Test Description:
This test is performed by the sequencing of select exons of the genes listed unless another method is noted. AKT1, BRAF, CTNNB1, EGFR, ERBB2, ERBB4, FGFR1, FGFR2, FGFR3, HRAS, JAK3, KRAS, MET, NOTCH1, NRAS, PDGFRA, PIK3CA, PTEN, SMAD4, SMO, SRC, TP53, MET FISH, PTEN FISH and PD-L1 IHC. Test orders include summary interpretation of all results together.

Results Summary Table

<table>
<thead>
<tr>
<th>Abnormalities</th>
<th>FDA Approved Therapies (in patient’s tumor type)</th>
<th>FDA Approved Therapies (in another tumor type)</th>
<th>Possible Therapy Resistance</th>
<th>Potential Clinical Trials</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIK3CA: NP_006209.2: p.Gln546Pro</td>
<td>None</td>
<td>Everolimus, Temsirolimus</td>
<td>Yes</td>
<td>Yes, See Clinical Trials Section</td>
</tr>
<tr>
<td>PTEN: NP_000305.3: p.Pro248ThrfsTer5</td>
<td>None</td>
<td>Everolimus, Temsirolimus</td>
<td>Yes</td>
<td>Yes, See Clinical Trials Section</td>
</tr>
</tbody>
</table>

Results Summary / Diagnostic & Prognostic Implications

Overall Summary
- There are mutations in the genes PIK3CA and PTEN.
- Moderate membrane staining for PD-L1 is detected in about 5% of the tumor by IHC.
- The presence of a PIK3CA mutation predicts response to PI3K/AKT/mTOR inhibitors.
- The presence of a PTEN mutation suggests sensitivity to PI3K/AKT/mTOR and PARP inhibitors.
- The expression of PD-L1 is very low, but raises the possibility of response to immunotherapy with anti-PD-1 or anti-PD-L1 antibodies.

- FISH studies show no abnormalities in MET and no evidence of deletion in PTEN.
- No evidence of mutations were detected in the following genes tested: AKT1 · BRAF · CTNNB1 · EGFR · ERBB2 · ERBB4 · FGFR1 · FGFR2 · FGFR3 · HRAS · JAK3 · KRAS · MET · NOTCH1 · NRAS · PDGFRA · SMAD4 · SMO · SRC · TP53

Clinical Significance
The NeoTYPE Cervical Tumor Profile characterizes primary or metastatic cervical tumors of any histological subtype for the most significant genetic changes relevant to therapy decisions, prognosis, and clinical research. It is appropriate for patients with newly-diagnosed or recurrent disease, and for patients with resistant disease to explore options in clinical trials.
Therapeutic Implications

Additional FDA Approved Therapies

**PIK3CA** NP_006209.2:p.Gln546Pro  
Everolimus: mTOR kinase inhibitor, immunosuppressant.  
Temsirolimus: mTOR inhibitor.

**PTEN** NP_000305.3:p.Pro248ThrfsTer5  
Everolimus: mTOR kinase inhibitor, immunosuppressant.  
Temsirolimus: mTOR inhibitor.

Drug Sensitivity

**PIK3CA** NP_006209.2:p.Gln546Pro  
Activating PIK3CA mutations may predict sensitivity to PI3K/Akt/mTOR pathway inhibitors, although data have been mixed in clinical trials (Janku et al., 2011; 21216929, Loi et al., 2013; 23301057, Mackay et al., 2014; 24166148, Deming et al., 2013; 23593290, Massacesi et al., 2013; 23551097). Inhibitors of PI3K and Akt, alone or in combination with other therapies, are currently in clinical trials in solid tumors. Several inhibitors designed to target both the mTORC1/Raptor and mTORC2/Rictor complexes are being tested in early phase clinical trials for advanced solid tumors (Grunt and Mariani, 2013; 23215720). The mTOR inhibitors everolimus and temsirolimus, which have been approved by the FDA in some tumor types, as well as other mTOR inhibitors, are being tested in clinical trials in a variety of solid tumors.

**PTEN** NP_000305.3:p.Pro248ThrfsTer5  
Because PTEN negatively regulates the PI3K/Akt/mTOR pathway, PTEN loss or mutation leads to activation of the PI3K pathway and may therefore predict sensitivity to inhibitors of the PI3K/Akt/mTOR pathway (Wu et al., 2011; 21903772). The mTOR inhibitors temsirolimus and everolimus have been approved by the FDA for use in various solid tumors. These and other mTOR inhibitors, as well as inhibitors of PI3K and Akt, are also currently in clinical trials, alone or in combination with other therapies. In addition, preclinical studies have shown that Pten deficient tumors may be sensitive to PARP inhibitors; PARP inhibitors, such as olaparib, are being studied in clinical trials (Mendes-Pereira et al., 2009; 20049735, Dedes et al., 2010; 20944090, McEllin et al., 2010; 20530668).

