Development of in-situ nasal gel for preexposure prophylaxis of COVID-19

And

other Initiatives



https://phil.cdc.gov/details.aspx?pid=23312

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Development of in-situ nasal gel for pre-exposure prophylaxis of COVID-19



Transmission electron microscope image of SARS-COV-2 the virus that causes coronavirus disease 2019

https://www.sciencemag.org/news/2020/03/

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Funded by DST



Identification of the causative agent of the Wuhan outbreak



- Coronaviruses are a group of related RNA viruses that cause disease in mammals and birds
- First human coronavirus was identified in 1965
- Named "corona" because of their crown-like appearance







Where did this mystery virus come from?



https://evolution.berkeley.edu/evolibrary /news/060101 batsars

How COVID-19 is different from earlier outbreaks?

Comparis	No. of	Deaths	Case fatality	$\mathbf{R_0}^{\#}$
on	cases		rate [#]	
SARS- COV-2*	15656884	636583	2.3	2-2.5
SARS	8437	813	9.5	1.7-1.9
MERS	2499	861	34.4	0.7

COVID-19 is much more contagious than influenza, due to asymptomatic/mildly symptomatic condition SARS-COV-2 appears to be more stable outside the human body SARS-COV-2 seems to have accumulated beneficial mutations that make them

efficient in binding to host cells

*--from https://www.worldometers.info/coronavirus/

#-Petrosillo N, Viceconte G, Ergonul O, Ippolito G, Petersen E. COVID-19, SARS and MERS: are they closely related?. *Clin Microbiol Infect*. 2020;26(6):729-734. doi:10.1016/j.cmi.2020.03.026



Modes of transmission of SARS-COV-2

DIRECT

Direct transmission means that the disease is passed directly from one infected person or animal to another person or animal.

INDIRECT

Indirect transmission occurs when a disease is passed from an infected person to another person, even though the two people have not had direct contact.

VECTOR

Vector transmission requires another organism to transmit a disease from person to person or from animal to person. This is a type of zoonotic (animal to person) transmission, but differs from direct zoonosis, in which a vertebrate animal contracts a disease and passes it directly to a person, as with rabies.



1. PERSON-TO-PERSON

Person-to-person transmission can occur anytime an infected person touches or exchanges body fluids with another person. For example, kissing can be one method of person-toperson transmission. A pregnant mother can also pass a disease on to her unborn child.



2. DROPLET

Some diseases are spread by coughing or sneezing, which can cause droplets containing the infectious agent to land on nearby people.



3. FECAL-ORAL

Fecal-oral transmission occurs when feces—often microscopic amounts are transmitted from an infected person or animal to another person by mouth. This can happen if food workers use the restroom but do not adequately wash their hands before preparing food for customers to eat.



4. AIRBORNE

Sometimes, an infectious agent enters the air when an infected person sneezes, coughs, laughs—or even just breathes—and it can remain in the air for an extended period of time. When another person comes into contact with the agent, this can lead to airborne transmission.



A fomite is an inanimate object that serves as a vehicle to pass an infectious disease from an infected person to a healthy person. For example, a water fountain might become contaminated by the saliva of an infected person and pass that disease on to another person who drinks from it. Other examples of potential fomites include doorknobs, handrails, and shared computer keyboards.



6. INSECT BITE

Vector-borne diseases are most commonly transmitted by insect bites. For example, mosquitoes acquire malaria parasites by feeding on infected humans and then transfer that infection to other people when they feed again. The plaque, which killed tens of millions of Europeans in the fourteenth century, was transmitted from rats to humans through flea bites.

NATIONAL





https://www.nationalgeographic.org/media/methods-disease-transmission/

The Gross Science of a Cough and a Sneeze!

