Global Perspective, Data Gaps, Quality Issues, Surveillance Data, Actions-AMR

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My Main Points

- Horizontal gene exchange, a focal point for control
- Sectors & regions must be considered individually
  - Diary, pig, chicken, fish, WWTP, AB Production
  - Advance, high production, middle income, low income, rural, urban
  - Rapidly changing operations
- Surveillance data
  - Validate relationships among, qPCR, metaG, isolate and residue data
  - NARMS-like 2.0, realtime data, e.g. cow-side
- Action
  - Education and training – sector targeted
Stages on the continuum to crisis

Infection control

Mitigation

Stewardship

Organismal Soup

Selection

Growth conditions

ARGs

Pathogens

MGEs

Commensals

Cell density/contact

HGT

Environmental selection

Native resistome

Pollution

AB Production

WWTP

Animal Agric

Aquaculture

Correlations

Crisis

Time to Impact
ARG Abundances in MetaGs of Different Environments

Bing Li, Ying Yang...Tiedje, Tong Zhang, ISMEJ (2015)
Clusters of identical sequences

**int1-IS6100 cluster**

- Chinese Pigs, all 3 farms

**IS1216-tet**

- Treponema
- Succinivibrio
- unclassified Lachnospiraceae
- unclassified Veillonellaceae
- unclassified Ruminococcaceae
- Corynebacterium
- Acinetobacter
- unclassified Bacillales
- Gracilibacillus
- Bordetella
- Truepera
- IncP oriT

**NADL (no AB exposure) Pigs**

**blaTEM-sul2**

- Escherichia
- unclassified Enterobacteriaceae

**Legend**

- Degree:
  - 20
  - 10
  - 1
- ● ARG
- ● MGE
- ● E. coli marker
- ● Firmicutes
- ● Proteobacteria
- ● Other phyla

*Johnson et al. mBio, 2016*
“Growth” of one cluster in compost in one Chinese farm

Johnson et. al, mBio
Need for integration of data from environments to the clinic

Gathers and geospatially maps ARGs and ARB from environments & clinic

Stedtfeld et.al. 2016
Antimicrobial resistance (AR) dashboard...
FEMS Microbiol Ecol
Where is the Volume of Antibiotics?

80% of the Production is in China and India, R. Kookana

Ying, G-G et.al, ES&T 2017

Zhang, Q-Q, Ying, G-G, et. al, ES&T, 2015
Education & Training Example

Pork Checkoff’s Antibiotic Resource Center

Antibiotic Information/Resources

The Antibiotics Resource Center is your one-stop place to find information and resources about responsible antibiotic use on the farm. This includes details about the new Veterinary Feed Directive and prescription changes for water-based antibiotics that went into effect on Jan. 1, 2017.

As of Jan. 1, 2017, youth swine exhibitors, parents and project advisors will face major changes regarding access to feed and water medications for show pigs. That’s when the U.S. Food and Drug Administration (FDA) will implement new rules, known as Guidance 209, for antibiotic use in all animals raised for food.
Prioritized Gaps

1. Fate and transport (ARGs, ARB as pollutants)
   - Survival rates, conditions, compost (heat), other treatments
   - **Growth**: substrates, conditions, selection, co-selection (broad), concentrations below MIC; manure microbial ecology
   - Transport: water (surface, leaching), workers, produce, dust/air; regulatory tweaks?

2. HGT (GMO [microbes] experience)
   - Clusters: ARG, MGE, microbe; geographic range
   - ARG, MGE gene linkages, mechanisms, host range for HGT
   - Commensal host ecology

3. Data bases and nomenclature
   - Getting beyond the isolates
   - Efficient searching, communicating, recognizing the new

4. Data integration, mining, epidemiology

5. Quantitative risk assessment model
EDAR 2017

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www.antibiotic-resistance.de