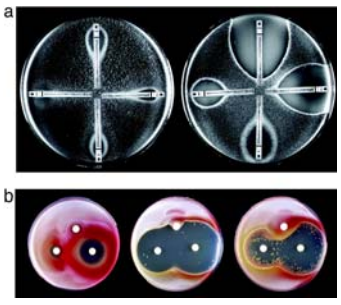
LS 2X03 - Lecture 16 – Globalization of Antibiotic Resistance

1. Antibiotic Resistance as a Public Health Issue
2. The Emergence of Antibiotic Resistance
3. How Old is Antibiotic Resistance?
4. Population Mobility and Resistance

Key Concepts

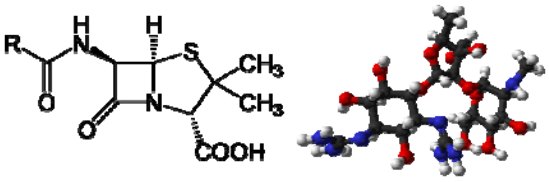
- Antibiotic Resistance as a Public Health Issue
- Antibiotics: what are they, types, modes of action
- History of antibiotic resistance, mechanisms, global trends
- Ecological role of antibiotic resistance, distribution in nature
- Role of population migration in disseminating resistance
- Examples of antibiotic resistance in pathogens

1. Antibiotic Resistance as a Public Health Issue



What is an Antibiotic?

- Refers only to drugs that kill or inhibit bacteria, fungi (or viruses)
-

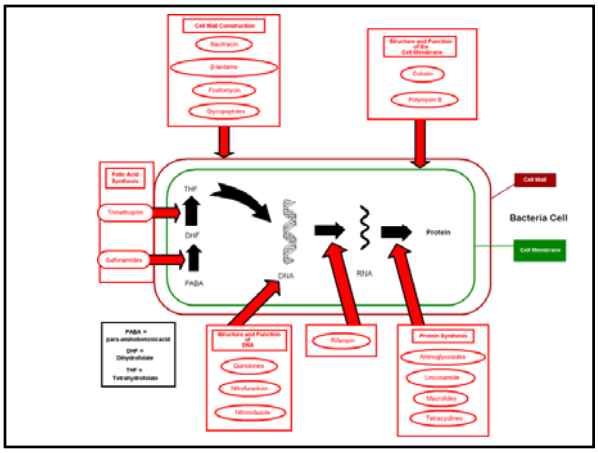


A Diverse Group of Chemicals

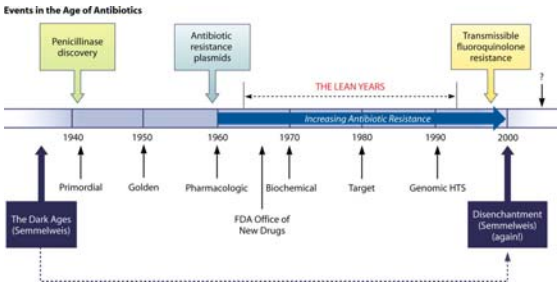
- Different sub-groups:

TABLE 1. Modes of action and resistance mechanisms of commonly used antibiotics[a]

Antibiotic class	Example(s)	Target	Mode(s) of resistance
β-Lactams	Penicillins (ampicillin), cephalosporins (cephamycin), penems (meropenem), monobactams (aztreonam)	Peptidoglycan biosynthesis	Hydrolysis, efflux, altered target
Aminoglycosides	Gentamicin, streptomycin, spectinomycin	Translation	Phosphorylation, acetylation, nucleotidylation, efflux, altered target
Glycopeptides	Vancomycin, teicoplanin	Peptidoglycan biosynthesis	Reprogramming peptidoglycan biosynthesis
Tetracyclines	Minocycline, tigecycline	Translation	Monooxygenation, efflux, altered target
Macrolides	Erythromycin, azithromicin	Translation	Hydrolysis, glycosylation, phosphorylation, efflux, altered target
Lincosamides	Clindamycin	Translation	Nucleotidylation, efflux, altered target
Streptogramins	Synercid	Translation	C-O lyase (type B streptogramins), acetylation (type A streptogramins), efflux, altered target
Oxazolidinones	Linezolid	Translation	Efflux, altered target
Phenicols	Chloramphenicol	Translation	Acetylation, efflux, altered target
Quinolones	Ciprofloxacin	DNA replication	Acetylation, efflux, altered target
Pyrimidines	Trimethoprim	C_1 metabolism	Efflux, altered target
Sulfonamides	Sulfamethoxazole	C_1 metabolism	Efflux, altered target
Rifamycins	Rifampin	Transcription	ADP-ribosylation, efflux, altered target
Lipopeptides	Daptomycin	Cell membrane	Altered target
Cationic peptides	Colistin	Cell membrane	Altered target, efflux

