Keywords:

Multiphase coupling, extremely sensitive method, peer reviews proven by proof of concept (04_2021), study approval diagnostic device currently until 02_2023, approval as test device 04_2022, testing of all known airborne pathogens, specialization Covid-19 / mutations current, result readable after approx. 1 minute*, zero contact with test person, safety and hygiene, waste prevention maximum, patents and approvals, research and development

Abstract:

In contrast to the vast majority of previously operated diagnostic procedures in medicine, the method of testing with the Vibamat® represents a completely new approach in the diagnosis of pathogenic germs in the exhaled air!

- The current methods use either biological and/or chromatic-chemical reactions to make statements about infections. These are often complex to organize, such as in the cultivation of pathogens in sensitive substrates from swabs and sputum or the need to obtain native blood, taken by qualified personnel. As a purely physical method, the Vibamat® uses only the volume of a single breathing exhalation under gentle cautiousness for client and test personnel. In a short time, the vibamate® detects as a positive statement whether molecules, peptides or their fragments have combined with their counterparts or counterparticles with the antibodies specifically applied to the chip. The connection level is the coating on the novel chip directly in the cone on the Vibamat® The device registers the lock between antigen and antibody (Covid-19) as a physical height difference in the smallest measuring range. The sensitivity is 99.97% and is therefore for the first time worldwide on par with the results of PCR diagnostics. In comparison, however, the results are available much faster, with extremely much less effort in terms of material, logistics and personnel. With simplified handling in the practical handling of the Vibamat®!
- Registration number: BfArM **00104483** since 04/2022
- In the current version, the Vibamat® generates a barcode on a display that shows the test result personalized or anonymous. The tested person can scan this barcode into corresponding systems with a smartphone and thus decides on the transfer of data. The device itself does not store any information beyond the duration of the test process.
- In addition to the high hygienic safety of personnel and test person, the use of Vibamat® significantly relieves the environment in high incidences and high test requirements. There is no packaging waste. No non-sterile products have to be disposed of at great expense. All work is done by the chip in the Vibamat® At the end of all test phases, it is simply sent back to the manufacturer or the elliptic analysis and recycled internally.
- The Vibamat® is ingeniously designed and robustly developed. The base unit is designed for daily continuous use and, to the exclusion of willfulness or extreme external influences, will be functional for many years! The chip allows 500 individual tests!

***Depending on local humidity. Absolute test reliability between -02 and 40 °C**

Evaluation of the field study with the in the Health Department Berlin-Neukölln, Research Group Neukölln (Room 18) 03_04_2021 (invited by the Health Department Berlin-Neukölln)

Result - strongly infectious are:

- 50% of PCR-positive K1 contacts with a fresh infection
- 40% of PCR-negative K1 contacts with corona-specific symptoms
- 25.9% of PCR-positive K1 contacts with an old infection (> 7 days)
- 20% of PCR-negative K1 contacts without any symptoms

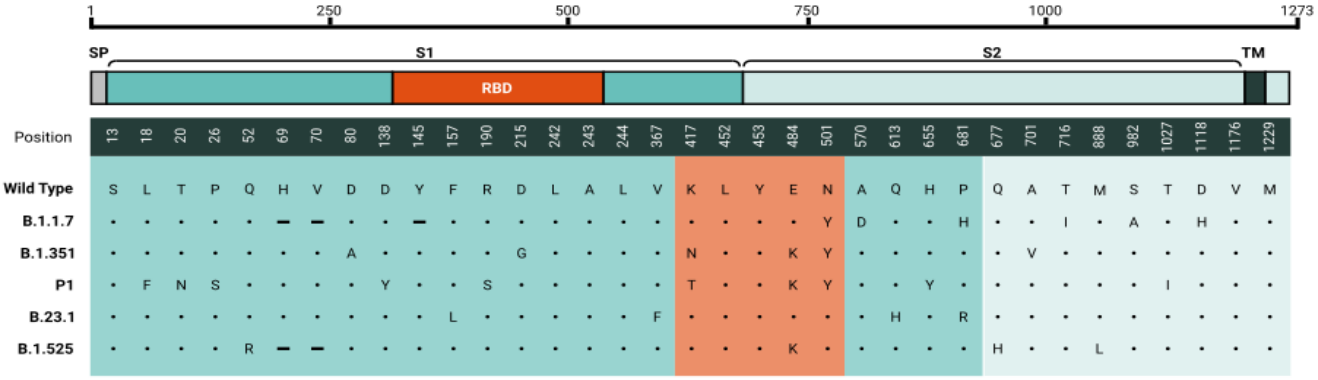
Cohort	Highly infectious	Mildly infectious	Uninfectious
First positive PCR test less than 7 days ago	50%	25%	25%
First positive PCR test more than 7 days ago	25,9%	37%	37%
Negative PCR test K1 contacts with symptoms	40%	40%	20%
Negativer PCR-Test K1 contacts without symptoms	20%	35%	45%
K1 contact persons (total cohort)	31,7%	31,7%	36,6%
K2 contacts (total cohort)	16%	40%	44%
People from the personal environment (No contact persons)	0%	10%	90%

