STICHTING WERKGROEP ANTIBIOTICABELEID

Dutch Guideline for Antibiotic Stewardship:

What is the evidence for hospital Antimicrobial Stewardship objectives?

and…how to implement it in daily practice?

Jaap ten Oever, MD PhD

October 2017
Istanbul

Antimicrobial stewardship program (ASP)

- **WHAT** do you want to achieve in patient care?

  Stewardship objectives (**process**- and **outcome** quality indicators (QI))

- **HOW** do you achieve these goals?

  Conditions (A-team, infrastructure to measure, guideline; **structure** QI)

  Other (education, audit and feedback, goal setting,…)

Stewardship objectives

Quality Indicators to Measure Appropriate Antibiotic Use in Hospitalized Adults

Caroline M. A. van den Bosch,[1] Suzanne E. Geerlings,[1] Stephanie Natsch,[2] Jan M. Prins,[1] and Marlies E. J. L. Hulscher[3]

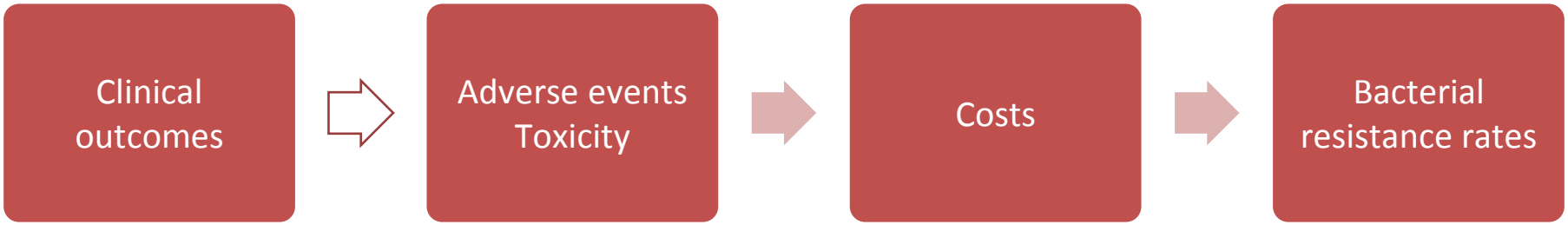
[1]Department of Internal Medicine, Division of Infectious Diseases, Academic Medical Center, University of Amsterdam, and Departments of [2]Clinical Pharmacology and [3]Scientific Institute for Quality of Healthcare, Radboud University Medical Center, Nijmegen, The Netherlands

Clin Infect Dis. (2015)

Stewardship objectives

1. Blood cultures
2. Cultures from infection site
3. Guideline adherence
4. Antibiotic plan
5. Renal function
6. IV/PO switch
7. De-escalation
8. Stop criteria
9. Therapeutic Drug Monitoring
10. Local guide available
11. Local vs. national guideline
12. List of restricted antimicrobials
13. Bedside consultation
14. Therapy compliance

Outcomes


Clinical outcomes
Adverse events Toxicity
Costs
Bacterial resistance rates

Inclusion and exclusion criteria

14 systematic reviews

Inclusion

- Hospital or long-term care facilities
- Dutch, English, German, Spanish, French
- Adults (≥18yr)

Exclusion

- Children (<18yr)
- Outpatients/GP setting
- Outbreak setting
- Resource-limited settings
- Prophylactic and peri-operative treatment
- Malaria, HIV, *Mycobacterium, H. pylori*

Intervention studies

ORIGINAL INVESTIGATION

Early Switch and Early Discharge Strategies in Patients With Community-Acquired Pneumonia

A Meta-analysis

David C. Rhew, MD; George S. Tu, MD; Joshua Ofman, MD, MSHS; James M. Henning, MS; Margaret S. Richards, PhD; Scott R. Weingarten, MD, MPH

Search

Search	# of records after duplicates removed	# of full-text articles assessed	# of studies included in qualitative synthesis
Empirical therapy according to the guidelines	760	110	40
Take blood cultures	1921	9	0
Take cultures from site of infection	1352	14	0
De-escalation of therapy	2726	121	25
Adjustment of therapy to renal function	1087	24	5
Switch from intravenous to oral therapy	1499	112	18
Documented antibiotic plan	234	2	0
Therapeutic Drug Monitoring (TDM)	2250	64	17
Discontinuation of antibiotic therapy if infection is not confirmed	447	19	3
Presence of a local antibiotic guide	946	4	1
Local guide in agreement with the national guidelines	295	8	0
List of restricted antbiotics	1231	140	30
Bedside consultation	684	24	7
Assessment of patients' adherence	868	18	0
Total	**16300**	**669**	**146**

GRADE

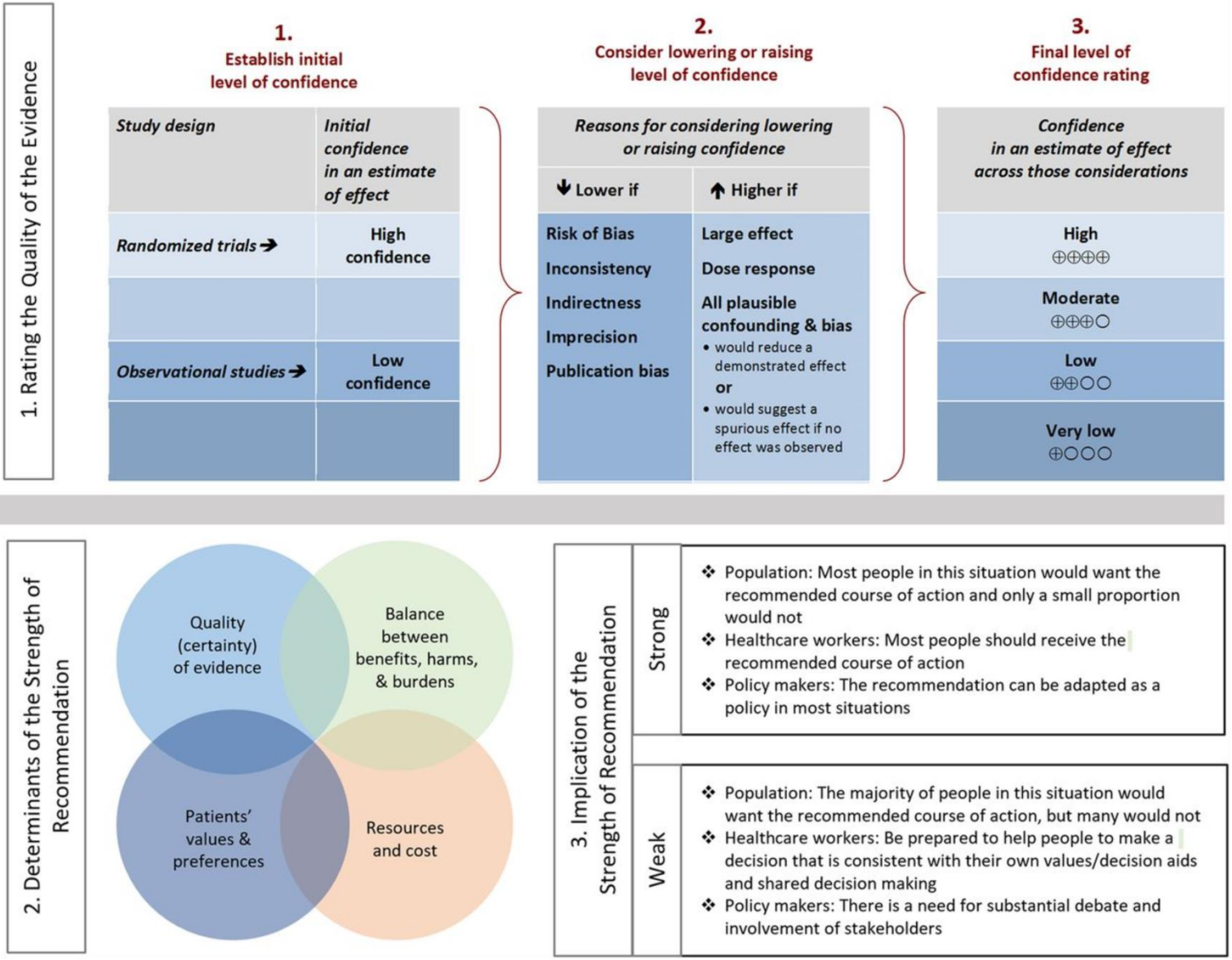
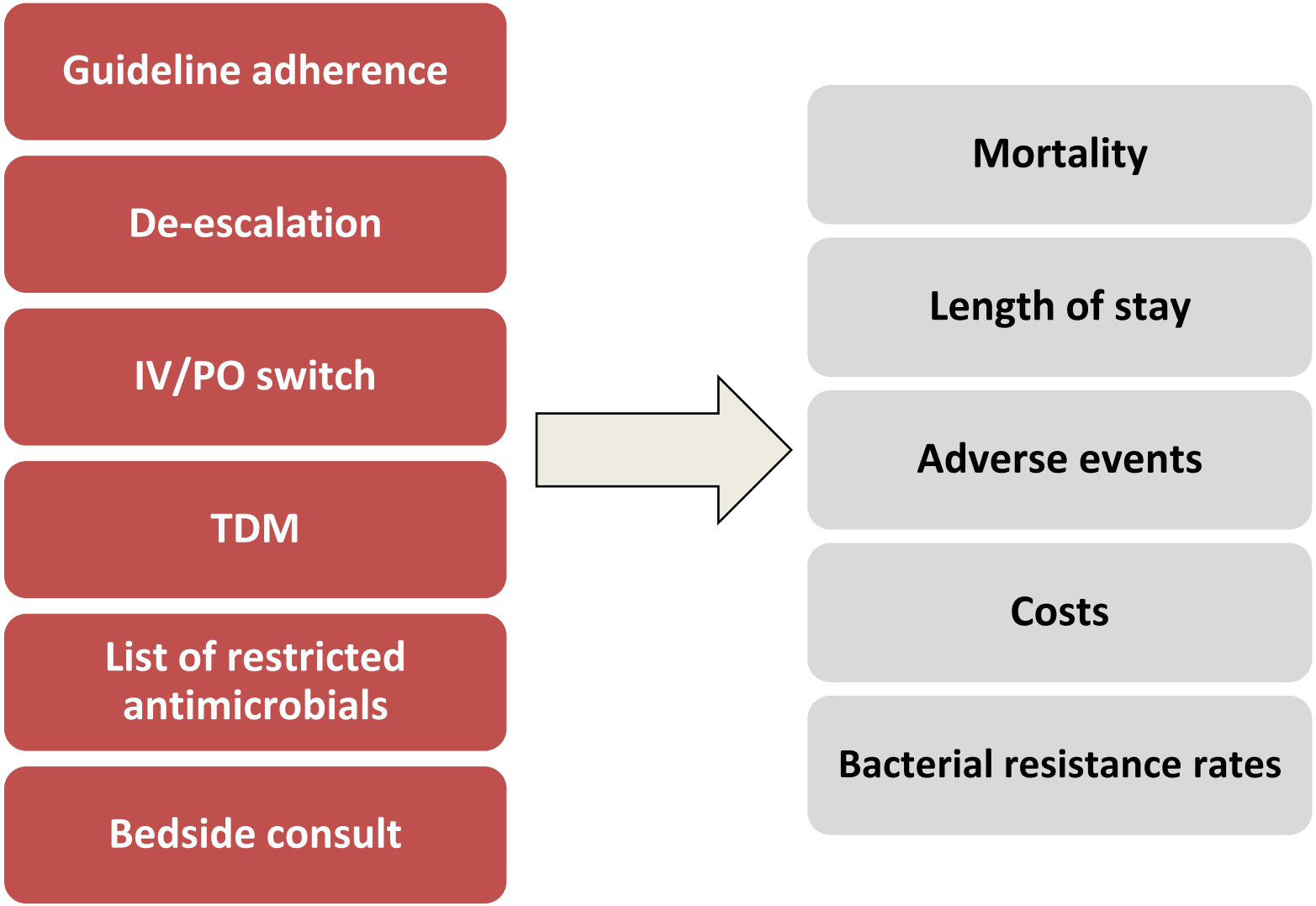

