



REVIEW ARTICLE

OPEN ACCESS

Corona Virus Disease and Characteristics of Sars – Cov-2 – A Review

Ashish S. Kanthale*, Vivek V. Paithankar, Anjali Wankhade, Jugal Vyas

Vidyabharati College of Pharmacy, Amravati, Maharashtra, India.

ABSTRACT – A new epidemic of acute respiratory viral pneumonia was discovered in central China at the end of 2019. The complaint was given the name nimbus virus complaint 2019 (COVID- 19), and the virus that caused this complaint was known as severe acute respiratory pattern nimbus virus (SARS- CoV- 2). So far, individual system has been concentrated on viral gene discovery, the ultimate using RT- PCR being the most accurate approach. bludgeons are known to be the primary beast force for nimbus viruses. In this paper, we present a summary of the COVID- 19 epidemic, clinical features and epidemiology. The emergence of a nimbus virus poses a serious global public health trouble and possibly carries the eventuality of causing a major epidemic outbreak in the naïve mortal population. The recent outbreak of COVID- 19, the complaint caused by SARS- CoV- 2, in Wuhan, Hubei Province, China has infected over 36.5 million individualities and claimed over one million lives worldwide, as of 8 October 2020. researchers have reported that the virus is constantly evolving and spreading through asymptomatic carriers, further suggesting a high global health trouble. To this end, current up- to date information on the nimbus virus elaboration and SARS- CoV- 2 modes of transmission.

KEYWORDS: Covid-19, SARS CoV2, Diagnosis, Pandemic, Epidemiology, Syndrome.

Date of acceptance: 20-05-2026

Date of Publish: 06-07-2026

I. INTRODUCTION

The World Health Organization declared an epidemic on January 30, 2020, following the outbreak of the SARS CoV- 2 virus in Wuhan, Hubei Province, China, and its rapid-fire spread to 25 countries. This happened just 1 month after the advertisement of the first case of the complaint on December 31, 2019 (1- 2). Corona viruses are positive single stranded RNA virus that belong to the nimbus virus family and are genetically classified into four rubrics α , β , γ and δ nimbus virus (3- 4) Since December 2019, a new nimbus virus complaint had fleetly spread throughout China, leading to a global Outbreak and causing considerable public health concern. World Health Organization (WHO) blazoned the outbreak of COVID- 19 as a global public health exigency on 30 January 2020. In India, the first case of COVID- 19 was reported on January 27, 2020, in Kerala quarter. Since also, there's a wide variation in the reporting of cases across the country. The case

reporting is grounded on the SARS- CoV- 2 antigen testing by Real- Time Rear Recap Polymerase Chain response (RT- PCR) or by Rapid Antigen Test (RAT) (5). Corona virus (CoV) is clustered under the viral family group that causes complaint in mammals and catcalls. An epidemic new Corona virus was named as “Corona Virus Disease 2019” (2019 nCoV) by World Health Organization (WHO) in Geneva, Switzerland. As its RNA pattern is near to SARS, the 2019 Corona virus is renamed as SARS CoV- 2 epidemic. It belongs to the subfamily Ortho nimbus virinae inside the family Corona viridae, order Nido virales, and the realm Riboviria (6). Corona viruses, belonging to the Corona viridae family, beget respiratory infection in mammals, similar as batons, camels and masked win civets, and in avian species (7,8). Symptoms and towel tropism of Corona virus infection can vary across different host species (9).

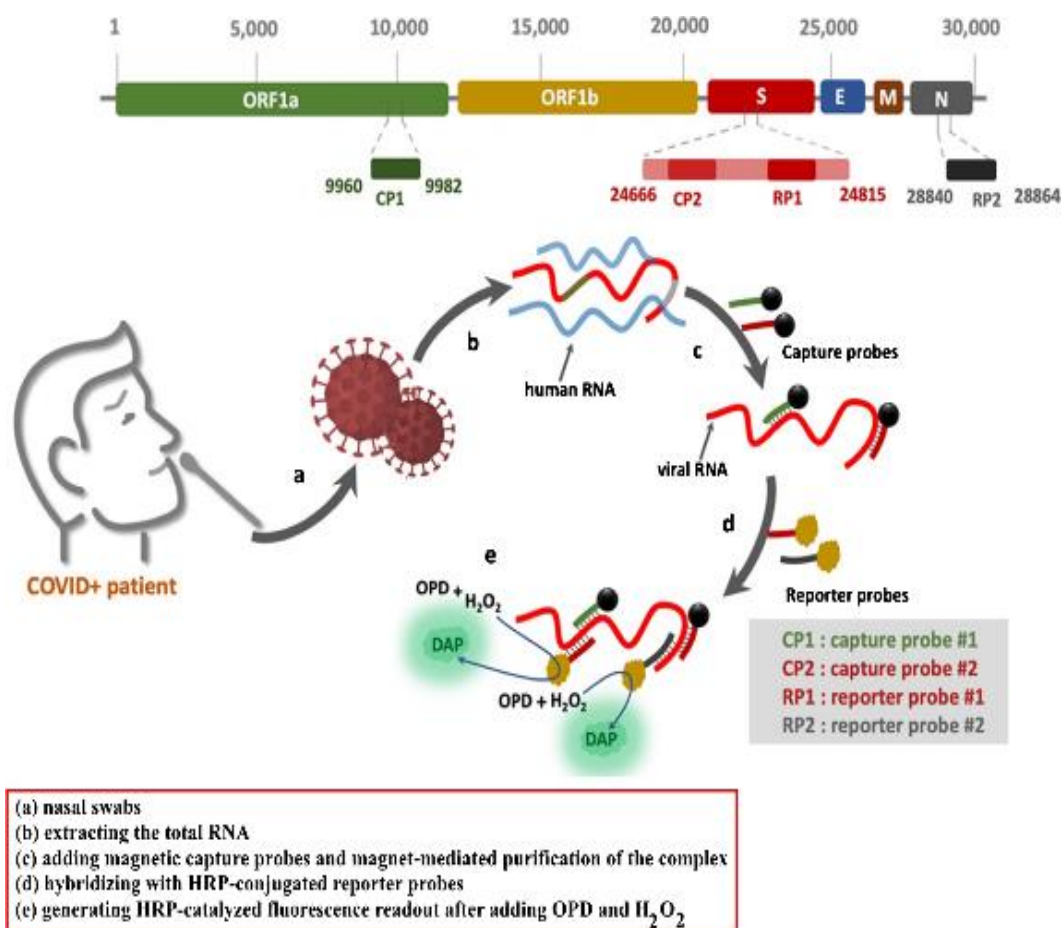


Fig. 1 The schematic depicts the step-by-step process for capturing and detecting viral RNA using magnetic probes and HRP-terminated reporters. Reproduced with permission from [10]

What are corona viruses -

Corona viruses are single- stranded, enveloped RNA viruses 80 – 120 nm in periphery and they're classified into four groups α , β , γ and δ . Prior to the identification of COVID- 19, only six types of Corona virus could infect humans, and COVID- 19, a member of the β - Corona virus family, was the seventh. Of these viruses, four Corona viruses, HCoV- OC43, HCoV- 229E, HCoV- NL63 and HCoVHKU1, they're less pathogenic and beget only mild respiratory conditions, but the two Corona viruses, SARS- CoV and MERS- CoV, are better than humans, independently. They transmitted two fatal pandemics. Meanwhile, the homology and pathogenesis medium of SARS- CoV is veritably analogous to COVID- 19. Due to the adaption of

COVID- 19 in batons, which have a advanced temperature than the mortal body, this virus is more resistant to temperature than SARS- CoV (11,12). Corona virus has four major structural proteins called S (Shaft), E (Envelope), N (Nucleocapsid) and M (Membrane) as shown in Fig. 1. COVID- 19 uses angiotensin converting enzyme- type- 2 (ACE2) as a receptor and infects cells with ACE2 via a receptor- binding sphere (RBD) in the shaft protein. The ACE2 receptor is set up in alveolar cells, myocytes and vascular endothelial cells due to the high affinity of COVID- 19 for ACE2. Genital pathology, including testes and ovaries, is also effective. COVID- 19 presumably affects sperm product and reduces its number, and also produces coitus hormones and can reduce sexual desire (13,14).

