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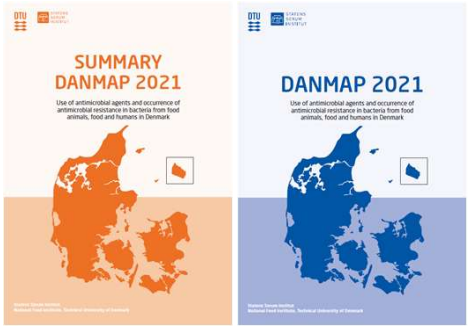
DANMAP Seminar

Danish Programme for surveillance of antimicrobial consumption and resistance in bacteria from food animals, food and humans



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Agenda

- Antibiotikaforbrug til dyr
- Antibiotikaforbrug til mennesker
- Antibiotikaresistens i zoonotiske bakterier og indikatorbakterier fra dyr og fødevarer
- Antibiotikaresistens i bakterier fra mennesker
- Antibiotikaresistens i patogene bakterier fra dyr

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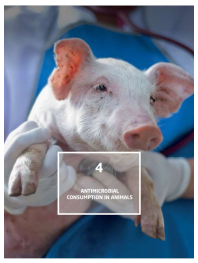
FORBRUG AF ANTIBIOTIKA TIL DYR

Birgitte Borck Høg
Dyrlæge, Fødevarestyrelsen
(Tidligere: Specialkonsulent, DTU Fødevareinstituttet)
Vibe Dalhoff Andersen
Dyrlæge, Akademisk medarbejder, DTU Fødevareinstituttet



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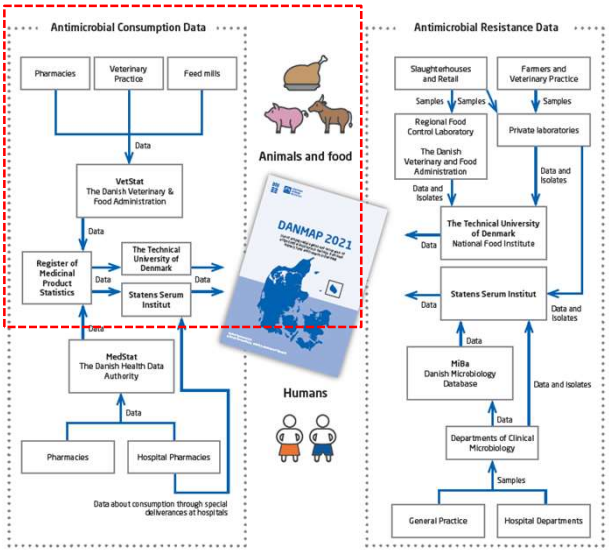
Danmap data flow



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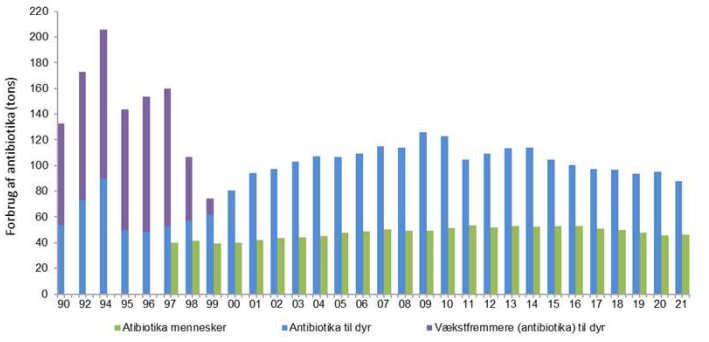
Forbrug af antibiotika til dyr og mennesker – historisk overblik



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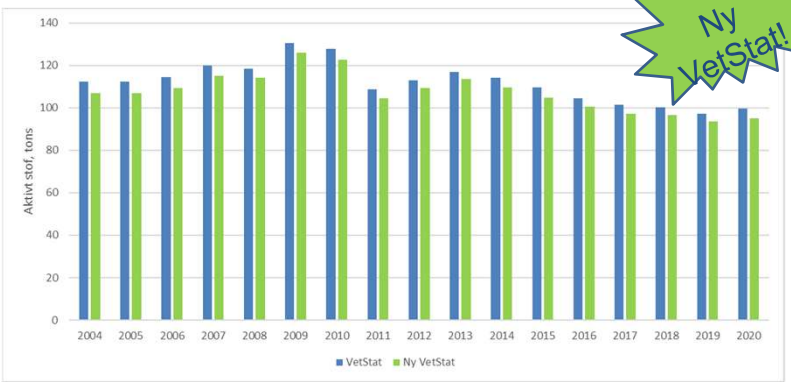
Forbrug af antibiotika til dyr



Ny VetStat!

https://vetstat.fvst.dk/vetstat/

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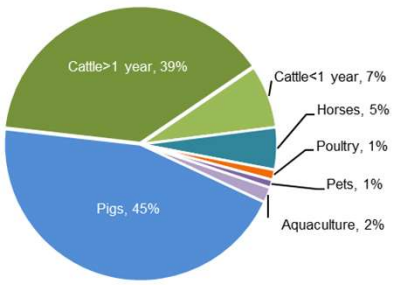
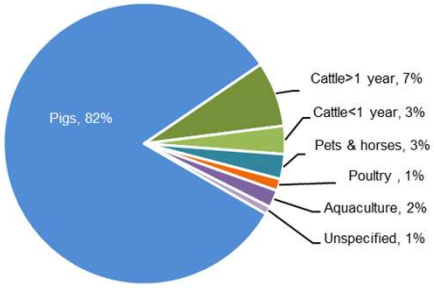
Relative fordelinger af biomasse og antibiotikaforbrug, dyr, 2021





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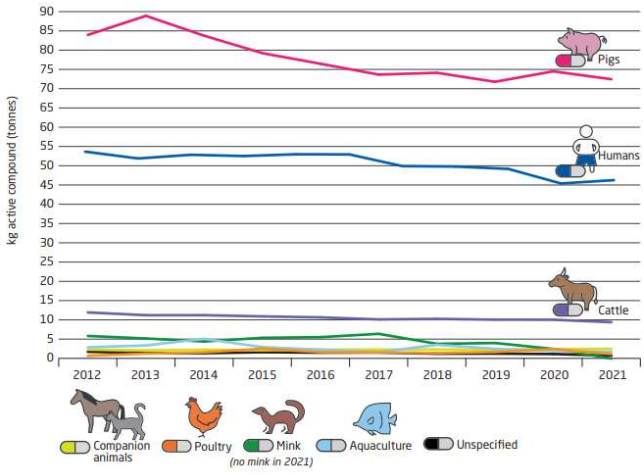
Forbrug af antibiotika til dyr og mennesker, 2012-2021



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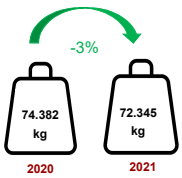
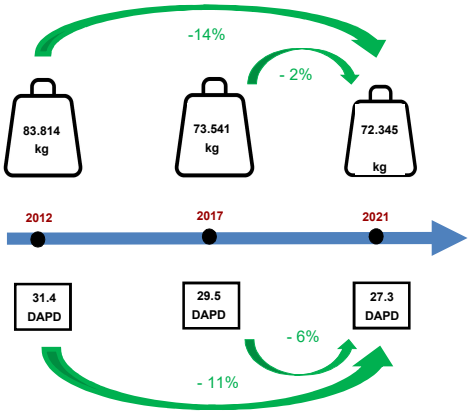
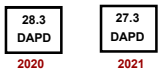
Enheder til opgørelse af antibiotikaforbrug - kg aktivt stof & behandlinger i svineproduktionen





Eller målt i **DAPD** (DADD pr 1000 dyr pr dag)



10 DAPD svarer til at **1% af den pågældende population** er under behandling på en given dag

9

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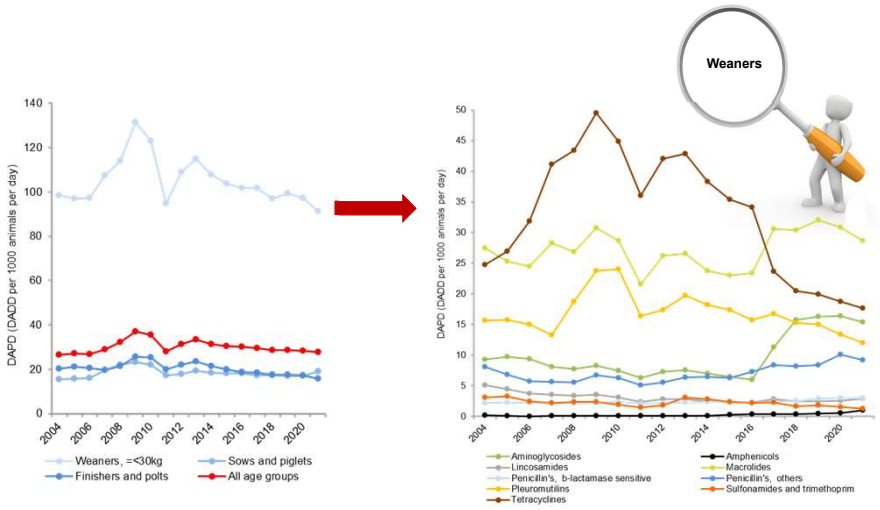
Forbrug af antibiotika til svin



