Standardised reports with a template format are superior to free text reports: the case for rectal cancer reporting in clinical practice

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Abstract

Purpose Rectal cancer staging with magnetic resonance imaging (MRI) allows accurate assessment and preoperative staging of rectal cancers. Therefore, complete MRI reports are vital to treatment planning. Significant variability may exist in their content and completeness. Template-style reporting can improve reporting standards, but its use is not widespread. Given the implications for treatment, we have evaluated current clinical practice amongst specialist gastrointestinal (GI) radiologists to measure the quality of rectal cancer staging MRI reports.

Materials and methods Sixteen United Kingdom (UK) colorectal cancer multi-disciplinary teams (CRC-MDTs) serving a population over 5 million were invited to submit up to 10 consecutive rectal cancer primary staging MRI reports from January 2016 for each radiologist participating in the CRC-MDT. Reports were compared to a reference standard based on recognised staging and prognostic factors influencing case management.

Results Four hundred ten primary staging reports were submitted from 41 of 42 (97.6%) eligible radiologists. Three hundred sixty reports met the inclusion criteria, of these, 81 (22.5%) used a template. Template report usage significantly increased recording of key data points versus non-template reports for extra-mural venous invasion (EMVI) status (98.8% vs 51.6%, \( p < 0.01 \)) and circumferential resection margin (CRM) status (96.3% vs 65.9%, \( p < 0.01 \)). Local tumour stage (97.5% vs 93.5%, NS) and nodal status (98.8% vs 96.1%, NS) were reported and with similar frequency.

Conclusion Rectal cancer primary staging reports do not meet published standards. Template-style reports have significant increases in the inclusion of key tumour descriptors. This study provides further support for their use to improve reporting standards and outcomes in rectal cancer.

Key Points

• MRI primary staging of rectal cancer requires detailed tumour descriptions as these alter the neoadjuvant and surgical treatments.
• Currently, rectal cancer MRI reports in clinical practice do not provide sufficient detail on these tumour descriptors.
• The use of template-style reports for primary staging of rectal cancer significantly improves report quality compared to free-text reports.

Keywords Rectal cancer · Magnetic resonance imaging · Medical audit · Template-reporting
Introduction

Magnetic resonance imaging (MRI) is the most accurate method of rectal cancer pre-operative staging and re-assessment [1–4]. Tumour features identified on the rectal cancer baseline staging MRI (‘primary staging’) determine the subsequent clinical management including whether neo-adjuvant radiotherapy or chemoradiotherapy (CRT) is given prior to surgical resection [1, 5]. Follow-up rectal cancer assessment MRI (‘restaging’) helps to determine the operative technique or alternative treatment approaches including the ‘watch and wait’ approach. The timing of imaging post neo-adjuvant CRT is debated, but is typically 6–8 weeks after completion of CRT [1, 5–9]. Imaging reports describe the tumour features to clinical teams influencing clinical decisions. This emphasises the importance of accurate and reproducible primary staging and restaging MRI reports.

There is increasing interest in structured reporting in radiology and pathology to improve communication of imaging findings and generating consistent reports, for clarity and content [10–13]. This applies to rectal MRI reporting with recent consensus statements published by the European Society of Gastrointestinal Abdominal Radiology (ESGAR) and Society of Abdominal Radiology (SAR) both recommending report templates for primary staging and restaging [14, 15]. Radiological imaging templates have been produced and evaluated elsewhere but often these templates have not been widely adopted, with many radiologists preferring free-text reports [16, 17]. Across 16 different hospital sites in UK (14 different NHS trusts) serving our population of 5.7 million, there is variable usage of template reporting in clinical practice for primary staging [18].

Across our population of approximately 1000 new rectal cancer diagnoses per year, we retrospectively evaluated the current standard of primary staging rectal cancer MRI reports in clinical practice [19].

Materials and methods

This was a retrospective service evaluation study, so local ethical approval was waived. This study used only primary staging reports generated as a routine part of patients care. All reports were anonymised before entrainment to remove any patient identifiable information.

