

## Immunohistochemistry

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| Policy Number: AHS –P2018 –<br>Immunohistochemistry | Prior Policy Name and Number, as<br>applicable: |
| Effective Date: 12/01/2023                          |   |

[POLICY DESCRIPTION | INDICATIONS AND/OR LIMITATIONS OF COVERAGE | TABLE OF TERMINOLOGY | SCIENTIFIC BACKGROUND | GUIDELINES AND RECOMMENDATIONS | APPLICABLE STATE AND FEDERAL REGULATIONS | APPLICABLE CPT/HCPCS PROCEDURE CODES | EVIDENCE-BASED SCIENTIFIC REFERENCES | REVISION HISTORY](#)

### I. Policy Description

Immunohistochemistry (IHC) is a very sensitive and specific staining technique that uses anatomical, biochemical, and immunological methods to identify cells, tissues, and organisms by the interaction of target antigens with highly specific monoclonal antibodies and visualization through the use of a biochemical tag or label (Fitzgibbons et al., 2014).

### II. Indications and/or Limitations of Coverage

Application of coverage criteria is dependent upon an individual's benefit coverage at the time of the request. Specifications pertaining to Medicare and Medicaid can be found in Section Applicable State and Federal Regulations of this policy document.

- 1) Code 88342 should be used for the first single antibody procedure and is reimbursed at one unit per specimen, up to four specimens, per date of service.
- 2) Code 88341 should be used for each additional single antibody per specimen and is reimbursed up to a maximum of 13 units per date of service.
- 3) Code 88344 should be used for each multiplex antibody per specimen, up to six specimens, per date of service.

### III. Table of Terminology

| Term        | Definition                                |
|-------------|---|
| AFP         | Alpha-fetoprotein                         |
| ASCO        | The American Society of Clinical Oncology |
| <i>Bcl2</i> | <i>BCL2 apoptosis regulator</i>           |
| b-HCG       | Beta human chorionic gonadotropin         |
| CAIX        | Carbonic anhydrase IX                     |
| CAP         | College of American Pathologists          |
| CD1a        | Cluster of differentiation 1a             |
| CD5         | Cluster of differentiation 5              |

| Term         | Definition   |
|--------------|--|
| CD10         | Cluster of differentiation 10                      |
| CD21         | Cluster of differentiation 21                      |
| CD30         | Cluster of differentiation 30                      |
| CD31         | Cluster of differentiation 31                      |
| CD34         | Cluster of differentiation 34                      |
| CD35         | Cluster of differentiation 35                      |
| CD43         | Cluster of differentiation 43                      |
| CD56         | Cluster of differentiation 56                      |
| CD99         | Cluster of differentiation 99                      |
| CD117        | Cluster of differentiation 117                     |
| <i>CDH17</i> | <i>Cadherin-17</i>                                 |
| <i>CDK4</i>  | <i>Cyclin-dependent kinase 4</i>                   |
| CDX2         | Caudal-type homeobox 2                             |
| CEA          | Carcinoembryonic antigen                           |
| CK           | Creatine kinase                                    |
| CK17         | Cytokeratin 17                                     |
| CK20         | Cytokeratin 20                                     |
| CK5/6        | Cytokeratin 5/6                                    |
| CK903        | Cytokeratin 903                                    |
| CLIA'88      | Clinical Laboratory Improvement Amendments of 1988 |
| CMS          | Centres for Medicare and Medicaid                  |
| CRC          | Colorectal cancer                                  |
| D2-40        | Anti-Podoplanin                                    |
| DNA          | Deoxyribonucleic acid                              |
| DOG1         | Delay of germination 1                             |
| ERG          | ETS-related gene                                   |
| ESMO         | The European Society of Medical Oncology           |
| FDA          | Food and Drug Administration                       |
| FISH         | Fluorescence in situ hybridization                 |
| Fli-1        | Friend leukemia integration 1                      |
| FOXL2        | Forkhead box protein L2                            |
| GATA3        | GATA binding protein 3                             |
| GCDFP15      | Gross cystic disease fluid protein 15              |
| GI           | Gastrointestinal tract                             |
| HepPar-1     | General hepatocyte paraffin 1                      |
| <i>HER2</i>  | <i>Human epidermal growth factor receptor 2</i>    |
| HMB-45       | Human melanoma black-45                            |
| HNF-1b       | Hepatocyte nuclear factor 1 beta                   |
| HPV          | Human papillomavirus                               |
| IHC          | Immunohistochemistry                               |
| IMP3         | U3 small nucleolar ribonucleoprotein protein IMP3  |
| INI1         | Integrase interactor 1                             |

