

THE LANCET Microbe

Supplementary appendix

This appendix formed part of the original submission and has been peer reviewed. We post it as supplied by the authors.

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Appendix to harnessing genomics for the surveillance of antimicrobial resistance

Supplement 1 Individuals in the SEDRIC Genomics Surveillance Working Group

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	Dr Janet T Midega	Wellcome Trust
	Mr Jamie G Nunn	Wellcome Trust
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	Dr Josefina Campos	ANLIS Malbran
	Professor Alessandra Carattoli	University of Rome La Sapienza
	Dr Beverly Egyir	Noguchi Memorial Institute for Medical Research, University of Ghana
	Professor Sabiha Y Essack	University of KwaZulu-Natal
	Dr Alison L Halpin	US Centers for Disease Control And Prevention
	Professor Rene S Hendriksen	Technical University of Denmark
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	Dr Katie L Hopkins	UK Health Security Agency
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	Professor Rifat Atun	Harvard University
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Professor Deborah A Williamson	University of Melbourne
Professor Dorothy Yeboah-Manu	Noguchi Memorial Institute for Medical Research, University of Ghana
Professor Ruth N Zadoks	University of Sydney

Supplement 2 Template agenda and break out room prompts for workshops 1 – 3

The workshops of approximately 30 participants each followed a similar agenda over a 25 hour timeframe with two breakout rooms sessions interspersed with unifying discussion Each room had a rapporteur and facilitator

After a short introduction and ice breaker presentations participants were split into four breakout rooms to conduct a landscape analysis

Breakout session one: room prompts

Workshop	Room 1	Room 2	Room 3	Room 4
1	<i>In what ways can genomics improve the provision of actionable information to hospital-based surveillance and infection prevention and control (IPC) teams that is likely to improve the quality and/or safety of patient care?</i>	<i>Despite the available use cases of genomics-based hospital AMR surveillance and IPC, implementation is not ubiquitous What are the disadvantages of, and/or barriers to, implementing genomics in a clinical hospital environment?</i>	<i>What factors outside of the direct space of AMR genomic surveillance in hospitals might provide timely facilitation for broader implementation? (eg movement at other scales of AMR surveillance? Work on other pathogens? Technological or infrastructural advancements? Funding or health policy priorities?)</i>	<i>What factors outside of the direct space of AMR genomics for hospital surveillance act as barriers to implementation? (eg missing technology or infrastructure? funding or health policy priorities? Sociopolitical factors?)</i>
2	<i>In what ways can genomics at a public health level improve the provision of actionable AMR surveillance data compared with traditional methods?</i>	<i>Despite the advantages of genomics-based public health AMR surveillance, implementation is not ubiquitous What are the disadvantages of, and/or barriers to, implementing genomics for public health AMR surveillance within, and across, individual surveillance networks?</i>	<i>What factors outside of the direct space of genomics for public health AMR surveillance might provide timely facilitation for broader implementation? (eg movement at other scales of AMR surveillance (eg hospital implementation)? Work on other pathogens? Technological or infrastructural advancements? Funding or health policy priorities?)</i>	<i>What factors outside of the direct space of AMR genomics for public health surveillance act as barriers to implementation? (eg missing technology or infrastructure? funding or health policy priorities? Sociopolitical factors?)</i>
3	<i>In what ways can genomic surveillance at One Health interfaces provide actionable AMR surveillance data compared with traditional methods? What is the use case for routine genomic surveillance here?</i>	<i>What are the disadvantages of, and/or barriers to, implementing genomics for AMR surveillance at One Health Interfaces?</i>	<i>What factors outside of the direct space of genomic AMR surveillance at One Health interfaces might provide timely or broader implementation in this area? (eg movement in other areas of AMR surveillance (eg human public health)? Work on other pathogens such as SARS-CoV2? Technological or infrastructural advancements? Changes in regulation? Funding priorities?)</i>	<i>What factors outside of the direct space of genomic AMR surveillance at One Health interfaces might act as barriers to implementation? (eg missing technology or infrastructure? funding or policy priorities? Sociopolitical factors?)</i>