Sixteen UK colorectal cancer multi-disciplinary teams (CRC-MDTs) serving a combined population of over 5.7 million in Yorkshire, UK, were invited to participate. The CRC-MDT lead radiologist at each centre was invited by email to submit 10 consecutive primary staging reports for each radiologist in their department routinely reporting rectal MRI or regularly participating in the CRC-MDT. The anonymised consecutive reports had to be within a 12-month period from January 2016 until January 2017; therefore, those radiologists with a small workload of rectal cancer supplied all their primary staging reports for the year. All radiologists involved are gastrointestinal (GI) sub-specialists; all have received specialist training in rectal MRI and are members of either ESGAR or BSGAR.

Each site anonymised the clinical information, history and report content prior to submission. In addition, a coding system was employed by the lead radiologist at each site to allow unbiased analysis of each radiologist’s set of reports, whilst also allowing individualised feedback via the lead at each site.

Reports were compared by a single investigator to a reference standard based on key tumour descriptors from UICC-TNM 5 staging and other recognised factors known to influence case management that have subsequently been included in ESGAR and SAR recommendations [14, 15]. In total, the inclusion of 22 key tumour descriptors was evaluated within each report (Table 1). The inclusion of each tumour descriptor, or a comment confirming a negative finding within each report counted as ‘reported’. The failure to provide a description of the presence or absence of a feature in a report counted as ‘not reported’. Some appropriate report exclusions were allowed depending on the tumour features (e.g. the absence of a distance through the muscularis propria was considered acceptable for T1/T2 tumours or not stating which organs are involved by tumour with T3a–d).

Several differing descriptive methods were permitted in reports for the relationship to the mesorectal fascia (MRF), and so depth of mesorectal fat invasion; either an absolute measurement or subcategories (i.e. T3a–d) and thus the potential risk to the circumferential resection margin (CRM) status.

To allow comparisons between reporting styles, the template or free-text style of reporting was also recorded.

A simple report scoring system for overall report quality was used based on the accumulated inclusion (or lack) of each key tumour descriptor giving a maximum score of 22. This

| Abbreviations | Description |
|---------------|-------------|
| BSGAR | British Society of Gastrointestinal and Abdominal Radiology |
| CRC-MDTs | Colorectal cancer multi-disciplinary teams |
| CRM | Circumferential resection margin |
| CRT | Chemoradiotherapy |
| EMVI | Extra-mural venous invasion |
| ESGAR | European Society of Gastrointestinal Abdominal Radiology |
| GI | Gastrointestinal |
| MRF | Mesorectal fascia |
| MRI | Magnetic resonance imaging |
| SAR | Society of Abdominal Radiology |
| UK | United Kingdom |
was adjusted to calculate a ‘completeness’ percentage score
for each reporter which corrected for case sets which appro-
priately excluded a tumour descriptor.

**Statistical analysis**

All data was tabulated in Microsoft Excel (Office 365,
Microsoft Corp.) and statistical analysis performed using
Stata Statistical Software (Release 15, StataCorp LLC.).
Fisher’s exact test was used to test for statistical significance
in differences in reporting standards between free-text and
template reports. Corrections for multiple testing were per-
formed using Holm’s method of correction [20]; therefore, a

**Results**

Four hundred ten primary staging reports were submitted from
41 of 42 (97.6%) eligible radiologists across the region. One
trust (one radiologist) did not participate. Fifty reports (12.2%)
were excluded; 16 reports as they were not pre-intervention
MRI scans (of these, 14 were re-staging scans and 2 were
baseline scans that acquired post-total excision biopsy), 4
were scans for non-rectal lower gastrointestinal tract tumours
and 2 were rectal MRI for benign indications. A further 28

