UNIVERSITÄTS KLINIKUM jena

Endokarditis und Cardiac – Device assoziierte Infektionen

PD Dr. med. Stefan Hagel, M. Sc.
Institut für Infektionsmedizin & Krankenhaushygiene

Agenda

- Endokarditisprophylaxe
- Endokarditisteam
- Diagnose
- Therapie
- Cardiac-Device assoziierte Infektionen

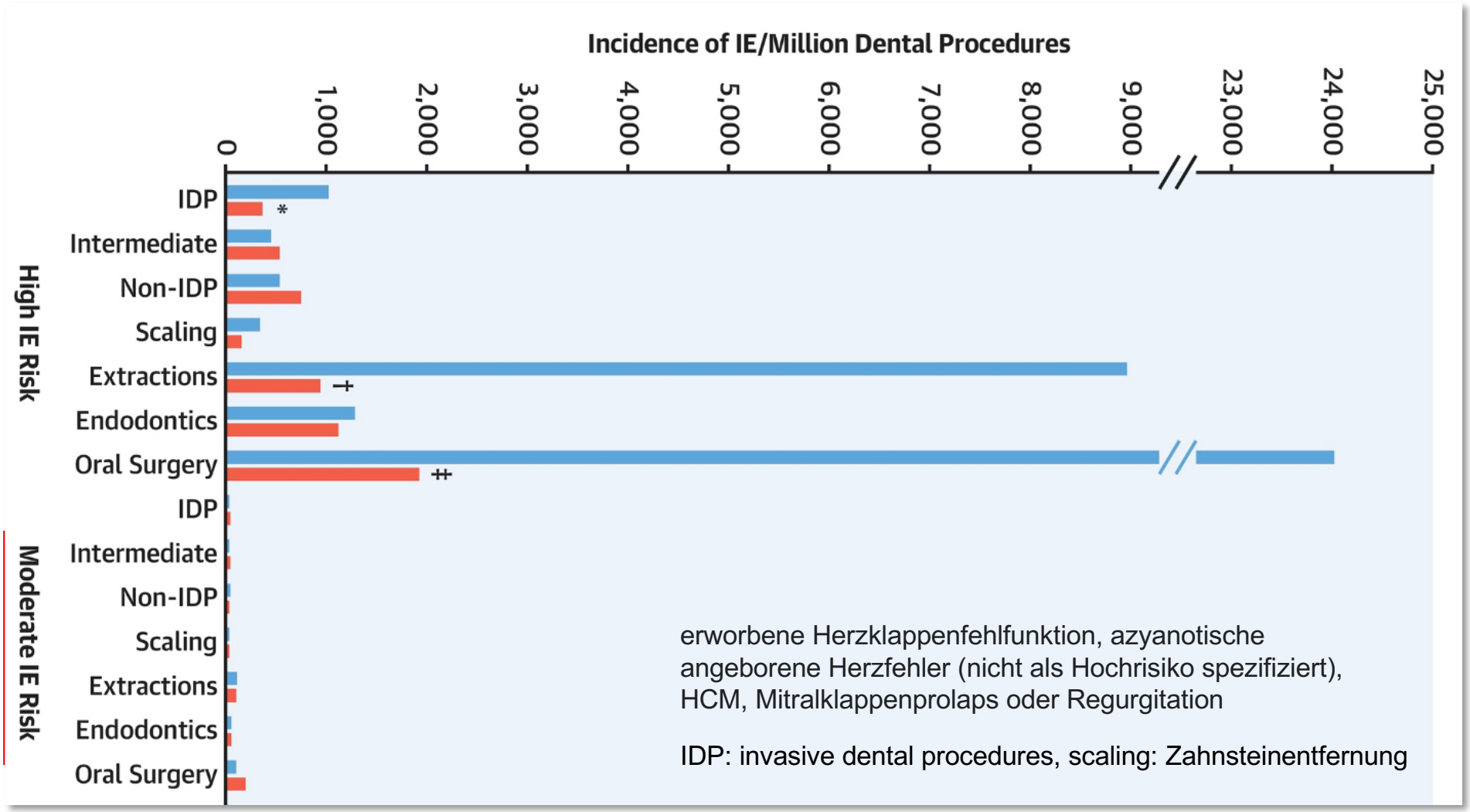
Endokarditisrisiko nach einem Zahnarztbesuch

- 7.951.972 U.S. Bürger mit Arbeitgeber-Krankenversicherung
- Case-Crossover Design (= Individuen dienen selbst als Kontrollgruppe)
- Pat. mit hohem Risiko (u.a. PVE, Z.n. IE, Pt. mit angeb. Herzfehler)
  - → sig. Risiko für IE < 4 Wochen nach invasiver dent. Prozedur (IDP)
    OR 2.00 (95% CI: 1.59 - 2.52; *P* = 0.002)
    - → Zahnextraktion OR 11.08 (7.34-16.74; *P* < 0.0001)
    - → Oral-chir. Eingriffe OR 50.77 (20.79-123.98; *P* < 0.0001)
  - → Endokarditisprophylaxe bei IDP: **OR 0.49 (0.29-0.85; *P* = 0.01)**

- Kohortenstudie (Endokarditisprophylaxe bei Pt mit hohem Risiko):
  - → Zahnextraktion: OR: 0.13 (0.03-0.34; *P* < 0.0001)
  - → Oral-chir. Eingriffe: OR: 0.09 (0.01-0.35; *P* = 0.002)

Thornhill et al., Journal of the American College of Cardiology, Volume 80, Sept 2022, Pages 1029-1041

Endokarditisrisiko nach einem Zahnarztbesuch



Thornhill et al., Journal of the American College of Cardiology, Volume 80, Sept 2022, Pages 1029-1041

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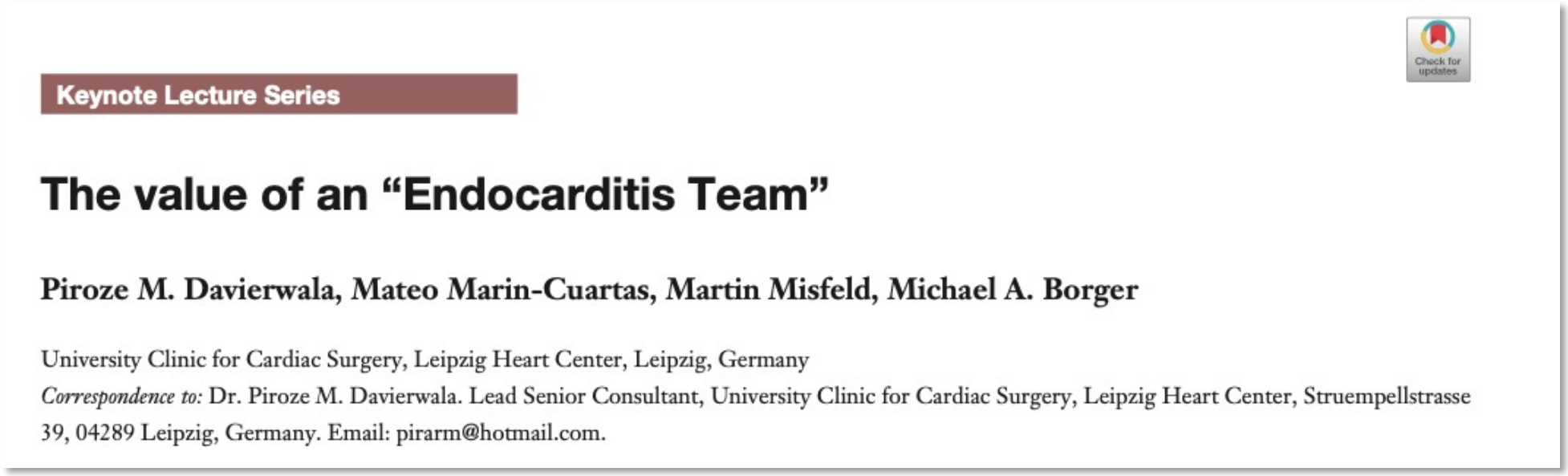


Keynote Lecture Series

The value of an "Endocarditis Team"

Piroze M. Davierwala, Mateo Marin-Cuartas, Martin Misfeld, Michael A. Borger

University Clinic for Cardiac Surgery, Leipzig Heart Center, Leipzig, Germany

Correspondence to: Dr. Piroze M. Davierwala. Lead Senior Consultant, University Clinic for Cardiac Surgery, Leipzig Heart Center, Struempellstrasse 39, 04289 Leipzig, Germany. Email: pirarm@hotmail.com.

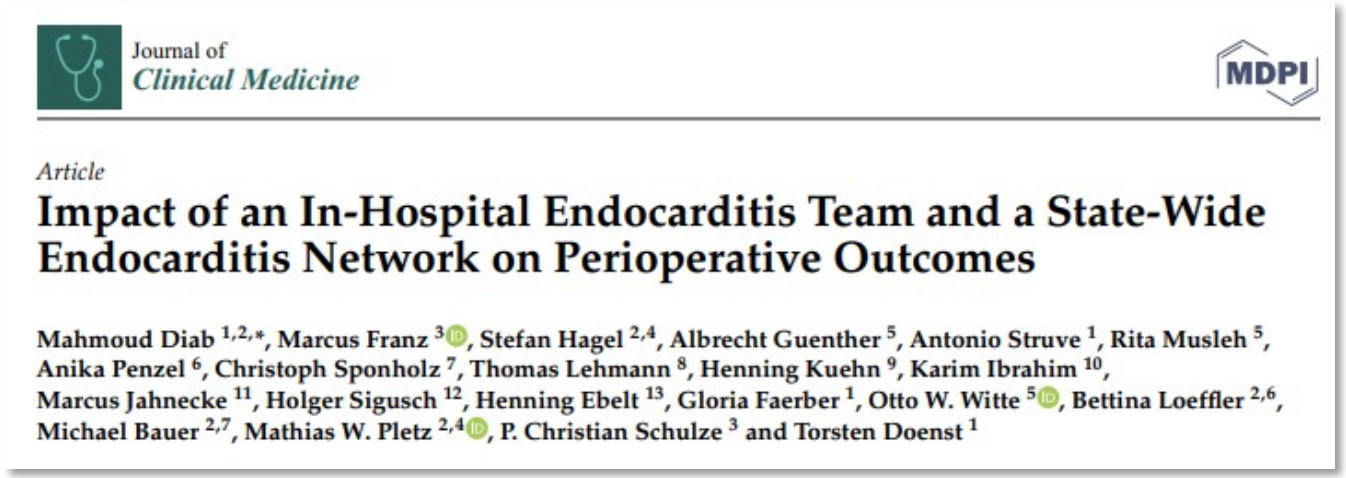
Bothelo-Nevers et al.

