Asking the Right Questions

Or there is such a thing as a bad question :)

Mysterious Case of BeriBeri

It is 1897 and people are dying in Java, an island in Indonesia or the Dutch East Indies. They all seemed to share the same hideous symptoms beginning with overall muscle weakness, and loss of appetite, and eventually, they suffered paralysis and eventually death by heart failure. This disease was called beriberi by the indigenous people. This was a word from their native language that meant “I cannot, I cannot.”

What do you want to know?

Imagine you are a medical investigator and are trying to get to the bottom of what is making these individuals sick. What questions would you ask to solve this medical mystery?

- What makes a “good question”?
- Think “outside the box”
- Make sure you are looking at the problem from multiple angles (who, what, why, when and how)

The next piece of the medical puzzle…

Scientists thought the disease might be caused by bacteria. (After all, since the discovery of bacteria, almost all previously unknown diseases were attributed to a bacterial infection.)

They decided to prove that a bacterium was the culprit by conducting an experiment. They used chickens as their trial subject. All chickens were fed a special diet.

They injected a group of chickens with the blood from a patient who had beriberi and then to prove that the blood carried the "bacterium that caused the disease" they injected another group of chickens with saline or simple salt solution. Well, both groups got beriberi! So back to the starting board they went.

And the next piece…

One of the scientists who had been sent to work on this mystery was a Dutch physician and pathologist named Dr. Christiaan Eijkman. One day, as he walked around the hospital compound he observed his surroundings. He noticed that the cook fed every one of the patients the staple diet of the nation polished or white rice. Polished rice is wild, brown rice with the husk or outer layer rubbed off so that its color is white. It was the rice of choice of the middle class of the Indonesian people. He also noticed that the hospital staff fed the chickens (that would eventually be the chicken soup for the patients) wild rice. White rice was more expensive than brown rice, so the chickens were usually fed brown rice.

And the final piece…

Dr. Eijkman realized that what the chickens were being fed was an important observation and thought that maybe the wild rice contained something that the white rice did not. So he conducted another experiment. He divided the chickens once again into two separate groups. He fed one group of chickens only white rice and the other group only wild rice. Then he watched and waited.

It turned out that the chickens that had been fed wild rice did not get sick at all, but the chickens that had been fed the polished or white rice became weak, lost their appetite and eventually died from beriberi. Eureka, the case was solved!

As Dr. Eijkman and others continued to research this interesting case, they found that polished rice lacked thiamine, a vitamin necessary for good health. This was actually the first "vital amine" or vitamin to be discovered. It is also called vitamin B1.

We've now known for more than a hundred years that brown rice is more nutritious than white rice. But most Asian cultures associate eating white rice with prosperity and eating brown rice with bad luck. Most rice is still milled or polished, both in Asia and elsewhere. In Europe and America both white rice and brown rice are consumed, but mostly white. In fact, some white rice is chemically fortified to add back the B vitamins. In 1929, Eijkman and Hopkins were awarded the Nobel Prize for Physiology or Medicine for this discovery.

Wrap-Up: What makes a good scientific question

What a good scientific question does:

It's testable:

- It's about facts (will X reduce Y?), not values (do you prefer chocolate or vanilla?)
- It can be investigated using an experiment
- It can generate multiple possible explanations (hypotheses) that are falsifiable (can be proven false)
- It can be measured (e.g. using a variable to measure an outcome like a disease)

What a good scientific question does NOT do

- Has known answers (e.g. are google-able for a number, word, or short statement)
- Cannot be tested or measured ("does God exist?")
- Elicits an opinion or value statement (e.g. "do you like the color blue?" or "is this the right thing to do?")