Disparities in Early Diagnosis, Treatment, and Survival Outcomes among Patients with Early-Onset Colorectal Cancer in Texas

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INTRODUCTION

- Early-onset colorectal cancer (EO-CRC) is defined as the colorectal cancer diagnosed in patients **under 50 years**, which accounts for approximately **10%** of the new colorectal cancer diagnosis.[1,2]
- In contrast to the late-onset colorectal cancer (50 years or older) whose incidence and mortality continuously declined in the last a few decades, **the incidence and mortality of EO-CRC keep increasing.**[1]
- **Texas-Mexico border (TMB) is a medically underserved region** with numerous health-care access barriers. Previous research has discovered a poor presentation and a poor prognosis in other cancer types, including blood cancers.[3-5]
- **Disparities in the demographics** between Texas-Mexico border (TMB) and non-border area is significant.[6]
- Evidence of the disparities **in early-diagnosis, treatment and survival** outcomes of EO-CRC is still limited.

OBJECTIVES

- This study aims to determine if **disparities in early diagnosis, treatment, and survival outcomes** existed between **urban vs. rural**, as well as between **US-Mexico border vs. non-border areas** among EO-CRC patients in Texas.

METHOD

❑ **Study design**
- **Secondary database analysis study**

❑ **Data source**
- **Texas cancer registry (TCR) limited use data** (2011-2019)
- TCR is a statewide, population-based registry, which collects information on all cancer cases diagnosed and treated in Texas.

❑ **Study population**
- **EO-CRC population** (18-49 years old) (**ICD-O-2/3 code**)[7]
- **Exclusion criteria:**
  - Metastatic or unknown stage
  - Cases identified by death certificate only
  - Date of diagnosis, treatment, or last contact missing
  - Demographic information missing

❑ **Outcomes**
- Age at diagnosis
- Time between diagnosis to treatment
- Optimal (NCCN guideline-concordant)[8,9] treatment receipt
- Overall and 5-year survival

❑ **Stratified analysis**
- Analysis stratified by stage (In situ/localized; regional)

❑ **Main independent variables**
- Texas-Mexico border vs. non-border residence
- Urban vs. rural area residence

❑ **Other independent variables**
- Age at diagnosis
- Sex
- Race/ethnicity
- Insurance type
- Poverty index
- Comorbidities

RESULTS

❑ Demographic characteristics

	Overall	Texas-Mexico border			Urban area residence		
		Border	Non-Border	p-value	Urban	Rural	p-value
Sample size (%)	8,099	624 (7.7%)	7,475 (92.3%)		7,244 (89.4%)	855 (10.6%)	
Mean age at diagnosis(std)	41.6 (6.9)	41.5 (6.8)	41.6 (6.8)	0.6713	41.5 (0.1)	42.5 (0.2)	<.0001
Sex							
Male	4,323 (53.4%)	353 (56.6%)	3,970 (53.1%)	0.1033	3,852 (53.2%)	471 (55.1%)	0.2890
Female	3,776 (46.6%)	271 (43.4%)	3,505 (46.9%)		3,392 (46.8%)	384 (44.9%)	
Race/Ethnicity							
Hispanic	2,135 (26.4%)	511 (81.9%)	1,624 (21.7%)		1,906 (26.3%)	229 (26.8%)	
NH-White	4,424 (54.6%)	97 (15.5%)	4,327 (57.9%)		3,884 (53.6%)	540 (63.2%)	
NH-Black	1,175 (14.5%)	10 (1.6%)	1,165 (15.6%)	<.0001	1,095 (15.1%)	80 (9.4%)	<.0001
NH-AIAN	34 (0.4%)	0 (0%)	34 (0.5%)		31 (0.4%)	3 (0.4%)	
NH-Asian	316 (3.9%)	5 (0.8%)	311 (4.2%)		313 (4.3%)	3 (0.4%)	
NH-PI	15 (0.2%)	1 (0.2%)	14 (0.2%)		15 (0.2%)	0 (0%)	
Insurance type							
No insurance	1,324 (16.4%)	129 (20.7%)	1,195 (16%)		1,186 (16.4%)	138 (16.1%)	
Self-insured	4,640 (57.3%)	265 (42.5%)	4,375 (58.5%)		4,196 (57.9%)	444 (51.9%)	
Public	1,175 (14.5%)	135 (21.6%)	1,040 (13.9%)	<.0001	1,019 (14.1%)	156 (18.3%)	0.0002
Insured-NOS	586 (7.2%)	66 (10.6%)	520 (7%)		504 (7%)	82 (9.6%)	
Unknown	374 (4.6%)	29 (4.7%)	345 (4.6%)		339 (4.7%)	35 (4.1%)	
Poverty index							
0-5%	1,515 (18.7%)	17 (2.7%)	1,498 (20%)		1,498 (20.7%)	17 (2%)	
5-9.9%	1,763 (21.8%)	58 (9.3%)	1,705 (22.8%)		1,654 (22.8%)	109 (12.8%)	
10-19.9%	2,556 (31.5%)	127 (20.4%)	2,429 (32.5%)	<.0001	2,115 (29.2%)	441 (51.6%)	<.0001
20-100%	2,265 (28.0%)	422 (67.6%)	1,843 (24.7%)		1,977 (27.3%)	288 (33.7%)	
Charlson comorbidity index							
0	4,816 (59.5%)	347 (55.6%)	4,469 (59.8%)		4,288 (59.2%)	528 (61.8%)	
1	475 (5.9%)	48 (7.7%)	427 (5.7%)		416 (5.7%)	59 (6.9%)	
>=2	182 (2.2%)	8 (1.3%)	174 (2.3%)	0.0169	168 (2.3%)	14 (1.6%)	0.0959
Unknown	2,626 (32.4%)	221 (35.4%)	2,405 (32.2%)		2,372 (32.7%)	254 (29.7%)	
Stage							
In situ/localized	3,553 (43.9%)	260 (41.7%)	3,293 (44.1%)	0.2484	3,181 (43.9%)	372 (43.5%)	0.8221
Regional	4,546 (56.1%)	364 (58.3%)	4,182 (56%)		4,063 (56.1%)	483 (56.5%)	

