ViroReal® Kit Parainfluenzavirus

Kit version 1.1

Instructions for Use

CE

IVD **For *in vitro* diagnostic use**

REF **DHUV01653**

Σ **50 reactions**

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Index

1 Intended purpose 3
2 Product description 3
3 Pathogen information 3
4 Principle of one-step reverse transcription real-time PCR 4
5 Contents of the kit, stability, and storage 4
6 Additionally required materials and devices 5
7 Precautions and safety information 5
7.1 General information 5
7.2 Specific information 5
8 Limitations 6
9 Preparation of samples 7
9.1 Sample collection and storage 7
9.2 Recommended extraction methods 7
9.3 Quality control for RNA extraction and RT PCR inhibition with IPC 7
9.3.1 Application of IPC as control of extraction and RT real-time PCR 7
9.3.2 Application of IPC as quality control for RT PCR reaction 7
10 Preparation of real-time PCR 8
10.1 Pipetting scheme 8
10.2 Programming of temperature profile 9
11 Interpretation of PCR-data 10
11.1 Controls 10
11.2 Clinical samples 11
12 Troubleshooting 11
12.1 No virus specific signal with positive control and with IPC 11
12.2 Virus specific signal with negative control 11
12.3 Virus specific signal with negative control of extraction 11
12.4 IPC specific signal with PCR negative control and positive control 12
12.5 No signal with IPC and no virus specific signal with sample 12
13 Specifications and performance evaluation 13
13.1 Kit performance on different real-time PCR instruments 13
13.2 Limit of detection, LoD95% 15
13.3 Linearity and dynamic measuring range 15
13.4 Precision 15
13.5 Analytical specificity 15
13.6 Diagnostic evaluation 16
14 References 16
15 Revision history 17

Explanation of symbols

LOT	Batch code		Use by date
REF	Catalogue number		Manufacturer
Σ	Contains sufficient for <n> tests		Temperature limit (Store at)
CE	This product fulfils the requirements of the European Directive 98/79 EC for *in vitro* diagnostic medical devices	IVD	In vitro diagnostic medical device
	Consult instructions for use	UDI	Unique device identifier
	Keep away from sunlight	QTY	Contents

1 Intended purpose

ViroReal® Kit Parainfluenzavirus is a non-automated IVD test, based on one-step reverse transcription real-time PCR (RT-PCR), for the qualitative detection of RNA of the HN gene of parainfluenzavirus 1, 2, 3 and 4 strains (HPIV-1, HPIV-2, HPIV-3, HPIV-4).
Proper specimens are RNA extracts isolated from samples of the human respiratory tract.

This test is suitable for patients of all ages with or without a suspected parainfluenzavirus infection and is intended as an aid in the diagnosis of such infections in combination with patient history and additional clinical information.

The test is intended for professional use and is limited to qualified personnel instructed in the procedures of real-time PCR and *in vitro* diagnostic procedures.

2 Product description

ViroReal® Kit Parainfluenzavirus is a one-step reverse transcription real-time PCR test and detects RNA of the hemagglutinin-neuraminidase glycoprotein gene (HN gene) of human parainfluenzavirus types 1, 2, 3 and 4.
A probe-specific amplification-curve in the FAM channel indicates the amplification of parainfluenzavirus type 1 and 3 (HPIV-1 and HPIV-3) specific RNA, while a probe-specific amplification-curve in the VIC channel indicates the amplification of parainfluenzavirus type 2 and 4 (HPIV-2 and HPIV-4) specific RNA. An internal RNA positive control (IPC) is detected in Cy5 channel and serves as a control for RNA extraction and possible RT-PCR inhibition. The target for the RNA IPC (artificial target RNA) is added during sample extraction.

This test has been validated with the ABI® 7500 Fast Real-time PCR System (Thermo Fisher Scientific) and tested with a LightCycler® 480 Instrument II (Roche), Mx3005P® QPCR System (Agilent), MIC instrument (bio molecular systems), QuantStudio™ 7 Pro (Thermo Fisher Scientific) and qTOWER^{3}G (Analytik Jena).
It is also compatible with other real-time PCR instruments which detect and differentiate fluorescence in FAM, VIC and Cy5 channel (e.g., QuantStudio™ 5 (Thermo Fisher Scientific), cobas z 480 Analyzer (Roche)).
When using PCR-platforms not tested by ingenetix, an evaluation of the multiplex-PCR shall be done. Keep in mind that some PCR-platforms first must be calibrated with the corresponding dye before performing multiplex-PCR.

Ingenetix ViroReal®, BactoReal®, MycoReal®, PanReal and ParoReal® Kits are optimized to run under the same thermal cycling conditions. RNA and DNA can be analysed in one run.

3 Pathogen information

Human parainfluenzaviruses (HPIV) are enveloped, negative single-stranded RNA viruses (ss(-)RNA) of the family *Paramyxoviridae*. At present four serotypes are known (types 1, 2, 3, 4). Parainfluenzavirus type 1 and 3 belong to the genus *Respirovirus*, while parainfluenzavirus type 2 and 4 belong to the genus *Rubulavirus.*
Human parainfluenzavirus type 1 (HPIV-1) is the major cause of acute croup, but can also cause respiratory tract infections at all ages. Human parainfluenzavirus type 2 (HPIV-2) can also cause croup as well as upper and lower respiratory tract illnesses. Human parainfluenzavirus type 3 (HPIV-3) causes bronchiolitis and pneumonia. Human parainfluenzavirus type 4 with the subtypes 4a and 4b is less likely to cause servere disease.

