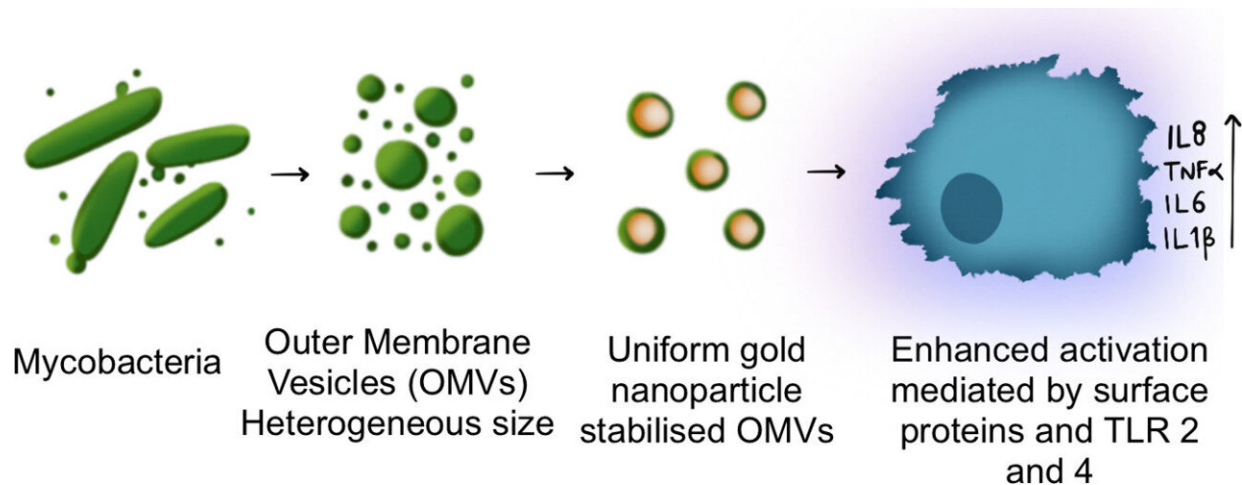


Bacterial vesicles coated on gold nanoparticles to combat TB

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Graphical abstract. Credit: *Biomaterials Advances* (2022). DOI: 10.1016/j.bioadv.2022.213003

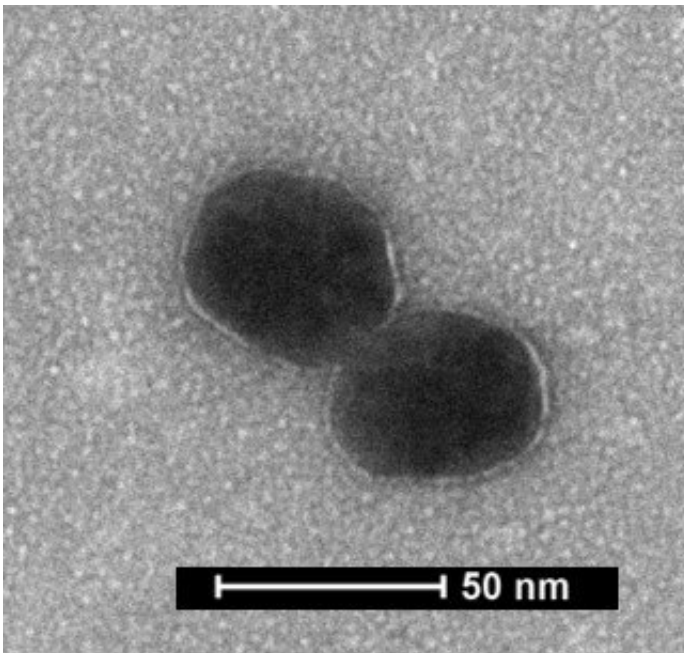
Researchers from the Indian Institute of Science (IISc) have designed a new method to deliver a vaccine candidate for tuberculosis (TB). It involves using spherical vesicles secreted by bacteria coated on gold nanoparticles which can then be delivered to immune cells. This can potentially trigger an immune response and offer protection against the disease.

Caused by the bacterium *Mycobacterium tuberculosis*, TB [kills](#) over a million people worldwide every year. The only effective vaccine

currently in use is the BCG vaccine. It contains a weakened form of the disease-causing bacterium. When injected into our bloodstream, it triggers the production of antibodies that can help fight the disease.

While the BCG vaccine works well in children, it is not as effective at protecting adolescents and adults. This prompted Rachit Agarwal, Assistant Professor at the Center for BioSystems Science and Engineering (BSSE), IISc, and his group to develop a potential subunit [vaccine candidate](#) that contains only parts of the infectious bacterium to stimulate an immune response.

Scientists have earlier developed subunit vaccines based on just a handful of proteins from the disease-causing bacteria, but none of them have been effective so far. Instead, Agarwal's group decided to use Outer Membrane Vesicles (OMVs). OMVs are spherical membrane-bound particles released by some bacteria, and contain an assortment of proteins and lipids which could induce an immune response against the pathogen.



Transmission electron microscope image of gold nanoparticles coated with bacterial Outer Membrane Vesicles. Credit: Edna George

"They're safer compared to a live bacterium, and since they are membrane-derived, they contain all kinds of antigens," explains Agarwal, the senior author of the paper published in *Biomaterials Advances*. Subunit vaccines typically only contain a limited number of antigens—bacterial proteins that can elicit an immune response in the host. In contrast, OMVs contain a variety of antigens and can induce a better [immune response](#), according to the researchers.

Mycobacterium-derived OMVs are usually unstable and come in different sizes, making them unsuitable for vaccine applications. But the OMVs coated on [gold nanoparticles](#) (OMV-AuNPs) by the IISc team were found to be uniform in size and stable. The researchers also found that human immune cells showed a higher uptake of OMV-AuNPs than of OMVs or gold nanoparticles alone.

"Producing the OMVs is a complex process, and scaling it up was challenging," says Avijit Goswami, a former postdoctoral fellow at BSSE and one of the first authors of the study.

"To synthesize OMV-AuNPs, the OMVs and the gold nanoparticles are forced together through a 100 nm filter. The OMVs break up in the process and encapsulate the gold nanoparticles," explains Edna George, a former postdoctoral fellow at BSSE, and co-first author of the study.

In the study, [immune cells](#) cultured in the lab were treated with OMVs derived from *Mycobacterium smegmatis*, a related bacterial species that does not cause disease in humans. In future studies, the team plans to develop gold-coated OMVs derived directly from *Mycobacterium*

tuberculosis and test them on animal models to take the results forward for clinical applications. Such efforts could open up new avenues for the development of vaccines for other bacterial diseases as well.

More information: Edna George et al, Immunomodulatory effect of mycobacterial outer membrane vesicles coated nanoparticles, *Biomaterials Advances* (2022). [DOI: 10.1016/j.bioadv.2022.213003](https://doi.org/10.1016/j.bioadv.2022.213003)

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