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**Table 1** Tumour descriptors collected from each baseline rectal cancer staging MRI

| Key tumour descriptor | Description of what the tumour descriptor assessed |
|-----------------------|--------------------------------------------------|
| Tumour                |                                                  |
| Vertical location     | An indication of ‘lower’, ‘mid’ or ‘upper’ rectum |
| Length                | The vertical, unidirectional size of the tumour  |
| Distance from the anal verge | Measurement from anal verge to help plan the operation/radiotherapy |
| Shape                 | A description of the tumour morphology, e.g. annular, semi-annular, polypoidal, flat |
| Radial location of wall involvement | Inclusion of either a clock-face description or equivalent descriptive term (e.g. left lateral) |
| MRI signal            | A description of the predominant component (i.e. solid or mucinous tumour type) |
| Relationship to peritoneal reflection | A description of the tumour relative to the peritoneal reflection; above, at the level of or below |
| T stage               |                                                  |
| If ≥ T3               | Inclusion of either a direct or indirect measurements; i.e. mm or T3 subcategories; T3⁺⁻ |
| MRF                   |                                                  |
| MRF status            | A description of if the MRF was threatened or involved |
| If threatened/involved, by what | A description of what threatened/involved the MRF; i.e. tumour, EMVI, lymph node |
| Minimum distance to the MRF | If threatened a measurement was required here, unless involved |
| Location closest to MRF | Inclusion of descriptors of the location closest to the MRF; either a clock-face description or equivalent descriptive term (e.g. left lateral) |
| If ≥ T4               |                                                  |
| Involvement of peritoneum and/or which organs | A statement of which organs/ peritoneal involvement |
| Nodes                 |                                                  |
| Nodal status          | A statement of mesorectal or extra-mesorectal lymph node metastatic status |
| If N⁺, location of involved nodes | A description of the involved lymph node location (i.e. mesorectal or extra-mesorectal) |
| If N⁺, radial location of mesorectal nodal involvement | A description of the involved lymph node location (i.e. radial location for surgical planning) |
| If N⁺, superior location of node involvement | A description of the involved lymph node location (i.e. radial location for surgical/radiotherapy planning) |
| EMVI                  |                                                  |
| EMVI status           | A statement of EMVI involvement (i.e. present or not) |
| EMVI radial and/or superior location | A description of the involved lymph node location (e.g. radial location for surgical planning) |
| Metastases            |                                                  |
| Distant metastatic status | A statement on metastatic status if liver sequences included in the imaging protocol or known from other cross-sectional imaging assessment |

MRF mesorectal fascia, EMVI extra-mural venous invasion

corrected p value < 0.01 was required for consideration of statistical significance.
‘potential reports’ were not analysed as they fell outside the
1 year data collection window. A total of 360 primary staging
reports were included for analysis (median 10 per radiologist,
Inter-Quartile Range 6–10, range 4–10 reports per radiolo-
gist); 81 (22.5%) were reported using intra-departmental
standardised templates; this involved two different hospital
organisations (a large teaching hospital and smaller district
general hospital), the remaining 279 reports were free-text
reports.

**Standard of report contents**

There was substantial variability of tumour descriptor inclu-
sion in reports (Table 2). Certain variables were reported in
over 85% of all reports, including vertical location of tumours,
tumour length, tumour and nodal staging and location of in-
volved lymph nodes. However, other tumour descriptors were
included in less than 75% of reports, including radial location
of wall involvement by the tumour, distance through the
muscularis propria (for tumours > T3; 229 reports were of
T3 or T4 tumours), MRF status and extra-mural venous inva-
sion status. The tumour descriptors with the lowest likelihood
of being included in primary staging reports were the tumour
relationship to the peritoneal reflection and location of the
most superior malignant mesorectal lymph node (relative to
the sacral level), which are important surgical and radiother-
apy landmarks respectively.

| Table 2 Tumour descriptors and their inclusion in the total number of reports | Total number of reports including the variable/total number of reports (%) |
|---|---|
| Tumour | Vertical location | 327/360 (91%) |
| | Length | 312/360 (87%) |
| | Distance from the anal verge | 305/360 (85%) |
| | Shape | 260/360 (72%) |
| | Radial location of wall involvement* | 156/270 (57%) |
| | MRI signal | 114/360 (32%) |
| | Relationship to peritoneal reflection | 152/360 (42%) |
| | T stage | 340/360 (94%) |
| If ≥ T3 | Distance through muscularis propria* | 114/227 (50%) |
| MRF | MRF status | 262/360 (73%) |
| | If threatened/involved, by what* | 160/167 (96%) |
| | Minimum distance to the MRF* | 96/151 (64%) |
| | Location closest to MRF | 217/360 (60%) |
| If ≥ T4 | Which organs involved* | 75/83 (90%) |
| Nodes | Nodal status | 348/360 (97%) |
| | If N+, location of involved nodes* | 207/215 (96%) |
| | If N+, radial location of mesorectal nodal involvement* | 125/206 (61%) |
| | If N+, superior location of node involvement* | 69/204 (34%) |
| EMVI | EMVI status | 224/360 (62%) |
| | EMVI radial and/or superior location* | 71/115 (62%) |
| Metastases | Metastatic status* | 107/244 (44%) |
| Overall predicted stage | 329/360 (91%) |

