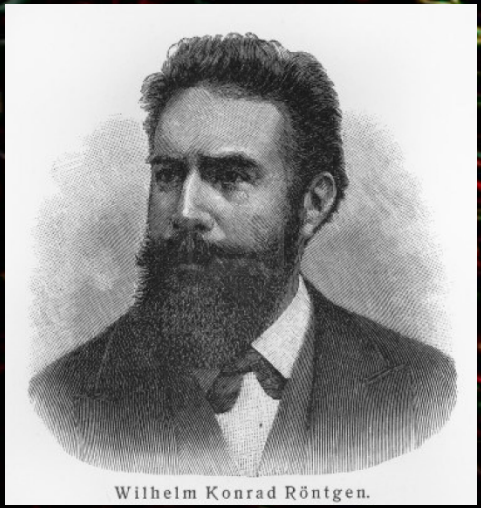
DEUTSCHE RÖNTGENGESELLSCHAFT

# Trends in der Bildgebung – Herz CT als Beispielfall



MUSC
MEDICAL UNIVERSITY of SOUTH CAROLINA

U. Joseph Schoepf, MD
Prof. (h.c.), FAHA, FSCBT-MR, FNASCI, FSCCT
Professor of Radiology, Medicine, and Pediatrics
Director, Division of Cardiovascular Imaging

# Interessenskonflikte

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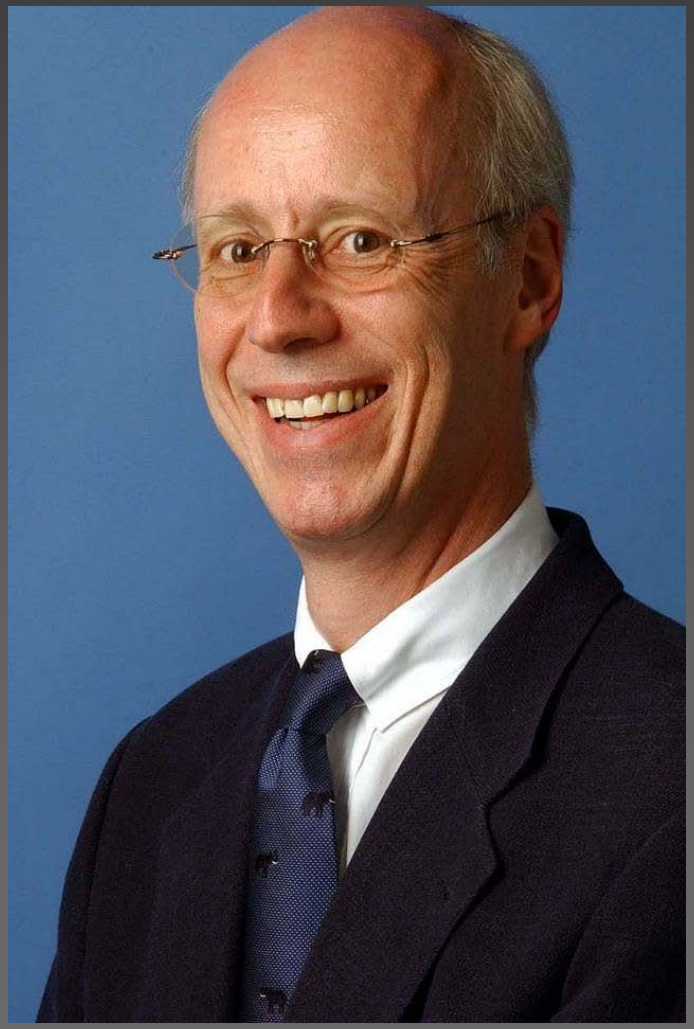
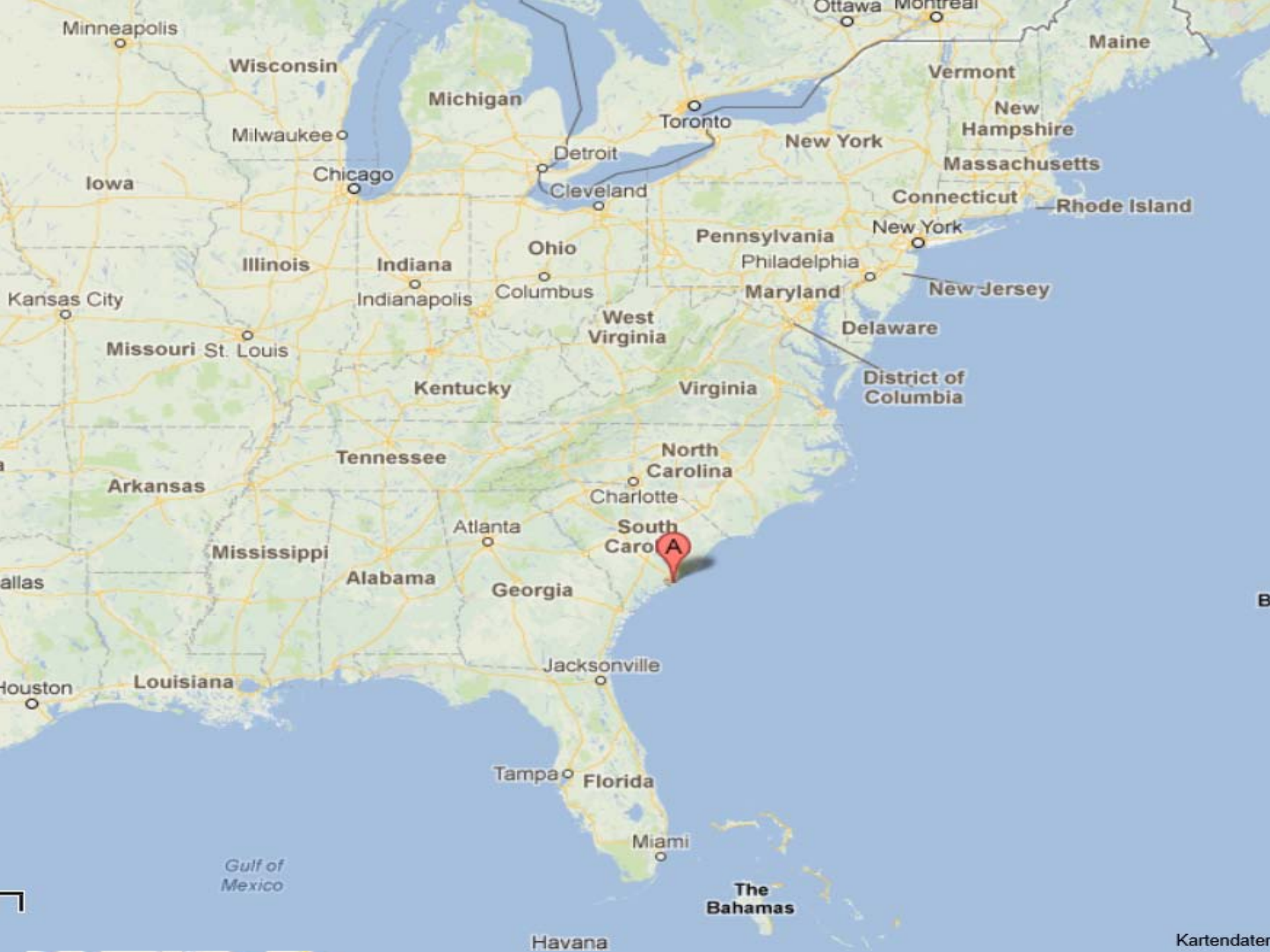
# Dank

