



Advancing Data Technologies to corner AMR 2019

KIT Royal Tropical Institute Amsterdam
5 June 2019

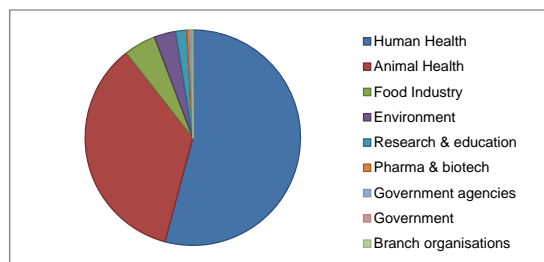
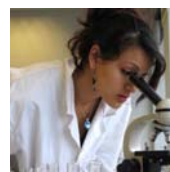
This presentation

- AMR Insights
- Antimicrobial resistance (AMR) in 10 statements
- Solutions to AMR
- Data Technologies to corner AMR
- Program today

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AMR for professionals: EU 2.3 M, USA 1.5M



Source: AMR Insights (2017)

AMR Insights: 3 objectives for professionals

INFORMING:



E-Newsletter *

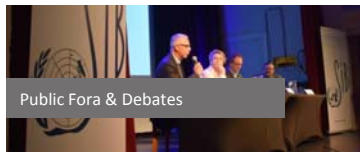
Information Platform **

* 5,000 professionals (EU, USA, Asia)
** 30,000 visitors pa (idem)

EDUCATING:



Masterclasses & Lectures

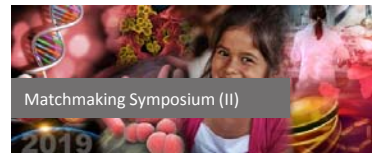


Public Fora & Debates

CONNECTING:



Matchmaking Symposium (I)



Matchmaking Symposium (II)

AMR Insights 6 focal areas ('use cases')

➤ Interest of professionals leading



Healthy Patients



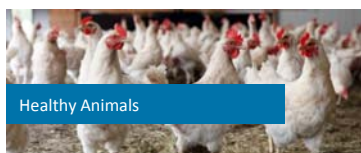
Effective Surveillance



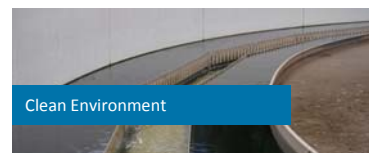
Smart Innovation



Secure Foods



Healthy Animals



Clean Environment

Screenshot news overview

- Selected global news AMR
- Categorized to Focal area(s)
- Short text messages
- Name of publisher
- Link to publication



Advancing Data Tech to corner AMR



7

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8

Antimicrobial resistance

“Planet earth faces the very real threat of having to survive in a ‘post-antibiotic’ era in which there are few, if any, antibiotics which effectively and affordably cure infections”

Source: *Dag Hammarskjold Foundation*

Antimicrobial resistance

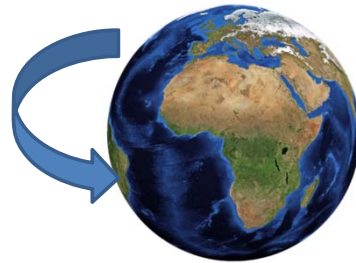
- Complex, abstract
- For most professionals a distant problem
- Overflow of information, publications, data, statistics, guidelines, action plans
- Lack of understanding and insights
- AMR in 10 ‘statements’

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1. AMR a global threat

- Can affect any body, everywhere, any time
- Global spreading (travel, transport):
 - Microorganisms
 - Plasmids (genetic material)
 - Antimicrobials



2. AMR a hidden threat

- Diagnosed?
- Documented?
- Data collected?

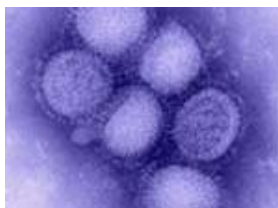


3. AMR applicable to most microorganisms

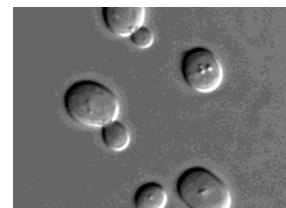
ABR: Antibiotic resistance
AMR: Antimicrobial resistance



Bacteria



Viruses



Yeasts

The New York Times

DEADLY GERMS, LOST CURES

A Mysterious Infection, Spanning the Globe in a Climate of Secrecy

The rise of *Candida auris* embodies a serious and growing public health threat: drug-resistant germs.