Table 1: Summary of results (breath measurement)

1. Definition of the types of viruses that can be detected:

The CR 3022 antibodies we use are recombinant high-affinity anti-SARS-CoV-2 spike S1 antibodies (RBD) directed against the RBD epitope. The data sheet can be found at https://www.antikoerper-online.de/productsheets/ABIN6952546.pdf . The antibody binds to the amino acid sequence 318-510

Mutations in the field of 318 - 510	Positive charges opposite Origin	Negative charges opposite Origin	Ladungsdifferenz	Influence on the folding of the RBD epitope
N501Y	-1	+1	-2	yes
N501S	-1	+1	-2	yes
N501T	-1	+1	-2	yes
K417T	0	+1	-1	yes
K417N	0	0	0	no
E484K	+1	-1	+2	yes
L452R	+1	0	+1	yes



- The mutation B.1.351
- The mutation P1

For the mutation B.1.351 we have found an antibody, whether this antibody can also detect the mutation P1 is not yet known.

2. Definition of the ranges "Non-infectious", "Mildly infectious" and "Highly infectious"

The limits are defined as follows:

0 to 10000 viruses:Non-infectious

10000 to 60000 viruses:Easily infectious

>60000 viruses: Highly infectious

Justification for the limit of 10000 viruses:

The virus load is determined on an area of approx. 18 mm². Assuming a mouth opening of 5 cm², then the exhaled viral load is higher by a factor of 28 per breath. At a distance of 1.5 m, the viral load is distributed over an area of approx. 1.5 m x 1.5 m = 2.25 m². The viral load that can be inhaled by mouth is then about 0.006 multiplied by the measured viral load. If one assumes that 3000 viruses are sufficient for infection, then the counterpart must exhale a viral load of about 500,000 viruses to produce infection. If the other person exhales as much air per breath as when breathing, then with a viral load of 10,000 measured viruses, only 60 viruses per breath arrive at his contact person. Further breathing accumulates this value, so that an infection is only possible in about 15 minutes with absolute calm.

Justification for the limit of 60000 viruses:

FFP 2 masks are specified with a filtering performance of at least 94% of viruses under laboratory conditions. In practice, a filter performance of 83% is probably achieved at best. When using an FFP 2 mask, an infection takes place only after 15 minutes with a measured viral load of 60000 viruses.

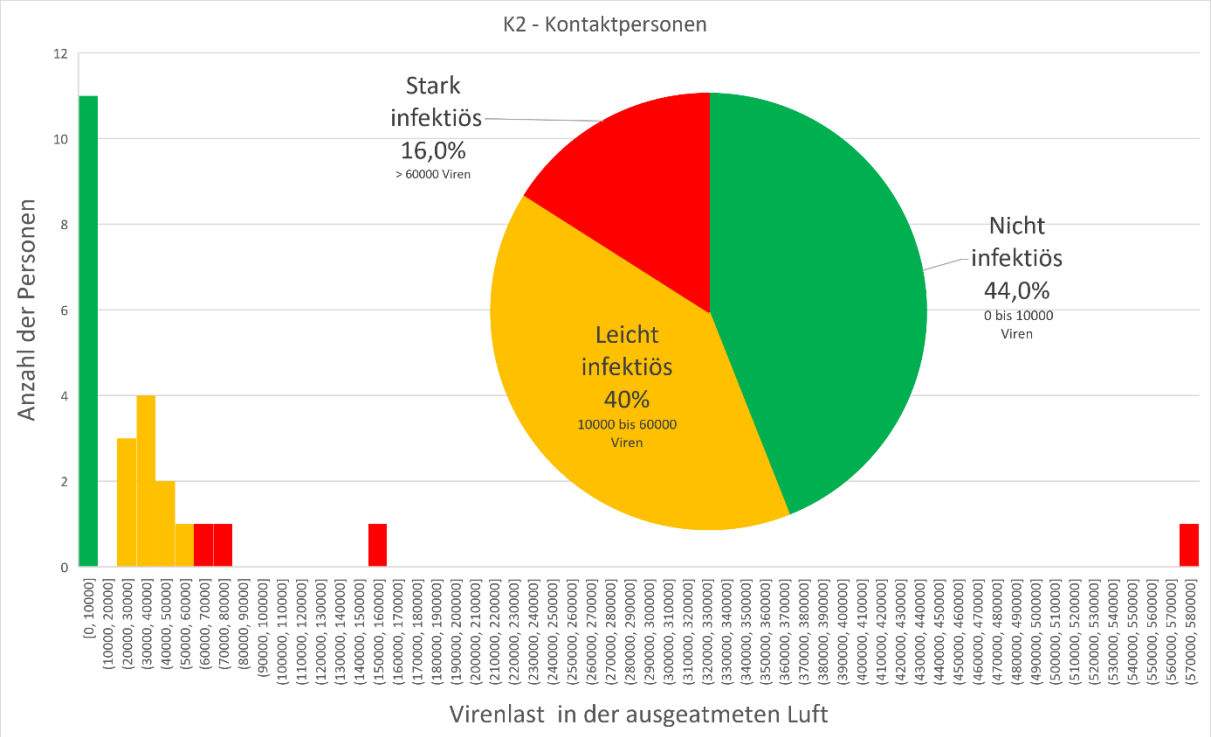
The current state of science according to RKI:

