

Primer Design Ltd

R00969

# JC Polyomavirus

**Kit version: 2**

**Target region:**

VP1 gene

genesig<sup>®</sup> Advanced Kit

150 tests

GENESIG

Kits by Primerdesign

For general laboratory and research use only

# Introduction to JC Polyomavirus

Polyomavirus is a genus of viruses within the family Polyomaviridae. Polyomaviruses are icosahedral, non-enveloped viruses with a circular, double-stranded viral DNA genome of approximately 5.5 kb. The name Polyomaviridae is derived from early observation that cells infected with murine polyomavirus produced multiple (poly-) tumours (-oma) in immunocompromised mice. Later studies concluded that many members of the family were capable of mediating transformation and tumorigenesis.

JC Polyomavirus (JCV) is an extremely common human infection, it is estimated that between 50%-90% of the world's population would test positive for the virus. Serological studies show that most exposure to JCV occurs in childhood, where in immunocompetent individuals the virus may infect the kidneys and tonsils before becoming dormant. During this period the individual is asymptomatic and many go through life not realising they were infected. In severely ill or immunocompromised individuals the virus may reactivate, with JCV reactivation being associated with progressive multifocal leukoencephalopathy (PML).

PML is a rare and devastating central nervous system (CNS) infection caused by JCV. The disease is characterised by progressive damage or inflammation of the white and grey matter of the brain. The infection targets the myelin sheath of nerve cells in the brain, gradually destroying them and causing significant impairment to the transmission of nervous impulses. Symptoms include, impaired coordination, impaired speech and dementia, leading to life-threatening disability and frequently death.

As a secondary infection, until the development of effective antiretroviral therapy (ART), as many as 5% of people living with HIV eventually developed PML, equating to approximately 43% of all reported PML. Organ transplant recipients and cancer patients who are typically immunosuppressed are also at risk of PML. Treatment is limited and revolves around improving immune system function. Monitoring of JCV DNA levels in patients at risk of PML is crucial for early detection and intervention.

# Specificity

The genesig® Advanced Kit for JC Polyomavirus (JCV) is designed for the in vitro quantification of JCV genomes. The kit is designed to have a broad detection profile. Specifically, the primers will detect over 95% of sequences available on the NCBI database at the time of last review.

The dynamics of genetic variation means that new sequence information may become available after the initial design. If you require further information or have a specific question about the detection profile of this kit then please send an e-mail to [techsupport@primerdesign.co.uk](mailto:techsupport@primerdesign.co.uk) and our team will answer your question.

# Kit contents

- **1x JCV\_v2.0 primer/probe mix (150 reactions, BROWN)**  
FAM labelled
- **1x JCV\_v2.0 positive control template (RED)**
- **1x Internal extraction control primer/probe mix (150 reactions, BROWN)**  
VIC labelled as standard
- **1x Internal extraction control DNA (150 reactions, BLUE)**
- **1x Endogenous control primer/probe mix (150 reactions, BROWN)**  
FAM labelled, Target: Human ACTB gene as standard
- **1x RNase/DNase free water (WHITE)**  
for resuspension of primer/probe mixes
- **3x Template preparation buffer (YELLOW)**  
for resuspension of internal control template, positive control template and standard curve preparation

## Reagents and equipment to be supplied by the user

### Real-time PCR Instrument

#### Extraction kit

This kit is recommended for use with genesig® Easy DNA/RNA extraction kit or exsig®Mag. However, it is designed to work well with all processes that yield high-quality nucleic acid with minimal PCR inhibitors.

#### oasig® lyophilised or PrecisionPLUS® 2X qPCR Master Mix

This kit is intended for use with oasig® lyophilised or PrecisionPLUS® 2X qPCR Master Mix.

