How would you build an automated lab for analysing pathogens?

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A consensus statement on dual purpose pathogen surveillance systems: The always on approach

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- Lots of investment in surveillance systems for COVID-19
- But interest in pandemic preparedness is waning
- And still lots of inequity (gaps)
- Opportunity to repurpose systems for other infectious diseases and challenges
    - E.g., AMR, endemic diseases
- But resources are limited
- Take a multi-pathogen approach, keep the system "always on"
- Use for routine clinical care as much as possible

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Which pathogens?

- Bacterial
- Viral
- Parasitic
- ...and vectors

- Airborne
- Respiratory
- Vector-borne
- Food & water-borne
- Sexually-transmitted
- Zoonotic
- Healthcare-associated
- ...

- By syndrome (febrile, respiratory, ...)
- Endemic / epidemic / pandemic potential
- Newly emerging / re-emerging / emerging resistance
- Burden in low vs high income countries
- Tropical / temperate
- Urban / rural
- Impacted by environmental change
- ...

Ideally multiple pathogens...

...but need to start somewhere.

E.g., EIT Pathogena initial focus on TB.

I'll focus on **malaria in Africa** for this presentation.

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Malaria - a note on clinical care versus public health (prevention)

Effective diagnostics for clinical decision making are important - rapid diagnostic tests (RDT) to confirm or rule out malaria as a cause of febrile illness.

But main value of pathogen (and vector) data is to support public health interventions aimed at prevention:

- Vector control (primarily insecticide-treated bednets)
- Vaccines
- Preventive antimalarial treatments (SMC, IPTP)

=> think differently about value of data and how it used at point of care versus for public health

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What kind of lab?

- Hospital labs
  - District / regional / community
- RDTs and other diagnostics used by community health workers and public health household surveys
- Public health research labs
- National reference labs

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- **Dry lab** (i.e., data, compute, pipelines, analytics, reporting, ...)

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Lab => end-to-end surveillance system

How would you build an automated lab for analysing pathogens?

What kind of automation?

Across an end-to-end surveillance system:

- Think "automation" broadly as any way to streamline processes and use technology to reduce time, increase efficiency, reduce cost, reduce error, ...
- Many opportunities to improve current systems for malaria molecular surveillance, both within and between different parts of the system
- Sample collection, metadata capture, sample transfer, data transfer, lab procurement and supply chains, sample preparation (DNA extraction), library prep, sequencing, variant calling, analytics, reporting, ...

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Need integrated solutions!

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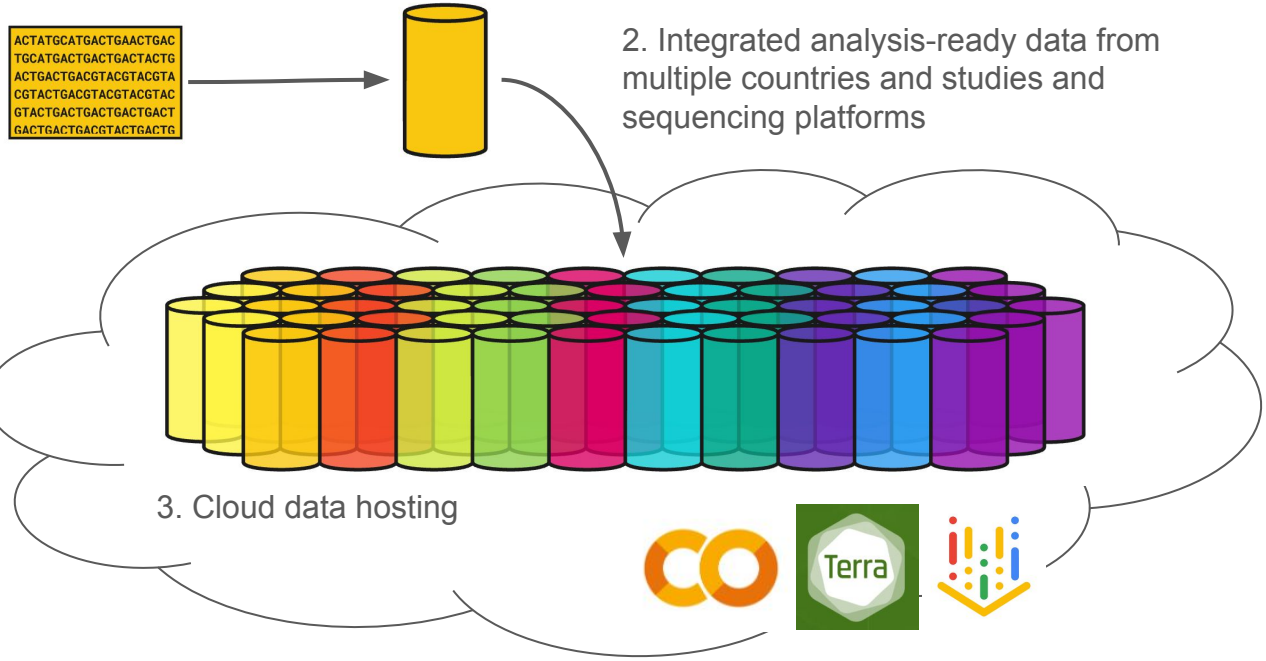
Malaria Vector Genome Observatory

