LONGITUDE PRIZE

A QUICK GUIDE TO DIAGNOSTICS FOR ANTIBIOTIC RESISTANCE

INTRODUCTION

Diagnostic tests help physicians and patients make informed decisions about their healthcare. A diagnostic test is any kind of medical test performed to aid in the diagnosis or detection of disease. Diagnostic tests can also be used to provide prognostic information on people with established diseases. Based on the results of these tests, treatment options - if needed - can be selected.

Examples of well known and common diagnostic tests include:

- **Blood tests**
- **X-rays**
- **ECG**
- **CAT scan**
- **Ultrasound**
- **Biopsy**

Point-of-care (POC) diagnostics mean that these tests are hand-held and can be used without access to a laboratory - by physicians, pharmacists, any other healthcare provider, or even by members of the public.

Everyday POC diagnostic tests include:

- **Pregnancy tests**
- **Glucose tests**
- **pH test strips**
- **HIV snap tests**
- **Blood pressure**

Now, imagine we had a POC diagnostic test that could indicate within 30 minutes whether a patient needed antibiotics or not, or what antibiotic they should take - that is the role of the Longitude Prize.

WHY DOES THE LONGITUDE PRIZE FOCUS ON DIAGNOSTICS?

The race to design a point-of-care diagnostic test to aid in reducing antibiotic resistance began in November 2014 when BBC Horizon held a public vote between six different currently relevant issues that would be eligible for a challenge prize, including water, paralysis, food sustainability, antibiotic resistance, dementia and low-carbon flight. Being one of the most pressing issues, antibiotic resistance won the most votes.

The goal since has been to design and develop a point-of-care diagnostic test that is rapid, accurate, affordable and easy-to-use anywhere in the world.

To meet the overall vision of the Longitude Prize, winning tests must impact treatment decisions to significantly reduce the misuse or overuse of antibiotics, conserving them for future generations.

The Longitude Prize is a £10 million project with an £8 million prize for the winner. It is the largest UK science prize and the first prize of its kind to be determined through a public vote.

WHAT STAGE OF THE COMPETITION ARE WE AT IN 2018?

After launching in November 2014, there are currently 75 teams competing from 14 countries, including a combination of established private companies, groups from academic institutions and startups.

The prize is still open to new competitors and funding opportunities, and the Longitude Prize team continues to support existing competitors with technical and financial resources.

HOW CAN A DIAGNOSTIC MAKE A DIFFERENCE?

Better and faster diagnosis of infections will enable clinicians and patients to make more informed decisions on the course of prescribed treatment. Crucially important will be the ability to encourage patients to accept when antibiotics are not required, for example when the patient has a viral or self-limiting illness. In addition, correct diagnosis can ensure the right antibiotic is selected if required, and that more treatments are successful. All these outcomes will help in the fight against antibiotic resistance.

Where can diagnostics aimed at antibiotic resistance make a difference?

- **A sore throat** is a common presentation at the doctor's office. A rapid diagnostic could identify whether the sore throat is caused by a bacterial or viral infection, and confirm whether an antibiotic prescription is required in a significantly shorter amount of time than a lab test.

- **Sepsis** is an inflammatory state across the body caused by infection which can lead to multiple organ failure and death. Detection and management of sepsis is a huge challenge for health professionals in hospital. A rapid diagnostic could enable early detection of sepsis soon after a patient visits an emergency department or advise physicians on the correct treatment required.

- **Urinary tract infections (UTIs)** are a common condition often treated with antibiotics without sufficient diagnostic evidence. Resistance to available antibiotics is a significant problem. A rapid diagnostic could tell a physician what bacteria are present (if any) and what antibiotics are most appropriate for fighting the infection.

WHAT DIAGNOSTIC TESTS ARE LONGITUDE PRIZE TEAMS DESIGNING AND HOW DO THEY WORK?

The winning diagnostic test should rule out unnecessary antibiotic use and help identify a suitable antibiotic. A diagnostic test may do this in a number of ways:

1. **Differentiate between viral or bacterial infections**
2. **Identify the type of bacteria causing an infection**
3. **Identify which antibiotic(s) the bacteria is susceptible to**

A few definitions you should know

DNA is the molecule that contains the genetic code of all organisms (including animals, plants, and bacteria).

Antibiotic susceptibility testing (AST) determines which antibiotic will be most successful in treating a bacterial infection.

A **biomarker** is a biological molecule found in blood, or other body fluids that is a measurable indicator of a normal or abnormal process, or of a condition or disease.

