



Bio Nano Consulting

Nanotech Knowledge Solutions™

Crowd-Dx™: Using crowd-sourced data analytics to elucidate trends in healthcare, wellness and disease

Dr David Sarphie, CEO

*BNC Presentation to:
ATTRACT Consortium
Tripolis, Greece, May 2017*



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Good morning

Καλημέρα

Μετά από μένα, τελειώσαμε

Bio Nano Consulting



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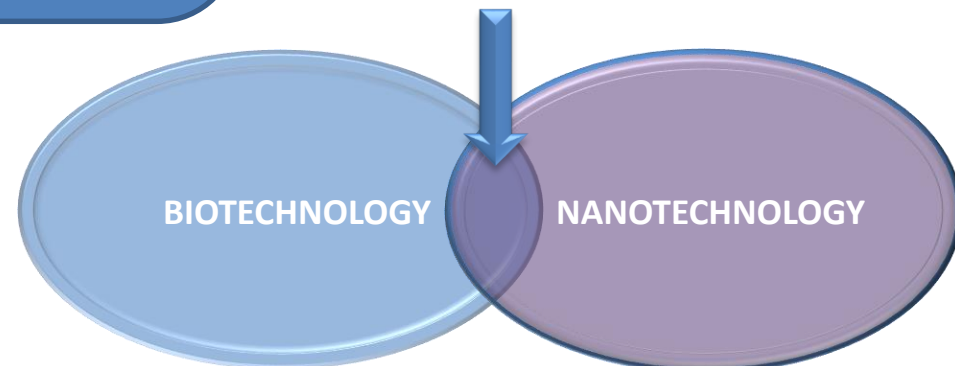
- Independent globally-active technology solutions provider
- Delivering cutting edge technology solutions to clients in a range of industrial sectors
- Strategic research links with Imperial College & UCL

Nanotech Knowledge Solutions™: working for international clients from industry, government and academia

R&D consortia experience:



- Programme management & coordination
- Focus: interface of biotech & nanotechnology



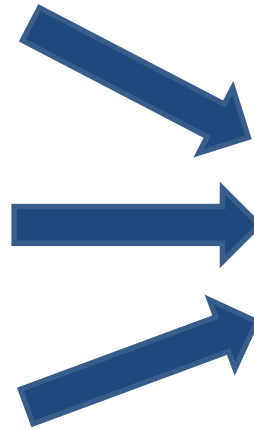
International clients



A (not-so) Quiet Revolution: *Health Monitoring + Crowdsourced Data*



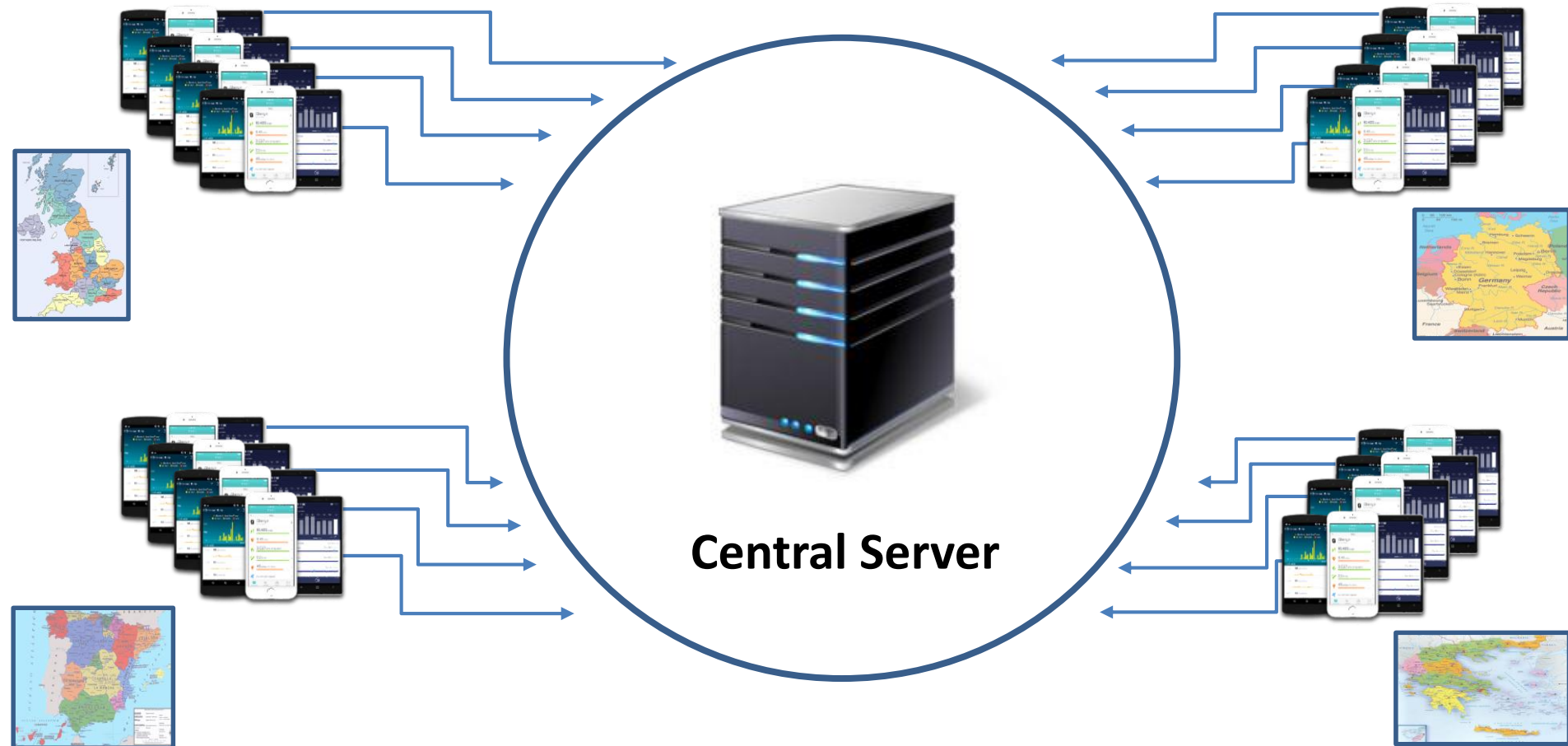
Wearable fitness monitors



Smartphone app

Networked apps connected to server

Provides fitness data from across Europe (& world!)



Fitness data: aggregation & analysis



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Can answer such questions as:

- Who are more active, Germans or Greeks?
- Who sleep longer and better, Parisians or Londoners?
- Who take more steps per day, New Yorkers or Los Angelinos?



