LEIPZIG INTERVENTIONAL COURSE
LINC 2021

Carotid artery revascularization:

A systematic review and meta-analysis comparing clinical outcomes of second vs. first generations stents

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on behalf of **CARMEN** Collaborators

CArotid **R**evascularization systematic review and **ME**ta-a**N**alysis

Disclosure

Speaker name:

Adam Mazurek MD, PhD

I have the following potential conflicts of interest to report:

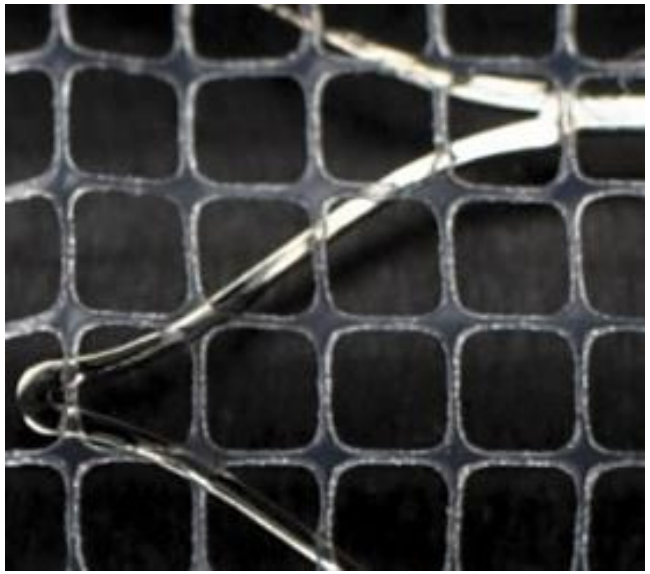
- ☐ Consulting
- ☐ Employment in industry
- ☐ Stockholder of a healthcare company
- ☐ Owner of a healthcare company
- ☐ Other(s)

- ☑ I do not have any potential conflict of interest

Introduction

- Comparisons of data in individual studies suggest that the use of **second-generation carotid stents** (**SGS**; dual-layer, mesh-covered) may improve clinical outcomes.

Casper/RoadSaver



Gore Carotid Stent

CGuard MicroNET Stent

- This has not been systematically evaluated.

Purpose

1. Are the 30-day and 12-month outcomes for **SGS** ***different*** than those for first-generation stents (FGS) **?**

2. Is there a ***'class effect'*** for SGS **?**

FGS – first generation stents
SGS – second generation stents (mesh/dual-layer)

METHODS

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We performed a systematic review and meta-analysis (PRISMA* methodology) of clinical studies that have used First-generation carotid stents (FGS; open or close-cell) and Second-generation carotid stents (SGS).

1. Evaluation of typically reported 30-day and 12-month endpoints.
3. PubMed search (’carotid’ + ’stent’ + ’trial’ or ’study’).
4. Prespecified criteria for record initial screening (CADIMA#).
5. Prespecified criteria for study eligibility.
6. Cumulative data integration.
7. Random effect model meta-analysis.
8. Endpoints compared for **FGS** (open/close-cell) vs **SGS** (as a group and per individual stent types – **RoadSaver/Casper** Stent, **Gore Stent**, **CGuard MicroNET** Stent)

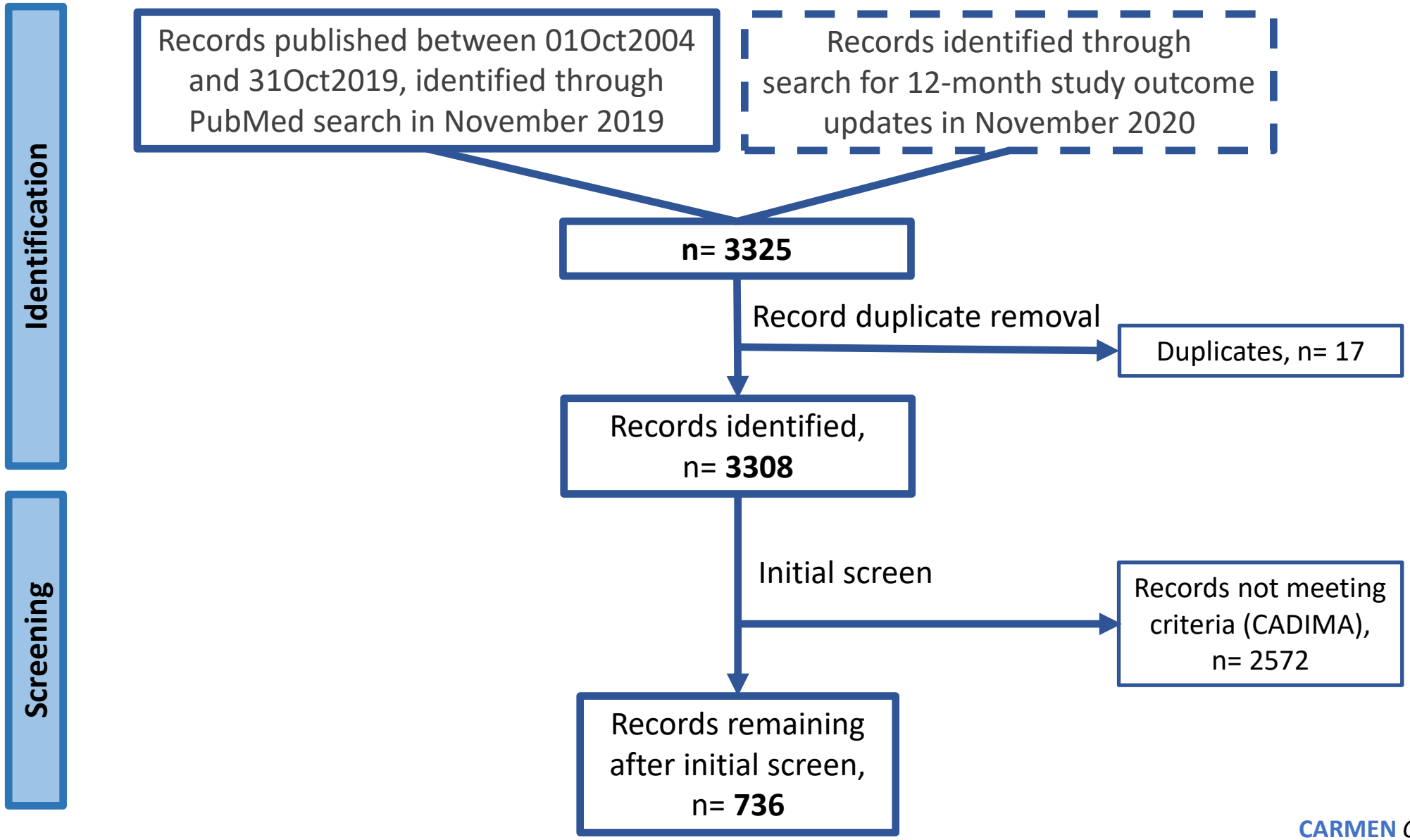
**Moher D at al.* Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *BMJ. 2009*
www.cadima.info

Carotid revascularization outcomes of interest

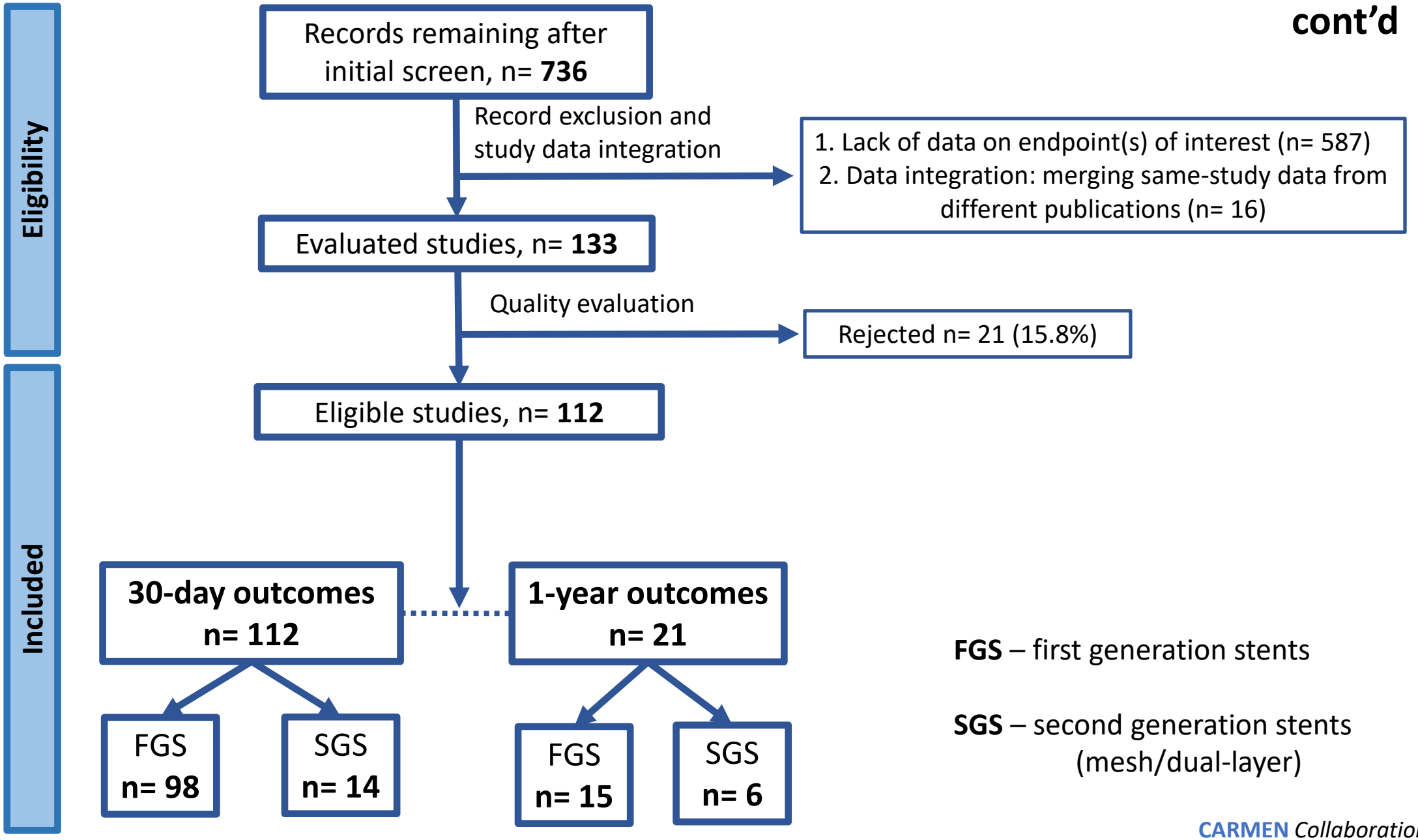
- Random search for typical 30-day outcomes and 12-month outcomes in carotid revascularization studies (2004-2019)
- Identification of: 50 studies with 30-day outcomes
  50 studies with 12-month outcomes