4 Principle of one-step reverse transcription real-time PCR

The test is based on multiplex one-step reverse transcription real-time PCR (RT-PCR) by 5´-nuclease-assay technology. In a first step, a specific RNA sequence is transcribed into cDNA and subsequently the DNA is amplified. The generated PCR-products are detected by an oligonucleotide-probe labelled with a fluorescent dye. This allows the sequence-specific detection of PCR amplificates.
During PCR, primers are extended by *Taq* polymerase and probes hybridized to the target are cleaved by the 5'-exonuclease activity of *Taq* polymerase. According to the accumulation of PCR product, the fluorescence of the probe increases with each PCR cycle. The change in fluorescence of the different dyes is recorded cycle by cycle in the real-time PCR instrument in the closed reaction tube at different fluorescence wavelengths.
The Cq value (Cq = Quantification cycle, Ct = Cycle threshold, Cp = Crossing point) describes the cycle at which the fluorescence rises significantly above the background fluorescence.

5 Contents of the kit, stability, and storage

Table 1

Labelling	Content	Amount	Storage
Parainfluenzavirus 1-4 + IPC3 Assay Mix (green cap)	Primer and probe for detection of - HPIV-1 (FAM) - HPIV-2 (VIC) - HPIV-3 (FAM) - HPIV-4 (VIC) - RNA IPC (Cy5)	1 x 50 µl	-25 to -15 °C
IPC-Target (RNA) (orange cap)	Target for RNA IPC (internal RNA positive control system)	1 x 200 µl	-25 to -15 °C
Parainfluenzavirus 1 & 2 Positive Control (red cap)	RNA positive control for HPIV-1 and HPIV-2 (à approx. 10^3 copies/µl)	1 x 300 µl	-25 to -15 °C
RNA Reaction Mix (white cap)	PCR reaction mix for RNA amplification	1 x 500 µl	-25 to -15 °C
Nuclease-free water (blue cap)	Nuclease-free water	1 x 1000 µl	-25 to -15 °C

RNA Reaction Mix: The Master Mix provided with the kit has been designed for reliable, high-sensitivity one-step reverse transcription real-time PCR even in the presence of common reaction inhibitors. The Master Mix contains a thermostable MMLV Reverse Transcriptase, an RNase inhibitor, a highly purified Taq Polymerase for rapid hot-start PCR, dNTPs, ROX™ dye (passive reference) and buffer components – additives optimized to handle RT-PCR inhibitors.

Delivery and Storage

Shipment is with dry ice. When stored properly, the kit components are stable until the specified expiration date. This also applies after opening. Store kit protected from light.

Quality Control Release Testing

In accordance with the ISO 13485 certified Quality Management System of ingenetix, each lot is tested against predetermined specifications to ensure consistent product quality.
Quality control is performed with an artificial RNA representing parts of the pathogen RNA. The RNA concentration was determined using a standard curve of a plasmid containing parts of the pathogen sequence.

6 Additionally required materials and devices

- Reagents and devices for RNA-extraction which are appropriate for the listed sample material (see 9. Preparation of the samples)
- Nuclease-free water
- Powder-free disposable gloves
- Pipettes (adjustable)
- Filter pipette tips
- Vortex-Mixer
- Benchtop centrifuge with rotor for 2 ml reaction tubes
- Real-time PCR instrument detecting and differentiating fluorescence in FAM, VIC and Cy5 channel
- Appropriate 96 well optical reaction plates or reaction tubes with corresponding (optical) closing material
- Optional: Laminar flow box
- Optional: PCR workstation

7 Precautions and safety information

7.1 General information

- For *in vitro* diagnostic use. The use of this kit is limited to qualified personnel instructed in real-time PCR and *in vitro* diagnostic procedures.
- Transportation of clinical specimens must comply with local regulations for the transport of biological materials.
- Specimens should be handled as if infectious in accordance with safe laboratory procedures. Wear protective powder-free disposable gloves when handling kit reagents and specimens.
- Discard specimens, reagents, and waste according to your local safety regulations.
- Improper collection, transport or storage of specimens may hinder the ability of the assay to detect the target sequences.
- Quality of RNA has a profound impact on the test performance. Ensure that the used RNA extraction system is compatible with real-time PCR technology.
- The real-time PCR instrument should be calibrated, serviced, and cleaned regularly.
- Protect kit components from light.
- Avoid mixing reagents of different kits and lots and check expiry date of the kit.

7.2 Specific information

A workflow must be followed to avoid false positive results due to detection of contaminating RNA.

<u>Recommended measures to avoid RNA contamination:</u>

- Use separated workspaces for specimen preparation, set-up of real-time PCR and amplification. Supplies and equipment must be dedicated to each of these separate workspaces to ensure workflow in the laboratory from pre- to post-PCR.
- Laboratory benches and devices must be cleaned regularly.
- Sample preparation should be performed in a laminar flow box. Clean laminar flow box regularly in all areas.
- If possible, leave consumables and pipettes in the laminar flow sterile bench and PCR workstation.
- Preparation of real-time PCR should be done in a PCR workstation.
- The use of sterile aerosol-resistant pipette tips is required.
- Use only RNA-free consumables.
- Wear lab coat.
- Work only with powder-free disposable gloves, do not touch the outer surface of the palm and fingers of the gloves when putting them on. Change gloves frequently. To avoid skin contact, wear gloves over the sleeves of the lab coat. Use disposable sleeve protectors if possible.
- Do not touch the rim or threads of open vials.
- Caution is advised when handling specimens and positive control to avoid cross-contamination.
- Store positive and potentially positive material separately from all other reagents.
- For a valid interpretation of results, a negative control shall be included during RNA-extraction (e.g., extraction of water instead of sample material), to exclude false-positive results due to contamination with RNA of pathogen during extraction.
- Optional: include a negative control of PCR per PCR-run (nuclease-free water instead of sample, NTC).

8 Limitations

- Reliable results with this test are only achieved by appropriate specimen collection, transport and storage, as well as an appropriate RNA extraction procedure.
- RNA extraction and parainfluenzavirus detection have been validated for nasopharyngeal swabs with this kit. Test performance with other specimen types has not yet been assessed.
- A negative test result does not exclude the possibility of parainfluenzavirus infection, because test results may be affected by improper specimen collection, technical error, specimen mix-up or viral quantities below the assay sensitivity. PCR inhibitors may lead to invalid results.
- For this kit highly specific primers and probes have been selected. However, false-negative, or less sensitive results might be obtained due to sequence heterogeneity within the target region of yet unknown clinical subtypes.
- Results should be interpreted in context of other clinical and laboratory findings.

