Health Policy Development: The key role of diagnostics in the Antimicrobial Resistance challenge

Fiona Carragher FRCPath  @DepCSOFiona
Deputy Chief Scientific Officer for England

england.amrdiagnostics@nhs.net
December 2017
The ‘neck and neck’ race of antibiotic development - and resistance

Introduction of new antibiotic classes

1930s
- 1935 sulfonamides
- 1940 Penicillinase
- 1942 sulfonamide resistance
- 1947 streptomycin resistance

1940s
- 1949 chloramphenicol
- 1947 nitrofurantoin
- 1944 aminoglycosides

1950s
- 1956 glycopeptides
- 1952 lincomycins
- 1952 macrolides
- 1952 streptogramins
- 1950 tetracyclines
- 1962 quinolones

1960s
- 1969 nitroimidazoles
- 1968 trimethoprim

1970s
- 1961 methicillin resistance
- 1966 nalidixic acid resistance
- 1968 tetracycline resistance
- 1969 aminoglycoside modifying enzymes

1980s
- 1981 Amp C β-lactamase
- 1983 ESBL
- 1986 VRE
- 1990s fluoroquinolone resistance
- 1997 VISA

1990s
- 2000s resistance against linezolid and daptomycin

2000s
- 2003 lipopeptides
- 2000 oxazolidinones
- 2002 VRSA

Development of bacterial resistance
The challenge of 21\textsuperscript{st} Century antibiotic use

- 7\% of all deaths in the UK are caused by infectious diseases.
- 66 different antibiotics prescribed - top 15 account for 98\% in general practice and 88\% in hospitals.
- 35 million courses of antibiotics are prescribed by GPs in England each year.
- Without antimicrobials, the rate of post-operative infection for clean surgery could be 0-50\%.
  ~30\% of those with a serious infection would die.
The rising tide of Antimicrobial resistance

- Infections are increasingly developing that we cannot treat with a rapid spread of multi-drug resistant (MDR) bacteria
- We may not be able to treat or prevent everyday infections or disease
  - Existing antimicrobials are becoming less effective
  - Bacteria, fungi, viruses are adapting naturally and becoming increasingly resistant
  - Inappropriate use of these medicines
  - All-time low in new antibiotics being developed

Recognising this is a ‘one health’ agenda

WHO priority list of 12 resistant bacteria that pose the greatest threat to human health

- Acinetobacter baumannii carbapenem-resistant
- Pseudomonas aeruginosa carbapenem-resistant
- Enterobacteriaceae carbapenem-resistant, ESBL-producing
- Enterococcus faecium vancomycin-resistant
- Staphylococcus aureus methicillin-resistant
- Vancomycin-intermediate and resistant
- Helicobacter pylori clarithromycin-resistant
- Campylobacter spp. fluoroquinolone-resistant
- Salmonella fluoroquinolone-resistant
- Neisseria gonorrhoeae cephalosporin-resistant fluoroquinolone-resistant
- Streptococcus pneumoniae penicillin-non-susceptible
- Haemophilus influenzae ampicillin-resistant
- Shigella spp. fluoroquinolone-resistant

www.who.int
The future if we do not act now

By 2050: more deaths from resistant infections than cancer

Deaths attributable to antimicrobial resistance every year by 2050

- Asia: 4,730,000
- Europe: 390,000
- North America: 317,000
- Latin America: 392,000
- Africa: 4,150,000
- Oceania: 22,000

Source: Review on Antimicrobial Resistance 2014

Deaths attributable to antimicrobial resistance every year compared to other major causes of death

- Tetanus: 60,000
- Cholera: 100,000 - 120,000
- Measles: 130,000
- AMR in 2050: 10,000,000
- AMR: 700,000
- Road traffic accidents: 1,200,000
- Diarrhoeal disease: 1,400,000
- Diabetes: 1,500,000
- Cancer: 8,200,000

Source: Review on Antimicrobial Resistance 2014
UK response to this challenge

- Improving infection protection and control
- Optimising prescribing practice
- Developing new drugs, treatments and diagnostics
- Better access to and use of surveillance data
- Improved professional education, training & public engagement
- Strengthened international collaboration
- Better identification and prioritisation

Progress against the strategy is reported on an annual basis
Leading worldwide action on antimicrobial resistance

• UK Chief Medical Officer Dame Sally Davies has led a worldwide campaign to take action on antimicrobial resistance

• Sep 2016: 193 countries signed a United Nations declaration at the UN General Assembly in New York

• For the first time, Heads of State committed to taking a broad, coordinated approach to address the root causes of AMR across multiple sectors, especially human health, animal health and agriculture.
The role of diagnostics in AMR