| Term         | Definition                                       |
|--------------|--|
| ISH          | In situ hybridization                            |
| KIM-1        | Kidney injury molecule-1                         |
| LDTs         | Laboratory developed tests                       |
| Maspin       | Mammary serine protease inhibitor                |
| MCPyV        | Merkel cell polyomavirus                         |
| MDM2         | Mouse double minute 2 homolog                    |
| MIB-1        | MIB E3 ubiquitin protein ligase 1                |
| mIHC         | Multiplex immunohistochemistry                   |
| MiTF         | Microphthalmia-associated transcription factor   |
| MLH1         | MutL homolog 1                                   |
| MMR          | Mismatch repair protein                          |
| MPO          | Myeloperoxidase                                  |
| MSA          | Mammary serum antigen                            |
| MSH2         | Mismatch repair protein Msh2                     |
| MSI          | Microsatellite instability                       |
| MUC4         | Mucin 4  |
| MUC5AC       | Mucin 5AC  |
| MyoD1        | Myoblast determination protein 1                 |
| <i>NANOG</i> | <i>Nanog Homeobox</i>                            |
| napsin A     | Novel aspartic proteinase of the pepsin family A |
| NCCN         | The National Cancer Coalition Network            |
| NKX2.2       | Homeobox protein                                 |
| NKX3.1       | Homeobox protein                                 |
| NY-ESO-1     | New York esophageal squamous cell carcinoma 1    |
| OCT4         | Octamer-binding transcription factor 4           |
| p16          | Cyclin-dependent kinase inhibitor 2A             |
| p40          | Protein subunit                                  |
| P504S        | Cytoplasmic protein                              |
| p63          | Tumor protein p63                                |
| pan-Trk      | Pan-tropomyosin-related-kinase                   |
| PAX2         | Paired box 2                                     |
| PAX8         | Paired box 8                                     |
| PDX1         | Insulin promoter factor 1                        |
| PNET         | Primitive neuro-ectodermal tumor                 |
| PSA          | Prostate-specific antigen                        |
| PSAP         | Phosphoserine aminotransferase                   |
| PTEN         | Phosphatase and tensin homolog                   |
| pVHL         | Von hippel–lindau tumor suppressor               |
| RB           | Retinoblastoma protein                           |
| RCC          | Renal cell carcinoma                             |
| RCCma        | Renal cell carcinoma marker                      |
| S100P        | S100 calcium-binding protein p                   |

| Term  | Definition   |
|-------|--|
| SALL4 | Sal-like protein 4                                 |
| SATB2 | Special AT-rich sequence-binding protein 2         |
| SF-1  | Steroidogenic factor 1                             |
| SOX10 | SRY-box transcription factor 10                    |
| TFE3  | Transcription factor E3                            |
| TLE1  | Transducin-like enhancer protein 1                 |
| TTF1  | Transcription termination factor, RNA polymerase I |
| UPII  | Uroplakin II                                       |
| WT1   | Wilms tumor protein                                |

#### IV. Scientific Background

Immunohistochemistry (IHC) is used to identify certain components of tissues or cells (aka immunocytochemistry) via use of specific antibodies that can be visualized through a staining technique. The premise behind IHC is that distinct tissues and cells contain a unique set of antigens that allows them to be identified and differentiated. The selection of antibodies used for the evaluation of a specimen varies by the source of the specimen, the question to be answered, and the pathologist performing the test.

