Developing Tuberculosis Vaccines

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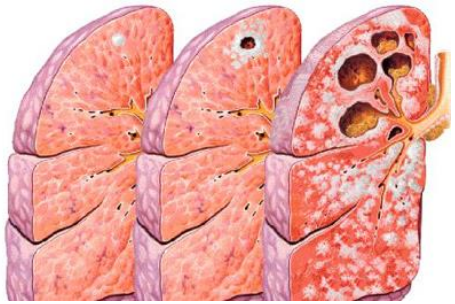
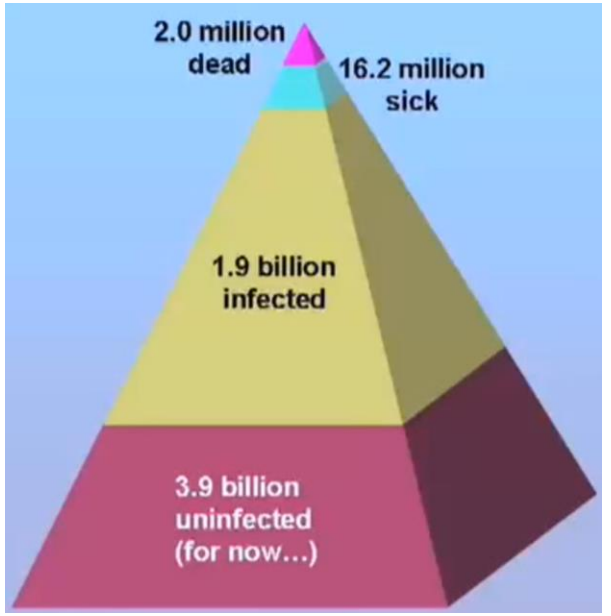
Tuberculosis Lung infections

- Mycobacterium Tuberculosis (MTB) infects nearly a third of human population
- 10 million new TB cases each year
- 5% had Multi-Drug Resistant (MDR) TB
  - India has highest MDR cases in world
- Total Drug Resistance (TDR) also reported in India
  - Resistant against all clinically used antibiotics
- Long treatment: 6-12 months
- BCG vaccine is not effective in adults

