# Sharks could save lives

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**A variety of shark compounds are finding applications in medical research. Here Marine researchers tag a black tipped shark near Gove in the Northern Territory.** Robert Kerton

**Shark populations are declining around the world, but their value to science, and the enormous potential value of bio-compounds to us generally, have been re-affirmed now researchers have discovered that sharks' unique antibodies may help diagnose a wide range of human diseases.**

While in an evolutionary context sharks are a long way from humans – our evolutionary lineages diverged almost 500 million years ago – sharks have an immune system similar in many ways to our own.

Antibodies are the effector proteins present in all immune systems. They are responsible for binding and neutralising the wide range of pathogens, toxins and foreign molecules we encounter. Until recently all antibodies were thought to have just a single, basic architecture, which with slight variations is found in all animals from sharks to humans.

Now, however, senior scientists Dr Victor Streltsov and Dr Stewart Nuttall from the CSIRO's Division of Health Sciences and Nutrition, and the Cooperative Research Centre (CRC) for Diagnostics, have determined the three-dimensional structure of a new class of shark antibodies termed IgNARs (short for Immunoglobulin New Antigen Receptor). The genes encoding these proteins were obtained from wobbegong sharks (*Orectolobus maculatus*), a species found in the Western Pacific ocean, including Australian waters.

Research has shown that these new antibodies have an unusual evolutionary history, with the shark immune system appearing to have co-opted a particular type of cell-surface protein to its own use. This has created the novel class of antibodies, completely unlike those seen in humans.

The IgNAR antibodies have evolved to a small size and are highly stable making them ideal for diagnostics application in medical research. This, the researchers say, is possibly due to shark blood being high in urea, a chemical hostile to other proteins. There is also enormous opportunity for using the antibodies in protein structure applications outside human health, such as the detection of biowarfare agents and rapid monitoring of environmental pollutants.

A next step is the design of antibody libraries within the laboratory. By mimicking the immune repertoire in a test tube, antibodies can be selected to match a wide range of targets.

Using the knowledge and insights gained from studying IgNAR antibodies' true three-dimensional structure will allow design of shark antibodies specifically aimed at the agents causing infectious diseases such as bacterial and viral pathogens.

The aim is to provide the antibodies for use when needed. As a diagnostic tool this would have enormous value, potentially allowing physicians to quickly determine if a person just has a common flu or has been exposed to more serious agents.

**More information:**

Streltsov, VA, Varghese, JN, Carmichael, JA, Irving, RA, Hudson, PJ, and Nuttall, SD, (2004). Structural evidence for evolution of shark Ig new antigen receptor variable domain antibodies from a cell-surface receptor. *Proc. Natl. Acad. Sci. USA* Vol. 101 (34), 12444-12449.