Importantly, an entirely sensitive and specific IHC marker rarely exists, and therefore, determinations are typically based on a pattern of positive and negative stains for a panel of several antibodies. The four most common IHC staining patterns include nuclear staining, cytoplasmic staining, membrane staining, and extracellular staining (Tuffaha et al., 2018). A single IHC marker approach (other than for pathogens such as cytomegalovirus or BK virus) is strongly discouraged since aberrant expression of a highly specific IHC marker can rarely occur. However, aberrant expression of the entire panel of highly specific IHC markers is nearly statistically impossible (Lin & Chen, 2014).

Multiplex immunohistochemistry (mIHC) is a particular IHC technique that allows multiple targets in a single tissue to be detected simultaneously; this approach is able to characterize “the tumor microenvironment including vascular architecture and hypoxia, cellular proliferation, cell death as well as drug distribution” (Kalra & Baker, 2017). Hence, mIHC can assist in the development of parameter tumor maps. Other researchers have utilized mIHC for its novel ability to provide quantitative data on different types of tumor-infiltrating immune cells within a single tissue; this may improve cancer patient immunotherapy stratification (Hofman et al., 2019).

##### *Clinical Utility and Validity*

IHC can be used for a variety of purposes including: differentiation of benign from malignant tissue, differentiation among several types of cancer, selection of therapy, identification of the origin of a metastatic cancer, and identification of infectious organisms (Shah et al., 2012). IHC has many uses in the realm of tumor identification, and it has even been clinically used to pinpoint various breast cancer-specific markers, such as progesterone and estrogen receptors, gross cystic duct fluid protein, and mammaglobin (Hainsworth & Greco, 2022). Further, overexpression of the *HER2* oncogene, a predictive breast cancer biomarker, is often identified via IHC (Yamauchi & Hayes, 2022). In regards to tumor identification, a specific type of IHC, known as pan-Trk

IHC, has been shown to positively identify inflammatory myofibroblastic tumors with a nuclear and cytoplasmic staining pattern that may assist in targeted therapy (Yamamoto et al., 2019).

Antibodies for use in IHC are available as single antibody reagents or in mixtures of a combination of antibodies. More than 200 diagnostic antibodies are generally available in a large clinical IHC laboratory, and hundreds of antibodies are usually available in research laboratories. The list of new antibodies is growing rapidly with the discovery of new biomarkers by molecular methodologies (Lizotte et al., 2016). Several studies have shown that a relatively low number of antibodies are capable of accurately diagnosing specific cancers and identifying the primary source of a metastasis (Le Stang et al., 2019; Lizotte et al., 2016; Prok & Prayson, 2006).

Common markers to identify tumor origin (Lin & Chen, 2014):

| <b>Primary Site</b>                          | <b>Markers</b>   |
|--|--|
| <b>Lung adenocarcinoma</b>                   | TTF1, napsin A   |
| <b>Breast carcinoma</b>                      | GATA3, ER, GCDFP15                                       |
| <b>Urothelial carcinoma</b>                  | GATA3, UPII, S100P, CK903, p63                           |
| <b>Squamous cell carcinoma</b>               | p40, CK5/6   |
| <b>RCC, clear cell type</b>                  | PAX8, RCCma, pVHL, KIM-1                                 |
| <b>Papillary RCC</b>                         | P504S, RCCma, pVHL, PAX8, KIM-1                          |
| <b>Translocational RCC</b>                   | TFE3   |
| <b>Hepatocellular carcinoma</b>              | Arginase-1, glypican-3, HepPar-1                         |
| <b>Adrenal cortical neoplasm</b>             | Mart-1, inhibin-a, calretinin, SF-1                      |
| <b>Melanoma</b>                              | S100, Mart-1, HMB-45, MiTF, SOX10                        |
| <b>Merkel cell carcinoma</b>                 | CK20 (perinuclear dot staining), MCPyV                   |
| <b>Mesothelial origin</b>                    | Calretinin, WT1, D2-40, CK5/6, mesothelin                |
| <b>Neuroendocrine origin</b>                 | Chromogranin, synaptophysin, CD56                        |
| <b>Upper GI tract</b>                        | CDH17, CDX2, CK20  |
| <b>Lower GI tract</b>                        | CDH17, SATB2, CDX2, CK20                                 |
| <b>Intrahepatic cholangiocarcinoma</b>       | pVHL, CAIX   |
| <b>Pancreas, acinar cell carcinoma</b>       | Glypican-3, antitrypsin                                  |
| <b>Pancreas, ductal adenocarcinoma</b>       | MUC5AC, CK17, Maspin, S100P, IMP3                        |
| <b>Pancreas, neuroendocrine tumor</b>        | PR, PAX8, PDX1, CDH17, islet-1                           |
| <b>Pancreas, solid pseudopapillary tumor</b> | Nuclear b-catenin, loss of Ecadherin, PR, CD10, vimentin |
| <b>Prostate, adenocarcinoma</b>              | PSA, NKX3.1, PSAP, ERG                                   |