**But what if you could answer more critical health questions?
Answers that might save lives...**



LCC™ Test: Rapid POC test for immunocompetence

Our Solution: Leukocyte Coping Capacity™ - the first and only rapid point-of-care test for leukocyte function

Rapid

Objective

Digital Output

1st Generation prototype:

- Rapid test for neutrophil function
- Being marketed in sports, veterinary and academic research sectors
- Provides a direct, objective measure of “coping capacity” which is a correlate of the stress response
- Being developed by partner company: **Oxford MediStress**

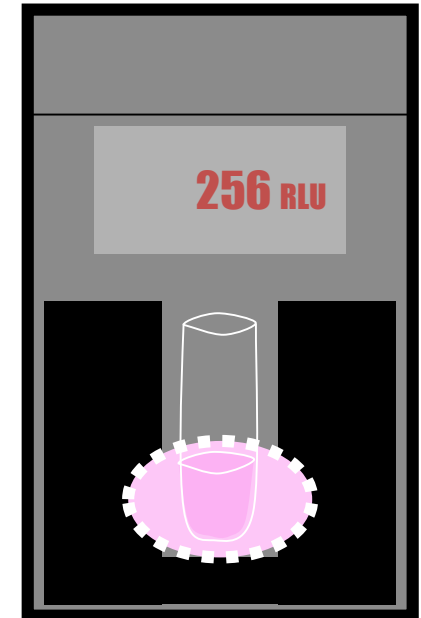
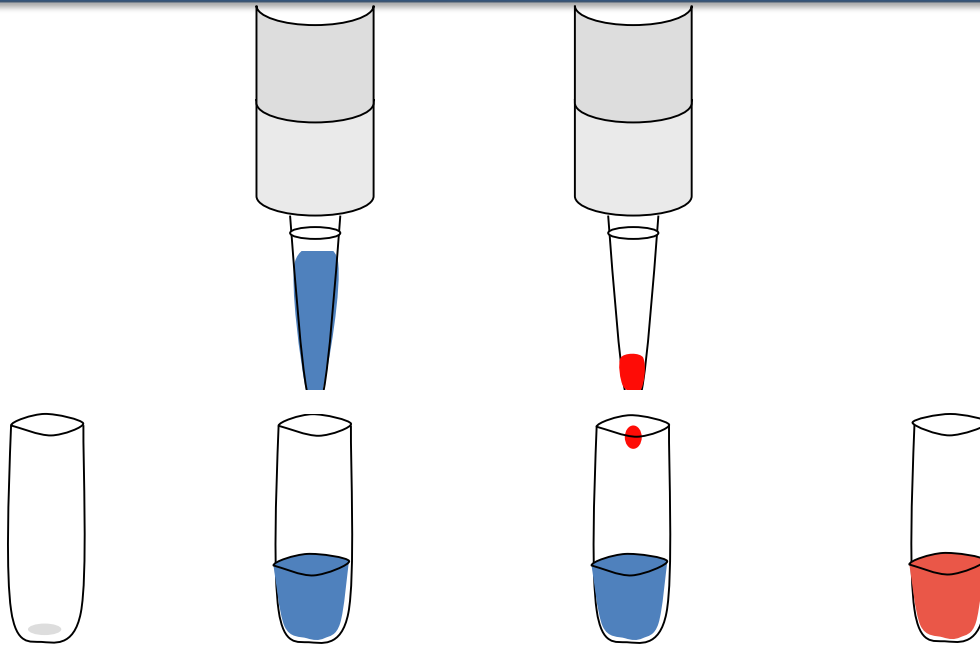


12 inches

Why are neutrophils important?

- Key part of the immune system that attacks bacterial locally during infection
- Implicated in many diseases, including most cancers
- Can also be used to measure “wellness” or “stress”

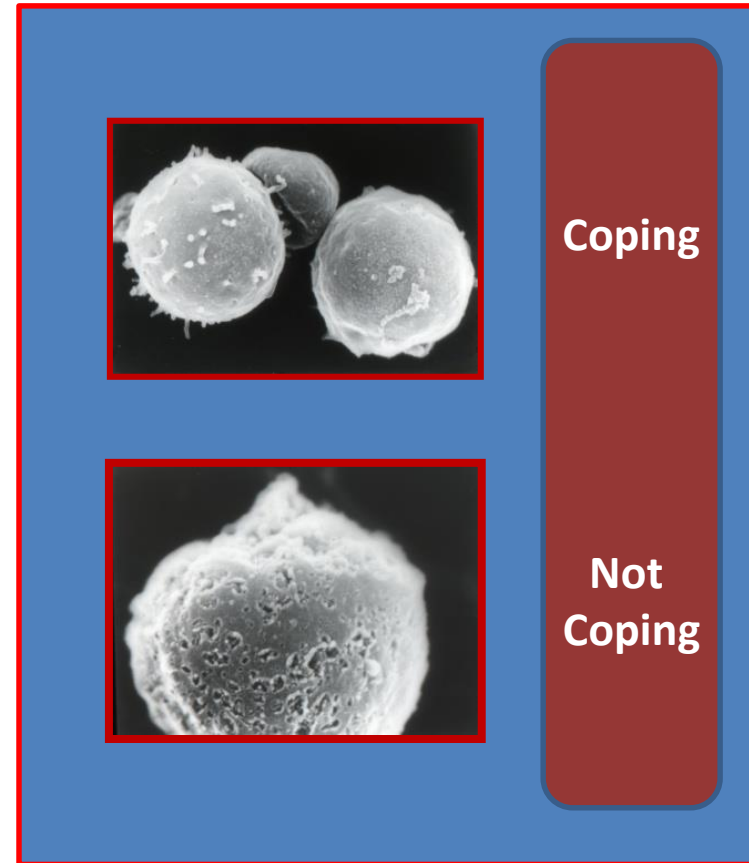
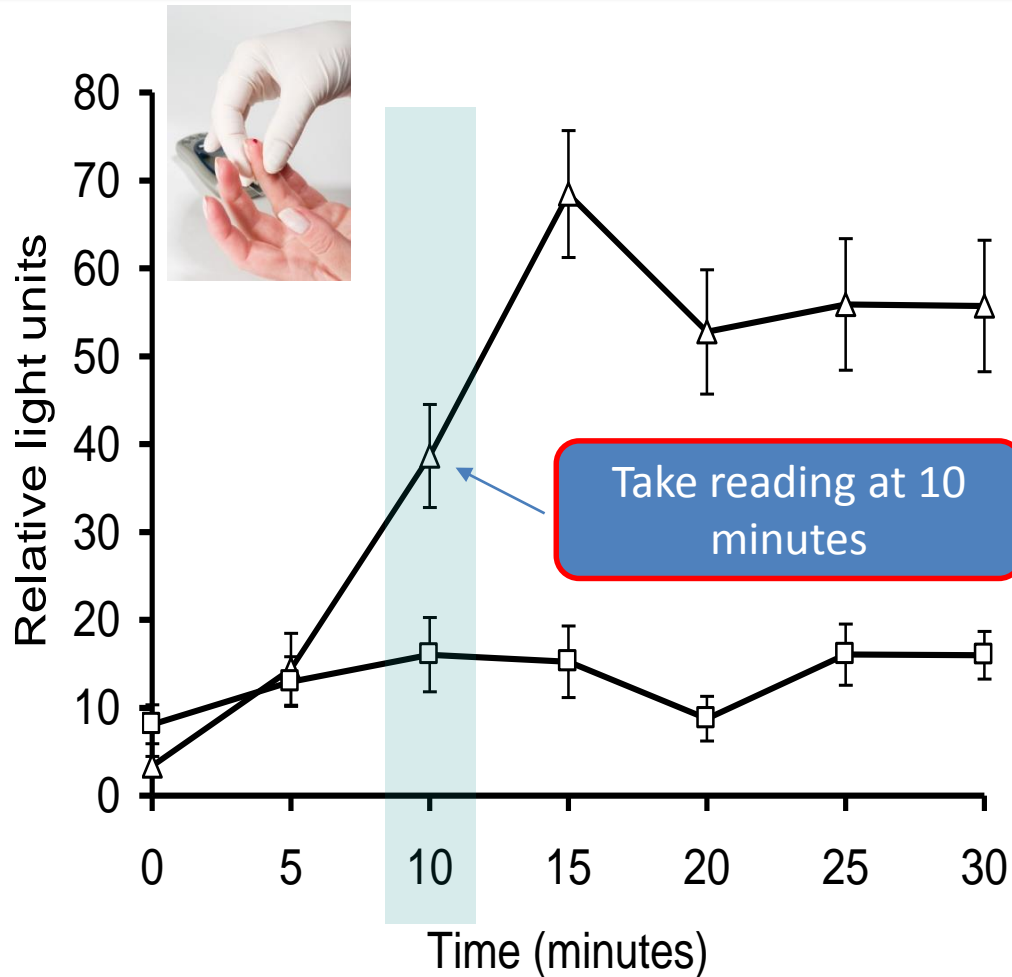
LCC™ Test: How does it work?



