Can insects spread COVID-19?

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Insects are beautiful creatures in nature and found in every environment on Earth. Many insects are considered to be pests by humans. However, some insects are crucial components of several ecosystems, performing many important functions such as pollination, decomposition *etc*. besides beneficial insects producing useful substances, such as honey, wax, lac, silk. Some insects act as food and medicine but some insects like mosquitoes, especially female ones act as vector for many bacterial and viral diseases as female mosquitoes need blood to nourish the development of young ones from eggs. Viruses take advantage of this biological requirement of mosquitoes to move from one host to host. In the process, the mosquitoes spread pathogens and results in half a million deaths each year and hundreds of million cases of severe illness.

Coronaviruses are important human and animal pathogens. At end of 2019, a novel coronavirus was identified as the cause of a cluster of pneumonia cases in Wuhan, China. This disease rapidly spread, resulting in an epidemic throughout the world. In February 2020, the World Health Organization designated the disease COVID-19, which stands for coronavirus disease 2019. The virus that causes COVID-19 is designated severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).

Full-genome sequencing and phylogenic analysis indicated that the coronavirus that cause COVID-19 is a beta-coronavirus in the same subgenus at the severe acute respiratory syndrome (SARS) virus, but in a different clade.

The mechanism of viral entry and replication and RNA packing in the human cell, the lungs are the organs most affected by COVID-19 because the virus accesses host cells via the enzyme angiotensin converting enzyme 2 (ACE2), which is most abundant in type II alveolar cells of the lungs. The virus uses a special surface glycoprotein called a “spike” (S) protein attaches to angiotensin converting enzyme 2 (ACE2) receptors that is found on the surface of many human cells, including those in the lungs allowing virus entry. The coronavirus S protein is subjected to proteolytic cleavages by host proteases (i.e. trypsin and furin), in two sites located at the boundary between the S1 and S2 subunits. In a later stage happens the cleavage of the S2 domain in order to release the fusion peptide. This event will trigger the activation of the membrane fusion mechanism. As the alveolar disease progresses, respiratory failure might develop and death may follow (Belouzard *et al*., 2012)

Understanding of the transmission risk is incomplete. Epidemiologic investigation in Wuhan, China at the

beginning of the outbreak identified an initial association with a seafood market that sold live animal, where most patients had worked or visited and which was subsequently closed for disinfection. However, as the outbreak progressed, person-to-person spread became the main mode of transmission.

Virus present on contaminated surfaces may be another source of infection if susceptible individuals touch these surfaces and then transfer infectious virus to mucous membranes in the mouth, eyes or nose. The frequency and relative importance of this type of transmission remain unclear. There may be a possibility of transmission of COVID-19 by insects such as Mosquitoes (through blood), House flies and cockroaches (through mucous). But there is no scientific evidence to suggest mosquitoes are transmitting SARS-CoV-2, the virus that causes COVID-19. There is much more to learn about the coronavirus but based on current understandings, it's highly unlikely a mosquito will pick up the virus by biting an infected person, let alone be able to pass it on.

Mosquitoes can transmit a number of viruses, including dengue, yellow fever, chikungunya, Zika and Ross River virus. The mosquitoes can also transmit malaria, which is caused by a parasite. But they can't transmit many other viruses, including HIV and Ebola. For HIV, mosquitoes themselves don't become infected. It's actually unlikely a mosquito will pick up the virus when it bites an infected person due to the low concentrations of the HIV circulating in their blood. For Ebola, even when scientists inject the virus into mosquitoes, they don't become infected. One study collected tens of thousands of insects during an Ebola outbreak but found no virus. Here actual question will arise that,

Can mosquitoes transmit corona virus?

The new coronavirus is mostly spread via droplets produced when we sneeze or cough, and by touching contaminated surfaces. Although coronavirus has been found in blood samples from infected people, there's no evidence it can spread via mosquitoes. Even if a mosquito did pick up a high enough dose of the virus in a blood meal, there is no evidence the virus would be able to infect the mosquito itself. And if the mosquito isn't infected, it won't be able to transmit it to the next person she bites(Cameron, 2020).