9 Preparation of samples

ViroReal® Kit Parainfluenzavirus is suitable for analysis of RNA extracts of samples from the human respiratory tract.

Sample preparation should be performed with the recommended measures to avoid RNA contamination (see precautions and safety information). Always include an extraction negative control during RNA-extraction (e.g., extraction of water instead of sample material).

Purified RNA should be stored at -25 to -15 °C or at -80 to -60 °C.

9.1 Sample collection and storage

Samples from the respiratory tract can be stored in microcentrifuge tubes. Swabs are stored either dry or in isotonic saline solution (NaCl 0.9%, not provided). Swabs can be collected with swab material proper for PCR (e.g., sterile polyester or rayon swabs with aluminium or plastic shaft).
It is recommended to process samples immediately after collection. Store samples at 2-8 °C for no longer than 48 hours. Do not freeze native samples prior to extraction. Samples in lysis buffer can be frozen.

9.2 Recommended extraction methods

Ensure that the extraction system used is not contaminated with RNA of pathogens detected with ViroReal® Kit Parainfluenzavirus. Extract samples with an RNA extraction system compatible with RT real-time PCR technology and appropriate for the sample material. Extract RNA from 140-200 µl sample (depending on the extraction method) and elute in approx. 50 µl.

For manual extraction recommended
- QIAamp Viral RNA Mini Kit (Qiagen)

When using extraction methods not recommended by ingenetix, an evaluation of the extraction method must be performed.

9.3 Quality control for RNA extraction and RT PCR inhibition with IPC

The RNA IPC system (internal RNA positive control) is used as a control for RNA extraction, identifies possible RT PCR inhibition and confirms the integrity of kit reagents.
For this, an artificial RNA (IPC-Target (RNA), approx. 10^5 copies/µl) is added during extraction.

Note: The Cq values of the IPC depend on the extraction method and on the type of sample material. Negative samples should show Cq values of the IPC between 27-30. The extraction method used must be validated accordingly with sample material. Use the IPC-Target (RNA) freshly diluted (1:10 with nuclease-free water) in the extraction, if Cq values < 27 are determined during validation with samples.

9.3.1 Application of IPC as control of extraction and RT real-time PCR

The IPC-Target (RNA) must be added during extraction.

→ Per sample spike 1 µl IPC-Target (RNA) (orange cap) directly into the appropriate volume of lysis buffer (or spike it to the sample after the lysis buffer has been added to the sample), then continue the extraction procedure.

Caution: The IPC-Target (RNA) shall not be added to sample material in the absence of lysis buffer, as degradation may occur. It must be added to the lysis buffer.

9.3.2 Application of IPC as quality control for RT PCR reaction

If the IPC-Target (RNA) has not been added during extraction, it can be added at a later stage to the PCR master mix.

→ Freshly dilute the IPC-Target (RNA) 1:100 with nuclease-free water and add 1 µl of the dilution/PCR reaction.

Caution: The IPC-Target (RNA) shall not be added undiluted to the master mix (inhibition of PCR).

10 Preparation of real-time PCR

- Include one positive control (red cap), one extraction negative control and optionally one PCR negative control (NTC, e.g., nuclease-free water) per PCR run.
- It is generally recommended to analyse samples in duplicates, which increases the probability of pathogen detection and facilitates interpretation of results.
- Best use RNA immediately after extraction and always keep it on ice. Alternatively, use RNA stored at -80 °C to -15 °C. Thaw RNA on ice, avoid prolonged exposure to room temperature and immediately refreeze the RNA after use.
- Just before use, thaw the RNA Reaction Mix on ice, and invert 2 to 3 times to ensure a homogenous solution. The RNA Reaction Mix does not freeze at -20°C, but gelling may occur. The RNA reaction mix should not be warmed to room temperature. Thaw the other kit components completely at room temperature. When thawed, mix components carefully, centrifuge briefly with low speed and subsequently put on ice. Prepare Master Mix for RT-PCR on ice and use as soon as possible.
- **Positive Control**
  → As positive control, use 10 µl of the Positive Control (red cap). Always, pipette positive control at last. The Positive Control is a mixture of two *in vitro* synthesized RNA fragments with a concentration of 10^3 copies/µl each. It has to be stored at -20 °C. Before use, gently mix Positive Control, do not vortex. To avoid frequent freeze/thaw cycles, it can also be temporarily stored at 4 °C if used several times on the same day.

10.1 Pipetting scheme

		Per sample
Preparation of Master Mix (mix well)	Nuclease-free Water*	4.0 µl
	RNA Reaction Mix	5.0 µl
	Parainfluenzavirus 1-4 + IPC3 Assay Mix	1.0 µl
	Total volume Master Mix	**10.0 µl**
Preparation of PCR	Master Mix	10.0 µl
	RNA-Sample*	10.0 µl
	Total volume	**20.0 µl**

*10 µl sample can be used. When using a volume other than 10 µl, the volume of nuclease free water must be adjusted accordingly.

→ **If IPC-Target (RNA) was not added during extraction:** Freshly dilute the IPC-Target (RNA) (orange cap) 1:100 with nuclease-free water and add 1 µl per sample directly to the master mix. In this case, the IPC-Target (RNA) is used as a quality control for the RT PCR reaction.

Caution: The use of undiluted IPC-Target (RNA) might cause inhibition of the real-time PCR reaction.

- Prepare the Master Mix according to the number of samples, calculating an additional volume of approx. 10% to account for pipetting loss.
- Pipette 10 µl of the prepared Master Mix per sample into the well of the optical reaction plate.
- Then add 10 µl of the extracted sample or controls. Pipette the positive control at last.
- Seal the plate with a suitable optical sealing material.
- Vortex the sealed plate for 1-2 seconds and briefly centrifuge the plate.