- 1-Jahres Sterblichkeit minus 50% (18.2% → 8.2%)
- Weniger Nierenversagen und embolische Ereignisse

Chirillo et al.

- Reduktion KH-Sterblichkeit (28% → 13%)
- Reduktion 3-Jahres Sterblichkeit (34% → 16%)
- Weniger Nierenversagen, weniger Kultur-neg Endokarditis

Ann Cardiothorac Surg 2019;8(6):621-629



Journal of Clinical Medicine

MDPI

Article

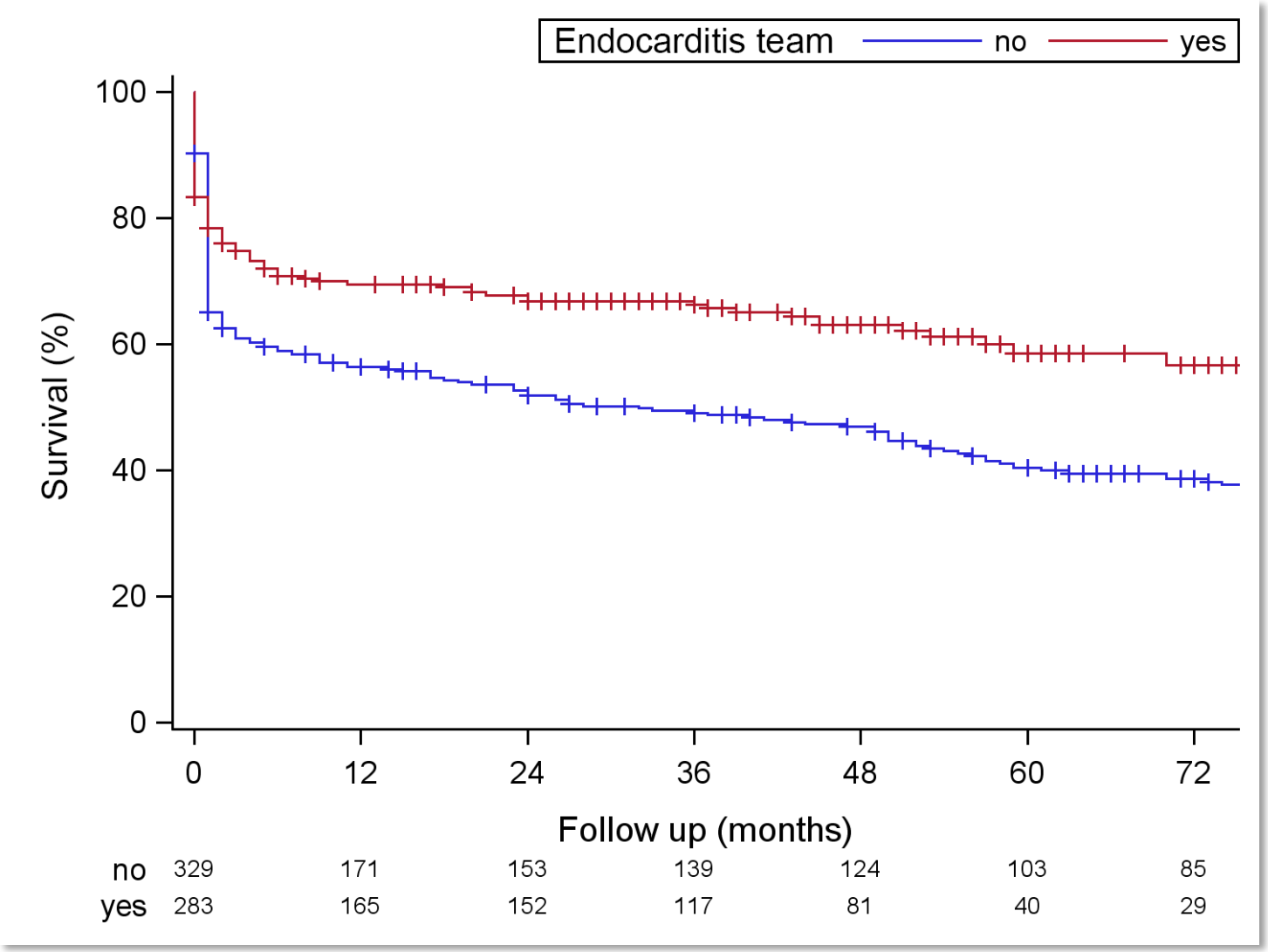
Impact of an In-Hospital Endocarditis Team and a State-Wide Endocarditis Network on Perioperative Outcomes

Mahmoud Diab [1,2,*], Marcus Franz [3], Stefan Hagel [2,4], Albrecht Guenther [5], Antonio Struve [1], Rita Musleh [5], Anika Penzel [6], Christoph Sponholz [7], Thomas Lehmann [8], Henning Kuehn [9], Karim Ibrahim [10], Marcus Jahnecke [11], Holger Sigusch [12], Henning Ebelt [13], Gloria Faerber [1], Otto W. Witte [5], Bettina Loeffler [2,6], Michael Bauer [2,7], Mathias W. Pletz [2,4], P. Christian Schulze [3] and Torsten Doenst [1]

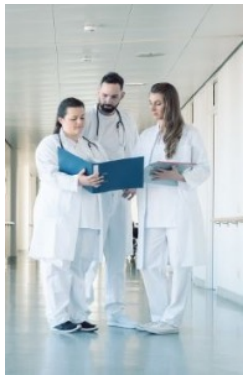
- UKJ Endokarditisteam ab 2011 (Kardio, Neuro, HCH, Infektio)
- ab 2015 Thüringenweit 24/7 Hotline Infektiologie und Kardiochirurgie

→ Verlegung	7d (IQR 2-19) vs. 15d (IQR 2-19), sig
→ prä-OP Herzinsuffizienz	45% vs. 69%, $p < 0.01$
→ prä-OP IE-Abszess	24% vs. 34%, $p = 0.018$
→ prä-OP Nierenersatztherapie	8% vs. 14%, $p = 0.026$
→ prä-OP Schlaganfall	14% vs. 27%, $p < 0.001$

Endokarditisteam Jena

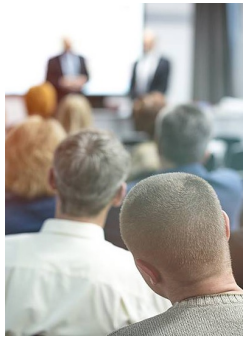


Rolle des Endokarditis Team



Patientenversorgung

- Team aus klinischen Experten
- Individ. Patientenbetreuung (Diagnostik – Management – Nachsorge)
- 24/7 Ansprechpartner für Zuweiser



Aus-/Weiterbildung

- Studenten
- Kollegen unterschiedlicher Disziplinen, ambulant und stationär

Forschung

- 2004 → 2015 ESC/AHA Guidelines
- Zunahme der Empfehlungen 6.8fach (37 → 253)
- Abnahme Evidenz Level A: n=7 (20%) → **n=4 (1.6%)**
- Zunahme Evidenz Level C: n=11 (31%) → n=134 (53%)

Ostergaard L et al., American Heart Journal, Volume 193, Nov 2017

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Welcher Patient mit *S. aureus*-BSI benötigt ein TEE?

POSITIVE Cutoff: >4		PREDICT Cutoff: ≥2 (for Day 5 Score)		VIRSTA Cutoff: ≥3	
Item	Points Assigned	Item	Points Assigned	Item	Points Assigned
TTP <9 h	5	ICD	2	Cerebral or peripheral emboli	5
TTP 9–11 h	3	Permanent pacemaker	3	Meningitis	5
TTP 11–13 h	2	Community acquisition	2	Permanent intracardiac device or previous IE	4
IV drug use	3	Healthcare acquisition	1	Preexisting native valve disease[a]	3
Vascular phenomena[b]	6	Positive culture after 72 h	2	IV drug use	4
Predisposing heart disease[c]	5			Positive culture after 48 h	3
				Community or healthcare-associated bacteremia	2
				Severe sepsis or septic shock	1
				C-reactive protein >190 mg/L	1

Abbreviations: ICD, implantable cardioverter defibrillator; IV, intravenous; TTP, time to positivity.

[a]Any condition classified as medium or high risk by Dajani et al [25].

[b]Defined as arterial embolus, septic pulmonary embolus, mycotic aneurysm, intracranial bleeding, conjunctival hemorrhage, or Janeway lesions.

[c]Previous endocarditis, prosthetic heart valve, or any condition classified as medium or high risk [25].

→ 477 Pt. (33% ambulant, 8% Prothesenklappe, 11% CIED)

→ 87% haben Echo bekommen, 47.6% der Patienten haben eine TEE bekommen

→ 87 Pt. (18.2%) mit Diagnose Endokarditis

van der Vaart et al, CID 2022:74 (15 April)

Welcher Patient mit S. aureus-BSI benötigt ein TEE?

Score	Sensitivität	Spezifität	NPV	PPV	AUC
POSITIVE	77.6	63.1	92.5	32.3	77.8
PREDICT d1	22.9	97.4	85.0	66.7	71.4
PREDICT d5	85.1	56.9	94.5	30.5	79.7
VRISTA	**98.9**	**35.7**	**99.3**	**25.5**	**88.9**
**VRISTA+ (TTP 11.5h)*	*100*	*33*	*100*	*23.4*	*90*

Anzahl TEEs in Kohorte (201/422)

+45%

*Simos: beste TTP für Vorhersage IE 11.5h (Sensitivität 88,9%; Spezifität 71,6%).

