Completeness of Colorectal Cancer Pathology Reports in Iranian National Population-Based Cancer Registry System

Nazanin Azmi-Naei [1], Ali Ghanbari-Motlagh [2], Afshin Ostovar [3], Yousef Moradi [4] and Mohsen Asadi-Lari [5, 1, *]

[1] Department of Epidemiology, School of Public Health, Iran University of Medical Sciences, Tehran, Iran
[2] National Cancer Control Secretariat, Ministry of Health and Medical Education, Tehran, Iran
[3] Osteoporosis Research Center, Endocrinology and Metabolism Clinical Sciences Institute, Tehran University of Medical Sciences, Tehran, Iran
[4] Department of Epidemiology and Biostatistics, Faculty of Medicine, Kurdistan University of Medical Sciences, Sanandaj, Iran
[5] Oncopathology Research Centre, Iran University of Medical Sciences (IUMS), Tehran, Iran

Corresponding author: Department of Epidemiology, School of Public Health, Iran University of Medical Sciences, Tehran, Iran. Email: mohsen.asadi@yahoo.com

Abstract

Background: Colorectal cancer is one of the top 5 common cancers in Iran with over 1.9 million new cases. Completeness of pathology reports is one of the key factors of cancer care management. So, sufficient reporting of pathological factors is vital for optimum diagnosis, projection of prognosis and patient care.

Objectives: To support epidemiological research, we determined the completeness of colorectal cancer pathology reports at the nationwide level.

Methods: Accessing to the text of pathology reports from a web-based application that was created by the Iranian National Population-Based Cancer Registry (INPCR) was considered the most complete and reliable. We requested that the INPCR extracts their pathology records for manual review for colorectal cancer (ICD-10 code 'C18', 'C19', 'C20', and 'C21').

Results: Exclusion criteria were applied and 2092 pathology reports were analyzed. The mean age of patients was 61 years; 56% were male. A vast number of colorectal cancer cases were at T3-stage (colon 68.4%, rectal 58.6%) and N0-stage (colon 55.7%, rectal 57%). Information on key prognostic factors, such as lymphovascular and perineural was frequently lacking (22.7% and 35.7% missing, respectively). On the other hand, Tumor type and tumor grade had a high percentage of reporting (100% and 100%, respectively). In addition, our study revealed a low rate of overall complete reporting (colon 0.2%, rectal 1.1%).

Conclusions: Optimum diagnosis, prediction of prognosis, and patient care require sufficient reporting of pathological factors, so efforts should be made to improve the reporting of overall pathology factors of Colorectal cancer (CRC).

Keywords: Pathology Reports, Colorectal Cancer, Completeness, Cancer Registry System

1. Background

Colorectal cancer (CRC) is the third most common cancer in the world and is also among the top five common cancers in Iran (1-3) with more prevalence in men. According to estimates by GLOBOCAN 2020 (1, 2), the number of new CRC cases was over 1.9 million and 900000 annual mortality. CRC causes approximately 9% of all new cancer cases in Iran, with a significant rise (54.1%) in CRC incidence from 2016 to 2025 (4-6). Despite having a high prevalence, detecting colorectal cancer at early stages can be more likely treatable (7).

Cancer registry plays an essential role in any successful cancer control program and population-based cancer registries provide the most valid epidemiological data on cancer (8). In Iran, the first activities of cancer registry were started in the 1950s (9). During early 2000s, the underestimation of incidence rates of pathology-based cancer registration led to the establishment of population-based cancer registries (PBCR) (8, 10). The Iranian National Population-based Cancer Registry (INPCR) covers all 31 provinces and the coverage of population-based cancer data is 100% (8). Comprehensive understanding the extent and severity of tumor to choose the most accurate treatment is vital (11). One of the pivotal factors of cancer care management is

the completeness of pathology reports. Ambiguity and incomplete reporting of pathology findings may adversely affect the clinical outcomes (12).

A vast number of pathologists use the checklist suggested by College of American Pathologists (CAP) for colorectal cancer (13). It contains different factors such as specimen type, tumor site, tumor size, macroscopic tumor perforation, tumor type, histologic grade, microscopic tumor extension, margins (proximal, distal and radial), treatment effect (for tumors treated with neoadjuvant therapy), lymphovascular invasion (LVI), perineural invasion, tumor deposits (discontinuous extramural extension), and TNM staging (including the number of resected and involved lymph nodes). At the population level, all these factors can be helpful to conduct epidemiology research and give information for cancer registrations (14, 15). At the individual level, some of the pathology elements are powerful prognostic factors in colorectal cancer including tumor invasion depth, the number of resected and involved lymph, positive/negative of harvested margins, and lymphovascular/perineural invasion (16-20). Since no study has been conducted in this regard in Iran, the aim of this study was to evaluate the completeness of the colorectal cancer pathology reports registered in the population-based cancer registry system in Iran in 2016.