1. Rating the Quality of the Evidence
1.
Establish initial level of confidence
Study design
Initial confidence in an estimate of effect
Randomized trials ➔
High confidence
Observational studies ➔
Low confidence
2.
Consider lowering or raising level of confidence
Reasons for considering lowering or raising confidence
Lower if
Higher if
Risk of Bias
Inconsistency
Indirectness
Imprecision
Publication bias
Large effect
Dose response
All plausible confounding & bias
• would reduce a demonstrated effect
or
• would suggest a spurious effect if no effect was observed
3.
Final level of confidence rating
Confidence in an estimate of effect across those considerations
High
⊕⊕⊕⊕
Moderate
⊕⊕⊕○
Low
⊕⊕○○
Very low
⊕○○○
2. Determinants of the Strength of Recommendation
Quality (certainty) of evidence
Balance between benefits, harms, & burdens
Patients' values & preferences
Resources and cost
3. Implication of the Strength of Recommendation
Strong
❖ Population: Most people in this situation would want the recommended course of action and only a small proportion would not
❖ Healthcare workers: Most people should receive the recommended course of action
❖ Policy makers: The recommendation can be adapted as a policy in most situations
Weak
❖ Population: The majority of people in this situation would want the recommended course of action, but many would not
❖ Healthcare workers: Be prepared to help people to make a decision that is consistent with their own values/decision aids and shared decision making
❖ Policy makers: There is a need for substantial debate and involvement of stakeholders

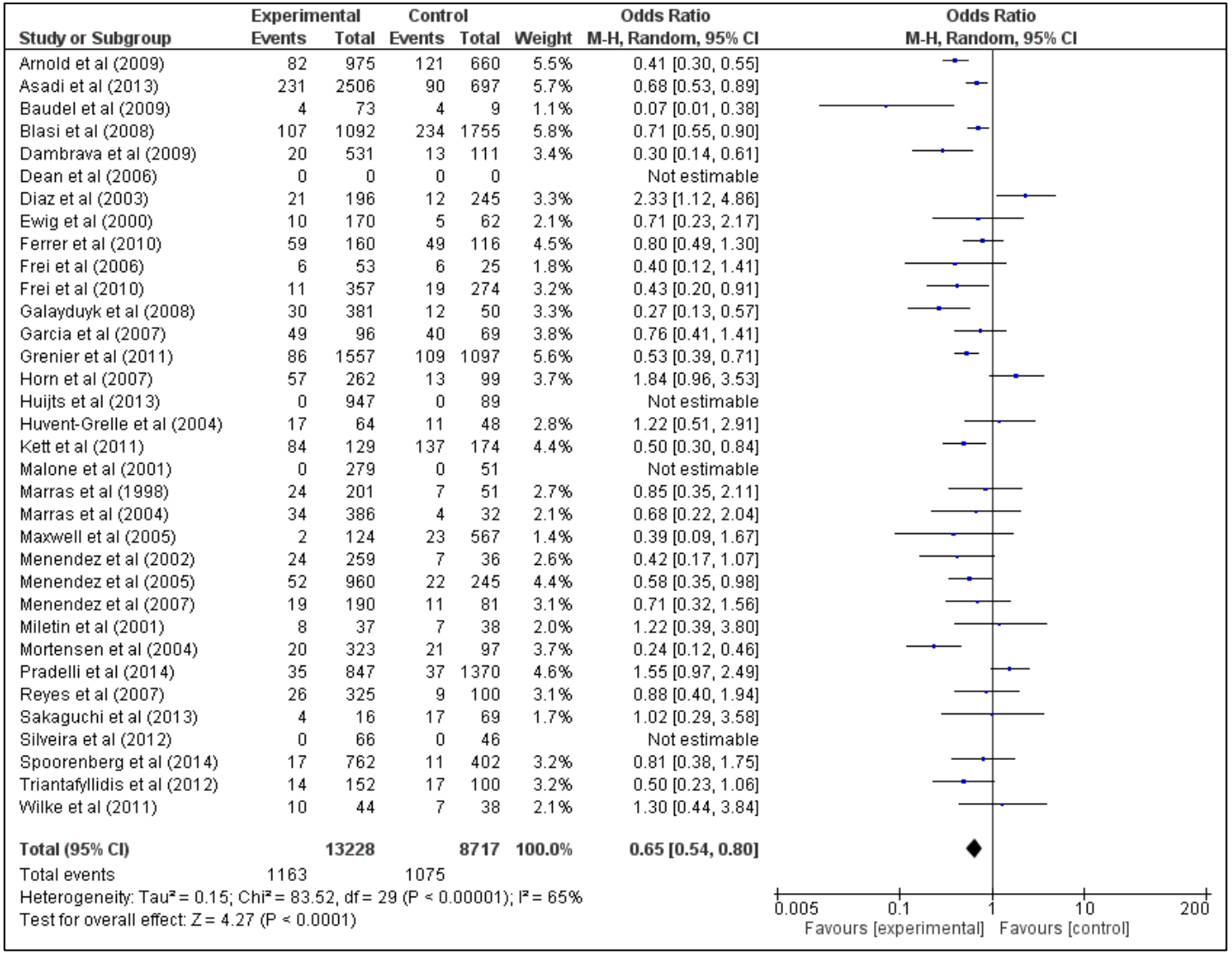
Table 2 GRADE Summary of findings and quality of evidence: Empirical antibiotic therapy according to the guideline

Study		№ of patients/episodes		Effect				Quality assessment				
№ of studies	Study design	Therapy according to guideline	Therapy not according to guideline	Study	Results	Difference (95% CI or Range) P-value	HR/OR (95%CI)	Risk of Bias	Inconsistency	Indirectness	Imprecision	Quality
CLINICAL OUTCOME AND ADVERSE EVENTS												
Length of hospital stay												
24	Obs	96	69	**Garcia et al(15) (2007)**	Adherent: 26.3 d (SD 17.3) Not adherent: 32.0 d (SD 29.9)	- 5.7 d 0.49		serious[1]	serious[2]	not serious	not serious	⊕ VERY LOW
		201	51	**Marras et al(25) (1998)**	Adherent: 9.9 d (median 6) Not adherent: 8.1 d (median 6)	+ 1.8 d 0.13						
		1092	1755	**Blasi et al(7) (2008)**	Adherent: Earlier discharge		HR: 1.10 (1.00-1.20) 0.050					
		975	660	**Arnold et al(4) (2009)**	Adherent: 8 d (IQR 5-15d) Not adherent: 10 d (IQR 6-24d)	- 2 d <0.01						
		531	111	**Dambrava et al(8) (2008)**	Adherent: 7.6 d Not adherent: 10.4 d	- 2.8 d (95%CI 0.93-4.66) 0.004	Multiv OR: 0.60 (0.36-0.99) 0.049					
		208	245	**Diaz et al(10) (2003)**	Adherent: 10.7 d Not adherent: 9 d	+ 1.7 d 0.054						
		170	62	**Ewig et al(11) (2000)**	Adherent: 17 d (SD 11) Not adherent: 14 d (SD 8)	-3 d 0.03						
		160	116	**Ferrer et al(12) (2010)**	Adherent: 43 d (SD 42) Not adherent: 40 d (SD 40)	+ 3 d 0.54						
		357	274	**Frei et al(13) (2006)**	Adherent: 5.0 d (SD 3.8) Not adherent: 6.2 d (SD 4.2)	- 1.2 d <0.01 (ITT)						