#### Pipettors and filter tips

#### Vortex and centrifuge

#### 1.5 ml microtubes

#### qPCR plates or reaction tubes

## Kit storage and stability

This kit is stable for shipping at ambient temperature but should be stored at -20°C upon arrival. Once the lyophilised components have been resuspended, they should not be exposed to temperatures above -20°C for longer than 30 minutes at a time and unnecessary repeated freeze/thawing should be avoided. The kit is stable for six months from the date of resuspension under these circumstances.

If a standard curve dilution series is prepared this can be stored frozen for an extended period. If you see any degradation in this serial dilution a fresh standard curve can be prepared from the positive control.

Primer Design Ltd does not recommend using the kit after the expiry date stated on the pack.

## Suitable sample material

This kit can be used with all types of samples from various origins. Please ensure that the extracted nucleic acid samples are suitable in terms of purity, concentration, and DNA integrity. An internal extraction control is provided to test for non-specific PCR inhibitors.

## Dynamic range of test

Under optimal PCR conditions the kit can achieve priming efficiencies between 90-110% and detect less than 100 copies of target template. If running a positive control standard curve for a quantitative result, and an efficiency of between 90% to 110% is not achieved, then the run should be repeated with a freshly prepared standard curve.

# Principles of the test

## Real-time PCR

A target specific primer and probe mix is provided, and this can be detected through the FAM channel.

The primer and probe mix provided exploits the so-called TaqMan® principle. During PCR amplification, forward and reverse primers hybridize to the target DNA. A fluorogenic probe is included in the same reaction mixture which consists of a DNA probe labelled with a 5'-dye and a 3'-quencher. During PCR amplification, the probe is cleaved, and the reporter dye and quencher are separated. The resulting increase in fluorescence can be detected on a range of qPCR platforms.

## Positive control

For copy number determination and as a positive control for the PCR set up, the kit contains a positive control template. This can be used to generate a standard curve of target copy number/Cq value. Alternatively, the positive control can be used at a single dilution where full quantitative analysis of the samples is not required. Each time the kit is used, at least one positive control reaction must be included in the run. A positive result indicates that the primers and probes for detecting the target gene worked properly in that particular experimental scenario. If a negative result is obtained the test results are invalid and must be repeated. Care should be taken to ensure that the positive control does not contaminate any other kit component which would lead to false- positive results. This can be achieved by handling this component in a Post PCR environment. Care should also be taken to avoid cross-contamination of other samples when adding the positive control to the run. This can be avoided by sealing all other samples and negative controls before pipetting the positive control into the positive control well.

## Negative control

To validate any positive findings a negative control reaction should be included every time the kit is used. For this reaction the RNase/DNase free water should be used instead of template. A negative result indicates that the reagents have not become contaminated while setting up the run. It is also known as a No Template Control or NTC.

## Internal DNA extraction control

When performing DNA extraction, it is often advantageous to have an exogenous source of DNA template that is spiked into the lysis buffer. This control DNA is then co-purified with the sample DNA and can be detected as a positive control for the extraction process. Successful co-purification and qPCR for the control DNA also indicates that PCR inhibitors are not present at a high concentration.

A separate primer and probe mix is supplied with this kit to detect the exogenous DNA using qPCR. The primers are present at PCR limiting concentrations which allows multiplexing with the target sequence primers. Amplification of the control DNA does not interfere with detection of the target DNA even when present at low copy number. The Internal control is detected through the VIC channel and gives a Cq value of 28+/-3 depending on the level of sample dilution.

## Endogenous control

A primer/probe mix for detection of the endogenous control gene is included in the kit, which allows confirmation of a valid biological sample from the host. Detection of the endogenous control is through the FAM channel, and it is therefore NOT possible to perform a multiplex reaction with the target specific primer/probe mix. Amplification of the endogenous control may depend on the sample type used. Please note that if samples from a different species are used, the endogenous control may not be appropriate, but the internal extraction control is advised to be use.