2. Objectives

The aim of this study was to evaluate the completeness of the colorectal cancer pathology reports registered in the population-based cancer registry system in Iran in 2016.

3. Methods

3.1. Data Sources

Iranian National Population-Based Cancer Registry (INPCR) was founded in 2010. Developing a comprehensive national guideline for population-based cancer registries, supporting and supervising the establishment and maintenance of regional cancer registries in provinces, collecting and aggregating regional cancer data to produce and publish national cancer statistics are core objectives of INPCR. Sima-ye-Saratan is a web-based application that was created by INPCR. Its mission is making a secure and facilitate the transmission of data from the university cancer registry secretariat to the

INPCR secretariat. There is a unique username/password for each university cancer registry secretariat to access the university dashboard. There are 2 ways to enter data into Sima-ye-Saratan: For individual data, it can be used data entry form and for batch files by import panel.

At the time of this study, Sima-ye-Saratan data was available for the period 2008 - 2018. We requested that the INPCR extracts their pathology records for manual review for colorectal cancer (ICD-10 code 'C18', 'C19', 'C20', and 'C21') from Sima-ye-Saratan in 2016. Among 5323 pathology reports, 2092 related pathology reports had been reviewed. We extracted data that could also be clinically useful, including the lymphovascular and perineural (not identified, present and cannot be determined), tumor grade (Garde I, II, III, GX), and margin status (involved, not involved, cannot be assessed).

This study was approved by the ethical committee of Iran University of Medical Sciences (IR.IUMS.REC.1400.742).

3.2. Data Collection

The surgical pathology report included various details Extracted such as sex, age, and insurance information. It also included other institutional factors like the date of the report, and reporting laboratory/center (public versus private sector). Additionally, it also contained histopathology characteristics such as tumor grade, tumor type, proximal, distal, and circumferential margin, T (primary tumor), N (lymph nodes), lymphovascular invasion (LVI), and perineural invasion.

3.3. Statistical Analysis

Summary statistics were provided as percentages of categorical variables and mean with standard deviation of continuous variables. A comparison of categorical variables was performed using the Pearson chi-square test. All analyses were performed using SPSS version 20.

4. Results

We assessed 2092 surgical pathology reports that were recorded in Sima-ye-Saratan in 2016. Table 1 describes characteristics of the men and women with colorectal cancer. Men accounted for the largest percentage of sex group with colon and rectal cancer (836 and 335 cases, respectively). Only 105 (11.1%) of the 2092 individuals are uninsured (Table 1) and 69% of colorectal cancer pathology reports were from private sectors.

Table 1. Demographic Characteristics by Sex

Characteristics	Female (%)	Male (%)	Total (%)	P-Value
Age				
$\leq$ 50	205 (22.3)	262 (22.4)	467 (22.3)	0.456
50 - 69	434 (47.1)	523 (44.7)	957 (45.7)	
$\geq$ 69	282 (30.6)	386 (33)	668 (31.9)	
Site				
Colon	689 (74.8)	836 (71.4)	1525 (72.9)	0.081
Rectal	232 (25.2)	335 (28.6)	567 (27.1)	
Center				
Public	275 (29.9)	374 (31.9)	649 (31)	0.307
Private	646 (70.1)	797 (68.1)	1443 (69)	
Insurance				
Insured	870 (94.5)	1117 (95.4)	1987 (95)	0.336
Uninsured	51 (5.5)	54 (4.6)	105 (5)	

Table 2 represents the proportion of grade and type of tumor by sex in colon and rectal cancer in which, 78.2% of colon cancer and 80.8% of rectal cancer were Adenocarcinoma. Grade 1 was the most common grade in our study population (Table 2).

4.1. Pathology Reports

According to Figure 1, which illustrates the overall reporting of pathology factors, only 0.2% and 1.1% of colon and rectal pathology reports were reported completely, respectively. It also can be seen that most of the reports had 1 missing in reporting.

Table 3 shows a summary of pathology factors. In all pathology reports, type (100%) and grade of tumor (100%) were documented. About T-stage, 2.8% of colon cancer and 3.2% of rectal cancer cases were not reported and N-stage was not documented in 7.7% and 8.5%, respectively. Regardless of size of tumor, 92.8% of colon cancer and 93.6% of rectal cancer were documented. In rectal cancer, among the three types of margins that we assessed, the circumferential margin had the most missing (25.7%) (Figure 2). Just over half of LVI (colon cancer: 23.7%, rectal cancer: 19.9%) were missing/not reported (Figure 3).