Freeze dried reagent	Add 100µl resuspension solution	Add 10µl whole blood	Mix & incubate at 37°C for 10 mins	Place tube in reader (luminometer)
Stable for months when stored in freezer	Freeze dried reagent immediately dissolves	Reagents stimulate leukocytes to release reactive oxygen species	Second reagent reacts with oxygen species to emit light	Light output measured and recorded

Leukocytes act as direct bio-indicators of immune function

Coping or Not Coping?

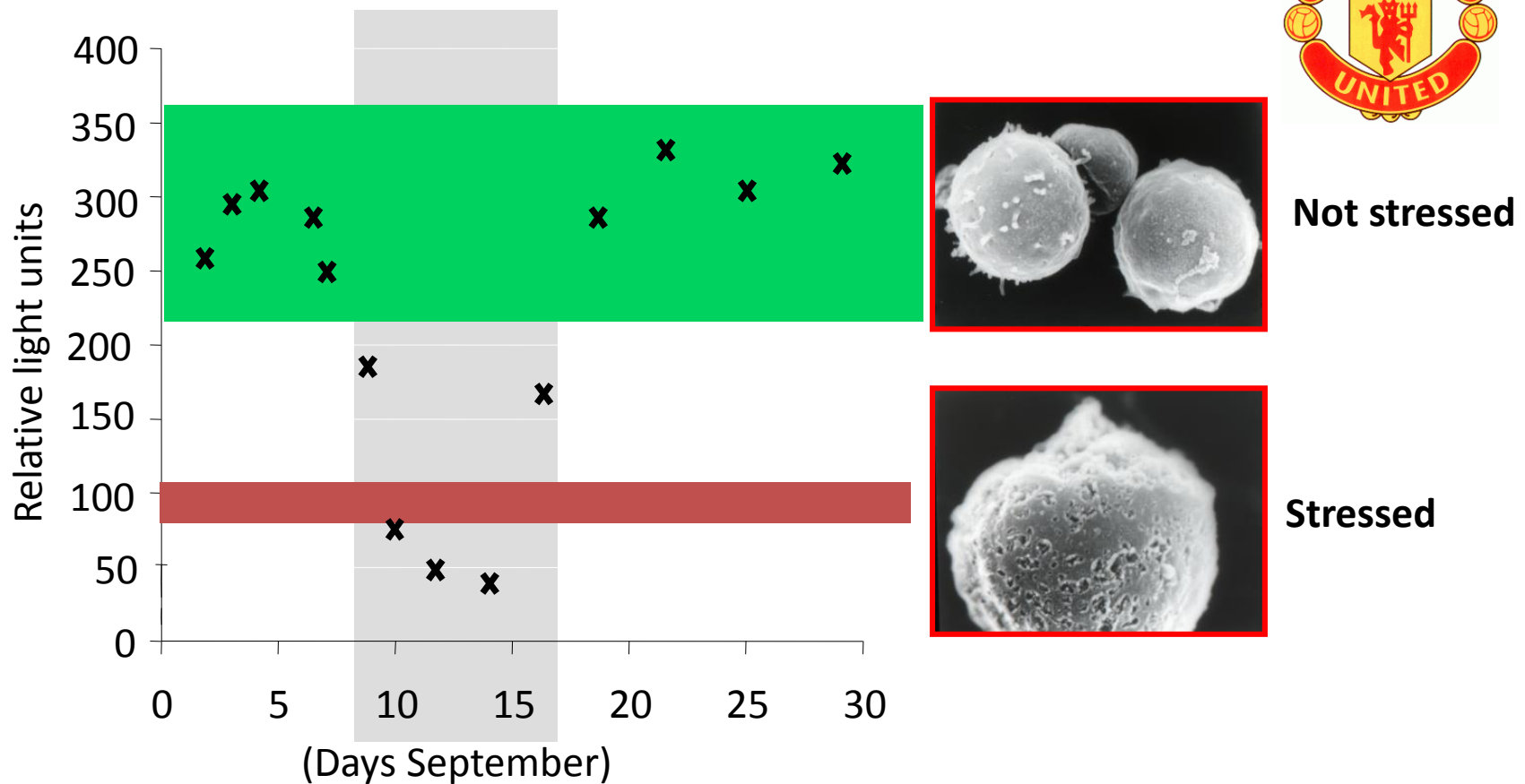


Leukocytes also act as correlate of stress

Used by English Premiership & F1 teams

Calculate green area for each player (formula)

