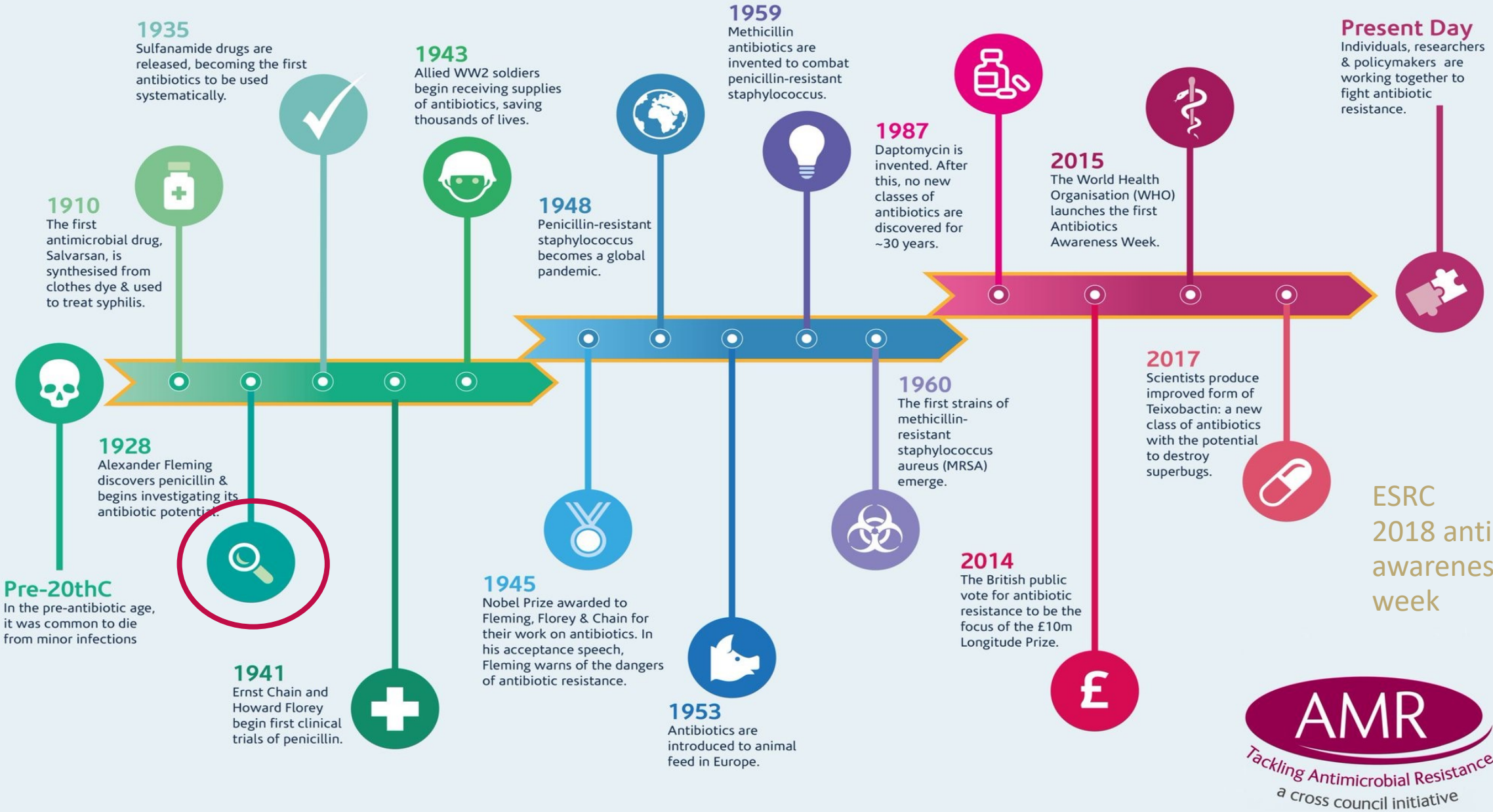
Comprehensive Infectious Disease Center Tübingen (CIDiC)

Antibiotic Stewardship: Impfen als Strategie im Kampf gegen resistente Keime

Dr. med. Siri Göpel
20.09.2019

Universitätsklinikum Tübingen

A BRIEF HISTORY OF ANTIBIOTICS & RESISTANCE



ESRC 2018 antibiotic awareness week

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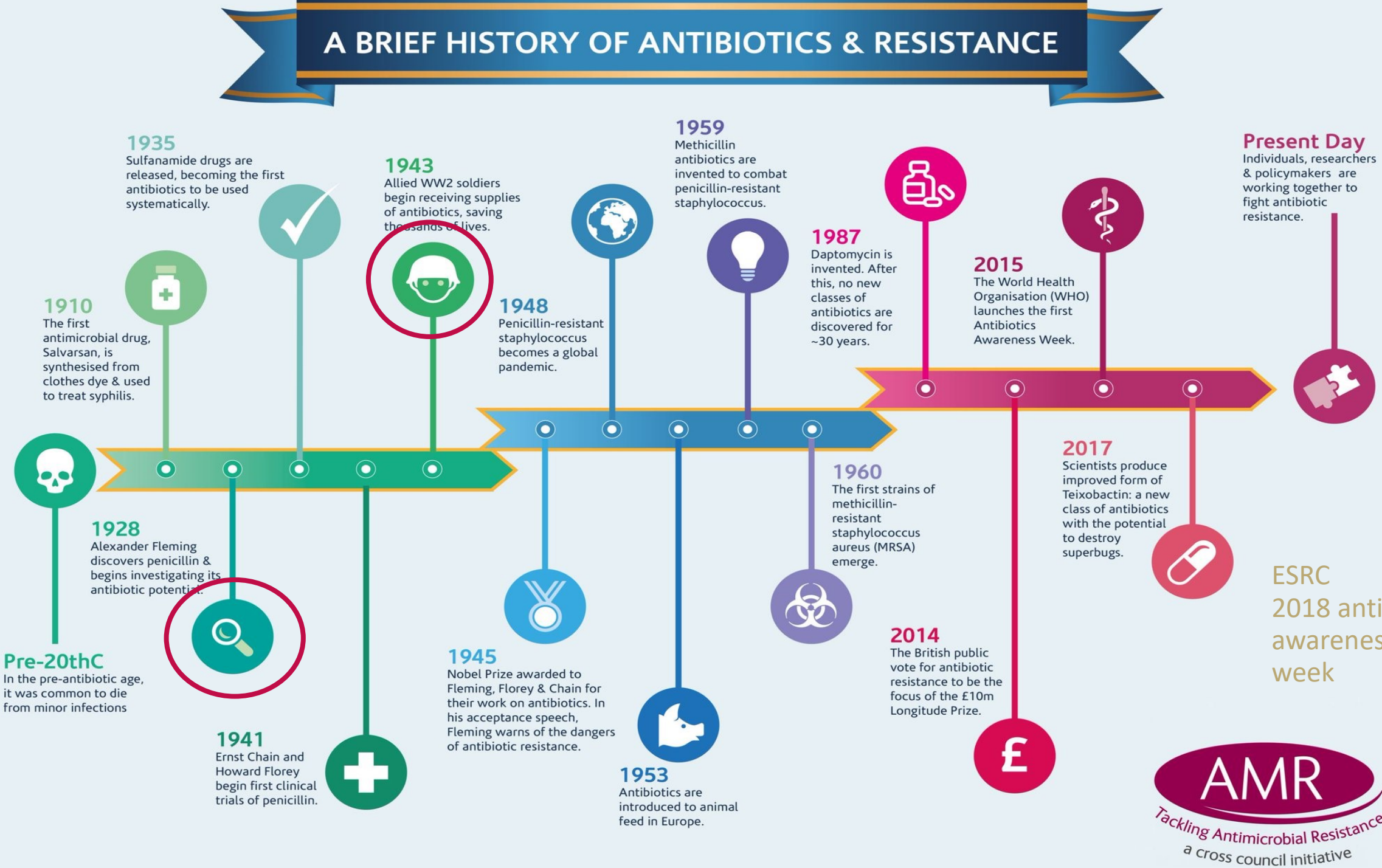

