

Corona – The Testing Conundrum

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Right since the time Corona has emerged on the global scene there is one thing which has been discussed time and again; how much to test for Corona.

Currently the Govt of India (GOI) is being consistently blamed for testing less.

To understand the rationale of how much to test we will have to understand how this testing actually works at the Community level.

Before looking for options in testing we must consider the fundamental concept that,

There is no perfect Test.

You can have a test that is accurate to a very high degree but “never 100% accurate”.

So inevitably every test we will do will have a certain percentage of,

1. False Positives – test showing the case as diseased where disease is absent and
2. False Negatives – test showing the case as free from disease where it’s actually present

Another concept which must be understood is that of “Prior Probability” or “Prevalence”.

How accurate or reliable a test is also highly dependent on the prior probability that someone being tested actually has the disease.

This is such a fundamental concept in Medicine that it is safe to say that,

All tests are meaningless without a fair degree of suspicion for the presence of a disease.

Ok, so enough of concepts.

Now let’s do some number crunching.

If we take a random person in an area and decide to test him, the “Prior Probability” that he has the disease is the overall incidence of that disease in the region defined as “Prevalence”. Let’s assume for now it’s 1% which is of course a presumption on the higher side for an early stage of an Epidemic.

Let’s assume we have a very highly accurate test too. We assume that this Test will have just 0.1% False Positive and 0.1% False Negative Results.

Meaning that such test will have 99.9% accuracy or it will detect 999 out of 1000 cases meaning thereby only 1 in 1000 with the disease will be marked as not having the disease. This is its False Negative Rate.

Being very accurate let’s also assume that the test will show only 1 in 1000 as falsely having disease where they are actually free from it. This is its False Positive Rate.

Now let’s see what happens if we use this test on a community.

Random Testing

Let’s start with 100,000 random people. Statistically, 1000 of them have the disease as Prevalence of disease is 1%.

Now out of these 1000 positive cases,

This test will mark 999 as “having the disease” but 1 also as “having no disease”. This is False Negative Error.

Among the other 99,000 Negative cases,

This test will mark 99 as “having the disease” and the rest as “having no disease”. This is False Positive Error.

So if the test says “Positive for disease”, what is the likelihood that the tested person actually has the disease?

It will be $999 / (999 + 99)$.

Or 10/11

Or 91%

So when you test “randomly”, 1 in 10 people you find positive are actually not positive for the disease. And please note that this happens with a highly accurate test.

Focused Testing

What if we were to test more carefully and become more selective?

What if we test only population who have higher "Prevalence"?

I.e., Populations of hotspots or the direct contacts of known infections or those having respiratory infections (like SARI testing done by ICMR).

Let's assume a Prevalence of 10% in a population of 100,000.

Now, out of our population of 100,000, people having the disease will be 10,000.

Out of these 10,000 Positive cases,

This Highly Accurate Test will mark 9990 as "having the disease" and 10 as "having no disease". False Negative Error.

Of remaining 90,000 Negative Cases,

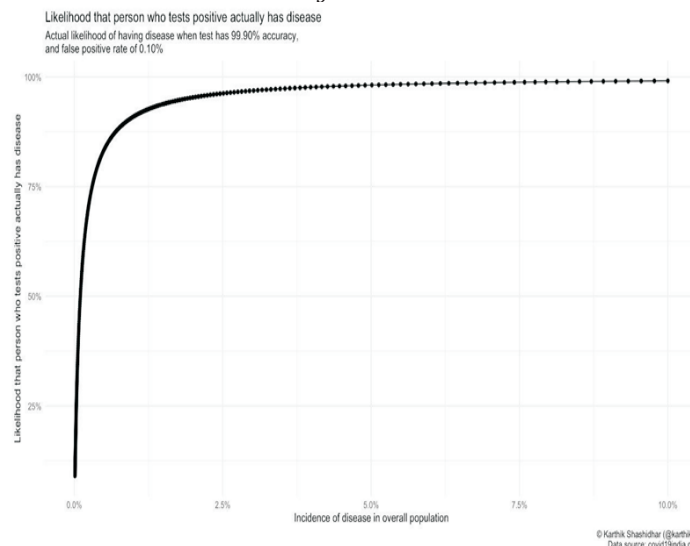
Test will mark 90 as "having the disease" and 89910 as "having no disease". False Positive Error.