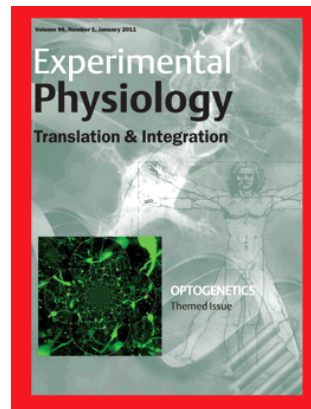
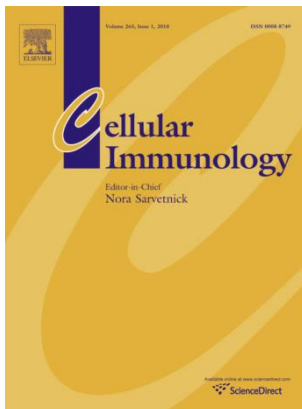
At a glance when results lie outside area – homeostasis disrupted



Validation

Published peer-reviewed articles:

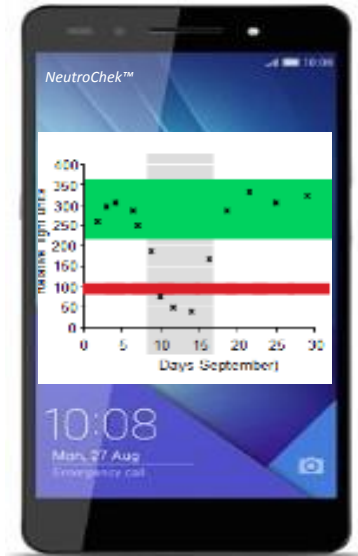
- *Cellular Immunology* 263 (1) 22-30 (2010)
- *Int J Occup Safety & Ergonomics* Vol 17 No 1 (2011)
- *International Journal of Computer Interactions* (2011)
- *International Journal of Industrial Ergonomics* (2011)



Project objectives

Develop connectivity, analytics

- Develop connectivity
- Develop data analytics
- Develop algorithms



**Communication link:
Meter-to-smartphone**

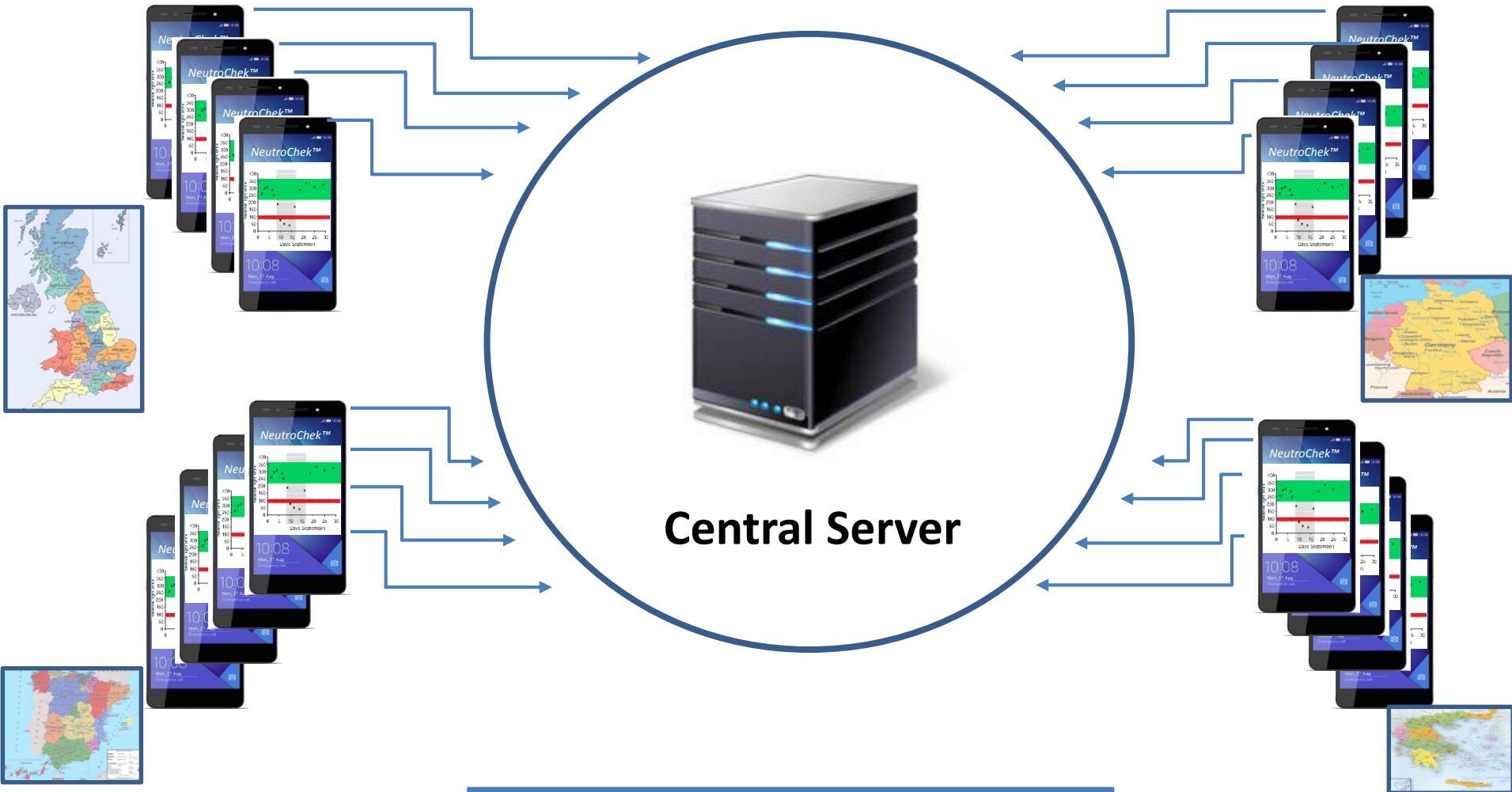
Smartphone app

Networked apps connected to server

Provides health-related data from across Europe



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Data analytics

- Will require “Big Data” handling & Structured Data Analytics
 - *Data analysis tools*
 - *Software-based algorithms*
- Will be used to analyse “wellness” trends over time and region-to-region
- Will benefit both patients and healthcare providers