ESRC
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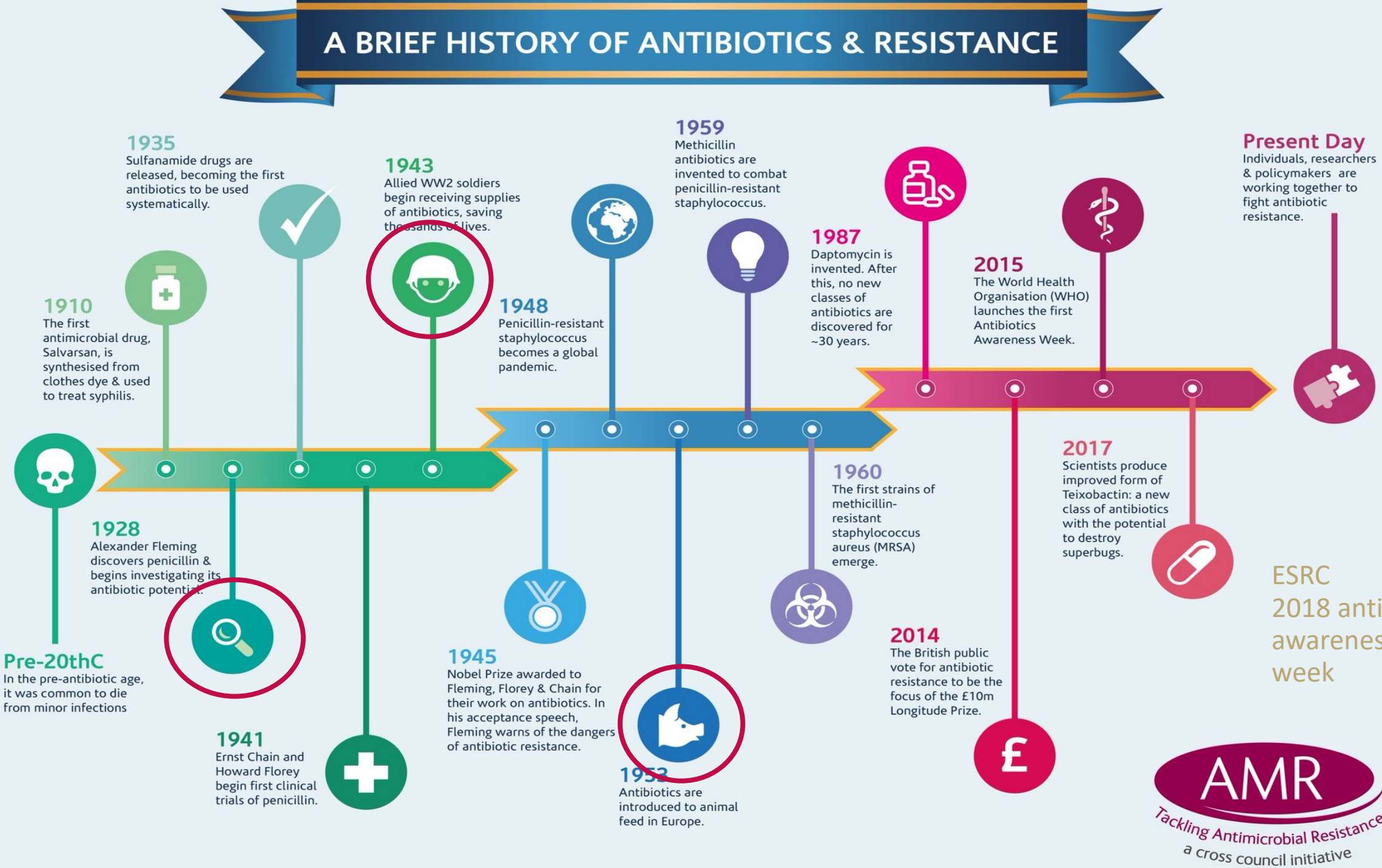
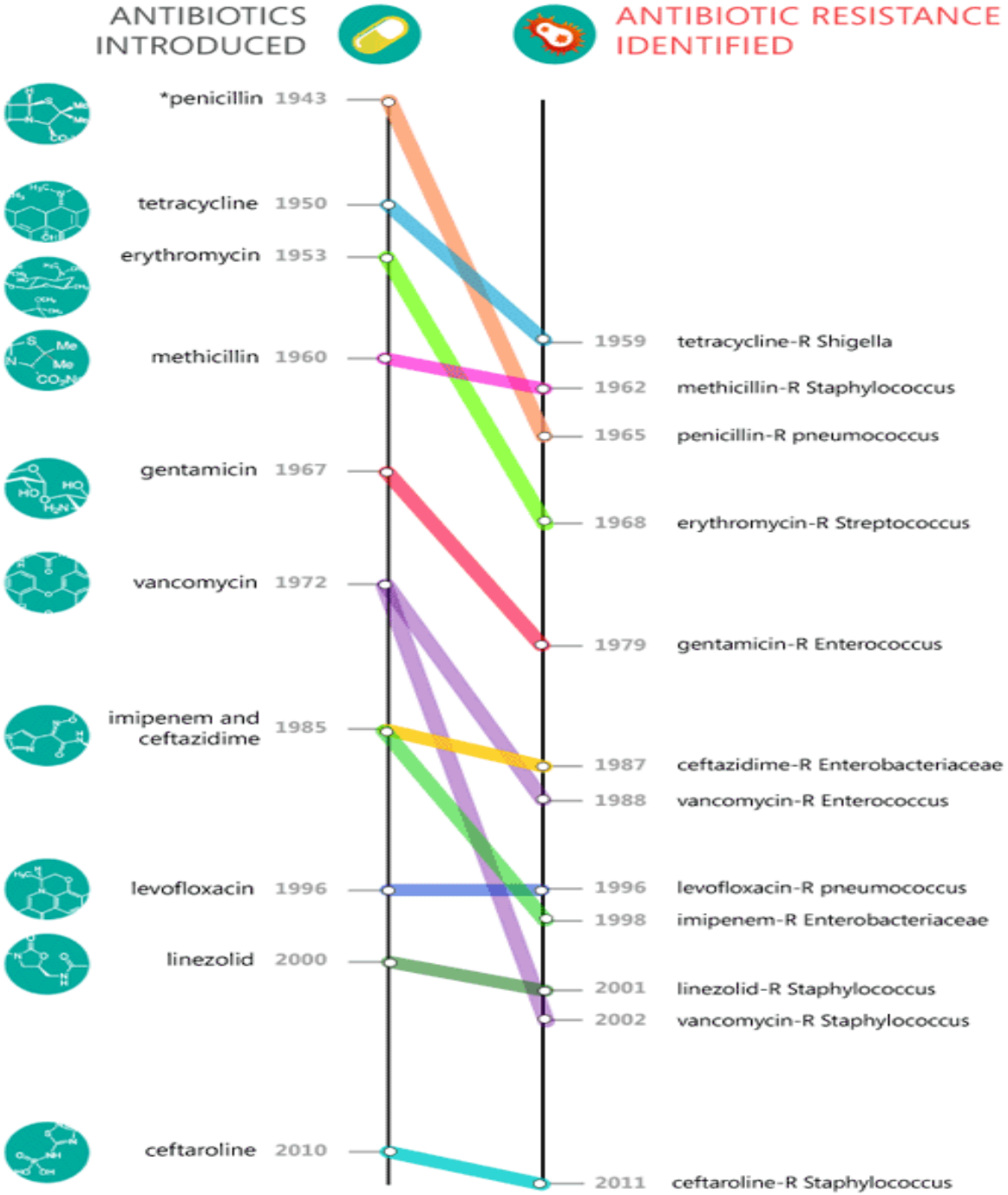
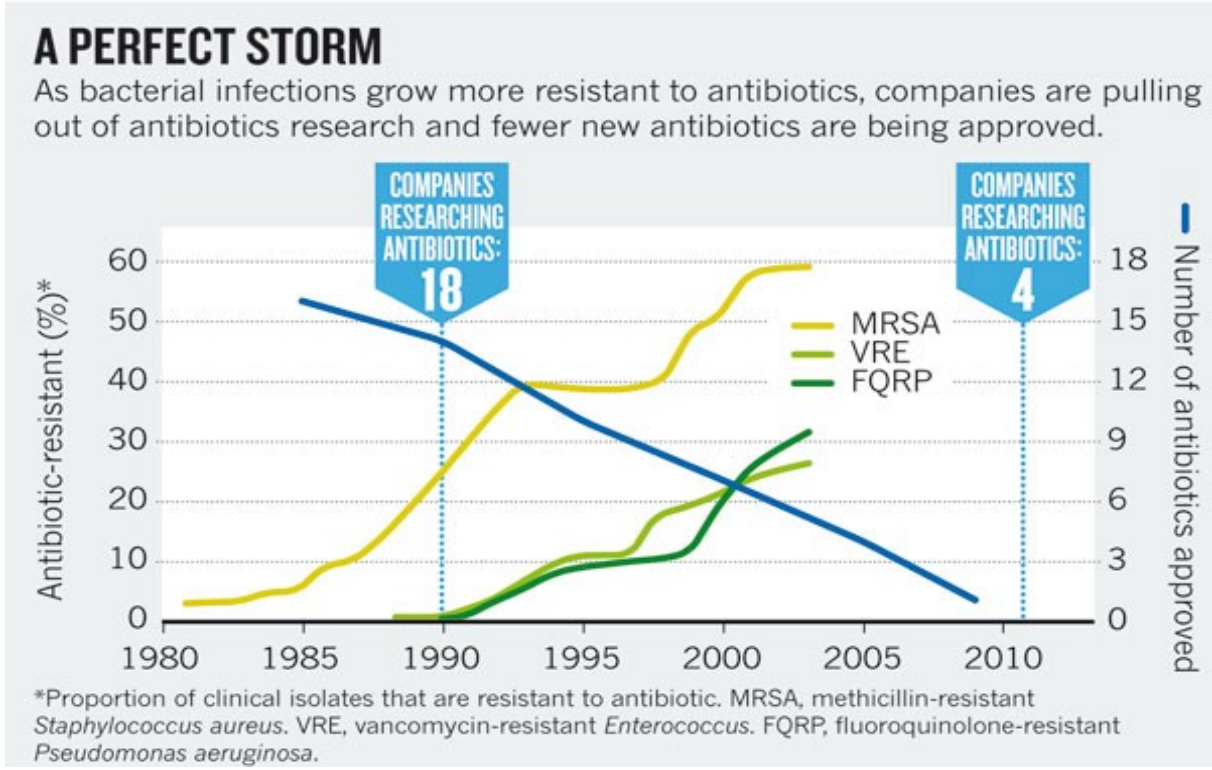


