



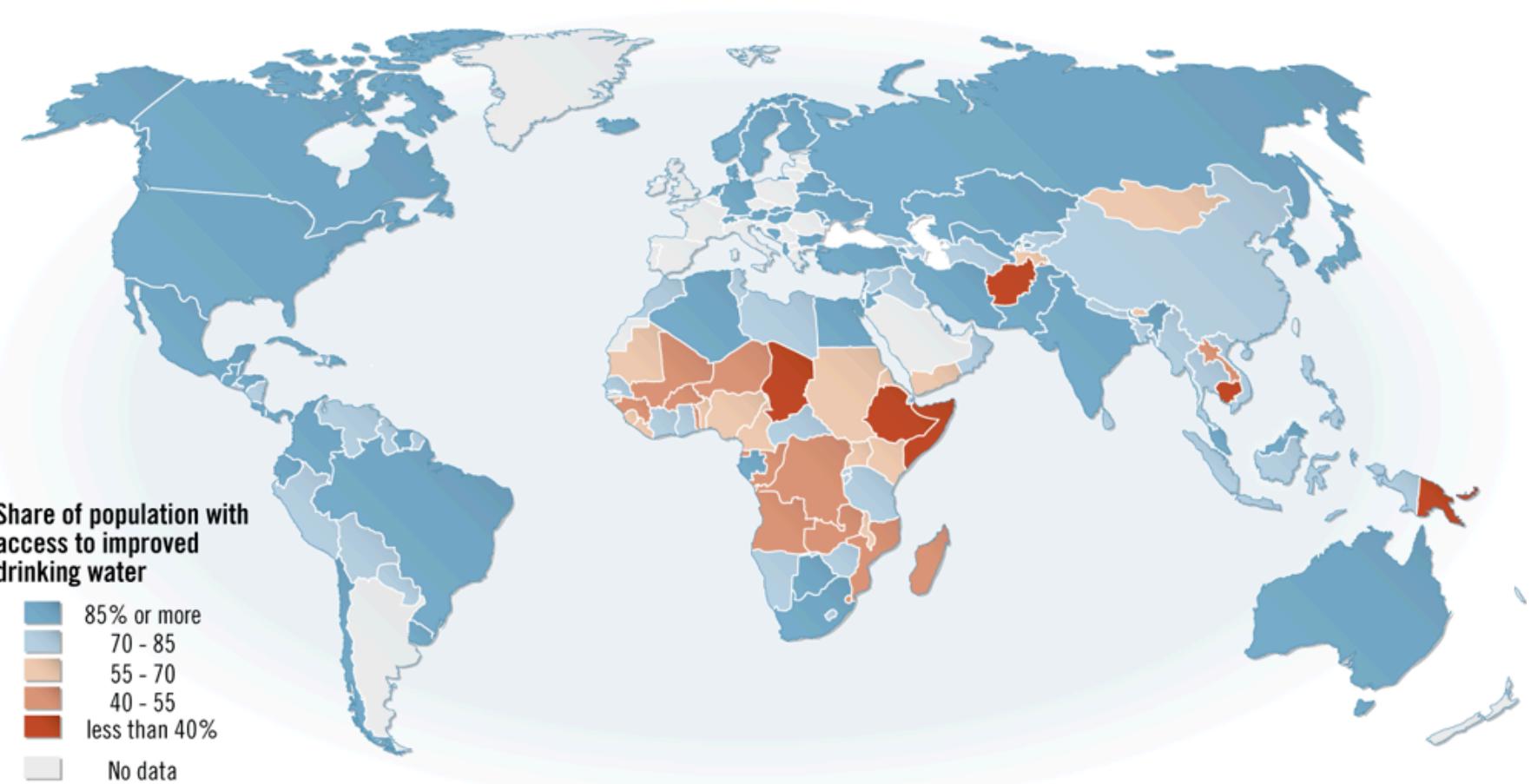
WaterScope

Empowering the bottom billion to
secure clean water

Developing an easy-to-use, low-cost device for detecting bacterial contamination in drinking water

Engineering Department, 5th March 2019

The Problem

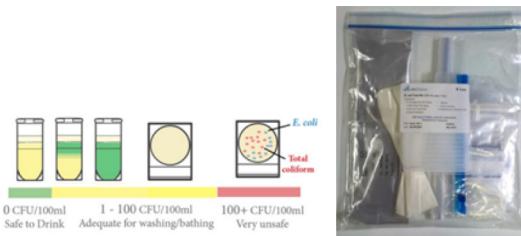


1 in 10 people have no access to clean water

Current testing systems



Aquagenx
Safe water for anyone, anywhere, anytime



Water Canary

>18 hrs incubation

Insufficient precision



- DelAgua** is considered the 'gold standard' method:
- ~£1600
 - 8kg
 - Needs training
 - Takes 18 hours to get results
 - Requires sterilization before each test
 - Not digital, manually record results on paper

Technology

1) Inexpensive microscope:

- Identify bacterial contamination
- Portable
- Affordable
- Automated
- Dissemination and mapping