10.2 Programming of temperature profile

Please find further information on programming of the real-time PCR instrument in the respective operator's manual. Keep in mind that some PCR-platforms must be calibrated with the corresponding dye before performing a multiplex-PCR.

Sample Volume: 20 µl
Ramp speed: "Standard" without "fast cycling" parameter for ABI® 7500 Fast Instrument, QuantStudio™ (Thermo Fisher Scientific)

Program 1	Program 2	Program 3
Cycles: 1 Analysis: None	Cycles: 1 Analysis: None	Cycles: 45 Analysis: Quantification Acquisition at 60 °C
50 °C 15 min	95 °C 2 min	95 °C 5 sec 60 °C 1 min

Ad program 1: This temperature profile can be used for all ingenetix ViroReal®, BactoReal®, MycoReal, PanReal and ParoReal® kits for the detection of DNA or RNA.
Ad program 2: the previous temperature profile with 20 sec in program 2 can still be used.

<u>Select detection channels</u>

FAM channel: Detection of HPIV-1 and HPIV-3
VIC channel: Detection of HPIV-2 and HPIV-4
Cy5 channel: Detection of IPC

For ABI® 7500 Instrument, QuantStudio™ 5/6/7 (Thermo Fisher Scientific), Mx3005P® (Agilent)
FAM-TAMRA
VIC-NONE
Cy5-NONE
Passive refence dye: ROX

For MIC Instrument (bio molecular systems)
FAM Green
VIC Yellow
Cy5 Red
Passive reference dye: no ROX needed

For cobas z 480 Analyzer / LightCycler® 480 II (Roche)
Detection format: 3 Color Hydrolysis Probe
FAM: Excitation at 465 nm, Emission at 510 nm
VIC: Excitation at 540 / 533 nm, Emission at 580 nm
Cy5: Excitation at 610 / 618 nm, Emission at 670 / 660 nm
Passive reference dye: no ROX needed

The color compensation for FAM and VIC must be selected from the Roche database after the analysis of Cy5.

11 Interpretation of PCR-data

For the analysis of the PCR results, select the fluorescence display options FAM and VIC channel for the pathogen target and Cy5 channel for the IPC.
Please note that some PCR platforms require Color Compensation when using a multiplex PCR.

IMPORTANT: Samples should be checked in both logarithmic (Roche instrument: Abs Quant/Fit Points) and linear view and compared to the negative control. In addition to the Cq values, also check the amplification curves and adjust the threshold (noise band) if necessary.
After you have saved the new settings, export the data. For the cobas z 480 Analyzer, export tables per dye.

Assessment of clinical specimen test results should be performed after the positive and negative controls have been examined and determined to be valid. If results of controls are not valid, no interpretation of results with clinical samples is possible.

Negative samples:
Samples without amplification curves (no Cq values, undetermined) are regarded as negative. No RNA was detected in these samples because there is no infection with the corresponding pathogen or the pathogen RNA concentration is below the detection limit of the test.

Positive samples:
Samples with Cq values < 45 in the fluorescence channel for the pathogen target are regarded as positive.

Table 2 shows the criteria for valid positive and negative controls. Table 3 shows interpretation of data with clinical samples.

11.1 Controls

Table 2 Criteria for valid positive and negative controls, IPC-Target (RNA) was added during extraction

	Cq FAM channel HPIV-1	Cq VIC channel HPIV-2	Cq Cy5 channel IPC[1]	Interpretation	Action
Positive control	<30	<30	Negative	Valid	-
Positive control	Negative	Negative	Negative	Invalid	See 12.1
Positive control	<30	Negative	Negative	Invalid	See 12.1
Positive control	Negative	<30	Negative	Invalid	See 12.1
Extraction negative control	Negative	Negative	27-30[2]	Valid	-
Extraction negative control	Negative	Negative	Negative	Invalid	See 12.1
Extraction negative control	Positive	Positive	27-30[2]	Invalid	See 12.3
Extraction negative control	Positive	Negative	27-30[2]	Invalid	See 12.3
Extraction negative control	Negative	Positive	27-30[2]	Invalid	See 12.3
NTC PCR (optional)	Negative	Negative	Negative	Valid	-
NTC PCR (optional)	Positive	Positive	Negative	Invalid	See 12.2
NTC PCR (optional)	Negative	Positive	Negative	Invalid	See 12.2
NTC PCR (optional)	Positive	Negative	Negative	Invalid	See 12.2

[1] If the IPC-Target (RNA) was added directly to the master mix, all samples in the Cy5 channel must be positive.
[2] Cq values of the IPC are dependent on the extraction method and should show Cq values of 27-30 (see 9. preparation of samples).

11.2 Clinical samples

Samples with positive Cq-values are considered positive, see Table 3.

Table 3 Interpretation of data with clinical samples

	Cq FAM channel HPIV-1 + HPIV-3	Cq VIC channel HPIV-2 + HPIV-4	Cq Cy5 channel IPC	Interpretation	Action
Clinical sample	Negative	Negative	27-30[1]	Negative	-
Clinical sample	Positive	Positive	Positive/Negative[2]	Positive for HPIV-1 or HPIV-3 and HPIV-2 or HPIV-4	-
Clinical sample	Positive	Negative	Positive/Negative[2]	Positive for HPIV-1 or HPIV-3	-
Clinical sample	Negative	Positive	Positive/Negative[2]	Positive for HPIV-2 or HPIV-4	-
Clinical sample	Negative	Negative	Negative	Invalid	See 12.5

[1] A positive signal of the IPC excludes potential PCR inhibition. However, IPC Cq-values should show comparable results among samples. A shift of Cq- values can indicate a partial inhibition of PCR. Cq values of the IPC are dependent on the extraction method and should show Cq values of 27-30 (see 9. preparation of samples).
[2] High pathogen load in the sample can lead to a reduced or absent fluorescence signal of the IPC.

