prof. dr hab. Matthias Bochtler

Pregnancy strip like COVID-19 test kit

The COVID-19 pandemic has had severe impact across the world. As of today (May 11th, 2020), over 4 million people have been infected, and over 280 000 people have died from the disease. The crisis has also had a profound impact on our individual lives. We are asked to stay at home, practice social distancing, and stay away from work, for many of us with severe economic consequences. Perhaps most disturbingly of all, each of us has to face the fact that we have become a potential danger to the seniors around, including older family members. Much of the problem is due to uncertainty whether we could be infected or not. If mass tests were available that detect the virus early on, the spread of the virus could be controlled much better, and a return to more normal living conditions would be easier.

In principle, the methods for detection of RNA viruses, such as COVID-19, are well established. The problem with these methods is that they require sophisticated laboratory equipment for analysis. In particular, so called qPCR machines are essential, capable to run the sample through multiple heating and cooling steps, and equipped with fairly sophisticated optics to monitor the amplification of nucleic acid material in the sample (with the use of indicator dyes). The required machines are sophisticated enough that they are available only in specialized laboratories and have to be operated by expert personnel. This comes with the overhead to transport samples to centralized testing facilities and the need to protect laboratory personnel from the highly infectious samples that arrive for testing.

Imagine there was a COVID-19 test that would work in a pregnancy strip format (technically called lateral flow assay format), which we could use in the comfort of our own homes, without endangering anyone else around us. Even an imperfect test of this nature would be very useful, as a guide to decide whether or not we should seek more definitive examination. The good news is that scientists are almost there, at least in principle, as demonstrated by a proof of principle experiments by the Feng Zhang lab at MIT and Harvard University. The qPCR reaction that requires complicated equipment can be replaced by nucleic acid amplification at a constant temperature, however, at the price of much lower efficiency. The lower efficiency, in turn, can be compensated for by an additional nucleic acid amplification step using an enzyme, called Cas13, taken from CRISPR biology. Finally, the last important ingredient in a COVID-19 self-test is the lateral flow assay format, familiar to all of us because of its use in pregnancy strips.

By shear chance, we have been working on the only non-commercially available reagent in the proposed testing format already prior to the COVID-19 outbreak. This puts us in the fairly unique position that we can put together a COVID-19 assay that would meet the criteria of a “do it at home by yourself” test. However, before releasing any such test, we need to be absolutely sure that it performs according to specifications. To avoid the severe safety restrictions that come with the use of real viral material, we will initially practice our detection skills on synthetic RNA mimicking the virus. Of course, we will then have to test real samples under appropriate safety conditions. For this, we will team up with Prof. Krzysztof Pyrć with whom we have already previously collaborated prior to the COVID-19 crisis on a CRISPR project.