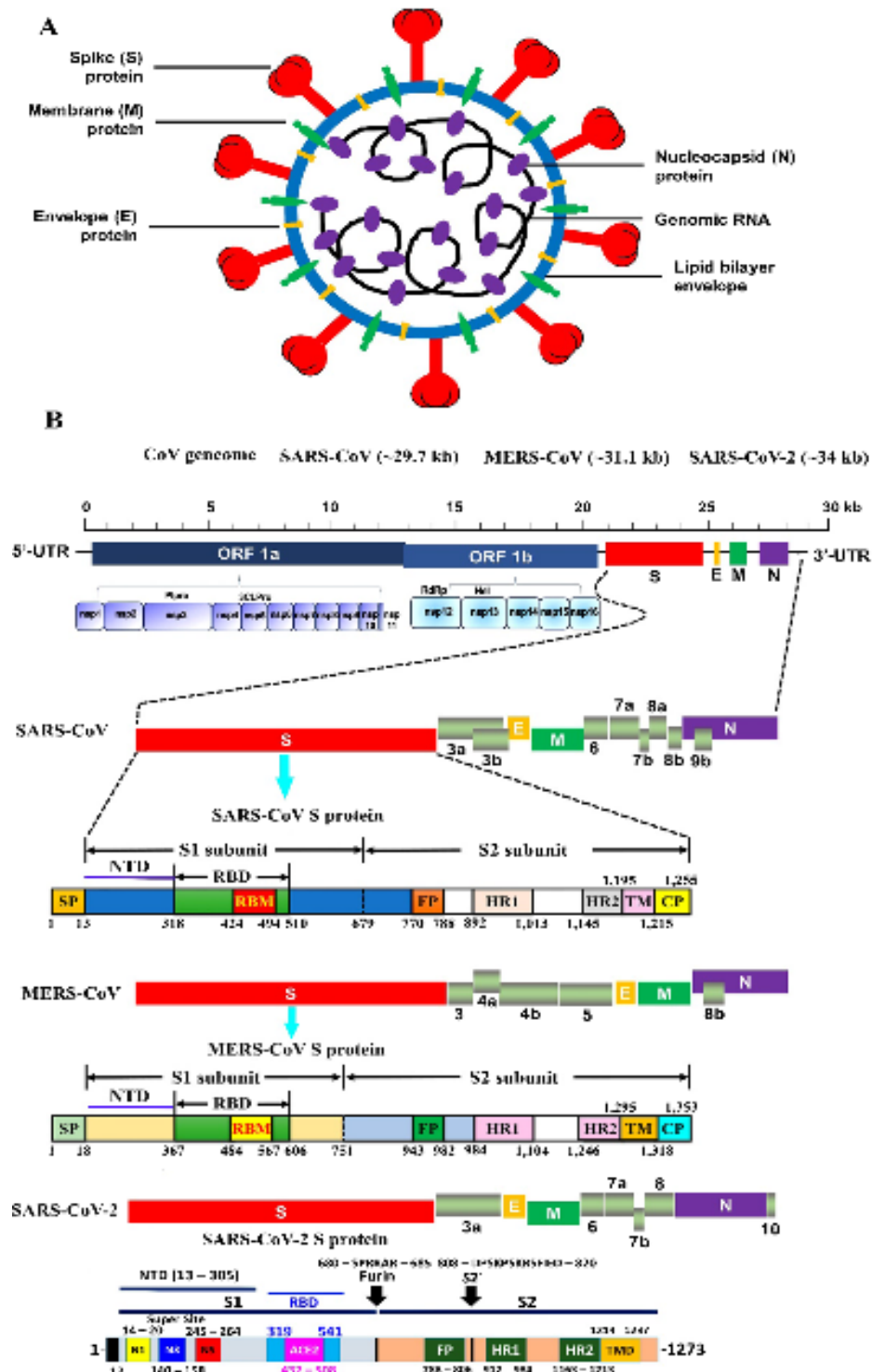


Fig. 2 **A** Schematic structure of Corona viruses [15]. **B** Schematic representation of the genome organization and functional domains of S protein for SARS-CoV, MERS-CoV and SARS-CoV-2. Reproduced with permission from [15, 16]. The

genomes of CoVs consist of 2 partially overlapping replicase open reading frames (ORF1a and 1b) and several downstream ORFs that encode viral functional structural proteins and other proteins with unknown function. 50-UTR and 30-UTR,



untranslated regions at the N and C-terminal regions, respectively. Kb, kilobase; pair SP, signal peptide; NTD, the N-terminal domain; RBD, receptor-binding domain; RBM, receptor-binding motif; FP, fusion peptide; HR1 and HR2, heptad repeat 1 and 2; TM, transmembrane domain; CP, cytoplasmic domain

Origin and spread of covid 19

Corona viruses, which are single- stranded and positive- sense RNA viruses, have the longest genome of any given RNA virus, with a genomic content (GC) ranging from 32 to 43 (17). They've a globular shape with poachingbranches and a crown, and this spatial shape has led to the picking of this viral family as Corona virus. The root of this name is deduced from the Latin word nimbus, meaning crown (18). Corona viruses beget 15 of

respiratory ails and generally don't beget an acute form of the complaint, but they can beget mild upper respiratory infections. This viral family infects a wide range of creatures (mammals) and humans (18, 19). According to exploration on Corona viruses since 1965, these viruses have the eventuality to infect creatures and humans, and some have the capability to transmit from creatures to humans or vice versa (20). Studies since the SARS epidemic have shown that batons carry colorful Corona viruses that have the eventuality to infect humans (18). Experimenters uprooted the inheritable material of the new virus from people who studied it and set up that the new nimbus virus had a analogous origin to the SARS virus and may have begun in batons or snakes, but that other creatures could still be intermediated hosts (21).

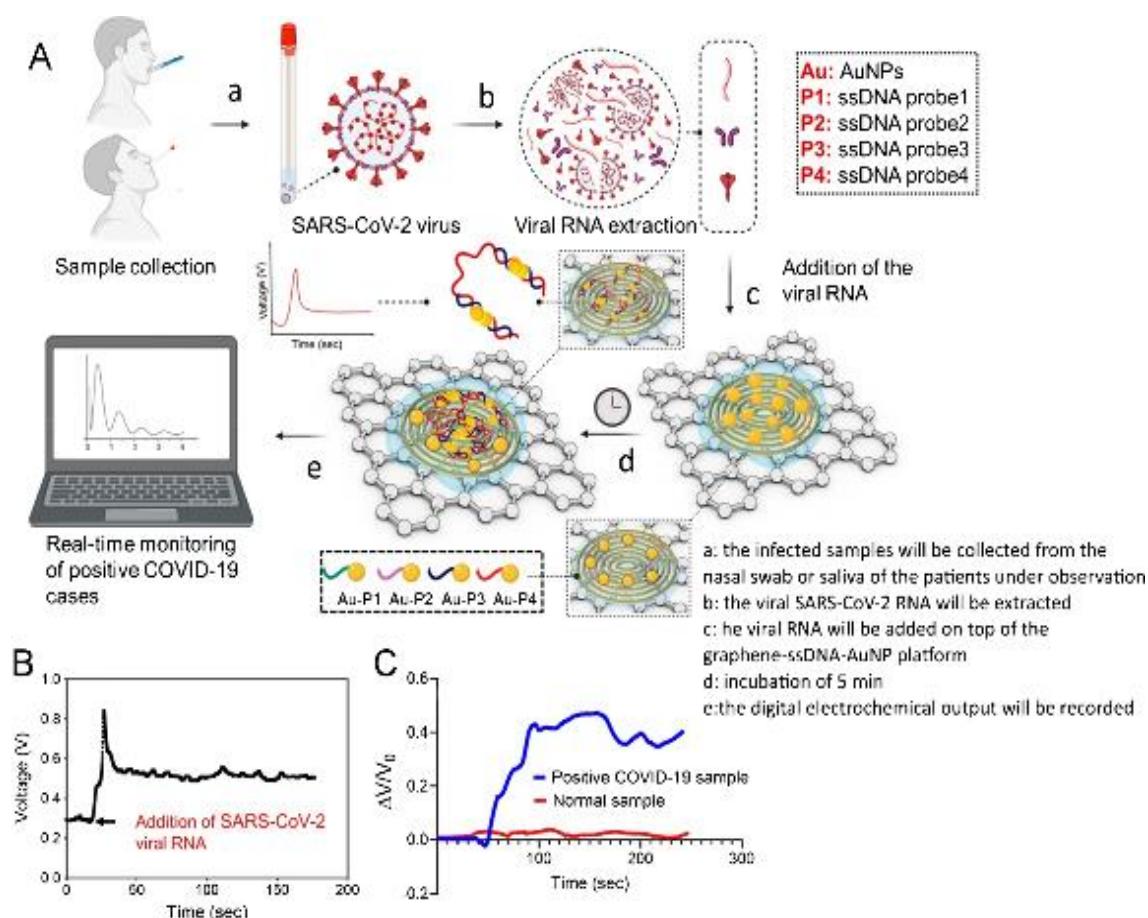


Fig. 3 **A** Schematic illustrations of the principle of the COVID-19 electrochemical sensing platform. **B** Sensor output signal as a function of time with the addition of SARS-CoV-2 viral RNA load. **C** Real-time response of the sensor chip toward COVID-19-positive clinical samples and healthy samples. Reproduced with permission from [22]



Symptoms

A wide range of symptoms are set up in COVID- 19 cases, ranging from mild/ moderate to severe, fleetly progressive, and fulminant complaint. Symptoms of COVID- 19 are non-specific and complaint donation can range from asymptomatic to severe pneumonia. Prevalence of asymptomatic cases ranges from 1.6 to 51.7 and these people don't present typical clinical symptoms or signs and don't present apparent abnormalities in lung reckoned tomography. The most common symptoms of COVID- 19 are fever, cough, myalgia, or fatigue and atypical symptoms include foam, headache, haemoptysis, puking, and diarrhoea. Some cases may present with sore throat, rhinorrhoea, headache, and confusion a many days before the onset of fever, indicating that fever is a critical symptom, but not the original incarnation of infection. likewise, some cases experience loss of smell (hyposmia) or taste (hypogeusia), which are now being considered early warning signs and suggestions for tone- insulation (23).