Healthcare benefits

Provides benefit to individual & healthcare provider

- **Individual**
 - *Monitor health through frequent measurement of immune system*
 - *Early detection of disease*
- **Healthcare provider**
 - *Detection of major disease outbreaks and spread*
 - *Evaluation of wellness differences between overall wellness across populations and over time*

End of Part One



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Thank you

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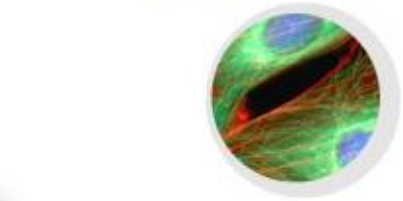
AquAffirm-GPS™: Developing a network of smart sensors & data analytic strategies to address a global environmental issue: excessive arsenic in drinking water

Dr David Sarphie, CEO

*BNC Presentation to:
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Tripolis, Greece, May 2017*



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AquAffirm

Assuring a safer future



Dr David Sarphie
AquAffirm.com



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AquAffirm™: point-of-use test to measure arsenic in drinking water

- Worldwide, 780 million people do not have access to clean water *(source: WHO)*
- **One in five deaths** in Bangladesh linked to drinking water contaminated with arsenic
- Arsenic, fluoride, cadmium, lead, mercury & manganese are key inorganic toxins affecting drinking water worldwide



Arsenic: a global problem

- Affects up to 140 million people in over 70 countries
- Up to 70 million in Bangladesh drink contaminated water at unsafe levels
- The **WHO** has called the situation in Bangladesh: "*The largest mass poisoning of a population in history*".



Chronic exposure causes skin lesions, cancers, fertility problems and affects childhood neurological development

Key Problem: Lack of simple, rapid, affordable point-of-use test giving quantitative results

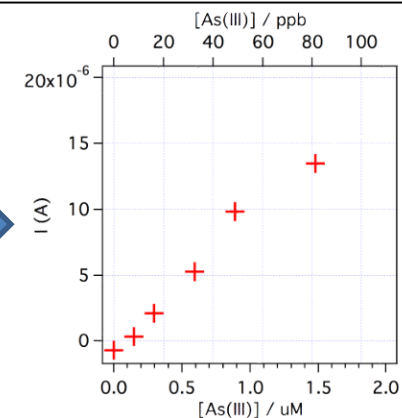
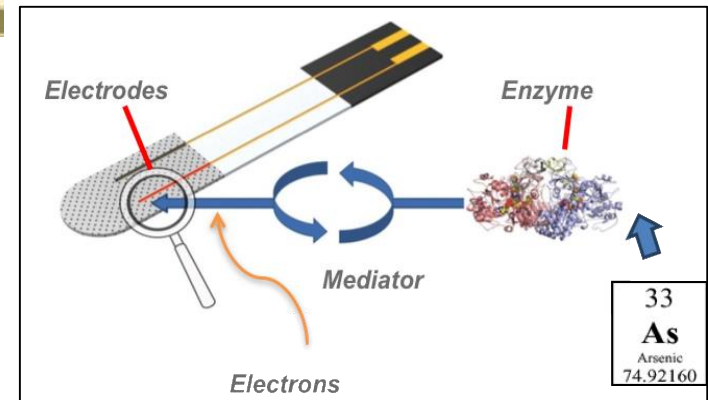
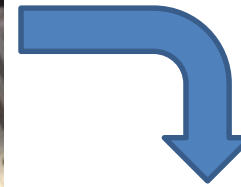
Introducing AquAffirm-As™

- Strip-based test for arsenic
- Easy-to-use
- Rapid
- Affordable
- Quantitative results
- No toxic by-products or waste
- GPS-enabled to facilitate mapping and improve management of arsenic problem

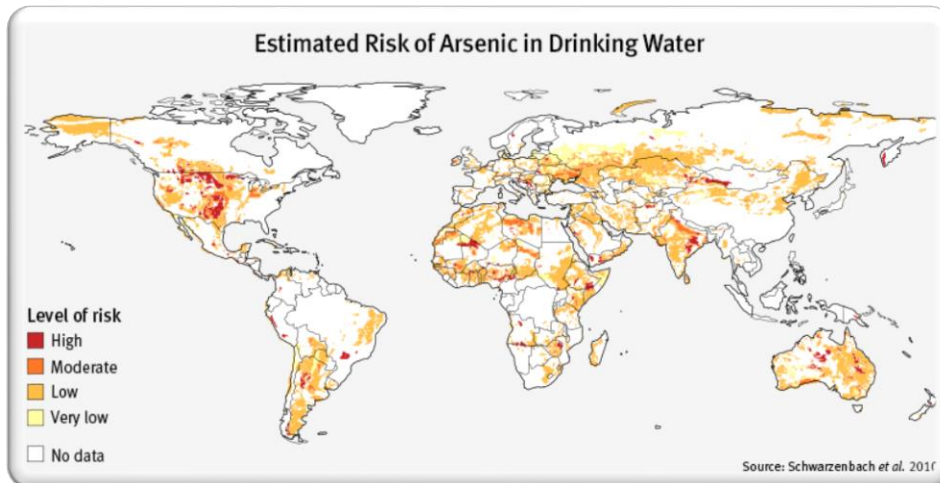


Technology: electrochemistry test

- Test-strip based technology
- Scalable manufacturing process
- Technology & manufacturing process currently being developed with support from 3 grants worth > £750k
- Manufacturing now at low volumes for field trials scheduled for 2017 in India & Bangladesh



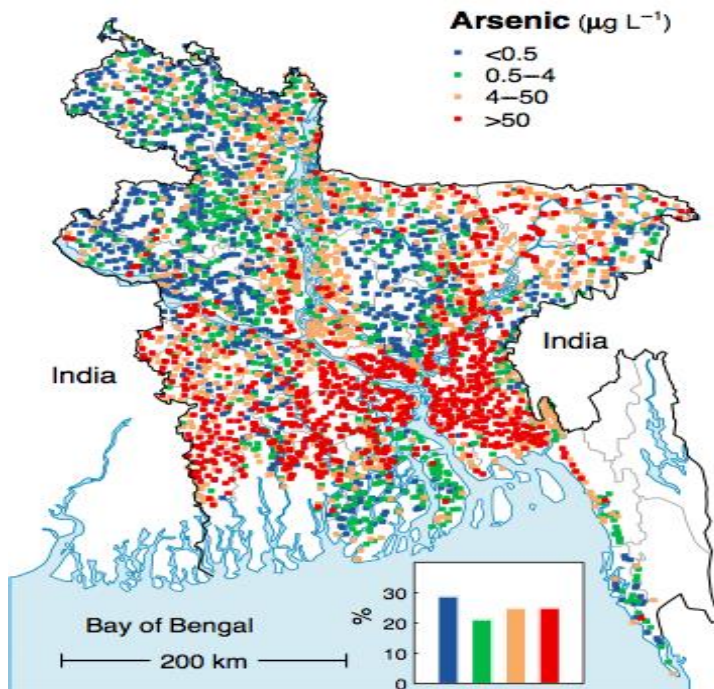
Value Proposition



- **AquAffirm-As™** is **first** and **only** quantitative point-of-use test for arsenic in Low-cost, rapid, easy-to-use format
- Will result in significant increase in monitoring of arsenic from wells worldwide
- Use in advanced countries will focus on unregulated private wells (15m in USA) and during fracking operations

Competing point-of-use tests are complicated, slow (30 mins), only semi-quantitative (colour-based) and result in toxic waste products.

