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Social trends and individual behaviours contributing to the spread of antibiotic resistance

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Lecture overview

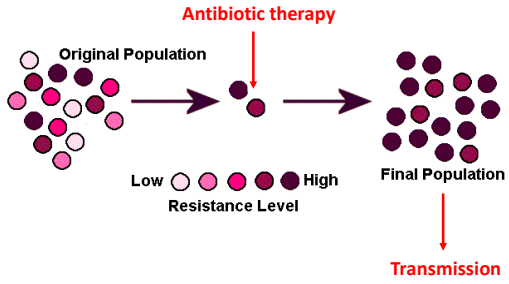
- Background on antibiotic resistance
- Why is antibiotic resistance a societal problem?
- Which social trends and individual behaviours favour the spread of antibiotic resistance?
- What are the primary areas that could contribute to a better control antibiotic resistance problems?
- What is the link between all the points above and household pets?

Facts about antibiotic resistance

- Antibiotics are essential in the cure of bacterial infections
- Antibiotic use promotes selection of resistant bacteria, thereby reducing their therapeutic efficacy

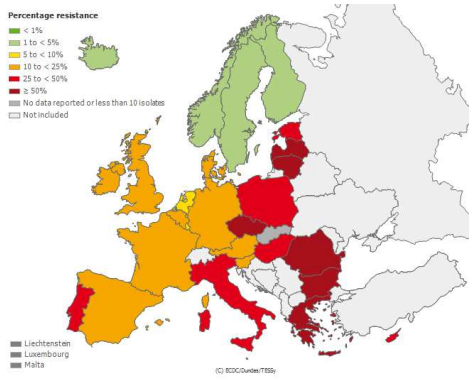
Resistance cannot be eradicated but has to be contained through a balance between the positive and negative effects of using antibiotics

Antibiotic selection: a reasonable biological model



Prevalence of cephalosporin-resistant *K. pneumoniae* in Europe

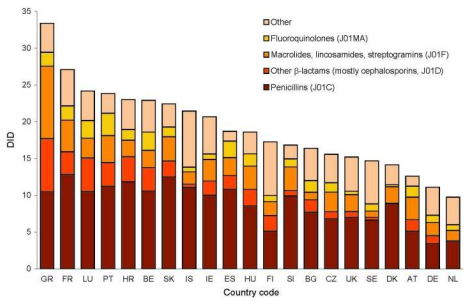
European Centre for Disease Prevention and Control (2010)



Antimicrobial Drug Use and Resistance in Europe

Nienke van de Sande-Bruinsma, Hajo Grundmann, Didier Verloo, Edine Tiemersma, Jos Monen, Herman Goossens, Matus Ferech, and the European Antimicrobial Resistance Surveillance System and European Surveillance of Antimicrobial Consumption Project Groups†

Emerging Infectious Diseases • www.cdc.gov/eid • Vol. 14, No. 11, November 2008



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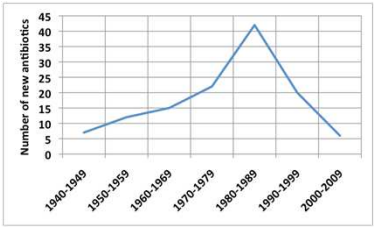
We lack new antibiotics in human medicine



Low profit for the big pharma due to high development costs, limited market and short treatment course

Why is antibiotic resistance a societal problem?

Antibiotic resistance is a cost for the society

- **Public health impact**
  - Increased mortality and morbidity
- **Economic impact**
  - More visits
  - More laboratory tests
  - New and more expensive antimicrobial therapy
  - Prolonged hospitalization
  - Absence from work
  - Costs for research and surveillance

Annual burden in the EU (www.ecdc.eu):

- **25.000 deaths**
- **1.5 billion euro**

Impact of antibiotic resistance on patient mortality and healthcare costs

Maragakis et al. 2008

Table 1 Impact of antibiotic resistance on patient mortality, length of hospital stay, and healthcare costs

Infection and causative organism	Increased risk of death (OR)	Attributable length of stay (days)	Attributable cost[a] (US$)
MRSA bacteremia	1.9	2.2	6916
MRSA surgical infection	3.4	2.6	13 901
VRE infection	2.1	6.2	12 766
Resistant *Pseudomonas aeruginosa* infection	1.8–5.4	5.7–6.5	11 981–32 949
Resistant *Enterobacter* infection	5.0	9.0	29 379
Resistant *Acinetobacter* infection	2.4–6.2	5–13	3758
ESBL-producing or KPC-producing *Escherichia coli* or *Klebsiella* infection	3.6	1.6-fold increase	1.7-fold increase

ESBL, extended-spectrum β-lactamase; KPC, *Klebsiella pneumoniae* carbapenemase; MRSA, methicillin-resistant *Staphylococcus* aureus; OR, odds ratio; VRE, vancomycin-resistant enterococci.