The most common symptoms of COVID-19 are

The most common symptoms of COVID- 19 are

- Fever.
- Dry cough.
- Fatigue.

Other symptoms that are less common and may affect some cases include

- Loss of taste or smell.
- Nasal business.
- Conjunctivitis (also known as red eyes).
- Sore throat.
- Headache.
- Muscle or joint pain.
- Different types of skin rash.
- Nausea or vomiting.
- Diarrhoea.
- Chills or dizziness.

Symptoms of severe COVID- 19 complaint include

- briefness of breath.
- Loss of appetite.
- Confusion.
- case pain or pressure in the casket.

- High temperature (above 38 °C).

Other less common symptoms are

- irritability.
- Confusion.
- Reduced knowledge (sometimes associated with seizures).
- Anxiety.
- Depression.
- Sleep conditions.
- More severe and rare neurological complications analogous as strokes, brain inflammation, distraction and vagrancy- whams damage. People of all ages who witness fever and/ or cough associated with difficulty breathing or briefness of breath, casket pain or pressure, or loss of speech or movement should seek medical care immediately. However, call your health care provider, hotline or health installation first, If possible.

Virus characteristics

Virus characteristics The genome of the new Corona virus SARS- CoV- 2, causing atypical pneumonia in humans ' population of Wuhan, had 89 nucleotide identity with club SARS- like- CoVZXC21 and 82 with that of mortal SARS- CoV and proved this as a new virus strain called SARS- CoV- 2 or COVID- 19.(25) Phylogenetic tree analysis using the whole genome sequences of SARS- CoV- 2 with five severe SARS CoV b sequences, two MERS- CoV sequences and five from club SARS - like Corona virus) from China origin showed that SARS- CoV- 2 have formed different cluster and were more analogous to Bat SARS - like Corona virus(nearly 80).(26) mortal angiotensin converting enzyme receptor(ACE2 cell receptor) was honoured by both SARS- CoV and Novel Corona virus SARS- CoV- 2 by preliminarily formalized beast models trials.(27,28) SARS- CoV- 2 genome is made up of globular or pleomorphic(having periphery of roughly 60 – 140 nm), single- stranded enveloped RNA patch covered with club shaped glycoprotein.(29) The genome consists of 29891 nucleotides which encodes 9860 amino acids. The Structural proteins are decoded by the four structural genes, including shaft (S), envelope (E), membrane (M) and nucleocapsid(N) genes (30).

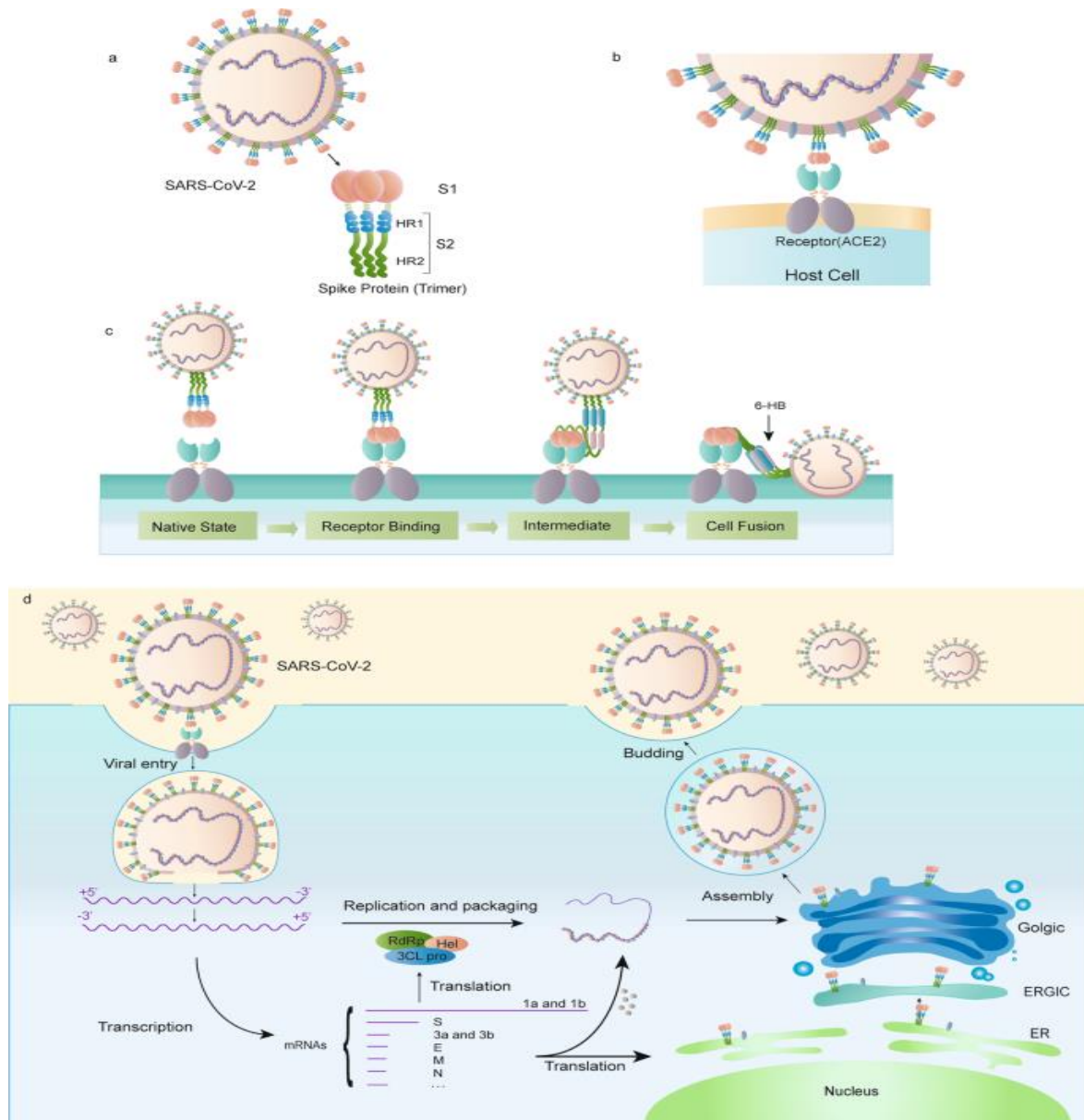


Fig. 4 **a** the schematic structure of the S protein. **b** The S protein binds to the receptor ACE2. **c** the binding and virus–cell fusion process mediated by the S protein. **d** the life cycle of SARS-CoV-2 in host cells.[31]

Emergency and spread

In late December 2019, several health installations in Wuhan, in Hubei terrain in China, reported clusters of cases with pneumonia of unknown cause (32). also, to cases with SARS and MERS, these cases showed symptoms of viral pneumonia, including fever, cough and chest discomfort, and in severe cases dyspnoea and bilateral lung infiltration (32,33). Among the first 27 proved rehabilitated cases, utmost cases were epidemiologically linked to Huanan Seafood

Wholesale Market, a wet request located in megacity Wuhan, which sells not only seafood but also live beasts, including meat and wildlife (34,35). According to a retrospective study, the onset of the first known case dates back to 8 December 2019. On 31 December, Wuhan Municipal Health Commission notified the public of a pneumonia outbreak of unidentified cause and informed the World Health Organization (WHO) (36)(Fig. 1) The first genome sequence of the new Corona virus was published on the Virological



website on 10 January, and more nearly complete genome sequences determined by different exploration institutes were also released via the GISAID database on 12 January(37). latterly, further cases with no history of exposure to Huanan Seafood Wholesale Market were linked. Several domestic clusters of infection were reported, and nosocomial infection also passed in health- care installations. All these cases handed clear confirmation for mortal- to-mortal transmission of the new virus (34,35 – 34). On 30 January, the WHO declared the new Corona virus outbreak a public health exigency of transnational concern (36). On 11 February, the International Committee on Taxonomy of Viruses named the new Corona virus ‘SARS- CoV- 2’, and the WHO named the complaint ‘COVID- 19 (37) The outbreak of

COVID- 19 in China reached an epidemic peak in February. According to the National Health Commission of China, the total number of cases continued to rise sprucely in early February at an average rate of further than 3,000 recently vindicated cases per day. To control COVID- 19, China executed unprecedentedly strict public health measures. The megacity of Wuhan was shut down on 23 January, and all trip and transportation connecting the megacity was blocked. In the following couple of weeks, all out- of- door exertion and gatherings were confined, and public installations were closed in utmost megalopolises as well as in country (38). Owing to these measures, the quotidian number of new cases in China started to drop steadily (39).

