CANCER is the second leading cause of death in Australia after heart disease. With so many lives at stake, the race is on to find better weapons to fight this terrible killer.

The keys to combating cancer are early detection, accurate diagnosis and personalised treatment. One material that is proving useful for diagnosis and treatment is gold. Yes, precious, shiny gold.

Normal bulk gold is well known for its uses in jewellery, coinage and art.

Much less familiar is gold’s useful properties when it exists not as discernible chunks of metal but as tiny particles hundreds of times smaller than a human cell.

Gold nanoparticles – so named because they are nanometres, or billionths of a metre, in size – are small enough to be absorbed by the human body and into cells.

Gold is unreactive so these nanoparticles are not toxic, which is a useful feature in a medical agent.

Gold nanoparticles can act as sensors to detect cancer cells in the body. By tuning their size, they can be made to absorb light in the visible or near-infrared region of the spectrum.

Unlike visible light, near-infrared light can penetrate quite far into human tissues.

By measuring the light absorbed by human tissues containing nanoparticles, an image similar to an MRI scan can be made, pinpointing the location of the nanoparticles.

By attaching tumour-targeting molecules to the nanoparticle surface, cancer cells can be located by imaging the nanoparticles.

Current techniques for detecting cancer cells use fluorescent dyes that damage healthy cells and require overnight staining of cells. So tissue samples have to be removed from the body before staining.

Using non-toxic gold nanoparticles instead could make cancer diagnosis quick and more accurate and improves the chances of early detection.

Gold nanoparticles can also be used to make drugs that kill cancer cells. The ultimate goal is to develop anti-cancer agents that can be efficiently, specifically and reliably delivered to cancer cells without damaging healthy cells or being degraded first.

The high stability of gold nanoparticles and the ease with which tumour-targeting agents can be attached to their surface make them perfect for the job.

The ability of nanoparticles to absorb specific wavelengths of light depending on their size makes it possible to trigger drug release with light only when the nanoparticles have reached cancer cells.

Gold nanoparticle-based anti-cancer treatments are not yet a clinical reality, but cutting-edge research should soon see these tiny bits of precious metal joining the fight against this disease.

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To find out more about the 10 Big Questions, go to http://ua.edu.au/sciences/10bq