DANMAP 2021

10 DAPD svarer til at **1% af den pågældende population** er under behandling på en given dag

10

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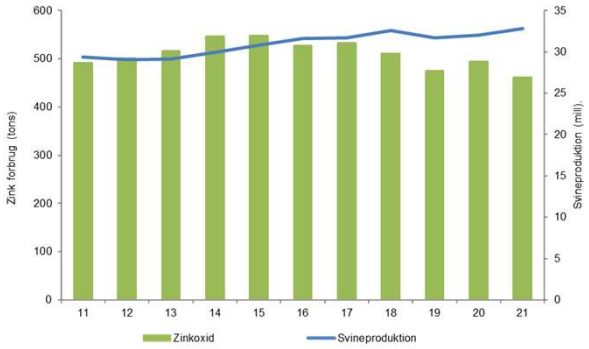
Forbrug af medicinsk zink til svin



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Handlingsplan - mål for antibiotikaforbrug til svin

Figure 2.5 Antimicrobial use in pigs and goals of the national action plan against antimicrobial resistance, Denmark, 2012-2021

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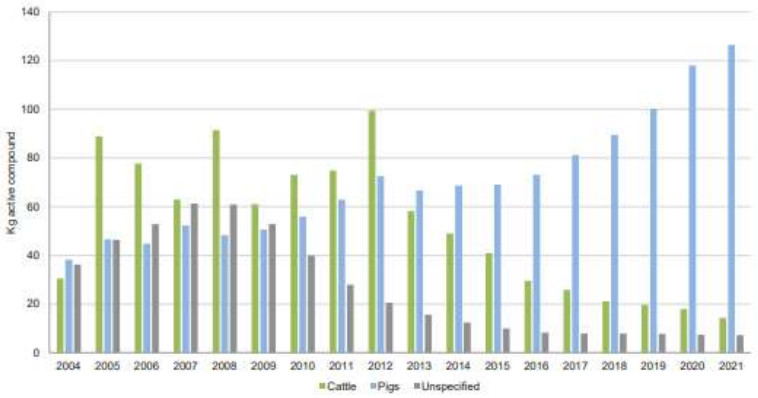
Forbrug af topikal chlortetracyklin til svin og kvæg, 2004-2021



DANMAP 2021

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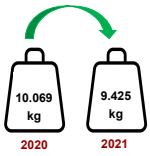
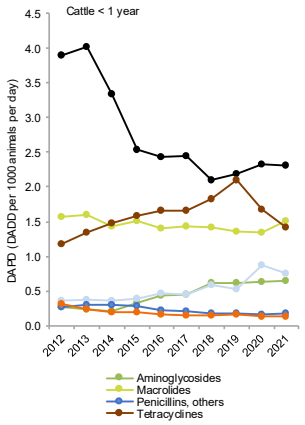
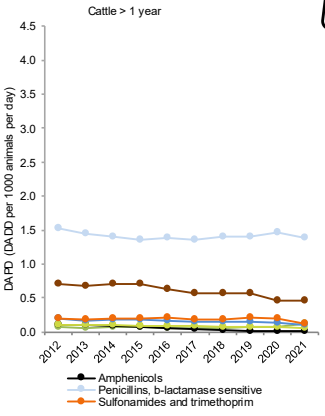
Antibiotikaforbrug til kvæg, systemisk







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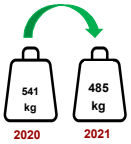
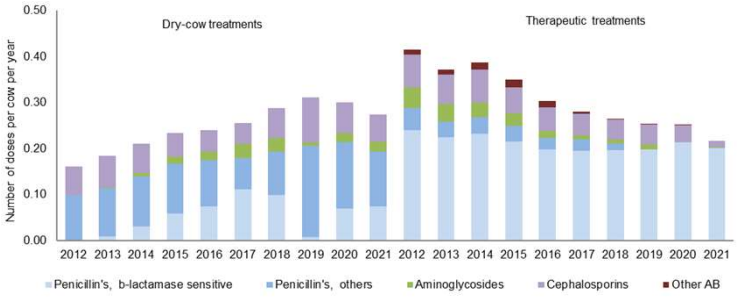
Forbrug af antibiotika til kvæg, intramammaria





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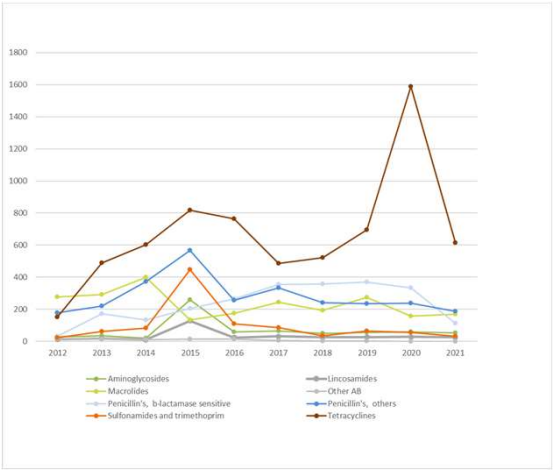
Forbrug af antibiotika til fjerkræ



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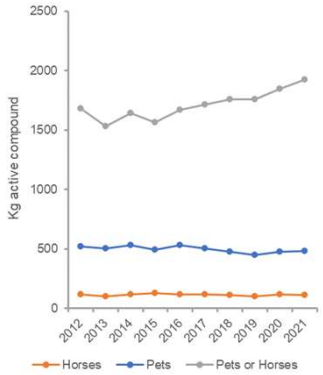
Antibiotikaforbrug til kæledyr og heste



- Estimeret forbrug steget 8% siden 2012
- Alle 3. og 4. generations cefalosporiner ordineret til dyr bruges til kæledyr
- Stort set alle fluorokinoloner anvendes til kæledyr

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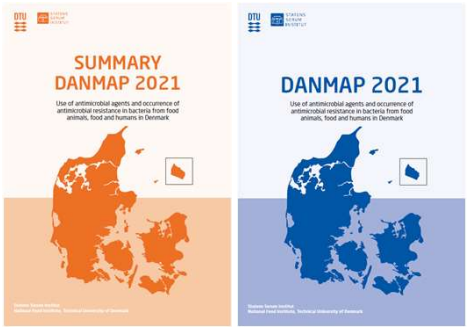
DANMAP Seminar

Overvågning af antibiotikaforbruget til mennesker

Majda Attauabi
Cand.pharm

Referencelaboratoriet for Antibiotikaresistens
Infektionsberedskabet
Statens Serum Institut



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Agenda

- **Opgørelsesmetoder**
- **Antibiotika på landsplan**
- **Antibiotika i primærsektoren**
- **Antibiotika på plejehjemmene**
- **Antibiotika på hospitalerne**
- **Opsummering**

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OPGØRELSESMETODER

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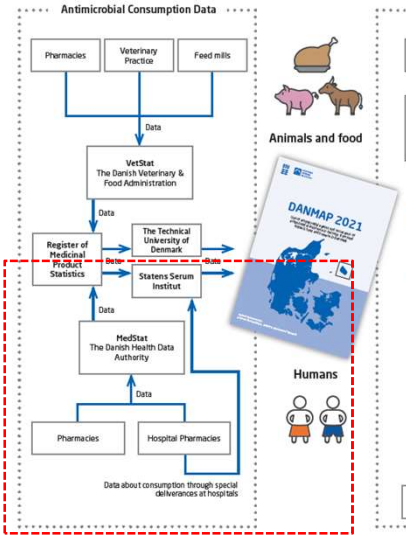
DANMAP data flow

Figure 2.1 Organisation of the DANMAP collaboration regarding data and data flow

DANMAP 2021



SUNDHEDSDATA-STYRELSEN
Tal fra Landspatientregisteret

DANMARKS STATISTIK
Indbyggertal

22

Forbrug kan måles på mange måder

Antal recepter

Antal behandlede

Definerede døgndoser (DDD)

> DDD er den gennemsnitlige vedligeholdelsesdosis per dag for et lægemiddel, når det bruges til dets hovedindikation til behandling af voksne

World Health Organization

[Colourbox]

23

Enheder

DDD

Defined Daily Dose

DID

DDD per 1000 Inhabitants per Day

DBD

DDD per 100 Bed-Days

DAD

DDD per 100 Admissions

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ANTIBIOTIKA PÅ LANDSPLAN

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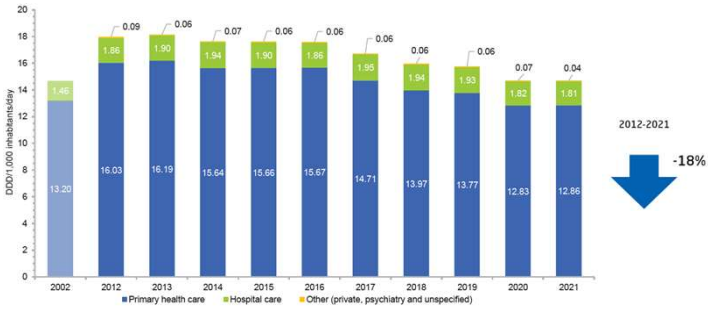
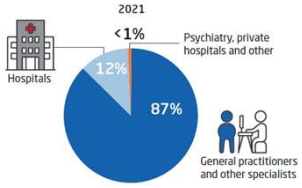
Antibiotika i Danmark

Figure 5.1 Total consumption of systemic antimicrobial agents in humans, DDD per 1,000 inhabitants per day, Denmark, 2002 and 2012-2021 DANMAP 2021