4.2. Clinicopathological Characteristics

4.2.1. Colon Cancer

Table 3 represents pathology factors that were compared by sex group. Considering T-stage, more than two-thirds of patients (68%) had T3 tumor. Just

over half of cases (n = 849) had no regional lymph node metastasis. Table 4 shows that invasion into subserosa or into pericolic or perirectal connective tissues comprised 78.4% of tumor extension.

4.2.2. Rectal Cancer

Table 3 presents that 58.6% of rectal cancer cases had T3 tumors. Just under three-fifths of the cases (57%) had metastasis in 1 to 3 regional lymph nodes. In terms of tumor extension, 69.1% of patients with rectal cancer had invasion into the subserosa or pericolic or perirectal connective tissues.

5. Discussion

Comprehensive and complete pathology reports are decisive factors in choosing accurate treatment. Tumor invasion depth, the number of resected and involved lymph, positive/negative of harvested margins, and lymphovascular/perineural invasion are powerful prognostic factors in CRC. Numerous international guidelines have developed a protocol on colorectal cancer pathology to improve its quality.

The purpose of this study was to evaluate whether all the essential parameters were included in the pathology report or not according to the CAP. We focused on analyzing the minimal requirements for surgical specimens. Sima-ye-Saratan provided us with colorectal pathology reports on a large-scale (over 2000 pathology

Table 2. Pathologic Characteristics in Colon and Rectal Cancers

Characteristics	Colon				Rectal			
	Female (%)	Male (%)	Total (%)	P-Value	Female (%)	Male (%)	Total (%)	P-Value
Tumor type				0.356				0.267
Adenocarcinoma	544 (79)	648 (77.5)	1192 (78.2)		181 (78)	277 (82.7)	458 (80.8)	
Mucinousadenocarcinoma	60 (8.7)	65 (7.8)	125 (8.2)		18 (7.8)	25 (7.5)	43 (7.6)	
Others	85 (12.3)	123 (14.7)	208 (13.6)		33 (14.2)	33 (9.9)	66 (11.6)	
Tumor grade				0.914				0.147
GX	63 (9.1)	71 (8.5)	134 (8.8)		18 (7.8)	42 (12.5)	60 (10.6)	
G1	286 (41.5)	361 (43.2)	647 (42.4)		101 (43.5)	157 (46.9)	258 (45.5)	
G2	282 (40.9)	334 (40)	616 (40.4)		92 (39.7)	110 (32.8)	202 (35.6)	
G3	58 (8.4)	70 (8.4)	128 (8.4)		21 (9.1)	26 (7.8)	47 (8.3)	
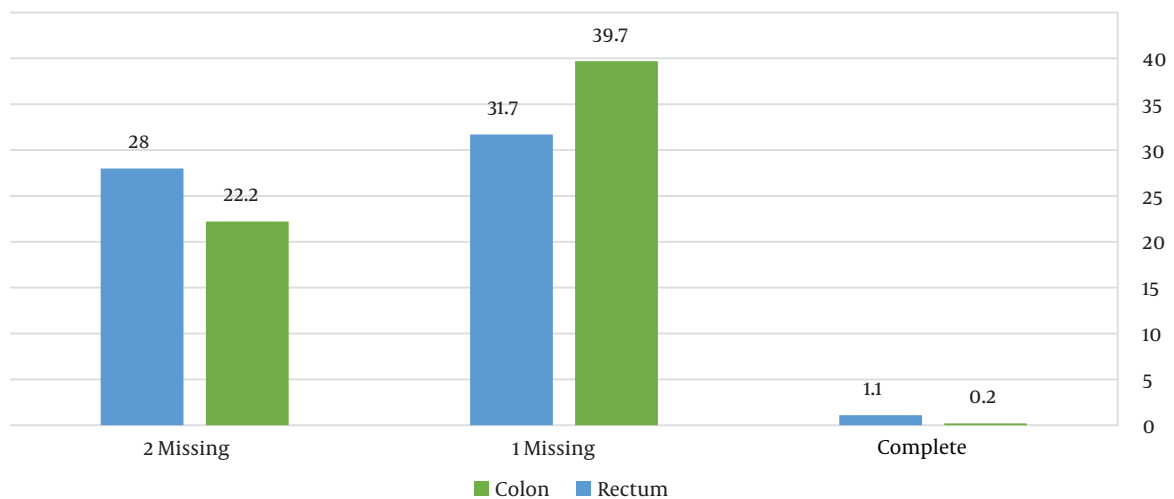
Figure 1. Overall reporting of pathology factors

reports). Our study highlights the low rate of overall complete reporting (colon 0.2%, rectal 1.1%) and high rate of incomplete reporting of lymphovascular invasion (colon 23.7%, rectal 19.9%), perineural invasion (colon 37.5%, rectal 33.9%) for colorectal cancer in Iran. Whereas, tumor type and tumor grade were present in all pathology reports.