Results


Guideline adherence
De-escalation
IV/PO switch
TDM
List of restricted antimicrobials
Bedside consult
Mortality
Length of stay
Adverse events
Costs
Bacterial resistance rates

Guideline adherence - mortality

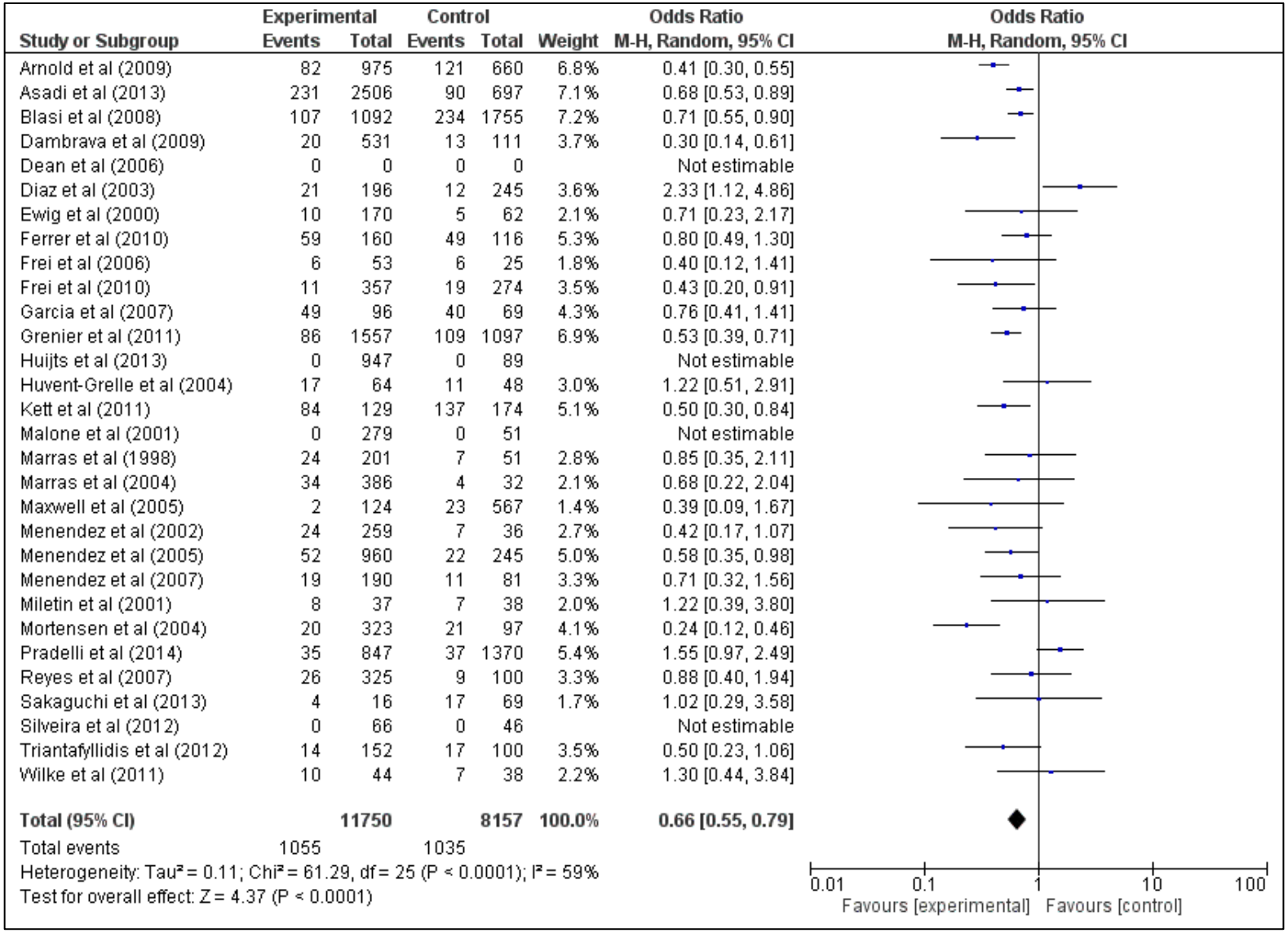


Study or Subgroup	Experimental Events	Experimental Total	Control Events	Control Total	Weight	Odds Ratio M-H, Random, 95% CI
Arnold et al (2009)	82	975	121	660	5.5%	0.41 [0.30, 0.55]
Asadi et al (2013)	231	2506	90	697	5.7%	0.68 [0.53, 0.89]
Baudel et al (2009)	4	73	4	9	1.1%	0.07 [0.01, 0.38]
Blasi et al (2008)	107	1092	234	1755	5.8%	0.71 [0.55, 0.90]
Dambrava et al (2009)	20	531	13	111	3.4%	0.30 [0.14, 0.61]
Dean et al (2006)	0	0	0	0		Not estimable
Diaz et al (2003)	21	196	12	245	3.3%	2.33 [1.12, 4.86]
Ewig et al (2000)	10	170	5	62	2.1%	0.71 [0.23, 2.17]
Ferrer et al (2010)	59	160	49	116	4.5%	0.80 [0.49, 1.30]
Frei et al (2006)	6	53	6	25	1.8%	0.40 [0.12, 1.41]
Frei et al (2010)	11	357	19	274	3.2%	0.43 [0.20, 0.91]
Galayduyk et al (2008)	30	381	12	50	3.3%	0.27 [0.13, 0.57]
Garcia et al (2007)	49	96	40	69	3.8%	0.76 [0.41, 1.41]
Grenier et al (2011)	86	1557	109	1097	5.6%	0.53 [0.39, 0.71]
Horn et al (2007)	57	262	13	99	3.7%	1.84 [0.96, 3.53]
Huijts et al (2013)	0	947	0	89		Not estimable
Huvent-Grelle et al (2004)	17	64	11	48	2.8%	1.22 [0.51, 2.91]
Kett et al (2011)	84	129	137	174	4.4%	0.50 [0.30, 0.84]
Malone et al (2001)	0	279	0	51		Not estimable
Marras et al (1998)	24	201	7	51	2.7%	0.85 [0.35, 2.11]
Marras et al (2004)	34	386	4	32	2.1%	0.68 [0.22, 2.04]
Maxwell et al (2005)	2	124	23	567	1.4%	0.39 [0.09, 1.67]
Menendez et al (2002)	24	259	7	36	2.6%	0.42 [0.17, 1.07]
Menendez et al (2005)	52	960	22	245	4.4%	0.58 [0.35, 0.98]
Menendez et al (2007)	19	190	11	81	3.1%	0.71 [0.32, 1.56]
Miletin et al (2001)	8	37	7	38	2.0%	1.22 [0.39, 3.80]
Mortensen et al (2004)	20	323	21	97	3.7%	0.24 [0.12, 0.46]
Pradelli et al (2014)	35	847	37	1370	4.6%	1.55 [0.97, 2.49]
Reyes et al (2007)	26	325	9	100	3.1%	0.88 [0.40, 1.94]
Sakaguchi et al (2013)	4	16	17	69	1.7%	1.02 [0.29, 3.58]
Silveira et al (2012)	0	66	0	46		Not estimable
Spoorenberg et al (2014)	17	762	11	402	3.2%	0.81 [0.38, 1.75]
Triantafyllidis et al (2012)	14	152	17	100	3.2%	0.50 [0.23, 1.06]
Wilke et al (2011)	10	44	7	38	2.1%	1.30 [0.44, 3.84]
Total (95% CI)		**13228**		**8717**	**100.0%**	**0.65 [0.54, 0.80]**
Total events	1163		1075			