NH = Non-Hispanic NOS = Not otherwise specified

❑ Age at diagnosis
- Bivariate (Mann-Whitney U test) and multivariate analysis (Logistic regression)

Age at diagnosis	Overall	Texas-Mexico border			Urban area residence		
		Border	Non-Border	p-value	Urban	Rural	p-value
<45 years	4,535 (56.0%)	354 (56.7%)	4,181 (55.9%)	0.6998	4,106 (56.7%)	429 (50.2%)	0.0003
>=45 years	3,564 (44.0%)	270 (43.3%)	3,294 (44.1%)		3,138 (43.3%)	426 (49.8%)	

Age at diagnosis	In situ/localized			Regional		
(event: <45 years)	Odds ratio	95% CI	p-value	Odds ratio	95% CI	p-value
Border (ref: non-border)						
Border	1.01	0.77-1.31	0.971	1.06	0.84-1.33	0.6164
Metro area (ref: urban)						
Rural	0.82	0.66-1.02	0.0747	0.76	0.62-0.92	0.0046
Sex (ref: Male)						
Female	1.09	0.95-1.24	0.2154	1.13	1.00-1.27	0.0432
Poverty index (ref: 0-5%)						
5-9.9%	1.31	1.06-1.61	0.0129	0.91	0.75-1.09	0.3096
10-19.9%	1.09	0.9-1.33	0.3844	0.92	0.77-1.1	0.3654
20-100%	1.13	0.92-1.40	0.2528	0.98	0.81-1.18	0.8451
Insurance type (ref: self-insured)						
No insurance	1.32	1.08-1.62	0.0072	1.20	1.02-1.42	0.0286
Public	0.87	0.72-1.05	0.1474	1.24	1.03-1.49	0.0205
Insured-unspecified	1.01	0.78-1.31	0.9182	0.68	0.54-0.87	0.0016
Unknown	0.74	0.54-1.00	0.052	1.13	0.85-1.52	0.4035

Among patients **in regional stage, those from rural areas (50.2%) were less likely to be diagnosed at age younger than 45** (OR=0.76, 95% CI 0.62-0.92, p=0.0046) compared to those from urban areas (**56.7%).**