Independent review of Antimicrobial Resistance - Jim O’Neill

• Diagnostics are critical to the appropriate use of antimicrobials
• Step change in the way technology is incorporated into the decision making process
• Currently many decisions are based on an empirical diagnosis
• Rapid point of care diagnostics enabling a precise, timely diagnosis
• Decision support approach to drive change in prescribing

“I call on Governments to ensure that, by 2020, all antibiotic prescriptions will need to be informed by .... a rapid diagnostic test wherever one exists” Jim O’Neill

“Having rapid, low-cost, and readily available diagnostics is an essential part of the solution to this urgent problem.” Dr Margaret Chan, DG, World Health Organisation
Diagnostics
– the signalling system for the NHS

• Direct patients and patient flows so that **the right people get to the right place at the right time**

• Ensure treatment and management is efficient, effective and coordinated

• Have a critical role in prioritising activity so that services are resilient and sustainable

• Fundamentally shape the health economics of particular patient pathways
Which diagnostics could be used in AMR?

• Bacterial or viral
• Bacterial type
• Resistance *(which antibiotics *must I not* use?)*
• Susceptibility *(which antibiotics *can I use?)*

*Recognising there is also a role for host response biomarkers*

National ambitions

1. Halve gram –ve HCAI blood infections by 50% by 2020
2. Halve inappropriate prescribing in humans by 2020
3. Reduce animal antibiotic use to 50mg/kg by 2018
4. Work internationally to bring new products to market
UK AMR Diagnostics - Vision

…..“This strategy will tackle the issues around AMR through patient-centred, cost effective diagnostics by ensuring that the right test is available at the right place at the right time.

“It will maximise the use of available technologies in human & animal health sectors in the most appropriate settings.”

The vision will be delivered through a coordinated & consistent national approach to standards & practice.

- In every part of the country, in every healthcare setting, the same level of access to rapid diagnostic technology & digital antimicrobial guidance tools are available
- The technology meets nationally set standards of quality & response times
- There is recognition that different settings might need different technical solutions
- Services are flexible & responsive to the adoption of new technologies that will provide continuous improvement
UK AMR Diagnostics – Strategy

Ensuring that the **right test** is available at the **right place** at the **right time**.

- **Self-care & monitoring**
- **Pharmacy & other high street services**
- **Primary and Community Care**
  - We need to capture good practice examples
  - Linked to changing behaviours and targeted education and training
- **Secondary and Tertiary Care**
- **Public health & surveillance**

Linked through integrated data-sharing

Coordinated by coherent commissioning
UK AMR Diagnostic Collaborative Programme

KEY AREAS OF FOCUS

- Clinical Pathways
- Diagnostic Stewardship
- One Health
- Innovation
- Policy and Communication
  Align to current policy and regulatory environment

SYSTEM PARTNERS

- Public Health England
- Health Education England
- DEFRA
Putting diagnostics at the centre of AMR management

- Ideal Pathways
- Gaps and Opportunities
- Economic Modelling/Value Proposition

A map of the Sepsis pathway across home and hospital
Diagnostic stewardship

**PRE-ANALYTIC**
- Patient presents
- Condition postulated
- Test ordered
- Sample Collection

**ANALYTIC**
- Sample processed

**POST-ANALYTIC**
- Reporting
- Intervention selected

**DIAGNOSTIC INPUT**
Integration and collaboration is everything

Academia  NHS  Patients  Industry  International

Area of maximum advance

INVENTION  EVALUATION  ADOPTION  DIFFUSION
Innovation - opportunities through new diagnostics

Handheld ‘lab on a chip’
Coupling smartphones with ‘lab on a chip’ technology for tests egg gene arrays
Still at research stage but show great potential

Point of care testing
Well established for indirect technologies such as CRP testing.
Developments in microarrays offer increased potential for direct testing

High throughput genomic technologies
Delivers rich direct testing, allowing detailed identification & surveillance
Seeing advances in speed of test and reduction in cost
The system must be responsive

- Define the capabilities
- Prioritise technologies
- Develop multiplex systems
- Supportive regulatory structure
- Streamline & develop evidence base
- Better availability of test results
The power of diagnostics in AMR: opportunities and challenges

**Opportunities**

- Transforming existing pathways and approaches to support new models of care
- Unpicking commissioning of diagnostics to focus incentives
- Quality of data available about current use of diagnostics and outcomes
- Constant evolution of AMR requiring ongoing innovation to keep up
- Next-gen diagnostics offer a precise, timely diagnosis – allowing the use of the right drug in the right place at the right time
- New settings for diagnostics allowing near-patient testing and greater use of other clan professionals (eg Pharmacy)
- Commissioning levers such as CQUIN, to drive uptake of new approaches