In case of invalid data, analysis has to be repeated with the remaining or newly extracted RNA sample (see 12. Troubleshooting).

12 Troubleshooting

12.1 No virus specific signal with positive control and with IPC

- Incorrect programming of the temperature profile or incorrect setting of detection channels on the real-time PCR instrument.
  → Compare temperature profile and setting of detection channels with details specified in the protocol.
- Incorrect configuration of the PCR reaction.
  → Check your pipetting steps with the pipetting scheme and repeat PCR, if necessary.
- The RNA may have been degraded.
- The IPC-Target (RNA) was added undiluted directly to the mastermix and not freshly diluted 1:100. The PCR reaction is therefore inhibited.
  → Freshly dilute IPC-Target (RNA) 1:100 and repeat PCR.
- No Positive Control was added.
  → Repeat PCR in case all clinical samples are negative.
- For control of the reverse transcription real-time PCR only, 1 µl of freshly 1:100 diluted IPC-Target (RNA) must be added to the mastermix. If the IPC-Target (RNA) has been forgotten to be added:
  → Freshly dilute IPC-Target (RNA) and repeat PCR.
- For control of RNA extraction and PCR inhibition, the undiluted IPC-Target (RNA) must be added during extraction to the lysis buffer. If the IPC-Target (RNA) has been forgotten to be added:
  → Repeat RNA extraction.

12.2 Virus specific signal with negative control

- A contamination occurred during preparation of the RT-PCR.
  → Repeat the RT-PCR with new reagents in replicates.
  → Strictly pipette positive control at last.
  → Make sure that workspace and instruments are cleaned at regular intervals.

12.3 Virus specific signal with negative control of extraction

- A contamination occurred during extraction.
  → Repeat RNA extraction and RT-PCR using new reagents.
  → Make sure that workspace and instruments are cleaned at regular intervals.

12.4 IPC specific signal with PCR negative control and positive control

- The IPC-Target (RNA) has been added to lysis buffer during extraction, but there is IPC specific signal with PCR negative control and positive control: Contamination with the IPC-Target (RNA).
  → Make sure that workspace and instruments are cleaned at regular intervals.

12.5 No signal with IPC and no virus specific signal with sample

- Incorrect assignment of detection channels in sample.
  → Please verify the correct assignment of detection channels.
- Incorrect RT-PCR conditions.
  → Check the RT-PCR conditions and repeat the RT-PCR, if necessary.
- The RNA might be degraded.
- If IPC-Target (RNA) was added during extraction:
  - Inhibition of RT-PCR may have occurred.
  - RNA extraction was unsuccessful.
  - The IPC-Target (RNA) was not added to the lysis buffer of the sample.
  - The extracted sample was not added to the RT-PCR reaction.

  → No statement is possible. Verify you use a recommended method for RNA isolation and re-examine the single steps of the RNA extraction.
- → If no operating mistakes during RNA extractions can be retraced, it is recommended to repeat the RT-PCR with lower amounts of RNA-eluate (1/5 or 1/10 of sample volume + the adequate volume of nuclease-free water).

13 Specifications and performance evaluation

13.1 Kit performance on different real-time PCR instruments

Performance of ViroReal® Kit Parainfluenzavirus with an ABI® 7500 Real-time PCR System (Thermo Fisher Scientific) is shown in Figures 1, 2.