So if the test says "having the disease", what is the likelihood that the tested person is actually having the disease?

9990 / (9990 + 90) or 99.1% of people marked out by the test as "Positive for disease" will actually have it.

And these results are with the assumption that the Test is highly accurate (1 in thousand errors, positive or negative). Graph in Figure 1 shows the likelihood of person actually having the disease is a function of the prior probability of having the disease in a given population being tested.

Figure 1



It can be clearly seen that the accuracy of final results are highly sensitive to the prior probability of having the disease.

Higher the Prevalence of the disease, the higher is the final accuracy of the test.

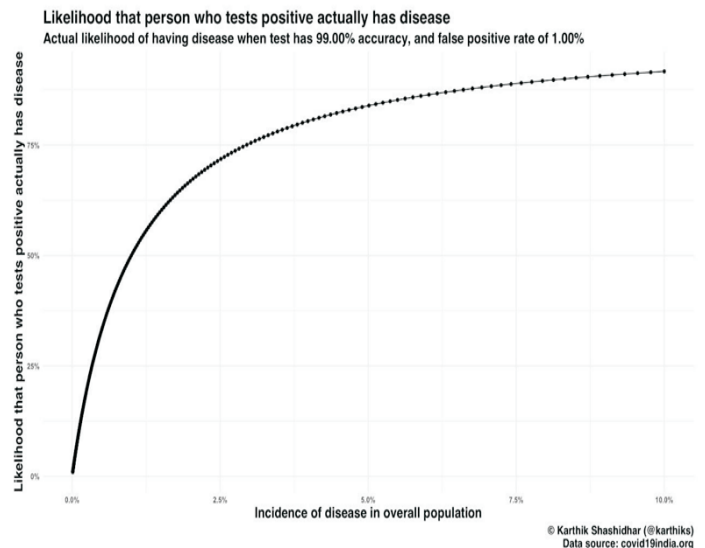
Now the problem is that we do not know the actual prevalence of the disease especially in the beginning of an Epidemic. (PROBLEM 1)

What Happens If The Test Is Less Accurate?

Now let's assume the test is not that accurate. Let's assume it is 99% accurate or wrong once every 100 times or 1% False Negative. Let's also assume a 1% False Positive rate.

The curve now looks very different.

Figure 2



We can see that final results become even less reliable.

Now another problem is that we also don't know the exact accuracy of the tests for Covid-19. (PROBLEM 2)

It's impossible to put a number on it since it's a new disease. We are reasonably certain of the accuracy of the PCR testing but that of Antibody tests are anybody's guess.

Infact it can be shown that if we keep the numbers realistic and assume that False Positive Rate of the Test is 1% and the Prevalence of the disease is 0.05%, as would be the case in early phase of Epidemic, the Test will be Wrong 95% times!

And this will give us a massively wrong picture.

So the correct strategy in this case is to test where the prior probability is already high and with your best possible test. This will give us the most accurate picture of the disease in the society.

GOI is thus using, PCR Test for COVID-19 and testing only those,

Who have travelled abroad

Who have come in contact with infected people

Who have respiratory illnesses

Who have travelled to Delhi in a certain religious congregation.

And the criteria are being consistently expanded.

Knowledge regarding COVID-19 is being gained very fast. New tests are coming up but releasing these tests on the population without exactly knowing their fallacies would cause mayhem.

This is also the reason why all agencies whether in US or Europe or in India are taking so much time to validate newer tests.

Hence we can very safely say that, This idea of Test, Test and Test is not without its pitfalls.

And we must trust the ICMR/GOI/Other Regulatory agencies which are trying to find the best possible way out of this testing conundrum.

Credits: Data has been taken from different Books, websites, Mr Karthik Shashidhar's graphs which are based on data from website www.covid19india.org, and material and news available on Mainstream and Social media.