Effects of the economic burden of antibiotic resistance

- **CROSS-SECTIONAL EFFECT S**
  - The consequences are imposed to people other than the immediate consumer
- **LONG -TERM EFFECTS**
  - The consequences of current use of antibiotics affect the generations to come with direct consequences on the quality of the service offered by national healthcare systems (e.g. reduced offer for advanced surgery procedures, cancer chemotherapy , etc.)

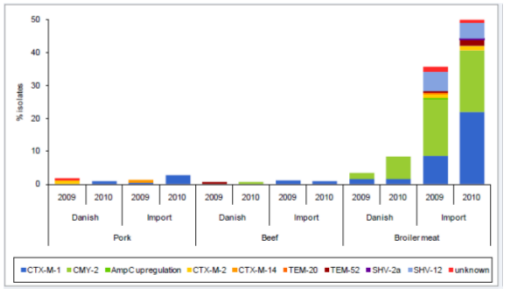
Which social trends favour the spread of antibiotic resistance?

Social trends

- Emigration
- Traveling
- Medical tourism
- Movement of animals/food

Occurrence of cephalosporin-resistant *E. coli* in meat in DK

DANMAP 2010



This is a global problem that requires a global approach

ANTIMICROBIAL AGENTS AND CHEMOTHERAPY, Sept. 2010, p. 3564–3568 Vol. 54, No. 9
0066-4804/10/$12.00 doi:10.1128/AAC.00220-10

Foreign Travel Is a Major Risk Factor for Colonization with *Escherichia coli* Producing CTX-M-Type Extended-Spectrum β-Lactamases: a Prospective Study with Swedish Volunteers▽

Thomas Tängdén,[1]* Otto Cars,[1] Åsa Melhus,[2]† and Elisabeth Löwdin[1]†

Sections of Infectious Diseases[1] and Clinical Bacteriology,[2] Department of Medical Sciences, Uppsala University, Uppsala, Sweden

- 24/100 travelers became positive after their trip
- 5 of 21 had persistent colonization (> 6 months)
- Traveling to India was the most significant risk factor (88%)
- Gastroenteritis during the trip was an additonal risk factor (P = 0.003)

Medical tourism

Worldwide spread of NDM-1

Jean and Hsueh 2011

Most of the European patients had been hospitalized in India, Pakistan or Bangladesh, were of South Asian origin or had spent some time in that part of the world.

This is a global problem requiring a global approach

- Establishment of **effective surveillance systems** to assess shift of antibiotic resistance patterns and use this information to guide prescribers on the appropriate use of antibiotics
- To improve patient's and provider's behaviour to **reduce inappropriate use** of antibiotics and **prevent transmission** of resistant bacteria
- To encourage **research and development of new antibiotics**

Which individual behaviours favour the spread of antibiotic resistance?

Individual behaviour – levels of responsability

- **National/international**
  - Governements
  - National and international organisations
- **Healthcare facilities**
  - Hospitals
  - Nursery homes
  - Veterinary practices
- **Prescribers**
  - Doctors
  - Veterinarians
- **Users**
  - Patients
  - Farmers
  - Companion animal owners

Strategies for control of resistance by level of responsibility

Modified from DiazGranados et al. 2008

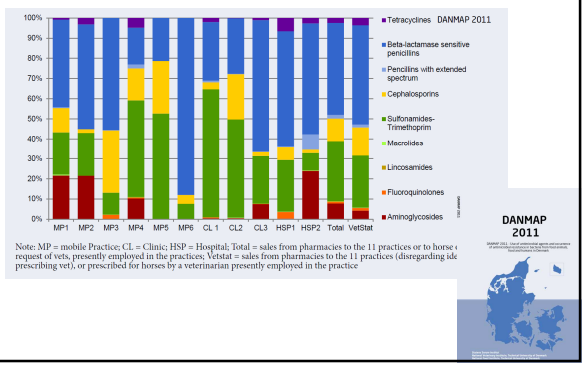
Strategy	National/International	Regional/Hospital	Prescriber
Patient education	Develop and provide materials	Provide materials	Educate patients
Prescriber education	Develop and provide materials	Provide training and materials	Educate self
Rational antibiotic use	Develop and provide guidelines and resources	Implement community programmes	Implement
Surveillance	Build/maintain laboratory capacity	Build/maintain laboratory capacity	Collect appropriate cultures and report cases
Preventing spread	Develop and provide guidelines	Promote infection prevention and control	Implement infection control programmes
Research	Support national studies on drug, diagnostic test and vaccine development	Study effective provision of service/policies	Case reports and case series