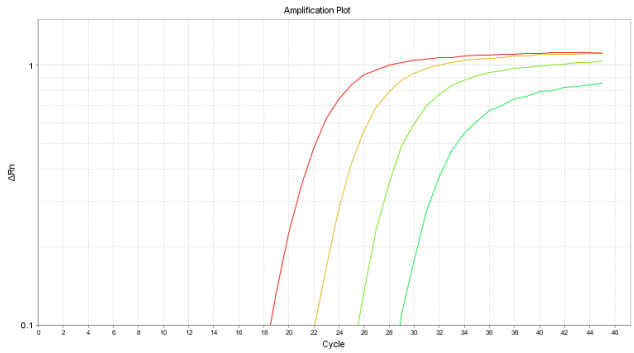
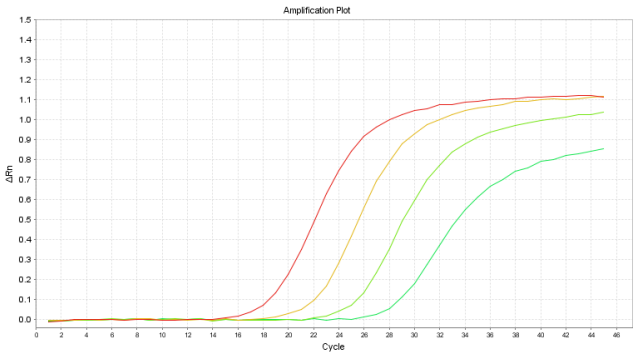
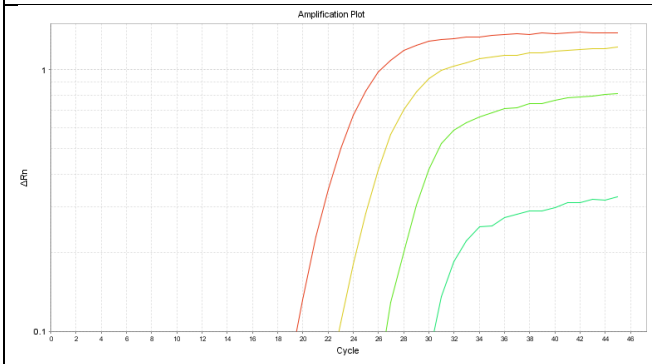
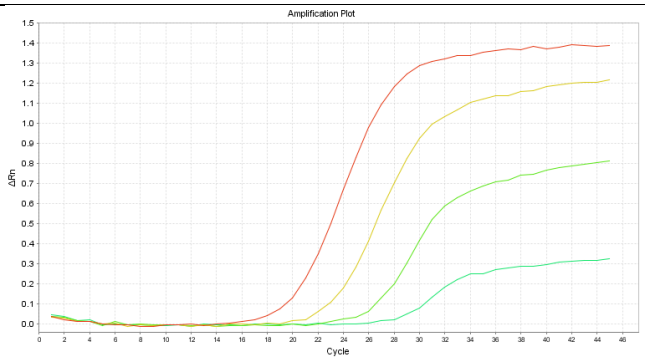
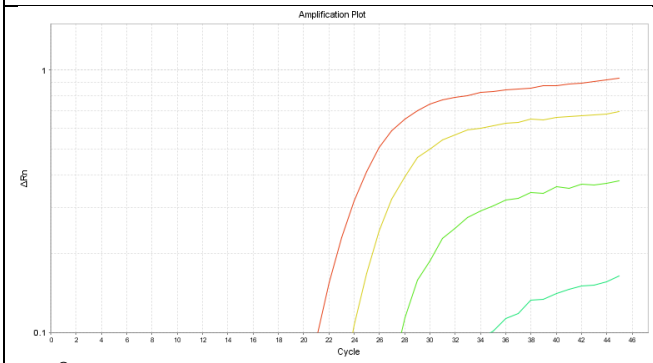
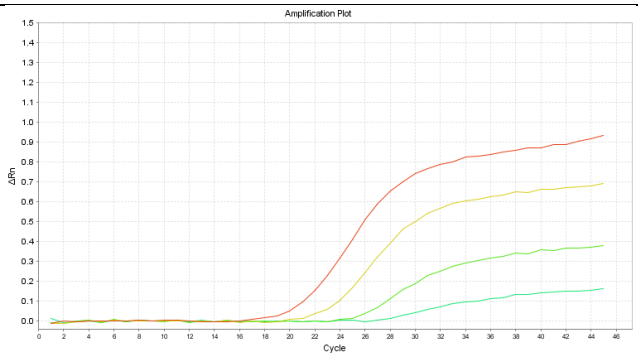
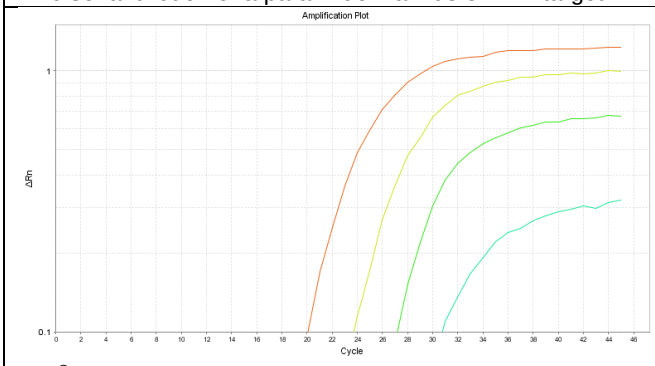
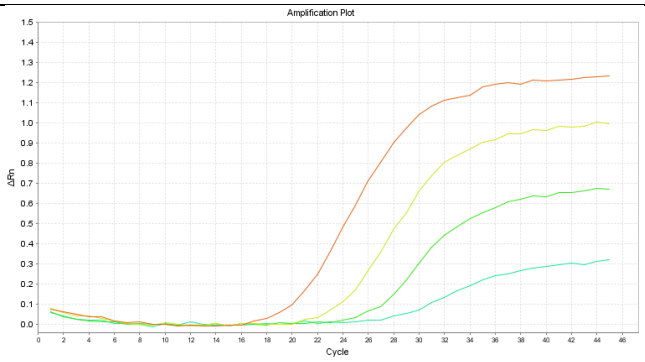
Logarithmic view	Linear view
	
