Nanomedicine uses unique properties to prevent, diagnose, and treat medical conditions. Materials <500 nm are used as contrast agents for imaging, diagnostic devices, drug delivery vehicles, nanosensors, tissue engineering, prosthetics, and other applications.

**Drug Delivery**

Tiny amounts of drug formulations are encapsulated in nanoparticles—resulting in fewer side effects, faster results, and less medicine needed.

- **Nanoformulations**
  - Nanoforumulations have a greater surface-area-to-volume ratio compared with "bulk" formulations, yielding a higher percentage of bioavailable medicine per dose.

- **COVID-19 Vaccines**
  - Fragile mRNA fragments are encapsulated into lipid nanoparticles that stabilize, protect, and deliver mRNA to your cells quickly.

**Diagnostics**

Properties of nanosized metals and semiconductors can be used to develop affordable, easy-to-deploy diagnostic devices.

- **Varying Functionality**
  - Nanoparticles of conducting and semiconducting materials usually have different physical and chemical properties than their bulk counterparts with wide-ranging functionality.
  - Minor changes in nanoparticle size and environment dramatically impact properties such as conductivity, color, and reactivity, which can enhance detection capability and performance of sensors and medical devices.

- **Home Pregnancy Tests**
  - In most home pregnancy tests, modified gold nanoparticles bind to a pregnancy hormone, causing the characteristic red line to appear. Gold nanoparticles are red due to localized surface plasmon resonance.

**Prosthetics**

Incorporating the right nanoparticles into standard materials results in unique nanocomposites or prosthetics.

- **Nano’s Big Advantages**
  - High strength-to-weight ratio enhances performance and allows the prosthetics to produce more power with every action.
  - Biocompatible nanomaterials help facilitate natural regeneration of bone and skin.
  - Antimicrobial properties decrease the probability of infection.

- **Bone and Dentures**
  - 3D printed nanocomposites of hydroxyapatite, bioceramics, and biopolymers improve design customization and flexibility, reduce costs, and increase biocompatibility.

Learn more at nano.gov