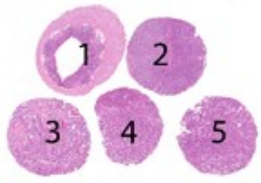
Assessment run 77 2026

Mismatch Repair Protein MSH2 (MSH2)

Purpose
Evaluation of the technical performance, analytical sensitivity and specificity of MSH2 IHC tests among the NordiQC participants for MSH2 status in colon adenocarcinomas. Mutations of the MSH2 gene gives rise to a dysfunctional mismatch repair system and frequently result in loss of nuclear MSH2 expression in neoplastic cells.
Relevant clinical normal and neoplastic tissues were selected to include a broad spectrum of MSH2 antigen expression levels (see below).

Material
The slide to be stained for MSH2 comprised:

1. Appendix, 2. Tonsil, 3-4. Colon adenocarcinomas, 5. Endometrial adenocarcinoma



All tissues were fixed in 10% neutral buffered formalin.

Criteria for assessing MSH2 staining as optimal included:

- At least weak to moderate distinct nuclear staining reaction of virtually all smooth muscle and stromal cells in the appendix and a moderate to strong nuclear staining reaction of the crypt columnar epithelial cells.
- At least weak to moderate, distinct nuclear staining reaction of virtually all mantle zone B-cells and a moderate to strong, distinct nuclear staining reaction of the germinal centre B-cells in the tonsil.
- A moderate to strong, distinct nuclear staining reaction of all neoplastic cells in the microsatellite stable (MSS) colon adenocarcinoma no. 3.
- No nuclear staining reaction of the neoplastic cells in the MSH2 mismatch repair deficient (MMRd) colon and endometrial adenocarcinoma no. 4 and no. 5. Importantly, the internal tissue control e.g., all stromal and lymphatic cells in these two cores show at least moderate and distinct nuclear staining reaction.

A weak cytoplasmic staining reaction was accepted provided that it did not compromise the interpretation.

KEY POINTS FOR MSH2 IMMUNOASSAYS
- The total pass rate was 98%.
- Using RTU systems by vendor recommendation protocols settings is preferable.
- Tonsil is recommended external control to ensure the analytical sensitivity of the assays.

Participation

Number of laboratories registered for MSH2, run 77	442
Number of laboratories returning slides	397 (90%)

Slides received after the assessment were not included in this report. However, all returned slides were assessed, and participating laboratories with insufficient results received advice.

Results
397 laboratories participated in this assessment and 389 laboratories (98%) achieved a sufficient mark (optimal or good), see Table 1a (page 2). Tables 1b and 1c summarise the antibodies (Abs) used and assessment marks (see page 3 and 4).

The most frequent causes of insufficient staining reactions were:
- Insufficient Heat Induced Epitope Retrieval (HIER) e.g acidic HIER buffer or too short incubation time
- Use of less sensitive detection systems
- Too diluted primary antibody
- An unnecessary amplification step caused nonspecific granular staining in expected negative tumour cells, interfering with interpretation.

Controls
Tonsil is recommended as an external positive tissue control for MSH2 and to monitor the IHC test reproducibility with a focus on the level of analytical sensitivity. Virtually all mantle zone B-cells must show at least weak to moderate nuclear staining reaction, while a moderate to strong nuclear staining reaction must be seen in the proliferating germinal centre B-cells.
MMRd colon adenocarcinoma with loss of MSH2 expression could be included as an external negative tissue control in which no nuclear staining reaction should be seen in the neoplastic cells, whereas a distinct nuclear staining reaction must be seen in all stromal cells and lymphatic cells (internal positive control). For IHC for Mismatch Repair proteins (MMR) such as MSH2 it must be emphasized that internal positive tissue controls e.g. normal stromal cells adjacent to the neoplastic cells, are preferred to external controls. An observed intact expression of MMR proteins in the internal normal cells together with loss of MMR proteins in the neoplastic cells is of diagnostic importance[1].

Conclusion
The most commonly used primary antibodies based on the mAb clones **FE11**, **G219-1129 and 79H11** are all recommendedfor demonstration of MSH2. Other antibody clones could also be used to obtain an optimal staining result for MSH2 (see Tables 1b and 1c). Irrespective of the clone applied, HIER in an alkaline buffer and use of a sensitive and specific polymer/multimer based detection system gave the highest proportion of optimal results.

In this assessment, 93% of laboratories used a Ready-To-Use (RTU) system for MSH2 detection, with superior results obtained using vendor-recommended protocol settings (VRPS) on fully automated platforms compared to protocols based on concentrated Abs (used by 7% of the laboratories). When grouped by VRPS RTU on the three fully automated main IHC systems, a 100% pass rate was achieved (163/163), and the RTU system 760-5093 alone obtained optimal results in 95% of submitted protocols (88/93). GA085 also provided a high pass rate using VRPS (100% sufficient, 93% optimal), as did the semi-automated IR085 (85% sufficient, 62% optimal). Due to the robustness of these RTU systems, the overall pass rate rose to 98% in run 77 (see Graph 1), with RTU and LD assays scoring 99% and 88%, respectively.

