

# Rapid Diagnostics: Tailoring Nanomaterial for Magnetic Capture of Pathogenic Bacteria

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## Introduction

When it comes to the practice of medicine, one of the limiting factors that can hinder disease treatment is the amount of time it takes to diagnose the disease. Diagnostic procedures can take days, even weeks. In this research, the goal was to test a quicker diagnostic method for bacterial infections like *M. tuberculosis* bacterium that causes tuberculosis (TB). Rapid diagnostic triage tests would help increase the diagnosis specially in the field.

To accomplish this rapid diagnosis, bacteria targeting magnetic nanoparticles probes were created. The cell wall of different bacteria has differently abundant carbohydrate epitopes. These naturally abundant carbohydrate epitopes can be recognized by carbohydrate binding proteins called lectins.

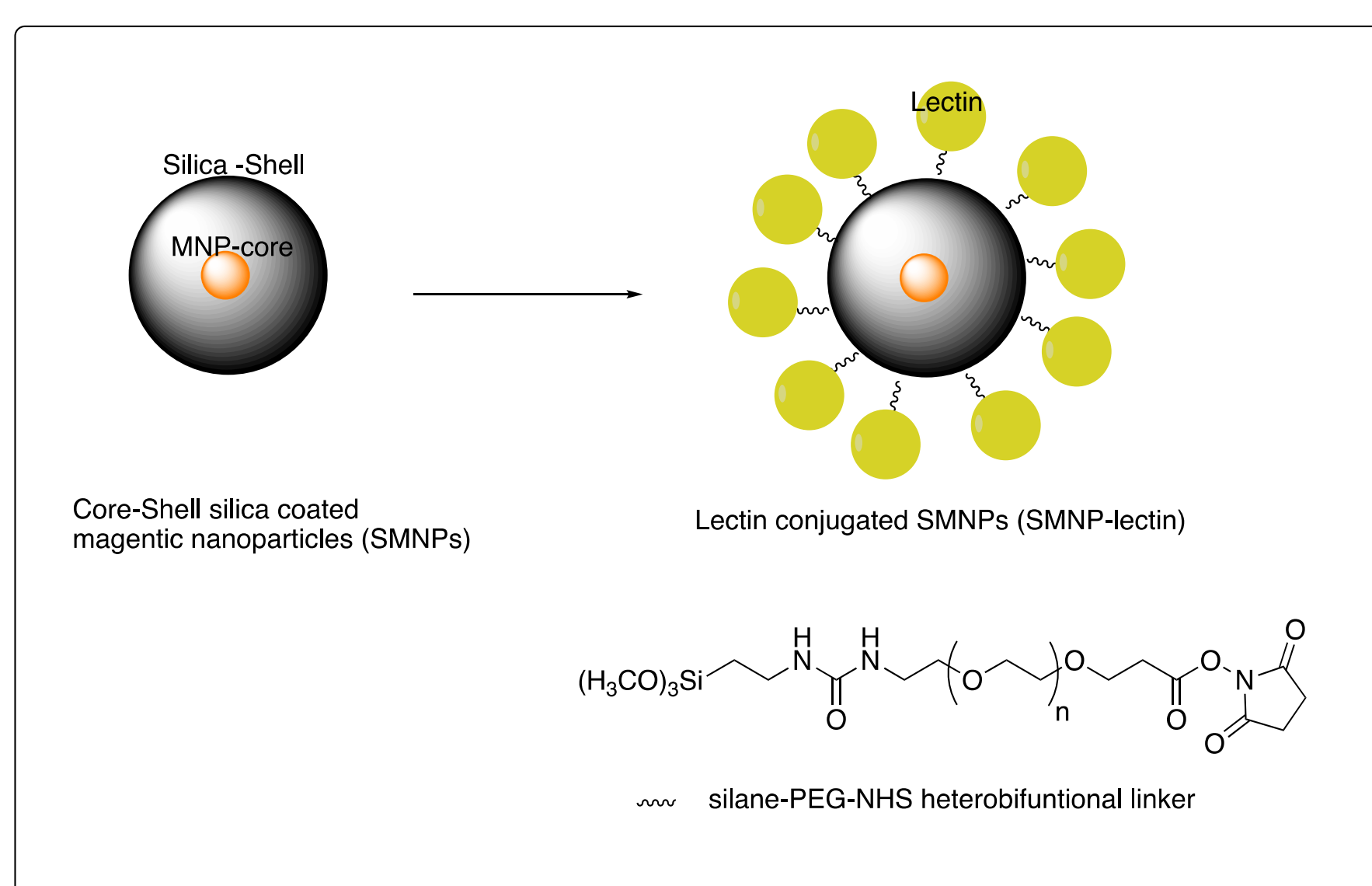
We use lectin conjugated magnetic nanoparticles as probes to tag bacteria. Multiple types of nanoparticles (fluorescent/magnetic) were created and conjugated to different heterobifunctional linkers and various lectins. *M. smegmatis*, in the same genus as *M. tuberculosis*, was the target bacteria tested.