- *Typically-reported* **30-day outcomes**: **DEATH (D)**
  (any) STROKE (S)
  MYOCARDIAL INFARCTION (MI)
- *Typically-reported* **12-mo outcomes**: **ipsilateral STROKE (IS)**
  RESTENOSIS (R/ISR)

CARMEN Systematic review and meta-analysis flowchart (PRISMA)



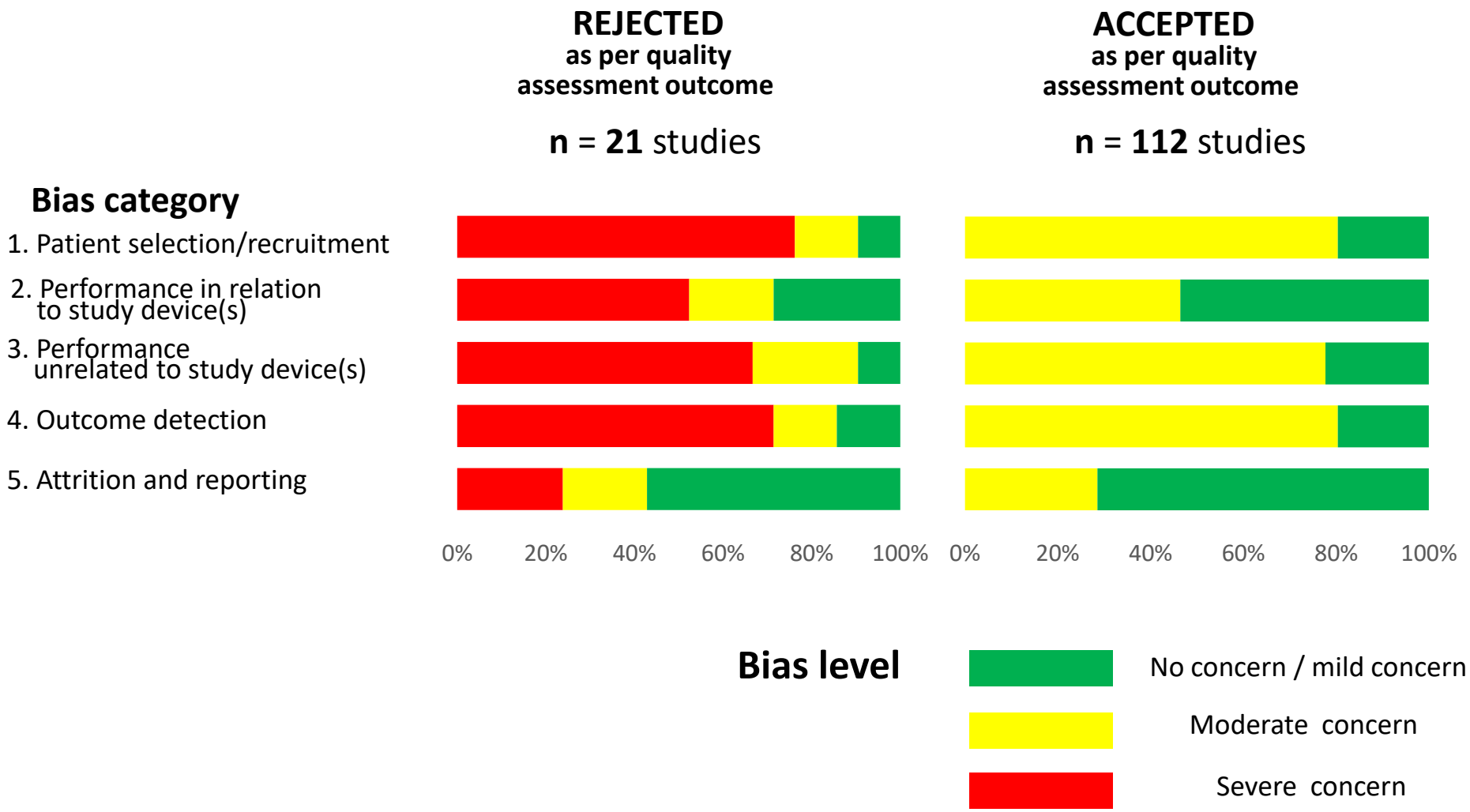
CARMEN Systematic review and meta-analysis flowchart (PRISMA) cont'd



FGS – first generation stents

SGS – second generation stents (mesh/dual-layer)

Data Quality: Study Bias Systematic Assessment



Severe bias (**red**) was reason for rejection.

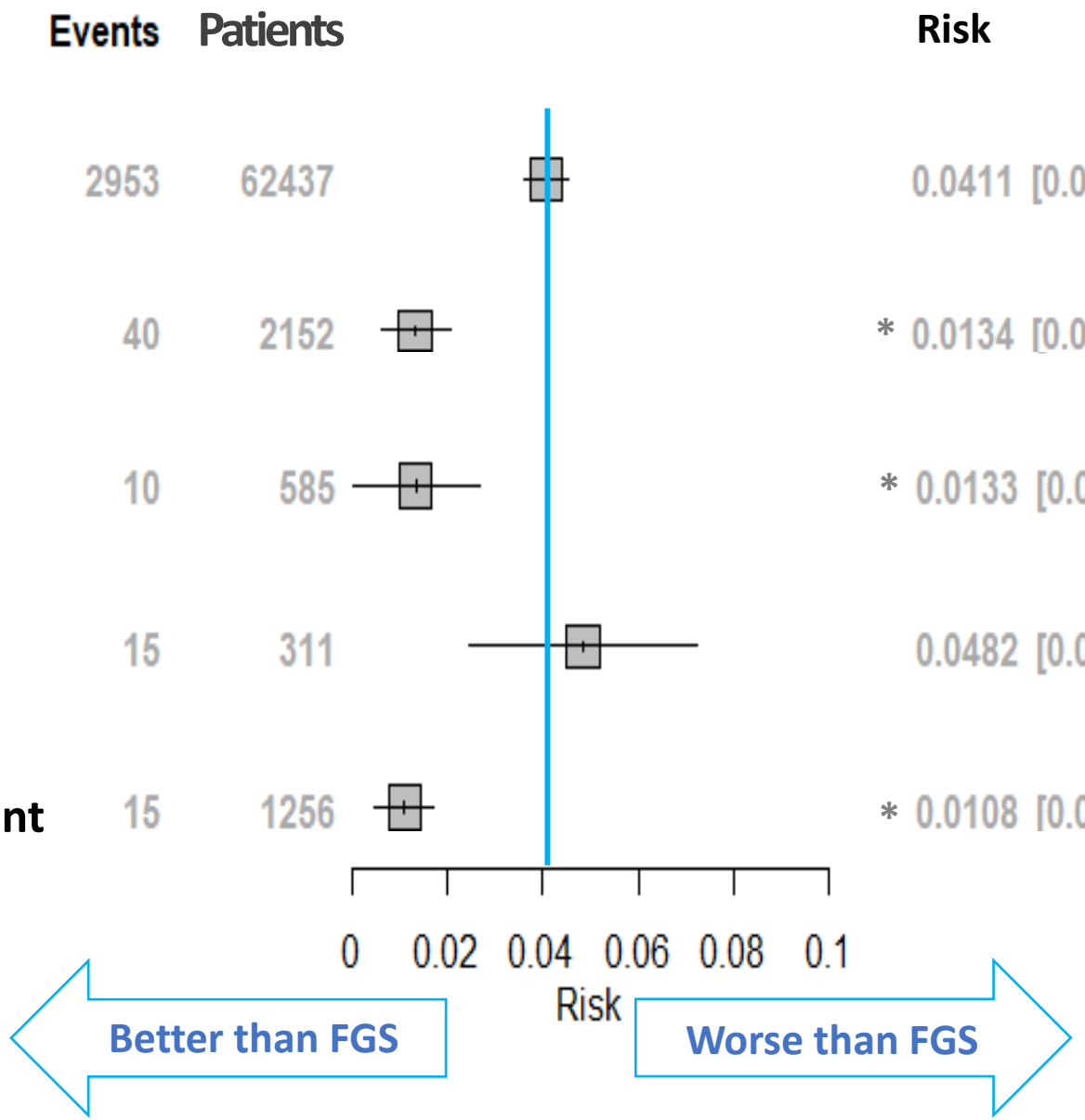
Stent type comparisons: Pooled populations characteristics