Table 1a. **Overall results for MSH2, run 77**

	n	Optimal	Good	Borderline	Poor	Sufficient results[1]	Optimal results
Concentrated antibodies	26	12	11	3	-	88%	46%
Ready-To-Use antibodies	371	325	41	4	1	99%	88%
Total	397	337	52	7	1		
Proportion		85%	13%	1%	1%	98%	

1) Optimal and good

Table 1b. **Concentrated antibodies and assessment marks for MSH2, run 77**

Concentrated antibodies	n	Vendor	Optimal	Good	Borderline	Poor	Suff.[1]	OR[2]
mAb clone **G219-1129**	12	Cell Marque	5	5	2	-	87%	47%
	2	BD Bioscience	1	1	-	-		
	1	Monosan	1	-	-	-		
mAb clone **FE11**	3	Dako/Agilent	1	1	1	-	80%	40%
	2	Biocare Medical	1	1				
mAb clone **79H11**	2	Leica Biosystems	1	1	-	-	-	-
rmAb clone **QR010**	2	Quartett	1	1	-	-	-	-
rmAb clone **GR45**	1	Genebio Solution	-	1	-	-	-	-
rmAb clone **ZR260**	1	Zeta Corporation	1	-	-	-	-	-
Total	26		12	11	3	-		
Proportion			46%	42%	12%	0%	88%	

1) Proportion of sufficient stains (optimal or good) (≥5 assessed protocols).
2) Proportion of Optimal Results (≥5 assessed protocols).

Table 1c. **Ready-To-Use antibodies and assessment marks for MSH2, run 77**

Ready-To-Use antibodies	n	Vendor	Optimal	Good	Borderline	Poor	Suff.[1]	OR[2]
mAb clone **G219-1129 760-5093 (VRPS)[3]**	93	Ventana/Roche	88	5	-	-	100%	95%
mAb clone **G219-1129 760-5093 (LMPS)[4]**	97	Ventana/Roche	83	12	2	-	98%	86%
mAb clone **FE11 IR085 (VRPS)[3]**	13	Dako/Agilent	8	3	1	1	85%	62%
mAb clone **FE11 IR085 (LMPS)[4]**	19	Dako/Agilent	11	7	1	-	95%	58%
mAb clone **FE11 GA085 (VRPS)[3]**	56	Dako/Agilent	52	4	-	-	100%	93%
mAb clone **FE11 GA085 (LMPS)[4]**	26	Dako/Agilent	24	2	-	-	100%	92%
mAb clone **79H11 PA0989 (VRPS)[3]**	14	Leica Biosystems	12	2	-	-	100%	86%
mAb clone **79H11 PA0989 (LMPS)[4]**	30	Leica Biosystems	28	2	-	-	100%	93%
rmAb clone **RED2 8327-C010**	2	Sakura Finetek	2	-	-	-	-	-
mAb clone **G219-1129 286M-17/18**	8	Cell Marque	7	1	-	-	100%	88%
mAb clone **FE11 PM219**	1	Biocare Medical	1	-	-	-	-	-
mAb clone **FE11 MAD-000677QD**	1	Vitro S.A	-	1	-	-	-	-
mAb clone **25D12 PDM179**	1	Diagnostic Biosystems	-	1	-	-	-	-
mAb clone **MX061 MAB-0836**	1	Fuzhou Maixin	1	-	-	-	-	-
mAb clone **C2G3 CMM-0191**	1	Celnovte	1	-	-	-	-	-
mAb clone **BY132 BFM-0452**	1	Bioin Biotechnology	1	-	-	-	-	-
mAb clone **BPM6143 I11372E**	1	Biolynx Biotechnology	1	-	-	-	-	-
mAb clone **DY49068 4911192**	1	ImmunoLogic	1	-	-	-	-	-
rmAb clone **QR010 P-M004-70**	2	Quartett	2	-	-	-	-	-

rmAb clone **RED2 GT2310**	1	Gene Tech	1	-	-	-	-	-
rmAb clone **644G5A4 PA194**	1	Abcarta	1	-	-	-	-	-
rmAb clone **644G5A4 B70013**	1	Guangzhou Biotron	-	1	-	-	-	-
Total	371		325	41	4	1		
Proportion			88%	10%	1%	1%	99%	

1) Proportion of sufficient stains (optimal or good) (≥5 assessed protocols).
2) Proportion of Optimal Results (≥5 assessed protocols).
3) Vendor Recommended Protocol Settings (VRPS) to a specific RTU product applied on the vendor recommended platform(s) (≥5 assessed protocols).
4) Laboratory Modified Protocol Settings (LMPS) to a specific RTU product (≥5 assessed protocols).