ESRC
2018 antibiotic awareness week

Timeline of antibiotic development and resistance

Center for Disease Control and Prevention 2019

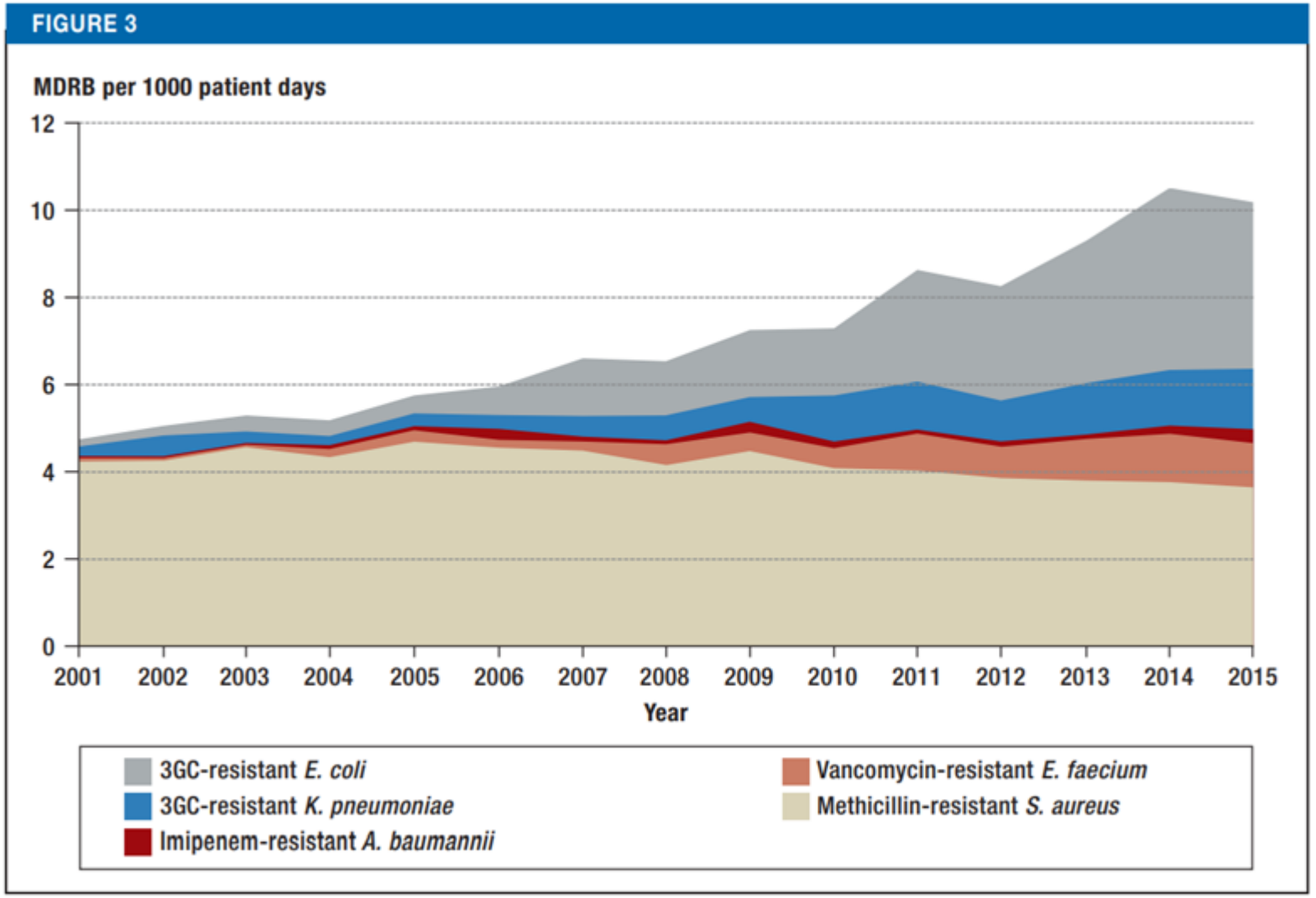




Antibiotic Stewardship – Aufgaben und Ziele

Global Alliance for Infections in Surgery

Anteil invasiver Isolate resistenter Keime auf deutschen Intensivstationen (SARI)



Trends in the incidence density of resistant pathogens in intensive care units (N = 77) from 2001 to 2015

MDRB: multidrug resistant bacteria; 3GC: 3rd generation cephalosporins; *E. coli*: *Escherichia coli*; *K. pneumoniae*: *Klebsiella pneumoniae*; *A. baumannii*: *Acinetobacter baumannii*; *E. faecium*: *Enterococcus faecium*; *S. aureus*: *Staphylococcus aureus*

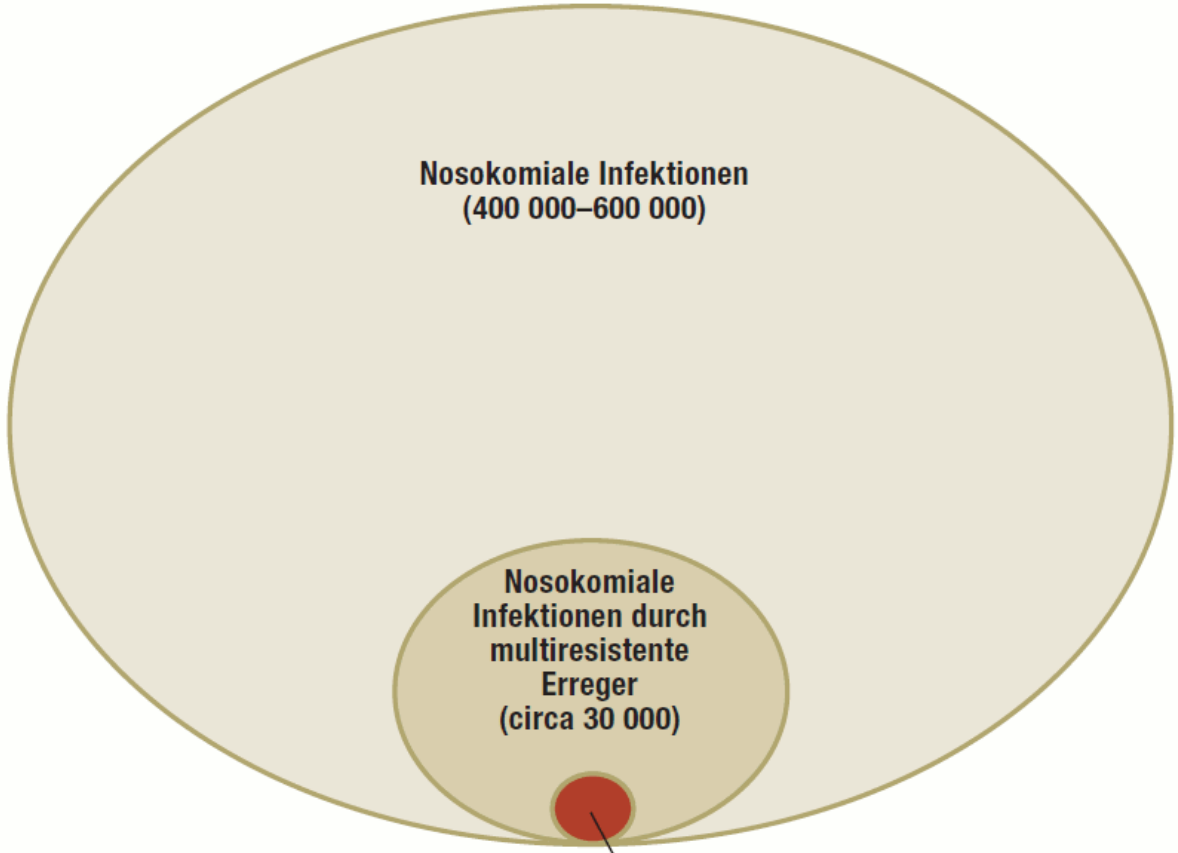
Remschmidt et al. Dtsch Arztebl Int 2017; 114:858–65

Aber: im Moment liegt die Problematik noch anders

	Deutschland
Einwohnerzahl 2013	81 Mio
Teilnehmende Krankenhäuser an nationaler Prävalenzstudie	Repräsentative Stichprobe: 46 [3]
Prävalenzrate nosokomialer Infektionen *	5,0 % [3]
Patienten mit nosokomialer Infektion (A)	400 000–600 000 [7], repräsentative ECDC-Stichprobe: 600 000 [3]
Anzahl der infolge einer nosokomialen Infektion verstorbenen Patienten (A)	ca. 10 000–15 000 [6] bzw. < 6000 (Abschätzung nach [14])
Anzahl der infolge einer Infektion mit MRE verstorbenen Patienten (D, E, F)	1000–4000 §