	FGS	**SGS**	p	Open-cell FGS	Close-cell FGS	p open vs close	p open vs SGS	p close vs SGS
No of studies	98	14	-	29	12	-	-	-
No of patients	65,891*	2,152*	-	20,676*	7,598*	-	-	-
Age [mean] ± SD	70.1 (2.8)	71.9 (2.5)	0.02	70.4 (3.2)	69.3 (3.4)	0.60	0.32	0.13
Male [%]	68%	73%	0.046	68%	66%	0.92	0.12	0.15
Symptomatic [%]	45%	41%	0.40	43%	50%	0.61	0.94	0.45
Diabetic [%]	34%	32%	0.43	35%	36%	0.71	0.88	0.61
CAD [%]	51%	47%	0.55	48%	55%	0.59	0.98	0.98
AF [%]	6%	3%	0.37	3%	ND	-	0.99	-
Contralateral occlusion [%]	10%	16%	0.22	10%	12%	0.87	0.63	0.99

FGS – first generation stents; **SGS** – second generation stents (mesh/dual-layer)

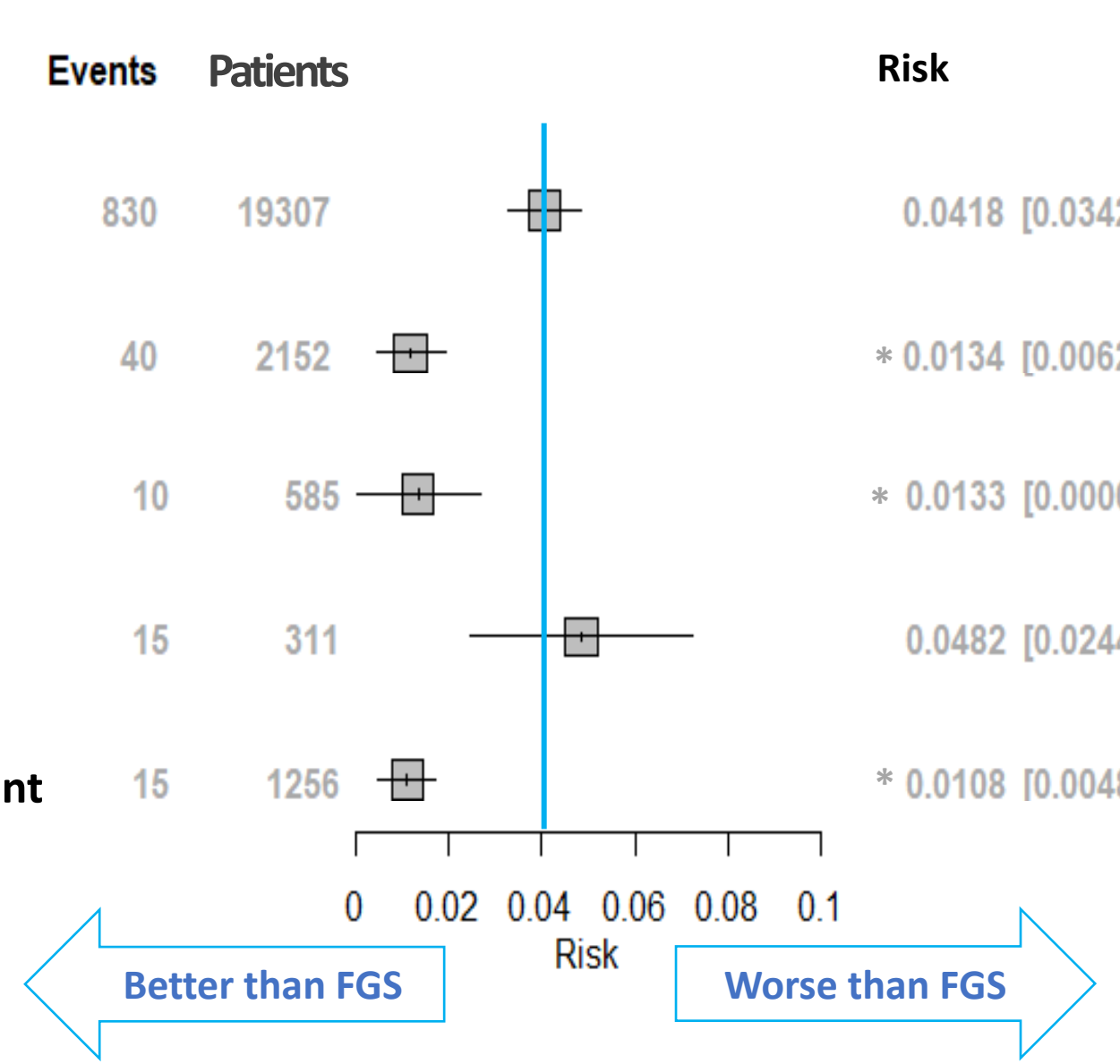
*Data per total number of patients as per published patient characteristics