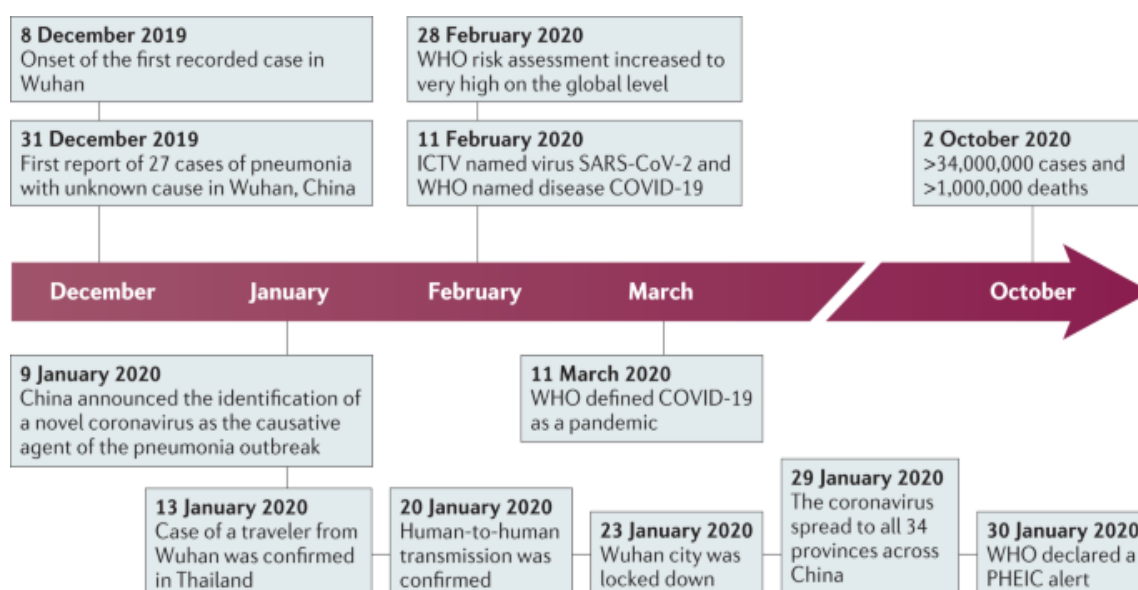


Fig. 5 Timeline of the key events of the COVID-19 outbreak. The first recorded cases were reported in December 2019 in Wuhan, China. Over the course of the following 10 months, more than 30 million cases have been confirmed worldwide. COVID-19, Corona virus disease 2019; ICTV, International Committee on Taxonomy of Viruses; PHEIC, public health emergency of international concern; SARS- CoV-2, severe acute respiratory syndrome Corona virus 2; WHO, World Health Organization [36].

Clinical and epidemiological features

It appears that all periods of the population are susceptible to SARS- CoV- 2 infection, and the median age of infection is around 50 years [36,40,41,42,43]. still, clinical instantiations differ with age. In general, aged men (> 60 times old) with co- morbidities are more likely to develop severe respiratory complaint that requires hospitalization or indeed die, whereas utmost youthful people and children have only mild conditions(non- pneumonia or mild pneumonia) or

are asymptomatic. specially, the threat of complaint wasn't advanced for pregnant women. still, substantiation of transplacental transmission of SARS- CoV- 2 from an infected mama to a bambino was reported, although it was an insulated case (45,46). utmost people showed signs of conditions after an incubation period of 1 – 14 days (most generally around 5 days), and dyspnoea and pneumonia developed within a median time of 8 days from illness onset (36). In a report of 72,314 cases in China, 81 of the cases were classified as



mild, 14 were severe cases that needed ventilation in an ferocious care unit (ICU) and a 5 were critical (that is, the cases had respiratory failure, septic shock and/ or multiple organ dysfunction or failure) (36,47). utmost cases also developed pronounced lymphopenia, analogous to what was observed in cases with SARS and MERS, and non- survivors developed severer lymphopenia over time. Compared with non- ICU cases, ICU cases had advanced situations of tube cytokines, which

suggests an vulnerable pathological process caused by a cytokine storm. In this cohort of case, around 2.3 people failed within a median time of 16 days from complaint onset (36,48). Men aged than 68 times had a advanced threat of respiratory failure, acute cardiac injury and heart failure that led to death, anyhow of a history of cardiovascular complaint (48)(Fig. 6). utmost cases recovered enough to be released from sanitarium in 2 weeks (36,42) (Fig. 6).

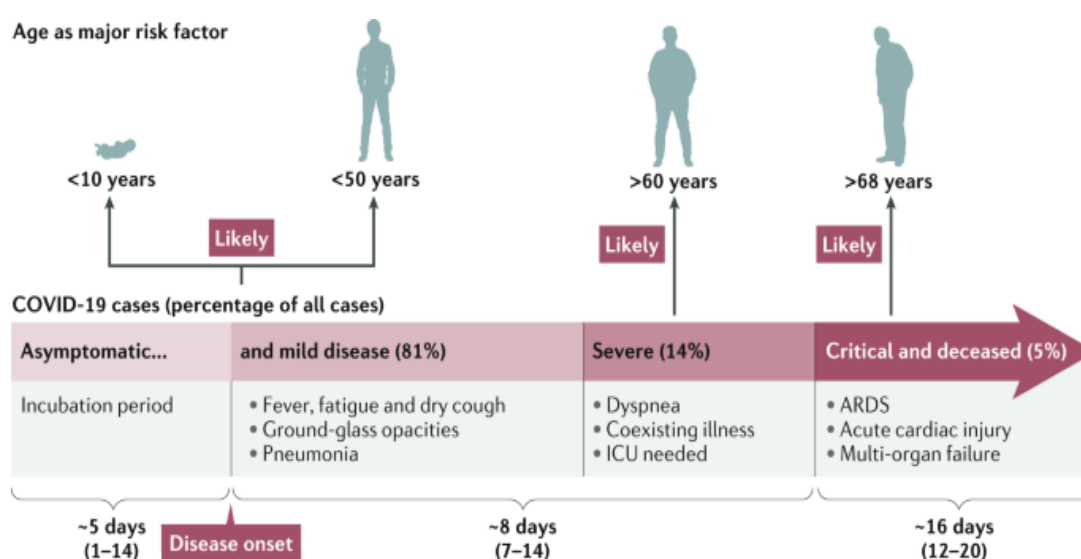


Fig no 6: Typical symptoms of Corona virus disease 2019 (COVID-19) are fever, dry cough and fatigue and in severer cases dyspnoea. Many infections, in particular in children and young adults, are asymptomatic, whereas older people and/or people with co-morbidities are at higher risk of severe disease, respiratory failure and death. The incubation period is ~5 days, severe disease usually develops ~8 days after symptom onset and critical disease and death occur at ~16 days. ARDS, acute respiratory distress syndrome; ICU, intensive care unit.

Types of Corona virus

Corona viruses are classified into four subtypes: nCoV, beta, gamma and delta, which scientists use these groups to classify different species. Seven Corona viruses have been linked to mortal complaint. The upper and lower airways, nose, sinuses, mouth and lungs are affected by four of these, including mortal Corona virus 229E and NL63 (which belong to nCoV-CoVs) (49), as well as mortal Corona virus OC43, and HKU1 (which belong to beta-CoVs) (50) as shown in Fig.

2. These viruses are wide in the world, counting for 15 – 30 of all common snap. They only spread to the lower respiratory tract in a small chance of cases. Three further Corona viruses surfaced from beast infections. These viruses developed over time and were eventually passed on to humans. These Corona viruses are more dangerous to people's health. They're listed as below:

- Severe acute respiratory pattern Corona virus (SARS CoV), which caused the SARS epidemic in 2002 – 2003 (51).

