT meetings improve decision-making for complex cases of EC and GC.
Period of measurement	01-02-2022 until 31-05-2023
Definitions	MDT = multidisciplinary team, SMDT = supra-regional multidisciplinary team.

Indicator 12

Name of the indicator	Percentage of patients for whom the actual received treatment deviated from the treatment advice of the SMDT meeting
Numerator	Number of patients with a treatment advice of a SMDT meeting that deviated from the treatment the patient received.
Denumerator	Total number of patients discussed at the SMDT meetings.
Patient in and exclusion criteria	Inclusion: • Patients discussed in a SMDT meeting. Exclusion: • Patients who are not discussed in a SMDT meeting. • Patients with incomplete or missing documentation about the treatment advice of the SMDT meeting and/or the received treatment.
Type of indicator	Process
Quality domain	Effectiveness
Rationale	The available evidence indicates that SMDT meetings may improve decision-making and clinical outcomes for complex, multidisciplinary diseases [33,34]. Measuring this indicator helps to identify whether the SMDT meetings improve decision-making for complex cases of EC and GC.
Period of measurement	01-02-2022 until 31-05-2023
Definitions	MDT = multidisciplinary team; SMDT = supra-regional multidisciplinary team.

Appendix B

Overall survival

Table 12
Overall survival of patients with potentially curable EC or GC treated within the MCN by year of diagnosis

	n	One-year survival	Two-year survival
Treatment with curative intent			
2016-2017 (T1)			
Cluster A	192	150 (78%)	122 (64%)
Cluster B	223	183 (82%)	143 (64%)
Cluster C	141	109 (77%)	76 (54%)
2018-2019 (T2)			
Cluster A	208	174 (84%)	142 (68%)
Cluster B	259	215 (83%)	164 (63%)
Cluster C	167	138 (83%)	105 (63%)
Treatment without curative intent			
2016-2017 (T1)			
Cluster A	74	16 (22%)	4 (5%)
Cluster B	87	16 (18%)	6 (7%)
Cluster C	86	20 (23%)	7 (8%)
2018-2019 (T2)			
Cluster A	74	17 (23%)	6 (8%)
Cluster B	107	33 (31%)	8 (7%)
Cluster C	47	8 (17%)	2 (4%)

Appendix C

Determinants for deviation in treatment advice and received treatment

Table 13
Univariable and multivariable logistic regression analysis for identifying determinants of deviation between the treatment advice of the SMDT meeting and the regional MDT meeting (n=21).

	Treatment advice of supra- versus regional MDT meeting		**Univariable analysis**		**Multivariable analysis**	
	Equal (n = 11)	Deviates (n = 10)	OR	*p*	OR	*p*
Hospital of application						
A	6 (55%)	6 (60%)	1		1	
B	3 (27%)	3 (30%)	0.350	0.034	23.86	0.236
C	2 (18%)	1 (10%)	0.303	0.062	0.065	0.259
Age	54 (IQR:20)	64 (IQR:12)	1.051	0.202	0.378	1.045
Gender						
Male	10 (91%)	7 (70%)	1		1	
Female	1 (9%)	3 (30%)	4.286	0.246	6.913	0.291
Clinical stage						
Potentially curable (cT1-4a & cM0)	5 (45%)	6 (60%)	1		1	
Non-curable (cT4b or cM1)	6 (55%)	4 (40%)	0.555	0.507	0.157	0.235

Table 14
Univariable and multivariable logistic regression analysis for identifying determinants of deviation between the treatment advice of the SMDT meeting and the received treatment (n=19).

	Treatment advice of SMDT meeting versus received treatment		**Univariable analysis**		**Multivariable analysis**	
	Equal (n=13)	Deviates (n=7)	OR	*p*	OR	*p*
Hospital of application						
A	8 (61%)	5 (71%)	1		1	
B	4 (31%)	2 (29%)	0.800	0.830	1.123	0.944
C	1 (8%)	0 (0%)	<0.001	0.995	<0.001	0.997
Age	59 (IQR:21)	65 (IQR:12)	1.061	0.205	1.074	0.195
Gender						
Male	10 (77%)	6 (86%)	1		1	
Female	3 (23%)	1 (14%)	0.555	0.751	0.334	0.478
Clinical stage						
Potentially curable (cT1-4a & cM0)	9 (69%)	1 (14%)	1			
Non-curable0 (cT4b or cM1)	4 (31%)	6 (86%)	13.504	0.035	18.083	0.040

Table 15
Fisher's Exact test for examining the association between the presence of medical specialists at the SMDT meetings and the deviation between treatment advices and received treatment (N = 22 SMDT meetings).

	n	***p***
Presence of core disciplines		
1 or more core disciplines are absent	2 (9%)	
Core disciplines are present irrespective of the centre	16 (73%)	
Core disciplines of two centres are present	4 (18%)	
Core disciplines of all participating centres are present	0 (0%)	
Presence of referring medical specialist		
Absent	9 (41%)	
Present	11 (50%)	
Unknown	2 (9%)	
Association with deviation between treatment advice of SMDT meeting and regional MDT meeting		
Presence of core disciplines		*0.441*
Presence of referring medical specialist		*1.000*
Association with deviation between treatment advice of SMDT meeting and received treatment		
Presence of core disciplines		*0.793*
Presence of referring medical specialist		*1.000*