Gimon et al. conducted a study in Alberta, Canada on 431 pathology reports (21). They analyzed 14 elements that the completeness of reporting tumor extension and histological grade were 62.6% and 82.4%, respectively. While the present study showed a higher percentage of complication (96%, 100%). In another study, Buttner et al. analyzed 5 factors: T stage, N stage, Lymphovascular

invasion, histological grade, and tumor perforation (22). In comparison with our study, N stage (87.6%) and histological grade (97.7%) had lower percentages. By contrast, the percentage of the T stage (100%) was at the higher level. Winn et al. conducted an audit on 116 pathology reports in Victoria (23). In this study, T stage (100%), N stage (100%), and histological grade (98%) reported that the percentage of Histological grade was lower compared with our study.

Evaluating surgical margin status should be reported as a core item. Particularly in rectal cancer, circumferential margin involvement is strongly predictive of local recurrence and poor survival (24, 25). However, the evidence of significant margin involvement in colon

Table 3. Surgical Characteristics (T-Stage and N-Stage)

Characteristics	Colon			P-Value	Rectal			P-Value
	Female (%)	Male (%)	Total (%)		Female (%)	Male (%)	Total (%)	
T								0.026
TX primary tumor cannot be assessed	1 (0.1)	0	1 (0.1)	0.553	0	0	0	
T0 no evidence of primary tumor	1 (0.1)	3 (0.4)	4 (0.3)		3 (1.3)	0	3 (0.5)	
Tis carcinoma in situ: invasion of lamina propria	11 (1.6)	5 (0.6)	16 (1)		4 (1.7)	4 (1.2)	8 (1.4)	
T1 tumor invades submucosa	25 (3.6)	30 (3.6)	55 (3.6)		22 (9.5)	20 (6)	42 (7.4)	
T2 tumor invades muscularis propria	100 (14.5)	123 (14.7)	223 (14.6)		51 (22)	71 (21.2)	122 (21.5)	
T3 tumor invades subserosa	470 (68.2)	573 (68.5)	1043 (68.4)		133 (57.3)	199 (59.4)	332 (58.6)	
T4 tumor directly invades other organs	61 (8.9)	80 (9.6)	141 (9.2)		17 (7.3)	25 (7.5)	42 (7.4)	
Not reported/missing	20 (2.9)	22 (2.6)	42 (2.8)		2 (0.9)	16 (4.8)	18 (3.2)	
N								0.513
NX regional lymph nodes cannot be assessed	17 (2.5)	17 (2)	34 (2.2)	0.740	10 (4.3)	13 (3.9)	23 (4.1)	
N0 no regional lymph node metastasis	394 (57.2)	455 (54.4)	849 (55.7)		125 (53.9)	198 (59.1)	323 (57)	
N1 metastasis in 1 to 3 regional lymph nodes	160 (23.2)	203 (24.3)	363 (23.8)		51 (22%)	70 (20.9%)	121 (21.3)	
N2 metastasis in 4 or more regional lymph nodes	70 (10)	97 (11.6)	167 (11)		21 (9.1)	31 (9.3)	52 (9.2)	
Not reported/missing	48 (7)	64 (7.7)	112 (7.3)		25 (10.8)	23 (6.9)	48 (8.5)	
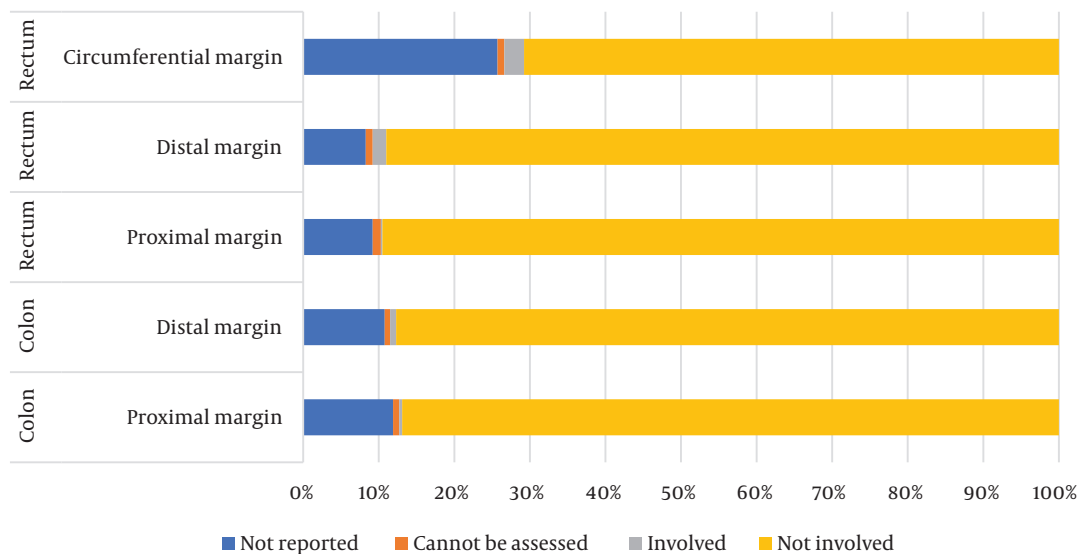
Figure 2. Percentage of reports with proximal, distal and circumferential margin