# Resuspension protocol

To minimize the risk of contamination with foreign DNA, we recommend that all pipetting is performed in a PCR clean environment. Ideally this would be a designated PCR lab or PCR cabinet. Filter tips are recommended for all pipetting steps.

**1. Pulse-spin each tube in a centrifuge before opening.**

This will ensure lyophilised primer/probe mix or template is in the base of the tube and is not lost upon opening the tube.

**2. Resuspend the primer/probe mixes in the RNase/DNase free water supplied, according to the table below:**

To ensure complete resuspension, vortex each tube thoroughly.

| Component - resuspend in water                                | Volume |
|---|--------|
| <b>Pre-PCR pack</b>   |        |
| JCV_v2.0 primer/probe mix ( <b>BROWN</b> )                    | 165 µl |
| Internal extraction control primer/probe mix ( <b>BROWN</b> ) | 165 µl |
| Endogenous control primer/probe mix ( <b>BROWN</b> )          | 165 µl |

**3. Resuspend the internal control template and positive control template in the template preparation buffer supplied, according to the table below:**

To ensure complete resuspension, vortex each tube thoroughly.

| Component - resuspend in template preparation buffer | Volume |
|--|--------|
| <b>Pre-PCR heat-sealed foil</b>                      |        |
| Internal extraction control DNA ( <b>BLUE</b> )      | 600 µl |
| <b>Post-PCR heat-sealed foil</b>                     |        |
| JCV_v2.0 Positive Control Template ( <b>RED</b> ) *  | 500 µl |

\* This component contains high copy number template and is a VERY significant contamination risk. It must be opened and handled in a separate laboratory environment, away from the other components.

## DNA extraction

The internal extraction control DNA can be added either to the DNA lysis/extraction buffer or to the DNA sample once it has been resuspended in lysis buffer.

**DO NOT add the internal extraction control DNA directly to the unprocessed biological sample as this will lead to degradation and a loss in signal.**

- 1. Add 4µl of the Internal extraction control DNA (**BLUE**) to each sample in DNA lysis/extraction buffer.**
- 2. Complete DNA extraction according to the manufacturer's protocols.**

# qPCR detection protocol

1. **For each DNA sample prepare a reaction mix according to the table below:**  
Include sufficient reactions for positive and negative controls.

| Component   | Volume       |
|---|--------------|
| oasig <sup>®</sup> lyophilised or PrecisionPLUS <sup>®</sup> 2X qPCR Master Mix | 10 µl        |
| JCV_v2.0 primer/probe mix ( <b>BROWN</b> )                                      | 1 µl         |
| Internal extraction control primer/probe mix ( <b>BROWN</b> )                   | 1 µl         |
| RNase/DNase free water ( <b>WHITE</b> )   | 3 µl         |
| <b>Final Volume</b>   | <b>15 µl</b> |

2. **(Optional) For each DNA sample prepare an endogenous control reaction according to the table below.**

This control reaction will provide useful information regarding the quality of the biological sample.

| Component   | Volume       |
|---|--------------|
| oasig <sup>®</sup> lyophilised or PrecisionPLUS <sup>®</sup> 2X qPCR Master Mix | 10 µl        |
| Endogenous control primer/probe mix ( <b>BROWN</b> )                            | 1 µl         |
| RNase/DNase free water ( <b>WHITE</b> )   | 4 µl         |
| <b>Final Volume</b>   | <b>15 µl</b> |

3. **Pipette 15µl of these mixes into each well according to your experimental plate set up.**
4. **Pipette 5µl of DNA template into each well, according to your experimental plate set up.**  
For negative control wells use 5 µl of RNase/DNase free water (**WHITE**). For positive control wells use 5 µl of the positive control template (**RED**). The final volume in each well is 20 µl.



## 5. (Optional) Standard curve preparation for quantitative analysis.

For quantitative analysis of the samples a standard curve dilution series can be prepared using the positive control template (**RED**). This is not required for qualitative analysis.