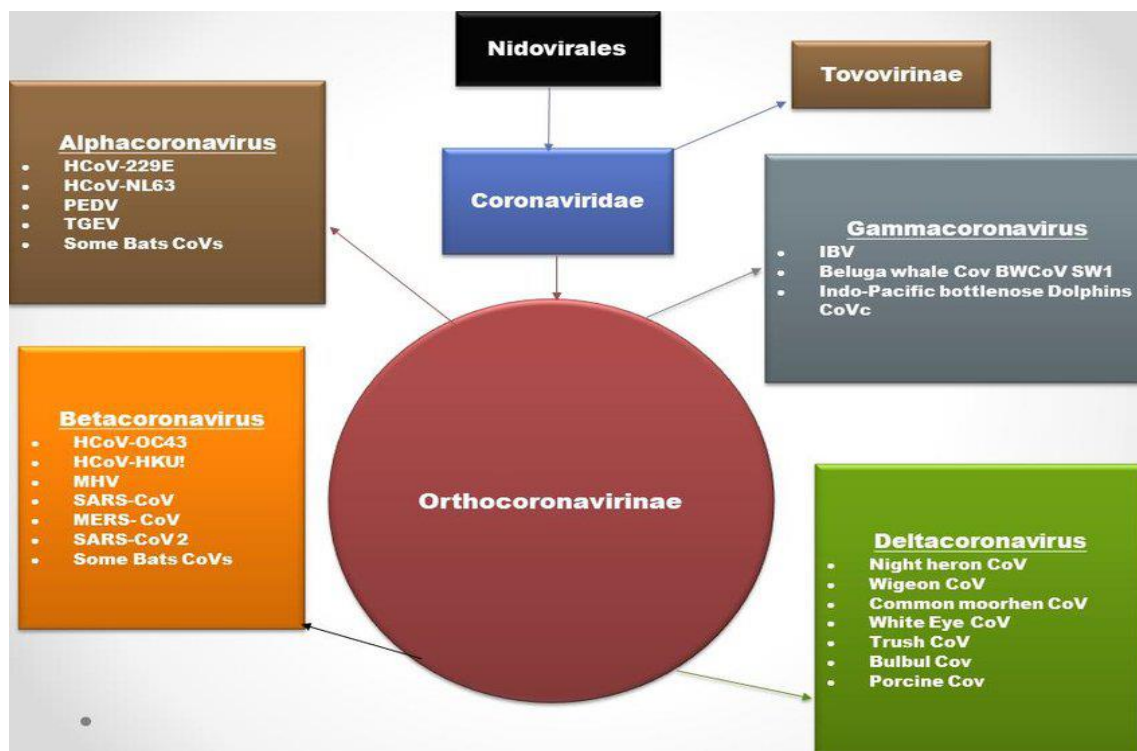


Fig no 7: Classification of different types of Corona viruses within the family Coronaviridae, subfamily Orthocoronavirinae, and the respective genera: alpha-, beta-, gamma-, and delta Corona viruses. The SARS-CoV-2 is classified as a beta Corona virus [52].

Elaboration of the Corona virus

Corona virus were named after the Latin word nimbus, meaning crown or halo, owing to their crown- suchlike harpoons on the face as seen when viewed under an electron microscope (53). Corona viruses belong in the subfamily coronavirinae of the coronaviridae family, in the order of nidovirales. The Coronavirinae subfamily consists of four rubrics nascence Corona virus, beta Corona virus, delta Corona virus and the gamma Corona virus, with the SARS- CoV- 2 strain being classified under the beta Corona virus rubric grounded on the genome sequence analysis (54,55). The Corona virus genome is known to have a 50 cap and a 30 poly (A) tail; thus, upon infecting the host cell, the genome acts as an mRNA for restatement of the replicase polyproteins needed for viral replication (56). Corona viruses have been reported to generally live in an beast force, similar as batons, mice, rats, cravens, tykes, pussycats, nags, and camels (7,57). lately, the virus has developed the capability to initiate an epidemic by conforming to humans via zoonotic transmission,

analogous to the former Zika virus outbreak in 2015 (58,59). batons have been reported to be the primary carrier and force for a vast range of viruses, including the Corona virus, therefore making the beast – mortal species hedge cross largely probable due to the large number of batons that congregate within the community and their capability to travel long distances (60). Human Corona viruses were first discovered in the 1960s (61). To date, studies have reported seven different strains of mortal Corona viruses. The four common Corona virus strains, including 229E, NL63, OC43 and HKU1, are known to beget mild respiratory tract infections worldwide (62,63). Corona viruses preliminarily known to infect creatures may evolve and acclimatize to infect humans, therefore performing in the emergence of a new virus and the possibility of a epidemic outbreak (64). The SARS-CoV, MERS- CoV and the more recent SARS-CoV- 2 are exemplifications of viruses crossing the beast- to- mortal species hedge and are known to beget more severe symptoms in cases (65)



Table 1. Properties of SARS-CoV-2, MERS-CoV and SARS-CoV [8,18,19,30,31,32,33,34]. (* updated as of 8 October 2020).

	SARS-CoV-2 *	MERS-CoV	SARS-CoV
Outbreak Date	December 2019	April 2012	November 2002
Epicenter of Disease Outbreak	Wuhan, China	Jeddah, Saudi Arabia	Guangdong, China
Original/Intermediate Reservoir	Animal Bats, Pangolins and potentially other mammals	Bats/Camels	Bats/Masked palm civets
Number of Cases	36,401,583	2494	8096
Number of Deaths	1,060,567	858	744
Transmission Rate	3–4	<1	3
Fatality Rate	1.4%	37%	10%
Countries/Territories affected	214	27	26

According to a phylogenetic study by Lu et al. (63), SARS-CoV-2 was reported to have jumped the species hedge from batons vended at the Huanan South China Seafood Market in Wuhan, Hubei Province, China. likewise, the study reported advanced SARS-CoV-2 genomic sequence similarity to the SARS-like club Corona contagions RaTG13(96.2 identity) collected from batons in Yunnan as compared to

the SARS-CoV (79) or MERS-CoV (51.8%), therefore suggesting batons as the primary source of SARS-CoV-2 Contagions 2021 (see Table 2). Due to the large variety of creatures being vended in the Huanan Seafood Market, experimenters presume an central beast, similar as snakes, pangolins, catcalls and other mammals, might have also played a part in easing the emergence of the current COVID-19 outbreak (63,64,65).

Table 2. SARS-CoV-2 genomic sequence similarity to SARS-like Corona viruses, SARS-CoV and MERS-CoV.

Corona virus Strain	Genomic Sequence Similarity to SARS-CoV-2
SARS-like Corona virus bat-RaTG13	96.2%
SARS-like Corona virus bat-SL-CoVZC45	88%
SARS-like Corona virus bat-SL-CoVZXC21	88%
SARS-CoV	79%
MERS-CoV	51.8%

COVID-19 Transmission

Although multiple reports have mentioned that a carrier must be present for SARS-CoV-2 to transmit, there are fresh forms of viral transmission that have been observed throughout this epidemic (7,66,67). A study recently performed by Chan et al. (68) reported Contagions 2021, 13, 202 4 of 25 the

case reports of a family of six cases who have been tested positive for the SARS-CoV-2, including their contact-tracing history and epidemiological, clinical, radiological and microbiological findings. Of the six family members, one member, who had not travelled to Wuhan municipality and yet had tested positive for SARS-CoV-2 after close



contact with the family members, was among the first suggestions of positive person- to- person transmission of COVID- 19 (68). Primarily, it's now recognized that the main form of mortal- to-mortal transmission occurs through respiratory droplets expelled by an infected existent; hence, coughing and sneezing renders SARS- CoV- 2

airborne, putting on- infected individualities at trouble of contracting the complaint (69,70). also, data have indicated that SARS- CoV- 2 transmission can also do as a result of contact with defiled insensible objects, also known as fomite transmission (71).

SARS-CoV-2 TRANSMISSION

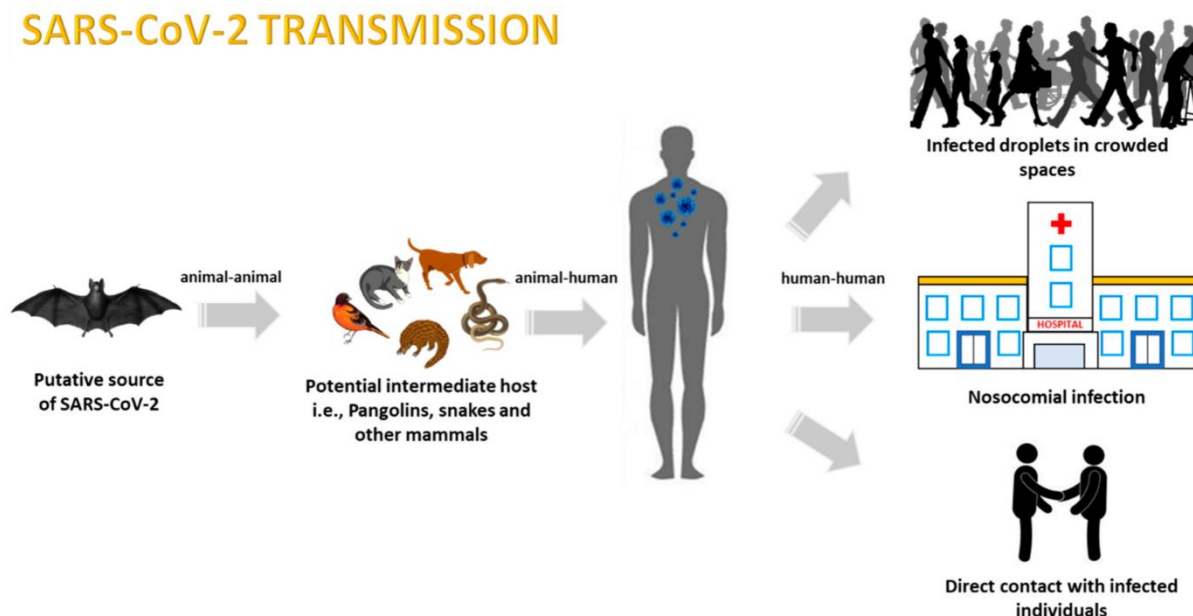


Figure 8 Representation of the zoonotic COVID-19 modes of transmission

COVID-19 Modes of Detection

1. Reverse Transcription Polymerase Chain Reaction (RT-PCR)-Based Testing

Whole genome sequencing analysis of the new nimbus contagion has been performed lately and has allowed the analysis and selection of genes that are specific to the contagion. This allows accurate and precise testing to be performed for the confirmational opinion of infected cases using conventional real- time or RT- PCR. With this information, Chan et al. (68) developed and optimized manuals for RT- PCR for the discovery of the shaft gene(S) that's specific only to the new nimbus contagion. The forward and rear manuals are as follows 50 CCTACTAAATTAAATGATCTCTGCTTTACT-30) and 50- CAAGCTATAACGCAGCCTGTA-30), independently. In addition, a study by Corman et al. (69) reported manuals specific to other genes of the new Corona contagion, similar as the RdRp gene, the E gene and the N gene. Any of the following case samples slaver, respiratory, coprolite, urine or serum or tube — are acceptable