Detailed analysis of MSH2, run 77
The following protocol parameters were central to obtain optimal staining:

Concentrated antibodies
mAb clone **G219-1129**: Protocols with optimal results were based on Heat Induced Epitope Retrieval (HIER) using Target Retrieval Solution (TRS, Dako/Agilent) High pH (1/2)*, Cell Conditioning 1 (CC1, Ventana/Roche) (4/6) or BOND Epitope Retrieval Solution 2 (BERS2, Leica Biosystems) (2/7) as retrieval buffer. The mAb was typically diluted between 1:100-1:400. Using these protocol settings, 12 of 14 (86%) laboratories produced a sufficient staining result (optimal or good).
*(number of optimal results/number of laboratories using this HIER buffer)

mAb clone **FE11**: Protocols with optimal results were based on HIER using TRS High pH (Dako/Agilent) (1/2) or BERS2 (Leica Biosystems) (1/3) as retrieval buffer. The mAb was diluted in the range of 1:12-1:50. Using these protocol settings, 3 of 4 laboratories produced a sufficient staining result.

Table 2. **Proportion of optimal results for MSH2 on the four main IHC systems by optimal titration settings as listed above**

Concentrated antibodies	**Dako/Agilent Autostainer[1]**		**Dako/Agilent Omnis**		**Ventana/Roche BenchMark[2]**		**Leica Biosystems BOND[3]**	
	TRS pH 9.0	TRS pH 6.1	TRS pH 9.0	TRS pH 6.1	CC1 pH 8.5	CC2 pH 6.0	BERS2 pH 9.0	BERS1 pH 6.0
mAb clone **G219-1129** 1:100-400	-	-	1/2	-	67% (4/6)	-	33% (2/6)	-
mAb clone **FE11** 1:12-50	0/1	-	1/1	-	-	-	1/3	-

1) Autostainer Link 48.
2) BenchMark Ultra, Ultra plus
3) BOND III, Prime

Ready-To-Use antibodies and corresponding systems
mAb clone **G219-1129**, product no. **760-5093**, Ventana/Roche, BenchMark GX/XT/Ultra/Ultra Plus:
Protocols with optimal results were typically based on HIER using CC1 (efficient heating time 32-64 min. at 95-100°C), 8-40 min. incubation of the primary Ab and OptiView (760-700) +/- amplification kit (760-099 /860-099) as detection systems. Using these protocol settings, 172 of 173 (99%) laboratories produced a sufficient staining result.

mAb clone **FE11**, product no. **GA085**, Dako/Agilent, Omnis:
Protocols with optimal results were typically based on HIER using TRS pH 9 (3-in-1) (efficient heating time for 30 min. at 97°C), 20-30 min. incubation of the primary Ab and EnVision FLEX (GV800) with Dual Linkers (GV821/GV809) as detection system. Using these protocol settings, 61 of 61 (100%) laboratories produced sufficient staining result.
The product was used by 1 laboratory on a non-intended platform. This data is not included.

mAb clone **FE11**, product no. **IR085**, Dako/Agilent, Autostainer:
Protocols with optimal results were typically based on HIER in PT-Link using TRS pH 9 (3-in-1) (efficient heating time for 15-20 min. at 95-97°C), 20-45 min. incubation of the primary Ab and EnVision FLEX+ (K8002/K8021) as detection system. Using these protocol settings, 15 of 17 (88%) laboratories produced a sufficient staining result (optimal or good).

The product was used by 13 laboratories on a non-intended platform. This data is not included.

mAb clone **79H11**, product no. **PA0989**, Leica Biosystems, BOND III:
Protocols with optimal results were typically based on HIER using BERS2 (efficient heating time 20-40 min. at 97-100°C), 15-30 min. incubation of the primary Ab and Bond Refine (DS9800) as detection system. Using these protocol settings, 26 of 26 (100%) laboratories produced a sufficient staining result.
17 laboratories used product no PA0989 on the BOND Prime with 100% optimal results.
The product was used by 1 laboratory on another type of non-intended platform. This data is not included.

Table 3 summarises the proportion of sufficient and optimal marks for the most commonly used RTU systems. The performance was evaluated both as "true" plug-and-play systems performed strictly according to the vendor recommendations and by laboratory modified systems with changes to basic protocol settings. Only protocols performed on the intended IHC stainer are included.