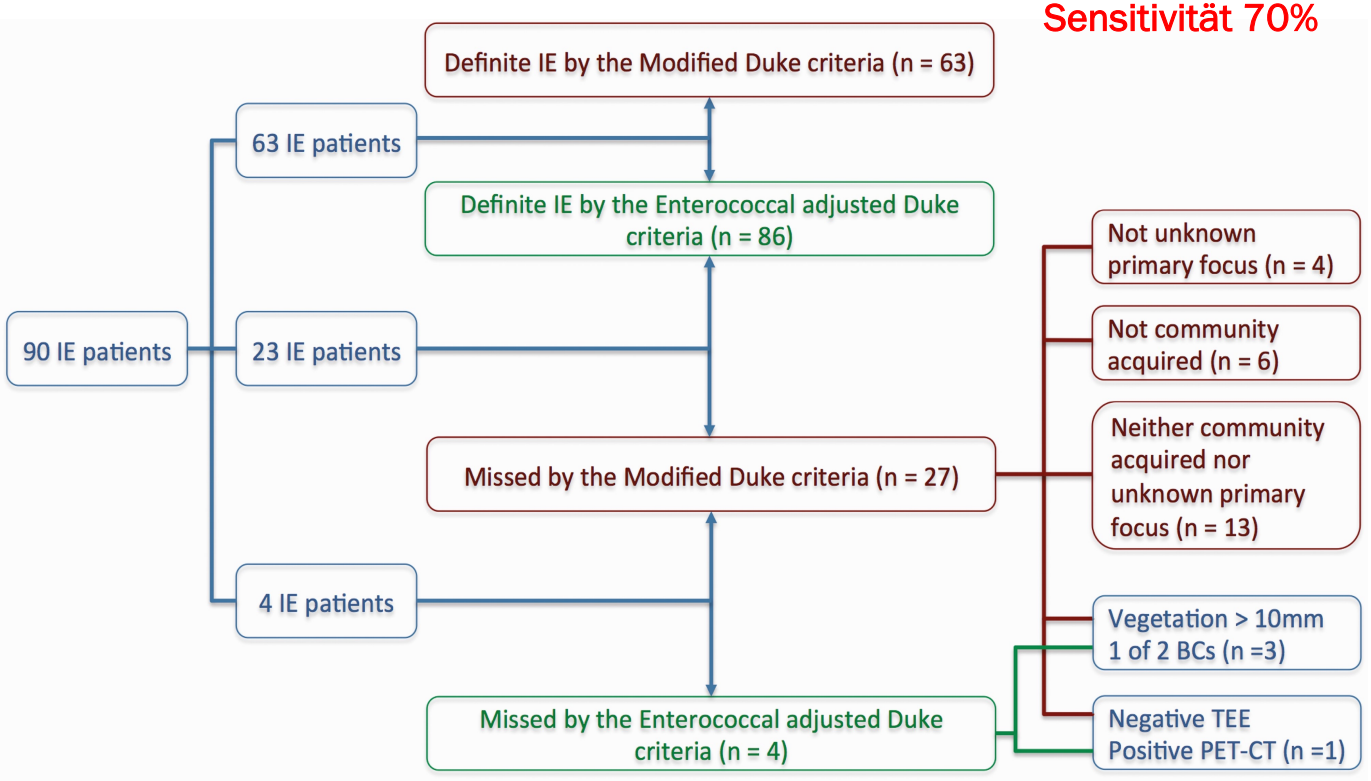
*Simos et al. J Antimicrob Chemother 2022; 77: 2003–2010

E. faecalis: Sensitivität der DUKE-Kriterien?

„Two separate blood cultures: Community-acquired enterococci, in the absence of a primary focus“

- 344 Pt. E. faecalis Bakteriämie, 100% Echo, 78% TEE
- 90 Pat. (26.1%) Endokarditis

Sensitivität 70%



van der Vaart et al, CID 2022:74 (15 April)

Go et al., OFID 2022: 1 pos. BK SAB → 3.8% IE

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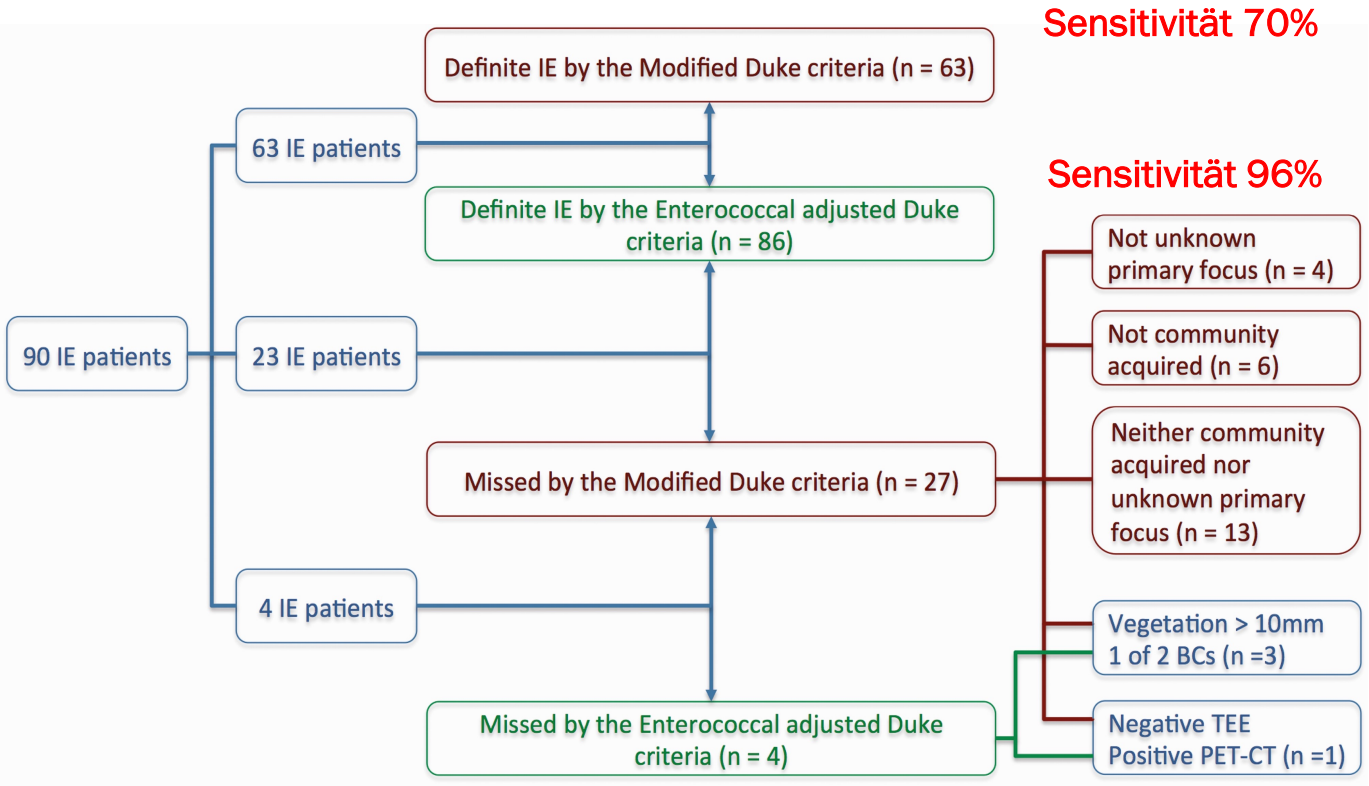

van der Vaart et al, CID 2022:74 (15 April)

Go et al., OFID 2022: 1 pos. BK SAB → 3.8% IE

Sensitivität der DUKE-Kriterien?

Author	Accuracy (%)	Sensitivity (%)	Specificity (%)
El-Dalati, 2019	78.57	75.0	100
Wahadat, 2019	100	100	100
Duval, 2020 - NVE	98.57	97.96	100
Duval, 2020 - PVE	98.57	97.87	100
Sag, 2020	89.66	89.0	100
Abikhzer, 2020	87.04	77.4	100
Philip, 2020	80.87	83.5	70.8
Pretet, 2021	74.67	69.8	100
Primus, 2021 - NVE	92.0	79.0	100
Primus, 2021 - PVE	84.38	75.0	92.0
Dahl, 2022	86.49	87.0	86.0
Venet, 2022	90.12	71.0	97.0

85% Sensitivität, 97% Spezifität

unpublished data

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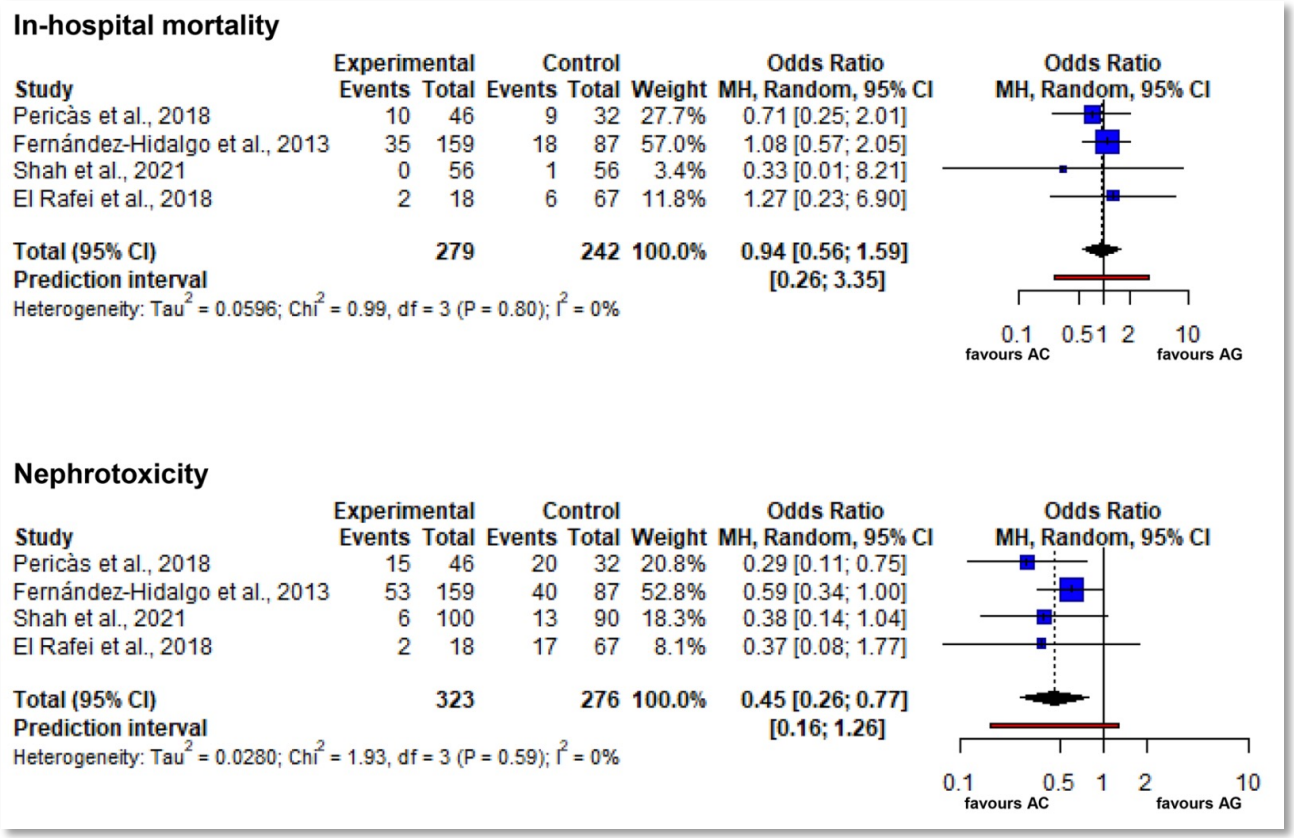
E. faecalis-IE: Amp+Genta od. Amp+Ceftriaxon?