CDK Centers for Disease Control and Prevention

Fungal Diseases

Isolate submission opportunity: Monitoring for Azole Resistance in *Aspergillus fumigatus*



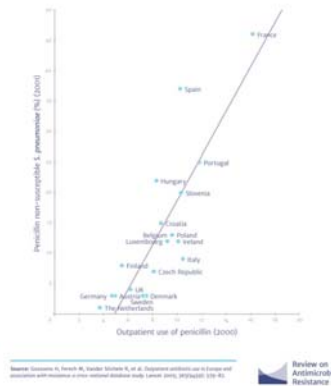
Parasites



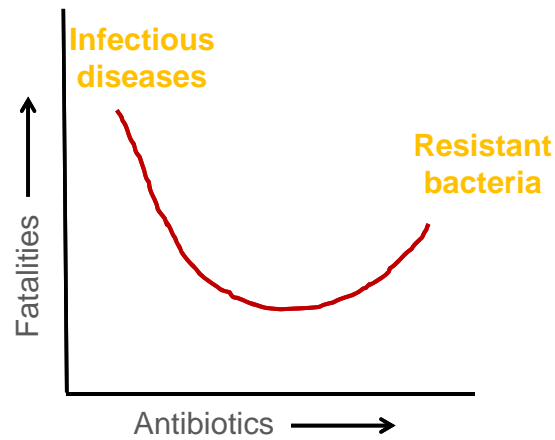
Fungi

4. Correlation antibiotic use and resistance

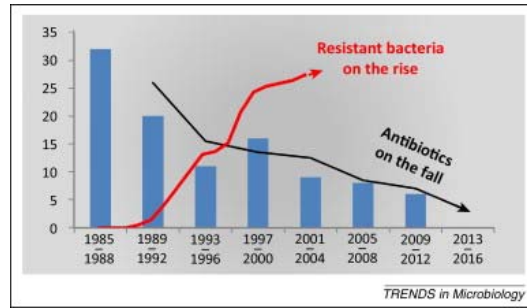
THERE IS A HIGH CORRELATION BETWEEN ANTIBIOTIC USE AND RESISTANCE



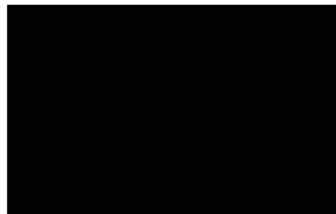
5. Banning antimicrobials not a solution



6. AMR escalating



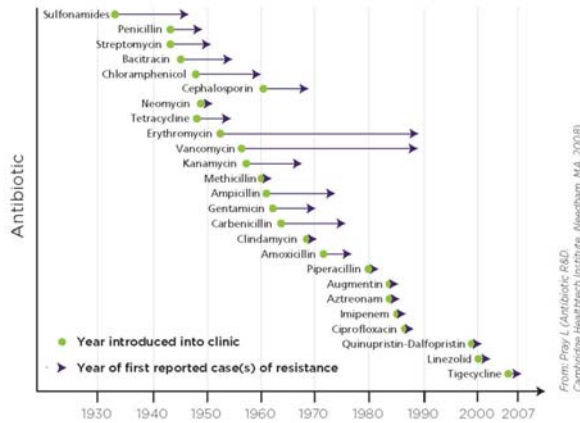
7. AMR unprecedented dynamics



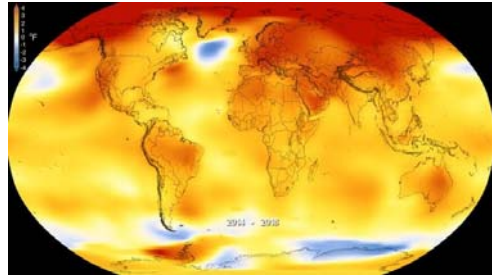
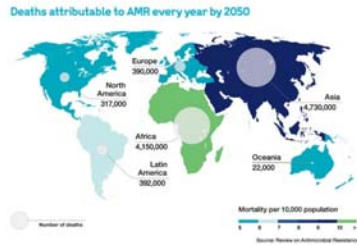
8. AMR makes medical interventions impossible