Bangladesh: area of greatest need



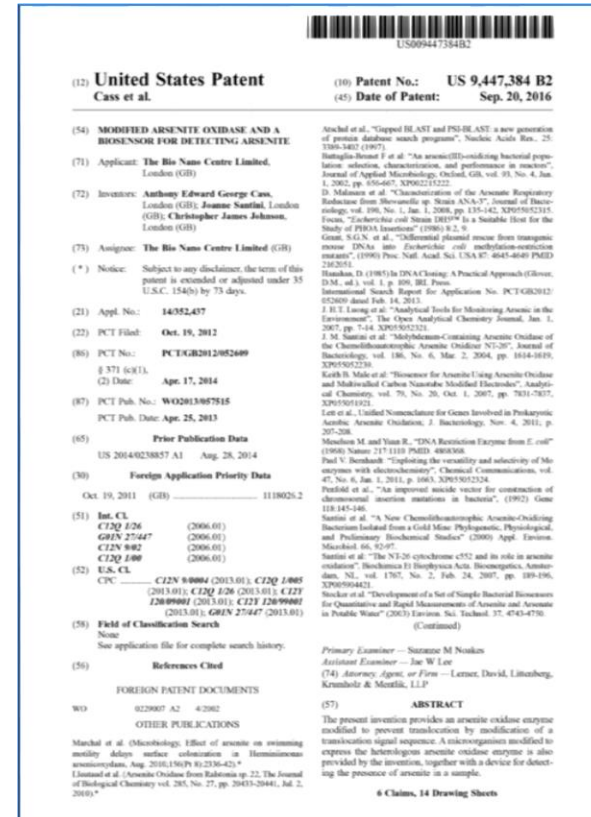
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/DFID (2000)

Scale of arsenic problem in Bangladesh

- **AquAffirm delivers improved functionality**
 - The AquAffirm device is easy to use, delivers an accurate measure of arsenic concentration using an affordable test strip and this is done rapidly and without toxic by-products
 - It can potentially be linked to a GPS-enabled device to assist in mapping arsenic contamination
 - In each respect, AquAffirm is significantly better than competing field tests
- In Bangladesh, AquAffirm aims to deliver this step-change in functionality at a price-per-test comparable to the cheapest kits on the market
- In USA & other advanced countries, price will scale according to competition and perceived benefits.

Intellectual Property: Patents

- Patent *granted* in USA for biosensor device which uses a modified enzyme (**US 9,447,384 B2**)
- Second patent pending in USA for the modified enzyme itself
- Patents also pending in Europe, Australia, and China



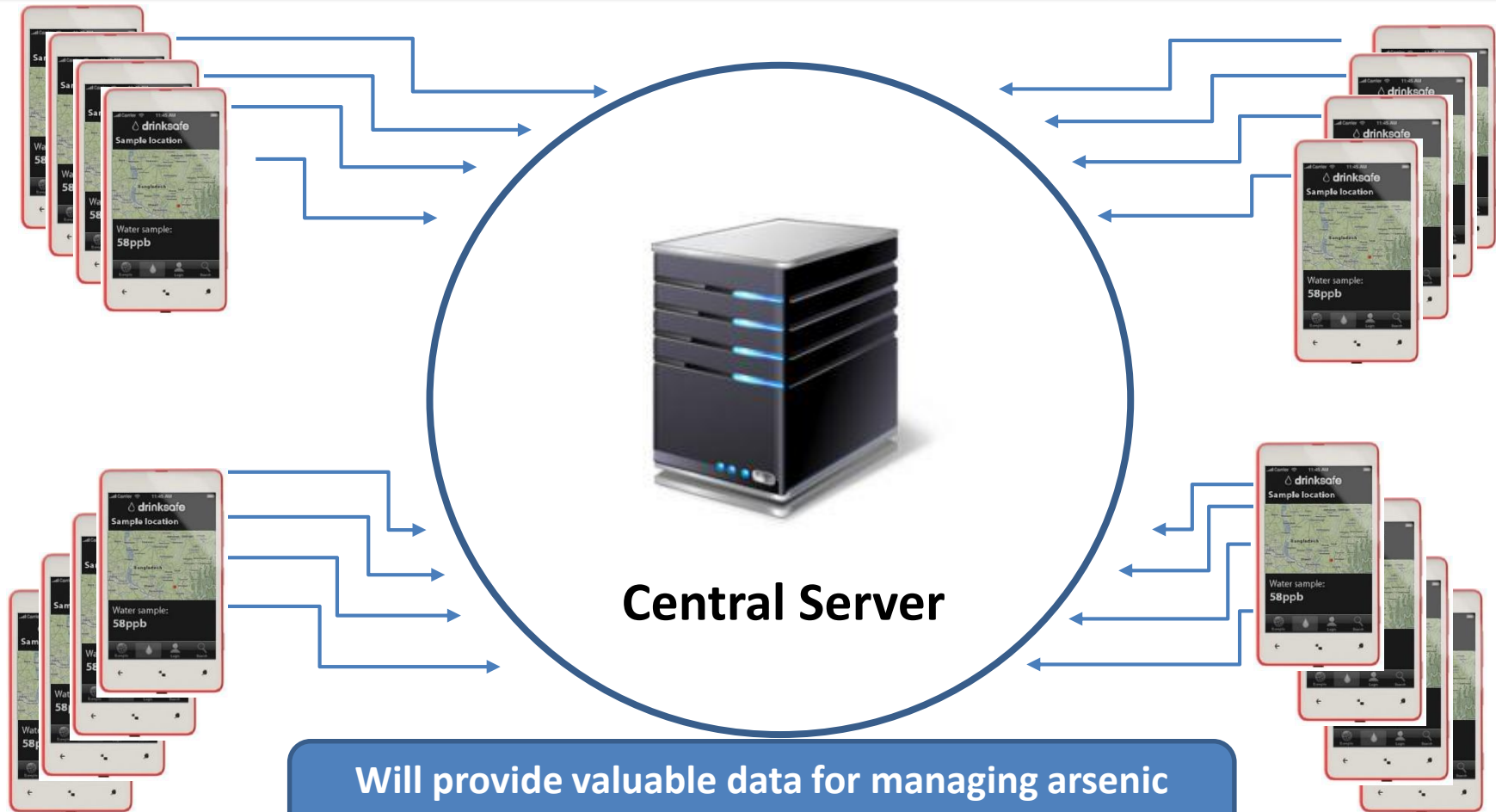
Developing GPS connectivity

- As part of a Newton Fund-supported project we are developing a mobile app
- This will use the GPS chip so that location and As-data are co-located in database