Possible Therapy Resistance

**PIK3CA** NP_006209.2:p.Gln546Pro  
A study of 60 cervical squamous cell carcinoma pre-treatment biopsies reported that patients harboring PIK3CA mutations or amplifications had lower response rates to cisplatin-based concurrent chemoradiotherapy than patients harboring wild-type PIK3CA (Wang et al., 2015; 25773678).

**PTEN** NP_000305.3:p.Pro248ThrfsTer5  
PTEN loss may also be associated with MEK-targeted therapy resistance, based on preclinical studies (Hoefferl et al., 2009; 19567590).

Clinical Trials Information

NOTE: Although we make every attempt to ensure that the information provided is as accurate as possible, please note that the information provided in this report has been obtained through public domains that are updated constantly and should be researched by the physician or research professionals. NOT ALL TRIALS ARE INCLUDED. Please go to www.clinicaltrials.gov to perform a detailed search of available clinical trials as the trials provided in this report is not meant to be a complete list.

<table>
<thead>
<tr>
<th>Gene</th>
<th>Trial ID</th>
<th>Title</th>
<th>Targets</th>
<th>Phase</th>
<th>Additional Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIK3CA</td>
<td>NCT01226316</td>
<td>Safety, Tolerability &amp; Potential Anti-cancer Activity of Increasing Doses of AZD5363 in Different Treatment Schedules</td>
<td>AKT</td>
<td>Phase 1</td>
<td><a href="http://clinicaltrials.gov/show/NCT01226316">http://clinicaltrials.gov/show/NCT01226316</a></td>
</tr>
<tr>
<td>PIK3CA</td>
<td>NCT01928459</td>
<td>Phase 1b Trial of BGJ398/BYL719 in Solid Tumors</td>
<td>FGFR3, FGFR4, FGFR1, FGFR2, PI3K</td>
<td>Phase 1</td>
<td><a href="http://clinicaltrials.gov/show/NCT01928459">http://clinicaltrials.gov/show/NCT01928459</a></td>
</tr>
<tr>
<td>PTEN</td>
<td>NCT01349660</td>
<td>Combination of BKML120 and Bevacizumab in Refractory Solid Tumors and Relapsed/Refractory Glioblastoma Multiforme</td>
<td>VEGFA, PI3K</td>
<td>Phase 2/Phase 2</td>
<td><a href="http://clinicaltrials.gov/show/NCT01349660">http://clinicaltrials.gov/show/NCT01349660</a></td>
</tr>
<tr>
<td>PTEN</td>
<td>NCT01449058</td>
<td>A Phase Ib Study of MEK162 Plus BYL719 in Adult Patients With Selected Advanced Solid Tumors</td>
<td>MEK, PI3K</td>
<td>Phase 2</td>
<td><a href="http://clinicaltrials.gov/show/NCT01449058">http://clinicaltrials.gov/show/NCT01449058</a></td>
</tr>
</tbody>
</table>
Phase 2

PIK3CA NP_006209.2:p.Gln546Pro A Phase 2 study in 66 evaluable cervical cancer patients treated with either cisplatin-based therapy alone or in combination with cetuximab reported a complete response in 27% (14/52) of patients harboring wild-type PI3K pathway genes, and in 0/14 patients with PI3K pathway mutations. The addition of cetuximab did not significantly increase the two year survival compared with chemotherapy alone (de la Rochefordiere et al., 2015; 25724520). A Phase 2 study of temsirolimus in patients with recurrent or metastatic cervical carcinoma reported a partial response in 3% (1/33) of patients and stable disease in 57.6% (19/33) of patients, with mild to moderate adverse effects and no toxicities greater than grade 3 (Tinker et al., 2013; 23672928).

PTEN NP_000305.3:p.Pro248ThrfsTer5 A Phase 2 study of temsirolimus in patients with recurrent or metastatic cervical carcinoma reported a partial response in 3% (1/33) of patients and stable disease in 57.6% (19/33) of patients, with mild to moderate adverse effects and no toxicities greater than grade 3 (Tinker et al., 2013; 23672928).