Synergismus (Amp: part. Sättigung der essenz. PBP 4/5, Ceftriaxon: vollst. Sättigung der nicht essenz. PBPs 2/3)



In-hospital mortality

Study	Experimental Events	Experimental Total	Control Events	Control Total	Weight	Odds Ratio MH, Random, 95% CI
Pericàs et al., 2018	10	46	9	32	27.7%	0.71 [0.25; 2.01]
Fernández-Hidalgo et al., 2013	35	159	18	87	57.0%	1.08 [0.57; 2.05]
Shah et al., 2021	0	56	1	56	3.4%	0.33 [0.01; 8.21]
El Rafei et al., 2018	2	18	6	67	11.8%	1.27 [0.23; 6.90]
Total (95% CI)		**279**		**242**	**100.0%**	**0.94 [0.56; 1.59]**
Prediction interval						**[0.26; 3.35]**

Heterogeneity: $Tau^2 = 0.0596$; $Chi^2 = 0.99$, df = 3 (P = 0.80); $I^2 = 0\%$

Odds Ratio MH, Random, 95% CI

0.1 0.5 1 2 10

favours AC favours AG

Nephrotoxicity

Study	Experimental Events	Experimental Total	Control Events	Control Total	Weight	Odds Ratio MH, Random, 95% CI
Pericàs et al., 2018	15	46	20	32	20.8%	0.29 [0.11; 0.75]
Fernández-Hidalgo et al., 2013	53	159	40	87	52.8%	0.59 [0.34; 1.00]
Shah et al., 2021	6	100	13	90	18.3%	0.38 [0.14; 1.04]
El Rafei et al., 2018	2	18	17	67	8.1%	0.37 [0.08; 1.77]
Total (95% CI)		**323**		**276**	**100.0%**	**0.45 [0.26; 0.77]**
Prediction interval						**[0.16; 1.26]**

Heterogeneity: $Tau^2 = 0.0280$; $Chi^2 = 1.93$, df = 3 (P = 0.59); $I^2 = 0\%$

Odds Ratio MH, Random, 95% CI

0.1 0.5 1 2 10

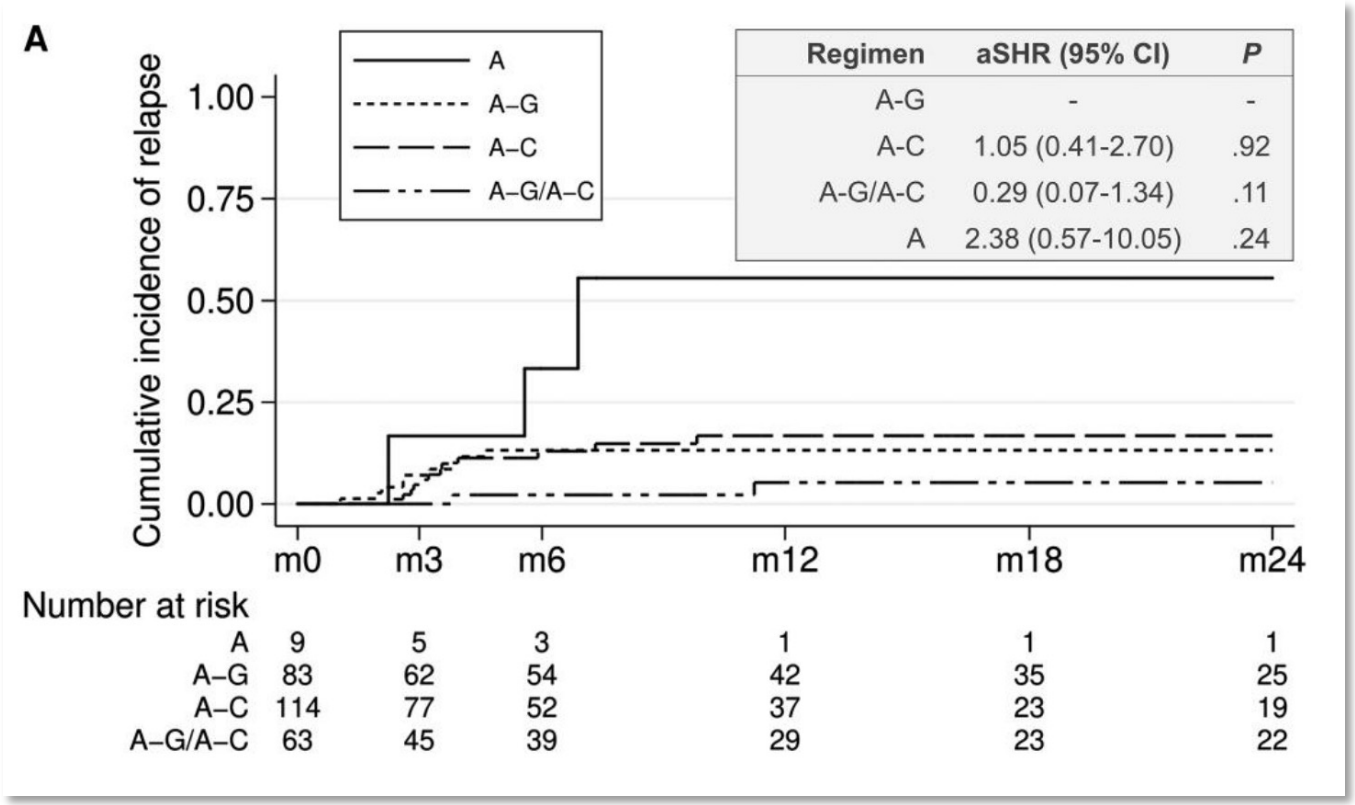
favours AC favours AG

Rezidiv: OR 1,21 (0,07-21,47), p = 0,81); Therapieversagen: OR 0,47 (0,03-8,16), p = 0,18

Mirna et al, 2021, Clinical Research in Cardiology

E. faecalis-IE: Ampicillin Mono?

- → 14 französische Krankenhäuser, 2015 – 2019
- → 279 Pt mit *E. faecalis* IE (30% A/G, 40% A/C, 25% AG-AC, 3% (**n=9**)



Regimen	aSHR (95% CI)	*P*
A-G	-	-
A-C	1.05 (0.41-2.70)	.92
A-G/A-C	0.29 (0.07-1.34)	.11
A	2.38 (0.57-10.05)	.24

<u>Rezidiv Monat 12</u>

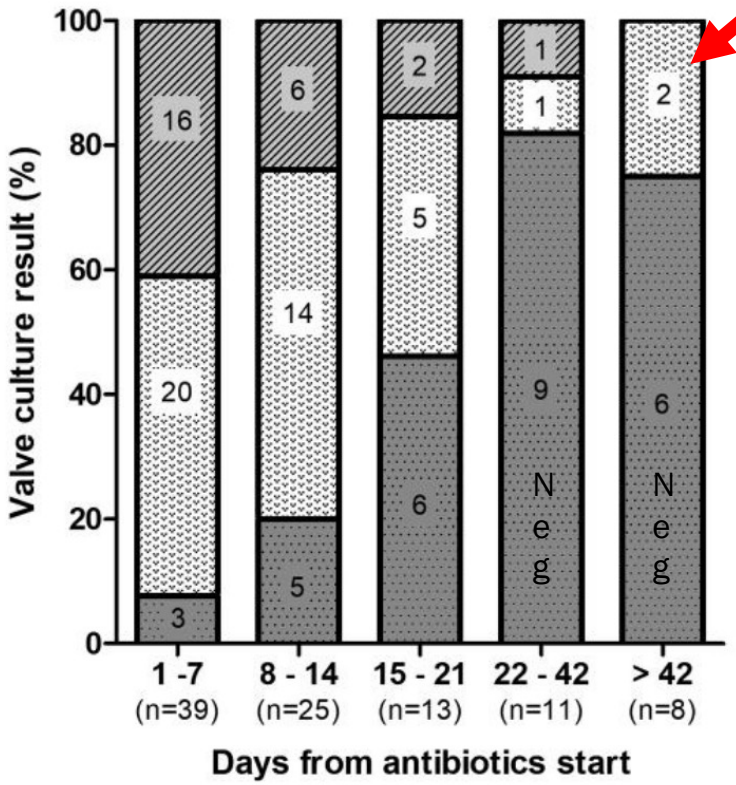
A: 46.2% (17.8%–85.8%)

AC: 14.7% (8.6%–24.5%)
AG: 13.4% (7.2%–24.2%)

Danneels et al, 2023, CID 76 (2), 281-90

E. faecalis-IE: Persistenz

96 Pat mit OP → 71 Pat mit Kulturergebnis der Klappe



Tag 141 und 192 nach TX-Ende
→ keine Infektzeichen
→ elektive OP

<u>Chir. Versorgung schützt vor Rezidiv</u>
aHR 0.42 (95% CI .21–.83, P = .01)

Danneels et al, 2023, CID 76 (2), 281-90

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S. aureus Prothesen-IE: Genta + Rifa?