cancer is not adequate (26, 27). Ihnat et al. conducted a study to assess the impact of CAP on the quality of colorectal cancer pathology reporting (28). The positive involvement of distal and proximal margin in colon cancer with 100% complete reporting was 0% while our study showed 0.8% and 0.4% positive involvement, respectively. In contrast to Ihnat et al., the present study had a low rate of positive involvement of circumferential margin (2.6% versus 15.5%). Perineural invasion in colorectal cancer had negative prognostic implications, notably in
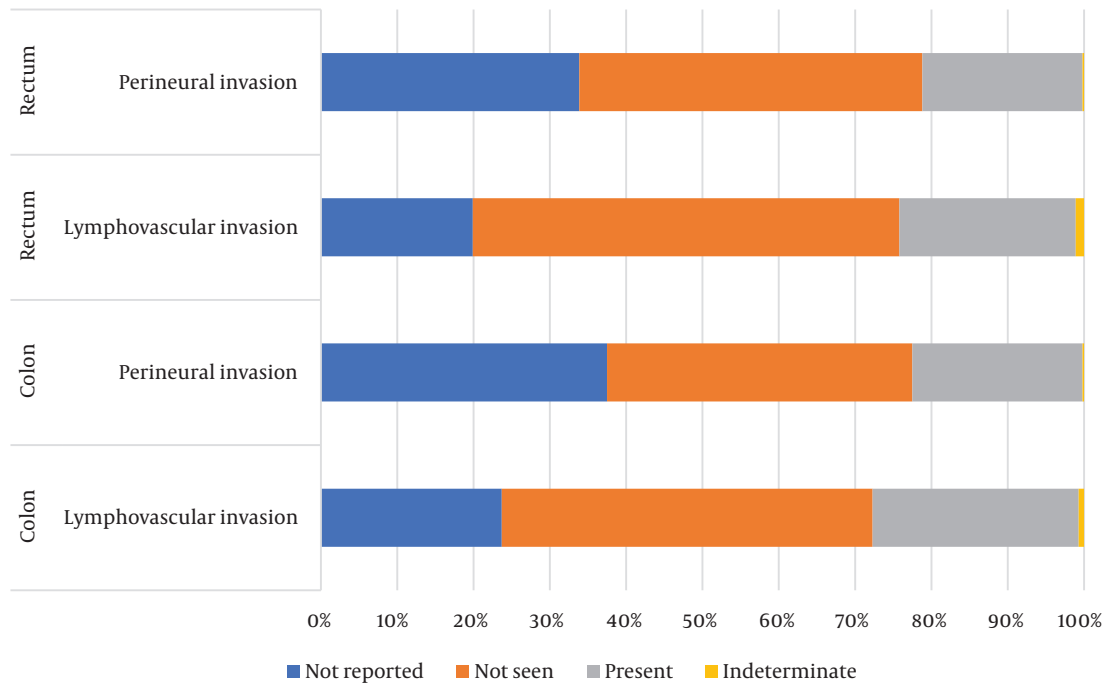
Figure 3. Percentage of reports with lymphovascular and perineural invasion

Table 4 . Surgical Characteristics (Tumor Size and Tumor Extension)

Characteristics	Colon			P-Value	Rectal			P-Value
	Female (%)	Male (%)	Total (%)		Female (%)	Male (%)	Total (%)	
Tumor size				0.821 *				0.768
Can be assessed	634 (92)	773 (92.5)	1407 (92.3)		215 (92.7)	312 (93.1)	527 (92.9)	
Cannot be assessed	3 (0.4)	5 (0.6)	8 (0.5)		1 (0.4)	3 (0.9)	4 (0.7)	
Not reported/missing	52 (7.5)	58 (6.9)	110 (7.2)		16 (6.9)	20 (6)	36 (6.3)	
Tumor extension				0.606				0.325
High grade dysplasia/non-invasive neoplasia	8 (1.2)	6 (0.7)	14 (0.9)		5 (2.2)	4 (1.2)	9 (1.6)	
Invasion into muscularis propria	82 (11.9)	113 (13.5)	195 (12.8)		44 (19)	62 (18.5)	106 (18.7)	
Invasion into submucosa	26 (3.8)	26 (3.1)	52 (3.4)		17 (7.3)	19 (5.7)	36 (6.3)	
Invasion into subserosa or into pericolic or perirectal connective tissues	538 (78.1)	658 (78.7)	1196 (78.4)		158 (68.1)	234 (69.9)	392 (69.1)	
No evidence of primary tumor	1 (0.1)	2 (0.2)	3 (0.2)		2 (0.9)	0	2 (0.4)	
Not reported/missing	34 (4.9)	31 (3.7)	65 (4.3)		6 (2.6)	16 (4.8)	22 (3.9)	