2012-2021 -18%

Data: Total sales in Denmark
Data source: Register of Medicinal Product Statistics and 2022 edition of the Anatomical Therapeutic Chemical (ATC) classification system



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ANTIBIOTIKA I PRIMÆRSEKTOREN

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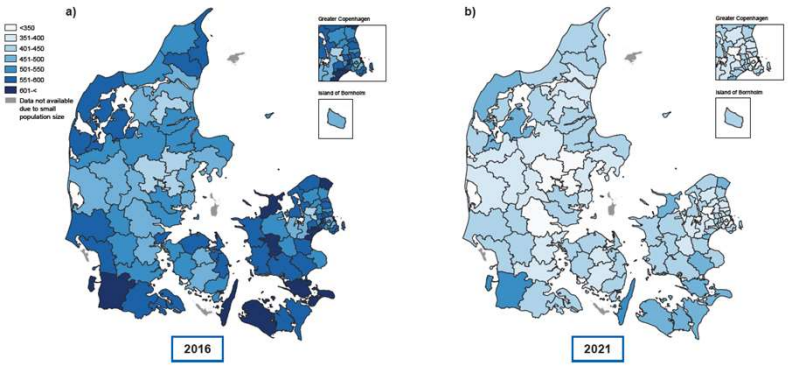
Antibiotika i primærsektoren

Figure 5.6 Number of prescriptions from primary health care per 1,000 inhabitants in Danish municipalities in a) 2016 and b) 2021
DANMAP 2021



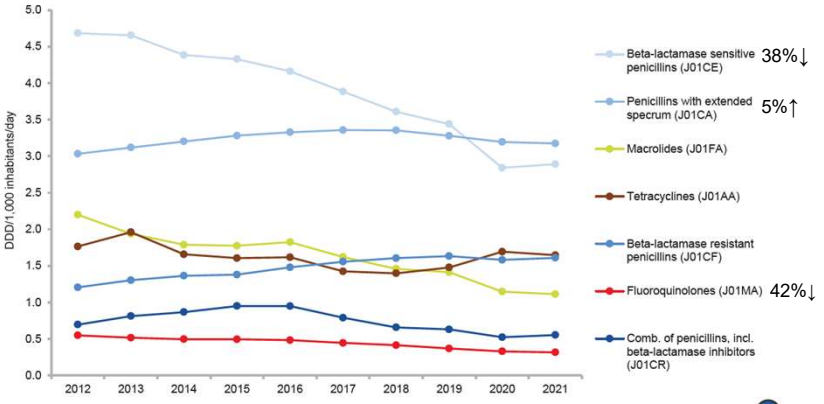
Data: Registered sales to individuals
Data source: Register of Medicinal Product Statistics and 2022 edition of the Anatomical Therapeutic Chemical (ATC) classification system

2016: 522 recepter/1000 indbyggere
2021: 396 recepter/1000 indbyggere
24% ↓

Antibiotika i primærsektoren

Figure 5.7 Consumption of leading antimicrobial groups for systemic use in primary health care, DDD per 1,000 inhabitants per day, Denmark, 2012-2021

DANMAP 2021



Data: Registered sales to individuals and clinics
Data source: Register of Medicinal Product Statistics and 2022 edition of the Anatomical Therapeutic Chemical (ATC) classification system

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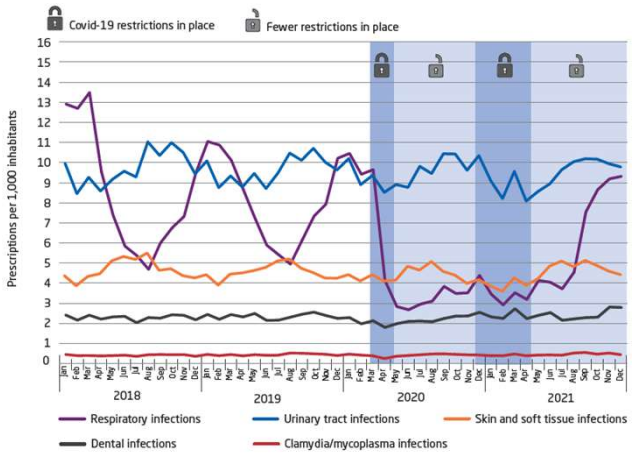
Antibiotika i primærsektoren

Figure 3.4 Monthly consumption of systemic antimicrobials by indication in primary health care, prescriptions per 1,000 inhabitants, Denmark, 2018-2021



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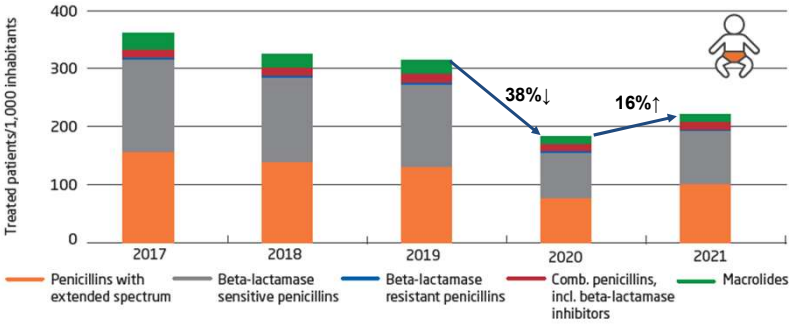
Antibiotika i primærsektoren

Figure 3.3 Antimicrobial consumption for children from 0-4 years old in primary health care, Denmark, 2017-2021



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ANTIBIOTIKA PÅ PLEJEHJEM

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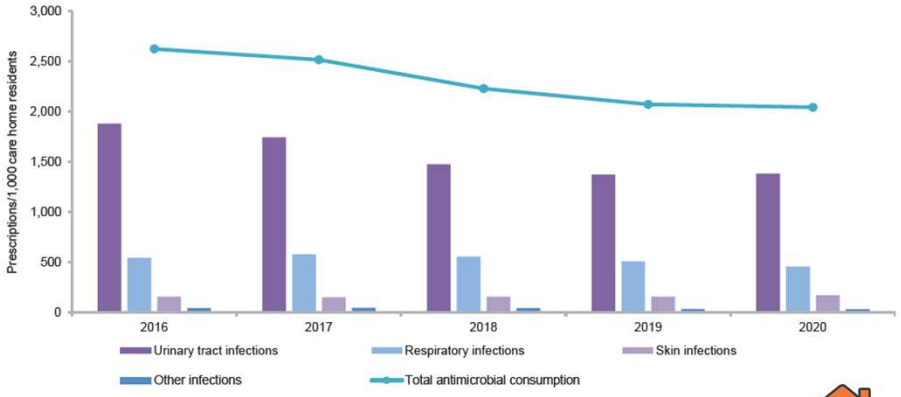
Antibiotika på plejehjem

Figure 1 Consumption of antimicrobials (J01 and P01AB01) in primary health care for elderly people living in care homes, Denmark, 2016-2020

DANMAP 2021



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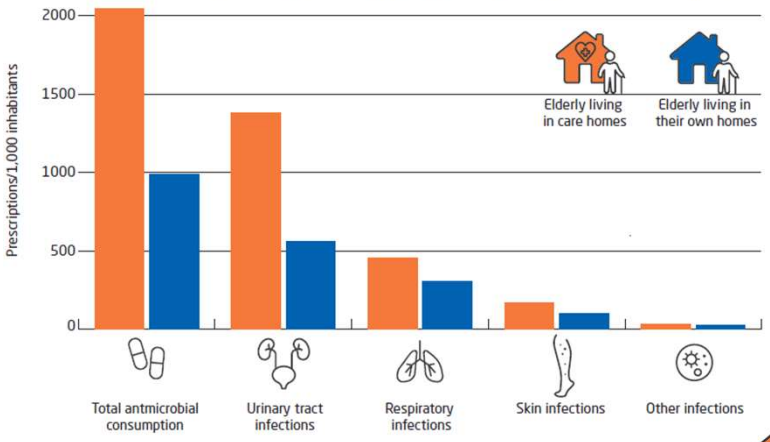
Antibiotika på plejehjem

Figure 3.5 Antimicrobial consumption in elderly living at care homes and in elderly living in their own homes, Denmark, 2020



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ANTIBIOTIKA PÅ HOSPITALERNE

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Antibiotika på hospitalerne

Figure 5.19 Consumption of antimicrobial agents for systemic use in Denmark, DDD per 1,000 inhabitants per day, Denmark, 2012-2021

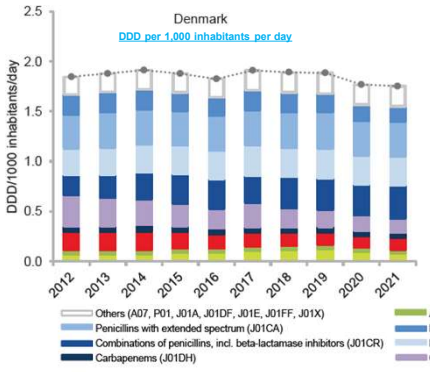
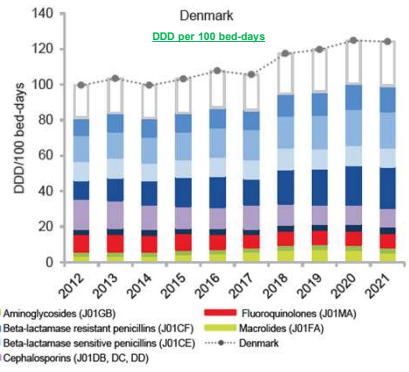