Table 3. **Proportion of sufficient and optimal results for MSH2 for the most commonly used RTU IHC systems**

RTU systems	**Recommended protocol settings***		**Laboratory modified protocol settings****	
	Sufficient	Optimal	Sufficient	Optimal
VMS BenchMark mAb G219-1129 **760-5093** **OptiView**	100% (93/93)	95% (88/93)	98% (95/97)	86% (83/97)
Dako Omnis mAb FE11 **GA085**	100% (56/56)	93% (52/56)	100% (25/25)	92% (23/25)
Dako AS mAb FE11 **IR085**	85% (11/13)	62% (8/13)	83% (5/6)	67% (4/6)
Leica BOND*** mAb 79H11 **PA0989**	100% (14/14)	86% (12/14)	100% (12/12)	83% (10/12)

*Protocol settings recommended by vendor – Retrieval method and duration, Ab incubation times, detection kit, IHC stainer/equipment.
**Modifications: retrieval method, retrieval duration and Ab incubation time altered, detection kit – only protocols performed on the specified vendor IHC stainer integrated.
*** BOND PRIME excluded, as there is currently no official protocol recommendation for this platform

Comments
In this assessment and in concordance with previous NordiQC MSH2 assessments, the most prevalent feature of an insufficient result was a too weak staining reaction of cells expected to be demonstrated. This pattern was seen in 75% (6/8) of the insufficient results. The remaining 25% (2/8) of insufficient results were characterized by either a false positive staining reaction, a combination of too weak and excessive counter staining and unspecific granular reaction pattern due to the use of OptiView detection kit with amplification (Ventana/Roche), compromising the interpretation of the specific signals.

Virtually all laboratories were able to demonstrate MSH2 in cells with a high-level antigen expression as proliferating germinal centre B-cells in the tonsil, basal epithelial cells of the appendix and neoplastic cells in the MSS colon adenocarcinoma (tissue core no. 3). Demonstration of MSH2 in low-level antigen expressing cells as mantle zone B-cells, smooth muscle cells and stromal/lymphatic cells in the MMRd colon adenocarcinoma and MMRd endometrial carcinoma (tissue cores no. 4 and 5) was more challenging, requiring an optimally calibrated protocol. In this context, it must be emphasized that identification of loss of MSH2 expression in tumours is characterized by a negative nuclear staining reaction of the neoplastic cells. Consequently, it is critical that normal cells within and around the neoplastic process show a distinct positive nuclear staining reaction, serving as a reliable internal positive tissue control.

Only 7% (26/397) of the laboratories used antibodies as concentrated formats within LD assays for MSH2. Compared to the performance of the RTU formats, the pass rate was only 88% (23/26) of which 46% (12/26) were optimal (see Tables 1a+b). The mAb clones FE11 and G219-1129 were the most widely used antibodies, both providing optimal results within LD assays, 40% (2/5) and 47% (7/15), respectively. As shown in Table 2, the mAb clone **FE11** gave optimal results on the Omnis (Dako/Agilent) and the BOND (Leica Biosystems) platforms, whereas the mAb clone **G219-1129** provided optimal results on the BenchMark Ultra (Ventana/Roche), the Omnis (Dako/Agilent) and the BOND (Leica Biosystems) instruments. For both clones, virtually all protocols assessed as optimal were based on efficient HIER in an alkaline buffer (20/20), careful calibration of the primary antibody in combination with a sensitive 3-step detection system (20/20) e.g., EnVision FLEX+(Dako/Agilent), Bond Refine (Leica Biosystems) or OptiView (Ventana/Roche). The prevalent cause for insufficient staining results was use of too diluted antibody e.g.,

for mAb clone **G219-1129** the average dilution factor (ADF) for optimal performance was 1:193 (range 1:100-1:400) whereas for protocols providing insufficient results, the ADF was 1:250 (range 1:100-1:400).

93% (371/397) of the laboratories used a RTU format for the demonstration of MSH2. This is a significant increase compared to the previous MSH2 assessments in 2017, 2019 and 2023, in which RTU formats were used by 69%, 78% and 88% of the participants, respectively. As shown in Table 1c, a high pass rate of 99% was seen (366/371). The RTU products on the fully automated systems from Dako/Agilent, Leica Biosystems and Ventana/Roche obtained a pass rate of 100% (163/163) when following VRPS - see Table 3.

For the Dako/Agilent RTU system the **GA085** based on the mAb clone **FE11** and developed for the fully automated platform Dako Omnis (Dako/Agilent), the pass rate was 100% and 92-93% optimal both for laboratory developed protocols and vendor recommended protocol settings respectively. Important features for this otherwise very robust assay were to use linker preferably as recommended with DUAL linker as described for the EnVision FLEX++ protocol, omission of the Rabbit linker (GV809) without calibrating the protocol provided the two protocols marked as good (see table 1c).