to use for viral RNA insulation with this system. The detailed conditions for this assay can be set up in the published composition by Chan et al. (68). More lately, a protocol for simple, accelerated and sensitive discovery of SARS- CoV- 2 using slaver samples, known as the Saliva Direct assay, has entered exigency use authorization from the Food and Drug Administration (70).

2 COVID-19 Testing Kits

With the critical demand for rapid-fire and robust COVID- 19 testing, multiple companies have developed COVID- 19 test accoutrements that are either being bought directly by individualities in the community for home- grounded testing or are being used in medical laboratories to round RT- PCR and radiological test results (Table 3). Although not as accurate as RT- PCR tests, COVID- 19 rapid-fire test accoutrements have a turn- around time of under one hour as compared to RT- PCR tests, which may take up to two days (71). Accoutrements also allow for point- of- care testing as well as the capability to incontinently test



an existent who's suspected of carrying the SARS-CoV- 2. Rapid discovery accoutrements also increase the capability to test a larger portion of the population, therefore further abetting in outbreak control and accurate determination of the complaint casualty rate. Besides detecting individualities with

ongoing SARS- CoV- 2 infections, COVID- 19 tests accoutrements also aid in detecting asymptomatic individualities who have developed impunity against SARS- CoV- 2, as detected through IgG and IgM motes (71,72).

Table 3. Recently developed COVID-19 test kits and their characteristics.

Name	Company	Date of Release	Sample Type	Target Antigen	Duration of Test	Country of Validation
COVID-19 IgG/IgM Point of Care Rapid test	Ait Biosciences	March 2020	Whole blood/serum/plasma	IgG/IgM	2–10 min	China and United States
Wantai SARS-CoV-2 Ab Rapid Test	Beijing Wantai Biological Pharmacy Enterprise	March 2020	Whole blood/serum/plasma	IgG/IgM	15 min	China and Australia
Biolidics 2019-nCoV IgG/IgM Detection Ki	Biolidics Limited	March 2020	Whole blood/serum/plasma	IgG/IgM	<10 min	Singapore
MAGLUMI IgG de 2019-nCoV	Snibe Diagnostic	March 2020	Whole blood	IgG	600 tests per hour	Brazil, China and United States
m2000 SARS-CoV-2 assay	Abbott Core Laboratory	April 2020	Whole blood/serum/plasma	IgG	100–200 tests per hour	United States
Rapid SARS-CoV-2 antigen detection test	Sona Nanotech	April 2020	nasal oropharyngeal swabs	S1 subunit	-	Canada and United States
COVID-19 Ag Respi-Strip	Coris Bioconcept	April 2020	Nasopharyngeal secretions	N protein	<15 min	Belgium
SGTi-flex COVID-19 IgM/IgG	Sugentech	April 2020	Whole blood/serum/plasma	IgG/IgM	10–15 min	South Korea and United States
INNOVITA 2019-nCoV Ab Test (Colloidal Gold)	Bioforge Solutions Pte Ltd.	April 2020	Whole blood/serum/plasma	IgG/IgM	<15 min	China, Singapore and United States



Shanghai Liang Run Lion Run Diagnostic Kit for Antibody IgM-IgG of Novel Corona virus COVID- 19	Veredus Laboratories Pte Ltd.	April 2020	Whole blood/serum/plas ma	IgG/IgM	<10 min	China and Singapore
DiagnoSure COVID-19 IgG/IgM Rapid Test Cassette	Grit Overseas Pte Ltd.	April 2020	Whole blood/serum/plas ma	IgG/IgM	<10 min	China, Singapore and Netherlands
VITROS Immunodiagn ostic Products Anti- SARSCoV-2 Total Reagent Pack	Ortho Clinical Diagnostics	May 2020	Serum/plasma	IgG/IgM/IgA	150 tests per hour	Singapore and United States
MP Diagnostics ASSURE® S ARS-CoV-2 IgG/IgM Rapid Test	MP BiomedicaAls Asia Pacific Pte Ltd.	May 2020	Whole blood/serum/plas ma	IgG/IgM	<25 min	Singapore
Roche Elecsys Anti- SARS-CoV-2	Roche Diagnostics Asia Pacific Pte Ltd.	May 2020	Serum/plasma	N protein/IgG	18 min	Singapore

REFERENCE

- [1]. Xu X, Chen P, Wang J et al (2020) Evolution of the novel corona virus from the ongoing Wuhan outbreak and modelling of its spike protein for risk of human transmission. *Science China Life Science* 63:457–460. [https:// doi. org/ 10. 1007/ s11427- 020- 1637-5](https://doi.org/10.1007/s11427-020-1637-5)
- [2]. He J, Tao H, Yan Y et al (2020) Molecular mechanism of evolution and human infection with SARS-CoV-2. *Viruses* 12:428. [https:// doi. org/ 10. 3390/ v1204 0428](https://doi.org/10.3390/v12040428)
- [3]. Guan W, Ni Z, Hu Y et al (2020) Clinical characteristics of corona virus disease 2019 in China. *N Engl J Med* 382:1708–1720. [https:// doi. org/ 10. 1056/ NEJMo a2002 032](https://doi.org/10.1056/NEJMo a2002032)
- [4]. Yan R, Zhang Y, Li Y, et al (2020) Structural basis for the recognition of SARS-CoV-2 by full-length human ACE2. *Science* (80-) 367:1444–1448. [https:// doi. org/ 10. 1126/ science. abb27 62](https://doi.org/10.1126/science.abb2762)
- [5]. Ji W, Wang W, Zhao X et al (2020) Cross-species transmission of the newly identified corona virus 2019-nCoV. *J Med Virol* 92:433–440. [https:// doi. org/ 10. 1002/ jmv. 25682](https://doi.org/10.1002/jmv.25682)
- [6]. Read R (2020) Flawed methods in “COVID-19: attacks the 1-beta chain of haemoglobin and captures the porphyrin