### 5.1 Reaction mix preparation for the standard curve.

Include sufficient reactions for each dilution of the standard curve.

| Component   | Volume       |
|---|--------------|
| oasig <sup>®</sup> lyophilised or PrecisionPLUS <sup>®</sup> 2X qPCR Master Mix | 10 µl        |
| JCV_v2.0 primer/probe mix ( <b>BROWN</b> )                                      | 1 µl         |
| RNase/DNase free water ( <b>WHITE</b> )   | 4 µl         |
| <b>Final Volume</b>   | <b>15 µl</b> |

### 5.2 Preparation of a 10-fold standard curve dilution series.

- Pipette 90 µl of template preparation buffer (**YELLOW**) into 5 tubes and label them tube 2-6. The neat positive control tube (**RED**) is considered tube 1.
- Pipette 10 µl of positive control template (**RED**) into tube 2.
- Vortex thoroughly.
- Change pipette tip and pipette 10 µl from tube 2 into tube 3.
- Vortex thoroughly

Repeat steps d and e to complete the dilution series.

| Standard Curve                         | Copy Number                |
|--|----------------------------|
| Tube 1 Positive control ( <b>RED</b> ) | 2 x 10 <sup>5</sup> per µl |
| Tube 2                                 | 2 x 10 <sup>4</sup> per µl |
| Tube 3                                 | 2 x 10 <sup>3</sup> per µl |
| Tube 4                                 | 2 x 10 <sup>2</sup> per µl |
| Tube 5                                 | 20 per µl                  |
| Tube 6                                 | 2 per µl                   |

### 5.3. Pipette 15 µl of reaction mix and 5 µl of the respective standard into each well for the standard curve according to your plate set up.

The final volume in each well is 20µl.

# qPCR amplification protocol

Recommended amplification conditions when using oasisig<sup>®</sup> lyophilised or PrecisionPLUS<sup>®</sup> 2X qPCR Master Mix.

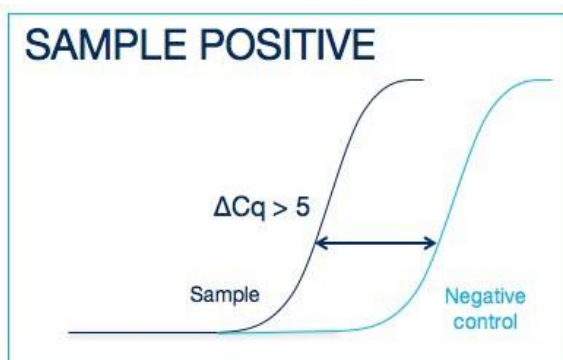
|                | <b>Step</b>       | <b>Time</b> | <b>Temp</b> |
|----------------|-------------------|-------------|-------------|
|                | Enzyme activation | 2 min       | 95 °C       |
| Cycling<br>x50 | Denaturation      | 10 s        | 95 °C       |
|                | DATA COLLECTION * | 60 s        | 60 °C       |

\* Fluorogenic data should be collected during this step through the FAM and VIC channels