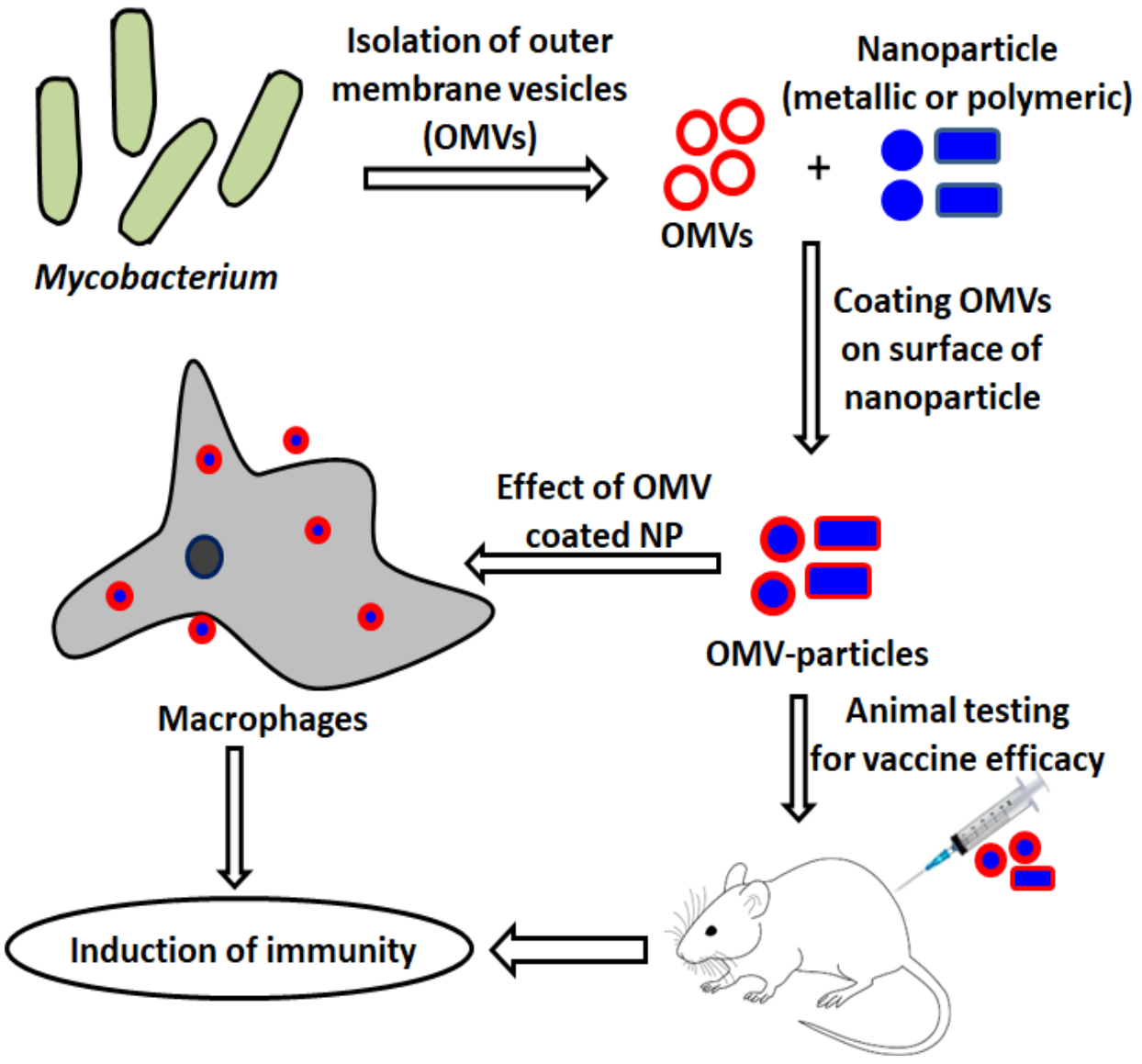




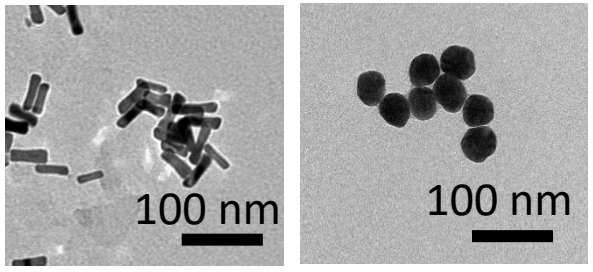
Zumla *et al.* Lancet Glob Health 3 (2015) Loewenberg *et al.* Lancet 379 (2012) Marais *et al.* Adv Drug Deliv Rev 102 (2016)

Overall system

- Isolation of bacterial outer membrane vesicles
- Synthesizing metal and polymeric particles of different size, shape and charge
- Coating bacterial membranes over to present antigens to immune system
- Testing in mice to determine efficacy of vaccines and compare it to BCG vaccine



Gold Nanospheres and rods



Learnings and major techniques

Students working on this project will develop following expertise:

- Problem solving ability and time management!
- Engineering materials for biological applications
- Designing nanoparticles with various polymers and lipids (liposomes)
- Encapsulating drugs and strategies for sustained and controlled release of drugs
- Immunotherapy
- Microscopic techniques such as fluorescence imaging, Scanning and transmission electron microscopy
- Mammalian and bacterial cell culture, animal handling
- Working with clinical samples and in biosafety level 3 facilities

Further reading

- Gao et al., Modulating antibacterial immunity via bacterial membrane-coated nanoparticles. Nano Letters 2015, 15 (2), 1403-9.

- Hu et al., Erythrocyte membrane-camouflaged polymeric nanoparticles as a biomimetic delivery platform. Proceedings of the National Academy of Sciences 2011, 108 (27), 10980-10985.