## Methodology

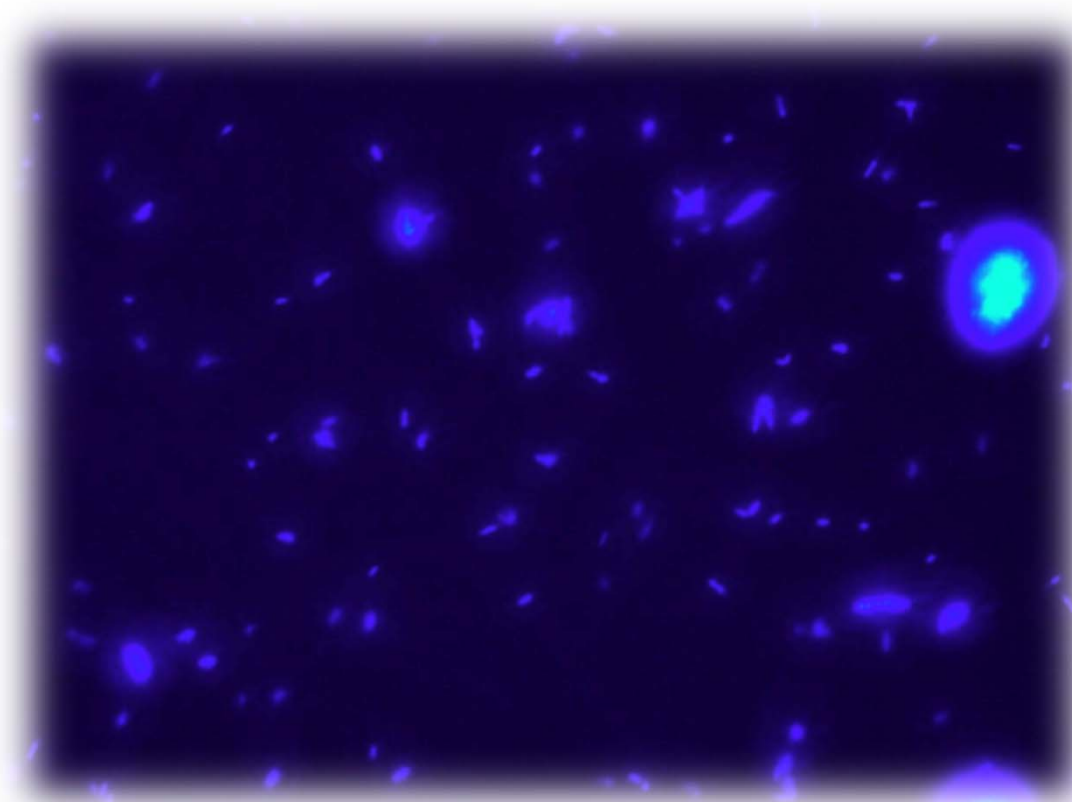
In summary silica-coated magnetic nanoparticles (SMNPs). were created using earlier published protocols and conjugated with silane-PEG-NHS linker. Lectins were conjugated to the SMNP-silane – PEG-NHS. SMNP-lectins were purified and incubated with sputum samples spiked with *Mycobacteria smegmatis*. Positive detection of the bacteria was through the formation of a magnetic precipitate.

## Acknowledgements

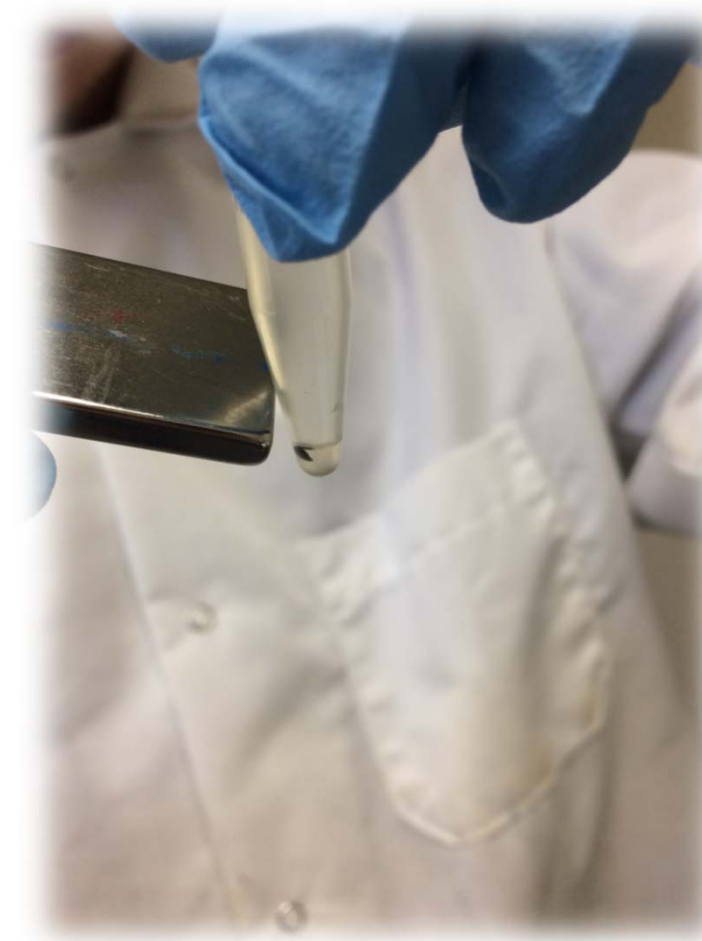
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Scheme 1. Synthesis of lectin conjugated core-shell silica coated magnetic nanoparticles



*M. smegmatis* under a 60x fluorescent microscope



*M. smegmatis* pulled by a magnet with the aid of SMNP-lectins

## Results, Conclusion and Future Work

SMNP-lectin conjugated nanoparticles could magnetically precipitate *M. smegmatis* bacteria within minutes from a sputum spiked sample. This requires no instrumentations or incubation time. This is an effective rapid diagnostic method that could be effectively utilized as a triage test in the field.

Control studies with contaminating species of bacteria found abundantly in the oral microflora such as from the genus of *Streptococcus* and *Lactobacillus* will be looked at.