*Tumour descriptors with appropriate report exclusions allowed depending on the tumour features (e.g. the
absence of a distance through the muscularis propria was considered acceptable for T1/T2 tumours or not stating
which organs are involved by tumour with T1–3 staging, or radial location of wall involvement for annular
tumours)

MRF mesorectal fascia, EMVI extra-mural venous invasion

**Impact of template reporting**

Further analysis assessing the impact of template reporting
showed statistically significant differences for most tumour
descriptors after correction for multiple testing (Table 3). The
only tumour descriptors with similar rates of inclusion in
reports for free-text and template reports were tumour loca-
tion, T-stage, descriptors of what threatened the MRF (i.e.
tumour or lymph node), nodal status and location of involved nodes. The remaining tumour descriptors all demonstrated a statistically significant increase in report inclusion when a template was used. Most notably, this included relationship to the MRF that was only included in 184 of 279 (65.9%) of free-text reports compared to 78 of 81 (96.3%) of template reports (p < 0.01). Similarly, extra-mural venous invasion status was only included in 144 of 279 (51.6%) of the free-text reports compared to 80 of 81 (98.7%) of the template reports respectively (p < 0.01).

The median report scoring system demonstrated ‘completeness’ percentage across all reports was 65% inclusion of all variables (inter-quartile range, 57–72%). Subgroup analysis comparing template and free-text report groups demonstrated a significant improvement (p = 0.039) in the ‘completeness’ percentage score with template use, a median of 96% inclusion of all variables (IQR, 92–97%) compared to median 57% inclusion of all variables (IQR, 55–68%) respectively. Figure 1 shows the completeness percentage scores across all radiologists involved in the study.

### Table 3 Tumour descriptors and their inclusion on prose and template with statistical differences between the report styles included

| Tumour descriptor | Total number of free-text reports including the variable/total number of free-text reports (%) | Total number of template reports including the variable/total number of template reports (%) | Fisher’s exact test p value | Critical p value |
|-------------------|-------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|----------------------------|-----------------|
| Tumour Vertical location | 248/279 (89%) | 79/81 (98%) | 0.0154 | 0.0100 |
| Length | 233/279 (84%) | 79/81 (98%) | 0.0004 | 0.0050 |
| Distance from the anal verge | 227/279 (81%) | 78/81 (96%) | 0.0004 | 0.0056 |
| Shape | 181/279 (65%) | 79/81 (98%) | 0.0000 | 0.0033 |
| Radial location of wall involvement* | 96/207 (46%) | 60/63 (95%) | 0.0000 | 0.0029 |
| MRI signal | 36/279 (13%) | 78/81 (96%) | 0.0000 | 0.0023 |
| Relationship to peritoneal reflection | 75/279 (26.9) | 77/81 (95%) | 0.0000 | 0.0024 |
| T stage | 261/279 (94%) | 79/81 (98%) | 0.2684 | 0.0167 |
| If ≥ T3 Distance through muscularis propria* | 60/169 (36%) | 54/58 (93%) | 0.0000 | 0.0028 |
| MRF MRF status | 184/279 (66%) | 78/81 (96%) | 0.0000 | 0.0036 |
| If threatened/involved, by what* | 111/118 (94%) | 49/49 (100%) | 0.1069 | 0.0125 |
| Minimum distance to the MRF* | 60/108 (56%) | 36/43 (84%) | 0.0013 | 0.0063 |
| Location closest to MRF | 85/279 (31%) | 58/81 (72%) | 0.0000 | 0.0031 |
| If ≥ T4 Which organs involved* | 33/41 (81%) | 42/42 (100%) | 0.0024 | 0.0071 |
| Nodes Nodal status | 268/279 (96%) | 80/81 (99%) | 0.3125 | 0.0250 |
| Location of involved nodes* | 157/164 (96%) | 50/51 (98%) | 0.6835 | 0.0500 |
| Radial location of mesorectal nodal involvement* | 81/156 (52%) | 44/50 (88%) | 0.0000 | 0.0045 |
| Superior location of node involvement* | 25/156 (16%) | 44/48 (92%) | 0.0000 | 0.0025 |
| EMVI EMVI status | 144/279 (52%) | 80/81 (99%) | 0.0000 | 0.0026 |
| EMVI radial and/or superior location* | 37/79 (47%) | 34/36 (94%) | 0.0000 | 0.0042 |
| Metastases Metastatic status* | 71/199 (36%) | 36/45 (80%) | 0.0000 | 0.0038 |
| Overall predicted stage | 249/279 (89%) | 80/81 (99%) | 0.0056 | 0.0083 |