Discussion from the rooms were reported into a shared live google document which was reviewed in real time and used to facilitate a joint group discussion to consolidate a view on the value of genomics for AMR surveillance in each domain

Breakout session two: room prompts

Workshop	Room 1	Room 2	Room 3	Room 4
1	<i>What action should be taken to build on these advantages to increase implementation of genomics for hospital-based AMR surveillance and who needs to do it? (eg advocacy, different use cases, further research)</i>	<i>How can these barriers and disadvantages be removed/minimised? What action should be taken and who needs to do it? (eg what further studies are needed, who needs to be leaned on to make this happen and at what level?)</i>	<i>What can we do to leverage these opportunities to enhance implementation of genomics for hospital-based AMR surveillance? What action is needed and from who? (eg new collaborative relationships forged, recommendations for strategic funding)</i>	<i>What can be done to counteract these threats? (eg new collaborative relationships forged, recommendations for strategic funding)</i>
2	<i>What action should be taken to build on these advantages to increase implementation of genomics for public health AMR surveillance and who needs to do it? (eg advocacy, different use cases, further research)</i>	<i>How can these barriers and disadvantages be removed/minimised? What action should be taken and who needs to do it? (eg what further studies are needed, who needs to be leaned on to make this happen and at what level?)</i>	<i>What can we do to leverage these opportunities to enhance implementation of genomics for AMR surveillance in public health? What action is needed and from who? (eg new collaborative relationships forged, recommendations for strategic funding)</i>	<i>What can be done to counteract these threats? (eg new collaborative relationships forged, recommendations for strategic funding)</i>
3	<i>What action should be taken to build on these advantages to increase implementation of genomics for AMR surveillance at One Health Interfaces and who needs to do it? (eg advocacy, different use cases, further research)</i>	<i>How can these barriers and disadvantages be removed/minimised? What action should be taken and who needs to do it? (eg better advocacy from policy organisations?)</i>	<i>What can we do to leverage these opportunities to enhance implementation of genomics for AMR surveillance at One Health interfaces? What action is needed and from who? (eg new relationships forged, recommendations for strategic funding)</i>	<i>What can be done to counteract these threats and by whom? (eg new collaborative relationships forged, recommendations for strategic funding)</i>

During discussion, the participants input their recommendations into a second live document, with pre-enumerated stakeholders (below) These recommendations were reviewed in real time and used to develop two polls to consolidate the outcome of the workshops, supported by a short break for participants

Live polls on both consensus statements and a prioritisation of recommendations was conducted at the start of the final group discussion and then used as a basis for a final discussion

Table: prepopulated stakeholders

Stakeholder Group	Subgroup
1. Hospitals and workforce	11 Individual hospitals/trusts/surveillance laboratories
	12 Workforce/teams
2. Public health networks/initiatives	21 Public health organisations
	22 Genome sequencing networks
	23 Clinical standards organisations
3. Health Policy Makers	31 International and regional health policy organisations
	32 National Ministries/Departments of Health/Environment/Agriculture
	33 Central government
4. Research Community	41 Researchers and their professional societies/communities
	42 Health research funders
5. AMR action groups	
6. Industry	61 Pharmaceutical
	62 Laboratory Supplies
	63 Infrastructure/engineering
	64 Software developers
	65 Other industry (eg agricultural)
7. Broader society	71 The public
	72 Patient Advocacy Groups
8. Other (please state)	
9. Not sure who this sits with	

Supplement 3 Agenda for final workshop on innovations

A similarly structured workshop on genomic innovations was conducted with the participants split into breakout rooms by innovation. The four rooms were:

Room 1 Clinical diagnostic and microbiome metagenomics

Room 2 Gene and plasmid-based frameworks

Room 3 Environmental metagenomics

Room 4 Machine learning

The first break out room session considered the following two prompts:

1 In what ways can this genomic surveillance innovation improve the provision of actionable AMR surveillance data (over and above isolate based sequencing) and what might its implementation look like?