Heterogeneity: Tau² = 0.15; Chi² = 83.52, df = 29 (P < 0.00001); I² = 65%

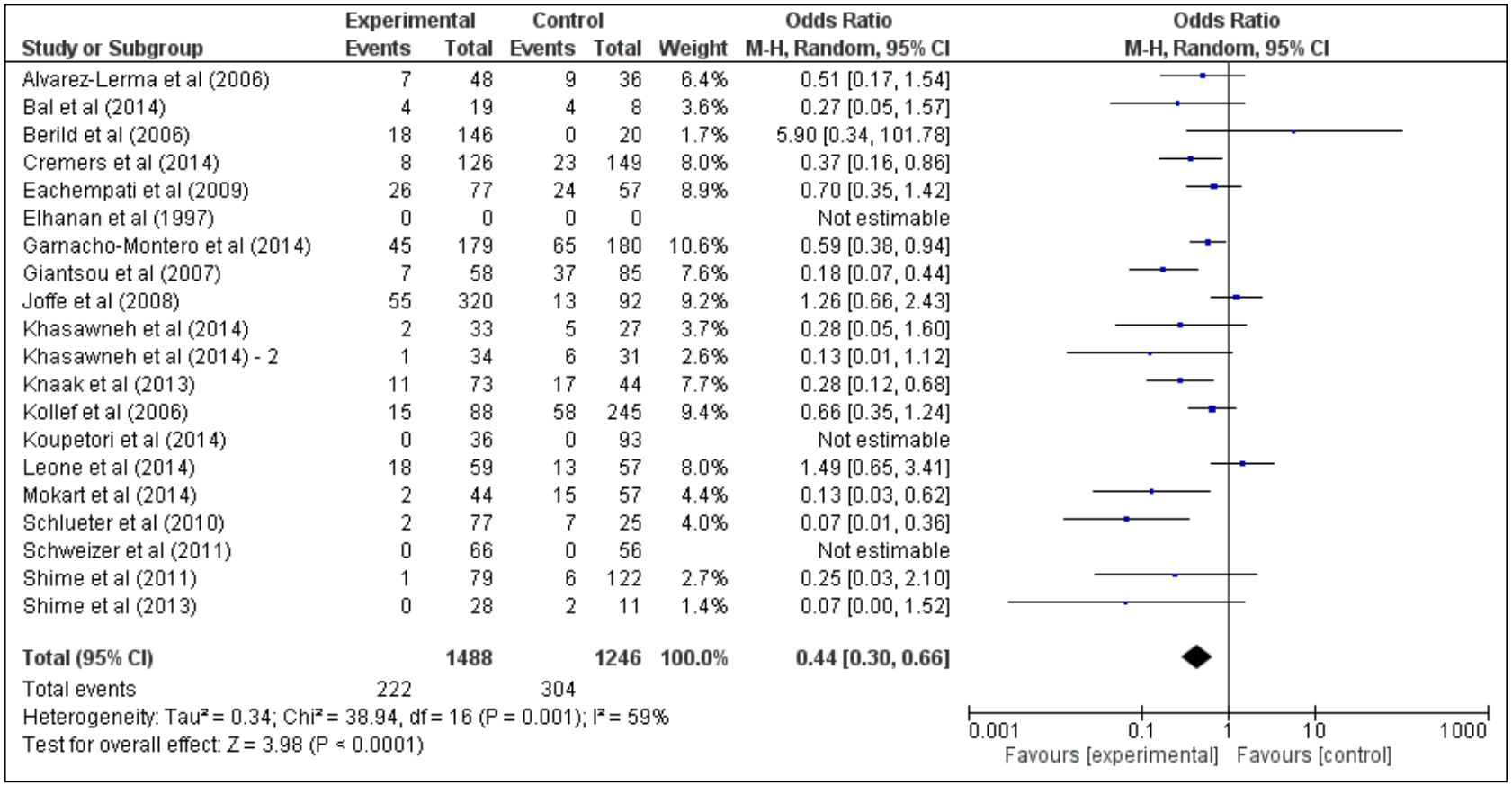
Test for overall effect: Z = 4.27 (P < 0.0001)

Guideline adherence – mortality *CAP*



Guideline adherence

De-escalation - mortality

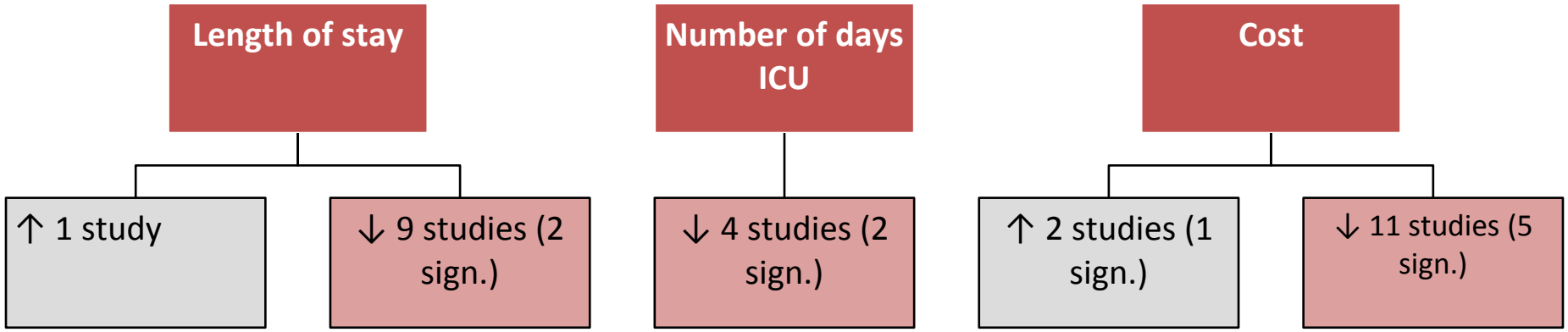


Study or Subgroup	Experimental Events	Experimental Total	Control Events	Control Total	Weight	Odds Ratio M-H, Random, 95% CI
Alvarez-Lerma et al (2006)	7	48	9	36	6.4%	0.51 [0.17, 1.54]
Bal et al (2014)	4	19	4	8	3.6%	0.27 [0.05, 1.57]
Berild et al (2006)	18	146	0	20	1.7%	5.90 [0.34, 101.78]
Cremers et al (2014)	8	126	23	149	8.0%	0.37 [0.16, 0.86]
Eachempati et al (2009)	26	77	24	57	8.9%	0.70 [0.35, 1.42]
Elhanan et al (1997)	0	0	0	0		Not estimable
Garnacho-Montero et al (2014)	45	179	65	180	10.6%	0.59 [0.38, 0.94]
Giantsou et al (2007)	7	58	37	85	7.6%	0.18 [0.07, 0.44]
Joffe et al (2008)	55	320	13	92	9.2%	1.26 [0.66, 2.43]
Khasawneh et al (2014)	2	33	5	27	3.7%	0.28 [0.05, 1.60]
Khasawneh et al (2014) - 2	1	34	6	31	2.6%	0.13 [0.01, 1.12]
Knaak et al (2013)	11	73	17	44	7.7%	0.28 [0.12, 0.68]
Kollef et al (2006)	15	88	58	245	9.4%	0.66 [0.35, 1.24]
Koupetori et al (2014)	0	36	0	93		Not estimable
Leone et al (2014)	18	59	13	57	8.0%	1.49 [0.65, 3.41]
Mokart et al (2014)	2	44	15	57	4.4%	0.13 [0.03, 0.62]
Schlueter et al (2010)	2	77	7	25	4.0%	0.07 [0.01, 0.36]
Schweizer et al (2011)	0	66	0	56		Not estimable
Shime et al (2011)	1	79	6	122	2.7%	0.25 [0.03, 2.10]
Shime et al (2013)	0	28	2	11	1.4%	0.07 [0.00, 1.52]
Total (95% CI)		**1488**		**1246**	**100.0%**	**0.44 [0.30, 0.66]**
Total events	222		304			

Heterogeneity: $Tau^2 = 0.34$; $Chi^2 = 38.94$, df = 16 (P = 0.001); $I^2 = 59\%$

Test for overall effect: Z = 3.98 (P < 0.0001)