30-day **Death/Stroke/MI**: FGS vs SGS

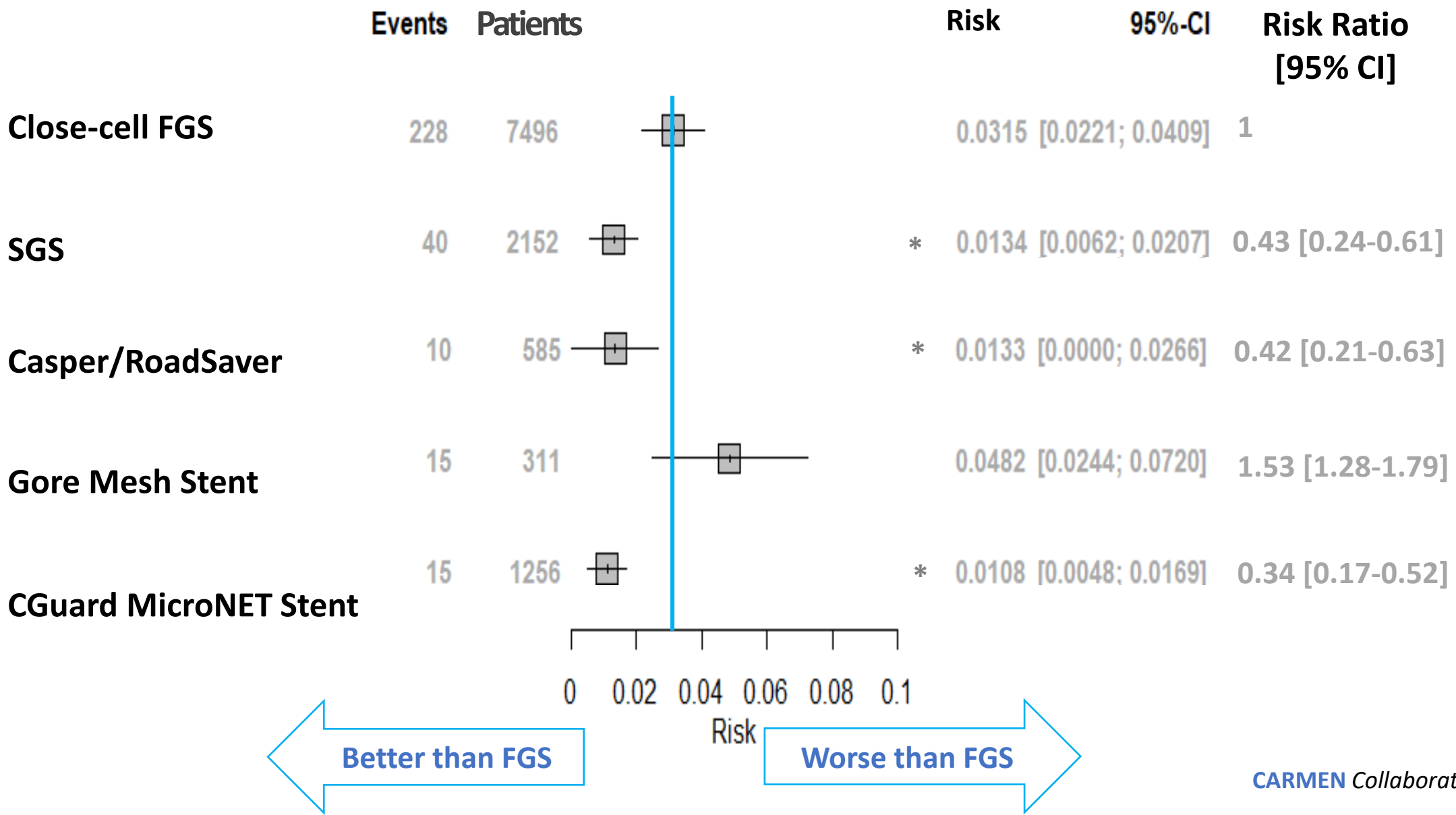


Patient numbers are as per endpoint(s) data

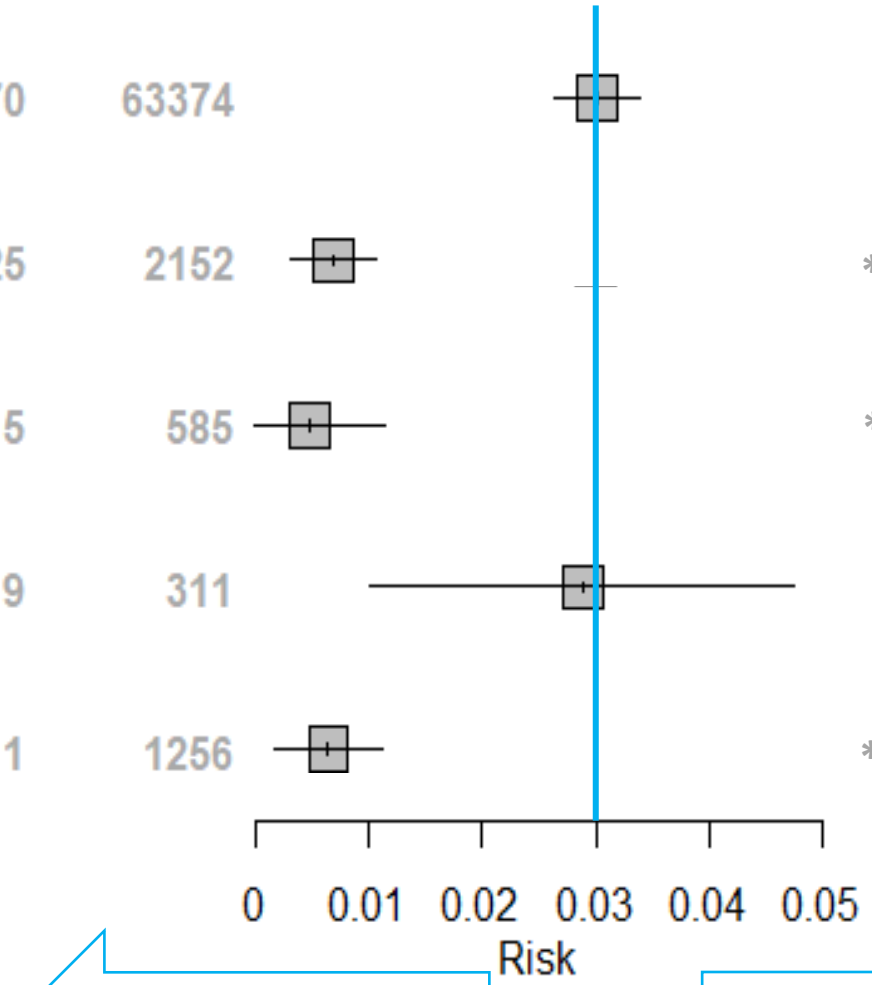
30-day **Death/Stroke/MI**: <u>open-cell</u> FGS vs **SGS**



30-day Death/Stroke/MI: close-cell FGS vs SGS



30-day **Stroke**: FGS vs SGS

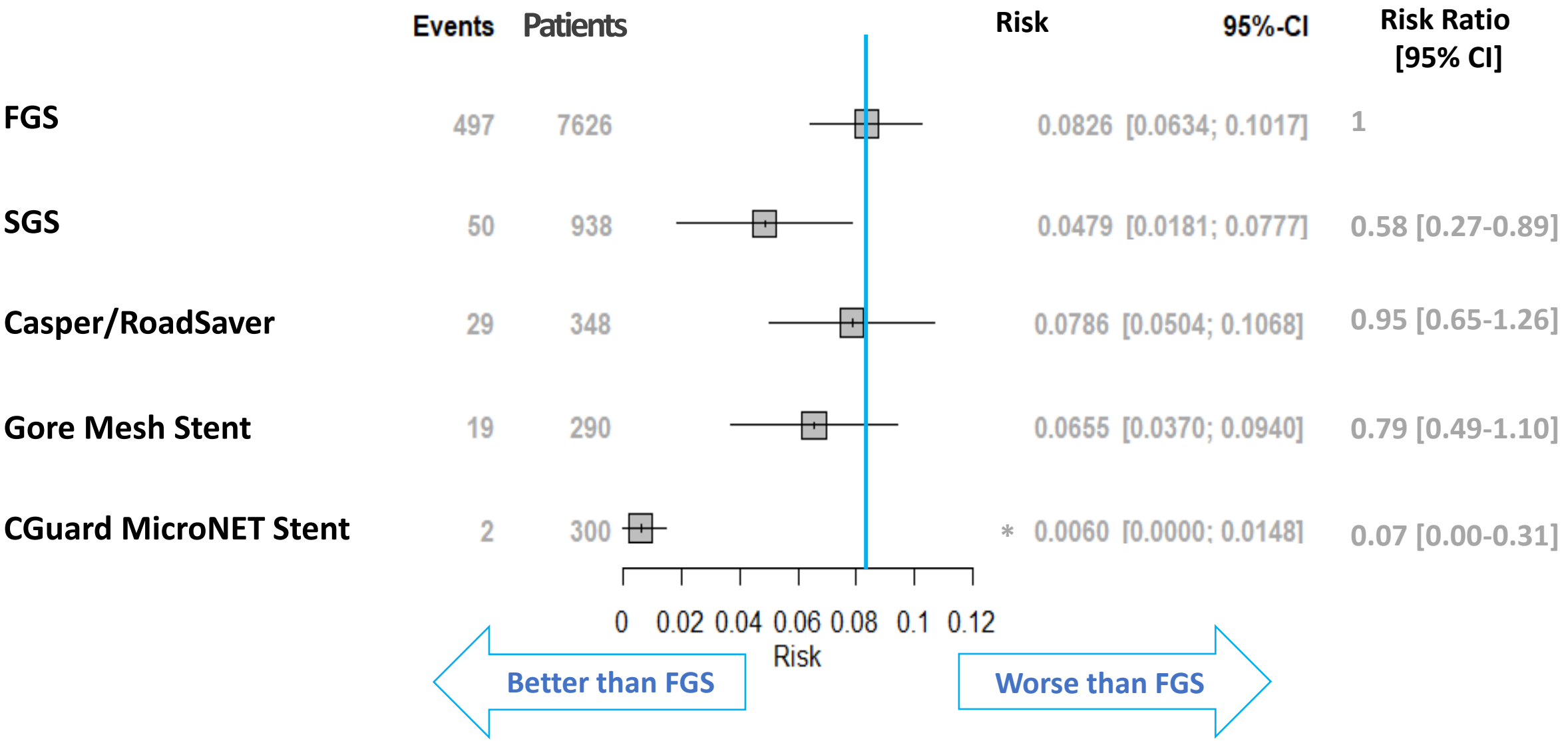


	Events	Patients		Risk	95%-CI	Risk Ratio [95% CI]
FGS	2270	63374		0.0301	[0.0263; 0.0338]	1
SGS	25	2152	*	0.0070	[0.0032; 0.0107]	0.23 [0.11-0.35]
Casper/RoadSaver	5	585	*	0.0050	[0.0000; 0.0115]	0.16 [0.22-0.31]
Gore Mesh Stent	9	311		0.0289	[0.0103; 0.0476]	0.96 [0.75-1.17]
CGuard MicroNET Stent	11	1256	*	0.0066	[0.0018; 0.0113]	0.22 [0.09-0.35]