	In situ/localized			Regional		
	Hazard ratio	95% CI	p-value	Hazard ratio	95% CI	p-value
Border (ref: non-border)						
Border	1.18	0.81-1.71	0.3797	0.99	0.79-1.23	0.9299
Metro area (ref: urban)						
Rural	1.05	0.77-1.45	0.7547	0.94	0.77-1.15	0.5574
Age at diagnosis	1.05	1.04-1.07	<.0001	1.00	0.99-1.01	0.738
Sex (ref: Male)						
Female	0.74	0.60-0.92	0.0071	0.80	0.70-0.91	0.0006
Poverty index (ref: 0-5%)						
5-9.9%	1.34	0.86-2.10	0.1935	1.45	1.15-1.83	0.002
10-19.9%	2.02	1.35-3.01	0.0006	1.59	1.27-1.98	<.0001
20-100%	2.03	1.35-3.04	0.0007	1.84	1.47-2.29	<.0001
Insurance type (ref: self-insured)						
No insurance	2.13	1.58-2.87	<.0001	1.20	1.01-1.42	0.0427
Public	2.7	2.06-3.53	<.0001	1.88	1.59-2.22	<.0001
Insured-unspecified	1.9	1.29-2.79	0.0012	1.06	0.83-1.36	0.6592
Unknown	1.26	0.74-2.16	0.4404	0.80	0.58-1.10	0.1666

❑ Optimal treatment receipt
- Bivariate (Mann-Whitney U test) and multivariate analysis (Logistic regression)

Optimal treatment receipt	Overall	Texas-Mexico border			Urban area residence		
		Border	Non-Border	p-value	Urban	Rural	p-value
Optimal treatment	5,922 (76.1%)	423 (72.6%)	5,499 (76.4%)	0.0376	5,282 (75.9%)	640 (78.0%)	0.1642
Sub-optimal treatment	1,861 (23.9%)	160 (27.4%)	1,701 (23.6%)		1,681 (24.1%)	180 (22.0%)	

Optimal treatment receipt	In situ/localized			Regional		
event: optimal treatment	Odds ratio	95% CI	p-value	Odds ratio	95% CI	p-value
Border (ref: non-border)						
Border	0.78	0.54-0.78	0.2116	0.9	0.71-1.15	0.4161
Metro area (ref: urban)						
Rural	1.33	0.91-1.94	0.1429	1.16	0.94-1.44	0.1685
Age at diagnosis	0.96	0.94-0.98	<.0001	0.99	0.98-0.999	0.0424
Sex (ref: Male)						
Female	1.19	0.96-1.49	0.1102	1.07	0.94-1.21	0.3149
Poverty index (ref: 0-5%)						
5-9.9%	1.00	0.7-1.44	0.9953	1.13	0.93-1.39	0.2226
10-19.9%	0.84	0.6-1.18	0.3121	1.1	0.91-1.33	0.309
20-100%	0.74	0.52-1.04	0.0844	0.99	0.81-1.21	0.9155
Insurance type (ref: self-insured)						
No insurance	0.64	0.47-0.87	0.004	1.07	0.9-1.29	0.4356
Public	0.91	0.66-1.25	0.5675	0.81	0.67-0.99	0.0376
Insured-unspecified	0.44	0.31-0.62	<.0001	0.79	0.61-1.01	0.0557
Unknown	0.62	0.39-0.998	0.0492	0.69	0.51-0.93	0.0147