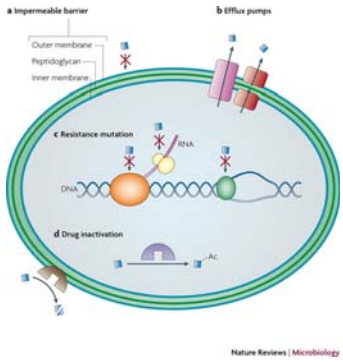


2. The Emergence of Antibiotic Resistance

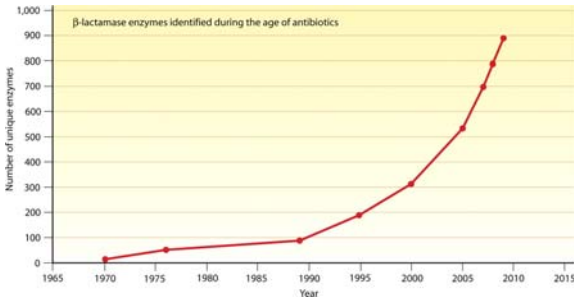


What are the Mechanisms of Antibiotic Resistance?

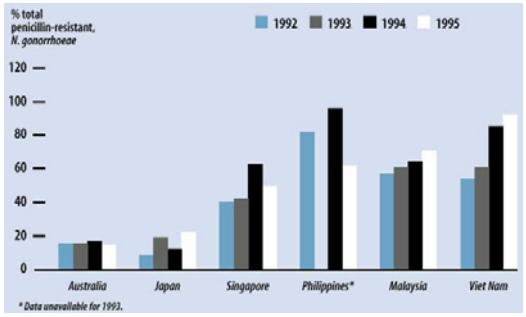
- Mechanisms existed naturally and were subject to exchange:

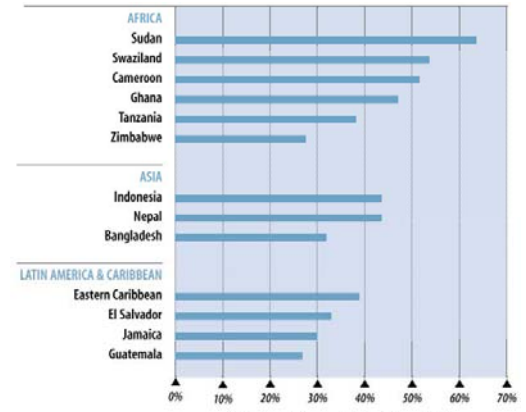


Antibiotic Resistance: a Growing Problem

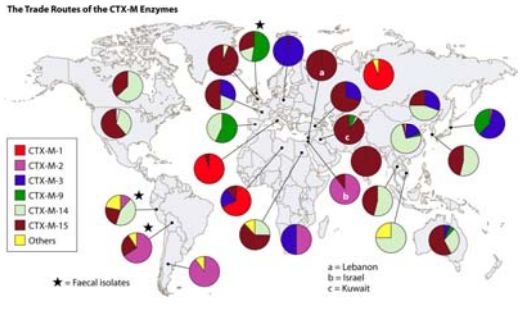


Rise of Antibiotic Resistance

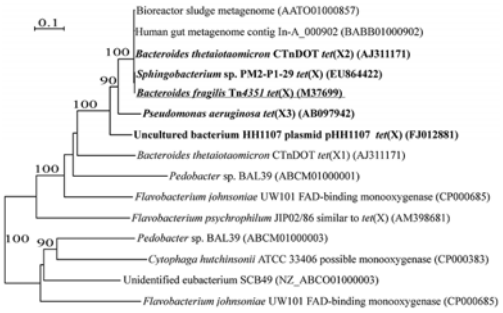




Antibiotic Resistance is found Worldwide

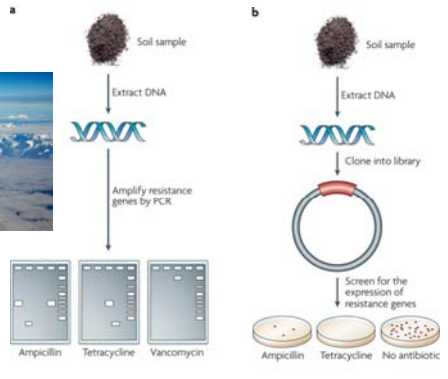


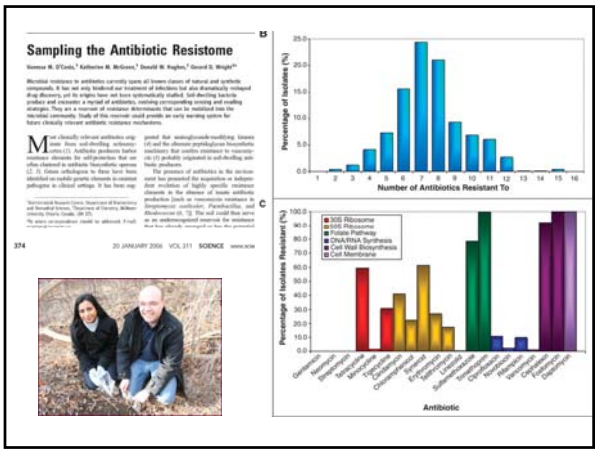
3. How Old is Antibiotic Resistance?

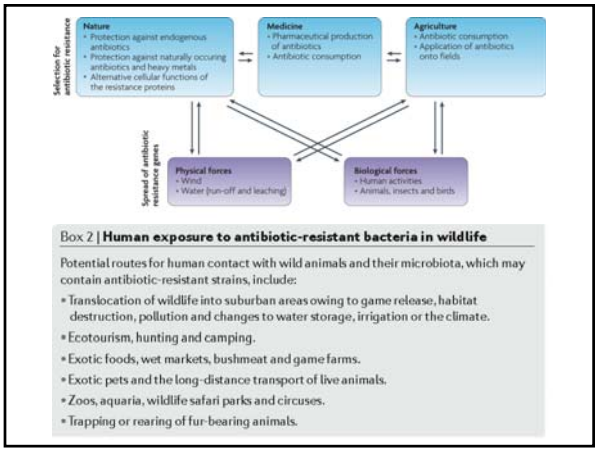


What is the Ecological Role of Antibiotic Resistance?

- Ecological examples of antibiotic functions for microbial products in nature are rare







Box 2 | **Human exposure to antibiotic-resistant bacteria in wildlife**

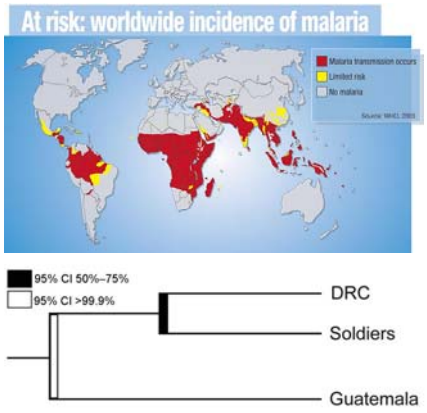
Potential routes for human contact with wild animals and their microbiota, which may contain antibiotic-resistant strains, include:

- Translocation of wildlife into suburban areas owing to game release, habitat destruction, pollution and changes to water storage, irrigation or the climate.
- Ecotourism, hunting and camping.
- Exotic foods, wet markets, bushmeat and game farms.
- Exotic pets and the long-distance transport of live animals.
- Zoos, aquaria, wildlife safari parks and circuses.
- Trapping or rearing of fur-bearing animals.

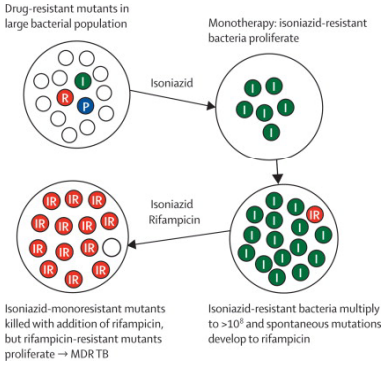
4. Population Mobility and Resistance

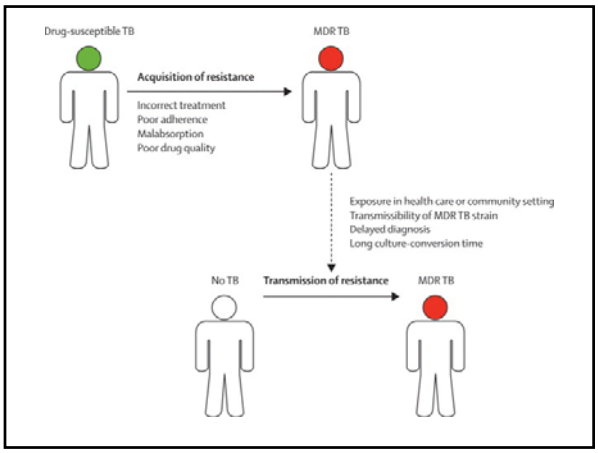
Global Estimates of Annual Migrant Populations