The Dako/Agilent RTU system **IR085** also based on the mAb clone **FE11** and developed for the semi-automated platform Autostainer (Dako/Agilent), provided a pass rate of 85% (11/13) using vendor recommended protocol settings – 62% (8/13) being optimal. For this assessment the lower pass rate compared to the **GA085** based on the same clone and buffers but only recommended with EnVision FLEX+ as detection system along with technical issues could explain the difference in pass rate.
A significant proportion of laboratories used IR085 off-label and 41% (13/32) of the protocols were applied on non-validated platforms such as Omnis, BenchMark Ultra and BOND III. In general, use of an RTU product on another platform than the intended should be avoided if not thoroughly validated on the platform in use. Alternative, and as seen in this assessment, laboratories are encouraged to substitute the non-validated RTU formats with the very well performing vendor validated RTU systems.

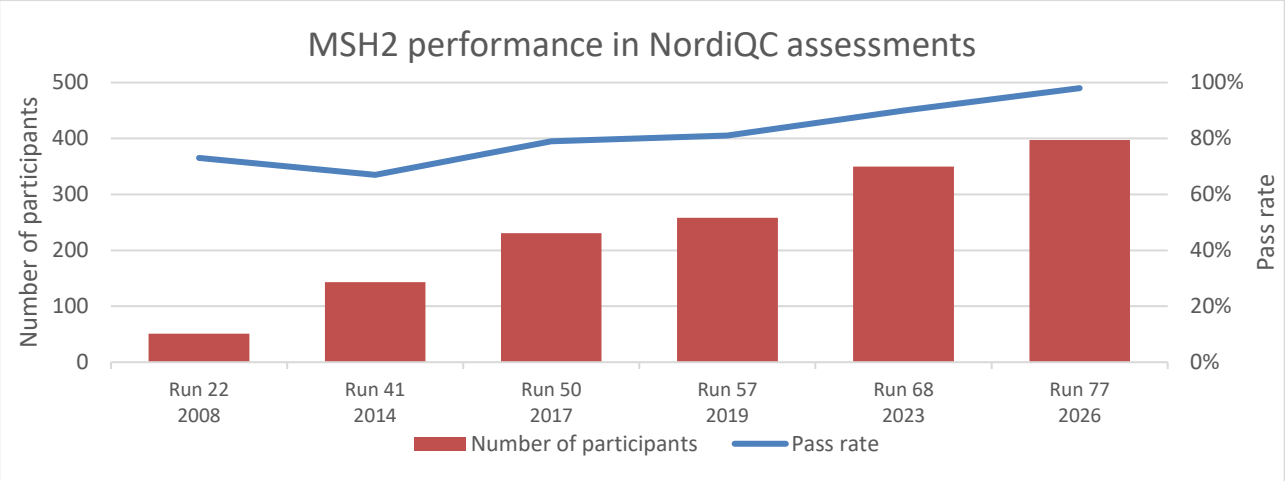
The most widely used RTU system for demonstration of MSH2 was **760-5093** (Ventana/Roche) based on the mAb clone **G219-1129**. As mentioned above, and using VRPS, the proportion of sufficient and optimal results was high, 100% (93/93) and 95% (88/93), respectively. The protocol settings recommended by vendor are based on a relatively short incubation time in primary Ab, (12 min.), HIER in CC1 for 40 min. at 100°C and OptiView as detection system.
As shown in Table 1c, and using RTU format **760-5093** based on LMPS, 2% (2/97) of the protocols were assessed as insufficient – typically using assays providing low analytical sensitivity as e.g too short HIER time in CC1, in combination with the low sensitive detection system UltraView.

The Leica RTU system **PA0989** for BOND III and Max, based on mAb **79H11**, was used by 44 laboratories and gave an overall pass rate of 100%, 91% optimal. In this run, VRPS based on HIER in BERS2 (high pH) for 20 min., 15 min. incubation of the primary Ab and Bond Refine DAB as detection system was used by 14 participants. **PA0989** is not validated by Leica Biosystems for use on the BOND Prime platform; nevertheless, 17 participants used the product as a laboratory-developed assay on this platform, all achieving optimal results. Most laboratories (n=9) applied settings comparable to those established for the BOND III and BOND MAX.

Eight laboratories used the RTU format **286M-17/18** (Cell Marque) also based on mAb clone **G219-1129**, providing a pass rate of 100% (8/8) of which 88% (7/8) gave an optimal mark.
The product was mainly used on the BenchMark platforms (Ventana/Roche) (6/8), providing 100% optimal results.

Performance history
The sixth NordiQC assessment for MSH2 (Run 77), demonstrated a substantial increase in pass rate to 98%. This marks a notable progression from the previous assessment in Run 68 (2023), which concluded with a 90% pass rate. The data reflect a consistent, long-term upward trend in performance standards across participating laboratories. (see Graph 1).