- to inhibit human heme metabolism.”
<https://doi.org/10.26434/chemrxiv.11938173>
- [7]. Nagargoje B, Palod A, Dixi J, et al. Seroprevalence of COVID-19 in a city in India: A community-based cross-sectional study. *J Res Med Dent Science* 2021; 9:48-53
- [8]. Singh DK, Garg A, Bagri S, et al. COVID-19 presentation and effect of associated comorbidities on severity of illness at a dedicated COVID hospital in North India. *J Res Med Dent Science* 2021; 9:49-54.
- [9]. DeWit, E.; Van Doremalen, N.; Falzarano, D.; Munster, V.J. SARS and MERS: Recent insights into emerging Corona viruses. *Nat. Rev. Microbiol.* **2016**, 14, 523–534. [Cross Ref] [Pub Med]
- [10]. Gong, S.R.; Bao, L.L. The battle against SARS and MERS Corona viruses: Reservoirs and Animal Models. *Anim. Model. Exp. Med.* **2018**, 1, 125–133. [Cross Ref] [Pub Med]
- [11]. Fehr, A.R.; Perlman, S. Corona viruses: An overview of their replication and pathogenesis. *Methods Mol. Biol.* **2015**, 1282, 1–23. [Cross Ref]
- [12]. Zayani R, Rezig D, Fares W et al (2021) Multiplexed magneto fluorescent bio platform for the sensitive detection of SARS CoV- 2 viral RNA without nucleic acid amplification. *Anal Chemistry* 93:11225–11232. <https://doi.org/10.1021/acs.analchem.1c01950>
- [13]. Chan JF-W, To KK-W, Chen H, Yuen K-Y (2015) Cross-species transmission and emergence of novel viruses from birds. *Curr Opin Virol* 10:63–69. <https://doi.org/10.1016/j.coviro.2015.01.006>
- [14]. He J, Tao H, Yan Y, et al (2020) Molecular mechanism of evolution and human infection with the novel Corona virus (2019-nCoV). *bioRxiv* 2020.02.17.952903. <https://doi.org/10.1101/2020.02.17.952903>
- [15]. Ding N, Zhao K, Lan Y et al (2017) Induction of atypical autophagy by porcine hemagglutinating encephalomyelitis virus contributes to viral replication. *Front Cell Infect Microbiol* 7:56. <https://doi.org/10.3389/fcimb.2017.00056>
- [16]. Segars J, Katler Q, McQueen DB et al (2020) Prior and novel Corona viruses, Corona virus disease 2019 (COVID-19), and human reproduction: what is known? *Fertil Sterile* 113:1140–1149. <https://doi.org/10.1016/j.fertnstert.2020.04.025>
- [17]. Wang N, Shang J, Jiang S, Du L (2020) Subunit vaccines against emerging pathogenic human Corona viruses. *Front Microbiol* 11:298. <https://doi.org/10.3389/fmicb.2020.00298>
- [18]. Song Z, Xu Y, Bao L et al (2019) From SARS to MERS, thrusting Corona viruses into the spotlight. *Viruses* 11:59. <https://doi.org/10.3390/v11010059>
- [19]. Woo PCY, Huang Y, Lau SKP, Yuen K-Y (2010) Corona virus genomics and bioinformatics analysis *Viruses* 2:1804–1820
- [20]. Wilson ME, Chen LH (2020) Travellers give wings to novel Corona virus (2019-nCoV). *J Travel Med* 27: <https://doi.org/10.1093/jtm/taaa015>
- [21]. Wu Z, McGoogan JM (2020) Characteristics of and important lessons from the Corona virus disease 2019 (COVID-19) outbreak in China. *JAMA* 323:1239. <https://doi.org/10.1001/jama.2020.2648>
- [22]. Gralinski LE, Menachery VD (2020) Return of the Corona virus: 2019-nCoV. *Viruses* 12:135
- [23]. Zhu N, Zhang D, Wang W et al (2020) A novel Corona virus from patients with pneumonia in China, 2019. *N Engl J Med* 382:727–733. <https://doi.org/10.1056/nejmoa2001017>
- [24]. Alafeef M, Dighe K, Moitra P, Pan D (2020) Rapid, ultrasensitive, and quantitative detection of SARS-CoV-2 using antisense oligonucleotides directed electrochemical biosensor chip. *ACS Nano* 14:17028–17045. <https://doi.org/10.1021/acsnano.0c06392>
- [25]. Dane S, Akyuz M. Symptom spectrum and the evaluation of severity and duration of symptoms in patients with COVID-19. *J Res Med Dent Science* 2021; 9:262-266.
- [26]. Almutairi MA. The Corona virus disease 2019 (COVID-19) outbreak: Challenges for paediatric dentistry. *J Res Med Dent Science* 2021, 9:116-121.
- [27]. Chan JFW, Kok KH, Zhu Z, Chu H, To KKW, Yuan S, Yuen KY. Genomic



- characterization of the 2019 novel human-pathogenic Corona virus isolated from a patient with atypical pneumonia after visiting Wuhan. *Emerg Microbes Infect* 2020; 9:221–36.
- [28]. Benvenuto D, Giovanetti M, Ciccozzi A, Spoto S, Angeletti S, Ciccozzi M. The 2019-new Corona virus epidemic: evidence for virus evolution. *J Med Virol* 2020; 92:455–9.
- [29]. Nagata N, Iwata N, Hasegawa H, Fukushi S, Yokoyama M, Harashima A, Sato Y, Saijo M, Morikawa S, Sata T. Participation of both host and virus factors in induction of severe acute respiratory syndrome (SARS) in F344 rats infected with SARS Corona virus. *J Virol* 2007; 81:1848–57.
- [30]. Shereen MA, Khan S, Kazmi A, Bashir N, Siddique R. COVID-19 infection: origin transmission and characteristics of human Corona viruses. *J Adv Res* 2020;24:91–8.
- [31]. Cascella M, Rajnik M, Cuomo A, Dulebohn SC, and Di Napoli R. Features evaluation and treatment Corona virus (COVID-19). *Stat Pearls* 2020; Available from: <https://www.ncbi.nlm.nih.gov/books/NBK554776/>
- [32]. Wan Y, Shang J, Graham R, Baric RS, and Li F. Receptor recognition by the novel Corona virus from Wuhan: an analysis based on decade-long structural studies of SARS Corona virus. *J Virol* 2020; 94:94: e00127–20. Available online at https://www.reuters.com/article/ushealth-corona-virus-usa-zooidUSKBN21N0WV?taid=5e8a6ed69a7fcd0001c4b7e9&utm_campaign=trueAnthem:+Trending+Content&utm_medium=trueAnthem&utm_source=twitter
- [33]. Zhu, N. et al. A Novel Corona virus from patients with pneumonia in China, 2019. *N. Engl. J. Med.* **382**, 727–733 (2020).
- [34]. Gralinski, L. E. & Menachery, V. D. Return of the Corona virus: 2019-nCoV. *Viruses* **12**, 135 (2020).
- [35]. Deng, S. Q. & Peng, H. J. Characteristics of and public health responses to the Corona virus disease 2019 outbreak in China. *J. Clin. Med.* **9**, 575 (2020).
- [36]. Jiang, S., Du, L. & Shi, Z. An emerging Corona virus causing pneumonia outbreak in Wuhan, China: calling for developing therapeutic and prophylactic strategies. *Emerg. Microbes Infect.* **9**, 275–277 (2020).
- [37]. Wu, Z. & McGoogan, J. M. Characteristics of and important lessons from the Corona virus disease 2019 (COVID-19) outbreak in China: summary of a report of 72314 cases from the Chinese Centre for Disease Control and Prevention. *JAMA* **323**, 1239–1242 (2020).
- [38]. Deng, S. Q. & Peng, H. J. Characteristics of and public health responses to the Corona virus disease 2019 outbreak in China. *J. Clin. Med.* **9**, 575 (2020).
- [39]. Chan, J. F. et al. A familial cluster of pneumonia associated with the 2019 novel Corona virus indicating person- to-person transmission: a study of a family cluster. *Lancet* **395**, 514–523 (2020).
- [40]. Wang, R., Zhang, X., Irwin, D. M. & Shen, Y. Emergence of SARS- like Corona virus poses new challenge in China. *J. Infect.* **80**, 350–371 (2020).
- [41]. National Health Commission of the People's Republic of China. Briefing on the latest situation of the novel Corona virus pneumonia epidemic. http://www.nhc.gov.cn/xcs/yqtb/list_gzbd.shtml (2020).
- [42]. Eurosurveillance Editorial Team. Note from the editors: World Health Organization declares novel Corona virus (2019-nCoV) sixth public health emergency of international concern. *Euro. Surveill.* **25**, 200131e (2020).
- [43]. Coronaviridae Study Group of the International Committee on Taxonomy of Viruses. The species severe acute respiratory syndrome- related Corona virus: classifying 2019-nCoV and naming it SARS- CoV-2. *Nat. Microbiol.* **5**, 536–544 (2020).
- [44]. Fisher, D. & Heymann, D. Q&A: the novel Corona virus outbreak causing COVID-19. *BMC Med.* **18**, 57 (2020).
- [45]. Lai, C. C., Shih, T. P., Ko, W. C., Tang, H. J. & Hsueh, P. R. Severe acute respiratory syndrome Corona virus 2 (SARS- CoV-2) and Corona virus disease-2019 (COVID-19): the epidemic and the challenges. *Int. J. Antimicrobe. Agents* **55**, 105924 (2020).