Prosthetic valves						
Methicillin-susceptible staphylococci						
(Flu)cloxacillin *or* oxacillin with Rifampin[e] and Gentamicin[f]	12 g/day i.v. in 4–6 doses 900–1200 mg i.v. or orally in 2 or 3 divided doses 3 mg/kg/day i.v. or i.m. in 1 or 2 doses **Paediatric doses:**[g] Oxacillin and (flu)cloxacillin as above Rifampin 20 mg/kg/day i.v. or orally in 3 equally divided doses	≥ 6 ≥ 6 2	I I I	B B B	6,8, 135, 136	Starting rifampin 3–5 days later than vancomycin and gentamicin has been suggested by some experts. Gentamicin can be given in a single daily dose in order to reduce renal toxicity

2015 ESC Guidelines for the management of infective endocarditis

Deconstructing the Dogma: Systematic Literature Review and Meta-analysis of Adjunctive Gentamicin and Rifampin in Staphylococcal Prosthetic Valve Endocarditis

Jonathan H. Ryder,[1] Steven Y. C. Tong,[2,3] Jason C. Gallagher,[4] Emily G. McDonald,[5] Irani Thevarajan,[2,3] Todd C. Lee,[5,a] and Nicolás W. Cortés-Penfield[1,a]

[1]Department of Internal Medicine, Division of Infectious Diseases, University of Nebraska Medical Center, Omaha, Nebraska, USA, [2]Victorian Infectious Diseases Service, Royal Melbourne Hospital, Peter Doherty Institute for Infection and Immunity, Melbourne, Australia, [3]Department of Infectious Diseases, University of Melbourne, Peter Doherty Institute for Infection and Immunity, Melbourne, Australia, [4]Department of Pharmacy Practice, Temple University, Philadelphia, Pennsylvania, USA, and [5]Clinical Practice Assessment Unit, Department of Medicine, McGill University, Montreal, Quebec, Canada

Therapie jeweils mit ß-Laktam od. Vancoymcin *PLUS*

1. Gentamicin + Rifampicin vs. Rifampicin-Mono (2 Studien; n = 117)
   → **OR 0,98** [95 % KI, 0.39-2. 46])
2. Gentamicin + Rifampin vs. Gentamicin-Mono (2 Studien; n = 201)
   → **OR 1,29** [95% CI, 0.71-2,33])
3. Gentamicin + Rifampicin vs. (Gentamicin od. Rifampicin jeweils Mono od. ohne zusätzlichen Kombinationspartner); 3 Studien; n = 320
   → **OR 1,18** [95% CI, 0.7- 1,96])

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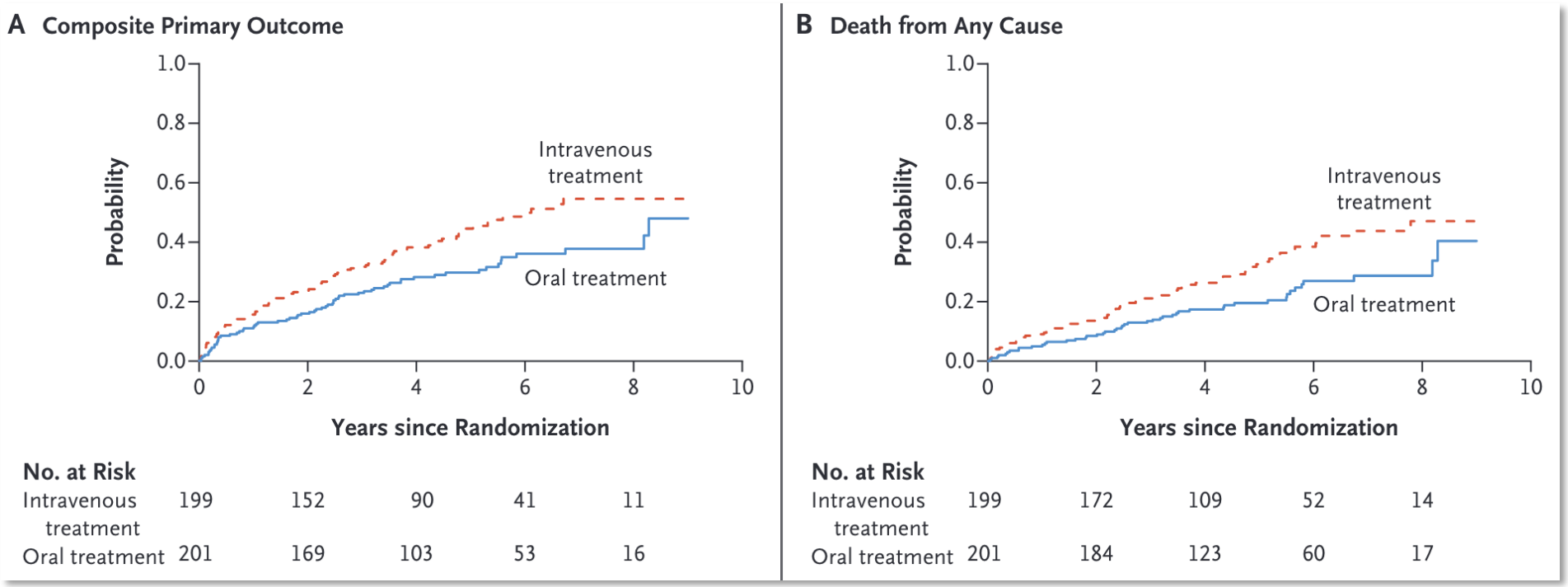
POET Studie: 5 Jahre Follow up



PO: 32,8% vs. IV: 45,2%

HR 0,65, 95% CI 0,47-0,90

PO: 23,4% vs. IV: 35,2%

HR 0,61, 95% CI 0,42-0,88

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POET Studie: PK/PD Substudie

E. faecalis

Amoxicillin and moxifloxacin	24 (47)
Amoxicillin and linezolid	13 (25)
Amoxicillin and rifampicin	6 (12)
Moxifloxacin and linezolid	5 (10)
Amoxicillin and ciprofloxacin	2 (4)
Amoxicillin	1 (2)

Streptokokken

Amoxicillin and rifampicin	47 (52)
Amoxicillin and moxifloxacin	12 (13)
Rifampicin and linezolid	8 (9)
Moxifloxacin and linezolid	8 (9)
Amoxicillin and linezolid	7 (8)
Penicillin	3 (3)

S. aureus

Dicloxacillin and rifampicin	15 (33)
Amoxicillin and rifampicin	13 (29)
Moxifloxacin and rifampicin	3 (7)
Amoxicillin and fusidic acid	2 (4)
Dicloxacillin and fusidic acid	2 (4)
Fusidic acid and linezolid	2 (4)

KNS

Fusidic acid and linezolid	5 (38)
Rifampicin and linezolid	4 (31)
Amoxicillin and linezolid	1 (8)
Dicloxacillin and rifampicin	1(8)
Moxifloxacin and linezolid	1(8)
Rifampicin and Fusidic acid	1(8)

Bock et al, CID 2023

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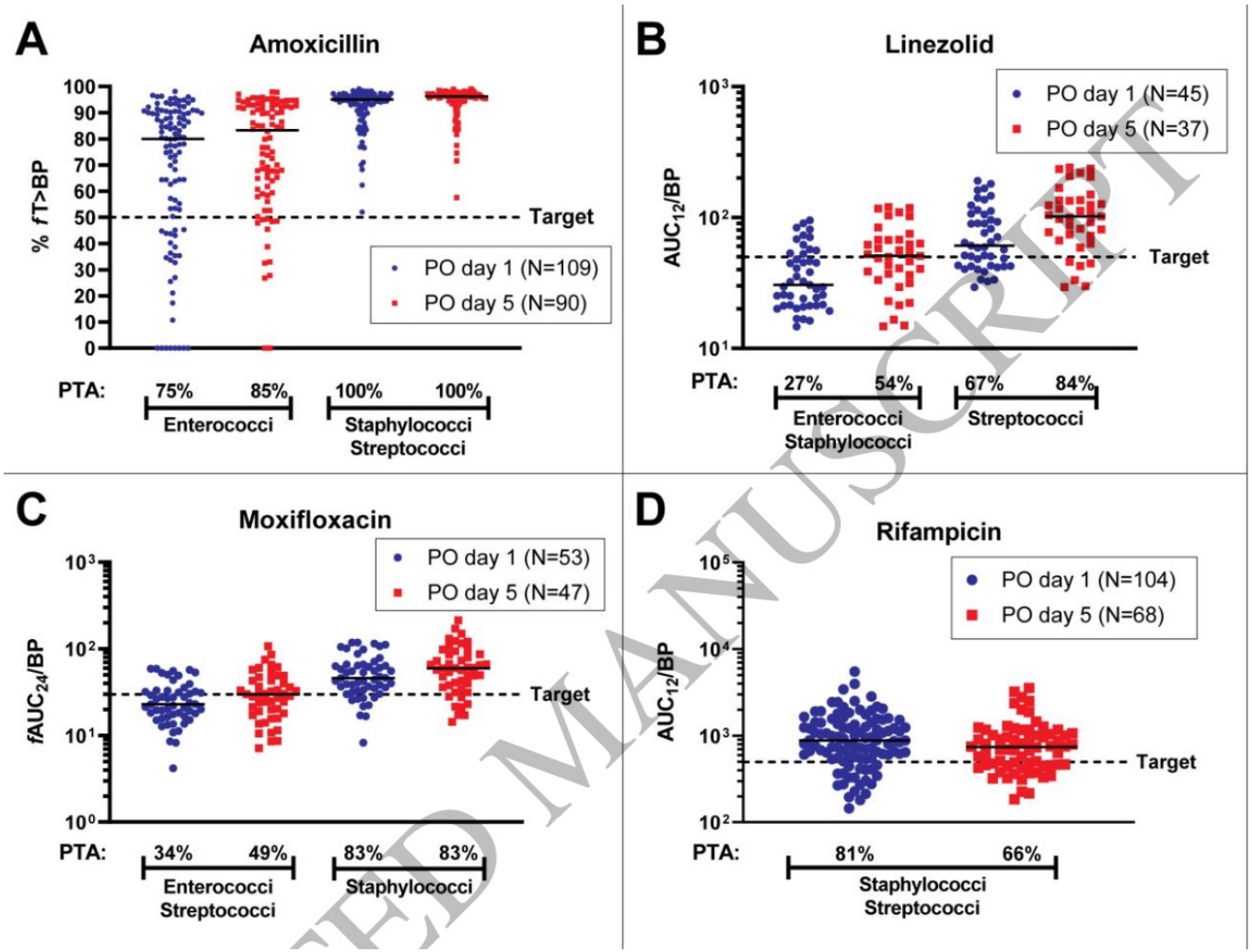
Attainment of Target: EUCAST Breakpoints