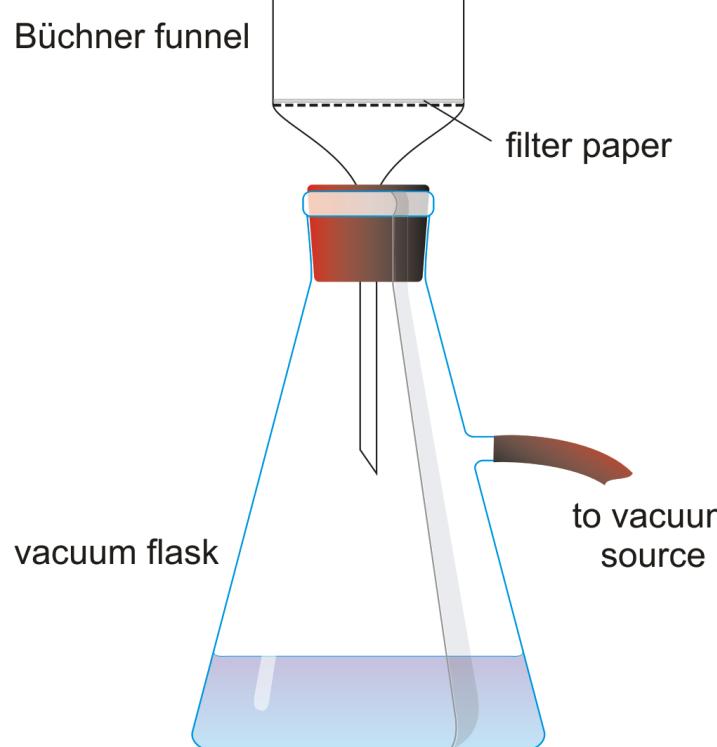


2) Novel disposable cartridge:

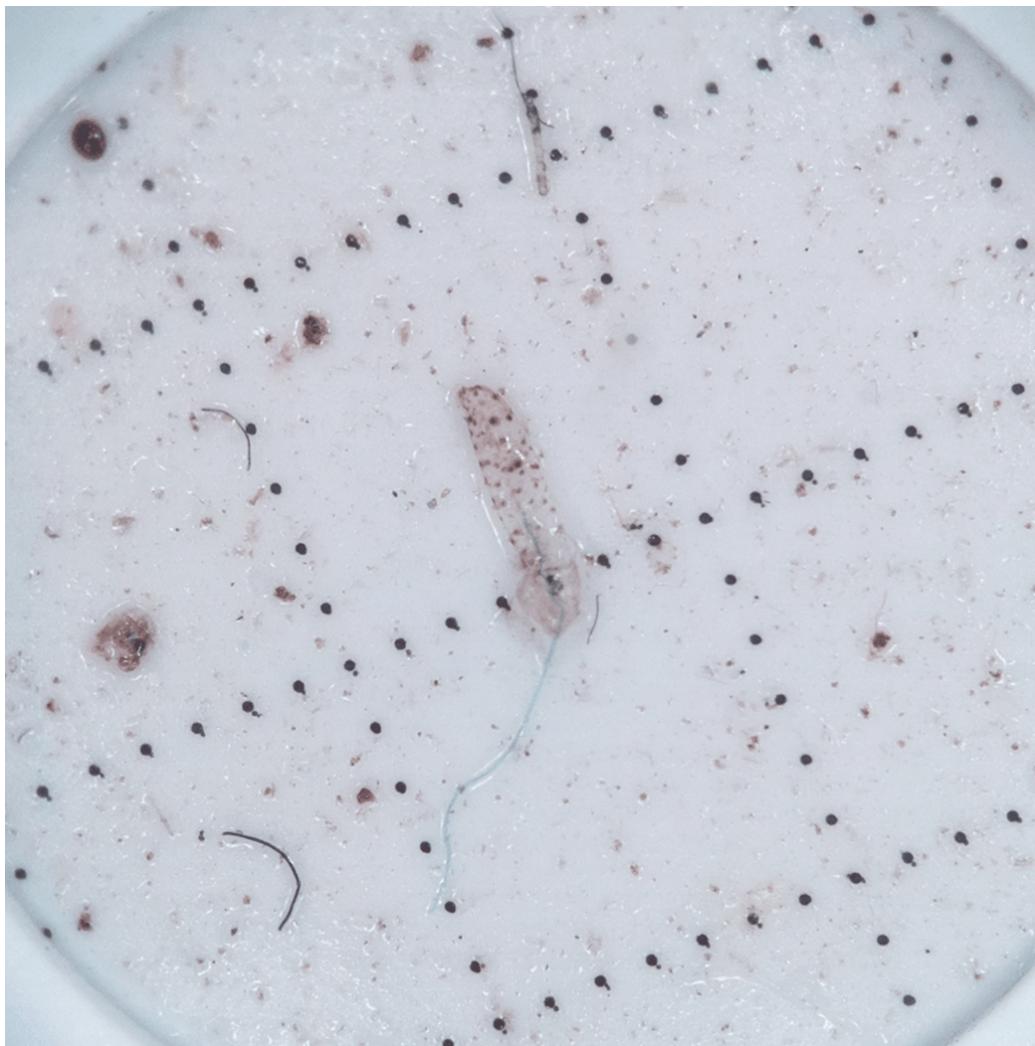
- Automates sample collection
- Sterile
- Simple to use
- Maintains integrity of a test
- Affordable <0.5 USD
- Allows testing of different disease bacteria