- [46]. Hu, D. et al. Genomic characterization and infectivity of a novel SARS- like Corona virus in Chinese bats. *Emergence Microbes Infect.* **7**, 154 (2018).
- [47]. Wu, Z. & McGoogan, J. M. Characteristics of and important lessons from the Corona virus disease 2019 (COVID-19) outbreak in China: summary of a report of 72314 cases from the Chinese Centre for Disease Control and Prevention. *JAMA* **323**, 1239–1242 (2020).
- [48]. Chen, N. et al. Epidemiological and clinical characteristics of 99 cases of 2019 novel Corona virus pneumonia in Wuhan, China: a descriptive study. *Lancet* **395**, 507–513 (2020).
- [49]. Huang, C. et al. Clinical features of patients infected with 2019 novel Corona virus in Wuhan, China. *Lancet* **395**, 497–506 (2020).
- [50]. Wang, D. et al. Clinical characteristics of 138 hospitalized patients with 2019 novel Corona virus infected pneumonia in Wuhan, China. *JAMA* **323**, 1061–1069 (2020).
- [51]. Guan, W. J. et al. Clinical characteristics of Corona virus disease 2019 in China. *N. Engl. J. Med.* **382**, 1708–1720 (2020).
- [52]. Lu, X. et al. SARS- CoV-2 infection in children. *N. Engl. J. Med.* **382**, 1663–1665 (2020).
- [53]. Chen, H. et al. Clinical characteristics and intrauterine vertical transmission potential of COVID-19 infection in nine pregnant women: a retrospective review of medical records. *Lancet* **395**, 809–815 (2020).
- [54]. Vivanti, A. J. et al. Transplacental transmission of SARS CoV- 2 infection. *Nat. Commun.* **11**, 3572 (2020).
- [55]. Chen, T. et al. Clinical characteristics of 113 deceased patients with Corona virus disease 2019: retrospective study. *BMJ* **368**, m1091 (2020).
- [56]. Yang, X. et al. Clinical course and outcomes of critically ill patients with SARS- CoV-2 pneumonia in Wuhan, China: a single- cantered, retrospective, observational study. *Lancet Respir. Med.* **8**, 475–481 (2020).
- [57]. Chiu SS, Hung Chan K, Wing Chu K et al (2005) Human Corona virus NL63 infection and other Corona virus infections in children hospitalized with acute respiratory disease in Hong Kong, China. *Clin Infect Dis* 40:1721–1729. [https:// doi. org/ 10. 1086/ 430301](https://doi.org/10.1086/430301)
- [58]. Zaki AM, van Boheemen S, Bestebroer TM et al (2012) Isolation of a novel Corona virus from a man with pneumonia in Saudi Arabia. *N Engl J Med* 367:1814–1820. [https:// doi. org/ 10. 1056/ NEJMo a1211721](https://doi.org/10.1056/NEJMo a1211721)
- [59]. Zhang N, Wang L, Deng X et al (2020) Recent advances in the detection of respiratory virus infection in humans. *J Med Virol* 92:408–417. [https:// doi. org/ 10. 1002/ jmv. 25674](https://doi.org/10.1002/jmv.25674)
- [60]. researchgate.net/figure/classification-of-different-types-of-Corona-viruses-within-the-family-coronaviridae-fig1-350897521
- [61]. Pyrc, K.; Berkhout, B.; Van der Hoek, L. The novel human Corona viruses NL63 and HKU1. *J. Virol.* **2007**, 81, 3051–3057. [Cross Ref] [Pub Med]
- [62]. Wang, L.; Byrum, B.; Zhang, Y. Detection and genetic characterization of \delta corona virus in pigs, Ohio, USA, 2014. *Emerg. Infect. Dis.* **2014**, 20, 1227–1230. [Cross Ref] [Pub Med]
- [63]. Zhu, N.; Zhang, D. A novel Corona virus from patients with pneumonia in China, 2019. *N. Engl. J. Med.* **2019**. [Cross Ref] [Pub Med]
- [64]. Sawicki, S.G.; Sawicki, D.L.; Siddell, S.G. A contemporary view of Corona virus transcription. *J. Virol.* **2007**, 81, 20–29. [Cross Ref]
- [65]. DeWit, E.; Van Doremalen, N.; Falzarano, D.; Munster, V.J. SARS and MERS: Recent insights into emerging Corona viruses. *Nat. Rev. Microbiol.* **2016**, 14, 523–534. [Cross Ref] [Pub Med]
- [66]. Van der Hoek, L.; Pyrc, K.; Jebbink, M.F.; Vermeulen-Oost, W.; Berkhout, R.J.M.; Wolthers, K.C.; Wertheim-van Dillen, P.; Kaandorp, J.; Spaargaren, J.; Berkhout, B. Identification of a new human Corona virus. *Nat. Med.* **2004**, 10, 368–373. [Cross Ref]
- [67]. Azhar, E.I.; El-Kafrawy, S.A.; Farraj, S.A.; Hassan, A.M.; Al-Saeed, M.S.; Hashem, A.M.; Hashem, A.; Madani, T. Evidence for camel-to-human transmission of MERS Corona virus. *N. Engl. J. Med.* **2014**, 370, 2499–2505. [Cross Ref]



- [68]. Sui, J.; Aird, D.R.; Tamin, A.; Murakami, A.; Yan, M.; Yammanuru, A.; Jing, H.; Kan, B.; Liu, X.; Zhu, Q.; et al. Broadening of neutralization activity to directly block a dominant antibody-driven SARS-Corona virus evolution pathway. *PLoS Pathog.* **2008**, 4. [Cross Ref]
- [69]. Kahn, J.S.; McIntosh, K. History and recent advances in Corona virus discovery. *Paediatric. Infect. Dis. J.* **2005**, 24, S223–S227. [Cross Ref]
- [70]. Zeng, Z.Q.; Chen, D.H.; Tan, W.P.; Qiu, S.Y.; Xu, D.; Liang, H.X.; Che, M.; Li, X.; Lin, Z.; Liu, W.; et al. Epidemiology and clinical characteristics of human Corona viruses OC43, 229E, NL63, and HKU1: A study of hospitalized children with acute respiratory tract infection in Guangzhou, China. *Eur. J. Clin. Microbiol. Infect. Dis.* **2018**, 37, 363–369. [Cross Ref]
- [71]. Lu, R.; Zhao, X.; Li, J.; Niu, P.; Bo, Y.; Wu, H.; Wang, W.; Song, H.; Huang, B.; Zhu, N.; et al. Genomic characterisation and epidemiology of 2019 novel Corona virus: Implications for virus origins and receptor binding. *Lancet* **2020**. [CrossRef]
- [72]. To, K.K.; Hung, I.F.; Chan, J.F.; Yuen, K.Y. From SARS Corona virus to novel animal and human Corona viruses. *J. Thorac. Dis.* **2013**, 3, S103–S108. [CrossRef]
- [73]. Gralinski, L.E.; Menachery, V.D. Return of the Corona virus: 2019-nCoV. *Viruses* **2020**, 12, 135. [CrossRef] [PubMed]
- [74]. Chowell, G.; Blumberg, S.; Simonsen, L.; Miller, M.A.; Viboud, C. Synthesizing data and models for the spread of MERS-CoV, 2013: Key role of index cases and hospital transmission. *Epidemics* **2014**, 9, 40–51. [CrossRef] [PubMed]
- [75]. DeWit, E.; Van Doremalen, N.; Falzarano, D.; Munster, V.J. SARS and MERS: Recent insights into emerging Corona viruses. *Nat. Rev. Microbiol.* **2016**, 14, 523–534. [CrossRef] [PubMed]
- [76]. Zaki, A.M.; Van Boheemen, S.; Bestebroer, T.M.; Osterhaus, A.D.; Fouchier, R.A. Isolation of a novel Corona virus from a man with pneumonia in Saudi Arabia. *N. Engl. J. Med.* **2012**, 367, 1814–1820. [CrossRef] [PubMed]
- [77]. Durai, P.; Batool, M.; Shah, M.; Choi, S. Middle East respiratory syndrome Corona virus: Transmission, virology and therapeutic targeting to aid in outbreak control. *Exp. Mol. Med.* **2015**, 47. [CrossRef] [PubMed]
- [78]. Chan, J.F.W.; Yuan, S.; Kok, K.H.; To, K.K.W.; Chu, H.; Yang, J.; Xing, F.; Liu, J.; Yip, C.; Poon, R.; et al. A familial cluster of pneumonia associated with the 2019 novel Corona virus indicating person-to-person transmission: A study of a family cluster.
- [79]. Carlos, W.G.; Crus, C.; Cao, B.; Pasnick, S.; Jamil, S. Novel Wuhan (2019-nCoV) corona virus. *Am. J. Respir. Crit. Care Med.* **2020**, 201, 7–8. [CrossRef] [PubMed]
- [80]. Ather, A.; Patel, B.; Ruparel, N.B.; Diogenes, A.; Hargreaves, K.M. Corona virus disease 19 (COVID-19): Implications for clinical dental care. *J. Endod.* **2020**, 45, 584–595. [CrossRef] [PubMed]
- [81]. Cai, J.; Sun, W.; Huang, J.; Gamber, M.; Wu, J.; He, G. Indirect Virus Transmission in Cluster of COVID-19 Cases, Wenzhou, China, 2020. *Emerg. Infect. Dis.* **2020**, 26. [CrossRef]
- [82]. Corman, V.M.; Landt, O.; Kaiser, M.; Molenkamp, R.; Meijer, A.; Chu, D.; Bleicker, T.; Brunink, S.; Schneider, J.; Schmidt, M.; et al. Detection of 2019 novel corona virus (2019-nCoV) by real-time RT-PCR. *Eurosurveillance* **2020**, 25. [CrossRef] [PubMed]
- [83]. Vogels, C.; Brackney, D.; Wang, J.; Kalinich, C.; Ott, I.; Kudo, E.; Lu, P.; Venkataraman, A.; Tokuyama, M.; Moore, A.; et al. Saliva Direct: Simple and sensitive molecular diagnostic test for SARS-CoV-2 surveillance. *MedRxiv* **2020**. [CrossRef]
- [84].