Networked apps connected to server

Provides water quality data across region



Will provide valuable data for managing arsenic problem: UNICEF has confirmed

Project needs

- Looking to partner with:
 - *Improved photon counters/detectors that are approx. as sensitive as photo multiplier tubes but cheaper (e.g. Si-photomultipliers)*
 - *Organisations developing **structured data analytical strategies** for use with Big Data*

Thank you



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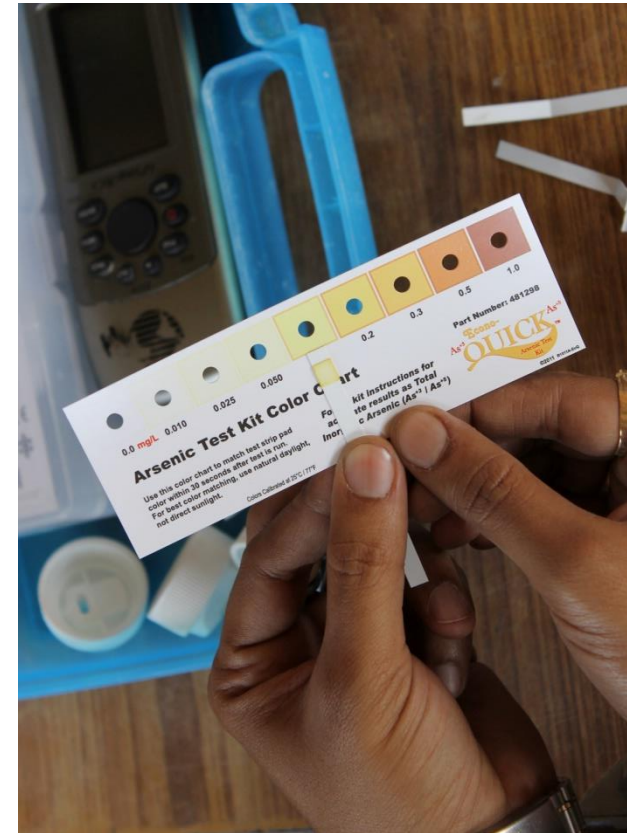
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Currently-used field test



- ✓ Low cost
- ✗ Difficult to use
- ✗ Slow 15 minutes

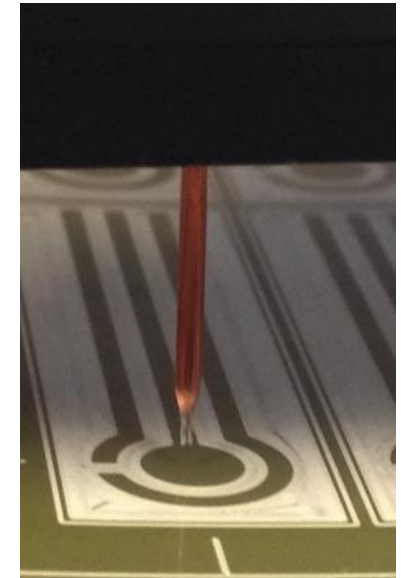
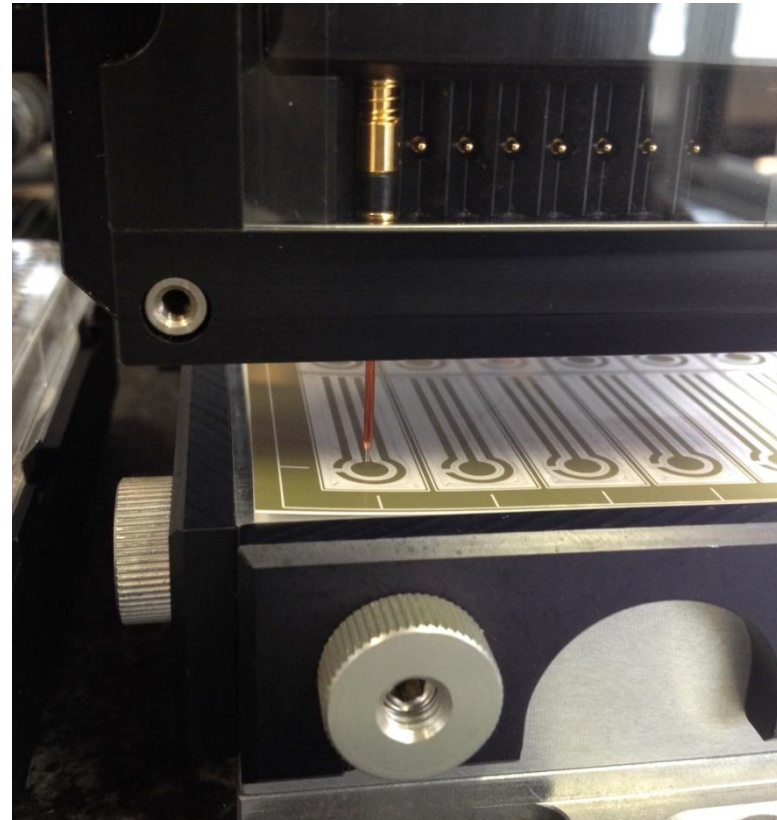
- ✗ Semi-Quantitative
- ✗ Toxic
- ✗ Manual data recording