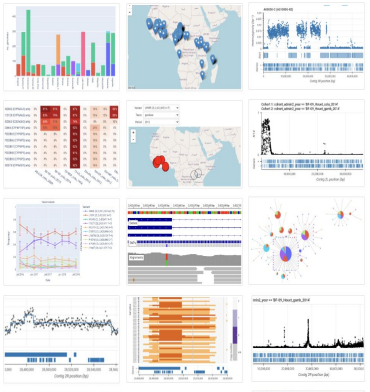
1. Standardised data processing



7. Support, collaboration and networking

6. Training

5. Analytical software



8. Automated surveillance analysis and report generation

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What kind of analysis?

- Sequencing
  - WGS / ampseq / metagenomics
  - Target enrichment / host depletion
  - Long read / short read / epigenome / ...
- Phenotypic assays
  - Drug / insecticide susceptibility
  - Infectivity / vectorial capacity
  - ...

- Sequence data processing
  - Assembly
  - Variant calling
  - Quality control

- Analytics, inference and decision support

- Clinical
  - Pathogen species ID
  - Resistance phenotype prediction
- Public health
  - Drug resistance
  - Diagnostic resistance
  - Vaccine escape
  - Insecticide resistance
  - Evolutionary threats (new forms of resistance)
  - Transmission & targeting
  - Outbreak prediction
  - ...

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How would you catalyse change toward sustainable, equitable, multi-purpose pathogen and vector surveillance systems to improve treatment and prevention of infectious diseases?

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- Identify a set of priority pathogens (verticals) and use cases
  - E.g., malaria - diagnostic resistance; drug resistance; insecticide resistance; ...
- Research to understand the existing systems for diagnostics and surveillance
  - Identify weaknesses (gaps, pain points) and opportunities (technology solutions available or feasible)
- Develop products and/or services targeting specific parts/slices of the system
  - Prioritise quick wins - low cost/risk/uncertainty, high benefit/utility/impact
  - E.g., EIT Pathogena for TB
- ...

How would you catalyse change toward sustainable, equitable, multi-purpose pathogen and vector surveillance systems to improve treatment and prevention of infectious diseases?

- Gain first-hand experience of surveillance system R&D/implementation/change projects
  - E.g., African Vector Genomics Hub project in Cameroon
  - E.g., Integrated Malaria Parasite and Vector Genomic Surveillance project in Ghana
  - E.g., East African Vector Genomic Surveillance project in Uganda and Kenya
- Feed experience back to improve products and services and identify new opportunities
- Work towards preferred end-to-end solutions

How would you catalyse change toward sustainable, equitable, multi-purpose pathogen and vector surveillance systems to improve treatment and prevention of infectious diseases?

How to catalyse transition to multi-pathogen systems?

- Look for opportunities to re-use tech/solutions across pathogens
  - E.g., re-use EIT Pathogena to develop a service for processing *Plasmodium* ampseq data on drug resistance or *Anopheles* ampseq data on insecticide resistance
- Look for opportunities to re-use samples collected for different purposes to generate new data streams
  - E.g., malaria RDTs could provide data on other pathogens
  - E.g., mosquitoes collected for ento surveillance could provide data on a range of pathogens
- Support transition of multiple pathogen and/or vector sequencing protocols into national reference labs

=> Examples where clear efficiency or utility from joining up or re-using parts of systems.