GRAFIK

Größenrelation: Nosokomiale Infektionen und Resistenzlage

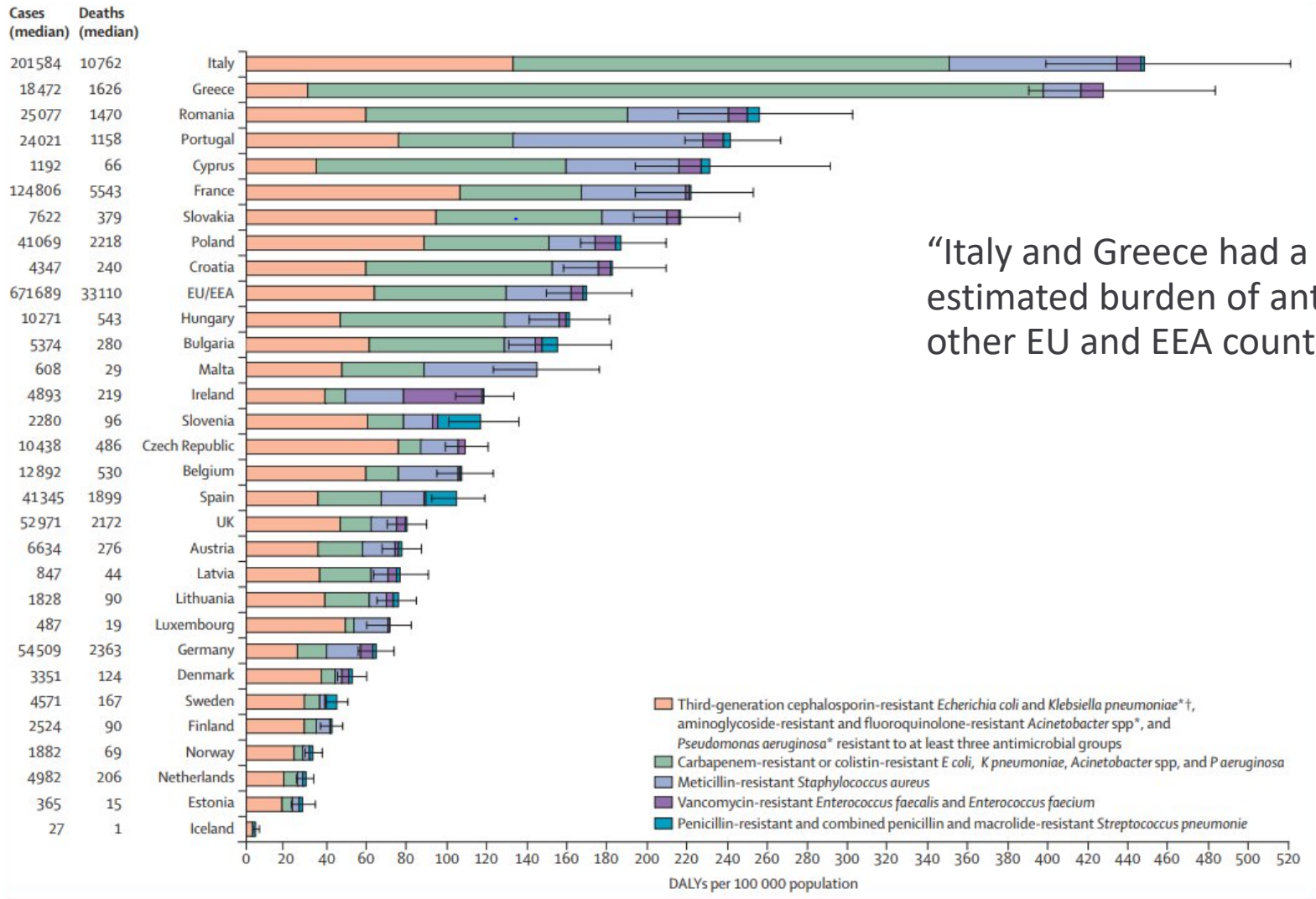


Quelle: Gastmeier/Fätkenheuer

Gastmeier Dtsch Arztebl 2015. 112(15)

Belastung durch Infektionen mit antibiotikaresistenten Bakterien in DALYs*, EU und Europäischem Wirtschaftsraum, 2015

(*Disability-Adjusted Life Year)



"Italy and Greece had a substantially higher estimated burden of antibiotic-resistant bacteria than other EU and EEA countries […]."

Cassini et al. 2019, The Lancet – Infectious Diseases

Auswirkungen von Impfungen im 20. und 21. Jahrhundert

Comparison of 20th Century Annual Morbidity & Current Morbidity: Vaccine-Preventable Diseases

Disease	20th Century Annual Morbidity*	2017 Reported Cases†	% Decrease
Smallpox	29,005	0	100%
Diphtheria	21,053	0	100%
Pertussis	200,752	18,975	91%
Tetanus	580	33	94%
Polio (paralytic)	16,316	0	100%
Measles	530,217	120	>99%
Mumps	162,344	6,109	96%
Rubella	47,745	7	>99%
CRS	152	5	97%
Haemophilus influenzae	20,000 (est.)	33§	>99%

* *JAMA*. 2007;298(18):2155-2163

† CDC. *National Notifiable Diseases Surveillance System, 2017 Annual Tables of Infectious Disease Data*. Atlanta, GA. CDC Division of Health Informatics and Surveillance, 2018. Available at: www.cdc.gov/nndss/infectious-tables.html. Accessed on December 3, 2018. NNDSS finalized annual data as of November 28, 2018.

§ *Haemophilus influenzae* type b (Hib) <5 years of age. An additional 10 cases of Hib are estimated to have occurred among the 203 notifications of Hi (<5 years of age) with unknown serotype.

Comparison of Pre-Vaccine Era Estimated Annual Morbidity with Current Estimate: Vaccine-Preventable Diseases

Disease	Pre-Vaccine Era Annual Estimate	2016 Estimate (unless otherwise specified)	% Decrease
Hepatitis A	117,333*	4,000†	97%
Hepatitis B (acute)	66,232*	20,900†	68%
Pneumococcus (invasive)			
All ages	63,067*	30,400¶	52%
<5 years of age	16,069*	1,700¶	89%
Rotavirus (hospitalizations <3 years of age)	62,500‡	30,625§	51%
Varicella	4,085,120*	102,128††	98%

* *JAMA*. 2007;298(18):2155-2163

† CDC. Viral Hepatitis Surveillance – United States, 2016

¶ CDC. Unpublished. Active Bacterial Core surveillance. 2016

‡ CDC. *MMWR*. February 6, 2009 / 58(RR02); 1-25

§ New Vaccine Surveillance Network 2017 data (unpublished); U.S. rotavirus disease now has biennial pattern

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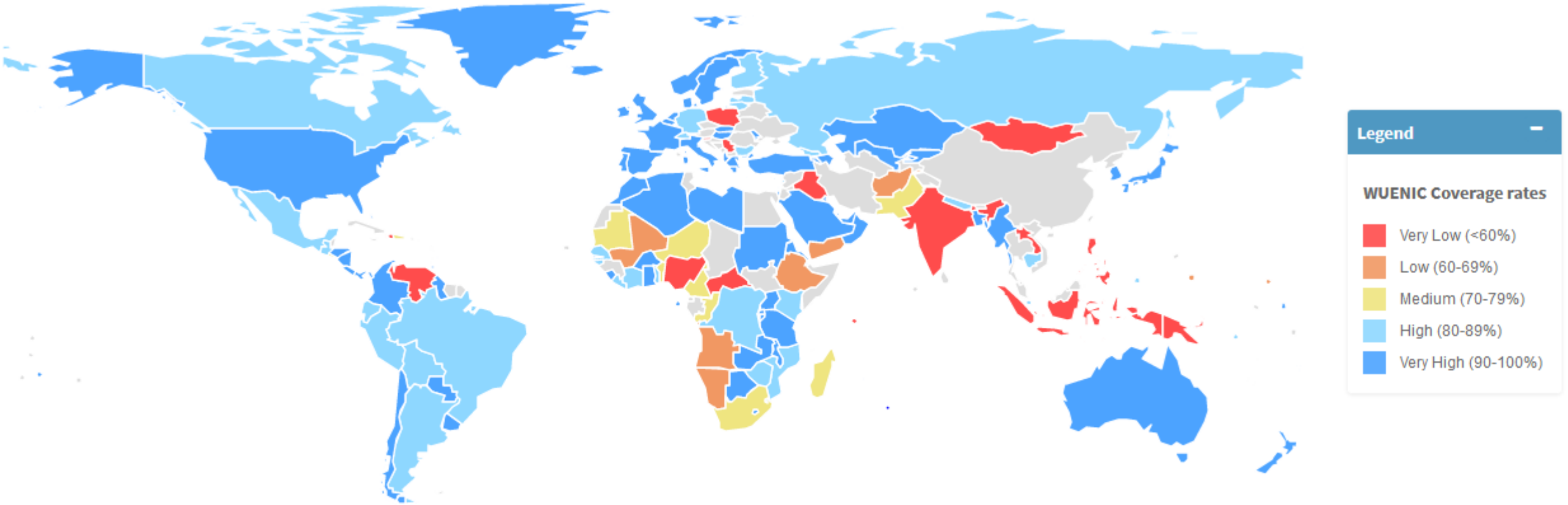
Impfung	Alter in Wochen	Alter in Monaten					Alter in Jahren							
	6	2	3	4	11–14	15–23	2–4	5–6	7–8	9–14	15–16	17	ab 18	ab 60
Rotaviren	G1 [b]	G2	(G3)											
Tetanus		G1	G2	G3	G4	N	N	A1	N	A2		N	A (ggf. N) [e]	
Diphtherie		G1	G2	G3	G4	N	N	A1	N	A2		N	A (ggf. N) [e]	
Pertussis		G1	G2	G3	G4	N	N	A1	N	A2		N	A3 [e]	ggf. N
Hib *H. influenzae* Typ b		G1	G2 [c]	G3	G4	N	N							
Poliomyelitis		G1	G2 [c]	G3	G4	N	N			A1		N	ggf. N	
Hepatitis B		G1	G2 [c]	G3	G4	N	N							
Pneumokokken [a]		G1		G2	G3	N								S [g]
Meningokokken C					G1 (ab 12 Monaten)		N							
Masern					G1	G2	N						S [f]	
Mumps, Röteln					G1	G2	N							
Varizellen					G1	G2	N							
HPV Humane Papillomviren										G1 [d]	G2 [d]	N [d]		
Herpes zoster														G1 [h] G2 [h]
Influenza														S (jährlich)

PCV-vaccine coverage rates according to WUENIC in 2018

WHO/UNICEF Estimates of National Immunization Coverage



http://view-hub.org/viz/

Pneumokokken

- Meist endogene Infektion
- 10% der Erwachsenen und ca. 50% (20-80%) der Kleinkinder besiedelt
- Invasive Infektion (Bakteriämie, Meningitis – Nachweis aus Blut/Liquor)
- Nicht invasive Infektionen (akute Otitis media, Sinusitis, Pneumonie (ohne Bakteriämie)
- Über 90 Serotypen
- Derzeit 3 Impfstoffe verfügbar:
  - PCV 7
  - PCV 13 (Einführung 2009)
  - PPSV 23