ABI® 7500: FAM channel 1:10 serial dilution of a parainfluenzavirus 1 RNA target	
	
ABI® 7500: VIC channe 1:10 serial dilution of a parainfluenzavirus 2 RNA target	
	
ABI® 7500: FAM channel 1:10 serial dilution of a parainfluenzavirus 3 RNA target	
	
ABI® 7500: VIC channel 1:10 serial dilution of a parainfluenzavirus 4 RNA target	

Figure 1 Performance of ViroReal® Kit Parainfluenzavirus with ABI® 7500

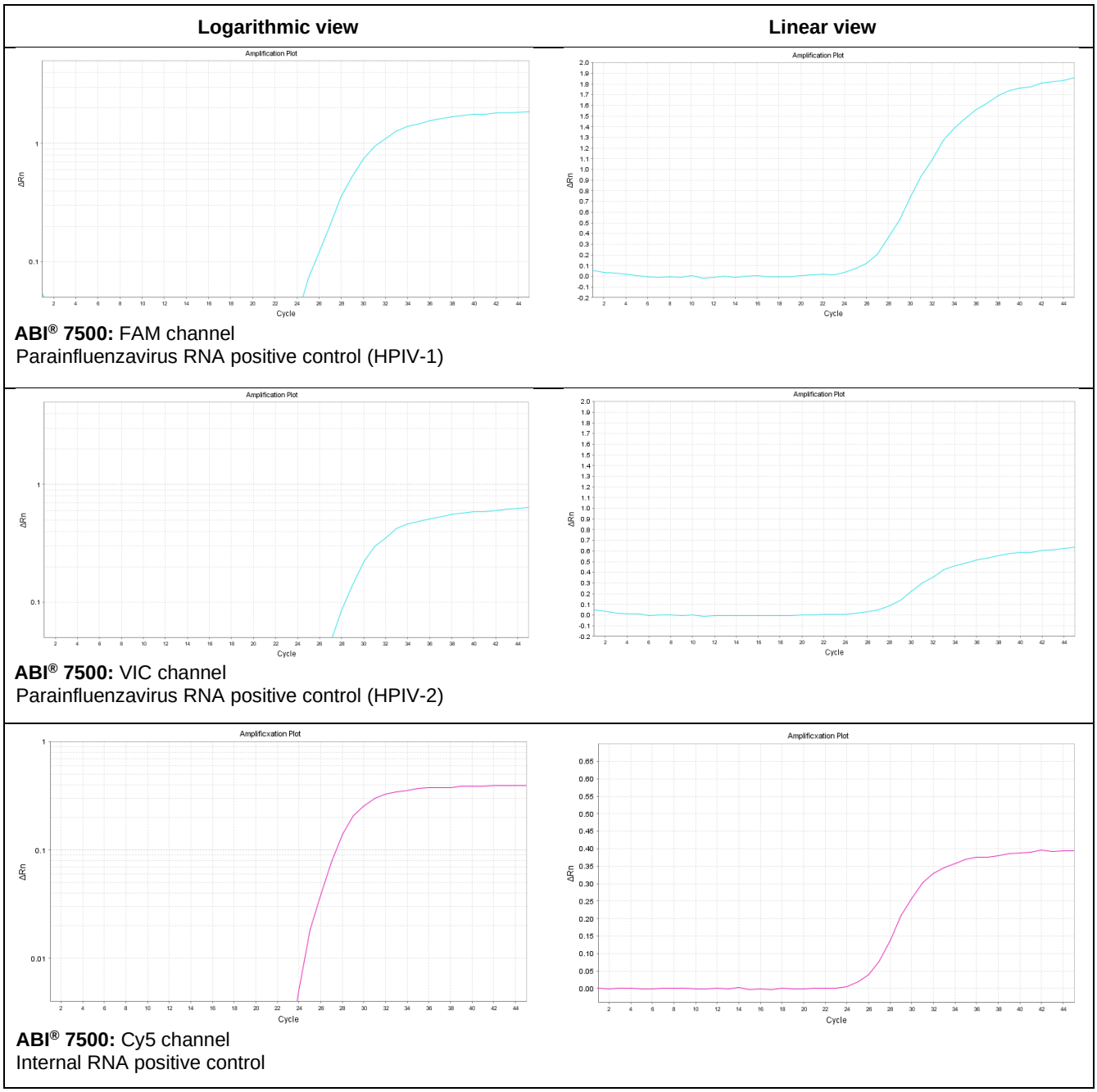


Figure 2 Performance of ViroReal® Kit Parainfluenzavirus with ABI® 7500

This test has been validated with the ABI® 7500 Fast Real-time PCR System (Thermo Fisher Scientific) and tested with a LightCycler® 480 Instrument II (Roche), Mx3005P® QPCR System (Agilent), MIC instrument (bio molecular systems), QuantStudio™ 7 Pro (Thermo Fisher Scientific) and qTOWER^{3}G (Analytik Jena), but is also compatible with other real-time PCR instruments which detect and differentiate fluorescence in FAM, VIC and Cy5 channel.

13.2 Limit of detection, LoD95%

Method: ViroReal® Kit Parainfluenzavirus was tested with a 10-fold dilution series of a synthetic RNA representing fragments of parainfluenzavirus RNA.
The limit of detection (LoD95% = smallest number of copies of target RNA which can be detected in 95% of cases) was determined with dilutions of the RNA around the analytical sensitivity using a non-linear curve fitting with the Graph Pad Prism Software.

Result: The LoD95% is 47 target copies/reaction for HPIV-1, 335 target copies/reaction for HPIV-2, 294 target copies/reaction for HPIV-3 and 346 target copies/reaction for HPIV-4.

13.3 Linearity and dynamic measuring range

Method: Linearity was determined using a 10-fold dilution series (10^6 – 10^1 target copies/reaction) of synthetic RNAs representing fragments of parainfluenzavirus RNA. The number of determinations (n) per dilution was ten.

Result: The assay shows linearity over the range of 100 to 10,000,000 target copies/reaction with a slope of -3.5 ± 0.02 and an R^2 of 0.99 for HPIV-1. For the other serotypes, it shows linearity over the range of 1000 to 10,000,000 target copies/reaction with a slope of -3.2 ± 0.1 and $R^2 > 0.99$ for HPIV-2, with a slope of -3.9 ± 0.1 and $R^2 > 0.99$ for HPIV-3 and with a slope of -3.8 ± 0.1.and $R^2 > 0.99$ for HPIV-4 as shown in Figure 3.