*Tumour descriptors with appropriate report exclusions allowed depending on the tumour features (e.g. the absence of a distance through the muscularis propria was considered acceptable for T1/T2 tumours or not stating which organs are involved by tumour with T1–3 staging, or radial location of wall involvement for annular tumours)

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Discussion

This study has shown the current standard of primary staging rectal cancer MRI reports used in clinical practice consistently omit important information describing tumours. Here, in the largest study of its type, the use of template reporting has been shown to significantly improve the inclusion of key tumour descriptors when compared to free-text reporting in primary staging. A comparative study where the content of reports has been audited contains an assessment of only 128 reports and...
11 tumour descriptors and did not assess the impact of template reports; by comparison, in our study, we have assessed 360 reports and 22 tumour descriptors including an assessment of the impact of template reports [21]. Here, it is shown the beneficial impact of template reports is similar to that observed in pathology reports for colorectal cancer [22–24]. Given that the majority of primary staging scans and reports are produced in regional hospitals rather than teaching hospitals, the same standards of reporting should be expected irrespective of the setting.

Alongside the significant improvement in the completeness percentage score for template reports compared to free-text reports, there was a reduction in spread of the interquartile range for the template report groups, with a reduction in the variability of template reports implying improved consistency for inclusion of key tumour descriptors. The inclusion of an increased number of tumour descriptors will inherently add important negative findings. Although the absence of tumour descriptors in free-text reports may imply a negative finding, the clear documentation of these may be helpful for clinicians and allow further studies assessing inter- and intra-radiologist agreement and correlation with pathological findings.

Several primary staging report templates have been developed with subtle differences in the tumour descriptors collected [14, 15, 25–27]. Irrespective of the template, we have assessed all of the key tumour descriptors included in each template recommended by the European and American abdominal imaging societies (ESGAR and SAR) [14, 15]. Although not acknowledged as key tumour descriptors, we have also assessed reports for descriptive information regarding the location of mesorectal fascia, metastatic lymph node and extra-mural venous involvement as these are reported locally to be helpful in surgical and radiotherapy planning.

Template reporting significantly improves tumour description compared to free-text reporting styles, Table 3.

Despite a well-established prognostic link between tumour involvement of the MRF being associated with worse clinical outcomes due to the more frequent occurrence of a positive CRM, it is included in only 65.9% of free-text reports compared to 96.3% of template reports (p < 0.01). Subgroup analysis within this dataset, using only T3 or T4 tumours, shows inclusion of tumour involvement of the MRF is still only included in 81.1% of free-text reports compared to 100% of template reports (p < 0.01). The influence on prognosis of CRM involvement by the primary tumour compared to venous or lymphatic vessel invasion, or lymph nodes has not been fully evaluated other than two relatively small studies that demonstrated lymph node-CRM involvement had no impact on local recurrence, in distinction from other tumour components [28, 29]. However, these tumour descriptors are recorded in the SAR guideline template [15]. We found there was no difference in report inclusion of what aspect of the primary tumour threatened the MRF in each report style. As a potentially important variable to assess in relation to the prognosis, its inclusion in template reports could help to better understand its value.