Figure 5.20b Consumption of antimicrobial agents for systemic use in Denmark, DDD per 100 bed-days, Denmark, 2012-2021



Data: Consumption at somatic hospitals
Data source: Register of Medicinal Product Statistics, 2022 edition of the Anatomical Therapeutic Chemical (ATC) classification system and The National Patient Register

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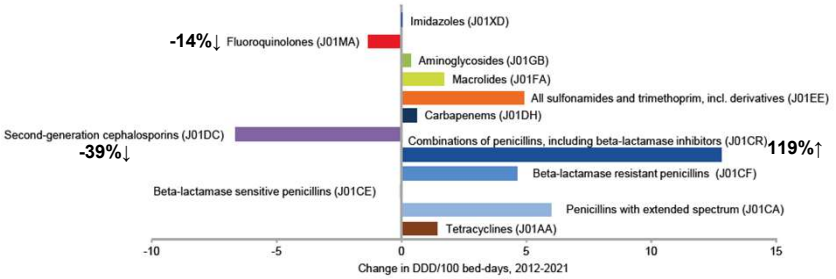
Antibiotika på hospitalerne

Figure 5.16 Changes in the consumption of leading groups of antimicrobial agents at somatic hospitals, DDD per 100 bed-days, Denmark, 2012-2021

DANMAP 2021



Data: Consumption at somatic hospitals
Data source: Register of Medicinal Product Statistics, 2022 edition of the Anatomical Therapeutic Chemical (ATC) classification system and The National Patient Register

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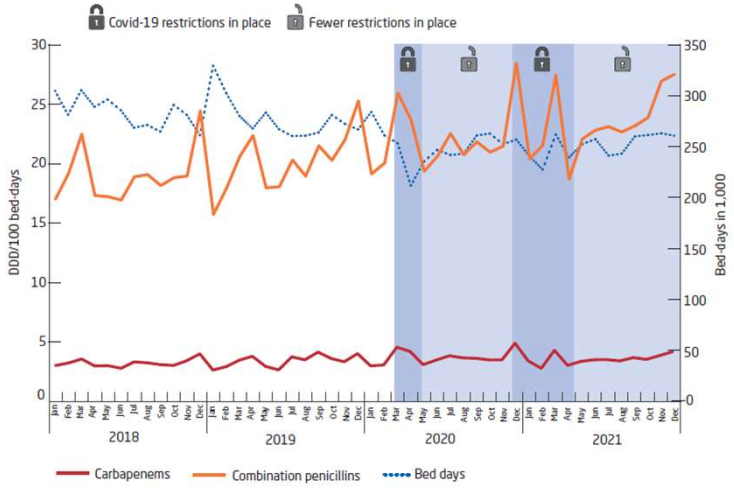
Antibiotika på hospitalerne

Figure 3.6 Consumption of key antimicrobials used for treatment of seriously ill patients in hospital, DDD per 100-bed-days, Denmark, 2018-2021



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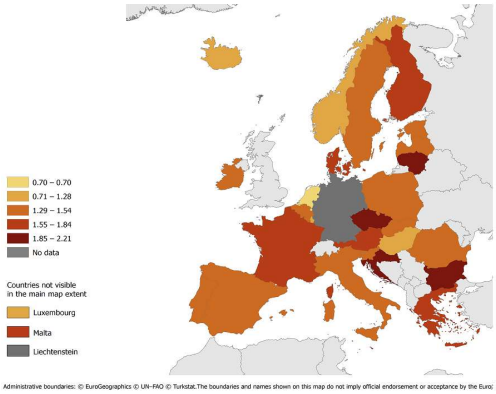
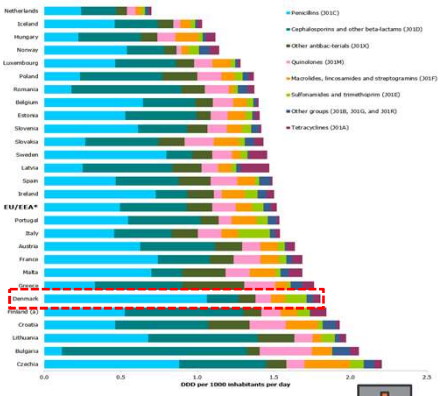
Antibiotika på hospitalerne i Europa

Figure 4. Hospital sector consumption of antibacterials for systemic use (ATC group J01), EU/EEA countries, 2021 (expressed as DDD per 1 000 inhabitants per day)



Finland: data include consumption in remote primary healthcare centres and nursing homes

Figure 5. Hospital sector consumption of antibacterials for systemic use (ATC group J01) at ATC level 3 sub-group, EU/EEA countries, 2021 (expressed as DDD per 1 000 inhabitants per day)



(a) Finland: data include consumption in remote primary healthcare centres and nursing homes.
EU/EEA refers to the corresponding population-weighted mean consumption based on countries that provided data for 2020 (25 countries).

https://www.ecdc.europa.eu/en/antimicrobial-consumption/database/country-overview

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Opsummering

- Forbruget af antibiotika i Danmark er stagneret fra 2020 til 2021
- Faldet i forbruget de sidste 10 år var drevet af primærsektoren
- Forbruget af bredspektret antibiotika på hospitalerne stiger fortsat, når man tager højde for ændringer i antal indlæggelser og sengedage på hospitalerne
- Covid-19 har påvirket forbruget af antibiotika betydeligt, men det ser ud til at forbruget er på vej tilbage til niveaet før pandemien

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Antimicrobial resistance in bacteria from food animals and food Denmark, 2021

Ana Sofia Ribeiro Duarte
Senior Researcher
DTU National Food Institute
Foodborne Pathogens and Epidemiology

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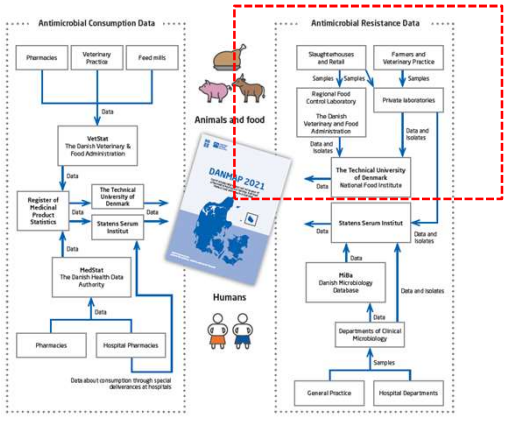

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New EU legislation for harmonized AMR monitoring

Decision 2020/1729/EU, 1 January 2021:

- Mandatory monitoring of:
  - *Campylobacter coli*
  - ESBL-, AmpC- or CP-producing *E. coli* in imported fresh meat sampled at Border Control Posts
  - ESBL-, AmpC- or CP-producing *E. coli* in fresh turkey meat sampled at retail and at BCPs
- Allows the use of WGS instead of AST for specific or confirmatory testing of ESBL-, AmpC- or CP-producing *E. coli*
- Changes in AST panels' substances and concentrations
- Changes in ECOFFs

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Changes in AST panels and ECOFFs

- *Salmonella* and *E. coli*
  - » inclusion of amikacin
- *Campylobacter*
  - » removal of nalidixic acid and streptomycin
  - » inclusion of chloramphenicol and ertapenem
- Changes in ECOFFs
  - » Ampicillin (8 -> 4)
  - » Cefepime (0.125 -> 0.25)
  - » Ertapenem (0.064 -> 0.03)
  - » Meropenem (0.125 -> 0.06)
  - » Nalidixic acid (16 -> 8)
  - » Temocilin (32 -> 16)
  - » Tigecycline (1 -> 0.5)

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Overview of animal isolates reported in DANMAP

Caecal samples:

- All samples: inc
- Pig and cattle s… *coli*
- Selection of pig samples: indicator *Enterococci (E. faecium, E. faecalis; E. faecalis AST)*

Broilers Cattle Pigs

Meat samples collected at retail/BCPs:

- All samples: ESBL/AmpC/carbapenemase-pl
- Retail samples: *Salmonella*

Beef Danish Beef Imported Pork Danish Pork Imported

Carcass swabs at the slaughterhouse:

- *Salmonella* (national control program)

Beef Danish Pork Danish

5

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Resistance in zoonotic bacteria

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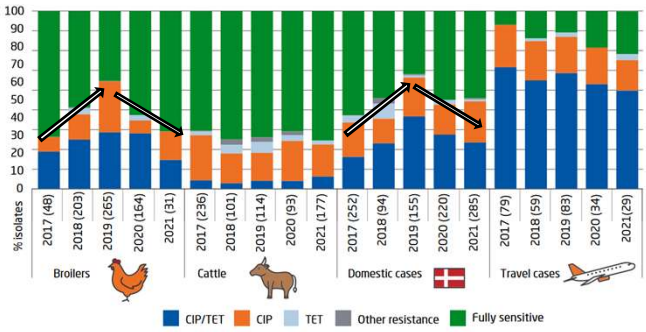
DANMAP 2021– *Campylobacter jejuni*

Figure 4.1 Distribution (%) of AMR profiles among *Campylobacter jejuni* from broilers, cattle and human cases, Denmark, 2017-2021



- Increase in %FS isolates continued in broilers
- Decrease in %CIP/TET isolates in broilers and domestic cases
- Increase in %FS isolates also in cattle and travel cases