9. AMR observed with all available antibiotics



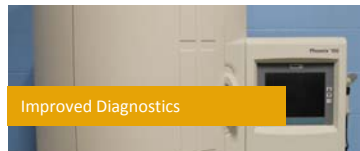
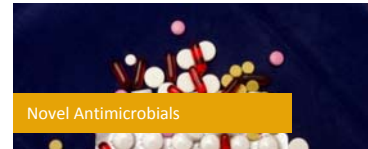
10. There is no one single solution to AMR



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Key strategies to combat AMR



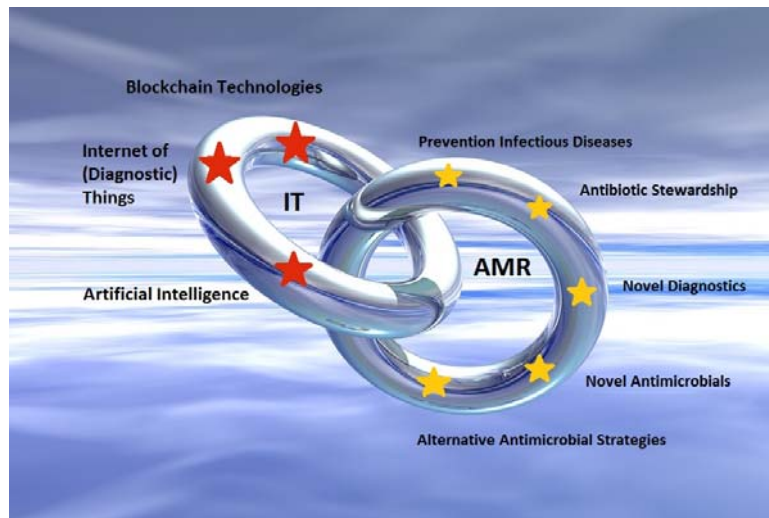
Key strategies to combat AMR in OneHealth approach

- **Prevention:** hygiene, sanitation, vaccination, probiotics
- **Stewardship:** human health, animal health
- **Diagnostics:** identification, typing & sensitivity analyses
- **Antimicrobials:** novel classes, modes of action
- **Alternatives:** phage therapy, lytic enzymes, Crispr Cas, photodynamic therapy, anti-quorum-sensing molecules, etc

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Data Technologies to corner AMR



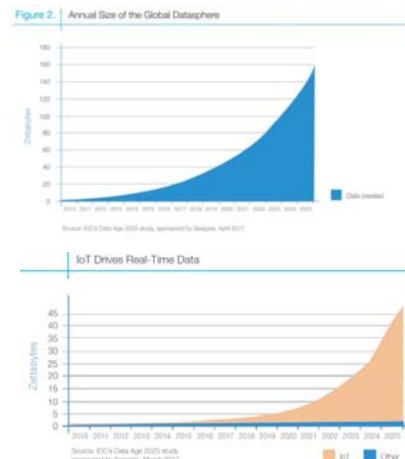
Data Technologies to corner AMR

	Data Technologies	Artificial intelligence	Internet-of-things	Blockchain technologies
Prevention	?	?	?	?
Stewardship	?	?	?	?
Diagnostics	?	?	?	?
Antimicrobials	?	?	?	?
Alternative therapies	?	?	?	?