- Scientists who study the ways we cough and sneeze are shedding light on how viruses like influenza and coronaviruses spread
- A cough [~ 2 billion viruses]
 - 3000 droplets
 - 50 miles/hour
- A Sneeze [1-2 billion viruses]
 - 20000 droplets
 - 200 miles/hour
- A breath [20 virus particles/min]
 - 50-5000 droplets
 - Low velocity
- Speaking [200 virus particles/min]
 - 100-1000 droplets
 - Low velocity

On an average one needs to ingest/inhale ~ 1000 virus particles to get infected



Main root of influenza A virus (H1N1) and coronavirus infections



Routes of exposure to SARS-COV-2 What is known so far

- Ocular invasion
- Inhalation
- Ingestion
- Through skin
- Bloodborne transmission
- Biological samples
- Intrauterine transmission ??

- Low-tear may contain virus
- Very high
- High
- Very low
- ??
- ??

हीरक जरांती २०१८ Diamond Jubilee 2018 एक साथ शारी की और Achieving Excellence Together More than 15 drugs are being tested to treat COVID-19

- Most are post-exposure options
- Target viral replication cycle
- Control symptoms of the disease



Pre-exposure treatment currently involves drug regimen

	Title	Status	Study Results	Conditions	Interventions	Locations
	Pro European Developing With the developing for the	Oracido	No Decide Available			
1	Pre-Exposure Prophylaxis With Hydroxychloroquine for High- Risk Healthcare Workers During the COVID-19 Pandemic	Suspended	No Results Available	•COVID-19	•Drug: Hydroxycnioroquine	•ISGiobal, Barcelona, Spain
					•Drug: Placebos	
2	Efficacy of Various Doses of Hydroxychloroquine in Pre- Exposure Prophylaxis for COVID 19	Recruiting	No Results Available	•COVID 19	•Drug: Hydroxychloroquine Sulfate 200 MG •Other: Placebo	Shaheed Zulfiaqar Ali Bhutto Medical University, Islamabad, Federal Capital, Pakistan
3	TAF/FTC for Pre-exposure Prophylaxis of COVID-19 in Healthcare Workers (CoviPrep Study)	Not yet recruiting	No Results Available	Healthcare Workers	•Drug: Emtricitabine/Tenofovir Alafenamide 200 MG-25 MG Oral Tablet	 Sociedad Argentina de Infectología, A. J. Carranza 974, Ciudad Autonoma de Buenos Aires, Capital Federal, Argentina
				•SARS-CoV 2	•Drug: Placebo	
4	HEalth Care Worker pROphylaxis Against COVID-19: The HERO Trial	Not yet recruiting	No Results Available	Prophylaxis COVID-19 Health Care Worker Hydroxychloroquine	Drug: Hydroxychloroquine Pre-Exposure Prophylaxis Drug: Placebo oral tablet	The New York Center for Travel and Tropical Medicine, New York, New York, United States
5	COVID-19 PrEP HCW HCQ Study	Recruiting	No Results Available	•COVID-19	 Drug: Hydroxychloroquine (HCQ) 	NYU Langone Health, New York, New York, United States
6	COVID-19 Infection in Patients Infected With HIV and/or on PrEP	Completed	No Results Available	•HIV •Pre-exposure Prophylaxis	•Other: Data research, database analysis	Croix-Rousse Hospital, Hospices Civils de Lyon, Lyon, France
7	Does Hydroxychloroquine Before & During Patient Exposure Protect Healthcare Workers From Coronavirus?	Enrolling by invitation	No Results Available	Pre-Exposure Prophylaxis Coronavirus SARS-CoV 2	Drug: Hydroxychloroquine Drug: Placebo oral tablet	University Health Network, Toronto, Ontario, Canada
8	Randomized Clinical Trial for the Prevention of SARS-CoV-2 Infection (COVID-19) in Healthcare Personnel	Recruiting	No Results Available	Coronavirus Infection	Drug: Emtricitabine/tenofovir disoproxil	Hospital Universitario de Ferrol, Ferrol, A Coruña, Spain
					Drug: Hydroxychloroquine Drug: Placebo: Emtricitabine/tenofovir disoproxil Placebo	 Hospital Clínico Universitario de Santiago, Santiago De Compostela, A Coruña, Spain
						•Hospital General de Elche, Elche, Alicante, Spain
					Drug: Placebo: Hydroxychloroquine	Hospital Universitario Central de Asturias, Oviedo, Asturias, Spain
						Hospital Sant Joan de Deu de Esplugues, Esplugues De Llobregat, Barcelona, Spain
						Parc Sanitari Sant Joan de Déu de Sant Boi, Sant Boi De Llobregat, Barcelona, Spain
						Hospital Infanta Margarita, Cabra, Córdoba, Spain
						•Hospital Insular de Las Palmas, Las Palmas De Gran Canaria, Gran Canaria, Spain
						 Hospital Universitario de Canarias, Las Palmas De Gran Canaria, Gran Canaria, Spain
						 Hospital de Donostia, San Sebastián, Guipuzcoa, Spain
						and 52 more
9	Pre-exposure Prophylaxis for SARS-Coronavirus-2	Active, not recruiting	No Results Available	COVID-19 Corona Virus Infection ARDS	Drug: Hydroxychloroquine Other: Placebo	Nationwide Enrollment via Internet, please email: covid19@umn.edu, Minneapolis, Minnesota, United States
						•University of Minnesota, Minneapolis, Minnesota, United States
				Acute Respiratory Distress Syndrome		
10	Control of COVID-19 Outbreaks in Long Term Care	Not yet recruiting	No Results Available	•COVID-19	Drug: Favipiravir	
				•SARS-CoV-2	Drug: Favipiravir Placebo	
11	Hydroxychloroquine for the Treatment of Mild COVID-19	Recruiting	No Results Available	•COVID-19	Drug: Hydroxychloroquine	Institute for Tropical Medicine, Tübingen, Germany
	<u>Disease</u>				Drug: Placebo	