De-escalation

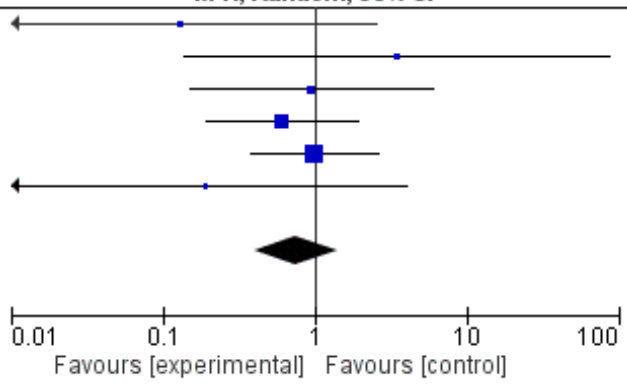


IV/PO switch - mortality

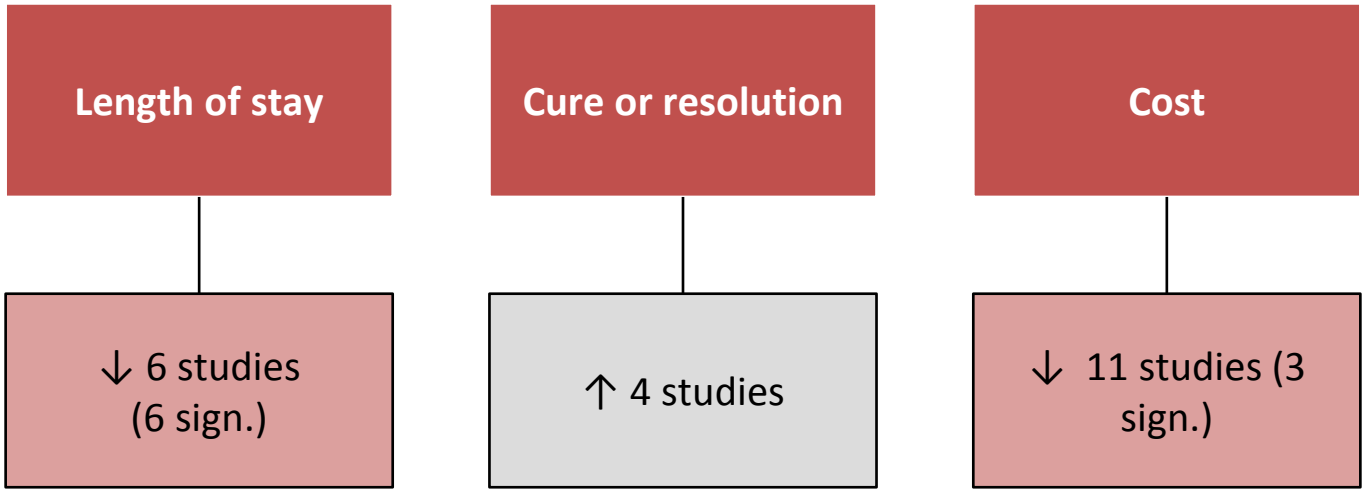
Study or Subgroup	Experimental Events	Experimental Total	Control Events	Control Total	Weight	Odds Ratio M-H, Random, 95% CI
Castro-Guardiola et al (2001)	0	57	3	55	4.6%	0.13 [0.01, 2.59]
Ng et al (2002)	1	48	0	55	4.0%	3.51 [0.14, 88.08]
Omidvari et al (1998)	3	58	2	37	12.3%	0.95 [0.15, 6.00]
Oosterheert et al (2006)	5	132	8	133	31.7%	0.62 [0.20, 1.93]
Terg et al (2000)	11	40	11	40	43.0%	1.00 [0.37, 2.67]
Vogel et al (1994)	0	47	2	47	4.4%	0.19 [0.01, 4.10]
Total (95% CI)		**382**		**367**	**100.0%**	**0.76 [0.40, 1.44]**
Total events	20		26			

Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 3.50$, df = 5 (P = 0.62); $I^2 = 0\%$

Test for overall effect: Z = 0.84 (P = 0.40)



IV/PO switch

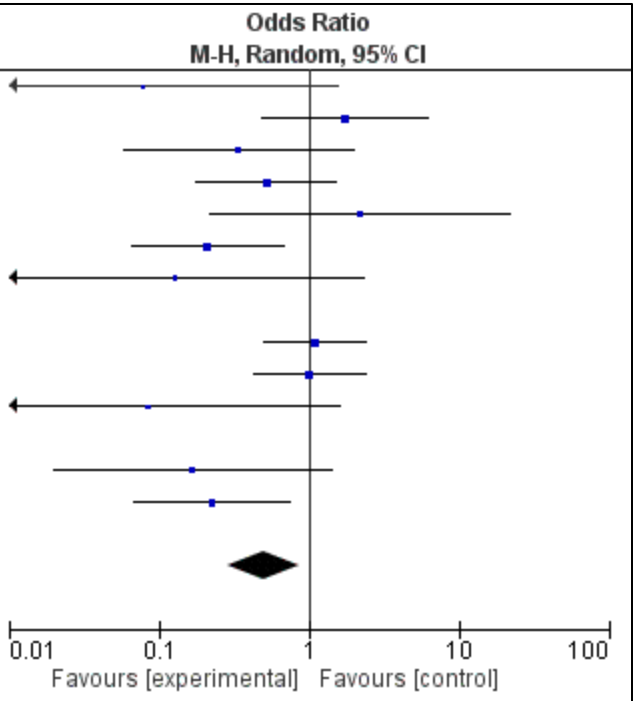

Length of stay
↓ 6 studies (6 sign.)
Cure or resolution
↑ 4 studies
Cost
↓ 11 studies (3 sign.)

TDM - Nephrotoxicity

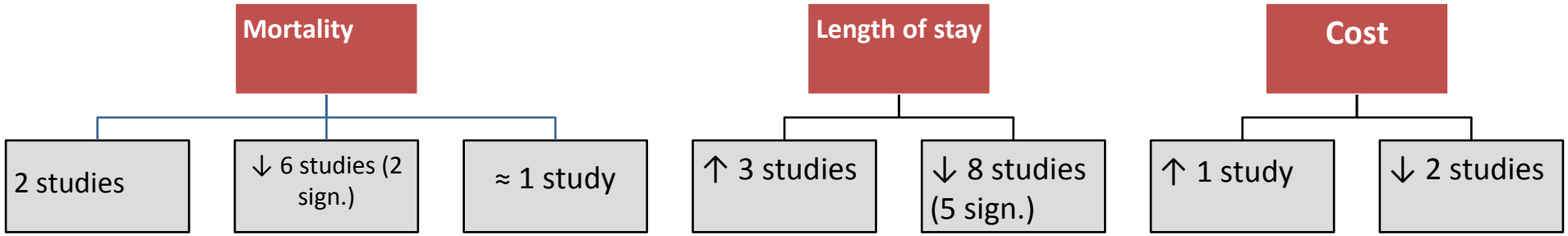
Study or Subgroup	Experimental Events	Experimental Total	Control Events	Control Total	Weight	Odds Ratio M-H, Random, 95% CI
Bootman et al (1979)	0	66	3	39	3.0%	0.08 [0.00, 1.56]
Burton et al (1991)	7	75	4	72	10.2%	1.75 [0.49, 6.25]
Destache et al (1989)	2	23	5	23	6.9%	0.34 [0.06, 1.99]
Destache et al (1990)	6	75	10	70	12.1%	0.52 [0.18, 1.52]
Dillon et al (1989)	3	48	1	34	4.6%	2.20 [0.22, 22.10]
Fernandez de Gatta et al (1996)	5	37	14	33	11.1%	0.21 [0.07, 0.68]
Hoffa et al (1989)	0	49	6	88	3.2%	0.13 [0.01, 2.33]
Iwamoto et al (2003)	0	0	0	0		Not estimable
Karam et al (1991)	16	85	15	86	15.2%	1.10 [0.50, 2.39]
Leehey et al (1993)	13	80	12	74	14.3%	1.00 [0.43, 2.36]
Leon-Djian et al (2011)	0	56	4	47	3.1%	0.09 [0.00, 1.63]
Sveska et al (1985)	0	0	0	0		Not estimable
Van Lent-Evers et al (1999)	1	48	7	62	5.2%	0.17 [0.02, 1.41]
Welty et al (1994)	4	61	13	55	10.9%	0.23 [0.07, 0.74]
Total (95% CI)		**703**		**683**	**100.0%**	**0.50 [0.29, 0.88]**
Total events	57		94			

Heterogeneity: $Tau^2 = 0.38$; $Chi^2 = 19.83$, df = 11 (P = 0.05); $I^2 = 45\%$

Test for overall effect: Z = 2.42 (P = 0.02)

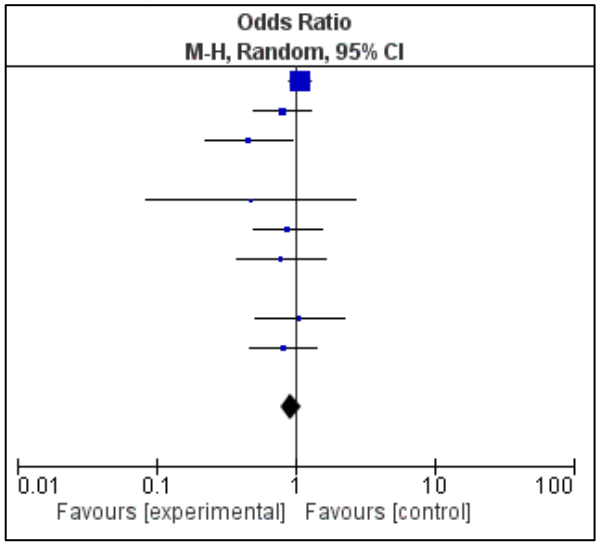


TDM-Nephrotoxicity



Restricted antimicrobials

Mortality



Length of stay

- ↑ 1 study
- ↓ 4 studies (2 sign.)