4 x 1g

1 x 400

2 x 600

2 x 600



Bock et al, CID 2023

Attainment of Target: akt. MHK, p.o Gruppe

- 74 Patienten mit Daten (PK und MIC) an Tag 1 und Tag 5
- Tag 1:
  - 82% erreichten PTA für beide Antibiotika
  - 18% nur für ein Antibiotikum
- Tag 5:
  - 77% erreichten PTA für beide Antibiotika
  - 22% nur für ein Antibiotikum
  - 2% (1 Pt) hat keine PTA erreicht

Ausblick

Accelerated treatment of endocarditis—The POET II trial: Rationale and design of a randomized controlled trial

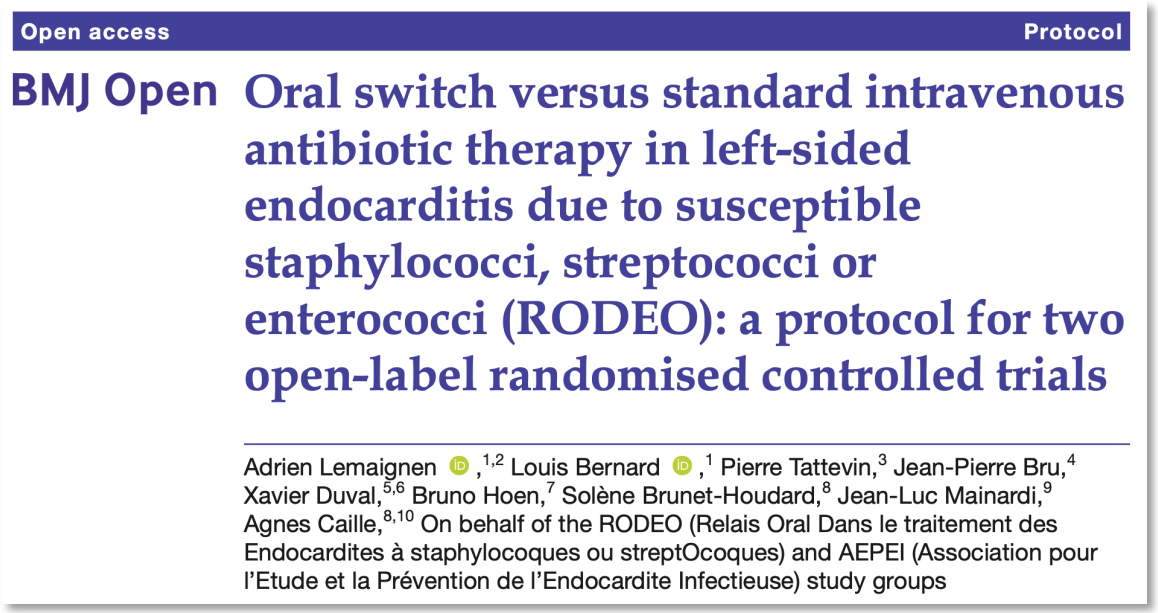
Lauge Østergaard, MD,[a,1] Mia Marie Pries-Heje, MD,[a,1] Rasmus Bo Hasselbalch, MD,[b] Magnus Rasmussen, MD, PhD,[c] Per Åkesson, MD,[c] Robert Horvath, MD,[d] Jonas Povlsen, MD, PhD,[e] Sabine Gill, MD, PhD,[f] Niels Eske Bruun, MD, DMSc,[g] Katrine Müllertz, MD, PhD,[h] Christian Ditlev Tuxen, MD, PhD,[i] Nikolaj Ihlemann, MD, PhD,[a] Jannik Helweg-Larsen, MD, DMSc,[j] Claus Moser, MD, PhD,[k] Emil Loldrup Fosbøl, MD, PhD,[a] Henning Bundgaard, MD, DMSc,[a,2] and Kasper Iversen, MD, DMSc[b,2] *Copenhagen, Aarhus, Odense, Roskilde, Hillerød, Denmark; Lund, Sweden; and Brisbane, Australia*

	Usual treatment regimen	Accelerated treatment regimen
Streptococcus spp uncomplicated (NVE)	4 wk	2 wk
Streptococcus spp complicated (PVE or abscess)	6 wk	3 wk
Staphylococcus aureus uncomplicated	4 wk	2 wk
Staphylococcus aureus complicated	6 wk	4 wk
E faecalis uncomplicated	6 wk	4 wk
E faecalis complicated	6 wk	4 wk
Subsequent to cardiac surgery with a negative valve culture	At least 2 wk	1 week
Subsequent to cardiac surgery with a positive valve culture	As new infection	As new infection

Complicated IE was defined as patients with intracardiac abscess, embolic event, surgically treated IE, and/or prosthetic valve endocarditis. For *Streptococcus* spp, *complicated IE* was defined as prosthetic valve endocarditis or IE with intracardiac abscess only.
NVE, native valve endocarditis; *PVE*, prosthetic valve endocarditis.

- non-inferiority margin (5% gesamte Kohorte, 10% für jeden einzelnen Erreger)
- Randomisierung erst wenn die Mindest-therapiedauer erreicht ist und der Pt. klinische Stabilitätskriterien erfüllt hat
- Oralisierung zu jedem Zeitpunkt mgl.
- 750 Patienten (184 je Erreger)
- 4 Jahre Rekrutierung (Ende Juni 2023)

Ausblick



Open access Protocol

BMJ Open

Oral switch versus standard intravenous antibiotic therapy in left-sided endocarditis due to susceptible staphylococci, streptococci or enterococci (RODEO): a protocol for two open-label randomised controlled trials

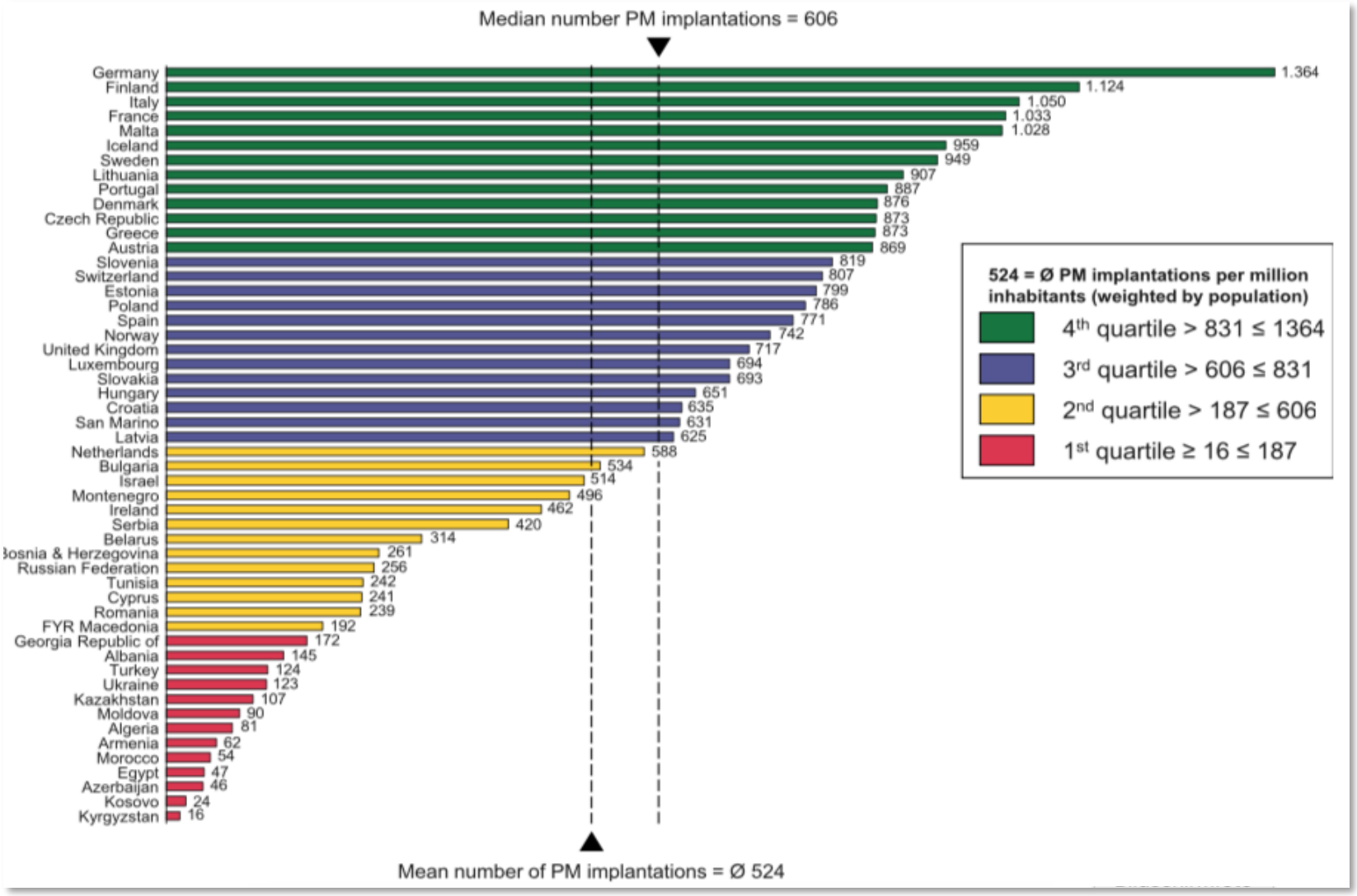
Adrien Lemaignen ,[1,2] Louis Bernard ,[1] Pierre Tattevin,[3] Jean-Pierre Bru,[4] Xavier Duval,[5,6] Bruno Hoen,[7] Solène Brunet-Houdard,[8] Jean-Luc Mainardi,[9] Agnes Caille,[8,10] On behalf of the RODEO (Relais Oral Dans le traitement des Endocardites à staphylocoques ou streptOcoques) and AEPEI (Association pour l'Etude et la Prévention de l'Endocardite Infectieuse) study groups

- 2 nested non-inferiority Studien bei Pat. mit Linksherzendokarditis
- RODEO-I: Staphylokokken (>70kg: Levofloxacin 1x 750mg + Rifampicin 900mg)
- RODEO II: Streptokokken und Enterokokken (>70kg: Amoxicillin 2g 1-1-1)
- Randdomisierung nach 10 Tagen i.v. Therapie wenn klinisch stabil
- NI-margin 10%, 648 Patienten (324 je Erreger)
- First patient in Januar 2016 (Stand 06/2020: n=97 Staph, n=205 Strep/Entero)

Agenda

- Endokarditisprophylaxe
- Endokarditisteam
- Diagnose
- Therapie
- **Cardiac-Device assoziierte Infektionen**

Wir sind Weltmeister im implantieren!