Graph 1**. Proportion of sufficient results for MSH2 in the six NordiQC runs performed.**



Summary

This was the sixth assessment of MSH2 in NordiQC (see Graph 1). The pass rate increased significantly compared to results obtained in the previous run 68 (2023) for MSH2. In this assessment, the RTU systems/formats gave superior results compared to LD-assays (concentrates), providing a pass rate of 99% (366/371) and 88% (23/26), respectively. This accounts for the overall improvement in performance seen in this assessment run 77 for MSH2.

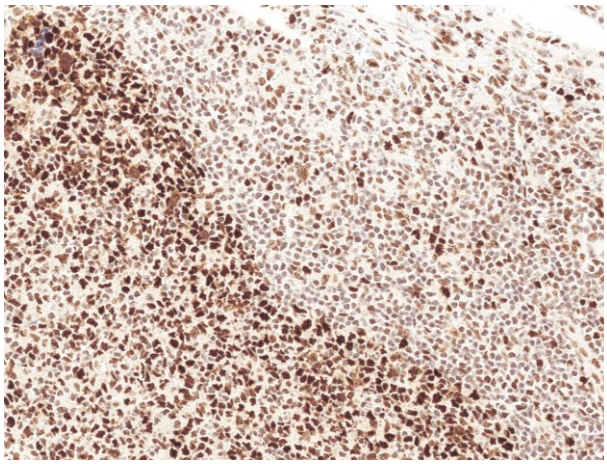


Fig. 1a
Optimal MSH2 staining reaction of the tonsil using the RTU system GA085 (Dako/Agilent), based on the mAb clone FE11 on a Dako Omnis, applying vendor recommended protocol settings with the 4-layer polymer detection system, EnVision FLEX++. Same protocol settings were used in Figs. 2a-5a.
Virtually all mantle zone B-cells show a moderate and distinct nuclear staining reaction, while the germinal centre B-cells show a strong nuclear staining reaction.

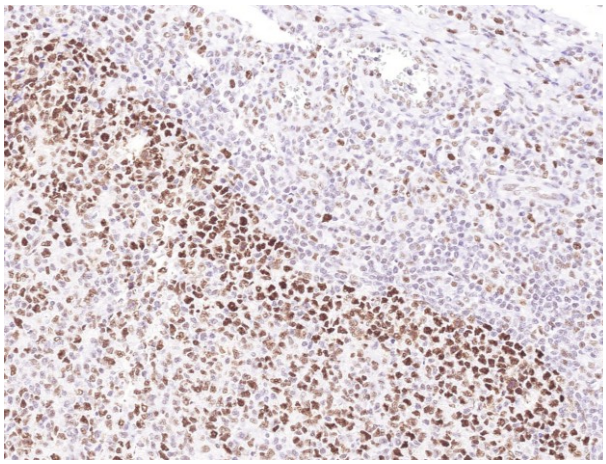


Fig. 1b
Insufficient MSH2 staining of the tonsil using the mAb clone FE11 RTU product IR085 on the Autostainer, with sufficient incubation times of HIER and primary Ab but with a 2-layer detection system, EnVision FLEX providing a too low analytical sensitivity. Same protocol settings were used in Figs. 2b – 4b.
Only dispersed mantle zone B-cells are demonstrated, and staining intensity is too weak although some germinal centre B-cells display a strong nuclear staining reaction. Compare with Figs. 1a, which shows the same field.

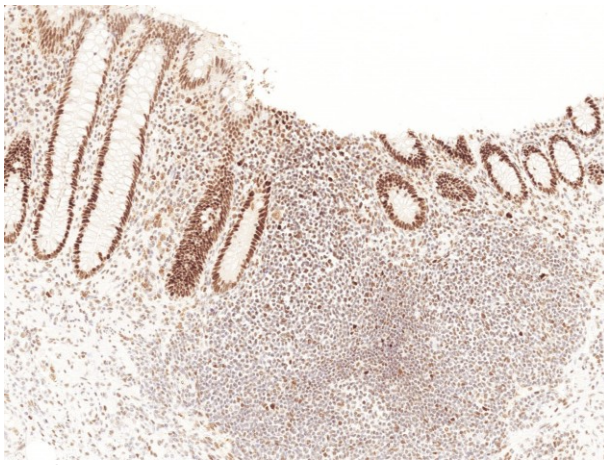


Fig. 2a
Optimal MSH2 staining of the appendix using the same protocol as in Fig. 1a.
Virtually all stromal and epithelial cells show a distinct nuclear staining reaction. In addition, the smooth muscle cells of lamina muscularis propria displayed a weak to moderate, but distinct nuclear staining intensity.