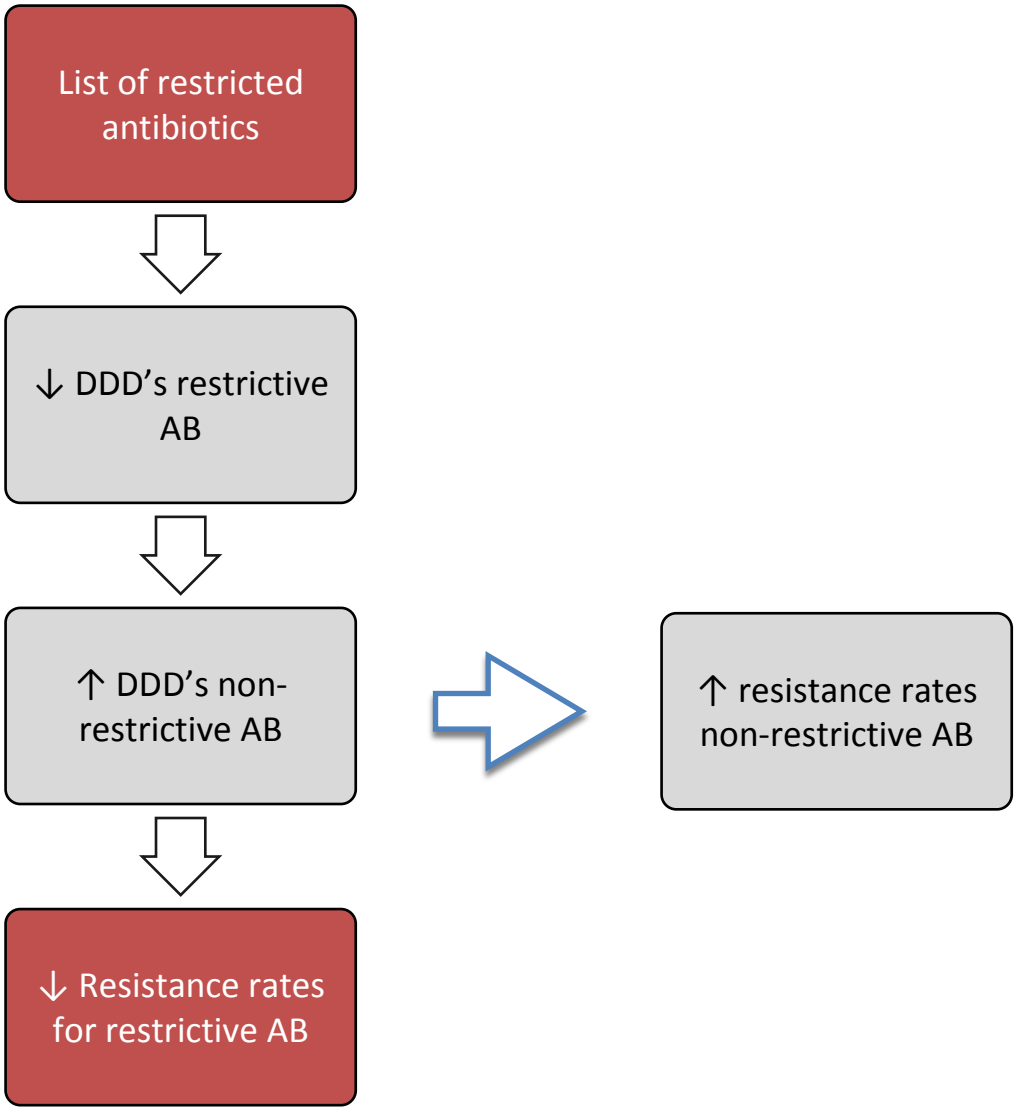
Nosocomial infection rates

- ↑ 2 studies (1 sign.)
- ↓ 3 studies (1 sign.)
- ≈ 1 study

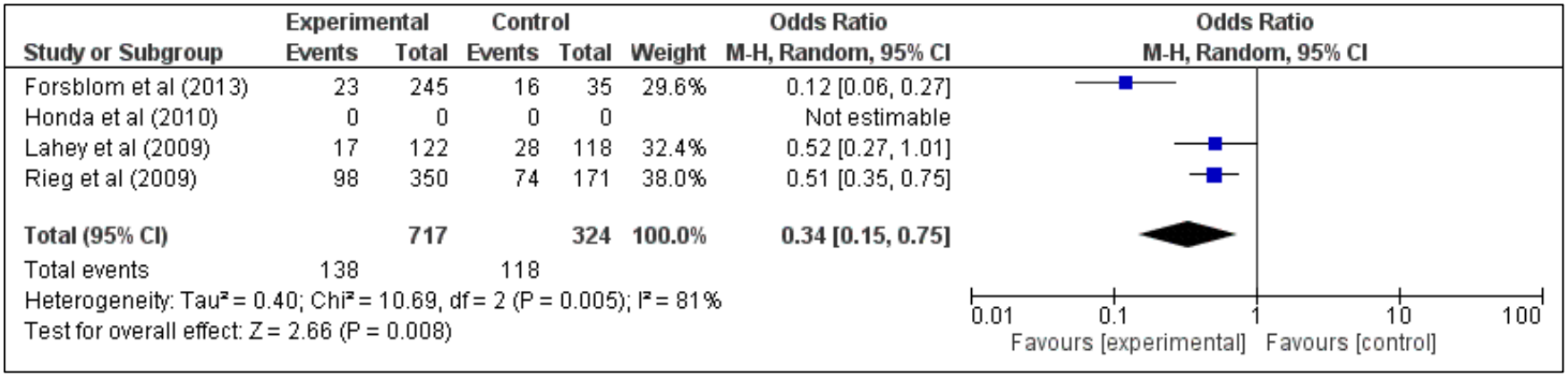
Cost

- ↓ 11 studies (4 sign.)

Restricted antimicrobials – Resistance rates



Bedside consultation – mortality *S.aureus*

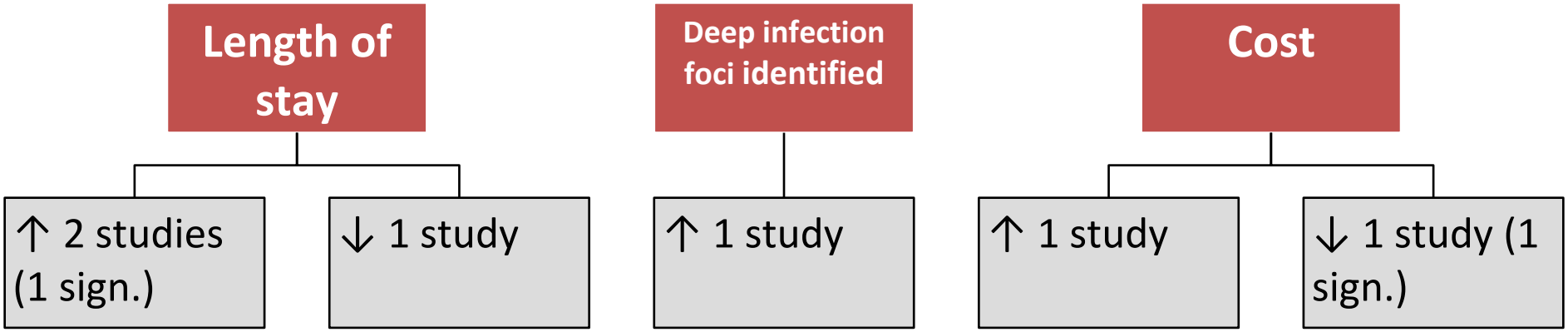


Study or Subgroup	Experimental Events	Total	Control Events	Total	Weight	Odds Ratio M-H, Random, 95% CI
Forsblom et al (2013)	23	245	16	35	29.6%	0.12 [0.06, 0.27]
Honda et al (2010)	0	0	0	0		Not estimable
Lahey et al (2009)	17	122	28	118	32.4%	0.52 [0.27, 1.01]
Rieg et al (2009)	98	350	74	171	38.0%	0.51 [0.35, 0.75]
Total (95% CI)		**717**		**324**	**100.0%**	**0.34 [0.15, 0.75]**
Total events	138		118			

Heterogeneity: Tau² = 0.40; Chi² = 10.69, df = 2 (P = 0.005); I² = 81%

Test for overall effect: Z = 2.66 (P = 0.008)

Bedside consultation



What does this imply for your ASP?

Guideline adherence

De-escalation

IV/PO switch

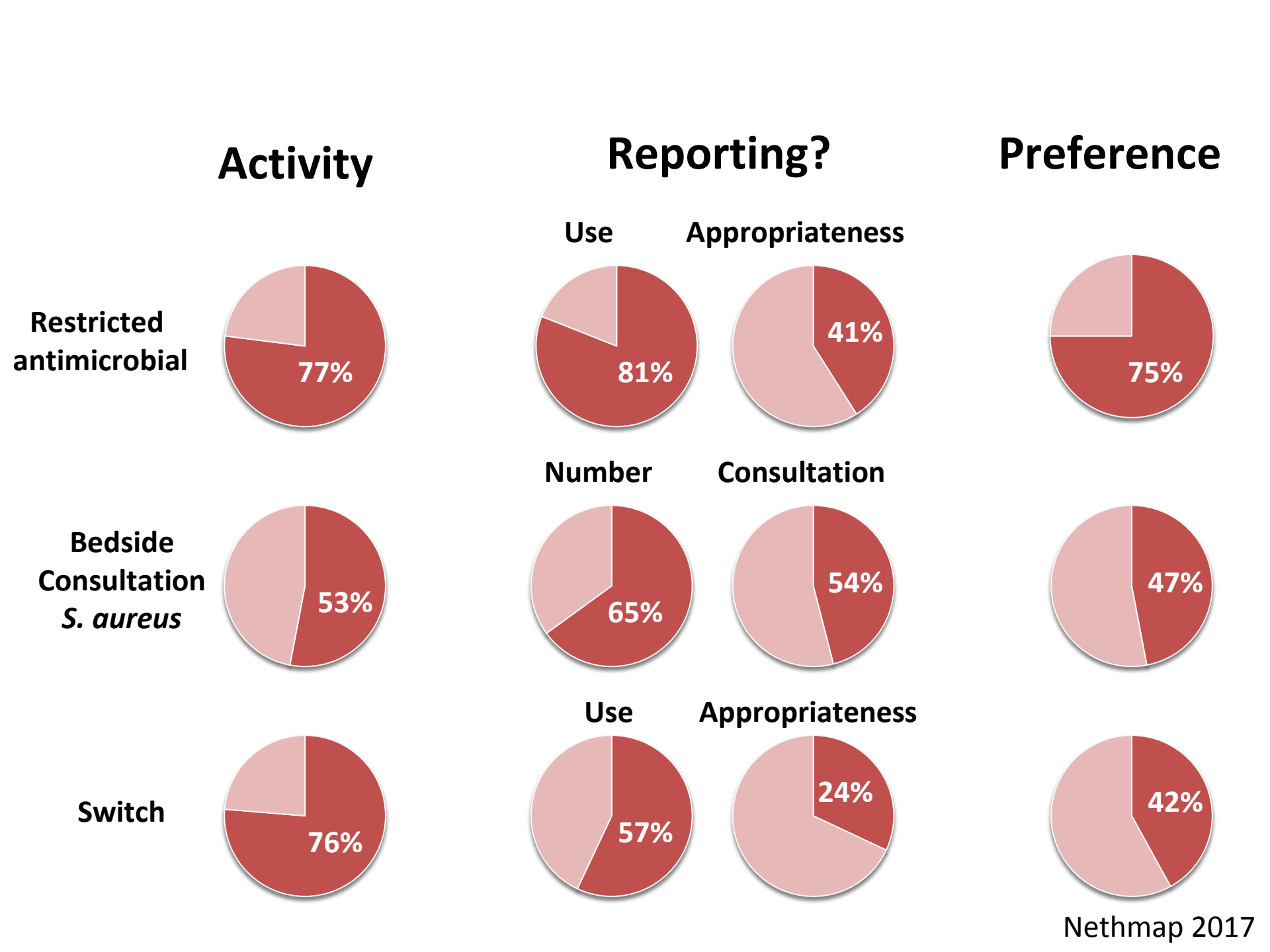
TDM

List of restricted antimicrobials

Bedside consult *S.aureus* bacteremia

What does this imply for your ASP?