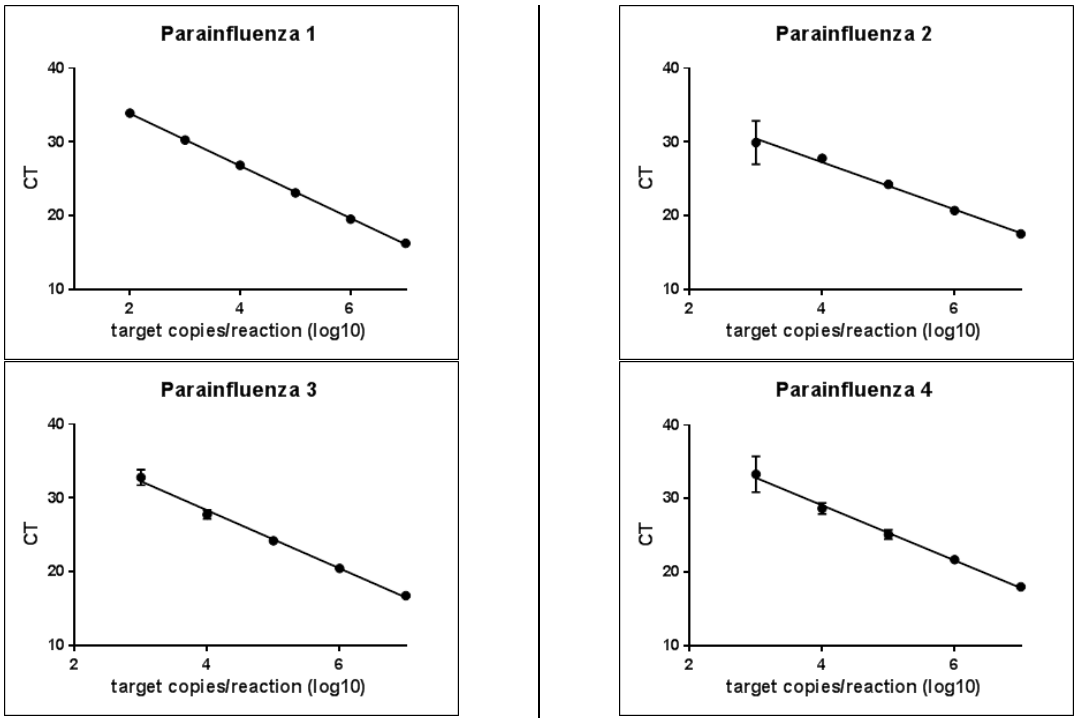


Figure 3 Ten-fold dilution series of parainfluenzavirus RNA standards plotted against Cq.

13.4 Precision

Method: Precision within a run (intra-assay), between multiple runs (inter-assay) and between two lots (inter-lot) was determined with 10-fold dilution series (10^6 – 10^1 target copies/reaction) of RNA.

Result: The mean values of the coefficients of variation (CV%) is 1.6% for the intra-assay, 1.6% for the inter-assay and 1.1% for the intra-lot precision.

13.5 Analytical specificity

Method BLAST analysis: The selection of highly specific primers and probes ensures analytical specificity. *In silico* validation of primers and probes was carried out with the Basic Local Alignment Search Tool (BLAST) against the NCBI database. Primers and probes have been checked for possible homologies to currently published sequences by sequence comparison analysis. This validates the detection of so far known human parainfluenzavirus strains type 1-4.

Result: Based on BLAST analysis, no relevant sequence variabilities were observed in the primer and probe region.

Method testing inclusivity: RNA of 3 parainfluenzavirus isolates from cell culture lysates was tested.

Result: All isolates were positive for HPIV-2 and HPIV-3.

Method testing exclusivity: Analytical specificity has been further evaluated by testing genomic DNA or RNA of viruses (adenovirus, enterovirus, metapneumovirus, respiratory syncytial virus, influenza A, influenza B) and of bacteria (*Bordetella pertussis, Bordetella parapertussis, Streptoccocus pneumoniae, Mycoplasma pneumoniae, Neisseria meningitidis*, *Haemophilus influenzae*).

Result: No cross-reactions were observed.

13.6 Diagnostic evaluation

Method: Diagnostic evaluation was performed with 27 parainfluenza-positive isolates (10 isolates from nasopharyngeal aspirates, 17 isolates from cell culture and ring trial samples). From these, 9 isolated were of serotype 1, 7 isolates of serotype 2, 10 isolates of serotype 3 and one isolate of serotype 4. No signal was obtained with 15 parainfluenza-negative samples.

Result: All samples were correctly analysed (Table 4, Table 5)

Table 4 Results of diagnostic evaluation of ViroReal® Kit Parainfluenzavirus

	Reference			
		pos	**neg**	**Total**
ViroReal® Kit Parainfluenza	**pos**	**27**	**0**	**27**
	neg	**0**	**15**	**15**
	Total	**27**	**15**	**42**

Table 5 Summary diagnostic evaluation of ViroReal® Kit Parainfluenzavirus

	Value	95% CI
Sensitivity	100%	87.23% to 100%
Specificity	100%	78.20% to 100%
NPV	100%	78.20% to 100%
PPV	100%	87.23% to 100%
Prevalence	64%	

14 References

Henrickson KJ. 2003. Parainfluenzaviruses. Clin Microbiol Rev. 16:242-264.

15 Revision history

Revision	Date	Description
1.3en	03 February 2020	4. Information about RNA Reaction Mix was added 8.Aadditional information about sample preparation was added 8.2 CAUTION! Positive Control was changed from storage in 15 µl RNA stabilizer (contained Guanidinium thiocyanate/Triton X-100) to storage in 150 µl citratbuffer. It must not be diluted 1:500 any more. 9. Table 1 and 2 were inserted 9. Table 1 and 2 were inserted 11.1. qTOWER3G (Analytik Jena) and MIC instrument (bio molecular systems) were added as validated real-time PCR devices 11.3 Added information about precision 11.5 Table 3 and 4 were inserted
1.4en	01 May 2023	**Change of the company address** **Explanation of symbols** Update **1. Intended purpose** Intended use specified in more detail **5. Contents, stability and storage** Kit version 1.1: Changed fill volume of IPC-Target (RNA) and Positive Control. The RNA IPC-Target is not stored in RNA/DNA Stabilizer anymore, concentration was changed from approx. $6x10^5$ copies/µl to approx. $6x10^4$ copies/µl and was renamed to IPC-Target (RNA). RNA IPC-3 Assay Mix has been removed. The former RNA IPC-3 Assay Mix is now included in the Parainfluenza 1-4 Assay Mix. **6. Additionally required materials and equipment** Update **7. Precautions and safety instructions** Update of this section Inclusion of additional information on specimen collection and storage, processing of specimens after collection, storage conditions of specimens, transport and storage conditions of purified RNA. Recommended measures to avoid RNA contamination added. **9. Preparation of samples** Update Note that for Cq values <27, the IPC-Target (RNA) must be diluted prior to extraction. **10. Preparation of real-time PCR** The pipetting scheme has changed. Dilution of IPC-Target (RNA) was changed from 1:500 to 1:100 The temperature profile has changed - the activation step in program 2 has been extended from 20 sec to 2 min. **11. Interpretation of PCR data** Update of tables for results with positive and negative controls and clinical samples. Inclusion of an explanation of how to evaluate clinical specimen test results in relation to controls. **12. Troubleshooting** Update regarding references in the new results tables. **13. Specifications and performance evaluation** Update.

Note:
Any serious incident that has occurred in relation to the device shall be reported to the manufacturer and the competent authority of the Member State in which the user and/or the patient is established.

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