- Compared to non-border areas, a **lower proportion of patients from border areas received optimal treatment** (76.4% vs. 72.6%, p=0.0367).
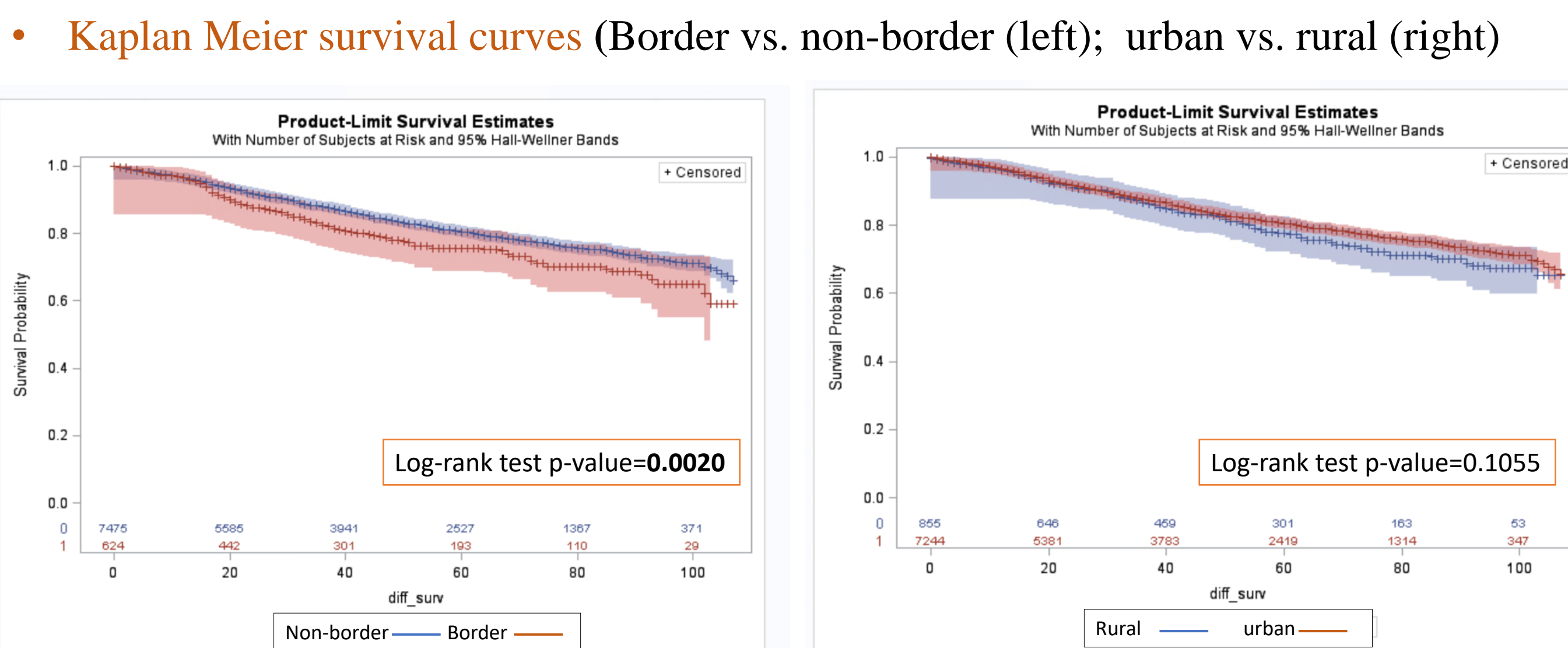
❑ Time between diagnosis to treatment
- There was no significant difference in diagnosis to treatment time between border vs. non-border or urban vs. rural areas.

❑ 5-year survival
- Life-table estimates

	In situ/localized		Regional	
	5-year survival rate (SE)	p-value	5-year survival rate (SE)	p-value
Border	84.91% (0.0270)	0.0418	69.75% (0.0294)	0.0598
Non-border	89.73% (0.00646)		73.21% (0.00860)	
Rural	86.23% (0.0220)	0.1066	71.48% (0.0251)	0.4283
Urban	89.78% (0.00654)		73.11% (0.00875)	

- Kaplan Meier survival curves (Border vs. non-border (left); urban vs. rural (right))

Log-rank test p-value=**0.0020**

Log-rank test p-value=0.1055

- The **5-year survival rates were significantly lower for in situ/localized patients in border areas** compared to non-border areas [84.9% vs. 89.7%, p=0.0418].
- The K-M curve indicates that compared to those from non-border area, **patients from border area have a worse survival** experience (p=0.002).

❑Overall survival
- Cox proportional hazard model
- There was no significant difference in hazard rates for overall survival between border vs. non-border or urban vs. rural areas.

DISCUSSION

- This study found that health disparities exist throughout the journey of patients with EO-CRC.
- Patients living in a rural area were likely to be diagnosis at older age compared to those in urban area.
- Lower proportion of patients in Texas-Mexico border region received optimal (NCCN guideline-concordant) treatment, compared to those in non-border region in Texas.
- Patients living in the border region had lower 5-year survival rate, compared to those in non-border region.
- Among other covariates, older age, non-commercial insurance were associated with lower likelihood of receiving optimal treatment, while older age, male gender, increased poverty, and non-commercial insurance were associated with increased risk of overall survival.

❑ Limitations
- Only the first course of treatment information was available in the TCR data
- Whether a patient received optimal treatment was determined by whether the patient had received surgery, chemotherapy, or radiotherapy, however, detailed information of the treatment (type/dose/duration, etc.) was not available in the data.
- Due to the lack of treatment facility information in the limited-use data, it was not adjusted in the multivariate models
- Race/ethnicity was not included in the multivariate models due to multicollinearity.
- Comorbidities was not included in the multivariate models due to a high proportional of missingness.

CONCLUSION

- This study discovered that health disparities exist throughout the EO-CRC patient journey between rural vs urban area, and Texas-Mexico border area vs. non-border area. Interventions that target these barriers may reduce health disparities and improve early-onset colorectal cancer survival.

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