- (Blood)cultures
- Antibiotic plan
- Local guide available
- Local vs. national guideline
- Stop criteria
- Renal function
- Patient compliance



Nethmap 2017

Improvement strategies

Cochrane Library

Cochrane Database of Systematic Reviews

Interventions to improve antibiotic prescribing practices for hospital inpatients (Review)

Davey P, Marwick CA, Scott CL, Charani E, McNeil K, Brown E, Gould IM, Ramsay CR, Michie S

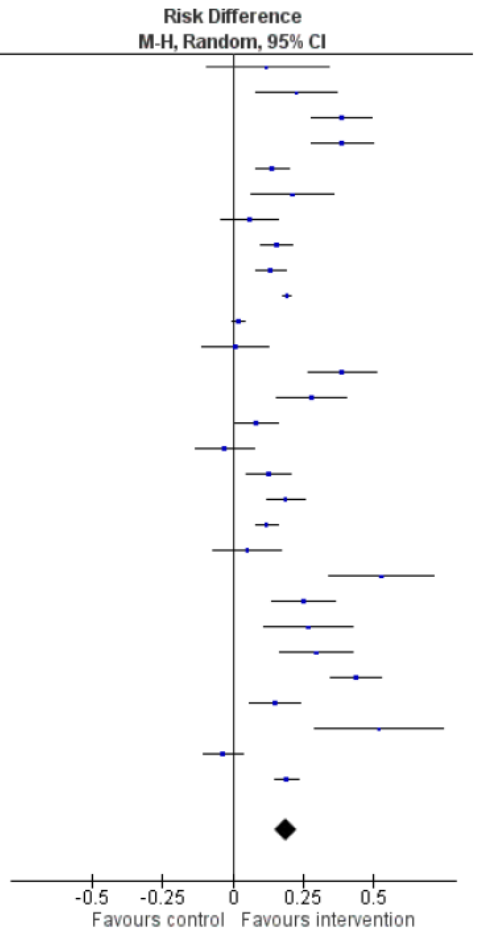
Interventions are effective

Figure 3. Forest plot of comparison: 1 Prescribing: RCTs of all interventions to reduce unnecessary prescribing, outcome: 1.1 Dichotomous outcomes, increase in desired practice.

Study or Subgroup	Intervention Events	Intervention Total	Control Events	Control Total	Weight	Risk Difference M-H, Random, 95% CI
Annane 2013	9	30	5	28	2.0%	0.12 [-0.10, 0.34]
Burton 1991	58	70	44	73	2.9%	0.23 [0.08, 0.37]
Camins 2009	92	112	60	138	3.4%	0.39 [0.28, 0.50]
Christ-Crain 2004	69	124	20	119	3.4%	0.39 [0.28, 0.50]
Christ-Crain 2006	23	151	2	151	4.0%	0.14 [0.08, 0.20]
Ding 2013	7	33	0	35	2.9%	0.21 [0.07, 0.36]
Dranitsaris 2001	122	162	102	147	3.5%	0.06 [-0.04, 0.16]
Esposito 2011	24	155	0	155	4.1%	0.15 [0.10, 0.21]
Franz 2004	419	656	320	635	4.1%	0.13 [0.08, 0.19]
Gulmezoglu 2007	895	3891	135	3613	4.4%	0.19 [0.18, 0.21]
Kritchevsky 2008	374	2225	331	2238	4.3%	0.02 [-0.00, 0.04]
Lacroix 2014	77	131	81	140	3.3%	0.01 [-0.11, 0.13]
Long 2014	46	90	11	90	3.2%	0.39 [0.27, 0.51]
Maravic-Stojkovic 2011	83	102	55	103	3.2%	0.28 [0.16, 0.40]
Paul 2006	216	297	176	273	3.8%	0.08 [0.01, 0.16]
Poehling 2006	92	135	121	170	3.5%	-0.03 [-0.13, 0.07]
Schnoor 2010	182	275	186	348	3.8%	0.13 [0.05, 0.20]
Schouten 2007	296	460	154	338	3.9%	0.19 [0.12, 0.26]
Schuetz 2009	136	628	61	629	4.2%	0.12 [0.08, 0.16]
Senn 2004	80	126	73	125	3.2%	0.05 [-0.07, 0.17]
Singh 2000	28	39	8	42	2.4%	0.53 [0.34, 0.71]
Solomon 2001	88	125	69	153	3.3%	0.25 [0.14, 0.37]
Stocker 2010	27	60	11	61	2.7%	0.27 [0.11, 0.43]
Stolz 2009	61	102	32	106	3.1%	0.30 [0.17, 0.43]
Strom 2010	111	194	20	148	3.7%	0.44 [0.35, 0.53]
Trenholme 1989	102	110	90	116	3.7%	0.15 [0.06, 0.24]
Walker 1998	22	25	9	25	1.9%	0.52 [0.29, 0.75]
Wyatt 1998	224	314	222	297	3.9%	-0.03 [-0.10, 0.04]
Yealy 2005	631	849	677	1227	4.2%	0.19 [0.15, 0.23]
Total (95% CI)		**11671**		**11723**	**100.0%**	**0.19 [0.15, 0.23]**
Total events	4594		3075			

Heterogeneity: Tau² = 0.01; Chi² = 367.98, df = 28 (P < 0.00001); I² = 92%

Test for overall effect: Z = 8.81 (P < 0.00001)



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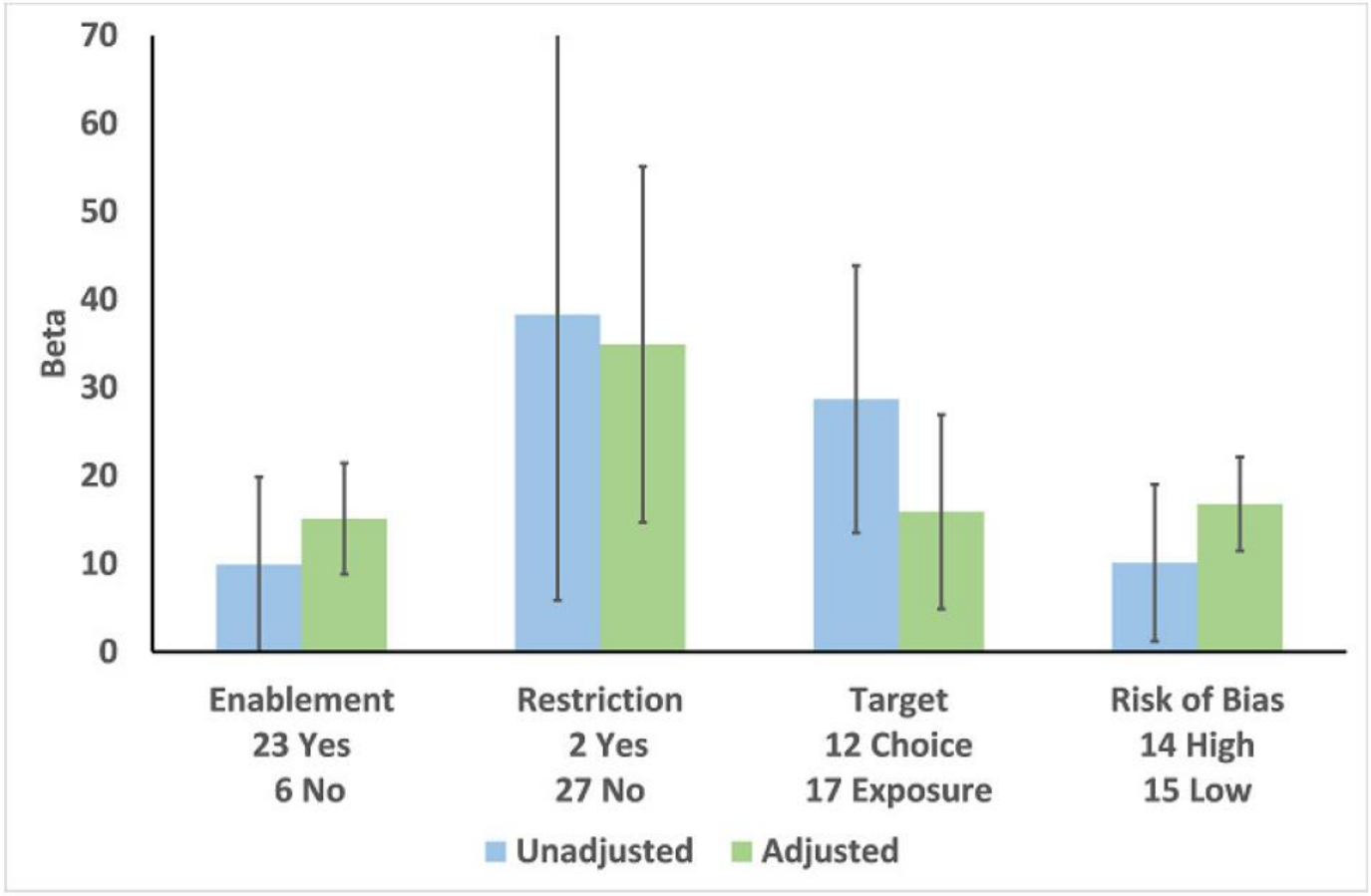
Explaining heterogeneity

Figure 7. Meta-regression by effect modifier for 29 RCTs. A positive value for Beta indicates enhanced intervention effect. One RCT had both enabling and restrictive components in the intervention (Strom 2010).