Technology overview



Timelapse capabilities



Challenge from WaterScope: a low cost, easy to use sterilization method



Possible sterilization methods

➤ **Heat treatment**

- Heat areas of cartridge and vessel where bacteria can reside

➤ **IPA spraying**

- Use 70/30 IPA/DI water mixture to spray areas of cartridge and vessel where bacteria can reside

➤ **Hydrophobic coating**

- Some papers suggest that superhydrophobic coating prevents bacteria from sticking to surfaces, a method of sterilization can be developed where cartridge/water collection vessel are washed with the water to be sampled

➤ **UV sterilization**

- Explore feasibility of UVC LED sterilization

Acknowledgements

Dr Mark Holmes
Prof Jeremy Baumberg
Dr Tom Wileman
All the Holmes lab

Wilson Chen
Yen Chun
Viola Introini
Sebastian Horstmann
Boyko Vodenicharski
Filip Ayazi

STIClab
Paul Nwauki
Valerian Sanga
Grace Angelwise

Darshana Joshi
Jay Patel

Funding
EPSRC GCRF
Humanitarian Innovation
Fund
CUE
Downing College
Newton Trust

Advisors
Lara Allen

Tech4Trade
Carl Heinz

IIT Roorkee
IIT Delhi
Miranda House
UPES



WaterScope team
Dr. Alex Patto
Tianheng Zhao
Dr. Nalin Patel
Alfred Wong
Dr. Richard Bowman



Oxfam
Dr. Gloria Kafuria
Dr. Josphat Singano
Geoffrey Bosco
Magdalen Nandawula
Serif (our driver)



Educational materials

What about life forms in freshwater THAT OUR EYES CAN'T SEE?

There are arthropods, worms and algae that our eyes can't see. Just like you would use a hand lens to zoom in small lettering that your eyes find hard to look at, we need a microscope with even more powerful lenses to look at life forms that our eyes can't capture at all. Even though invisible to our eyes, they are there!

Waterscope is a microscope that you can build yourself, and can be used by anyone, outside of a laboratory. Here is what it can show us if we look at pond water:



- Insects** — Many organisms belonging to the arthropod group such as insects are found in ponds. Some may be entirely aquatic or only live in water during certain stages of their lives.
- Tardigrades** — also called water bears, these tiny animals have 8 stubby legs and are slow moving. Do not confuse with millipedes!
- Rotifers** — these 0,1-0,5 mm long transparent organisms are a major food source in freshwater. They have hairy appendages for swimming, they cannot swim against the water current.
- Gastropods** — these 0,5-5 mm long and have a simple body structure with a head region and trunk.
- Hydra** — green, brown or colourless animals up to 0,2 cm long, formed by a body of many cells. Their tentacles flex and stretch, which allows them to move.

If we zoom in enough with **Waterscope** we can see that all these animals and plants are organised in very tiny structures that our eyes can't see called **cells**. They look like bricks of a wall and they are the basic building blocks of all animals and plants. Some organisms are made of many of these bricks — they are called **multicellular** — and others are made of just one of these bricks — they are called **unicellular**:

- Bacteria** — one of the most abundant of the microorganisms. Their single cells can be disk- or strand-shaped.
- Protozoa** — single cells with tiny hairs or tiny tails called pseudopodia, which they use for their movement.
- Algae** — although some algae can grow up to 50 meters in length, they can also be so small that our eyes can't see them — some are unicellular (such as diatoms) and others are multicellular (such as dinoflagellates).

challenge

Using the **Waterscope** we can see inside a pond's freshwater! Squeeze water from a pond's green scum into a jar and use the low and high magnification lenses on the **Waterscope** to look at it. What organisms can you find and which lifeform groups do they belong to? Finally, which of them are formed by many cells (**multicellular**) or just by one cell (**unicellular**)?

Water is everywhere and is needed for life - BUT WHAT LIFE FORMS ARE REALLY INSIDE FRESHWATER?



Hi, nice to meet you! I work in a different laboratory, studying plants. I have been passionate about plants since watching my family growing them from small seeds in our garden. Do you know that both animals and plants can be found in a pond's freshwater?



- Arthropoda** — this is a very diverse group of small animals with jointed limbs and a tough outer skeleton. Some examples are spiders, water fleas and other insects, water mites, freshwater shrimps and crayfish.
- Worms** — can be flattened and glide, round and move laterally in "S" shapes or even segmented.
- Algae** — very diverse group of organisms that vary in size and shape (they can be string-shaped and show tails called flagella) and colour (they are usually green, red or brown).