2 What are the barriers to achieving that potential?

A facilitated discussion then explored commonalities and differences between the advantages and barriers among the innovations.

The second break out room session then considered the below prompt:

How might the identified barriers to implementing these innovations be overcome?

A final facilitated discussion then resolved common actions to reach resolved recommendations for making the most of innovations in genomics for AMR surveillance.

Supplement 4 Community survey conducted on the consolidated findings of the group

Aim of this survey

The Surveillance and Epidemiology of Drug Resistant Infections Consortium (SEDRIC) is an international thinktank funded by Wellcome As part of genomics for AMR surveillance working group, comprised of 97 members (full list: <https://sedricorguk/working-groups>), three domain-theme workshops explored current situation for genomics for AMR surveillance and proposed actions needed for genomics for AMR surveillance implementation across settings and contexts

With this survey we seek to get wider scientific community consensus on the main findings from these workshops We appreciate your time spent filling this survey

Q1 Select what best describes your current position

- Professor or equivalent
- Associate professor or equivalent
- Lecturer or equivalent
- Post-doctoral researcher
- PhD student
- Student: Undergraduate/Masters Degree
- Scientist, non-academic
- Clinician/Consultant
- Public health professional
- Veterinary health professional
- Agricultural professional
- Other (please specify)

Q2 In which country do you currently reside?

Drop down list of countries

Q3 Which region are you based in?

Drop down list of regions (Africa, Asia, Australia, Europe, North America, South America, Middle East)

Q4 Please select your area of expertise (multiple choices allowed)

- Epidemiology and surveillance
- Infectious disease
- Microbiology
- Policy
- Public/Global health
- Genomics
- Mathematics/Modelling
- One Health
- Clinical
- Other (please specify)

Q5 What setting do you work in?

- Hospital
- Research non-academia
- Research in academia
- Veterinary Laboratory
- Public Health Laboratory
- Industry

Q6 Which of these four areas would you most associate your AMR work with?

- Hospital and Infection Prevention and Control
- Public Health and International Public Health
- One Health and Environment
- Other (please specify)

Q7 Do you do use do whole genome sequencing, analyse genomic data or use genomic data as part of your work?

- Yes, routinely
- Yes, as needed
- No

Q8 Do you have access to genomic sequencing facilities?

- Yes, at my institution
- Yes, centralised hub (eg regional/national laboratories, etc)
- Yes, through outsourcing this to a commercial company (eg MicrobesNG etc)
- Yes, access to all three mentioned above
- Yes, other (please specify)
- No

Q9 To what extent do you agree with the following statements for using genomic surveillance in hospital settings (matrix table by 5-6 strongly disagree, disagree, neither agree or disagree, agree and strongly agree; skip this statement) leave blank if unsure) Also, Jamie, would you please remove "somewhat" agree and just leave agree? Thank you

S1 Infection control and prevention is BEST use case of isolate based sequencing in hospital settings

S2 Infection control and prevention is ONLY use case of isolate based sequencing in hospital settings

S3 Organism specific genomic AMR standards need to be defined and quality control maintained intermittently

S4 There is a need for new workforce competencies either as a new staff category (eg hospital genomic epidemiologist) or training and expansion of existing workforces to support implementation of genomic sequencing in hospital laboratories

S5 The use case for genomics for AMR surveillance varies with an institution's existing capacity for AMR surveillance and anticipated scale of throughput

S6 Don't know or prefer not to say

Q10 To what extent do you agree with the following statements for using genomic surveillance in public health networks (matrix table by 5-6 strongly disagree, disagree, neither agree or disagree, agree and strongly agree; leave blank if unsure) Also, Jamie, would you please remove "somewhat" agree and just leave agree? Thank you

S1 Genomic surveillance of AMR in new areas should be first implemented in hub and spoke models, where training, infrastructure and supply chains can be centralised

S2 There is a need for better advocacy and focus for the use cases of genomics for AMR surveillance in public health

S3 Organism specific genomic AMR standards need to be defined, quality control is maintained continually and updated periodically