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Improvement strategies

Clinical Infectious Diseases Advance Access published April 13, 2016

Clinical Infectious Diseases

IDSA FEATURES

Implementing an Antibiotic Stewardship Program: Guidelines by the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America

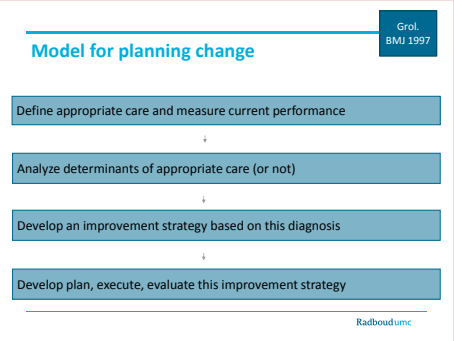
Tamar F. Barlam,[1] Sara E. Cosgrove,[2] Lilian M. Abbo,[3] Conan MacDougall,[4] Audrey N. Schuetz,[5] Edward J. Septimus,[6] Arjun Srinivasan,[7] Timothy H. Dellit,[8] Yngve T. Falck-Ytter,[9] Neil O. Fishman,[10] Cindy W. Hamilton,[11] Timothy C. Jenkins,[12] Pamela A. Lipsett,[13] Preeti N. Malani,[14] Larissa S. May,[15] Gregory J. Moran,[16] Melinda M. Neuhauser,[17] Jason G. Newland,[18] Christopher A. Ohl,[19] Matthew H. Samore,[20] Susan K. Seo,[21] and Kavita K. Trivedi[22]

27 key questions in ASP

Building blocks of stewardship

RECOMMENDATIONS to guide the teams' choice of potential interventions to ensure that professionals actually adhere to these 'appropriate antibiotic use recommendations':

APPLY THE MODEL FOR PLANNING CHANGE!



RECOMMENDATIONS on 'appropriate use' to guide the teams' choice of potential stewardship objectives: e.g.

- Streamlining or de-escalation of therapy
- Parenteral to oral conversion
- Dose optimization

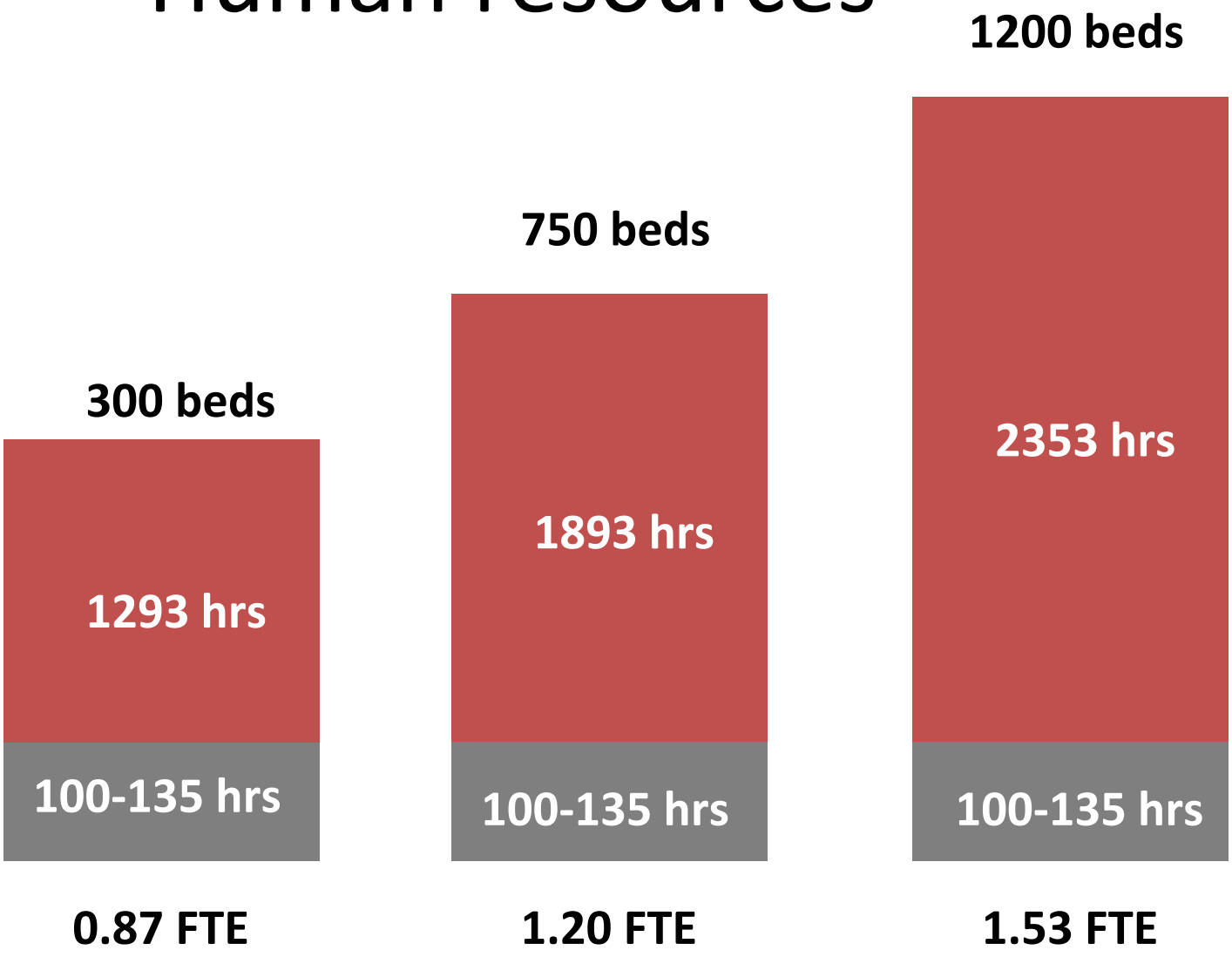
RECOMMENDATIONS on appropriate structural or system preconditions that should be met: e.g.

- Multidisciplinary antibiotic stewardship team
- Infrastructure to track antibiotic use
- Availability of local guidance, i.e. local diagnostic and therapeutic antibiotic guidelines or a list of restricted antibiotics

Implementation

- SWAB founded in 1996 www.swab.nl
- EBM Guidelines for Clinical Infectious Diseases (CAP, UTI, …)
- Surveillance of antibiotic use and resistance: yearly publication of Nethmap
- SWAB ID: web-based format for a national antibiotic booklet adaptable for every hospital
- 2012 White paper Antibiotic Stewardship: implement A-team in every hospital, controlled by Healthcare Inspectorate
- 2014 'Antimicrobial Stewardship Practice Guide' for the Netherlands www.ateams.nl
- 2015 Antimicrobial Stewardship monitor
- 2015 Staffing standard
- 2016 Guideline Antibiotic Stewardship

Human resources



www.ateams.nl/documenten; ten Oever, submitted

Human resources – following years

- Monitoring quality of antibiotic use
  = 300 hrs + 100 per 100 beds > 300 beds

- 3 stewardship objectives:
  - 300 beds: 1.25 FTE
  - 750 beds: 2.14 FTE
  - 1200 beds: 3.03 FTE

- France:
  - ID specialist: 3.6 FTE/1000 beds
  - Pharmacists: 2.5 FTE/1000 beds
  - Microbiologists: 0.6 FTE/1000 beds

Le Coz P Med Mal Infect 2016; Pulcini C CMI 2017

Guideline committee

Coordinator: Emelie Schuts (PhD student, AMC)

Chairs: Jan Prins (AMC) & Marlies Hulscher (IQ healthcare, RadboudUMC)

NIV/VIZ: B.J. Kullberg (RadboudUMC), J.M. Prins (AMC)

NVMM: J.W. Mouton (Erasmus MC), J. Cohen Stuart (MCA), C. Verduin (Amphia)

NVZA: H. Overdiek (MC Haaglanden), P. van der Linden (Tergooi), S. Natsch (RadboudUMC)

Verenso: C. Hertogh (VUmc)

NVK: T. Wolfs (UMCU)

NVIC: J.A. Schouten (CWZ/IQ healthcare, RadboudUMC)

SWAB STICHTING WERKGROEP ANTIBIOTICABELEID