There are at least two approaches that might demonstrate that something is scientifically correct. The first involves a statistical approach, while the second is based on first principles. Either way has its pitfalls, but each should result in correct analysis if done correctly.

The statistical approach at its simplest, is to consider multiple past occurences (a “sample”) and to use well-established mathematical means to analyze the value of a treatment. In this approach, we consider two sets of data. One set involves occurences that are treated with some method or substance we want to evaluate, and the other (a “control”) is not treated. Many useful tests use a “blind” methodology, in other words, one in which the evaluator does not know which occurences are treated and which are not.

In this simple case, mathematical formulae are used to compare the effectiveness of the treatment compared with the untreated part of the sample. A set value (called “alpha”) is established, and if the treated part of the sample is such that the likelihood of applying that treatment would only have happened by chance in that proportion of tests, the treatment is called “significant”. Formulae have been developed to determine an appropriate sample size, and tests to eliminate confounding factors. The alpha value is a judgement call on the part of the researcher. Often, a researcher uses “meta-analysis” based on multiple studies.

It is possible to misuse these mathematical methods. The most common means of misuse stems from a belief in one outcome before the test is complete. The biased researcher might “cherry-pick” from multiple studies, or increase the alpha in an individual study to get a result they want.

An approach based on first-principles is used to evaluate individual cases. Such famous inviduals as Copernicus and Einstein used this approach. In the case of Copernicus, who proposed that the Earth rotates around the Sun, there was only a single solar system to evaluate. Einstein only had a single universe to examine, in which the speed of light was a single value. Of course these principles must be correct. For example, Einstein’s principles extended those of Newton, who developed results based on basic principles. An instructive example is the case of Marcus von Plenciz who built on previous research to develop the so-called “germ theory” based on microorganisms. Until his theory gained general acceptance, practitioners universally were incorrect in what caused diseases. They were quite disdainful that tiny, unseen “germs” were involved.

Immunologists use the statistical approach in order to suggest policies that are most effective. So when one says “follow the science”, what they mean is that the policies recommended by immunologists are based on valid statistical methods.

Medical providers, that is, doctors who treat individual patients, use the first-principles approach, because they deal with single cases. How do doctors derive their first principles? They do so from medical school, from experience in seeing patients, and from consulation with others. They can be incorrect in their evaluation of the principles, but depending on the effectiveness of their knowledge and their ability to reason about it, they are usually correct. So it is not valid to say that an anecdotal experience is not true science. If the medical provider has used the first-principles approach, it may be very correct, although it may not appy to all cases.