Data and Data Technologies



- Next generation internet data driving change
- Exploding volumes of data
- Increasing real time data

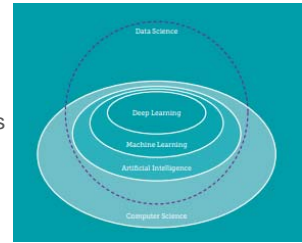


Source: International Data Corporation (Data Age 2025)

A. Artificial Intelligence



- Computer science** Study of **processes that interact with data** and represented as data in the form of programs. Enables use of algorithms to manipulate, store, and communicate digital information.
- Artificial intelligence** **Intelligence demonstrated by machines** that mimic cognitive functions (learning, problem solving).
- Machine learning** Study of **algorithms and statistical models** that computer systems use in order **to perform a specific task**. Machine learning algorithms build a mathematical model based on sample data to **make predictions**.
- Deep learning** Part of machine learning methods based **on artificial neural networks and applied to speech recognition, drug design, image analysis**.
- Data science** Multi-disciplinary field that uses scientific methods, processes, algorithms and **systems to extract knowledge and insights from (un)structured data**. Data science is the same concept as **data mining and big data**.

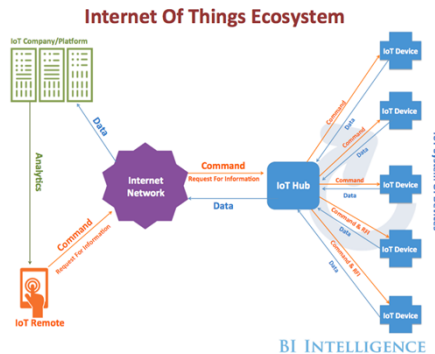


Source: Denkwerk

B. Internet-of-(Diagnostic)-Things



The Internet of things (IoT) is the **extension of Internet connectivity into physical devices** and everyday objects. Embedded with electronics, Internet connectivity, and other forms of hardware (such as sensors), these devices can communicate and interact with others over the Internet, and they can be **remotely monitored and controlled**.

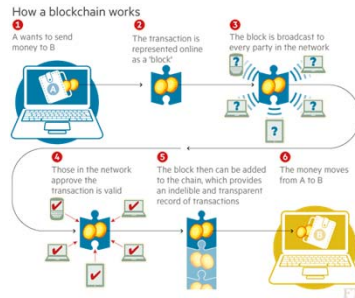


Source: Business insider; 2018

C. Blockchain Technologies



Blockchain is a growing list of records, called *blocks*, which are linked using cryptography. Each block contains a cryptographic hash of the previous block, a timestamp, and transaction data (generally represented as a Merkle tree). By design, a blockchain is resistant to modification of the data. It is **an open, distributed ledger that can record transactions between two parties efficiently and in a verifiable and permanent way.**



Source: Halpern Financial

Data Technologies to corner AMR

	Data Technologies	Artificial intelligence	Internet-of-things	Blockchain technologies
Prevention	☑	☑	☑	?
Stewardship	☑	☑	☑	?
Diagnostics	☑	☑	☑	?
Antimicrobials	☑	☑	☑	☑
Alternative therapies	☑	☑	☑	?

NB Value chains: R -> D -> Validation -> Implementation...

Data Technologies to corner AMR: literature data...

	Data Technologies	Artificial intelligence	Internet-of-things	Blockchain technologies
Prevention	serious gaming	tracking and control AMR AMR pattern development framework modelling transmission analyses		
Stewardship	serious gaming	antibiotics prescription	remote prescription control	Supply chain management Smart contracts (sales, prescription, use antibiotics)
Diagnostics	databases	predicting drug resistance predicting MIC values Identification biomarkers Identifying resistance genes gene prospecting	point of care diagnostics trend analyses prediction & prevention connected diagnostics wearables for remote patient monitoring smartphone capabilities	
Antimicrobials	Databases	antibiotics discovery	clinical development with PoC diagnostics & digital biomarkers	Managing confidentiality of patient information and integrity trial data Shortening clinical development
Alternative therapies	databases	whole genome analyses	remote prescription control	

33

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Data Technologies to corner AMR: today's program

	Data Tech	Artificial intelligence	Internet-of-things	Blockchain technologies
Prevention	Hooman Kashef Margreet Bloemers	Catrin Moore		
Stewardship				
Diagnostics	Michael Dowzicky Lasse Goerlitz	Andreas Posch Sebastian Duemcke	John Hays	
Antimicrobials	Rene Luigies Marcus Miethke	Tjeerd van Staa Pascal Mayer		Brett Hahn, Isabel Koopmanschap, Hannah van Schoubroeck
Alternative therapies		Pascal Mayer		

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35



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