"The exact period during which contagiousness exists is not yet clearly defined. It is considered certain that the contagiousness is greatest in the period around the onset of symptoms and that a significant proportion of transmissions occur before the first clinical symptoms appear.

According to a recent study by the US Centers for Disease Control and Prevention in Atlanta, almost 60 percent of all Covid-19 infections are due to infections with people who have not experienced symptoms. This calculation of the researchers from Atlanta also includes those people who transmitted the virus before they developed symptoms. The Robert Koch Institute speaks here of the "presymptomatic stage" of the infection. Many infections are due to this period of time, which usually amounts to one to two days. How many there are exactly, however, one does not know.

But even without the exact numbers, Zeeb is clear: "Asymptomatically infected people are an engine of the pandemic. We need to find more of them faster." To this end, it is important to further expand corona testing, including at kindergartens and schools. Young people, especially young adults, were apparently particularly often free of symptoms. This makes it all the more important to detect their infection at an early stage so that they can immediately go into quarantine instead of spreading the virus. "

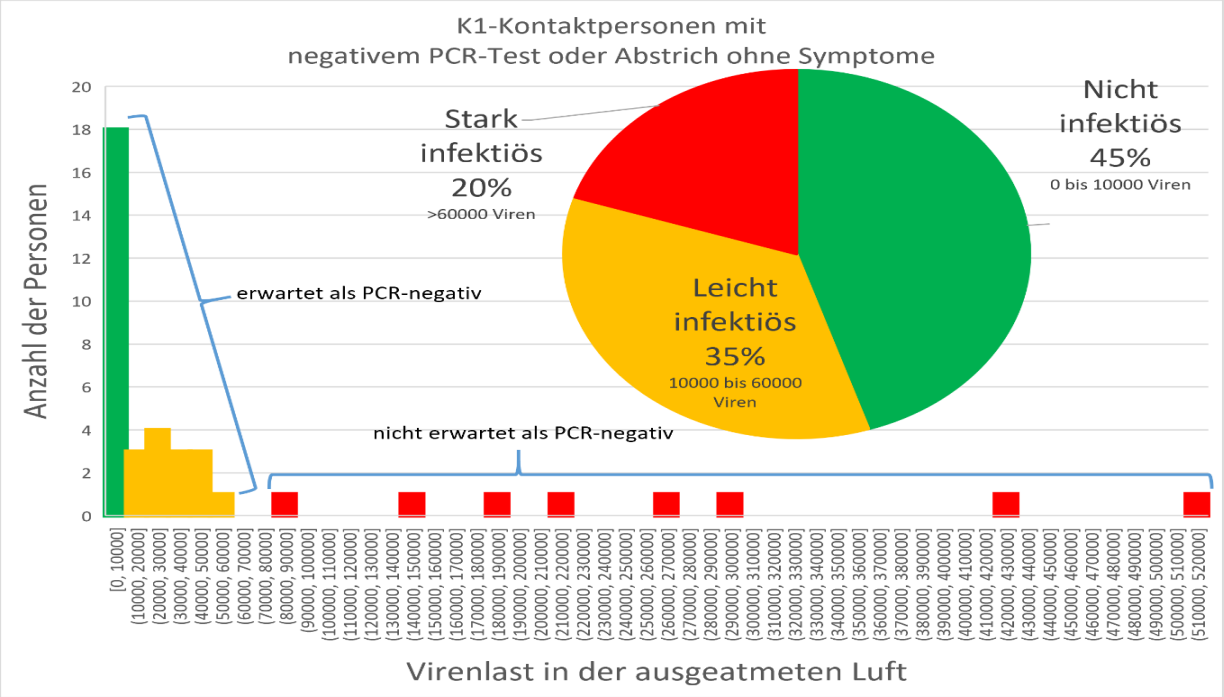
3. Comparison of K1 contacts with K2 contacts