S4 Genomics for AMR surveillance needs to be marketed alongside the use of genomics for surveillance of single species organisms

Q11 To what extent do you agree with the following statements for using genomic surveillance for One Health AMR (matrix table by 5 strongly disagree, disagree, neither agree or disagree, agree and strongly agree; skip this statement) leave blank if unsure) Also, Jamie, would you please remove "somewhat" agree and just leave agree? Thank you

S1 One Health genomic AMR surveillance should FEED INTO human health systems

S2 One Health genomic AMR surveillance should be COORDINATED ABOVE the level of human, animal, or environmental health systems

S3 The utility of genomic for AMR surveillance in One Health context will vary depending on national context

S4 The use of genomics to better understand AMR gene and mobile genetic element movement is critical for One Health AMR surveillance

S5 (Allow option to skip this question) – Don't know or prefer not to say

Q12 Please rank these proposed actions for improving AMR surveillance in your area

A1 To develop new training competencies for health surveillance scientists

A2 To build capacity, including through hub and spoke models to centralise training, infrastructure, and supply chains

A3 To define a use case for the use of genomic AMR surveillance at all levels

A4 To improve relationships and interactions among key stakeholders (eg industry, health deliverers, researchers, policy makers)

A5 To agree data sharing and governance (ensuring equity)

A6 To harmonise and standardise surveillance practices

A7 To better integrate environmental surveillance into One health

A8 To agree on continued funding models and conduct cost effectiveness studies

A9 To invest in AMR genomic surveillance innovation research

A10 Other (please specify)

Q13 Is there anything else you would like to communicate to the working group?

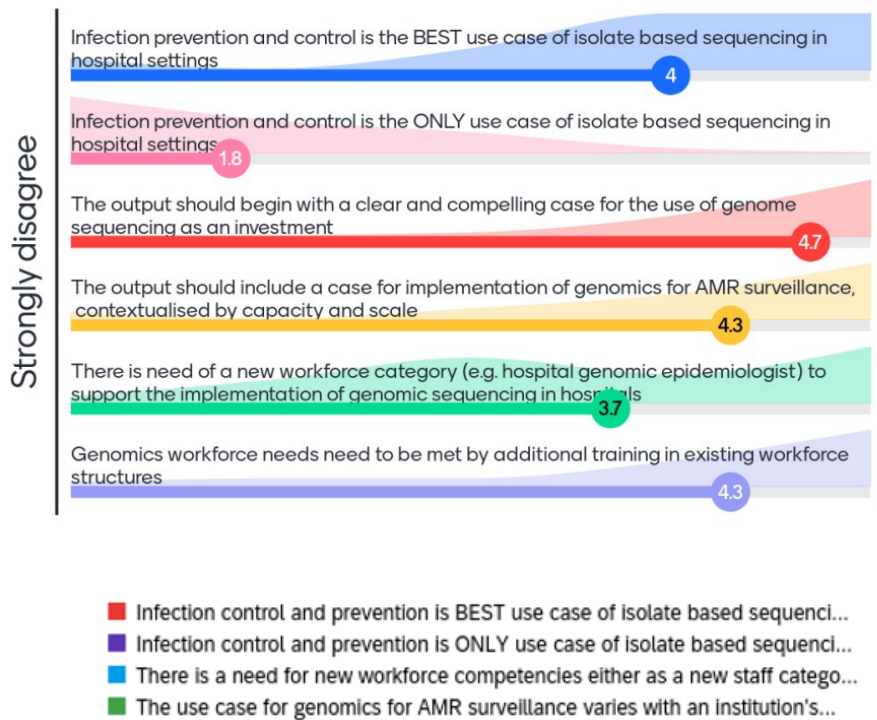
Free text (max 200 words)

Thank you for your participation Your input will be critical to shaping the outputs from the working group If you would like to receive a copy of the final outputs from the working group, please email sedric@wellcomeorg