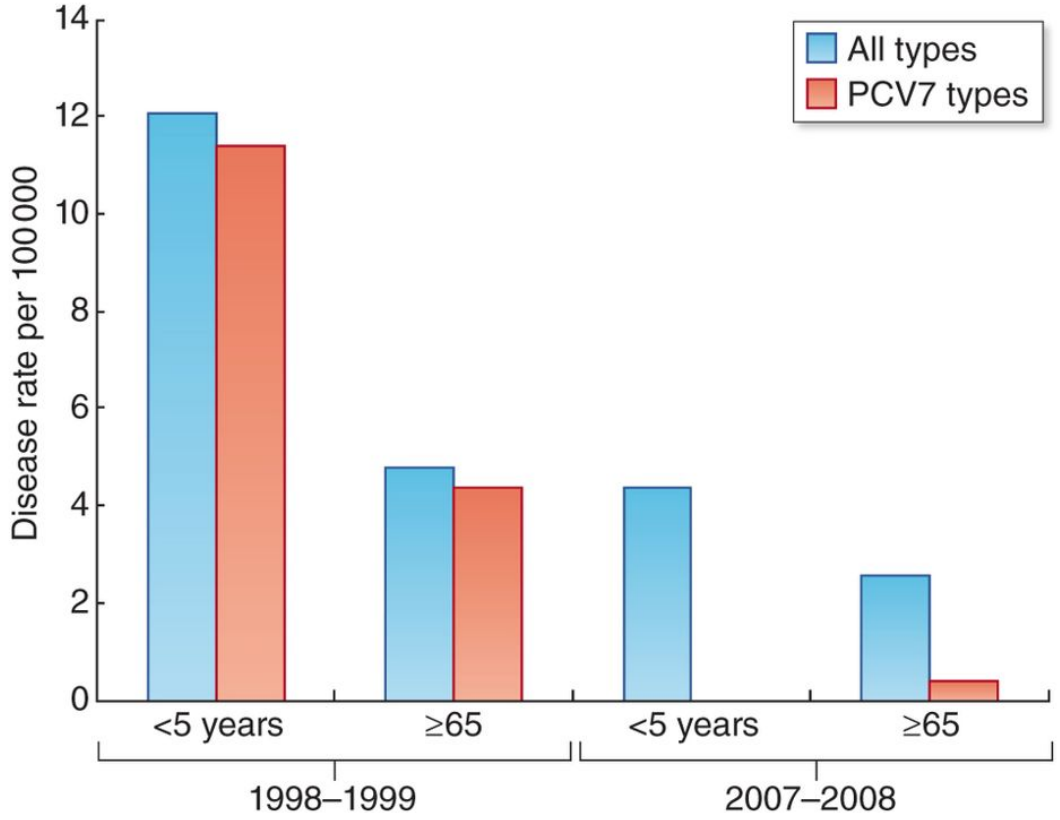
PPSV 23

– 73% Wirksamkeit gegen invasive Pneumokokken (PLoS ONE 2017,12:e169368)

PCV 13 (Konjugat)

– Bessere Schutzwirkung bei Immundefekt (Lancet 2000, 355:2106-11; NEJM 2010, 362:812-22)

Abnahme der Inzidenz nach Einführung der Konjugatvakzine PCV7 in den USA 2002



Praktisch Elimination der im Impfstoff enthaltenen Stämme

Der Effekt wird teilweise wieder aufgehoben durch eine Zunahme von im Impfstoff nicht enthaltenen Serotypen

Jansen et al. 2018, Nature Medicine

Erweiterung des Wirkspektrums auf 13 Serotypen unter Einbeziehung der neuen Stämme

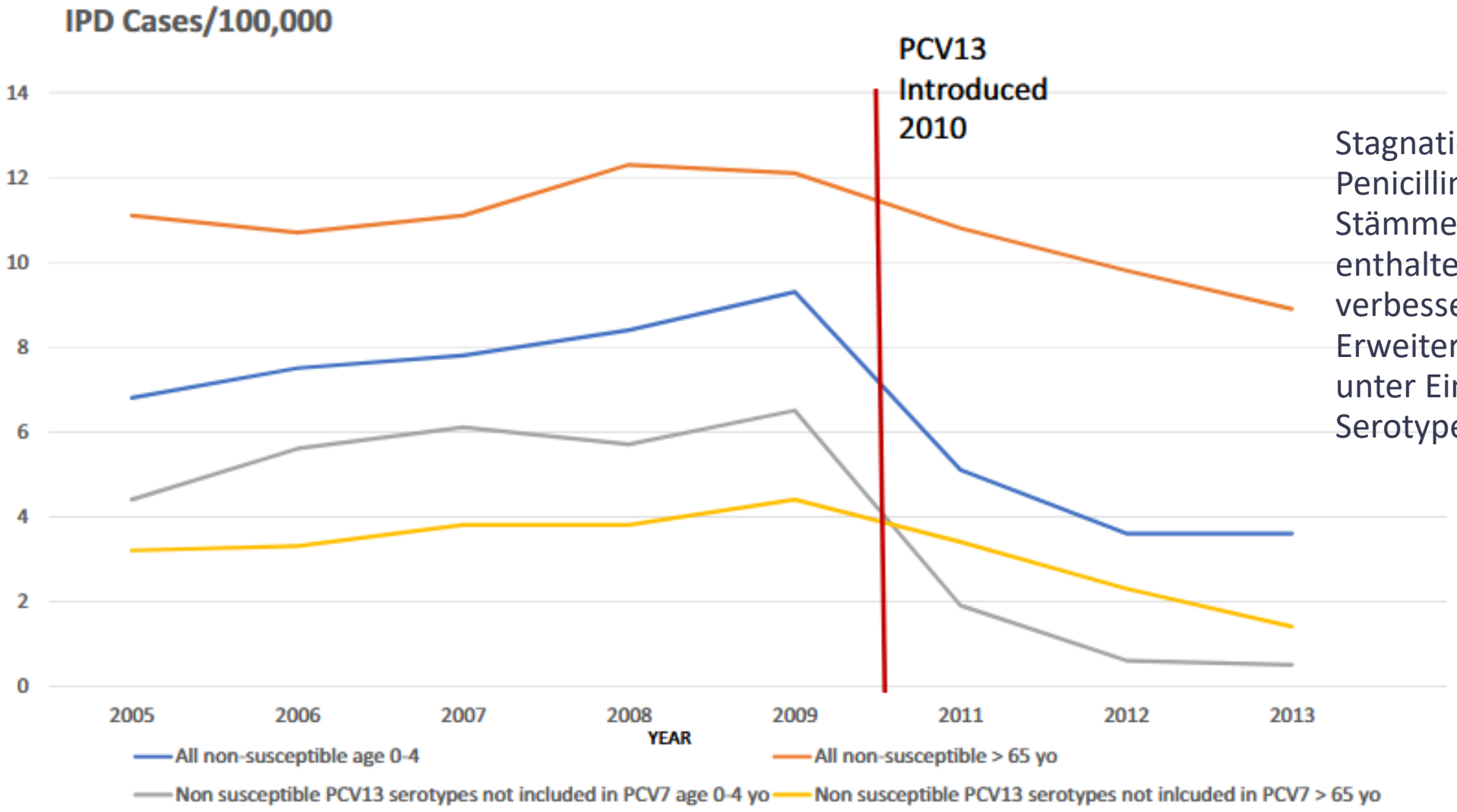
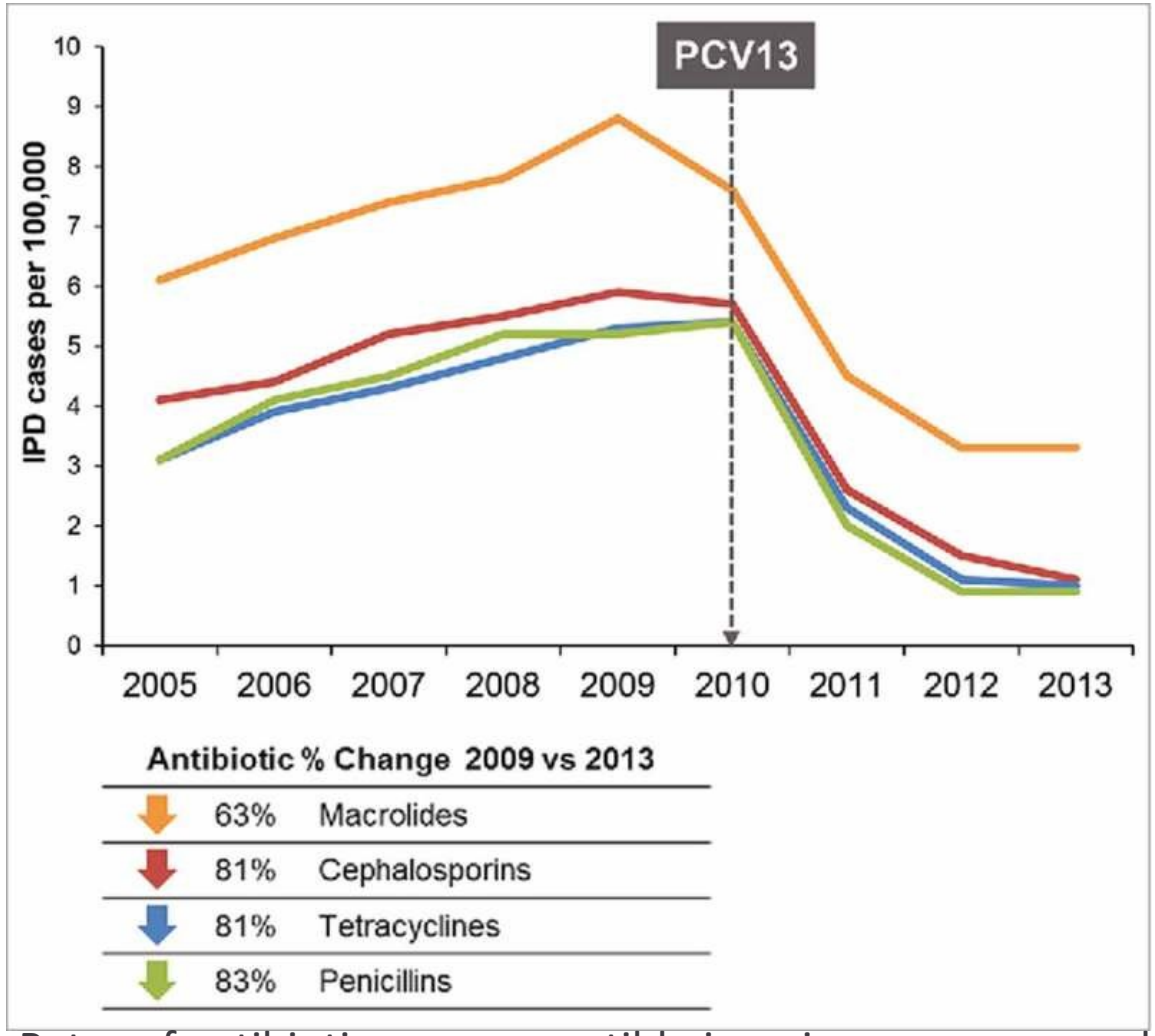


Fig. 2. US trends in invasive non–penicillin-susceptible pneumococcal disease 2005–2013.