Non-biomedical reasons leading to antibiotic overprescription

- Doctors in the public sector:
  - *"Antibiotics as time-saving measures"*
- Doctors in the private sector:
  - *"Fear of loosing clients"*
- Cultural beliefs by the patient:
  - *"There is a pill for every ill"*

Antimicrobial consumption in 11 Danish horse practices

DANMAP 2011



What are the primary areas that could contribute to a better control antibiotic resistance problems?

Control antibiotic use

- **Legal measures**
  - Limiting profit of prescriber
  - Ban/restriction
  - Control of consumption (e.g. taxation/penalties)
- **Educational measures**
  - Antibiotic stewardship
  - Improved education

Control transmission

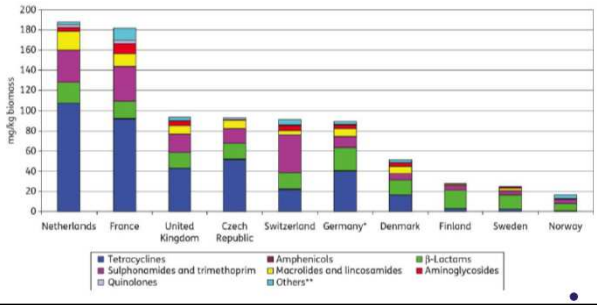
- **Pre-harvest control**
  - Preventive medicine
  - Farm hygiene
  - Control of animal trade
  - Improved diagnostics
  - Improved therapy
- **Post-harvest control**
  - Improved hygiene at slaughter

J Antimicrob Chemother 2010; 65: 2037–2040
doi:10.1093/jac/dkq247 Advance Access publication 29 June 2010

Journal of Antimicrobial Chemotherapy

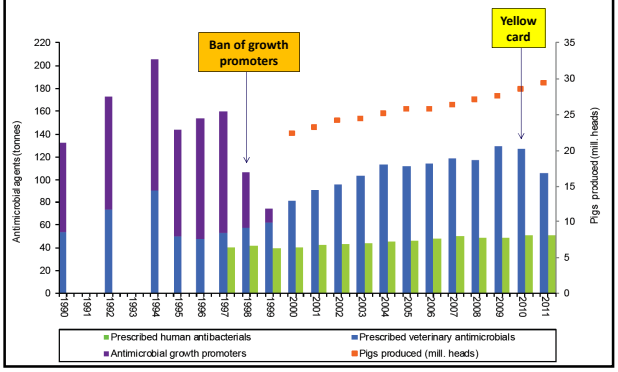
Comparison of the sales of veterinary antibacterial agents between 10 European countries

Kari Grave*, Jordi Torren-Edo and David Mackay



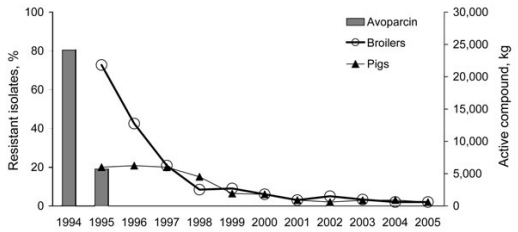
Antibiotic use in pig production and human medicine in DK

DANMAP 2011



Effect of the avoparcin ban on the prevalence of vancomycin-resistant *E. faecium* (VRE) in broilers and pigs in Denmark

(Hammerum et al. EID 2007)



Occurrence of VRE in faecal samples from Danish broilers and pigs in 2010

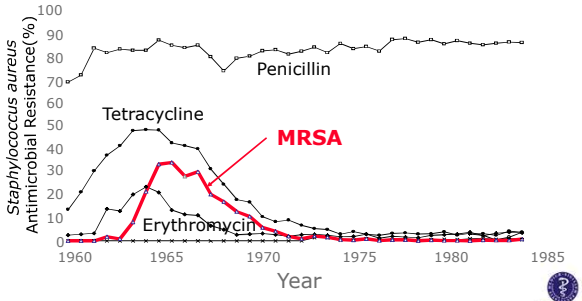
DANMAP 2010

	Selective method	DANMAP method
	**47%**	0
	0	0.8%

VREF has persisted in broilers 16 years after the ban of avoparcin!