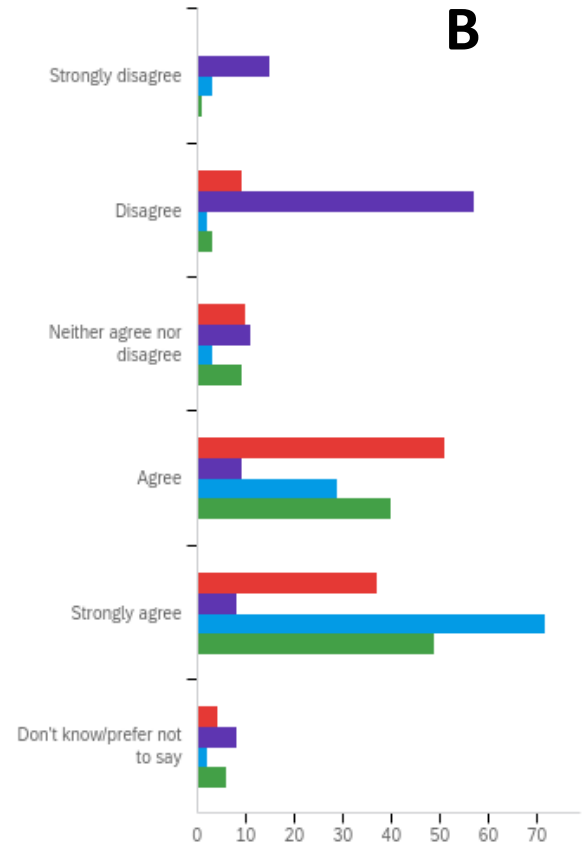
Supplement 5 Cross referencing of the results from the group and survey

To what extent do you agree with this statement:

A



B



Prioritise these actions:

C

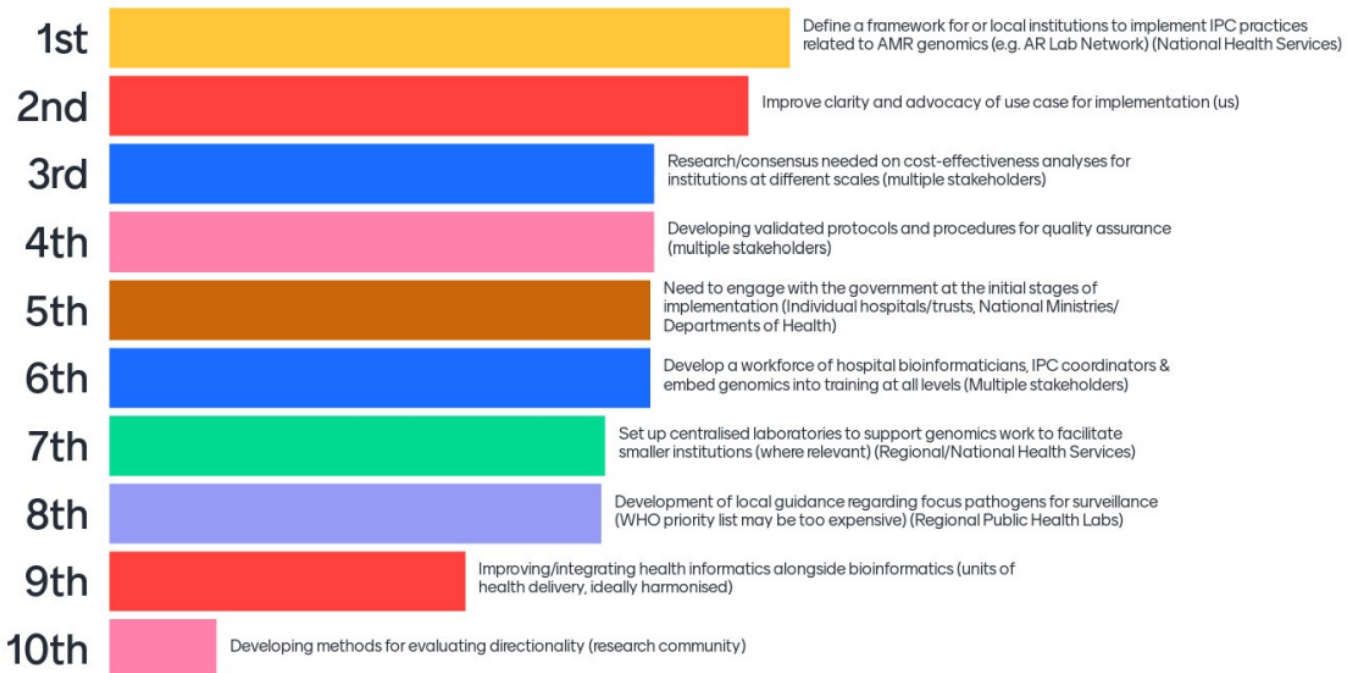
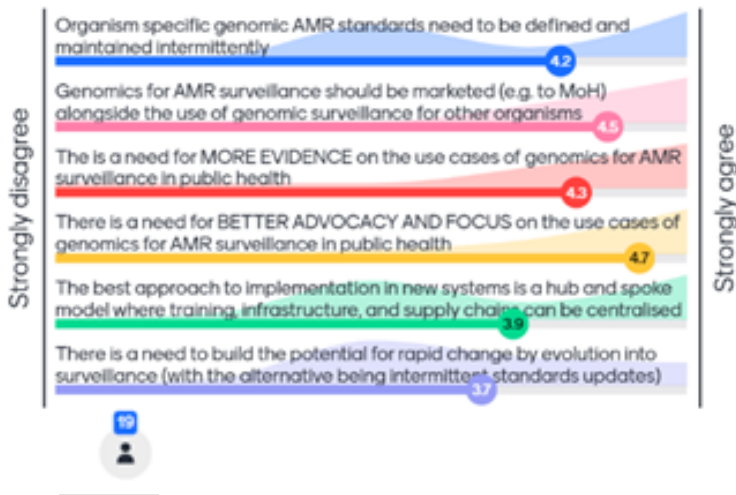