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DANMAP 2021– *C. jejuni and C. coli*

Table 4.1 Resistance (%) in *Campylobacter jejuni* isolates from broilers, cattle and human cases, Denmark, 2021

	Broilers	Cattle	Human			
	Danish	Danish	Domestically acquired	Travel abroad reported	Unknown origin	Total
Antimicrobial agent	%	%	%	%	%	%
Chloramphenicol	0	0	0	0	0	0
Ciprofloxacin	32	25	49	72	57	52
Ertapenem	0	0	4	14	6	5
Erythromycin	0	0	0	0	2	<1
Gentamicin	0	0	0	0	0	0
Tetracycline	16	9	27	59	31	30
Fully sensitive (%)	68	73	49	24	41	46
Number of isolates	31	177	285	29	49	363

Pigs

***Campylobacter coli*:**

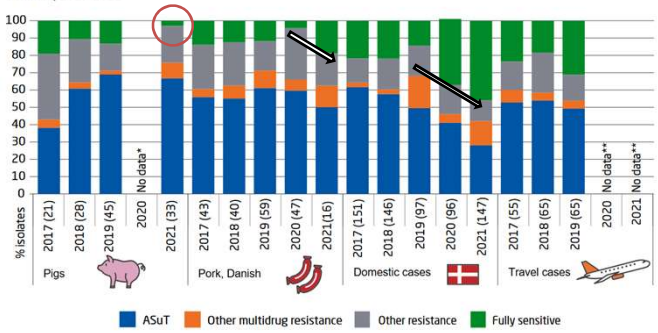
- 20% and 26% resistant against ciprofloxacin and tetracycline
- Gentamicin and chloramphenicol resistance - not observed
- Erythromycin resistance: 6% (7 isolates)
- Ertapenem resistance: 1 isolate

- Higher AMR occurrence in human isolates
- Common CIP and/or TET resistance
- Ertapenem resistance in *C. coli* from pigs, and *C. jejuni* from humans
- Erythromycin resistance detected in *C. coli*

48

DANMAP 2021– *Salmonella* Typhimurium

Figure 4.2 Relative distributions (%) of AMR profiles among *Salmonella* Typhimurium from pigs, pork and human cases, Denmark, 2017-2021



- Higher AMR occurrence in pig and pork isolates
- ASuT remains most common MDR profile
- Only 3% fully sensitive isolates from pigs
- Decrease in AMR occurrence in isolates from pork and domestic cases

NOTE: two outbreaks in 2021 with FS strains

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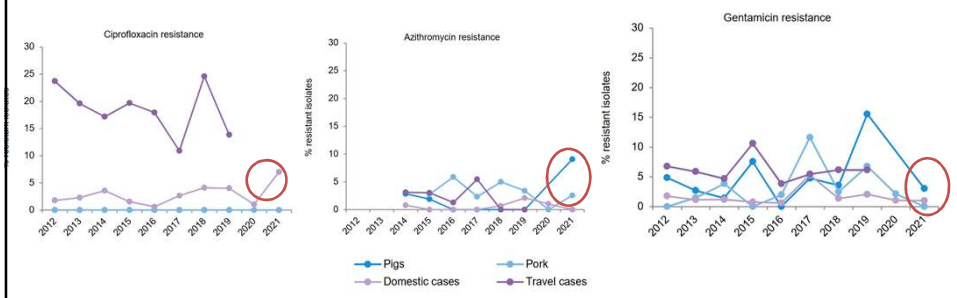
DANMAP 2021– *Salmonella* Typhimurium



- Increase in ciprofloxacin resistance in isolates from domestic cases
- Increase in azythromycin resistance in pig isolates

- Gentamicin resistance back to levels <2019
- <1% or no resistance to 3rd gen. cephalosporins, and no carbapenem resistance

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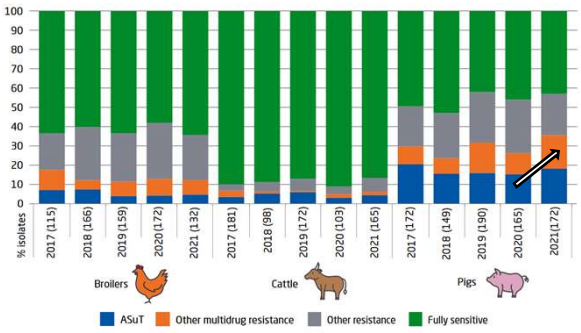
DANMAP 2021 - Indicator *E. coli*

Figure 5.1 Relative distributions (%) of fully sensitive, resistant and multidrug-resistant *Escherichia coli* isolates from broilers, cattle and pigs, Denmark 2017-2021



- %FS isolates increased in broilers and decreased in pigs and cattle
- No significant trend in %FS in the last 5 years
- %MDR isolates increased in pigs

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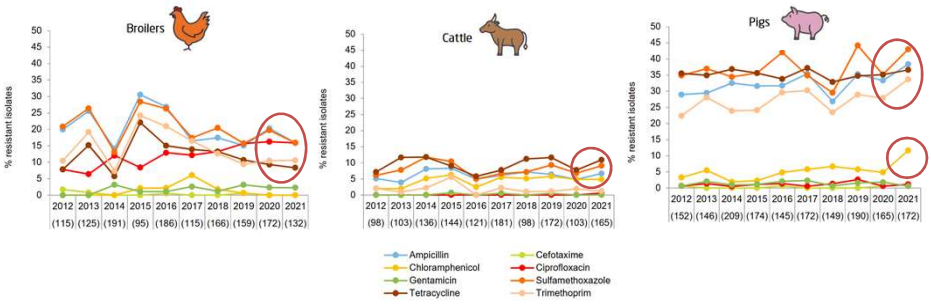
DANMAP 2021 - Indicator *E. coli*



- Increase in chloramphenicol resistance in pig isolates
- Increase in % resistance to ASuT substances in isolates from pigs and cattle

- Decrease in % resistance to ASuT substances in isolates from broilers

53

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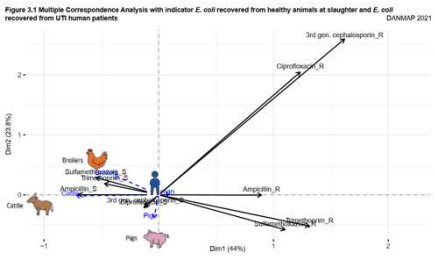
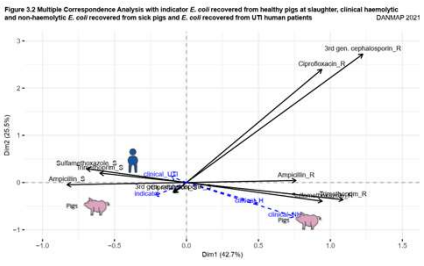
Indicator E. coli – One Health perspective





- Higher occurrence of resistance to ciprofloxacin and 3rd gen. cephalosporins in human UTI isolates
- More resistance in isolates from pigs and human UTI than in isolates from broilers and cattle
- More sensitivity among indicator *E. coli* than clinical *E. coli* in pigs

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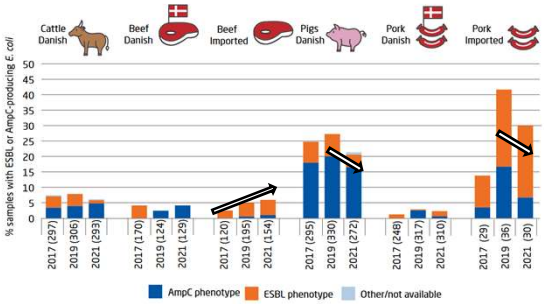
ESBL-, AmpC, CP-producing *E. coli*

Figure 5.2 Occurrence (%) of samples with phenotypic ESBL- or AmpC-producing *E. coli* from animals and meat recoved by selective enrichment, Denmark 2017-2021



- %ESBL- or AmpC-producing *E. coli* decreased in pigs and imported pork
- %ESBL- or AmpC-producing *E. coli* continued to increase in imported beef
- No occurrence of CP-producing *E. coli*

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ESBL-, AmpC, CP-producing *E. coli*

Table 5.2 Number of ESBL and AmpC enzymes detected in ESC-producing *E. coli* isolates from animals and meat recovered by selective enrichment, Denmark, 2021

	Cattle	Beef		Pigs	Pork	
Genotypes based on AmpC/ESBL enzymes	Danish %	Danish %	Import %	Danish %	Danish %	Import %
Number of AmpC genotypes	14	4	1	24	2	1
Number of ESBL genotypes	3	0	8	9	4	5
Number of AmpC+ESBL genotypes	1	0	1	14	0	1
Not available	1	1	0	11	1	2
Number (%) positive samples	18 (6%)	5 (4%)	10 (6%)	58 (21%)	7 (2%)	9 (30%)
Number of tested samples	293	129	154	272	310	30

- Phenotypic and genotypic profiles mostly in concordance
- WGS detected combined ESBL/AmpC encoding genes, but no combined resistance in AST

- Upregulated AmpC promotor C-42T mutations most common among AmpC-producing isolates
- Genes CTX-M-1 and TEM-1B most common among ESBL-producing isolates

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Indicator *Enterococcus faecalis*

Figure 7.4 Resistance (%) among *Enterococcus faecalis* isolates from pigs, Denmark DANMAP 2021