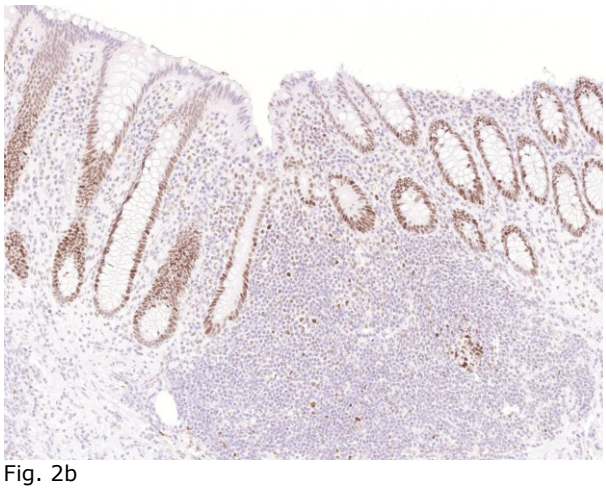


Fig. 2b
Insufficient staining reaction for MSH2 of the appendix using the same protocol as Fig. 1b.
The proportion of positive cells and the staining intensity are significantly reduced compared to the expected result shown in Fig. 2a – same field. In addition, a significant proportion of the smooth muscle cells in lamina muscularis propria were false negative or only faintly demonstrated.

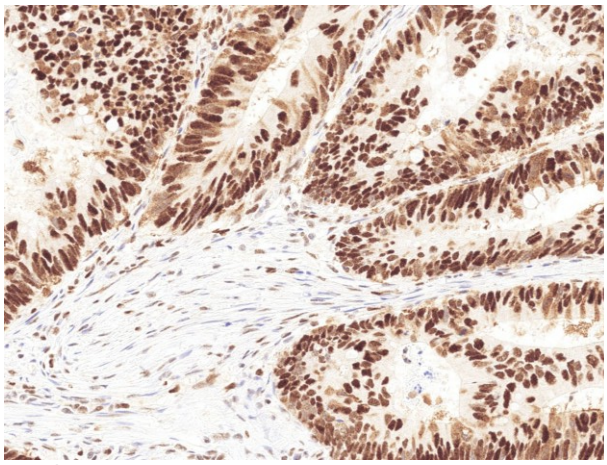


Fig. 3a
Optimal MSH2 staining of the MSS colon adenocarcinoma, tissue core no. 3, using the same protocol as in Figs. 1a - 2a.
All neoplastic cells are positive and essentially, all stromal cells show a distinct nuclear staining reaction serving as internal positive tissue control.

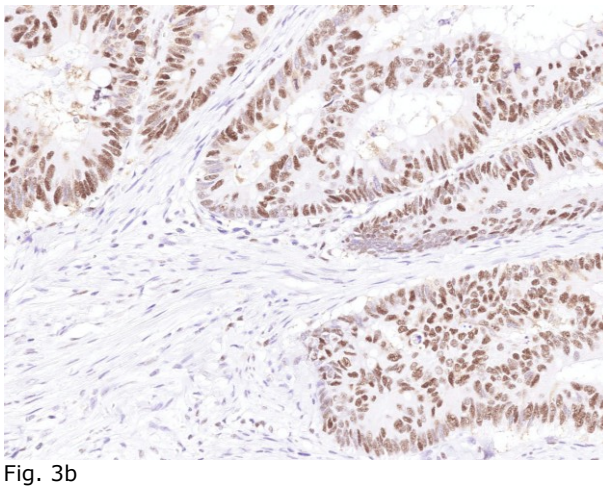


Fig. 3b
Insufficient MSH2 staining of the MSS colon adenocarcinoma, tissue core no. 3, using the same protocol as in Figs. 1b - 2b.
The neoplastic cells show unexpected partial loss of MSH2 expression and virtually all stromal cells (serving as internal control) are false negative – compare with Fig. 3a – same field.

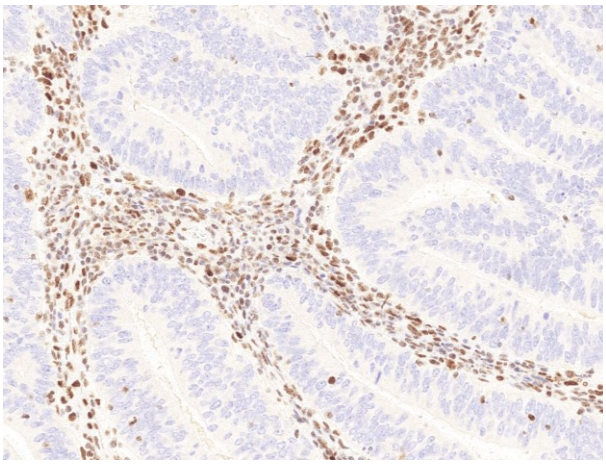


Fig. 4a
Optimal MSH2 staining of the MMRd colon adenocarcinoma, tissue core no. 4, using the same protocol as in Figs. 1a – 3a.
All neoplastic cells show loss of MSH2 and the stromal cells (internal control) show as expected a distinct nuclear staining reaction. The internal control, comprising stromal and lymphatic cells, shows distinct nuclear staining reaction.