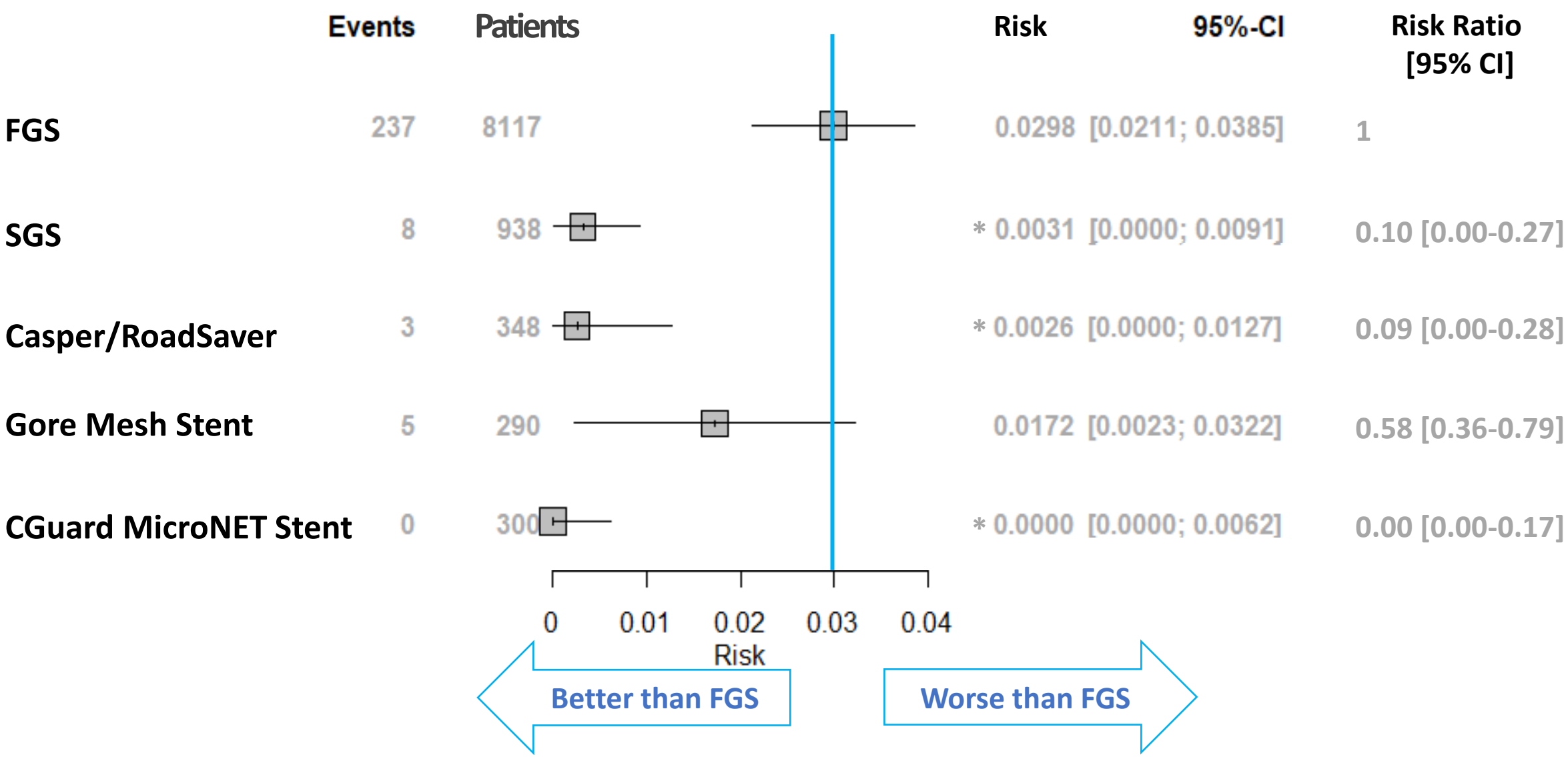
Better than FGS

Worse than FGS

12-month **Ipsilateral Stroke/ISR**: FGS vs SGS

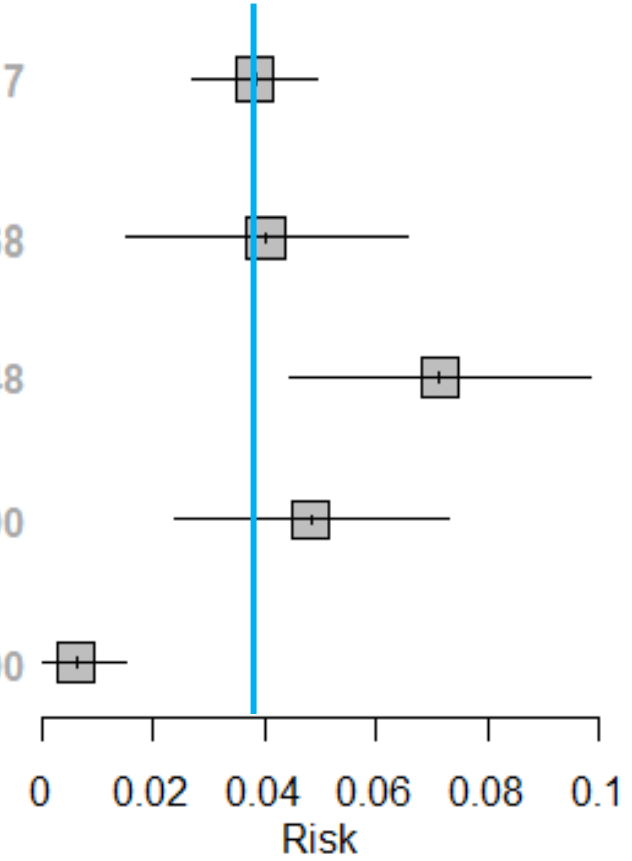


12-month **Ipsilateral Stroke**: FGS vs SGS



12-month **ISR**: FGS vs SGS

	Events	Patients	Risk	95%-CI	Risk Ratio [95% CI]
FGS	265.5	8117	0.0381	[0.0267; 0.0495]	1
SGS	42.0	938	0.0401	[0.0148; 0.0654]	1.05 [0.78-1.32]
Casper/RoadSaver	26.0	348	0.0716	[0.0445; 0.0986]	1.88 [1.60-2.15]
Gore Mesh Stent	14.0	290	0.0483	[0.0236; 0.0729]	1.27 [1.00-1.53]
CGuard MicroNET Stent	2.0	300	* 0.0060	[0.0000; 0.0148]	0.15 [0.00-0.36]



Better than FGS

Worse than FGS

SGS vs CEA

SGS – second generation stents
(mesh/dual-layer)

Purpose

- Is there a difference in **30-day**
  12-month outcomes

for SGS vs **CEA** **?**

CEA vs SGS meta-analysis

Major
RCTs
Involving CEA

1. **CEA** pooled data

SAPPHIRE
EVA 3S
SPACE-1
ICSS
CREST
ACST-1
ACT-1
Manhaim
SPACE-2

CEA in
Contemporary
Clinical Practice

2. **CEA** in Vascular Quality Initiative (**VQI**) database*

* Dakour-Aridi H, et al. *Ann Vasc Surg.* 2020;65:1-9
Columbo JA, et al. *J Vasc Surg.* 2019;69:104-109

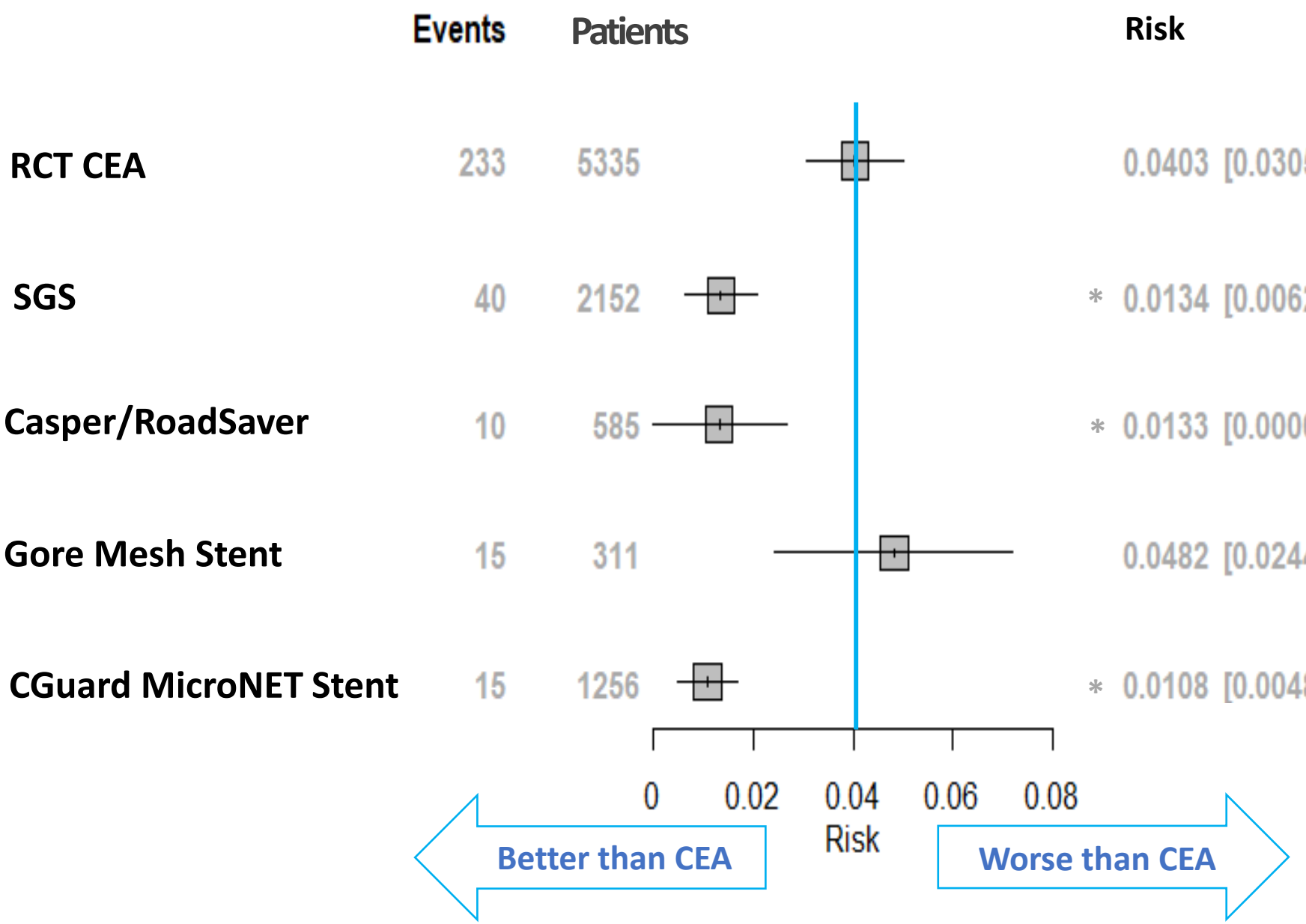
CEA vs SGS: Populations Characteristics

	RCTs CEA	VQI CEA	SGS	p RCTs-CEA vs SGS	p VQI-CEA vs SGS
No of studies	**9**	**2**	**14**	-	-
No of patients	5,335*	95,776*	2,152*	-	-
Age [mean] ± SD	69.4 (1.5)	71	71.9 (2.5)	0.03	-
Male [%]	69%	61%	73%	0.71	0.29
Symptomatic [%]	37%	23%	41%	0.75	0.83
Diabetic [%]	29%	35%	32%	0.44	0.99
CAD [%]	41%	27%	47%	0.75	0.35
AF [%]	3%	nd	3%	1.0	-
Contralateral occlusion [%]	7%	nd	16%	0.56	-

FGS – first generation stents; **SGS** – second generation stents (mesh/dual-layer)