Phase 1

PIK3CA NP_006209.2:p.Gln546Pro In a Phase 1 clinical trial of PI3K/Akt/mTOR pathway inhibitors in breast and gynecological cancers, including cervical SCC, patients with PIK3CA mutation achieved 30% partial response and 9% stable disease, compared with only a 10% response rate in patients with wild-type PIK3CA (Janku et al., 2012; 22271473). Retrospective meta-analyses of Phase 1 clinical trials in cervical cancer patients have reported that patients with PIK3CA pathway mutations and/or PTEN deletions treated with targeted therapies had greater occurrences of complete responses, partial responses, and stable disease as compared with cohorts who received standard-of-care treatment, or had received targeted therapies but did not harbor these genetic alterations (Hou et al., 2014; 25426553, Hou et al., 2014; 24778042). Two Phase 1 studies of buparlisib (BKM120) in solid tumor patients have reported confirmed partial responses in 1/31 and 1/83 evaluable patients, respectively (Bendell et al., 2012; 22162589, Rodon et al., 2014; 24652201). A Phase 1b trial of buparlisib in combination with carboplatin and paclitaxel in 30 patients with advanced solid tumors has reported a 20% objective response rate, which included one complete response and four partial responses (Hyman et al., 2015; 25672916). A Phase 1 study of pan-Akt inhibitor MK-2206 in 33 patients with advanced solid tumors resulted in decreased Akt phosphorylation, and one patient with a pancreatic adenocarcinoma with PTEN loss and KRAS G12D mutation achieved 23% tumor shrinkage, and two patients with pancreatic neuroendocrine tumors had minor responses (Yap et al., 2011; 22025163). A Phase 1 study of the Akt inhibitor MK-2206 combined with carboplatin/paclitaxel, docetaxel, or erlotinib in 60 evaluable advanced solid tumor patients reported a complete response in one patient with head and neck squamous cell carcinoma, and partial responses in patients with HNSCC, melanoma, endometrial cancer, neuroendocrine prostate cancer, non-small cell lung cancer, and cervical cancer; six patients also exhibited stable disease for at least six months (Molife et al., 2014; 24387695). In a Phase 1 study to assess the safety and pharmacokinetics of everolimus and paclitaxel in patients with advanced solid tumors, 6/16 patients exhibited stable disease for more than four months (Campone et al., 2009; 19127256). A first-in-human Phase 1 clinical trial of GDC-0941 in 60 solid tumor patients reported partial response in two patients, one with BRAF V600E mutation-positive melanoma, and one with epithelial ovarian cancer, who had PTEN loss and PIK3CA amplification (Sarker et al., 2015; 25370471).

PTEN NP_000305.3:p.Pro248ThrfsTer5 Retrospective meta-analyses of Phase 1 clinical trials in cervical cancer patients have reported that patients with PIK3CA pathway mutations and/or PTEN deletions treated with targeted therapies had greater occurrences of complete responses, partial responses, and stable disease as compared with cohorts who received standard-of-care treatment, or had received targeted therapies but did not harbor these genetic alterations (Hou et al., 2014; 25426553, Hou et al., 2014; 24778042). Two Phase 1 studies of buparlisib (BKM120) in solid tumor patients have reported confirmed partial responses in 1/31 and 1/83 evaluable patients, respectively (Bendell et al., 2012; 22162589, Rodon et al., 2014; 24652201). A Phase 1b trial of buparlisib in combination with carboplatin and paclitaxel in 30 patients with advanced solid tumors has reported a 20% objective response rate, which included one complete response and four partial responses (Hyman et al., 2015; 25672916). A Phase 1 study of pan-Akt inhibitor MK-2206 in 33 patients with advanced solid tumors resulted in decreased Akt phosphorylation, and one patient with a pancreatic adenocarcinoma with PTEN loss and KRAS G12D mutation achieved 23% tumor shrinkage, and two patients with pancreatic neuroendocrine tumors had minor responses (Yap et al., 2011; 22025163). A Phase 1 study of the Akt inhibitor MK-2206 combined with carboplatin/paclitaxel, docetaxel, or erlotinib in 60 evaluable advanced solid tumor patients reported a complete response in one patient with head and neck squamous cell carcinoma, and partial responses in patients with HNSCC, melanoma, endometrial cancer, neuroendocrine prostate cancer, non-small cell lung cancer, and cervical cancer; six patients also exhibited stable disease for at least six months (Molife et al., 2014; 24387695). In a Phase 1 study to assess the safety and pharmacokinetics of everolimus and paclitaxel in patients with advanced solid tumors, 6/16 patients exhibited stable disease for more than four months (Campone et al., 2009; 19127256).
Pre-Clinical

PIK3CA NP_006209.2:p.Gln546Pro  A preclinical study evaluating everolimus in combination with cytotoxic chemotherapies in xenograft models that included a cervical cancer model demonstrated modest increased response over chemotherapies alone, without marked increased toxicities (O'Reilly et al., 2011; 20890178).