Stagnation der Penicillinresistenzrate durch Stämme, die in PCV7 nicht enthalten waren konnte weiter verbessert werden durch Erweiterung des Wirkspektrums unter Einbeziehung neuer Serotypen

Auswirkung der Einführung von PCV13 auf Resistenzraten anderer Antibiotika



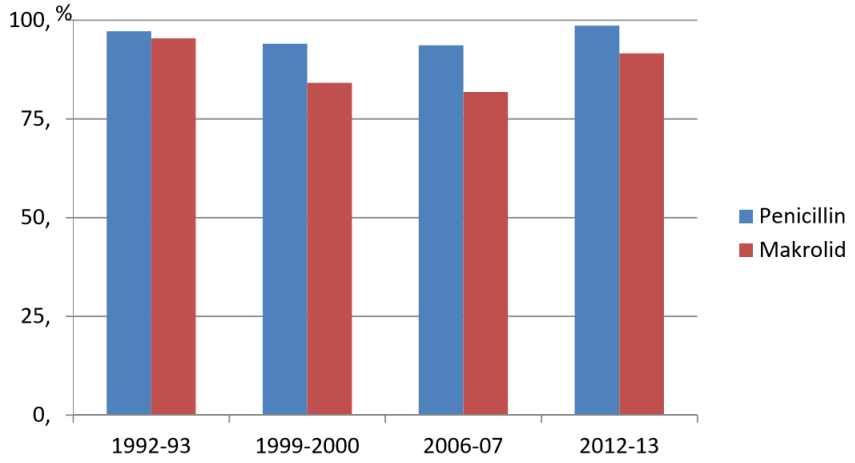
Rates of antibiotic non-susceptible invasive pneumococcal disease (<5 years) 2005–2013

Jansen et al. Hum Vaccin Immunother. 2018; 14(9): 2142–2149.

- 35 Antibiotikaverschreibungen / 100 geimpfte Kinder konnten allein durch PCV7 verhindert werden
(Klugman and Black PNAS)

Deutschland:

Antibiotikasensibilität invasiver Pneumokokkenstämme, 1992-2013



Imöhl, DMW 2014

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Influenza														S (jährlich)

Influenza aus ABS-Sicht

Hauptindikation für Antibiotikaverschreibungen im ambulanten Bereich:

Atemwegsinfekte

Akute Mittelohrentzündung (Kinder)

- ca 90% der Atemwegsinfekte sind viral bedingt
- vor allem im ambulanten Sektor wird von einer hohen antibiotischen Übertherapie der o.g. Erkrankungen ausgegangen
- Komplikation der Influenza sind allerdings bakterielle Superinfektion

Einfluß einer bevölkerungsweiten Influenzaimpfung auf Antibiotikagebrauch

Age Group	Province	Influenza Vaccination Rates												*p*-Value*
		1996–1997		2000–2001		2003		2005		Mean Post-UIIP[a]		Change (Percentage Points)[b]		
		Percent	95% CI	Percent	95% CI	Percent	95% CI	Percent	95% CI	Percent	95% CI	Percent	95% CI	
Overall	Ontario	18	(18–19)	36	(35–37)	35	(34–36)	42	(42–43)	38	(37–38)	20	(19–20)	<0.001
	Other provinces	13	(12–13)	21	(20–22)	23	(22–23)	28	(28–29)	24	(24–24)	11	(10–12)	
	Atlantic provinces[c]	16	(14–17)	19	(18–20)	24	(24–25)	31	(30–32)	25	(24–25)	9	(7–10)	
	Quebec	8	(7–9)	18	(17–20)	20	(19–21)	25	(24–26)	21	(20–22)	13	(12–14)	
	Manitoba	14	(13–16)	22	(19–25)	20	(19–21)	28	(27–30)	23	(22–25)	9	(7–10)	
	Saskatchewan	13	(11–15)	19	(17–21)	24	(22–25)	28	(27–30)	24	(23–25)	10	(8–13)	
	Alberta	15	(15–16)	23	(21–25)	23	(22–24)	28	(27–29)	25	(24–26)	9	(8–10)	
	British Columbia	17	(15–19)	26	(24–28)	27	(26–28)	33	(32–34)	29	(28–29)	11	(9–13)	
12–19 y	Ontario	16	(14–17)	29	(25–32)	28	(26–30)	37	(35–38)	31	(30–33)	15	(13–17)	<0.001
	Other provinces	6	(4–7)	9	(8–11)	10	(9–11)	14	(13–15)	11	(10–12)	5	(4–7)	
20–49 y	Ontario	8	(8–8)	27	(25–28)	23	(22–24)	30	(29–31)	27	(26–27)	19	(18–20)	<0.001
	Other provinces	6	(5–6)	12	(11–13)	13	(12–13)	18	(17–19)	14	(14–15)	9	(8–9)	
50–64 y	Ontario	21	(19–22)	42	(39–45)	45	(44–47)	54	(52–55)	47	(46–48)	26	(25–28)	<0.001
	Other provinces	15	(13–16)	23	(21–24)	29	(28–30)	35	(34–36)	29	(28–30)	14	(12–16)	
65–74 y	Ontario	54	(52–56)	69	(65–74)	71	(69–72)	73	(71–75)	71	(69–73)	17	(14–19)	0.86
	Other provinces	42	(39–46)	58	(55–61)	59	(57–60)	62	(61–63)	59	(58–61)	17	(13–21)	
75–84 y	Ontario	70	(67–72)	79	(74–83)	80	(78–82)	84	(82–85)	81	(79–82)	11	(8–14)	0.048
	Other provinces	54	(49–59)	71	(68–74)	68	(67–70)	73	(72–75)	71	(69–72)	17	(12–22)	
≥85 y	Ontario	67	(61–73)	73	(63–84)	78	(74–83)	82	(77–86)	78	(74–82)	11	(3–18)	0.01
	Other provinces	44	(33–55)	71	(64–77)	71	(67–74)	76	(73–78)	72	(70–75)	28	(17–40)	

[a]UIIP in Ontario.
[b]Change represents absolute percentage point difference between mean of the 2000–2001, 2003, and 2005 rates (post-UIIP) and the 1996–1997 rate (pre-UIIP).
[c]Atlantic provinces: Newfoundland and Labrador, Nova Scotia, New Brunswick, Prince Edward Island.
*p-Value for difference between the change over time in Ontario and other provinces combined (z-test).
doi:10.1371/journal.pmed.0050211.t002

Impfraten

Ontario: 42% maximal

Signifikante Steigerung vor allem bei den 12-65jährigen

Rest: 28% maximal

Kwong et al (2008). The effect of universal influenza immunization on mortality and health care use. PLoS medicine, 5(10), e211-e211.

Table 2 Effect of the Universal Influenza Immunization Program (UIIP) on Influenza-Associated Antibiotic prescriptions

Model, approach	Ontario			Other provinces combined			Ratio of RRs[a]	P^b
	Mean annual influenza-associated events rate (per 1000 people)		RR for post- vs. pre-2000 (95% CI)	Mean annual influenza-associated events rate (per 1000 people)		RR for post- vs. pre-2000 (95% CI)		
	Pre-2000	Post-2000		Pre-2000	Post-2000			
Primary analysis	17.9	6.4	0.36 (0.26–0.49)	8.3	8.2	0.99 (0.86–1.14)	0.36	<.001
Test of consistency (similar effect expected)								
Compare with other provinces individually								

Die Rate an Influenza-assoziierten Antibiotika-Verschreibungen fiel um 64%

144.000 Antibiotika-Verschreibungen „verhindert“

Include only influenza A(H3N2)–predominant seasons	20.1	10.0	0.49 (0.35–0.70)	10.2	8.0	0.78 (0.66–0.93)	0.63	.02
Test of amplification (increased effect expected)								
Exclude mismatched seasons post-UIIP (2003–2004, 2005–2006)	12.9	0.9	0.08 (0.01–0.93)	5.5	6.2	1.12 (0.87–1.42)	0.07	.04
Test of specificity (no effect expected)								
Use summer period (prescriptions not influenza associated)	44.1	38.6	0.88 (0.87–0.88)	40.2	37.9	0.94 (0.94–0.94)	0.93	<.001
Use control antibiotic tetracycline in February	7.3	5.2	0.71 (0.70–0.71)	8.8	7.0	0.80 (0.79–0.80)	0.89	<.001
Use control antibiotic trimethoprim in February	11.5	6.6	0.57 (0.57–0.57)	13.5	7.3	0.54 (0.54–0.54)	1.06	<.001

NOTE. The models used were for all ages. CI, confidence interval; RR, relative rate.

[a] Ratio of RR for Ontario to RR for other provinces.

[b] *P* value for comparison between post-2000 vs. pre-2000 RRs for Ontario and other provinces combined (calculated using the *z* test).

[c] Atlantic provinces are Newfoundland and Labrador, Nova Scotia, New Brunswick, and Prince Edward Island.