|  |   |
|--|---|
| <b>Ovarian serous carcinoma</b>                      | PAX8, ER, WT1   |
| <b>Ovarian clear cell carcinoma</b>                  | pVHL, HNF-1b, KIM-1, PAX8                                       |
| <b>Endometrial stromal sarcoma</b>                   | CD10, ER  |
| <b>Endometrial adenocarcinoma</b>                    | PAX8/PAX2, ER, vimentin   |
| <b>Endocervical adenocarcinoma</b>                   | PAX8, p16, CEA, HPV in situ hybridization, loss of PAX2         |
| <b>Thyroid follicular cell origin</b>                | TTF1, PAX8, thyroglobulin                                       |
| <b>Thyroid medullary carcinoma</b>                   | Calcitonin, TTF1, CEA   |
| <b>Hyalinizing trabecular adenoma of the thyroid</b> | MIB-1 (unique membranous staining pattern)                      |
| <b>Salivary duct carcinoma</b>                       | GATA3, AR, GCDFP-15, HER2/neu                                   |
| <b>Thymic origin</b>                                 | PAX8, p63, CD5  |
| <b>Seminoma</b>                                      | SALL4, OCT4, CD117, D2-40                                       |
| <b>Yolk sac tumor</b>                                | SALL4, glypican-3, AFP  |
| <b>Embryonal carcinoma</b>                           | SALL4, OCT4, NANOG, CD30  |
| <b>Choriocarcinoma</b>                               | b-HCG, CD10, SALL4  |
| <b>Sex cord–stromal tumors</b>                       | SF-1, inhibin-a, calretinin, FOXL2                              |
| <b>Vascular tumor</b>                                | ERG, CD31, CD34, Fli-1  |
| <b>Synovial sarcoma</b>                              | TLE1, cytokeratin   |
| <b>Chordoma</b>                                      | Cytokeratin, S100   |
| <b>Desmoplastic small round cell tumor</b>           | Cytokeratin, CD99, desmin, WT1 (N-terminus)                     |
| <b>Alveolar soft part sarcoma</b>                    | TFE3  |
| <b>Rhabdomyosarcoma</b>                              | Myogenin, desmin, MyoD1   |
| <b>Smooth muscle tumor</b>                           | SMA, MSA, desmin, calponin                                      |
| <b>Ewing sarcoma/PNET</b>                            | NKX2.2, CD99, Fli-1   |
| <b>Myxoid and round cell liposarcoma</b>             | NY-ESO-1  |
| <b>Low-grade fibromyxoid sarcoma</b>                 | MUC4  |
| <b>Epithelioid sarcoma</b>                           | Loss of INI1, CD34, CK  |
| <b>Atypical lipomatous tumor</b>                     | MDM2 (MDM2 by FISH is a more sensitive and specific test), CDK4 |
| <b>Histiocytosis X</b>                               | CD1a, S100  |