stage II disease (29). Our study indicated a higher rate of completeness of perineural invasion in colon cancer compared to Peter Ihnaˊt et al. study (62.5% versus 35.4%). Similarly, higher rate of presence of perineural invasion was found (22.3% versus 4.1%). In terms of rectal cancer, in our study, the rate of completeness of perineural invasion was lower at 66.1%. However, positive invasion of perineural was higher (20% versus 13.3%).

lymphovascular invasion should be considered as a core item due to having strong prognostic implications for CRC (30). According to several studies, completeness of reporting lymphovascular invasion in CRC was various in different countries; 75.6% (21), 37.2% (22), 88% (23), and in this study 77.3% with 27% and 23% positive invasion in colon and rectal cancer, respectively.

The considerable difference among percentage of reporting pathology factors might partly be explained by the ignorance of some certain features that are important for clinical management. Education and regular assessment with feedback can be the best way to overcome this reason (31). Moreover, having access to training and remote interaction is available for some pathologists. Strengthening laboratory capacity, facilitating implementation and application of a standardized reporting system and connecting pathologists to the most up-to-date information regarding histological techniques, laboratory guidelines and other continuing medical education activities are the results of those partnerships. By contrast, those pathologists who do not have such access are more likely to face problems with producing adequate histopathologic reports due to inadequate equipment and limited access to continued training, and an insufficient number of both pathologists and laboratory support staff (32).

The possible bias of our study is that the evaluation of "completeness of reporting" is restricted by absent or nonreported pathological factors. For instance, when pathologists do not report the data element, it is not obvious whether the feature was evaluated and absent but not reported as "negative" versus a feature that was not evaluated. It could lead us to report an overestimation or lack of reporting in some data factors.

One limitation of this study was that we were unable to report TNM staging of the patient's disease due to requiring the specification of the presence or absence of distant metastases. This data could be obtained from individual surgeon's records and requires some time and effort.

Moreover, some pathological factors were in CAP guidelines and were not evaluated in our study because there was not any information about them in the reports such as tumor budding and treatment effect.

To the best of our best knowledge, this is the first study that evaluates the completeness of pathology reports at the national level among CRC patients in Iran. Future studies could be directed towards the impact of adequate pathology reports on clinical decision-making.

5.1. Conclusions

Our results reveal a total incompleteness of colorectal pathology reports. Tumor type and grade had a high rate of completeness (100%) while lymphovascular invasion and perineural invasion which are powerful prognostic factors had a low rate of completeness. We suggest that the preformed checklists for colorectal reporting should be available in software for reporting pathology reports so that missing data will be reduced to a minimum. Sufficient reporting of pathological factors is vital for optimum diagnosis, prediction of prognosis and patient care. Moreover, performing high-quality research also requires complete pathology reports

Footnotes

Authors' Contribution: NAN, MAL, AGM, and AO contributed to the study's conception and design. NAN performed data collection and wrote the manuscript. MAL and AGM revised the manuscript. MAL edited the manuscript. AO, AGM, and YM reviewed the manuscript. All authors read and approved the final manuscript.

Conflict of Interests: The authors declare that they have no competing interests.

Data Availability: The data that support the findings of this study are openly available upon request from the corresponding author.

Ethical Approval: This study is approved under the ethical approval code of IR.IUMS.REC.1400.742.

References

1. International Agency for Research on Cancer (IARC). *World Cancer Report*. 2022. Available from: https://www.esmo.org/policy/international-agency-for-research-on-cancer-iarc.

2. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, et al. Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. *CA Cancer J Clin*. 2021;**71**(3):209–49. [PubMed ID: 33538338]. https://doi.org/10.3322/caac.21660.

3. Douaiher J, Ravipati A, Grams B, Chowdhury S, Alatise O, Are C. Colorectal cancer-global burden, trends, and geographical variations. *J Surg Oncol*. 2017;**115**(5):619–30. [PubMed ID: 28194798]. https://doi.org/10.1002/jso.24578.

4. Roshandel G, Ferlay J, Ghanbari-Motlagh A, Partovipour E, Salavati F, Aryan K, et al. Cancer in Iran 2008 to 2025: Recent incidence trends and short-term predictions of the future burden. *Int J Cancer*. 2021;**149**(3):594–605. [PubMed ID: 33884608]. https://doi.org/10.1002/ijc.33574.