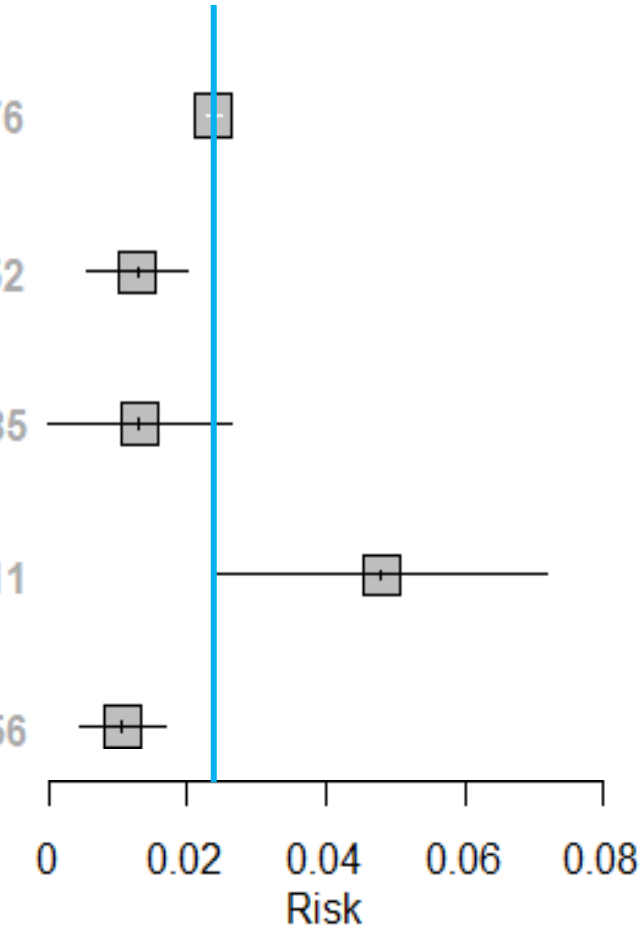
* as per published characteristics of study patients

30-day Death/Stroke/MI: RCT CEA vs SGS



30-day **Death/Stroke/MI: VQI CEA** vs SGS

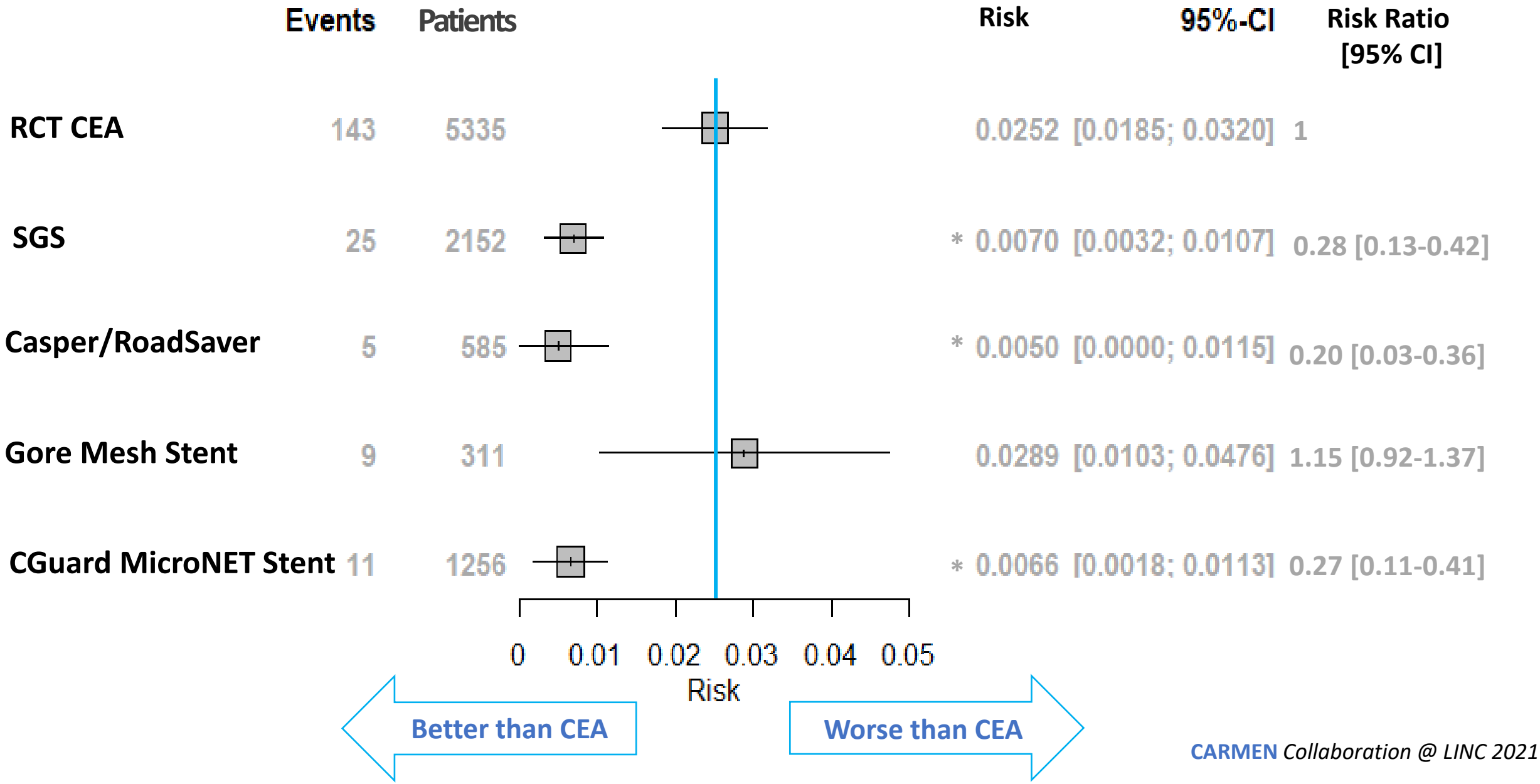
	Events	Patients	Risk	95%-CI	Risk Ratio [95% CI]
VQI CEA	2337	95776	0.0244	[0.0234; 0.0254]	1
SGS	40	2152	0.0134	[0.0062; 0.0207]	0.55 [0.42-0.68]
Casper/RoadSaver	10	585	* 0.0133	[0.0000; 0.0266]	0.54 [0.38-0.71]
Gore Mesh Stent	15	311	0.0482	[0.0244; 0.0720]	1.98 [1.76-2.20]
CGuard MicroNET Stent	15	1256	* 0.0108	[0.0048; 0.0169]	0.44 [0.33-0.56]