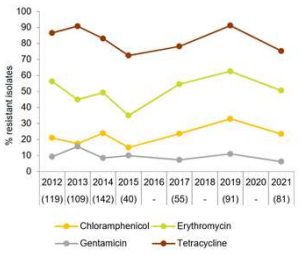

Table 7.4 Resistance (%) in *Enterococcus faecalis* isolates from pigs, Denmark DANMAP 2021

Antimicrobial agent	*Enterococcus faecalis* %
Ampicillin	0
Chloramphenicol	23
Ciprofloxacin	0
Daptomycin	0
Erythromycin	51
Gentamicin	6
Linezolid	0
Teicoplanin	0
Tetracycline	75
Tigecycline	0
Vancomycin	0
Fully sensitive (%)	21
Number of isolates	81

E. faecalis are assumed inherently resistant to streptogramins (Quinopristin/Dalfopristin)

- General decrease in resistance in comparison with 2019

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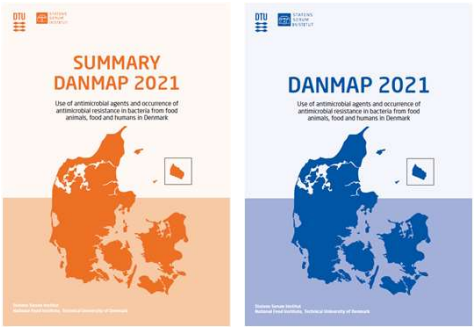
Antibiotikaresistens i humane patogener

Mikkel Lindegaard
Akademisk medarbejder
Cand.polyt, ph.d.

Referencelaboratoriet for antibiotika resistens
Statens Serum Institut



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Datakilder

Table 8.1 Summary of species/types, sampling and sources of isolates for national resistance surveillance in humans, Denmark, 2021 DANMAP 2021

Routine diagnostics from all 10 DCMs in Denmark. All data are directly identified and extracted in MiBa	
Species	**Sampling**
Escherichia coli *Klebsiella pneumoniae*	First isolate per patient per year from blood or cerebrospinal fluid, from urine in hospitalised patients and from urine from primary health care
Pseudomonas aeruginosa *Acinetobacter* species *Enterococcus faecalis* *Enterococcus faecium*	First isolate per patient per year from blood or cerebrospinal fluid
Voluntary submissions of isolates to the reference laboratories at SSI	
Species or type	**Sampling**
Staphylococcus aureus Beta-haemolytic streptococci	One isolate per patient per episode from blood or cerebrospinal fluid
Neisseria gonorrhoeae	One isolate per patient per episode from any sample site
3rd generation cephalosporin resistant *Escherichia coli*	First isolate per patient within 12 months from blood
Vancomycin-resistant enterococci	First isolate per patient within 12 months from any sample site (excluding screening samples)
Enterococci with exceptional phenotype (e.g. linezolid, daptomycin and tigecycline R)	First isolate per patient within 12 months from any sample site (clinical and screening samples)
All bacterial species with other exceptional phenotypes (e.g. acquired colistin resistance)	One isolate per patient per episode from any sample site
Mandatory submissions of isolates to the reference laboratories at SSI	
Species or type	**Sampling**
Carbapenemase-producing organisms	First isolate per patient within 12 months from any sample site (clinical and screening samples)
Methicillin-resistant *Staphylococcus aureus*	First isolate from all new cases of MRSA postive patients from any sample site (clinical and screening samples)
Streptococcus pneumoniae	One isolate per patient per episode from blood or cerebrospinal fluid
Haemophilus influenzae serotype b, Hib	All invasive isolates

Regarding submissions of isolates to the reference laboratories normally more isolates are received, but for the statistics each patient is counted only once

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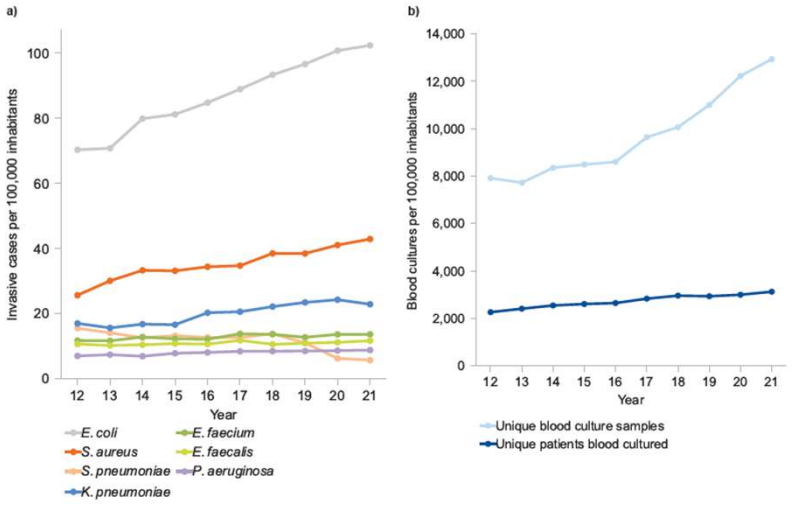
Invasive cases og unikke bloddyrkninger

Figure 8.2 a) Invasive cases and b) blood cultures taken per 100,000 inhabitants, Denmark, 2012-2021 DANMAP 2021



Datakilde: MiBa og Danmarks Statistik

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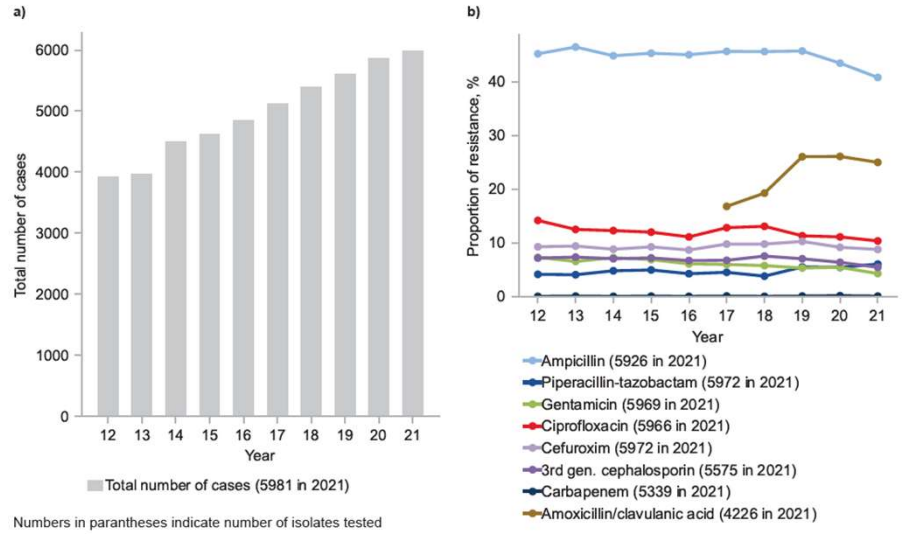
E. coli invasive infektioner



Numbers in parantheses indicate number of isolates tested

Datakilde: MiBa

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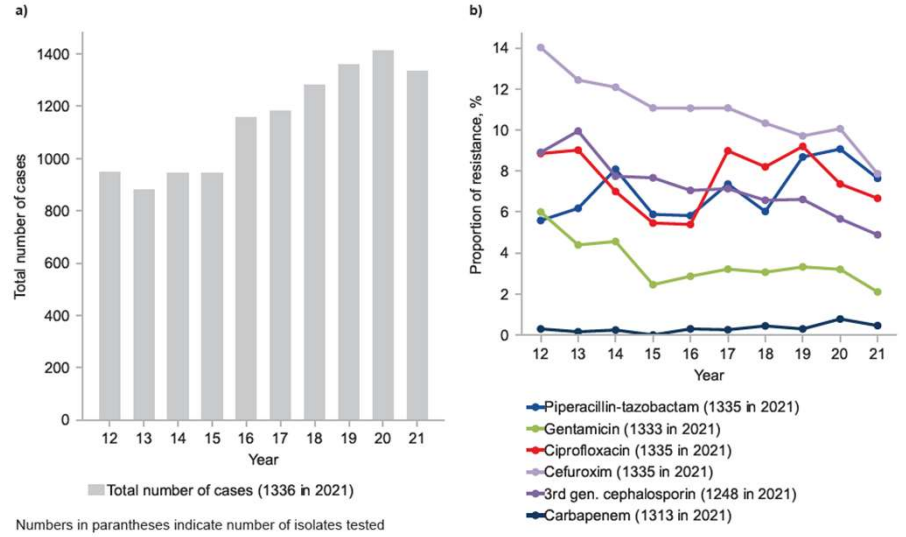
K. pneumoniae invasive infektioner



Numbers in parantheses indicate number of isolates tested

Datakilde: MiBa

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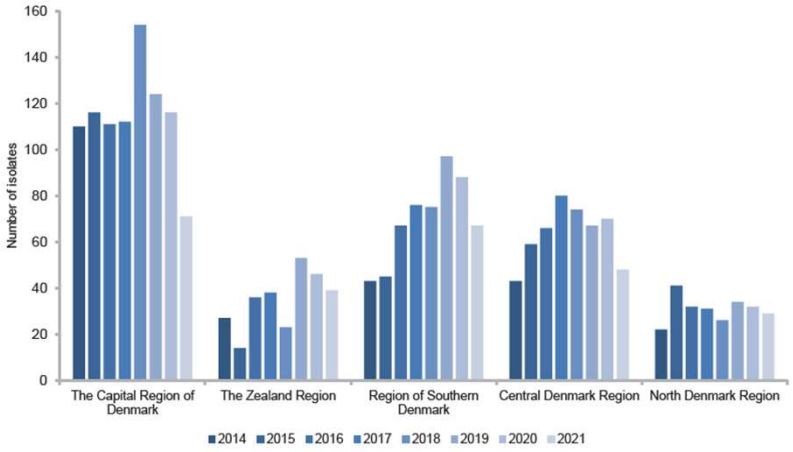
ESBL *E. coli*