Figure S51 Results of a workshop Mentimeter poll on consensus statements (A) and analogous questions from survey respondents (B) with prioritisation of actions from Workshop 1 (C)

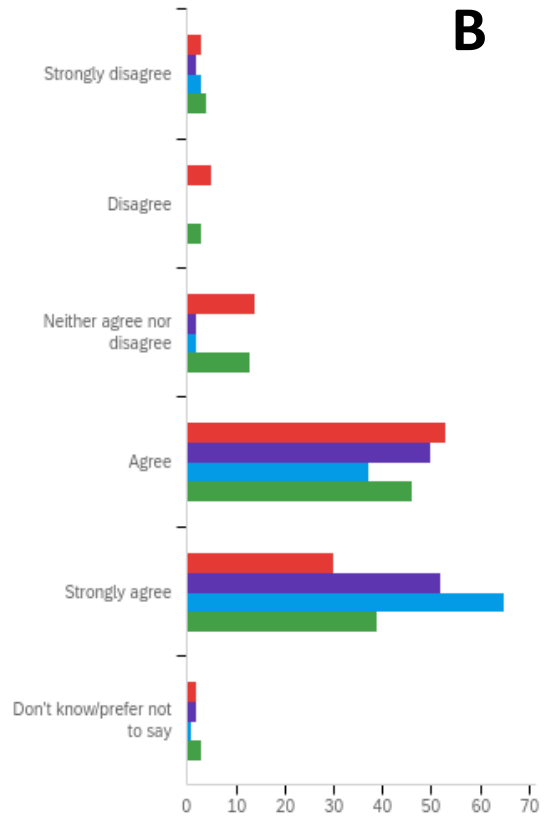
To what extent do you agree with this statement:

A

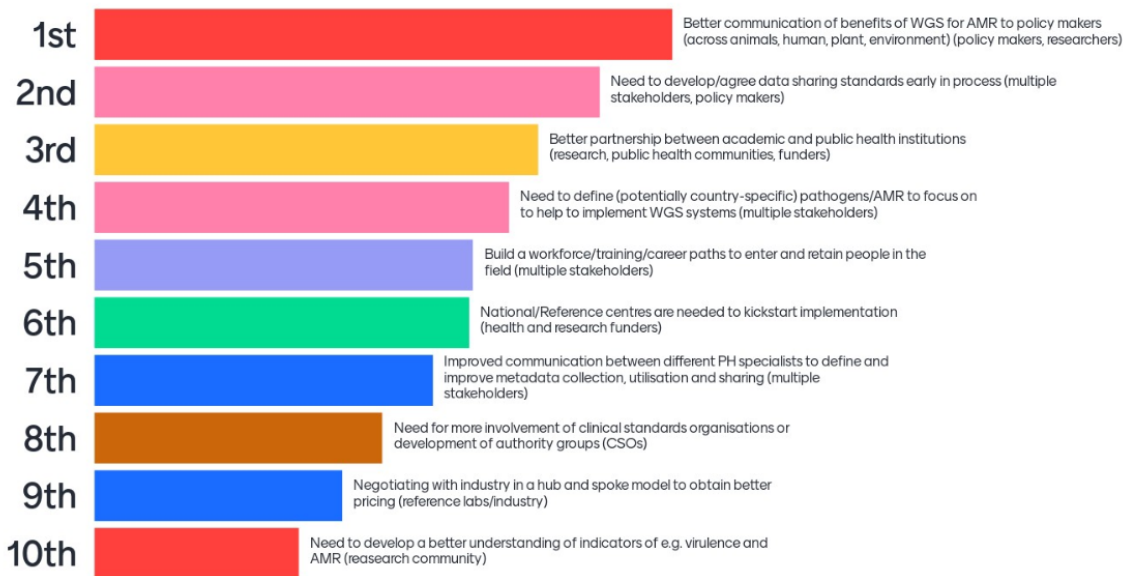


- Genomic surveillance of AMR in new areas should be first implemented in hub...
- There is a need for better advocacy and focus for the use cases of genomics...
- Organism specific genomic AMR standards and interpretation guidelines should...
- Genomics for AMR surveillance needs to be marketed alongside the use of gen...

B



Prioritise these actions:

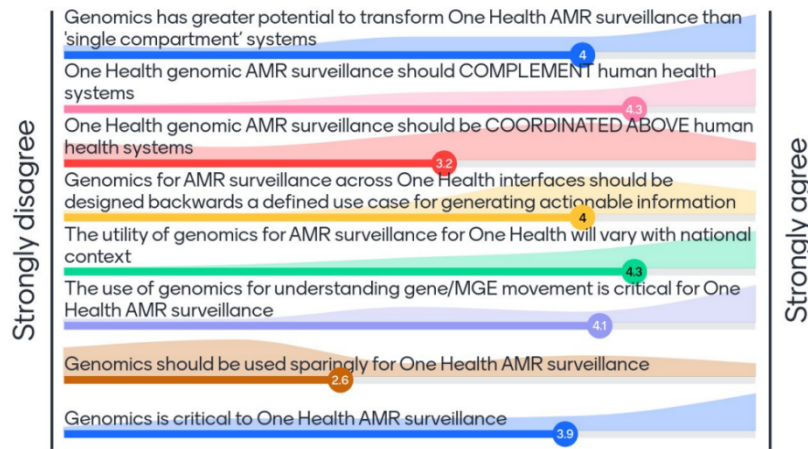


C

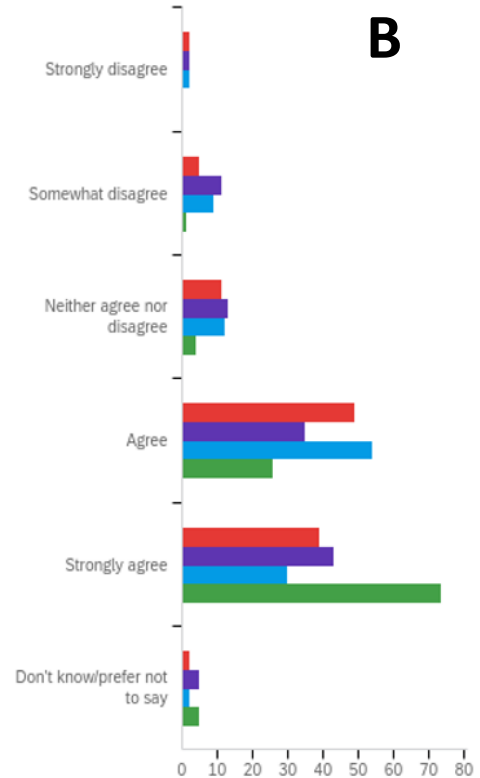
Figure S52 Results of a workshop Mentimeter poll on consensus statements (A) and analogous questions from survey respondents (B) with prioritisation of actions from Workshop 2 (C)