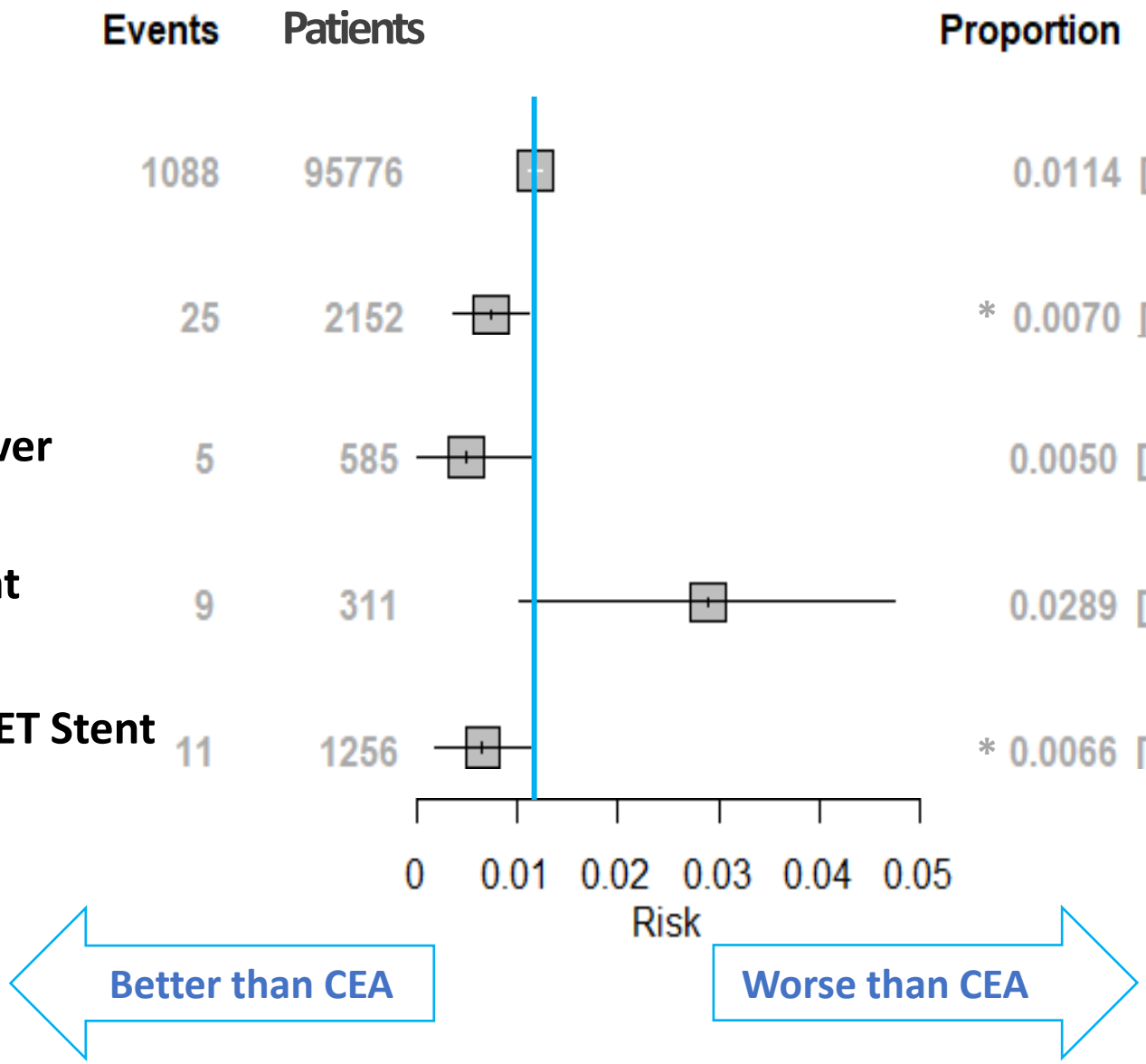
Better than CEA

Worse than CEA

30-day **Stroke: RCT CEA** vs SGS

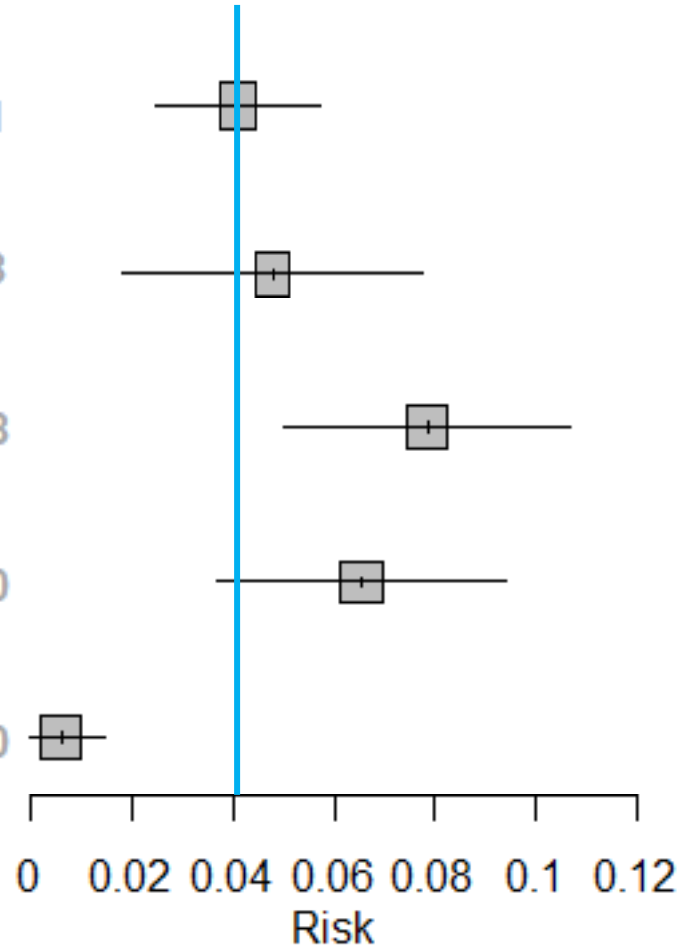


30-day **Stroke: VQI CEA** vs SGS



1-year Ipsilateral Stroke/Restenosis: RCT CEA vs SGS

	Events	Patients	Risk	95%-CI	Risk Ratio [95% CI]
RCT CEA	141	3971	0.0409	[0.0248; 0.0571]	1
SGS	50	938	0.0479	[0.0181; 0.0777]	1.17 [0.87-1.47]
Casper/RoadSaver	29	348	* 0.0786	[0.0504; 0.1068]	1.92 [1.63-2.22]
Gore Mesh Stent	19	290	0.0655	[0.0370; 0.0940]	1.60 [1.31-1.90]
CGuard MicroNET Stent	2	300	* 0.0060	[0.0000; 0.0148]	0.15 [-0.07-0.37]

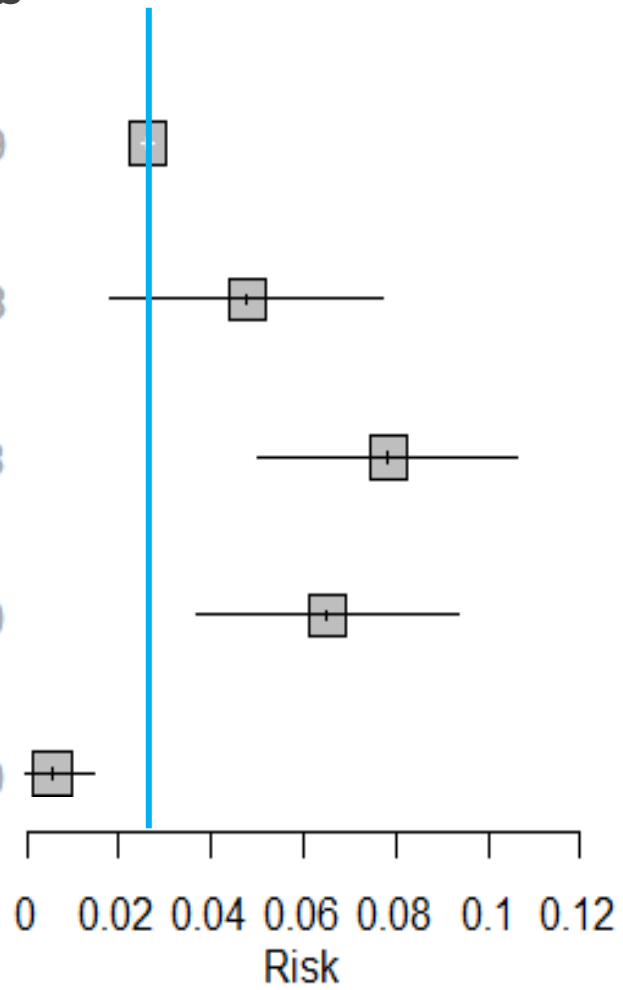


Better than CEA

Worse than CEA

1-year Ipsilateral Stroke/Restenosis: VQI CEA vs SGS

	Events	Patients	Risk	95%-CI	Risk Ratio [95% CI]
VQI CEA	1717	65319	0.0263	[0.0251; 0.0275]	1
SGS	50	938	0.0479	[0.0181; 0.0777]	1.82 [1.58-2.07]
Casper/RoadSaver	29	348	* 0.0786	[0.0504; 0.1068]	2.99 [2.75-3.23]
Gore Mesh Stent	19	290	* 0.0655	[0.0370; 0.0940]	2.49 [2.25-2.73]
CGuard MicroNET Stent	2	300	* 0.0060	[0.0000; 0.0148]	0.23 [0.09-0.37]

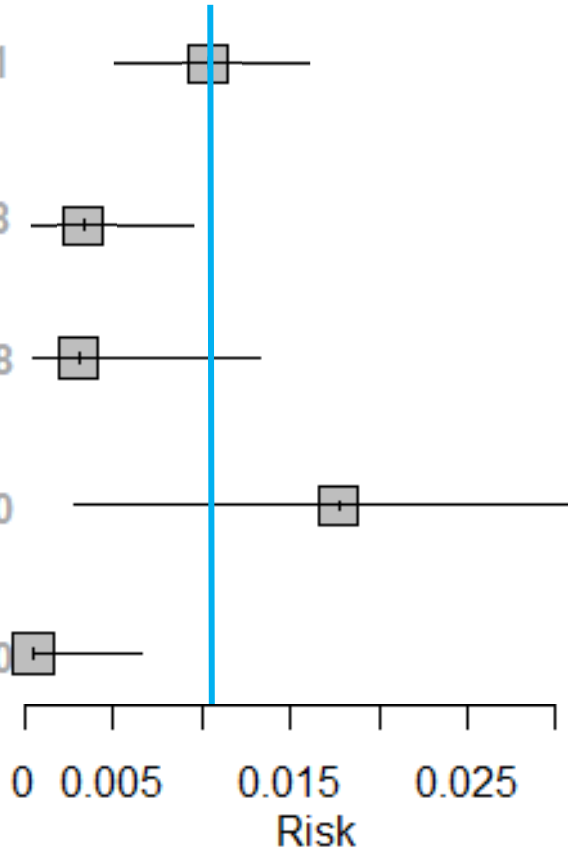


Better than CEA

Worse than CEA

1-year Ipsilateral Stroke: RCT CEA vs SGS

	Events	Patients	Risk	95%-CI	Risk Ratio [95% CI]
RCT CEA	49	3971	0.0101	[0.0046; 0.0155]	1
SGS	8	938	0.0031	[0.0000; 0.0091]	0.30 [0.15-0.45]
Casper/RoadSaver	3	348	0.0026	[0.0000; 0.0127]	0.25 [0.08-0.43]
Gore Mesh Stent	5	290	0.0172	[0.0023; 0.0322]	1.71 [1.51-1.91]
CGuard MicroNET Stent	0	300	0.0000	[0.0000; 0.0062]	0.00 [0.00-0.15]