Figure 8.12 ESBL/pAmpC producing *E. coli* from bloodstream infections by region, Denmark, 2014-2021 DANMAP 2021



Datakilde: NRL

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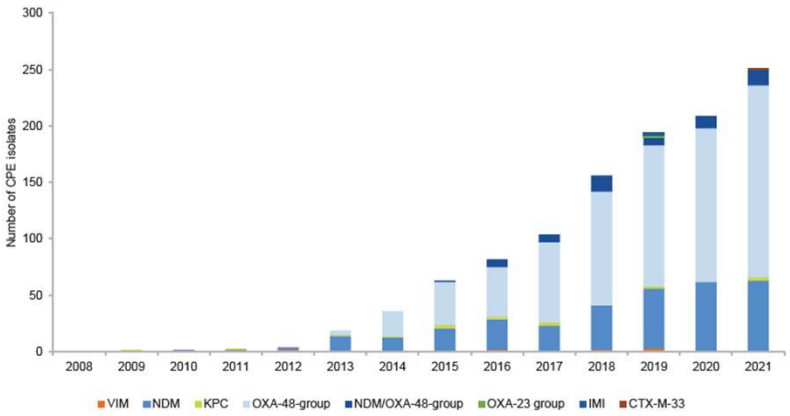
CPE

Figure 8.13 Numbers of carbapenemase-producing Enterobacterales (CPE), Denmark, 2008-2021 DANMAP 2021



Datakilde: NRL

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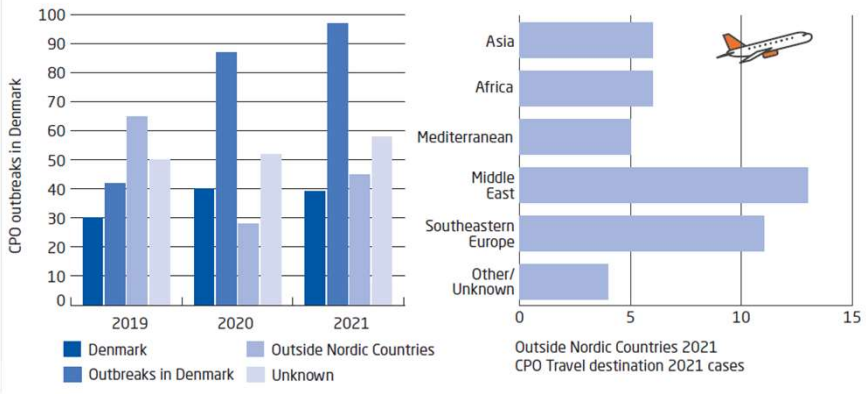
CPO

Figure 6.3 CPO a) Classification of CPO cases from 2019 through 2021 b) world regions where the patients with travel related cases had travelled



Datakilde: NRL

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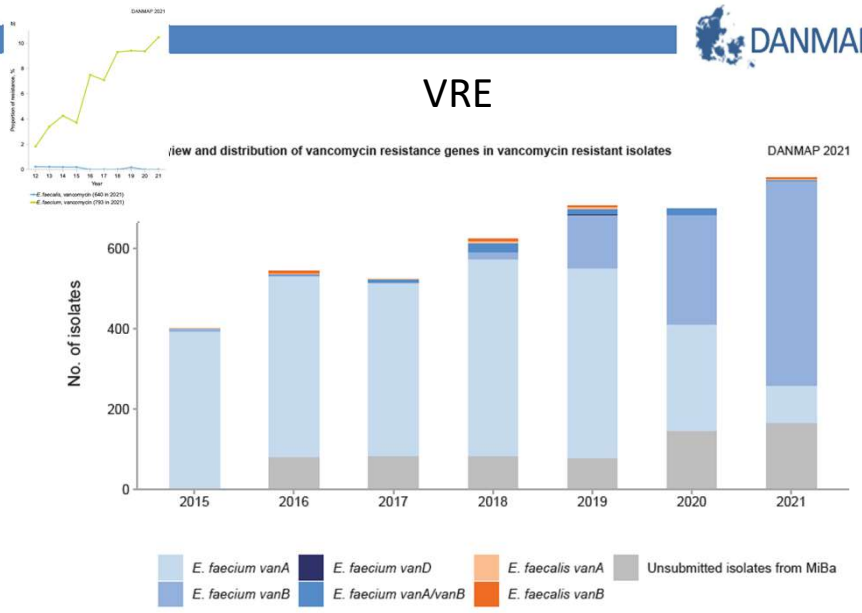
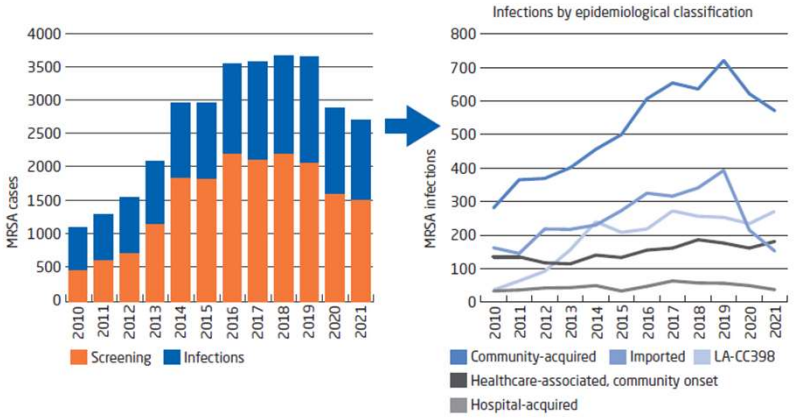
VRE



Datakilde: NRL/MiBa

MRSA



Datakilde: NRL

Opsummering

- Generelt faldende resistens under pandemien
  - Dog øget resistens mod kombinationspenicilliner i nogle tilfælde
- Fald i forekomsten af ESBL og MRSA under pandemien
- Fortsat øget forekomsten af VRE og CPO
  - VRE udviser betydelige klonale skift
  - Stigende forekomst af CPO relateret til udbrud i Danmark

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Resistens i patogene bakterier fra svin

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Peter Damborg
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Charlotte M. Salomonsen & Svend Haugegaard
Veterinært Laboratorium, Landbrug & Fødevarer

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Resistensovervågning i svin

- Veterinært Laboratorium, Landbrug & Fødevarer
  - Modtager kliniske prøver fra svin
  - Udfører bakteriedyrkning, artsidentifikation og fænotypisk resistensbestemmelse
  - Publiceret i DANMAP siden 2015
    - *Actinobacillus pleuropneumoniae*
      - Ondartet lungesyge
    - Hæmolytisk *Escherichia coli*
      - Diarré i farestald og klimastald, septikæmi, toksæmi, ødemsyge
    - *Streptococcus suis*
      - Kan forårsage infektioner i mange organer, herunder hjerne, mellemøre, led eller hjerteklapper, ligesom den forårsager septikæmi
  - Fra 1. januar 2021 sendes udvalgte stammer til Dansk Veterinært Konsortium (n≈700 i 2021)

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Resistensovervågning i svin

- Dansk Veterinært Konsortium (KU/SSI)
  - WGS
    - Forskellige Illumina-platforme
  - Identifikation af resistensgener og -mutationer
    - ResFinder og PointFinder
  - Sammenligning med fænotypiske resistensdata
    - ECOFFs, tentative ECOFFs, veterinære kliniske breakpoints, humane kliniske breakpoints

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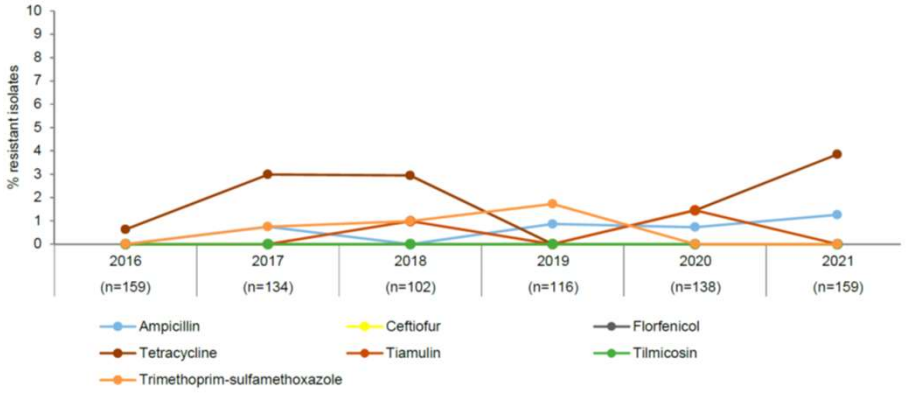
A. pleuropneumoniae

Figure 6.5 Resistance (%) in *Actinobacillus pleuropneumoniae*, Denmark DANMAP 2021