The SARS-CoV-2 Virion and Its Proteins

Our strategy

Irreversible capture of virus particles and their inactivation

Intended for application to the nasal passages either as gel or spray for local effects

For people who do not have ^{NS} infection but have a higher risk of exposure

- Healthcare workers
- Public service personnel (Police, Transportation, etc.)
- People who work in a store



https://www.nejm.org/doi/10.1056/NEJMcibr2007042



Visco-elasticity optimization of the Gel formulations



Liposome formulations with active anti-SARS-COV-2 ingredient have been optimized and characterized by DLS.



Detection of SARS-CoV-2 Nucleic Acid in wastewater

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Detection of SARS-CoV-2 Nucleic Acid in wastewater using low-cost sensing platform Siddharth Tallur, Department of Electrical Engineering, IIT Bombay

Andrew Ward, Charles Knapp, Adrian Butterworth, University of Strathclyde

Partly funded by UK Research & Innovation Fund-Scottish Funding Council --Global Challenges Research (UKRI, SFC GCRF COVID19 Response Fund)

Detection of viral RNA from wastewater is a great tool for surveillance

SARS-COV-2 RNA appears in wastewater well before the detection in the community



SARS-CoV-2 N1 Synthetic DNA SARS-CoV-2 N2 Synthetic DNA





Presence of SARS-CoV-2 RNA in wastewater



Tested untreated wastewater sample contains an estimated 3.5 \pm 1.2 log 10 copies of SARS-COV-2 RNA/L

Results have been validated by independent methods

Complete workflow for detection and quantification of SARS-COV-2 nucleic acid from wastewater using RTPCR has been established





Other COVID-19 projects and initiatives

Development of a two colour-based detection of SARS-COV-2 at point-of-care Collaboration with Prof. Debjani Paul and Prof. Kantimay Dasgupta Funding: Wadhwani Research Centre for Bioengineering, IIT Bombay

Development of UVC-based sterilization units and their validation Collaboration with Prof. Ambarish Kunwar Funding: IIT Bombay Wadhwani Research Centre for Bioengineering, IIT Bombay BIRAC

Bio-safety training With Prof. Ambarish Kunwar