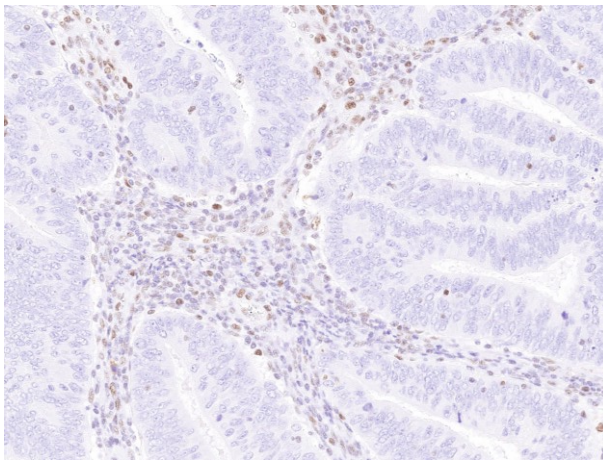


Fig. 4b
Insufficient MSH2 staining of the MMRd colon adenocarcinoma, tissue core no. 4, using the same protocol as in Figs 1b – 3b.
MSH2 expression status cannot reliably be interpreted as many of the stromal and lymphatic cells (internal control) are false negative. In this case, loss of MSH2 expression is difficult to identify due to lack of staining in the internal tissue control - compare with Fig. 4a – same field.

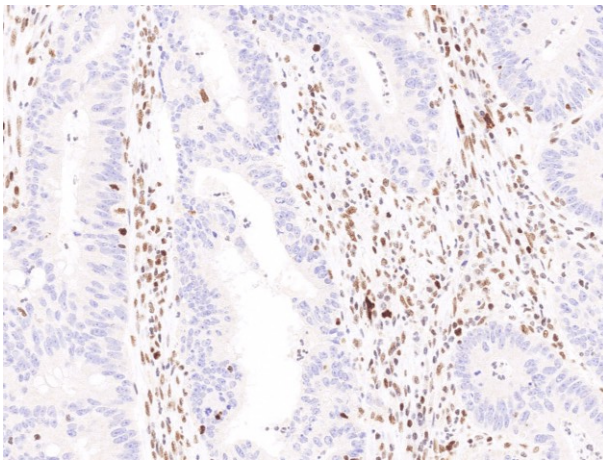


Fig. 5a
Optimal MSH2 staining of the MMRd endometrial adenocarcinoma, tissue core no. 5, using the same protocol as in Figs. 1a – 4a.
The neoplastic cells show as expected loss of MSH2 expression and stromal cells display a distinct nuclear staining reaction serving as internal positive tissue control.

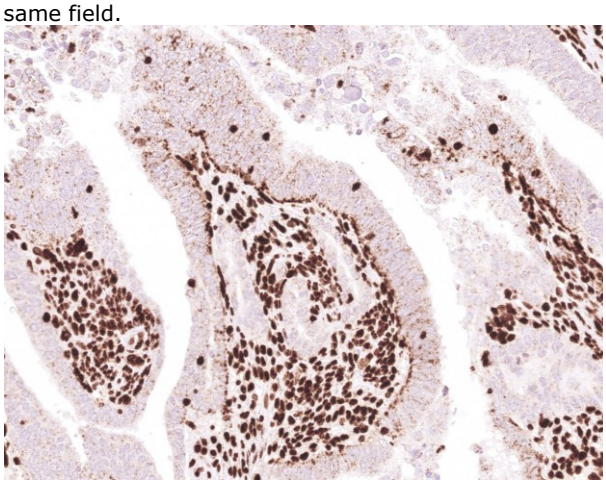


Fig. 5b
MSH2 staining reaction of the MMRd endometrial adenocarcinoma, tissue core no. 5, using the G219-1129 RTU product from Ventana/Roche with vendor recommended protocol settings, but with the addition of OptiView Amplification. The increased sensitivity provided by the tyramide produced an unspecific granular reaction over the expected negative tumour cells that interfered with the interpretation. This is a well-known problem when using tyramide in protocols with too high sensitivity. Careful calibration with this detection system is very important.

MK/TJU/HLK/KBA/RR 07.07.2026

[1]Torlakovic EE, Nielsen S, Francis G, Garratt J, Gilks B, Goldsmith JD, Hornick JL, Hyjek E, Ibrahim M, Miller K, Petcu E, Swanson PE, Zhou X, Taylor CR, Vyberg M. Standardization of positive controls in diagnostic immunohistochemistry: recommendations from the International Ad Hoc Expert Committee. Appl Immunohistochem Mol Morphol. 2015 Jan;23(1):1-18. doi: 10.1097/PAI.0000000000000163. Review. PubMed PMID: 25474126.