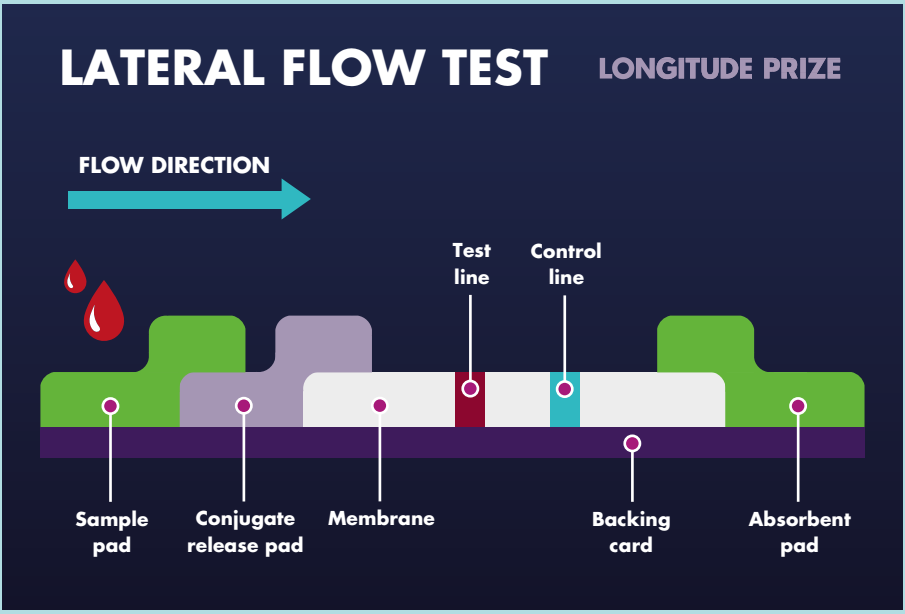
An **assay** determines the presence of a substance and the amount of that substance in a sample being tested.

TYPES OF DIAGNOSTIC TECHNOLOGIES

1. DIFFERENTIATING BETWEEN VIRAL OR BACTERIAL INFECTIONS

Lateral flow tests are simple paper-based devices that detect the presence (or absence) of a target, such as a pathogen or biomarker, in a liquid sample. These tests do not require specialised expensive equipment and can be performed in a range of settings including POC testing. A widely known application is the home pregnancy test.

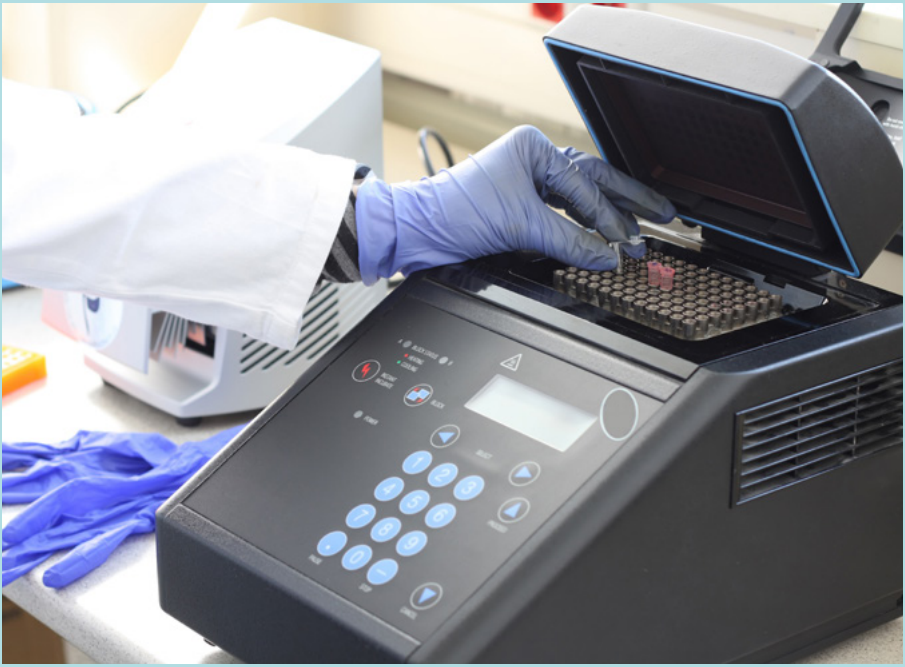
Lateral flow tests can be used as a technology to identify between bacterial or viral infection. Biomarkers indicating that the patient's immune system is responding to a bacteria, if present in the patient's sample (e.g. blood, urine), would react with molecules coated on the strip to produce a positive test result, normally visualised by a colour change.



2. IDENTIFY THE TYPE OF BACTERIA CAUSING AN INFECTION

Polymerase chain reaction (PCR) is a biochemical technology used to amplify a specific DNA target. It can identify a specific target (bacterial DNA) in a sample and then generate thousands to millions of identical copies. These copies can then be visualised and analysed by a technique called electrophoresis, which separates the amplified DNA from other molecules.

PCR can be used to detect and identify a bacteria in a sample by looking for a specific DNA target unique to that bacteria. Although well established as a means of diagnostic testing in laboratories, PCR is difficult to do at POC due to its cost and complexity.