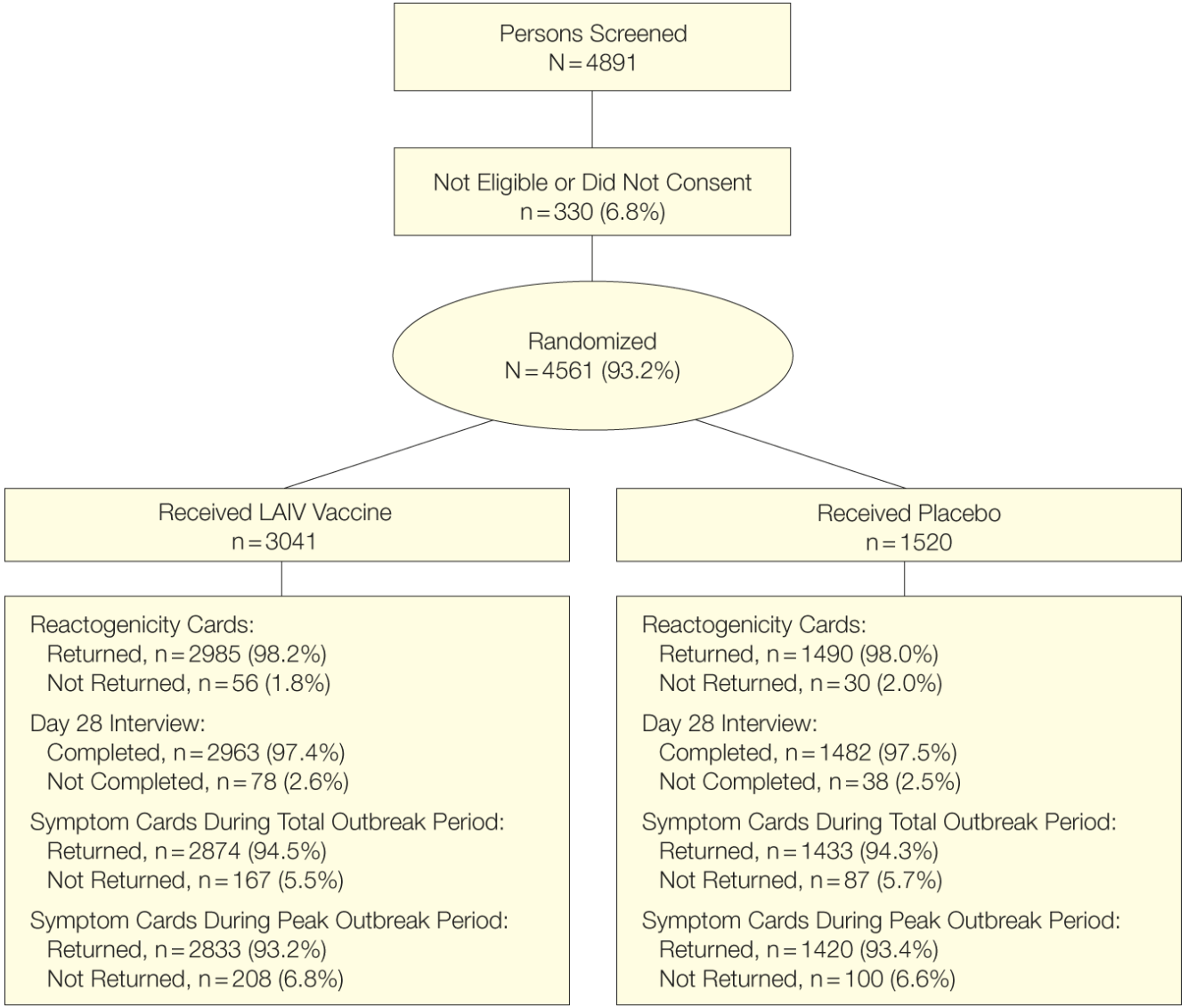
Kwong et al. Clinical Infectious Diseases, September 2009
https://doi.org/10.1086/605087

Effectiveness of Live, Attenuated Intranasal Influenza Virus Vaccine in Healthy, Working Adults

A Randomized Controlled Trial

Kristin L. Nichol, MD, MPH; Paul M. Mendelman, MD; Kenneth P. Mallon, MS, MHS; et al

- Randomisierte, doppelblinde, plazebo-kontrollierte Studie mit gesunden Erwachsenen – 4561 Personen
- Einschluß September 1997-November 1997, Nachbeobachtungszeit bis April 1998
- Einschlußkriterien: 18-64 Jahre, mindestens 30h Berufstätigkeit, bestehende Krankenversicherung, keine Indikation für Routineimpfung gegen Influenza



JAMA 1999

Effectiveness of Live, Attenuated Intranasal Influenza Virus Vaccine in Healthy, Working Adults: A Randomized Controlled Trial

Table 3. Numbers and Rates of Outcomes During the Total Outbreak Period*

	Vaccine Group		Placebo Group			
	Total Outcomes, No. (n = 2874)	Rate per 1000 Persons per 14-Week Outbreak Period	Total Outcomes, No. (n = 1433)	Rate per 1000 Persons per 14-Week Outbreak Period	Reduction in Rates, % (95% CI)	*P* Value
Febrile illness						
Illness episodes, No.	751	276.5	412	302.5	8.6 (–2.0 to 18.0)	.11
Illness, d	6929	2551.3	3886	2853.1	10.6 (–0.7 to 20.6)	.07
Work missed because of illness, d	812	299.0	484	355.3	15.9 (3.9 to 26.4)	.01
At least 1 health care provider visit, d	213	78.4	128	94.0	16.5 (3.2 to 28.0)	.02
Taking antibiotics, d	1037	381.8	723	530.8	28.1 (16.6 to 38.0)	<.001
Taking over-the-counter medications, d	3163	1164.6	1846	1355.3	14.1 (2.7 to 24.1)	.02
Severe febrile illness						
Illness episodes, No.	543	199.9	326	239.3	16.5 (6.2 to 25.6)	.002
Illness, d	5945	2189.0	3473	2549.9	14.2 (2.8 to 24.2)	.02
Work missed because of illness, d	717	264.0	454	333.3	20.8 (9.2 to 30.9)	<.001
At least 1 health care provider visit, d	191	70.3	124	91.0	22.8 (10.3 to 33.4)	<.001
Taking antibiotics, d	957	352.4	684	502.2	29.8 (18.5 to 39.6)	<.001
Taking over-the-counter medications, d	2757	1015.2	1681	1234.2	17.7 (6.4 to 27.7)	.003
Febrile upper respiratory tract illness						
Illness episodes, No.	472	173.8	285	209.2	16.9 (6.5 to 26.2)	.002
Illness, d	5047	1858.4	2873	2109.4	11.9 (–0.1 to 22.4)	.05
Work missed because of illness, d	530	195.1	365	268.0	27.2 (16.1 to 36.8)	<.001
At least 1 health care provider visit, d	142	52.3	98	72.0	27.3 (15.2 to 37.7)	<.001
Taking antibiotics, d	793	292.0	553	406.0	28.1 (16.0 to 38.4)	<.001
Taking over-the-counter medications, d	2345	863.4	1483	1088.8	20.7 (9.7 to 30.4)	<.001

*Data shown are event rates per 1000 subjects per 14-week outbreak period. Among vaccine recipients, 2874 participants provided information for 266 154 participant days. Among placebo recipients, 1433 participants provided information for 133 480 participant days. The rates were calculated as follows: rate = (counts/total participant days) × (7 days per week) × (14 weeks per outbreak period) × (1000 persons). CI indicates confidence interval. The total outbreak period extended from December 14, 1997, through March 21, 1998. See "Methods" section of text for definitions of illness categories.

28% Reduktion der Tage mit Antibiotikatherapie

Effekt einer Grippeimpfung auf akute Otitis Media und Antibiotikabehandlung bei Kindern

Table 2. Effectiveness of influenza vaccine, as indicated by the occurrence of febrile respiratory illness and acute otitis media (AOM) and the receipt of antibiotic treatment in children during the 6-month period after the administration of vaccine.

Variable	Vaccine recipients (n = 67)	Control subjects (n = 66)	Vaccine efficacy, %	P
Febrile respiratory illness[a]	55 (82.1)	63 (95.5)	13.2	.03
Receipt of ≥1 course of antibiotics	26 (38.8)	42 (63.6)	38.9	.007
≥1 episode of AOM	24 (35.8)	42 (63.6)	43.7	.002
1 episode of AOM	18 (26.9)	26 (39.4)	31.8	.21
≥2 episodes of AOM	6 (9.0)	16 (24.2)	63.1	.03

NOTE. Data are no. (%) of patients, unless otherwise specified.

[a] Temperature ≥38.1°C.

Clin Infect Dis. 2002 Jul 15;35(2):168-74. Epub 2002 Jun 19.
Efficacy of intranasal virosomal influenza vaccine in the prevention of recurrent acute otitis media in children.
Marchisio P[1], Cavagna R, Maspes B, Gironi S, Esposito S, Lambertini L, Massimini A, Herzog C, Principi N.