|  |  |
|--|--|
| <b>Angiomyolipoma</b>                  | HMB-45, SMA  |
| <b>Gastrointestinal stromal tumor</b>  | CD117, DOG1  |
| <b>Solitary fibrous tumor</b>          | CD34, Bcl2, CD99                                     |
| <b>Myoepithelial carcinoma</b>         | Cytokeratin and myoepithelial markers; may lose INI1 |
| <b>Myeloid sarcoma</b>                 | CD43, CD34, MPO                                      |
| <b>Follicular dendritic cell tumor</b> | CD21, CD35   |
| <b>Mast cell tumor</b>                 | CD117, tryptase                                      |

## V. Guidelines and Recommendations

Guidelines are lacking regarding the selection and number of antibodies that should be used for most immunohistochemistry evaluations. However, IHC is broadly used for conditions such as cancers, which are mentioned across many different societies. The below section is not a comprehensive list of guidance for immunohistochemistry.

### **College of American Pathologists (CAP)**

CAP has published several reviews in Archives of Pathology & Laboratory Medicine that detail the quality control measures for IHC; further, CAP has also published more than 100 small IHC panels to address the frequently asked questions in diagnosis and differential diagnosis of specific entities. These diagnostic panels are based on literature, IHC data, and personal experience. A single IHC marker approach (other than for pathogens such as cytomegalovirus or BK virus) is strongly discouraged since aberrant expression of a highly specific IHC marker can rarely occur. However, aberrant expression of the entire panel of highly specific IHC markers is nearly statistically impossible (Lin & Chen, 2014; Lin & Liu, 2014).

### **The American Society of Clinical Oncology (ASCO) and the College of American Pathologists (CAP)**

ASCO and CAP currently recommend that “all newly diagnosed patients with breast cancer must have a HER2 test performed” (Wolff et al., 2013). Also, for those who develop metastatic disease, a HER2 test must be done on tissue from the metastatic site, if available. In less common HER2 breast cancer patterns, as observed in approximately 5% of cases by dual-probe in situ hybridization (ISH) assays, new recommendations have been made to make a final determination of positive or negative HER2 tissue. This new “diagnostic approach includes more rigorous interpretation criteria for ISH and requires concomitant IHC review for dual-probe ISH groups... to arrive at the most accurate HER2 status designation (positive or negative) based on combined interpretation of the ISH and IHC assays;” further, “The Expert Panel recommends that laboratories using single-probe ISH assays include concomitant IHC review as part of the interpretation of all single-probe ISH assay results” (Wolff et al., 2018).

The 2018 update included the following changes from the prior 2013 update, particularly focusing on infrequent HER2 test results that were of “uncertain biologic or clinical significance”:

- “Revision of the definition of IHC 2+ (equivocal) to the original FDA-approved criteria.
- Repeat HER2 testing on a surgical specimen if the initially tested core biopsy is negative is no longer stated as mandatory. A new HER2 test *may* (no longer *should*) be ordered on the excision specimen on the basis of some criteria (such as tumor grade 3).
- A more rigorous interpretation criteria of the less common patterns that can be seen in about 5% of all cases when HER2 status in breast cancer is evaluated using a dual-probe ISH testing. These cases, described as ISH groups 2 to 4, should now be assessed using a diagnostic approach that includes a concomitant review of the IHC test, which will help the pathologist make a final determination of the tumor specimen as HER2 positive or negative.

The Expert Panel also preferentially recommends the use of dual-probe instead of single-probe ISH assays, but it recognizes that several single-probe ISH assays have regulatory approval in many parts of the world” (Wolff et al., 2018)

### **The National Cancer Coalition Network**

The NCCN has made numerous recommendations for use of IHC to diagnose and manage various types of cancer. Cancers with clinically useful IHC applications include breast, cervical, various leukemias, and colorectal cancer.