PTEN NP_000305.3:p.Pro248ThrfsTer5  A preclinical study evaluating everolimus in combination with cytotoxic chemotherapies in xenograft models that included a cervical cancer model demonstrated modest increased response over chemotherapies alone, without marked increased toxicities (O'Reilly et al., 2011; 20890178).

Results Detail

Molecular Testing Detail:

<table>
<thead>
<tr>
<th>Gene Name</th>
<th>Mutation Name</th>
<th>Alternate Nucleotide Mutation Name</th>
<th>Consequence</th>
<th>Allele Frequency (%)</th>
<th>Read Depth</th>
<th>Predicted Effect on Protein</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTEN</td>
<td>NP_000305.3:p.Pro248ThrfsTer5</td>
<td>NM_000314.4:c.740_741insA</td>
<td>frameshift_variant, feature_elongation</td>
<td>7.4</td>
<td>3755</td>
<td></td>
</tr>
<tr>
<td>PIK3CA</td>
<td>NP_006209.2:p.Gln546Pro</td>
<td>NM_006218.2:c.1637A&gt;C</td>
<td>missense_variant</td>
<td>3.9</td>
<td>11833</td>
<td>deleterious(0)</td>
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</table>

FISH Testing Detail:

<table>
<thead>
<tr>
<th>Test</th>
<th>Results</th>
<th>ISCN Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>MET FISH</td>
<td>Negative</td>
<td></td>
</tr>
<tr>
<td>PTEN FISH</td>
<td>Negative</td>
<td></td>
</tr>
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</table>

Histology Testing Detail:

<table>
<thead>
<tr>
<th>Test</th>
<th>Result</th>
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</thead>
<tbody>
<tr>
<td>PD-L1-IHC</td>
<td>Positive, Moderate 5% of tumor</td>
</tr>
</tbody>
</table>

Genes Evaluated (by molecular analysis unless otherwise noted)

<table>
<thead>
<tr>
<th>AKT1</th>
<th>BRAF</th>
<th>CTNNB1</th>
<th>EGFR</th>
<th>ERBB2</th>
<th>ERBB4</th>
<th>FGFR1</th>
<th>FGFR2</th>
<th>FGFR3</th>
<th>HRAS</th>
<th>JAK3</th>
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</thead>
<tbody>
<tr>
<td>MET</td>
<td>MET</td>
<td>NOTCH1</td>
<td>NRAS</td>
<td>PDGFRA</td>
<td>PIK3CA</td>
<td>PTEN</td>
<td>SMAD4</td>
<td>SMO</td>
<td>SRC</td>
<td>TP53</td>
</tr>
</tbody>
</table>

Patient Name: Test, Test
Patient DOB / Sex: 08/18/1945 / F
Accession / Case No.: 9999999 / NTP15-999999
Methodology