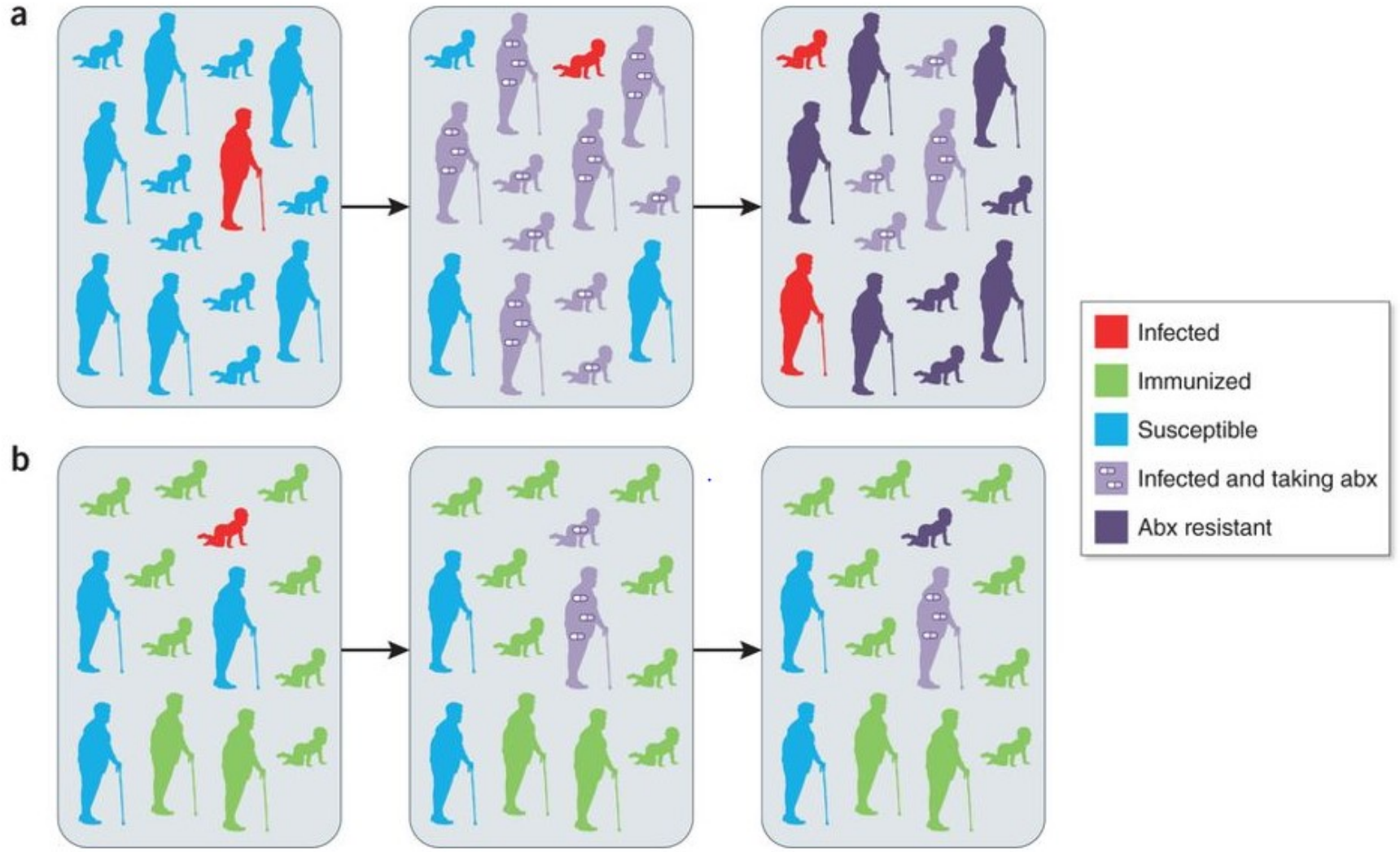
Modellrechnung zu Influenzaimpfung von Kindern in Deutschland

(Annahme: 50% Durchimpfungsrate)

Undiscounted 10-year outcomes (overall cases across all age groups)	Current policy	Current policy + LAIV-based routine childhood vaccination (2–17 years)	Difference (total cases prevented)	Distribution of avoided cases by age group	
				Under 18 years (%)	18 years and over (%)
Infections	58,863,475	34,958,394	23,905,081	38	62
Symptomatic cases	39,379,665	23,387,166	15,992,499	38	62
Cases of AOM	1,145,311	544,343	600,968	83	17
Cases of CAP	282,447	153,586	128,861	57	43
Deaths	13,960	8,902	5,058	16	84
Prescribed antibiotics	4,172,573	2,490,181	1,682,392	38	62
Hospitalisations	406,297	239,178	167,119	42	58

Damm et al., Eur J Health Econ 2015

Immunization against a bacterial pathogen and its effect on antibiotic use and spread of antibacterial resistance



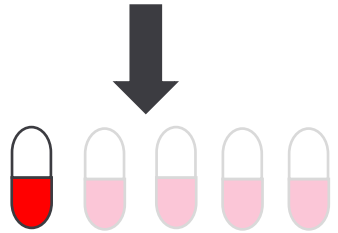
Jansen et al. 2018, Nature Medicine

Impfen als Strategie im Kampf gegen resistente Keime

Immunization

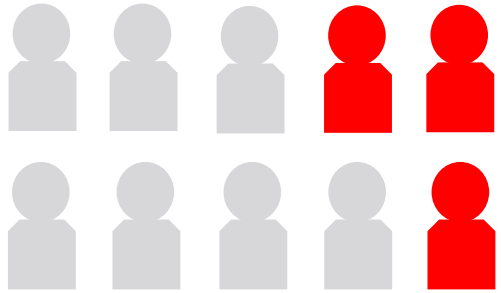
Direkter Effekt:
Schutz gegen Erkrankung und z.T. auch Kolonisation

Indirekter Effekt:
Verminderte Krankheitsübertragung und Kolonisierung anderer



Reduzierung von Antibiotikaeinnahme

(Laxminarayan et al. 2016, Lancet)



Reduktion der Entwicklung multiresistenter Keime

Die Proportion der Reduzierung ist nur illustrativ!

Impfungen in klinischer Entwicklung

Vaccine	Composition	Latest trials
	C. difficile	
PF-06425090 (Pfizer)[58]	Genetically/chemically inactivated *C. difficile* toxins A and B ClinicalTrials.gov identifier NCT03090191	Phase 3
ACAM-CDIFF (Sanofi)[86]	Formalin-inactivated wild-type toxoid (A and B) ClinicalTrials.gov identifier NCT01887912	Phase 3
VLA84 (Valneva)[87]	Recombinant fusion protein consisting of truncated toxin A and B ClinicalTrials.gov identifier NCT02316470	Phase 2
	S. aureus	
SA4Ag (Pfizer)[88]	CP5/CP8-CRM_{197}, P-Y variant ClfA, MntC ClinicalTrials.gov identifier NCT02388165	Phase 2b
4C-Staph (GSK)[89]	Csa1A (Sur2), FhuD2, EsxA/EsxB, HlAH35L ClinicalTrials.gov identifier NCT01160172	Phase 1
	Group B *Streptococcus*	
Trivalent GBS vaccine (GSK)[90]	Capsular epitopes of GBS serotypes Ia, Ib and III conjugated to CRM197 ClinicalTrials.gov identifier NCT02270944	Phase 2
Bivalent GBS protein vaccine (Minervax)[91]	N-terminal domains of the Rib and alpha C surface proteins	Phase 1
	E. coli	
EcoXyn-4V (GlycoVaxyn)[92]	*E. coli* bioconjugate vaccine ClinicalTrials.gov identifier NCT02289794	Phase 1
FimH adhesin vax[93] (Sequoia)	Protein-based vaccine	Phase 1
JNJ63871860 (Janssen)[94]	*E. coli* bioconjugate vaccine	Phase 2
	M. tuberculosis	
Multiple vaccines	http://www.aeras.org/pages/global-portfolio	Phases 1–3
	RSV	
Multiple vaccines	http://who.int/immunization/research/vaccine_pipeline_tracker_spreadsheet/en/	Phases 1–3

Profile of pig farms combining high performance and low antimicrobial usage within four European countries

Lucie Collineau, Annette Backhans, Jeroen Dewulf, Ulf Emanuelson,
Elisabeth grosse Beilage, Anne Lehébel, Svenja Loesken, Elisabeth Okholm Nielsen,
Merel Postma, Marie Sjölund, Katharina D C Stärk, Catherine Belloc

„Vergleich 44 Top-Performer (hinsichtlich niedrigem Antibiotikaverbrauch und hoher Produktivität) in Frankreich, Belgien, Deutschland, Schweden mit Kontroll-Zuchtbetrieben mit „normalen Charakteristika“

Hoher Antibiotikaverbrauch

Niedriger Antibiotikaverbrauch

Veterinary Record 2017

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Hoher Antibiotikaverbrauch

Hohe Populationsdichte

Biosicherheit

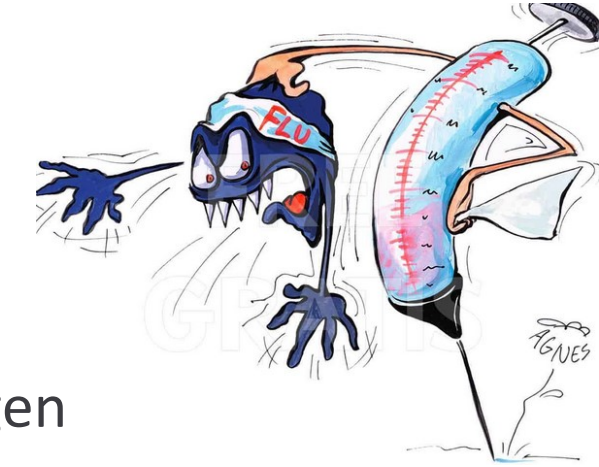
Hohe Impfquote

Weniger Infekte

Niedriger Antibiotikaverbrauch

Veterinary Record 2017

FAZIT



Impfungen spielen eine der wichtigsten Rollen im Kampf gegen Infektionserkrankungen

Direkte Effekte verringern Morbidität und Mortalität

Im Sinne des Antibiotic Stewardship sollten nicht nur die direkten Effekte Beachtung finden:

Reduktion des Antibiotikagebrauchs

Verminderung der Resistenzentstehung

sind wichtige Bestandteile eines ganzheitlichen Konzepts im Kampf gegen resistente Keime

Vielen Dank für die Aufmerksamkeit!

Comprehensive Infectious Disease Center Tübingen (CIDiC)

Antworten des Robert Koch-Instituts und des Paul-Ehrlich-Instituts zu den 20 häufigsten Einwänden gegen das Impfen

Stand: 22.4.2016 (Erstveröffentlichung: 2007)