5. Farhood B, Raei B, Malekzadeh R, Shirvani M, Najafi M, Mortezazadeh T. A review of incidence and mortality of colorectal, lung, liver, thyroid, and bladder cancers in Iran and compared to other countries. *Contemp Oncol (Pozn)*. 2019;**23**(1):7–15. [PubMed ID: 31061631]. [PubMed Central ID: PMC6500388]. https://doi.org/10.5114/wo.2019.84112.

6. Mohammadi E, Aminorroaya A, Fattahi N, Azadnajafabad S, Rezaei N, Farzi Y, et al. Epidemiologic pattern of cancers in Iran; current knowledge and future perspective. *J Diabetes Metab Disord*. 2021;**20**(1):825–9. [PubMed ID: 34222092]. [PubMed Central ID: PMC8212225]. https://doi.org/10.1007/s40200-020-00654-6.

7. Levin B, Lieberman DA, McFarland B, Andrews KS, Brooks D, Bond J, et al. Screening and surveillance for the early detection of colorectal cancer and adenomatous polyps, 2008: a joint guideline from the American Cancer Society, the US Multi-Society Task Force on Colorectal Cancer, and the American College of Radiology. *Gastroenterology*. 2008;**134**(5):1570–95. [PubMed ID: 18384785]. https://doi.org/10.1053/j.gastro.2008.02.002.

8. Roshandel G, Ghanbari-Motlagh A, Partovipour E, Salavati F, Hasanpour-Heidari S, Mohammadi G, et al. Cancer incidence in Iran in 2014: Results of the Iranian National Population-based Cancer Registry. *Cancer Epidemiol*. 2019;**61**:50–8. [PubMed ID: 31132560]. https://doi.org/10.1016/j.canep.2019.05.009.

9. Habibi A. Epidemiological aspects of cancer in Iran. *International surgery*. 1985;**70**(2):105–8.

10. Zendehdel K, Mohebbi E, Malekzadeh R. Underestimation of cancer incidence in Iran and necessity for establishing population-based cancer registries. *Eur J Cancer Care (Engl)*. 2018;**27**(1). [PubMed ID: 29372623]. https://doi.org/10.1111/ecc.12754.

11. Srigley JR, McGowan T, Maclean A, Raby M, Ross J, Kramer S, et al. Standardized synoptic cancer pathology reporting: a population-based approach. *J Surg Oncol*. 2009;**99**(8):517–24. [PubMed ID: 19466743]. https://doi.org/10.1002/jso.21282.

12. Bull AD, Biffin AH, Mella J, Radcliffe AG, Stamatakis JD, Steele RJ, et al. Colorectal cancer pathology reporting: a regional audit. *J Clin Pathol*. 1997;**50**(2):138–42. [PubMed ID: 9155695]. [PubMed Central ID: PMC499739]. https://doi.org/10.1136/jcp.50.2.138.

13. College of American Pathologists. *CAP Cancer Protocols and Checklists*. 2024. Available from: https://www.cap.org/protocols-and-guidelines/cancer-reporting-tools/cancer-protocol-templates.

14. Manser MD, Levine DF, Pheby DF, Pitcher RW. Colorectal cancer registration: the central importance of pathology. *J Clin Pathol*. 2000;**53**(11):875–7. [PubMed ID: 11127275]. [PubMed Central ID: PMC1731103]. https://doi.org/10.1136/jcp.53.11.875.

15. Loughrey MB, Webster F, Arends MJ, Brown I, Burgart LJ, Cunningham C, et al. Dataset for Pathology Reporting of Colorectal Cancer: Recommendations From the International Collaboration on Cancer Reporting (ICCR). *Ann Surg*. 2022;**275**(3):e549–61. [PubMed ID: 34238814]. [PubMed Central ID: PMC8820778]. https://doi.org/10.1097/SLA.0000000000005051.

16. Shen SS, Haupt BX, Ro JY, Zhu J, Bailey HR, Schwartz MR. Number of lymph nodes examined and associated clinicopathologic factors in colorectal carcinoma. *Arch Pathol Lab Med*. 2009;**133**(5):781–6. [PubMed ID: 19415953]. https://doi.org/10.5858/133.5.781.

17. Jestin P, Pahlman L, Glimelius B, Gunnarsson U. Cancer staging and survival in colon cancer is dependent on the quality of the pathologists' specimen examination. *Eur J Cancer*. 2005;**41**(14):2071–8. [PubMed ID: 16125926]. https://doi.org/10.1016/j.ejca.2005.06.012.

18. Chang GJ, Rodriguez-Bigas MA, Skibber JM, Moyer VA. Lymph node evaluation and survival after curative resection of colon cancer: systematic review. *J Natl Cancer Inst*. 2007;**99**(6):433–41. [PubMed ID: 17374833]. https://doi.org/10.1093/jnci/djk092.