To what extent do you agree with this statement:

A

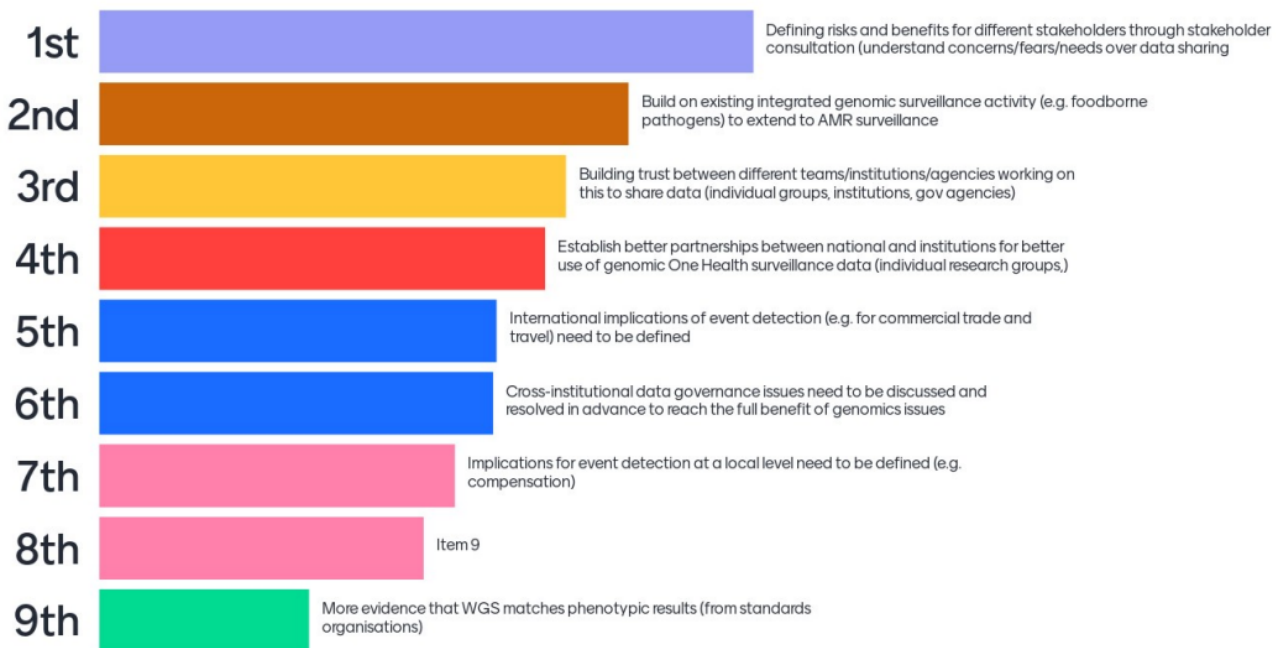


B



- One Health genomic AMR surveillance should FEED INTO human health systems
- One Health genomic AMR surveillance should BE COORDINATED ABOVE the level o...
- The usefulness of genomics for One Health AMR surveillance will vary with t...
- The use of genomics to better understand AMR gene and mobile genetic elemen...

Prioritise these actions:



C

Figure S53 Results of a workshop Mentimeter poll on consensus statements (A) and analogous questions from survey respondents (B) with prioritisation of actions from Workshop 3 (C)