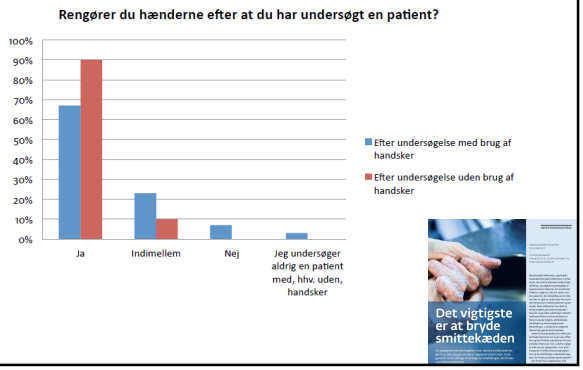
Prevalence of MRSA in *S. aureus* blood isolates, Denmark, 1960-1995

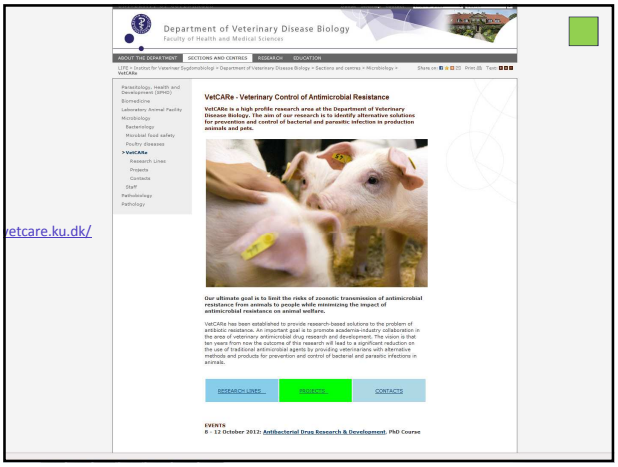
DANMAP 1997 (www.danmap.org)



Hand washing of Danish veterinarians after visits

Helmfrid and Guardabassi 2012 – Dansk Veterinætidsskrift





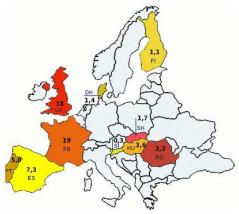
vetcare.ku.dk/

What is the link to household pets?

JAC

Pet animals as reservoirs of antimicrobial-resistant bacteria

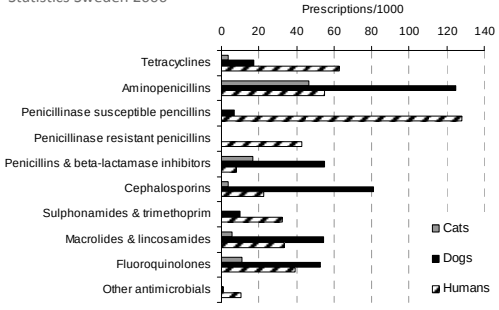
Luca Guardabassi[1]*, Stefan Schwarz[2] and David H. Lloyd[3]



Approximately 40% Danish families have a pet at home

Antibiotic use in pets and humans in Sweden

Statistics Sweden 2006



New facts...

- Dangerous types of **multi-resistant bacteria** (MRSP, MRSA and ESBL) have spread globally in pets since 2006
- Serious **consequences to animal health** due to treatment failure and increase euthanasia
- Potential **zoonotic risks** for people exposed to pets (veterinarians, owners, pet care takers, patients using pet therapy, etc.)
- Veterinarians have started using **critically important antibiotics (CIAs)** licensed for human use (carbapenems and vancomycin)

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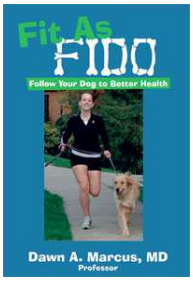
Cultural and societal aspects related to antibiotic resistance in pets

- People do not perceive pets as possible sources of disease
- Risks to pet owners may be overlooked by doctors and veterinarians
  - Scarce knowledge of the problem
  - Pet ownership is not recognized as a risk factor
  - Diagnostic problems

Recommended reading ☺



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Thank you!

Coffee?