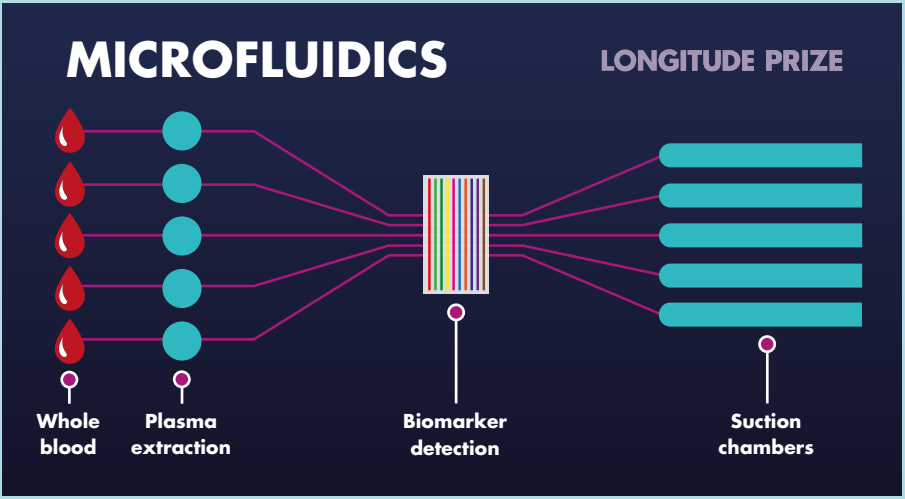


3. IDENTIFY WHICH ANTIBIOTIC(S) THE BACTERIA ARE SUSCEPTIBLE TO

Microfluidics is the most common diagnostic technology. It looks at the manipulation of fluid at the micro scale, often flowing through channels. It has three basic components.

- It requires a fluid sample (e.g. urine, blood).
- It processes the fluid sample by applying filters to isolate the desirable sample, or introducing a chemical reaction.
- It has a validation method to visualise the outcome, for example, a colour change, or detection under a fluorescent microscope.

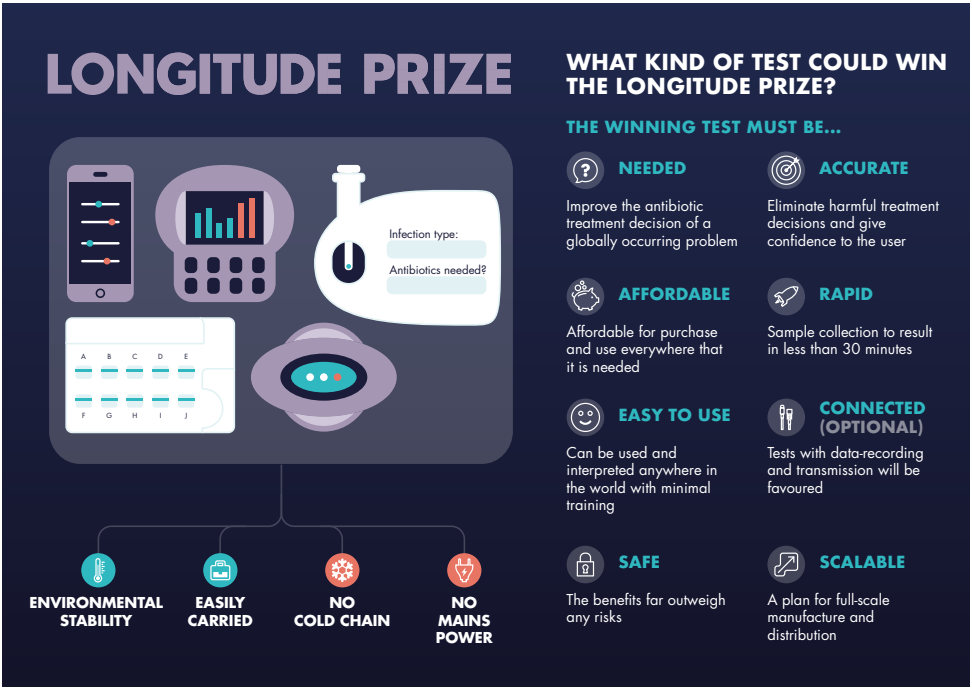
This technology can be incorporated into a lab-on-a-chip which is used as a portable diagnostic test (as shown in the image below).



Microfluidics can be used for antibiotic susceptibility testing. Each well is coated with a different antibiotic and bacterial growth in those wells can be measured. If the bacteria is resistant to the antibiotic coating the well, bacteria will continue to grow. In wells where no growth is recorded, the bacteria is identified to be susceptible to that antibiotic.

CONCLUSION

Longitude Prize competitors are working on a huge range of diagnostic devices using multiple different technologies and focusing on multiple settings and infection types. Our ultimate goal is to award the £8 million payout to a team who meets all of our criteria and who can significantly impact the use of antibiotics globally. We hope to empower all of our teams to continue in this field, helping to reduce antibiotic misuse and resistance.



The Longitude Prize is still accepting registrations and the Nesta team are currently fundraising to help support teams.

If you would like to contribute, work/partner with us or have an idea then please get in touch.

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LONGITUDE PRIZE

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