Why only some viruses and why not others like Corona?

It's easy to think of mosquitoes as tiny flying dirty syringes transferring droplets of infected blood from person to person. The reality is far more complex. When a mosquito bite a COVID-19 patient and sucks up some blood that contains a virus, the virus quickly ends up in the gut of the insect. From there, the virus needs to infect the cells lining the gut and "escape" to infect the rest of the body of the mosquito, spreading to the legs, wings, and head. The virus then has to infect the salivary glands before being passed on by the mosquito when it next bites. This process can take a few days to over a week. But time isn't the only barrier. The virus also has to negotiate getting out of the gut, getting through the body, and then into the saliva. Each step in the process can be an impenetrable barrier for the virus. This may be straightforward for viruses that have adapted to this process but for others, the virus will perish in the gut or be excreted. The U.S. Department of

Agriculture is studying whether the novel coronavirus can be spread by mosquitoes, although the theory was ruled out by the World Health Organization and independent experts say such transmission is virtually impossible.

Joseph Conlon, a former U.S. Navy entomologist and technical adviser for the American Mosquito Control Association, said that possibility of mosquito transmission of the coronavirus is "nil." The WHO has definitively stated that the coronavirus cannot be transmitted via mosquitoes, while the U.S. Centers for Disease Control and Prevention said it "has no data to suggest" that the coronavirus is spread by mosquitoes or ticks. Independent experts said there has been no demonstrated case of any of the family of viruses to which the novel coronavirus belongs being transmitted by a mosquito.

Tarik Jasarevic, a WHO spokesman said that Mosquitoes cannot transmit the Covid-19 disease because the virus does not widely circulate in blood and is more prevalent in lungs and the respiratory tract. Even if the mosquito did digest the virus, it would have to survive the digestive process and transfer to the insect's salivary glands to then infect a human. Conlon also said that "It's an extremely complicated process and there are a number of different barriers there in insect body.

Can House flies and Cockroaches transmit corona virus?

Yes, these insects can transmit COVID-19 mechanically. Feces can be considered a one of important possible source of COVID-19 transmission. Therefore, insects or any organism in contact with or feeding on human feces may play a role in COVID-19 transmission. Therefore, the role of insects such as houseflies and cockroaches in the transmission of COVID-19 becomes important. These insects have the potential to mechanically transmit pathogens such as viruses, bacteria, and parasites. They are capable of transmitting more than 100 pathogens through their legs, body hair, mouthparts, feces, and vomit. Houseflies and cockroaches feed a variety of substances including human and animal food waste, milk, sugar, rotten fruits, sputum, nasal secretions, various wastes, fresh and dried blood, decaying corpses, stool, *etc*. Given that these insects feed contaminated materials, return them, and defecate on food materials, they are among the most important insects that can mechanically carry bacteria, viruses, worm eggs, and protozoan cysts. Flies and cockroaches play a role in the transmission of agents that cause diseases such as tuberculosis, leprosy, diarrhea, dysentery, cholera, typhoid, trachoma, conjunctivitis, polio, and hepatitis A. They are also vectors of rotaviruses, coronaviruses, some fungi (such as those in the genera Trichophyton and Candida) and eggs of parasitic worms and protozoan cysts. Flies and cockroaches are restless, active insects with strong visual and olfactory powers, and are constantly moving between food, feces, objects, and humans (Dehghani and Kassiri, 2020).

Dealing with the COVID-19 virus and preventing its rapid spread is a global challenge. Therefore, the fight against this disease requires universal management. In this regard, it is important eliminate possible mechanical vectors such as cockroaches and flies in public places and residential homes by improved environmental sanitization and also people still need to avoid even

mosquito bites because mosquitoes cannot spread corona virus but transmit several other diseases and these diseases can weaken our immune system, that would make people particularly susceptible to a coronavirus infection. So, please stay at home - stay safe - stay happy.

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