Furthermore, there are subtle differences between the method of sub-categorisation for T3 tumours within the ESGAR and SAR templates [14, 15]. The ESGAR template dichotomises T3 tumours into two groups (either ≤5 mm or ≥5 mm extra-mural growth beyond the muscularis propria) [14]. By comparison, the SAR template uses four T3 subcategories (a, < 1 mm; b, < 5 mm; c, 5–15 mm or d, ≥15 mm) for tumour penetration beyond the muscularis propria. Each system stratifies patients, which influences the neoadjuvant therapies offered based on prior studies...
demonstrating the prognostic significance of the depth extra-
mural of tumour extension on locoregional recurrence [28, 30,
31]. There is conflicting evidence as to the precise depth that is
significant for an increased risk of locoregional recurrence,
either 5 mm or 10 mm beyond the muscularis propria [28,
30, 31]. However, irrespective of the sub-categorisation meth-
od used, this study demonstrates the use of template reports
significantly increases documentation of depth of invasion
beyond the muscularis propria (93.1% vs 35.5% inclusion of
T3 subcategories/depth in template vs free-text reports,
\( p < 0.01 \)).

Accurately determining tumour involvement in lymph
nodes based on size and morphological appearance can be
difficult in rectal cancer MRI, but the description of
involved/potentially involved lymph nodes is undeniably
important [32]. In our population the use of a template did
not improve reporting on nodal status (96.1% inclusion in
free-text reports compared to 98.8% inclusion in template
reports; corrected \( p < 0.3125 \) or descriptions of intra- or
extra-mesorectal node location (95.7% inclusion in free-
text reports compared to 98.0% inclusion in template re-
ports; corrected \( p < 0.68 \)). One limitation of our study is
that neither the free-text nor template reports assessed if
established criteria were applied to determine if nodes
were involved with tumour or not. Template reports allow
more categorisation of the rationale for determining nodal
status; for example based on size and/or other morpholog-
ical features as in the ESGAR and SAR consensus tem-
plates [14, 15]. Further assessment of the features and
pathological correlation may improve radiologist and cli-
nician confidence in determining which nodes are in-
volved with malignant disease.

The retrospective design of this study assesses the current
reporting standards of primary staging for rectal cancer in
routine clinical practice in 2017 provided by subspecialised
GI radiologists. It highlights potential areas for quality
improvement and standardisation through the use of template
reports despite subspecialised GI training for radiologists
reporting large volumes of rectal cancer staging MRI.
Unlike the study by Siddiqui et al, the existing use of the
template reports in two centres (by nine radiologists) elimi-
nates the potential bias arising from the introduction and as-
associated training with template reports when assessing their
impact [26, 33]. However, to maximise the benefits of tem-
plate reports in our population, their introduction to free-text
reporting centres should occur in conjunction with appropriate
training that would reiterate the importance of key tumour
descriptors. Furthermore, here we have demonstrated that
template reports include more tumour descriptors than free-
text reports. Further work is required to demonstrate that re-
port accuracy and inter-radiologist agreement is maintained or
even improves with standardised descriptive terms found in
template reports.

A limitation of this study is the relatively small number of
template reports used within two trusts, compared to free-text
reports. Although this might increase the likelihood of a type 1
statistical error in assessing the impact of template reports, we
have primarily assessed the current standard of primary stag-
ing reports irrespective of template use. Additionally, because
our findings are replicated across multiple tumour descriptors
and show strong statistical significance after correction, mul-
tiple type 1 errors are unlikely.

Primary staging rectal cancer MRI reports in routine clinical
practice do not meet published standards with multiple key tu-
mour descriptors omitted from reports. A standardised report
template results in a significant increase in the inclusion of key
tumour descriptors for subspecialised GI radiologists. This study
provides further support for the routine use of template reports to
improve reporting standards and outcomes in rectal cancer.

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Statistics and biometry John Taylor aided the statistical analysis of this
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Institutional Review Board.

Ethical approval Institutional Review Board approval was waived.

Methodology
• retrospective
• case-control study
• performed across multiple institutions

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