Nucleic acid was isolated from cells or microdissection-enriched FFPE tissue. The NeoTYPE™ Cervical Profile includes massive parallel sequencing and mutation analysis of the following genes: AKT1: EX: 2 (AA: G16_E49); BRAF: EX: 11 and 15 (AA: G2695_K2727); CTNNB1: EX: 3 (AA: M12_G50); EGFR: EX: 3, 7, 15, 18-20, and 21 (AA: R108_E142, G288_R297, G598_G627, K708_W817, and G857_K875); ERBB2: EX: 2, 19, 20 and 21 (AA: L755_D769, V773_L817, and R840_G882); ERBB4: EX: 3-4, 6-9, 15, and 23 (AA: P98_T140, L208_D349, K579_P619, and G907_C945); FGFR1: EX: 4 and 7 (AA: D153_S158 and E280_P283); FGFR2: EX: 6, 8 and 11 (AA: E250_K313, A363_Y382, and D522_N550); FGFR3: EX: 6, 8, 13, 15 and 17 (AA: R248_L288, G382_Q424, R642_N655, W687_L725, and L795_T808X); HRAS: EX: 2 and 3 (AA: M1_G15 and D38_E62); JAK3: EX: 12 and 15 (AA: S568_A573 and M683_T723); KRAS: EX: 2, 3, and 4 (AA: M1_I21, D38_E62, and K104_A146); MET: EX: 1, 13, 15, and 18 (AA: E168_H209, N375_R400, P1009_D1028, V1110_R1132, and Y1248_V1284); NOTCH1: EX: 26 and 27 (AA: A1562_L1600 and G1673_L1678); N-RAS: EX: 2 and 3 (AA: M1_A18 and D38_E62); PDGFRα: EX: 12, 14, 15, and 18 (AA: K552_G592, N659_S667, I673_R718, and V824_S854); PIK3CA: EX: 1, 4, 7, 9, 13, and 20 (AA: D84_G118, N345_K353, E418_N444, P539_R555, H701_K729, and Y988_N1068X); PTEN: EX: 1, 2, and 6-8 (AA: K6_Y27, I67_L70, and Q171_K342); SMAD4: EX: 2, 4-5, and 7-11 (AA: F119_D142, G168_N207, G243_N263, and Q311_Q534); SMO: EX: 3-4, 6, 9, and 11 (AA: V198_G242, Y323_W365, V404_G422, T534_R551, and V639_V646); SRC: EX: 11 (AA: M1_E11, A69_G112, Y126_T253, and R267_R306). When applicable, confirmation of the presence or lack of mutation was performed using Sanger sequencing on the following genes: BRAF, EGFR, HRAS, HRAS, KRAS, NRAS, and PTEN. In addition, FISH analysis is performed on interphase nuclei using the PTEN (10q23) and MET (7q31) probes. For IHC, anti-PD-L1 primary antibody (clone SP142) and a polymer-technology based system was used for detection. The sequencing method has a typical sensitivity of 5% for detecting mutations. Various factors including quantity and quality of nucleic acid, sample preparation and sample age can affect assay performance.

Abnormal Biomarker Information

PIK3CA NP_006209.2:p.Gln546Pro  PIK3CA-Q546P is an activating mutation. PIK3CA encodes the protein p110-alpha, which is the catalytic subunit of phosphatidylinositol 3-kinase (PI3K). The PI3K pathway is involved in cell signaling that regulates a number of critical cellular functions, including cell growth, proliferation, differentiation, motility, and survival (Samuels et al., 2005; 15950905, Engelman, 2009; 19629070). Alterations that activate the PI3K/Akt/mTOR pathway may predict sensitivity to PI3K or Akt inhibitors, which are under investigation in clinical trials, or to mTOR inhibitors, which are approved in some tumor types and in clinical trials for other solid tumors (Janku et al., 2011; 21216929, Massacesi et al., 2013; 23551097).

PTEN NP_000305.3:p.Pro248ThrfsTer5  PTEN-P248fs*5 is an inactivating mutation. PTEN loss or inactivating mutation may lead to increased activation of the PI3K/Akt/mTOR pathway. Therefore, inhibitors of this pathway may be relevant in a tumor with loss or mutation of PTEN (Courtney et al., 2010; 20085938, Wu et al., 2011; 21903772, Simpson and Parsons, 2001; 11237521). The mTOR inhibitors temsirolimus and everolimus have been approved by the FDA for use in various solid tumors. These and other mTOR inhibitors, as well as inhibitors of PI3K and Akt, are also currently in clinical trials, alone or in combination with other therapies.

Molecular Function

PIK3CA NP_006209.2:p.Gln546Pro  PIK3CA Q546P is a missense alteration within the p110-alpha helical domain (UniProt). Q546P has been described as a gain-of-function mutation that leads to oncogenic transformation in cell culture (Rudd et al., 2011; 21266528, Gymnopoulos et al., 2007; 17376864).

PTEN NP_000305.3:p.Pro248ThrfsTer5  This frameshift mutation is expected to effectively truncate the 403 amino acid protein Pten within the first 348 N-terminal amino acids. One study has reported that the region between amino acids 1 and 349 corresponds to the minimal fully functional Pten protein (Andrés-Pons et al., 2007; 17942903). The resulting protein would also lack the PDZ domain-binding region; this domain mediates the interaction of Pten with PDZ domain-containing proteins, which stabilize Pten and target it for phosphorylation by MAP kinases (Valiente et al., 2005; 15951562). This alteration is therefore predicted to lead to a loss of function.
Incidence