Raatikainen et al., Europace (2017) 19, ii1–ii90

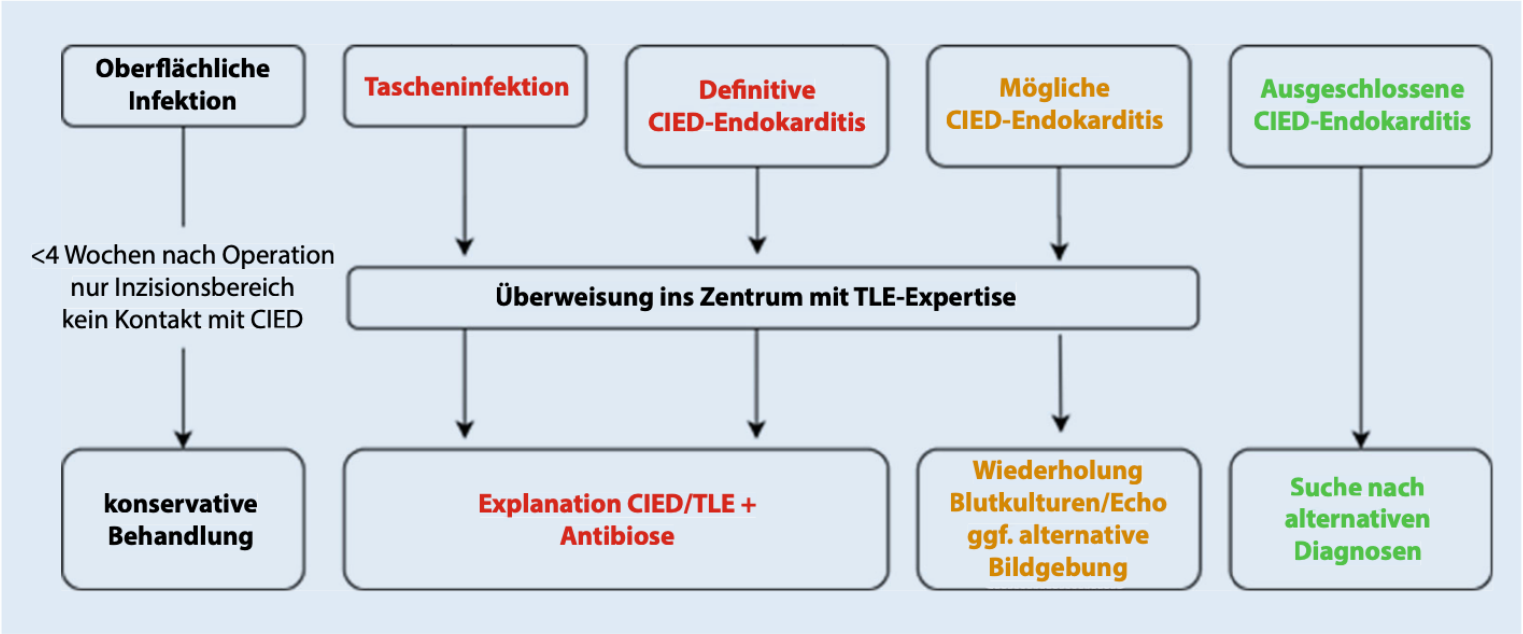
Konsensuspapiere

Kardiologie
https://doi.org/10.1007/s12181-022-00550-8
Angenommen: 15. März 2022

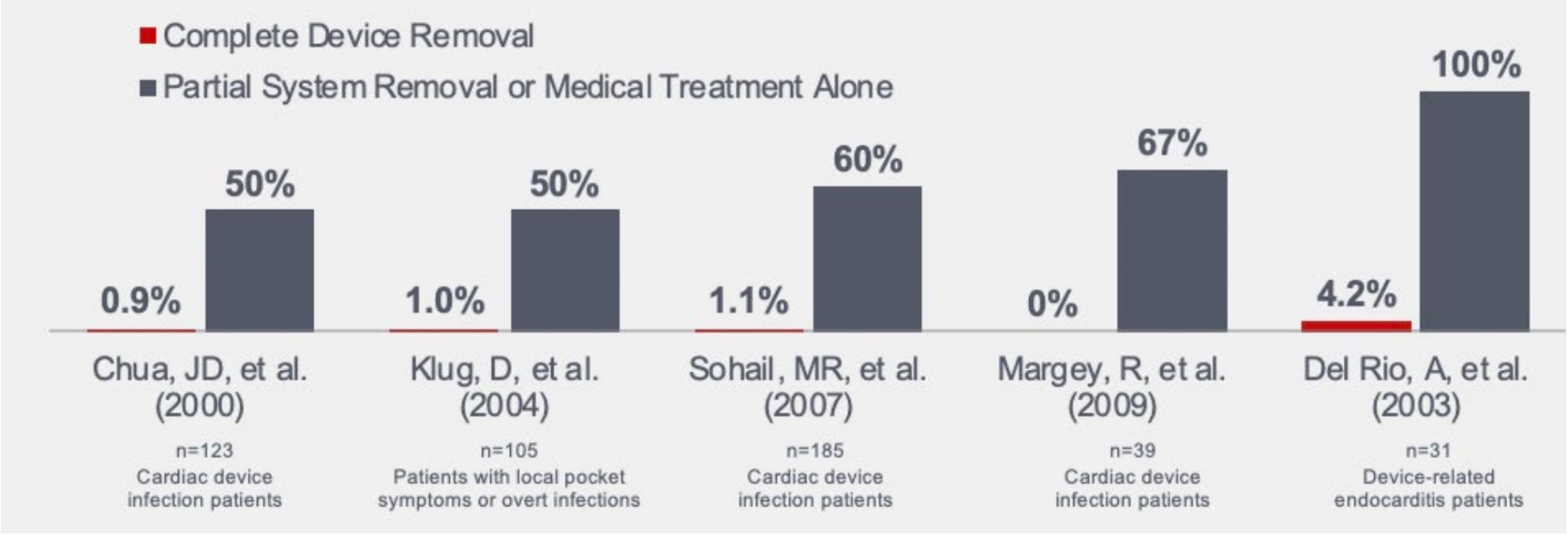
Empfehlungen zur Sondenextraktion – Gemeinsame Empfehlungen der Deutschen Gesellschaft für Kardiologie (DGK) und der Deutschen Gesellschaft für Thorax-, Herz- und Gefäßchirurgie (DGTHG)

Roland R. Tilz[1,2,14] · Ralph Bosch[3,13] · Christian Butter[4] · Karl-Heinz Kuck[1,14] · Sergio Richter[5] · Philipp Sommer[6] · Samer Hakmi[7] · Thorsten Hanke[8] · Michael Knaut[9] · Christoph Starck[10,11] · Heiko Burger[12]

Extraktion innerhalb von 3 Tagen!



Ohne komplette Extraktion der Sonden + Aggregat → hohes Rezidivrisiko!



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Klug D, et al. *Heart*. 2004;90(8):882-886.
Sohail MR, et al. *J Am Coll Cardiol*. 2007;49(18):1851-1859.
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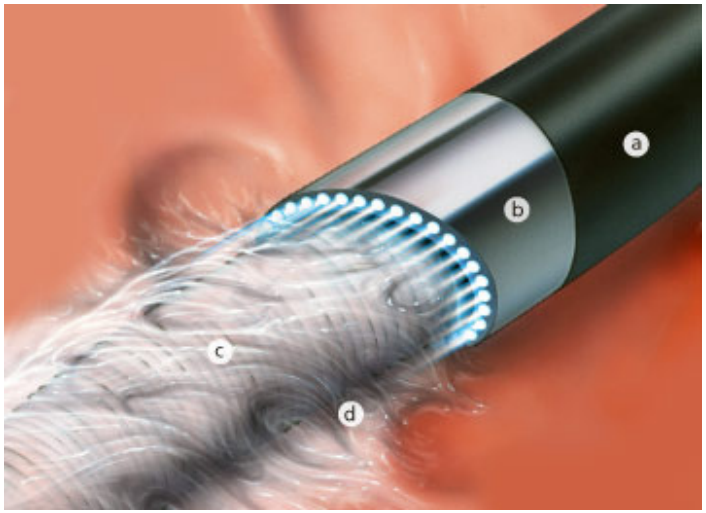
del Rio A, et al. *Chest*. 2003;124(4):1451-1459.