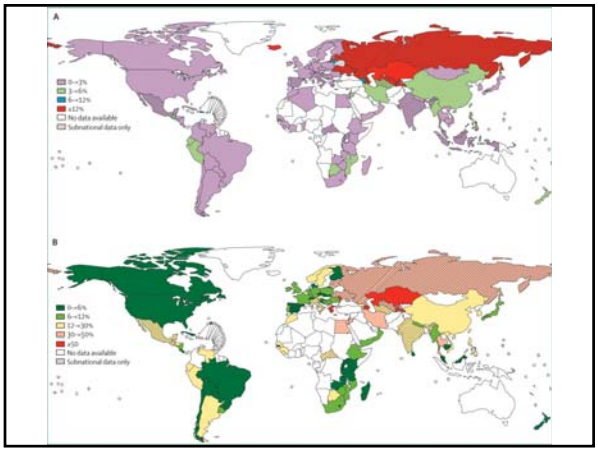
Category	Number of people/Year
Refugees	16 million
Asylum Seekers	650,000
Displaced (e.g. natural disasters)	51 million
Tourism/business	
Immigrants	2.4 million
International students	2.1 million
Migrant workers	81-86 million
Trafficked	800,000
Domestic arrivals, by air	

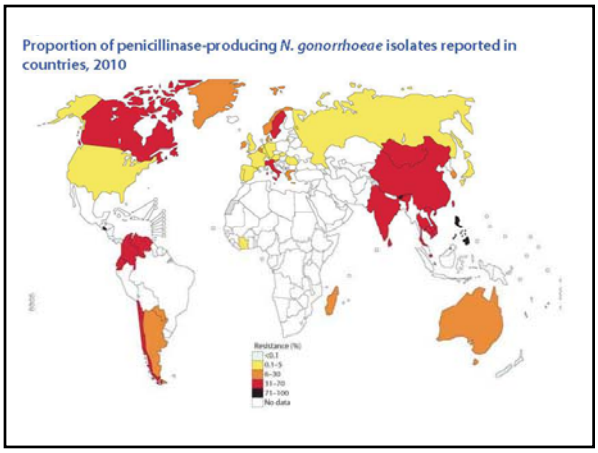


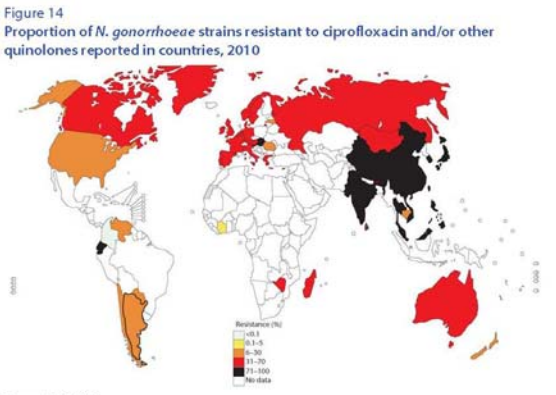
Resistance in Tuberculosis

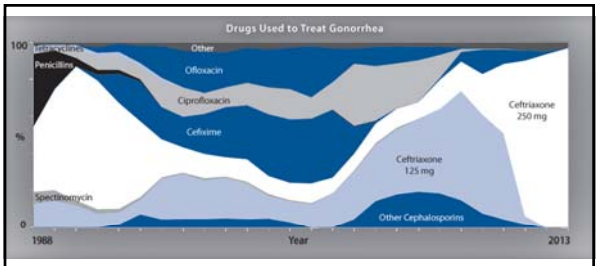



Drug-susceptible TB
MDR TB
Acquisition of resistance
Incorrect treatment
Poor adherence
Malabsorption
Poor drug quality
Exposure in health care or community setting
Transmissibility of MDR TB strain
Delayed diagnosis
Long culture-conversion time
No TB
Transmission of resistance
MDR TB


A
B


Proportion of penicillinase-producing N. gonorrhoeae isolates reported in countries, 2010
Resistance (%)
No data





CBSNEWS Video US World Politics Entertainment Health MoneyWa

By MARY BRIGHY MARCUS · CBS NEWS · December 28, 2015, 12:58 PM

Drug-resistant "super-gonorrhea" could be untreatable, doctors warn

Conclusion

- Antimicrobial drugs have contributed substantially to the control of infectious diseases, markedly decreasing associated illness and death
- Antibiotic resistance has emerged as significant health problem
- There are many examples of imported multidrug-resistant (MDR) infectious diseases, which are associated with migrant populations

TO DO!

1. For next Lecture: read Article 17

2. Tutorials this week: Group Presentations (Bring enough copies of the Judging Forms)

3. Tutorials next week: Group Presentations – *only if scheduled by TA*