Statistical evaluation of the viral load of K2 contact persons (Bundeswehr soldiers, etc.) 25 people were measured.

In addition to the K1 and K2 contact persons, we measured about 30 other persons. All had a viral load below 80,000 viruses. Three people were found to have a viral load between 60,000 and 80,000.

4. Measurement of PCR-negative persons without symptoms



In about 20% of the people, we have found high viral loads.

This can be due to the following reasons:

1. Measurement errors during PCR measurement or breathing air measurement
2. It is measured at different locations

The measured viral loads are too large to assume a measurement error in the breath measurement. Likewise, we consider it unlikely that the PCR test will give incorrect results.

Hypothesis:

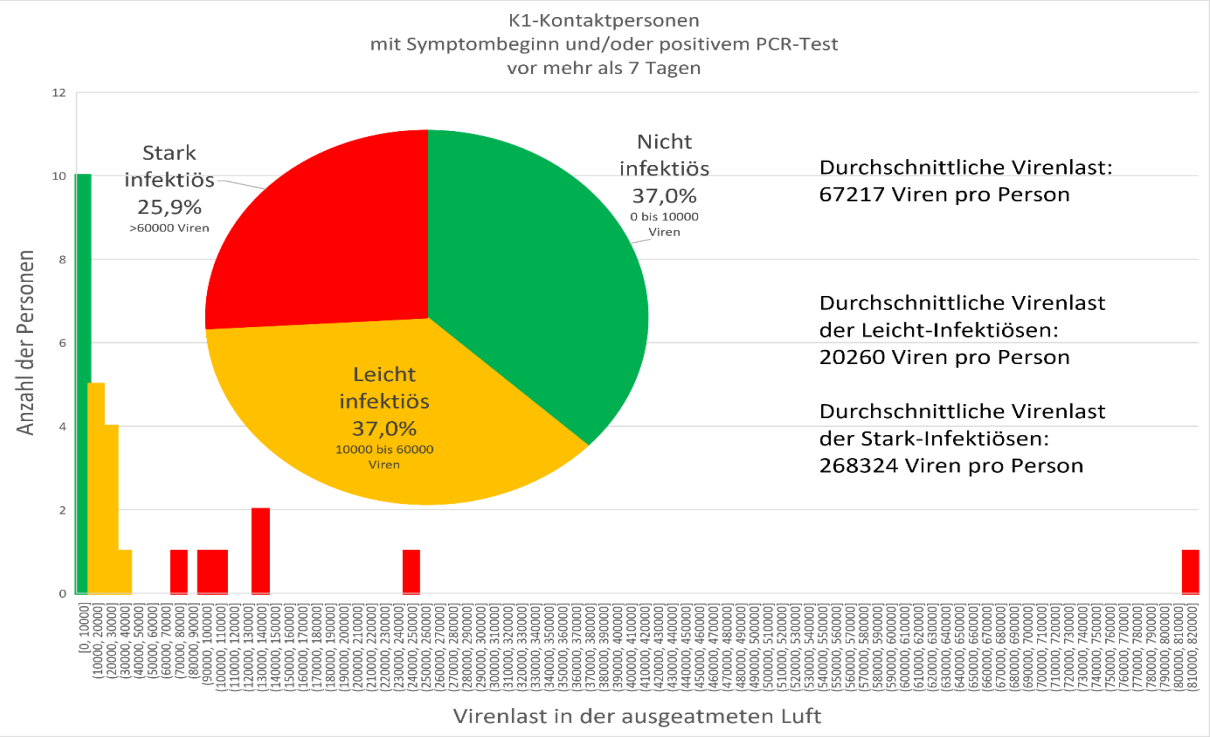
The PCR test measures in the nose and throat, the breath test measures aerosols produced in the throat and lungs, the nasal area is excluded by breathing. The pharynx has an area of about 12 cm^2 to produce aerosols, the lungs an area of 100 to 140 m^2. It is known that there can be a corona infection of the lungs, it is also known that the lungs also have cells with ACE2 receptors that can produce viruses.