19. Compton CC. Colorectal carcinoma: diagnostic, prognostic, and molecular features. *Mod Pathol*. 2003;**16**(4):376–88. [PubMed ID: 12692203]. https://doi.org/10.1097/01.MP.0000062859.46942.93.

20. Zlobec I, Lugli A. Prognostic and predictive factors in colorectal cancer. *Postgraduate Medical Journal*. 2008;**84**(994):403–11. https://doi.org/10.1136/jcp.2007.054858.

21. Gimon TI, Dykstra MA, Chezar K, Buie WD, MacLean A. Malignant Colorectal Polyp Pathology: Are We Getting Sufficient Information to Make Decisions? *Dis Colon Rectum*. 2020;**63**(2):135–42. [PubMed ID: 31914110]. https://doi.org/10.1097/DCR.0000000000001538.

22. Buttner S, Lalmahomed ZS, Coebergh van den Braak RR, Hansen BE, Coene PP, Dekker JW, et al. Completeness of pathology reports in stage II colorectal cancer. *Acta Chir Belg*. 2017;**117**(3):181–7. [PubMed ID: 28116987]. https://doi.org/10.1080/00015458.2017.1279872.

23. Winn RD, Robinson DR, Farmer KC, Bell SW. Deficiencies in pathological reporting of colorectal cancer in Victoria. *ANZ J Surg*. 2008;**78**(9):796–9. [PubMed ID: 18844912]. https://doi.org/10.1111/j.1445-2197.2008.04653.x.

24. Nagtegaal ID, Quirke P. What is the role for the circumferential margin in the modern treatment of rectal cancer? *J Clin Oncol*. 2008;**26**(2):303–12. [PubMed ID: 18182672]. https://doi.org/10.1200/JCO.2007.12.7027.

25. Birbeck KF, Macklin CP, Tiffin NJ, Parsons W, Dixon MF, Mapstone NP, et al. Rates of circumferential resection margin involvement vary between surgeons and predict outcomes in rectal cancer surgery. *Ann Surg*. 2002;**235**(4):449–57. [PubMed ID: 11923599]. [PubMed Central ID: PMC1422458]. https://doi.org/10.1097/00000658-200204000-00001.

26. Scott N, Jamali A, Verbeke C, Ambrose NS, Botterill ID, Jayne DG. Retroperitoneal margin involvement by adenocarcinoma of the caecum and ascending colon: what does it mean? *Colorectal*

Dis. 2008;**10**(3):289–93. [PubMed ID: 17764533]. https://doi.org/10.1111/j.1463-1318.2007.01365.x.

27. Bateman AC, Carr NJ, Warren BF. The retroperitoneal surface in distal caecal and proximal ascending colon carcinoma: the Cinderella surgical margin? *J Clin Pathol.* 2005;**58**(4):426–8. [PubMed ID: 15790712]. [PubMed Central ID: PMC1770631]. https://doi.org/10.1136/jcp.2004.019802.

28. Ihnat P, Delongova P, Horacek J, Ihnat Rudinska L, Vavra P, Zonca P. The impact of standard protocol implementation on the quality of colorectal cancer pathology reporting. *World J Surg.* 2015;**39**(1):259–65. [PubMed ID: 25234197]. https://doi.org/10.1007/s00268-014-2796-4.

29. Knijn N, Mogk SC, Teerenstra S, Simmer F, Nagtegaal ID. Perineural Invasion is a Strong Prognostic Factor in Colorectal Cancer: A Systematic Review. *Am J Surg Pathol.* 2016;**40**(1):103–12. [PubMed ID: 26426380]. https://doi.org/10.1097/PAS.0000000000000518.

30. Jiang HH, Zhang ZY, Wang XY, Tang X, Liu HL, Wang AL, et al. Prognostic significance of lymphovascular invasion in colorectal cancer and its association with genomic alterations. *World J Gastroenterol.* 2019;**25**(20):2489–502. [PubMed ID: 31171892]. [PubMed Central ID: PMC6543237]. https://doi.org/10.3748/wjg.v25.i20.2489.

31. Branston LK, Greening S, Newcombe RG, Daoud R, Abraham JM, Wood F, et al. The implementation of guidelines and computerised forms improves the completeness of cancer pathology reporting. The CROPS project: a randomised controlled trial in pathology. *Eur J Cancer.* 2002;**38**(6):764–72. [PubMed ID: 11937309]. https://doi.org/10.1016/s0959-8049(01)00258-1.

32. Sayed S, Lukande R, Fleming KA. Providing Pathology Support in Low-Income Countries. *J Glob Oncol.* 2015;**1**(1):3–6. [PubMed ID: 28804765]. [PubMed Central ID: PMC5551652]. https://doi.org/10.1200/JGO.2015.000943.