PIK3CA NP_006209.2:p.Gln546Pro  PIK3CA mutations have been reported in 15.8% (94/594) of cervical carcinoma samples analyzed in COSMIC, including in 11.5% (14/122) and 17.1% (76/443) of cervical adenocarcinoma and cervical squamous cell carcinoma (CSCC) samples, respectively (Aug 2015). Scientific studies in the literature analyzing either some or all of the exons in PIK3CA for mutations have reported that 11-25% of cervical adenocarcinoma, 14-38% of CSCC, and 16% of cervical adenosquamous cell carcinoma samples harbor PIK3CA mutations (Wright et al., 2013; 24037752, McIntyre et al., 2013; 23266353, Ojesina et al., 2014; 24390348, Spaans et al., 2015; 26197069).

PTEN NP_000305.3:p.Pro248ThrfsTer5  PTEN mutations have been reported in 3.9% (33/834) of cervical carcinoma samples analyzed in COSMIC, including in 8.1% (6/74) and 3.1% (18/587) of adenocarcinoma and squamous cell carcinoma (SCC) samples, respectively (Dec 2015). PTEN mutation has been reported in 7.7% (15/194) of sequenced tumors in the Cervical Squamous Cell Carcinoma and Endocervical Adenocarcinoma TCGA dataset (cBioPortal for Cancer Genomics, Dec 2015). A literature study reported PTEN mutation in 1/102 analyzed cervical carcinoma samples. PTEN mutation was not reported in 62 and 20 cervical SCC samples in two additional studies (Qi et al., 2014; 25054006, Cheung et al., 2004; 15196854, Loures et al., 2014; 25003471).

Role in Disease

PIK3CA NP_006209.2:p.Gln546Pro  PIK3CA mutations are not mutually exclusive with EGFR or KRAS or BRAF mutations, and are associated with increased PI3K signaling and increased activation of Akt (Yamamoto et al., 2008; 18757405, Janku et al., 2011; 21829508). PIK3CA activating mutations are thought to be an early event in the initiation of cervical SCC tumorigenesis (Costa et al., 2009; 19475528).

PTEN NP_000305.3:p.Pro248ThrfsTer5  Loss of PTEN (through mutation or deletion) can lead to uncontrolled cell growth and suppression of apoptosis (Staal et al., 2002; 12085208). PTEN haploinsufficiency has been associated with tumorigenesis in some tumor types, including astrocytoma and prostate cancer (Couto et al., 2009; 19281769, Kwon et al., 2008; 18451155, Kwabi-Addo et al., 2001; 11553783, Velickovic et al., 2002; 12011252). PTEN germline mutations are found in several cancer-predisposition syndromes, such as Cowden syndrome and Proteus syndrome (Hollander et al., 2011; 21430697). Loss of Pten protein expression has been suggested to play a role in cervical carcinogenesis, with loss of expression detected in both cervical glandular intraepithelial neoplasia and cervical carcinoma cases (Vázquez-Ulloa et al., 2011; 21664656, Grapsa et al., 2014; 23729286). In cervical carcinoma, loss of Pten expression has been correlated with lymph node metastasis, and higher tumor grade, size, and stage (Eijssink et al., 2010; 21078436, Rizvi et al., 2011; 21698421, Lu et al., 2012; 23310986, Lee et al., 2006; 16482604).

References

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Gymnopoulos M, Elsiger M, Vogt P  Rare cancer-specific mutations in PIK3CA show gain of function.


Hollander M, Blumenthal G, Dennis P  PTEN loss in the context of common cancers, rare syndromes and mouse models.

phase I clinical trials program.


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Velickovic M, Delahunt B, Moliver B, Grebe S. Intrinsic PTEN/MMAC1 loss of heterozygosity in conventional (clear-cell) renal cell carcinoma is associated with poor patient prognosis.

Vázquez-Ulloa E, Lizano M, Avilés-Salas A, Alfaro-Moreno E, Contreras-Paredes A. Abnormal distribution of HDQ and PTEN in premalignant lesions and invasive cervical cancer.


Electronic Signature
Sample Doctor, M.D., Pathologist - NeoGenomics Laboratories
The Technical Component Processing, Analysis and Professional Component of this test was completed at NeoGenomics Irvine, 5 Jenner Street, Suite 100, Irvine, CA / 92618 / 866-776-5907 / CLIA # 05D1065194.

The performance characteristics of this test have been determined by NeoGenomics Laboratories. This test has not been approved by the FDA. The FDA has determined such clearance or approval is not necessary. This laboratory is CLIA certified to perform high complexity clinical testing.