ESC European Society of Cardiology
Europace (2022) **00**, 1–9
https://doi.org/10.1093/europace/euac056
CLINICAL RESEARCH

The GermAn Laser Lead Extraction GallerY: GALLERY

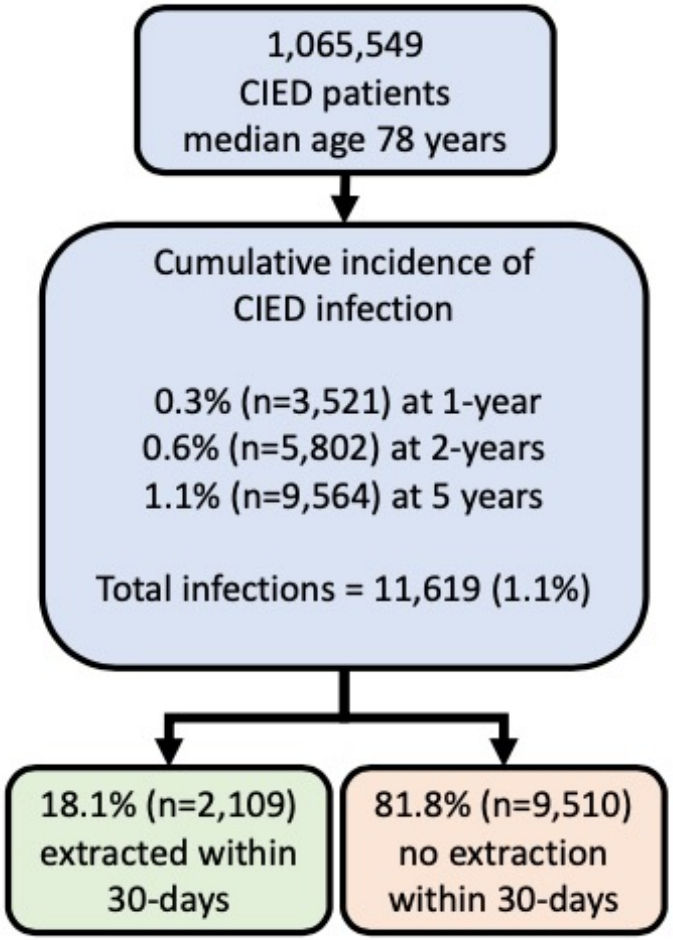
- 2013-2017, 24 Zentren, 2.524 Patienten, 6.117 Sonden extrahiert
- 64% Infektion (Aggregatinfektion 35%, Sondeninfektion 29%)
- Erfolgreiche Extraktion:
  → 94.8%
- Komplikationen:
  → Major* 2.06% (n=52), Minor 2.3% (n=57)
- Prozedur assoz. Sterblichkeit:
  → 0.55% (n=14)
- Krankenhaus-Sterblichkeit:
  → 3.56% (n=90)

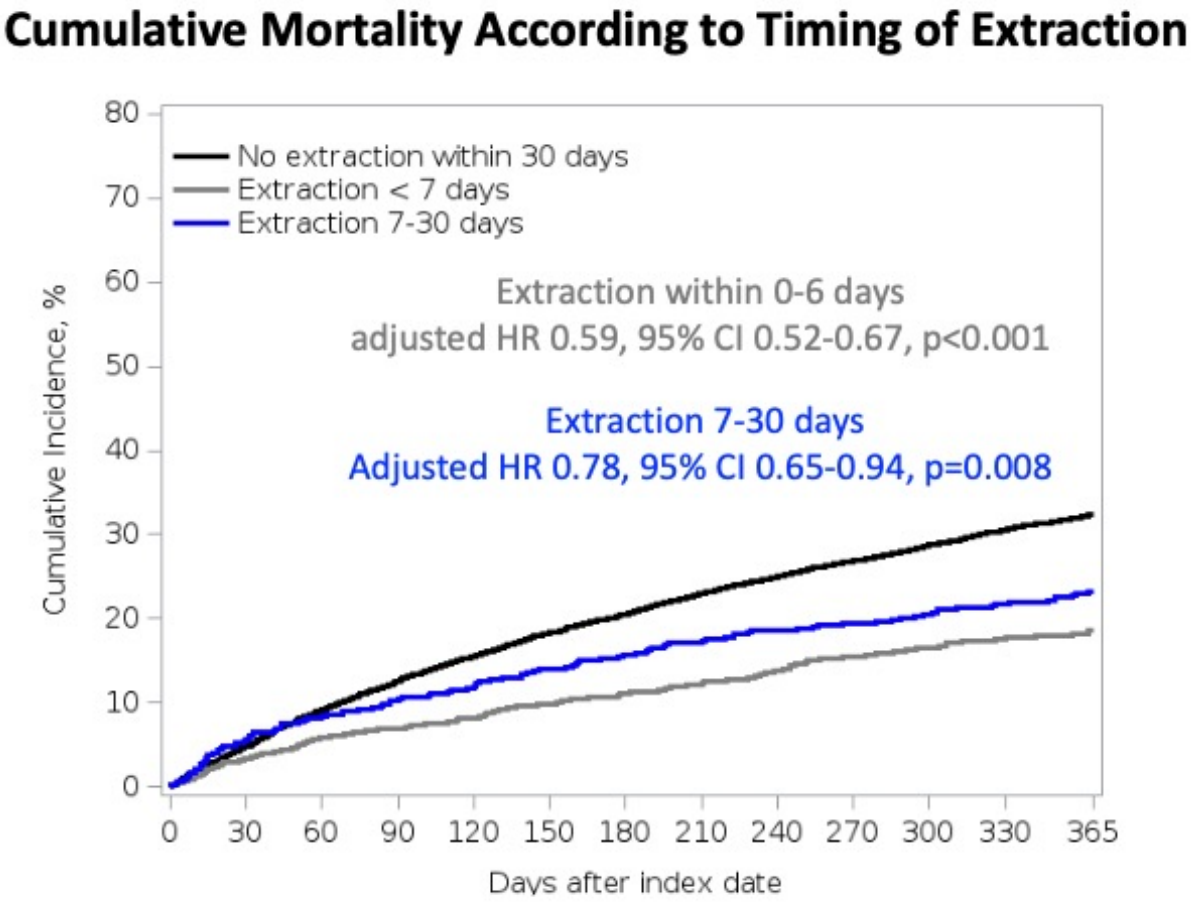


https://www.hirslanden.ch/de/corporate/publications/patientenzeitschriftmittelpunkt/defekte-herzschrittmacher-elektrodenmittelslaserohneoffeneoperat.html

* lebensbedrohlich, Tod, bleibende Schäden

Nur bei 1 von 5 Pat. erfolgt Extraktion des CIED!





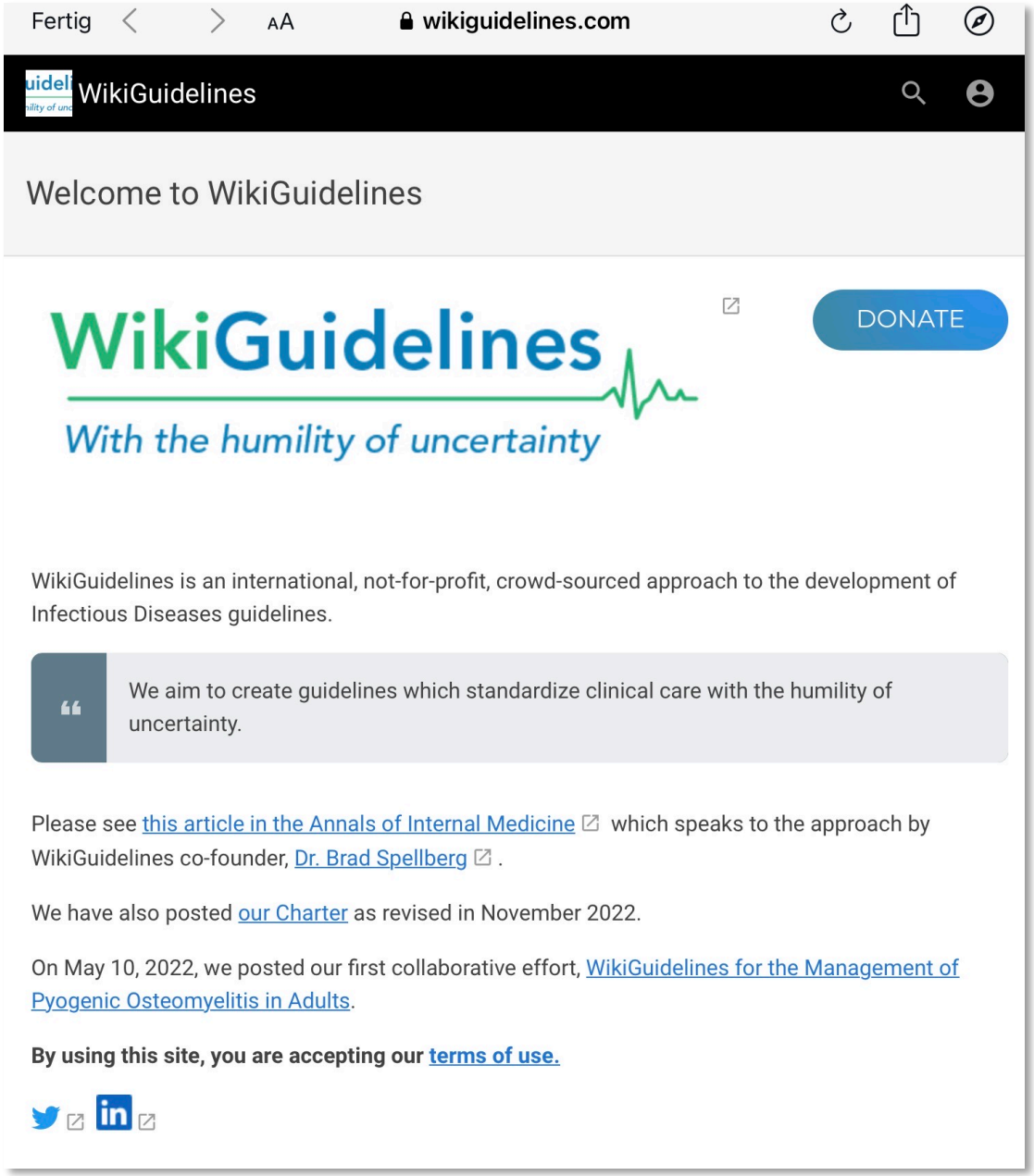
<u>365 Tage Sterblichkeit:</u> (Extraktion vs. no-Extraktion)

HR 0.73 (95% CI 0.7-0.81)

Pokorney et al, presented at AAC 2022

Fazit

- Endokarditisprophylaxe!!
- Es gibt wenig gute Evidenz für die Therapie einer Endokarditis
- Endokarditisteam sinnvoll
- DUKES Kriterien sind nicht in Stein gemeißelt
- Oralisierung ist sicher beim richtigen Patienten mit den richtigen Substanzen
- CIED - Extraktion ist ein sicheres Verfahren und geht im Vergleich zu einer konservativen Therapie mit einer geringeren 1-Jahres Sterblichkeit einher (2-3fach höher)


Fertig
AA
wikiguidelines.com
WikiGuidelines
Welcome to WikiGuidelines
WikiGuidelines
With the humility of uncertainty
DONATE
WikiGuidelines is an international, not-for-profit, crowd-sourced approach to the development of Infectious Diseases guidelines.
We aim to create guidelines which standardize clinical care with the humility of uncertainty.
Please see this article in the Annals of Internal Medicine which speaks to the approach by WikiGuidelines co-founder, Dr. Brad Spellberg .
We have also posted our Charter as revised in November 2022.
On May 10, 2022, we posted our first collaborative effort, WikiGuidelines for the Management of Pyogenic Osteomyelitis in Adults.
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