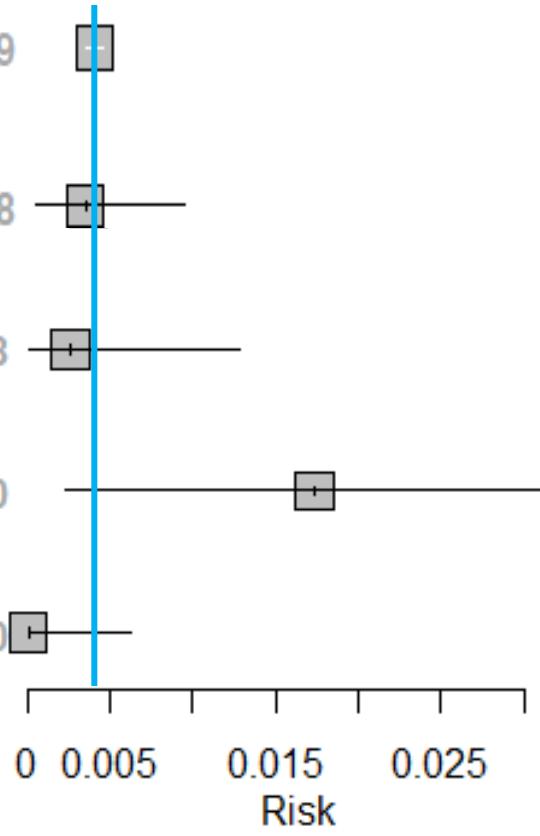


Better than CEA

Worse than CEA

1-year Ipsilateral Stroke: VQI CEA vs SGS

	Events	Patients	Risk	95%-CI	Risk Ratio [95% CI]
VQI CEA	235	65319	0.0036	[0.0031; 0.0041]	1
SGS	8	938	0.0031	[0.0000; 0.0091]	0.85 [0.74-0.96]
Casper/RoadSaver	3	348	0.0026	[0.0000; 0.0127]	0.71 [0.56-0.85]
Gore Mesh Stent	5	290	0.0172	[0.0023; 0.0322]	4.79 [4.62-4.97]
CGuard MicroNET Stent	0	300	0.0000	[0.0000; 0.0062]	0.00 [0.00-0.11]

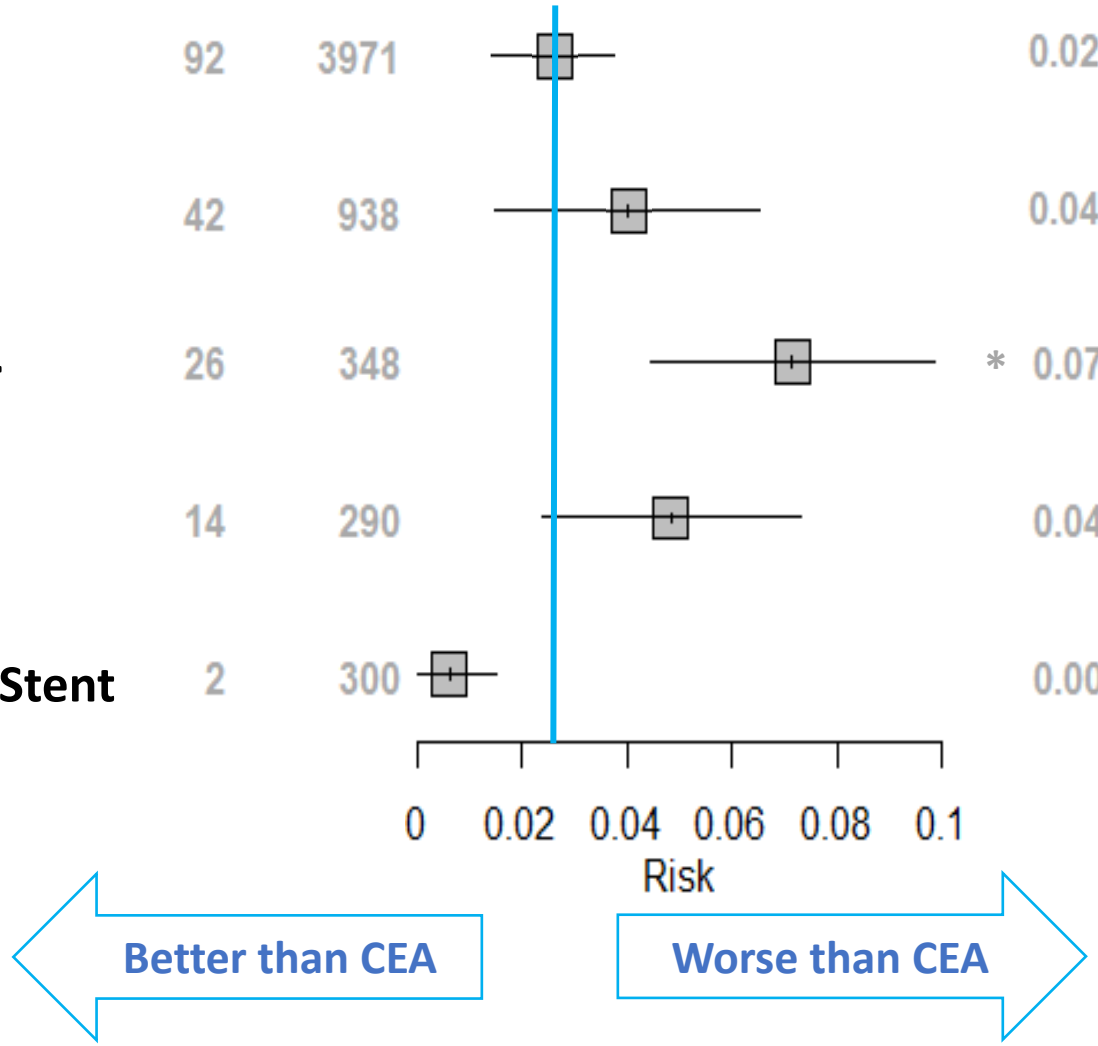


Better than CEA

Worse than CEA

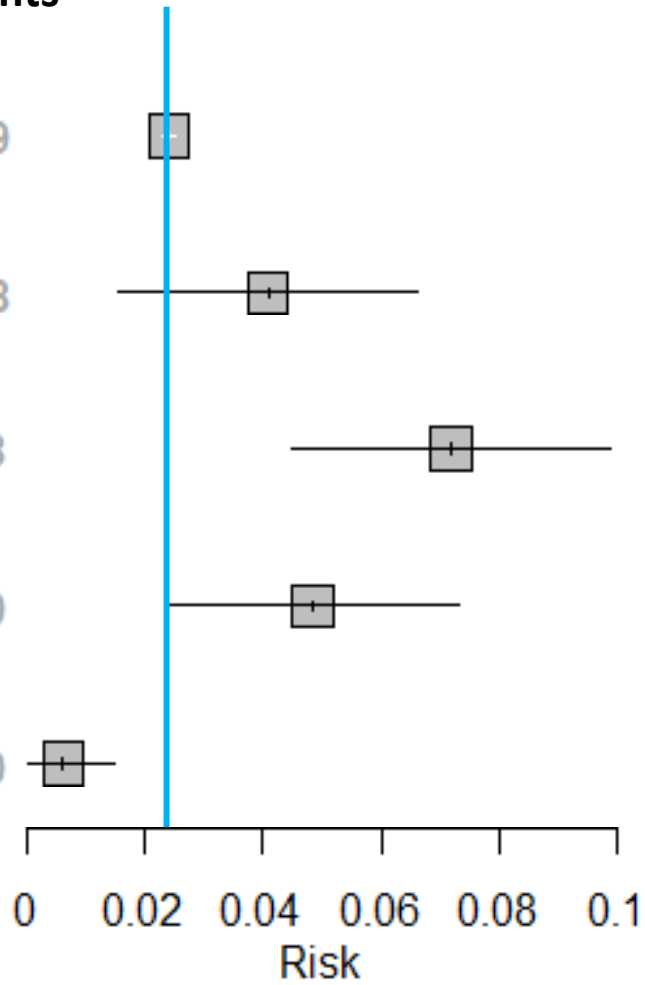
1-year **Restenosis: RCT CEA** vs SGS

	Events	Patients	Risk	95%-CI	Risk Ratio [95% CI]
RCT CEA	92	3971	0.0260	[0.0143; 0.0377]	1
SGS	42	938	0.0401	[0.0148; 0.0654]	1.54 [1.27-1.81]
Casper/RoadSaver	26	348	* 0.0716	[0.0445; 0.0986]	2.75 [2.48-3.03]
Gore Mesh Stent	14	290	0.0483	[0.0236; 0.0729]	1.86 [1.59-2.12]
CGuard MicroNET Stent	2	300	0.0060	[0.0000; 0.0148]	0.23 [0.03-0.43]



1-year **Restenosis: VQI CEA** vs SGS

	Events	Patients	Risk	95%-CI	Risk Ratio [95% CI]
VQI CEA	1519	65319	0.0233	[0.0221; 0.0244]	1
SGS	42	938	0.0401	[0.0148; 0.0654]	1.72 [1.50-1.95]
Casper/RoadSaver	26	348	* 0.0716	[0.0445; 0.0986]	3.08 [2.84-3.31]
Gore Mesh Stent	14	290	* 0.0483	[0.0236; 0.0729]	2.08 [1.85-2.30]
CGuard MicroNET Stent	2	300	* 0.0060	[0.0000; 0.0148]	0.26 [0.12-0.40]



Better than CEA

Worse than CEA

Conclusions: 30-day outcomes

- ***Casper/RoadSaver*** *and* ***CGuard MicroNET Stent*** **superior to FGS** as a group (and superior to both open- and close-cell stents)

- ↓ ***stroke*** *with* ***Casper/RoadSaver*** *and* ↓ ***stroke*** *with* ***CGuard MicroNET Stent*** *vs* RCT-**CEA** and VQI-**CEA**

- **NO class-effect** of SGS in relation to FGS or CEA

Mazurek et al. 2021 (at review)

Conclusions: 12-month outcomes

- **SGS superior to FGS**

  outcome driven by ↓ *in ipsi stroke with CGuard MiroNET Stent*
  ↓ *in restenosis with CGuard MiroNET Stent*

- **SGS similar to CEA in 12-month ipsilateral stroke**

- **SGS have a differential effect on restenosis** in relation to CEA

  ↑ *restenosis with Casper/RoadSaver and Gore Stent*

  ↓ *restenosis with CGuard MicroNET Stent*

- NO class-effect in SGS

Mazurek et al. 2021 (at review)