The NCCN states that the determination of estrogen receptor, progesterone receptor, and HER2 status for breast cancer is recommended and may be determined by IHC (NCCN, 2022a). Specifically, the NCCN guidelines state “consistent with the ASCO/CAP guidelines, the NCCN panel considers either IHC or ISH with either a single or dual probe as an acceptable method for making an initial determination of HER2 tumor status. PR testing by IHC on invasive cancers can aid in the prognostic classification of cancers and serve as a control for possible false negative ER results. Patients with ER-negative, PR-positive cancers may be considered for endocrine therapies, but the data on this group are noted to be limited” (NCCN, 2022a). Further, the NCCN recommendations concerning Lynch Syndrome (LS) state, “The panel recommends tumor testing with IHC and/or MSI be used as the primary approach for pathology-lab-based universal screening” (NCCN, 2022b). More recently, the NCCN has made additional recommendations to individuals diagnosed with any type of hereditary colorectal cancer (CRC) syndrome; these recommendations state that “all individuals newly diagnosed with CRC have either MSI or immunohistochemistry (IHC) testing for absence of 1 of the 4 DNA MMR proteins” (NCCN, 2022b).

### **The European Society of Medical Oncology (ESMO)**

The ESMO recommends that for cancers of unknown primary, “immunohistochemistry should be applied meticulously in order to identify the tissue of origin and to exclude chemosensitive and potentially curable tumors” (Fizazi et al., 2015).



## VI. Applicable State and Federal Regulations

DISCLAIMER: If there is a conflict between this Policy and any relevant, applicable government policy for a particular member [e.g., Local Coverage Determinations (LCDs) or National Coverage Determinations (NCDs) for Medicare and/or state coverage for Medicaid], then the government policy will be used to make the determination. For the most up-to-date Medicare policies and coverage, please visit the Medicare search website: <https://www.cms.gov/medicare-coverage-database/search.aspx>. For the most up-to-date Medicaid policies and coverage, visit the applicable state Medicaid website.

### Food and Drug Administration (FDA)

Many labs have developed specific tests that they must validate and perform in house. These laboratory-developed tests (LDTs) are regulated by the Centers for Medicare and Medicaid (CMS) as high-complexity tests under the Clinical Laboratory Improvement Amendments of 1988 (CLIA '88). LDTs are not approved or cleared by the U. S. Food and Drug Administration; however, FDA clearance or approval is not currently required for clinical use.

Recently, four clinical IHC biomarker assays (PTEN, RB, MLH1, and MSH2) have been validated for use as biomarkers in a nationwide clinical trial; these assays were then approved by the FDA as laboratory-developed tests to assist in the treatment selection of patients in clinical trials (Khoury et al., 2018). This shows that IHC assays are currently being utilized with molecular tests to assist in therapeutic decisions.

## VII. Applicable CPT/HCPCS Procedure Codes

Procedure codes appearing in medical policy documents are only included as a general reference. This list may not be all inclusive and is subject to updates. In addition, codes listed are not a guarantee of payment.

| CPT   | Code Description   |
|-------|--|
| 88341 | Immunohistochemistry or immunocytochemistry, per specimen; each additional single antibody stain procedure |
| 88342 | Immunohistochemistry or immunocytochemistry, per spec; initial single antibody stain                       |
| 88344 | Immunohistochemistry or immunocytochemistry, per specimen; each multiplex antibody stain procedure         |

Current Procedural Terminology<sup>®</sup> American Medical Association. All Rights reserved.

## VIII. Evidence-based Scientific References

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## IX. Revision History

| Revision Date | Summary of Changes  |
|---------------|---|
| 07/01/2021    | Initial Effective Date  |
| 05/23/2022    | Updated background, guidelines, and evidence-based scientific references. Literature review did not necessitate any modifications to the coverage criteria.   |
| 09/07/2023    | Updated the background, guidelines and recommendations, and evidence-based scientific references. Literature review did not necessitate any modifications to coverage criteria.<br><br>Committee approved 09/18/2023<br><br>ODM approved 09/07/2023 |