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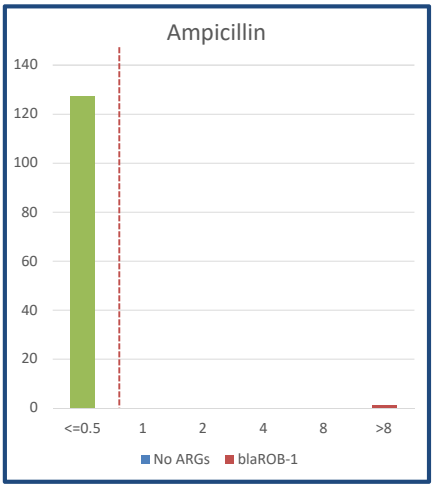
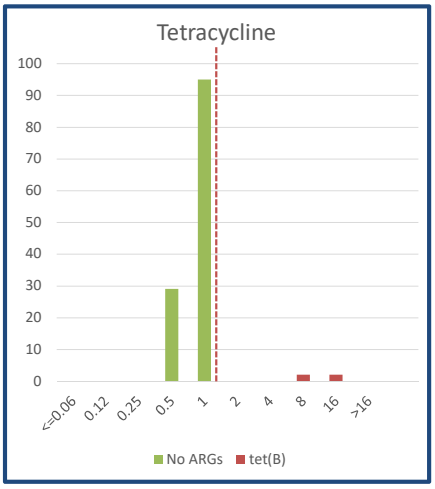
A. pleuropneumoniae





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A. pleuropneumoniae

128 stammer
7 antibiotika

		P	
		Res	Sus
G	+	5	0
	-	0	891

Concordance 100.0 %

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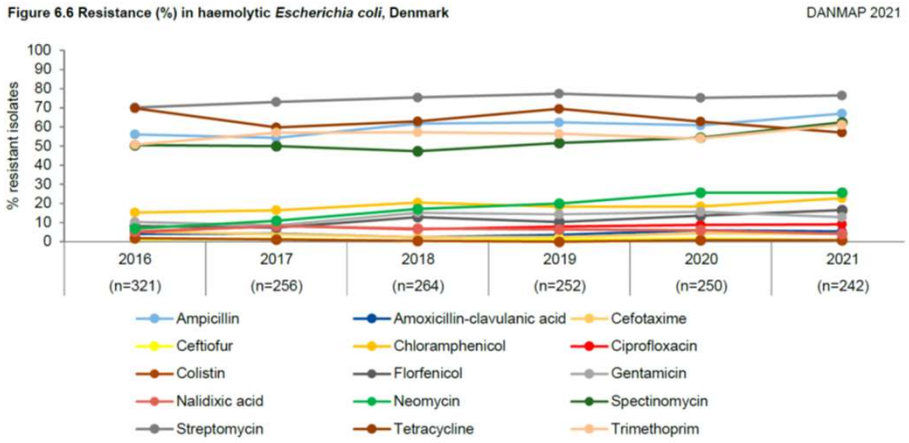
Hæmolytisk *E. coli*



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Hæmolytisk *E. coli*

104 stammer
15 antibiotika

		P	
		Res	Sus
G	+	430	51
	-	16	1083

Concordance 95.7 %

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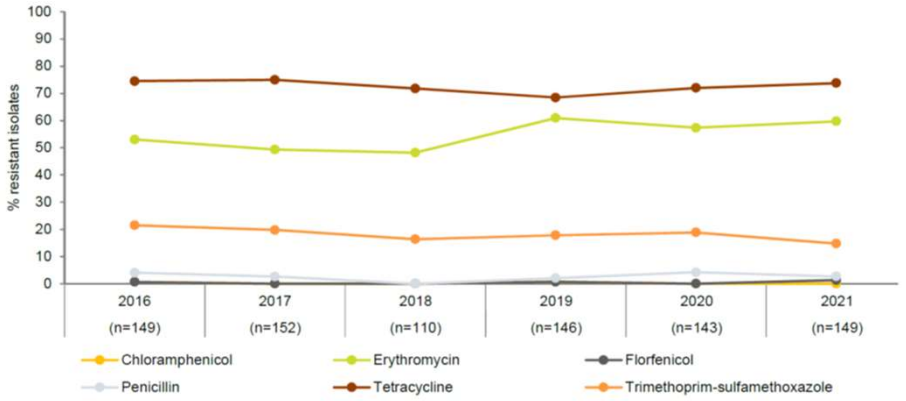
S. suis

Figure 6.7 Phenotypic antimicrobial resistance in *Streptococcus suis* from pigs, Denmark DANMAP 2021



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S. suis

108 stammer
6 antibiotika

		P	
		Res	Sus
G	+	101	2
	-	65	470

Concordance 89.5 %

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Genotype vs. Fænotype

- Generel god overensstemmelse mellem genotype og fænotype
- De fleste uoverensstemmelser skyldes:
  - Tilstedeværelse af resistensgener/-mutationer associeret med resistens overfor colistin, spectinomycin og streptomycin i fænotypisk følsomme *E. coli* stammer
  - Manglende tilstedeværelse af resistensgener/-mutationer associeret med resistens overfor tetracyklin og trimethoprim-sulfamethoxazole i fænotypisk resistente *S. suis* stammer

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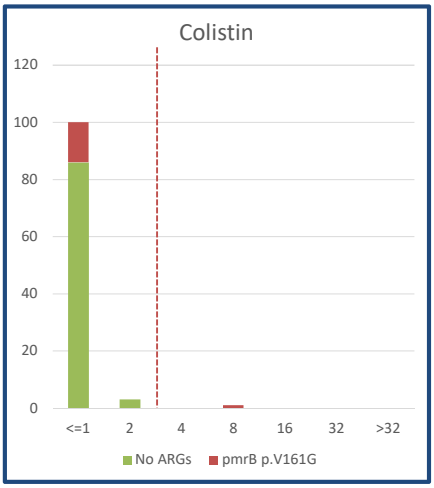
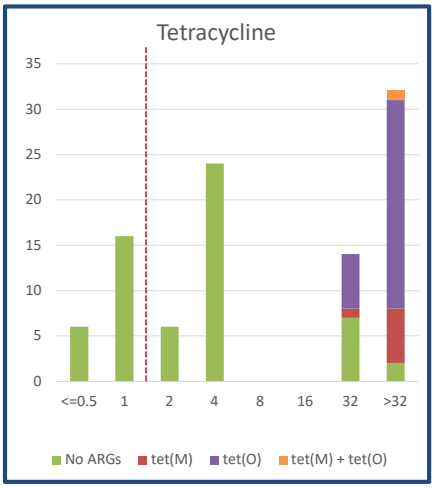
Hæmolytisk *E. coli*



S. suis



Human betydning

- Cefotaxim-resistens blev identificeret i 7 % af de hæmolytiske *E. coli* stammer og var altid forbundet med tilstedeværelse af enten $bla_{CTX\text{-}M\text{-}1}$ eller mutationer i *ampC* promoteren
- 14 % af de hæmolytiske *E. coli* stammer havde en mutation i *pmrB* , som er associeret med resistens overfor colistin. Dog var kun et af de 15 isolater med denne mutation fænotypisk resistent over for colistin.
- 2 % af *S. suis* stammerne var positive for *optrA*, som er associeret med resistens overfor linezolid (humant antibiotikum) og florfenicol (veterinært antibiotikum)

Videre arbejde

- Undersøge uoverensstemmelser mellem genotype og fænotype
  - Identifikation af nye resistensgener/-mutationer
  - Evaluering af etablerede ECOFFs/kliniske breakpoints
- Bioinformatiske analyser med henblik på at undersøge spredning af patogene bakterier og resistensgener mellem svinebesætninger og mellem svin og mennesker

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Videre arbejde

- Resultater for andre bakterier er undervejs og vil blive lagt på Dansk Veterinært Konsortiums hjemmeside (www.vetssi.dk/):
  - *Bordetella bronchiseptica*
  - *Clostridium perfringens*
  - *Erysipelothrix rhusiopathiae*
  - Non-hæmolytisk *E. coli*
  - *Haemophilus* parasuis
  - *Klebsiella pneumoniae*
  - *Salmonella enterica*
  - *Staphylococcus hyicus*

TAK FOR JERES OPMÆRKSOMHED!

DANMAP

TAK TIL

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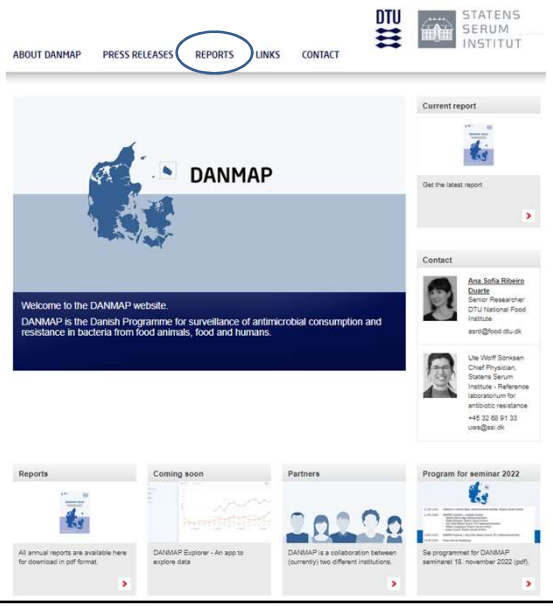

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