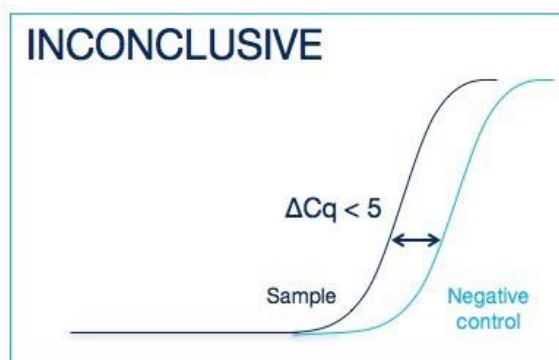
## Interpretation of results

| Target (FAM) | Internal control (VIC) | Positive control | Negative control | Interpretation   |
|--------------|------------------------|------------------|------------------|--|
| $\leq 30$    | + / -                  | +                | -                | <b>POSITIVE QUANTITATIVE RESULT</b><br>calculate copy number   |
| $> 30$       | +                      | +                | -                | <b>POSITIVE QUANTITATIVE RESULT</b><br>calculate copy number   |
| $> 30$       | -                      | +                | -                | <b>POSITIVE QUALITATIVE RESULT</b><br>do not report copy number as this may be due to poor sample extraction |
| -            | +                      | +                | -                | <b>NEGATIVE RESULT</b>   |
| + / -        | + / -                  | +                | $\leq 35$        | <b>EXPERIMENT FAILED</b><br>due to test contamination  |
| + / -        | + / -                  | +                | $> 35$           | *  |
| -            | -                      | +                | -                | <b>SAMPLE PREPARATION FAILED</b>   |
| + / -        | + / -                  | -                | + / -            | <b>EXPERIMENT FAILED</b>   |

\*Where the test sample is positive and the negative control is positive with a Cq  $> 35$ , the sample must be reinterpreted based on the relative signal strength of the two results:



If the sample amplifies  $> 5$  Cq earlier than the negative control, then the sample should be reinterpreted (via the table above) with the negative control verified as negative.



If the sample amplifies  $< 5$  Cq earlier than the negative control, then the positive sample result is invalidated, and the result should be determined inconclusive due to test contamination. The test for this sample should be repeated.

## Positive Control

The positive control template is expected to amplify between Cq 16 – 23 in the FAM channel. Failure to satisfy this quality control criterion is a strong indication that the experiment has been compromised and should be repeated.

## Internal PCR control

The Cq value obtained with the internal control will vary significantly depending on the extraction efficiency, the quantity of DNA added to the PCR reaction and the individual machine settings. Cq values of  $28 \pm 3$  are within the normal range. When amplifying a target sample with a high genome copy number, the internal extraction control may not produce an amplification plot. This does not invalidate the test and should be interpreted as a positive experimental result.

## Endogenous control

The signal obtained from the endogenous control primer and probe set will vary according to the amount of biological material present in a given sample. An early signal indicates the presence of a good yield of biological material. A late signal suggests that little biological material is present in the sample.

# Notices and disclaimers

This product is developed, designed and sold for research purposes only. It is not intended for human diagnostic or drug purposes or to be administered to humans unless clearly expressed for that purpose by the Food and Drug Administration in the USA or the appropriate regulatory authorities in the country of use. During the warranty period Primer Design Ltd genesig® detection kits allow precise and reproducible data recovery combined with excellent sensitivity. For data obtained by violation to the general GLP guidelines and the manufacturer's recommendations the right to claim under guarantee is expired. PCR is a proprietary technology covered by several US and foreign patents. These patents are owned by Roche Molecular Systems Inc. and have been sub-licensed by PE Corporation in certain fields. Depending on your specific application you may need a license from Roche or PE to practice PCR. Additional information on purchasing licenses to practice the PCR process may be obtained by contacting the Director of Licensing at Roche Molecular Systems, 1145 Atlantic Avenue, Alameda, CA 94501 or Applied Biosystems business group of the Applied Biosystems Corporation, 850 Lincoln Centre Drive, Foster City, CA 94404. In addition, the 5' nuclease assay and other homogeneous amplification methods used in connection with the PCR process may be covered by U.S. Patents 5,210,015 and 5,487,972, owned by Roche Molecular Systems, Inc, and by U.S. Patent 5,538,848, owned by The Perkin-Elmer Corporation.

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The PCR process is covered by US Patents 4,683,195, and 4,683,202 and foreign equivalents owned by Hoffmann-La Roche AG. TaqMan® is a registered trademark of Roche Molecular Systems, Inc., The purchase of the Primer Design Ltd reagents cannot be construed as an authorization or implicit license to practice PCR under any patents held by Hoffmann-LaRoche Inc.