Measurement of PCR-negative persons with corona-specific symptoms

In the case of K1 contacts with corona-specific symptoms, we also identified people with high viral loads.

We found high viral loads in 40% of people

5. Measurement of persons with PCR-positive test or antigen swab more than 7 days ago



In each case, 37% of the tested persons are no longer infectious or only mildly infectious.

POC conclusion:

Conclusion 1: As expected, there are more severely infected K1 contacts than K2 contacts. In the K2 group there are more "severely infected" than in the K2 group. The measurement is therefore plausible and corresponds to expectations.

Conclusion 2: The measurement results are consistent with the assumptions of the RKI. The American CDC assumes about 60% of infections by asymptomatic persons, in our study we come to 55% of mildly and severely infected people.

We assume that the virus-laden aerosols are produced in the lungs!

Conclusion 3: The measurement results are consistent with the assumptions of the RKI. We assume that the virus-laden aerosols are produced in the lungs.
PCR-negative K1 persons with corona-typical symptoms are highly infectious with 40% probability and also slightly infectious with 40% probability.

Conclusion 4: The measurement results are consistent with the assumptions of the RKI. The technology can be used to determine infectiousness after experiencing illness.

Conclusion 5: Immediately after the first positive PCR tests, the majority of the subjects are highly infectious.

6. Leistungsparameter des Versuchsgerätes:

- Device size:80 mm x 80 mm x 320 mm, 2 kg (portable)
  later: 60 mm x 120 mm x 150 mm, 1.5 kg
- Power supply:220 volts
  later: lithium-ion battery
  (24 - 72 hours operation)
- Resolution: approx. 130 viruses (with drool-free breathing)
- Sensitivity:99.987% (with drool-free breathing)
- Maximum detectable virus load:approx. 1 million viruses
  (limited by the amount of aerosol on the chip)
- Error due to drooling during breathing: <60000 viruses (80 femtoliters sticky sputum)
  Whether it is a virus cluster in the respiratory tract or sticky sputum in the femtoliter range still needs to be investigated.
- Error during follow-up measurement:After heavy breathing or hyperventilation
  reduces the viral load in the respiratory tract. It must:
  wait until new viruses have formed.
- Limitations:Since high-affinity antibodies are used,
  probably only 2019-nCoV and SARS CoV-1 viruses can be detected. The antibodies used are directed against the RBD region (amino acid sequence 318 – 510).

  Our measurements tend to indicate that other antibodies must be used for the mutations.

  There is currently a study to investigate the suitability of antibodies for mutations. In half a month we will receive the result.

  In addition, we found a source of antibodies against B1.1.7 and B1.351. A source of antibodies against the P1 variant is still missing.
- Possible extensions:For all mutations
- Specificity: 99.9% (for 2019-nCoV and SARS CoV-1 viruses)

- Cross-reactivity: only to SARS CoV-1 viruses and possibly some SARS CoV-2 mutations

- Reference method with native samples:the inclusion of a Sensitivity curve with heat-inactivated coronaviruses of an American reference laboratory.
  Method: Checkerboard titration or direct application with a femtoliter pipette or a needle (One femtoliter corresponds to approx. 780 viruses with 140 nm diameter)

  So far, the technology has been successfully tested in the converted ThyssenKrupp rolling mill 8 at normal rolling speed in the layer thickness range 0 nm to 6 nm with a picometer resolution. The coupling behavior of viruses takes place in the layer thickness range 0 nm to 0.1 nm (0 to 100 picometers). The test in the rolling mill covers this measuring range.

- Environmental conditions:15°C – 30°C
  When using the built-in Peltier element: 10°C – 35°C

  Can be used indoors or outdoors.

- Reusability of the chip:According to current estimates, about 20 – 30 positive and 50 – 100 negative measurements possible. The decision on further use is made by software. After that, the chip must be cleaned in 60°C warm water for 30 minutes to kill viruses before it can be disposed of.

- Occupational safety:The entire blow-in area of the device can and cleaned in 60°C warm water (30 minutes). Corona viruses are thereby heat-inactivated. The user blows into a paper tube that is disposed of after a single use by incineration. The remaining area of the device can be cleaned with a disinfectant cleaning cloth.