drinksafe™ arsenic field test

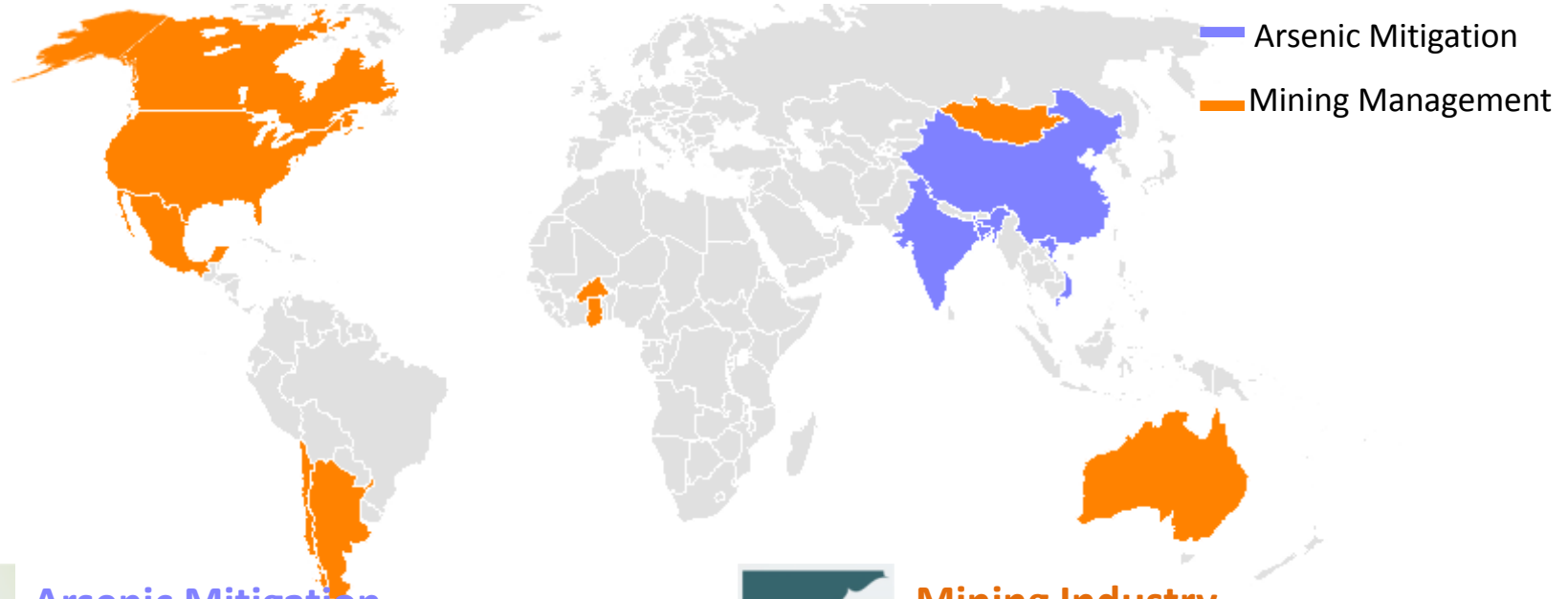


- ✓ Easy-to-use
- ✓ Fast <3 minutes
- ✓ Low cost
- ✓ Quantitative
- ✓ Non-toxic
- ✓ Automatic recording of test results with GPS of well position

BNC: Developing strip prototyping facilities



Manufacturing test strips in bulk



Arsenic Mitigation

Initial Market

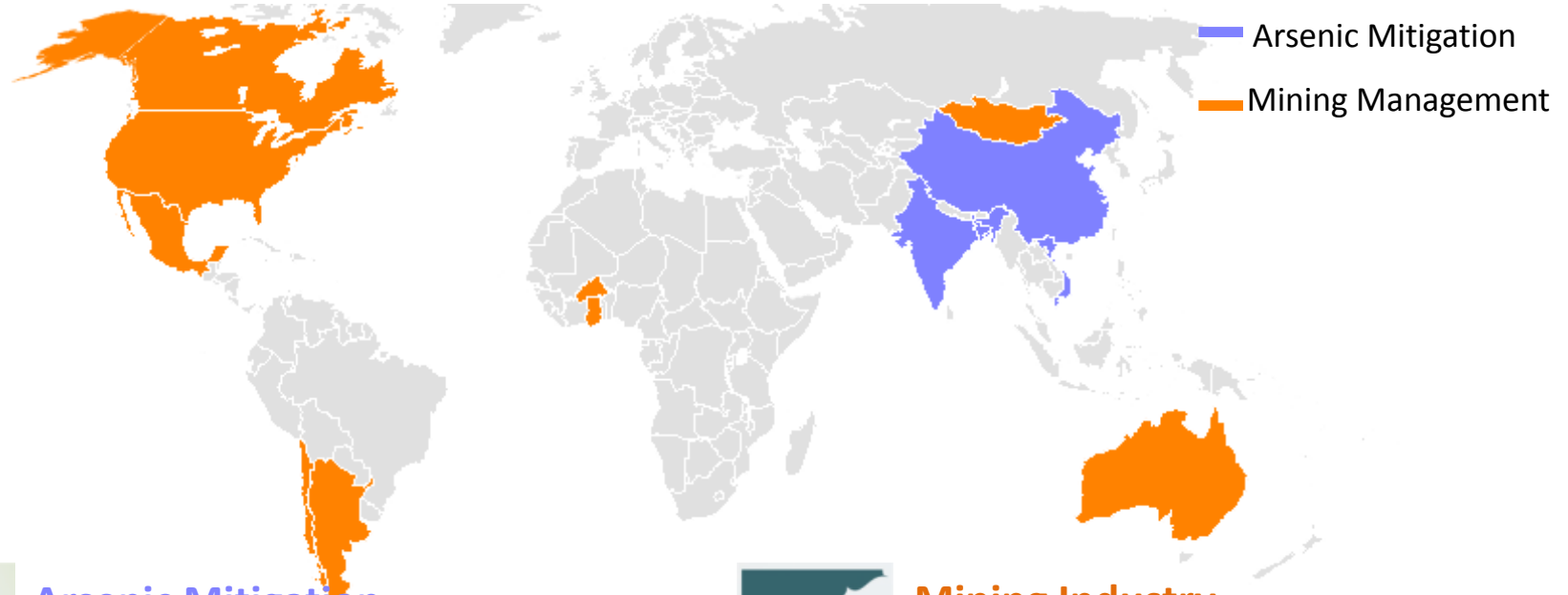
- High volume, low margin
- 4M tests/yr
- Growth potential up to 25 M tests/yr
- \$1/test

Mining Industry

Second Market

- Low volume, high margin
- 500k tests/year
- Growth due to Fracking
- \$6 - \$10/test





Arsenic Mitigation

Dr Rick Johnston, WHO

“the DrinkSafe improvements are exciting, quicker and simpler, no mercury waste and a digital reader that is less influenced by personal judgments”

Mining Industry

Robert Bowell (SRK Consulting)

“DrinkSafe will have great utility in the characterization of waste, pit lake evaluations and meeting environmental regulation”

