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University of Oslo

Antimicrobial resistance

One world – One Health

Ernst Kristian Rødland, MD PhD

Postdoctoral research fellow, Centre for Global Health

e.k.rodland@medisin.uio.no





Microbial biosphere

- Bacteria
 - Environmental
 - Pathogen
- Natural antibiotics
- Reservoir of antibiotic resistance genes → Resistome





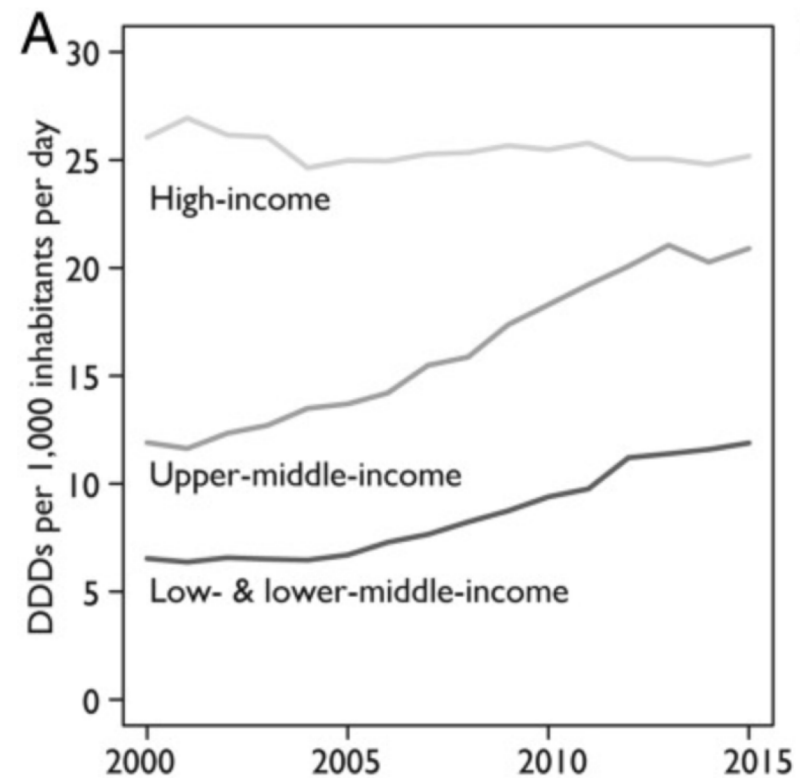
History of some antibiotics

- Penicillin – 1928, regular use in human medicine from the 1940s
- Chlortetracyclin (Aureomycin) – 1945, used as a growth promotor in meat production
- Fluoroquinolones (Nalidixic acid) – 1962



Usage of antibiotics

- 65% increase in human consumption (2000-2015) globally⁽¹⁾
- Approximately 80% of a.b. consumption is in the animal sector⁽²⁾
- Globally: 60-70000 tonnes in agriculture



(1) Klein et al. PNAS 2018

(2) WHO, 2017



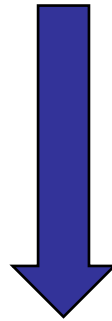
Exposure routes of antibiotics to the environment

- Discharge from manufacturing
- Urine and feces from users of antibiotics
- Antibiotics used in agriculture and aquaculture
- Discarded medicines – lack of take-back programs





Antibiotic selection pressure



**Significant impact on the resistome
in the microbial biosphere**



Agriculture, AMR transmission

- *«Drug resistance in Salmonella typhimurium and its implications»⁽¹⁾*
- *«Changes in intestinal flora of farm personnel after introduction of a tetracycline-supplemented feed on a farm»⁽²⁾*



(1) ES Anderson, Br Med J., 1968

(2) Levy et al. N Eng J Med. 1976



AMR in a globalized world

- Approx. 2 billion people move across large distances/year and 1 billion cross international borders
- 20–60% of asylum seekers are colonized with resistant microbes ^(1,2)
- 50-90% of tourists visiting the tropics get colonized with MDR enterobacteriaceae



New Dehli Metallo-beta-lactamase-1 (NDM-1)

(1) de Smalen, A.W., et al., Travel Med Infect Dis, 2017

(2) Heudorf, U., et al., GMS Hyg Infect Control, 2016



AMR is omnipresent

- E.coli from arctic birds
 - Siberia, Alaska, Greenland
 - AMR detected in 8/97 isolates
 - 17 antimicrobials were tested, resistance to 14 were detected