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West Virginia
Kentucky
Virginia
Tennessee
North Carolina
Charlotte
Arkansas
Atlanta
South Caro
A
Mississippi
Alabama
Georgia
Jacksonville
Louisiana
Houston
Tampa
Florida
Miami
Gulf of Mexico
The Bahamas
Havana
Kartendaten

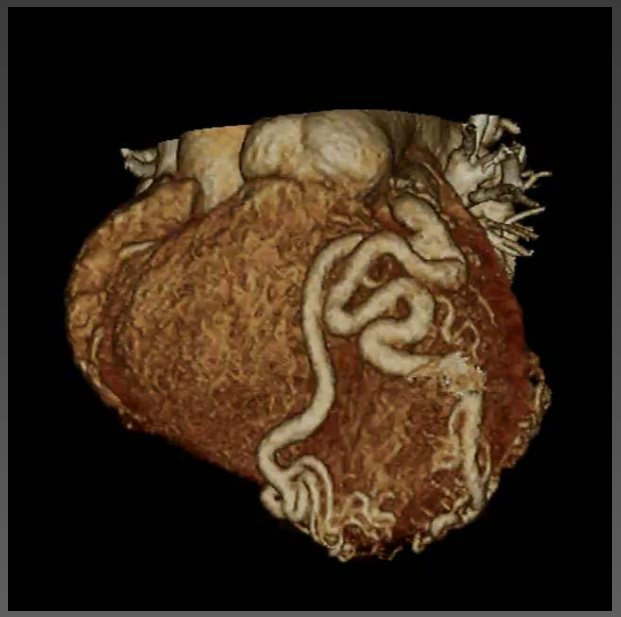
# Trends in der Bildgebung

Nicht neu, aber häufig verdrängt -

- Gesellschaftliche Trends
- Technische Trends
- Trends in der Anwendung - Effektivität
- Wirtschaftliche Trends / Evidenz

… Aus amerikanischer / internationaler Sicht

# Warum Herz CT?



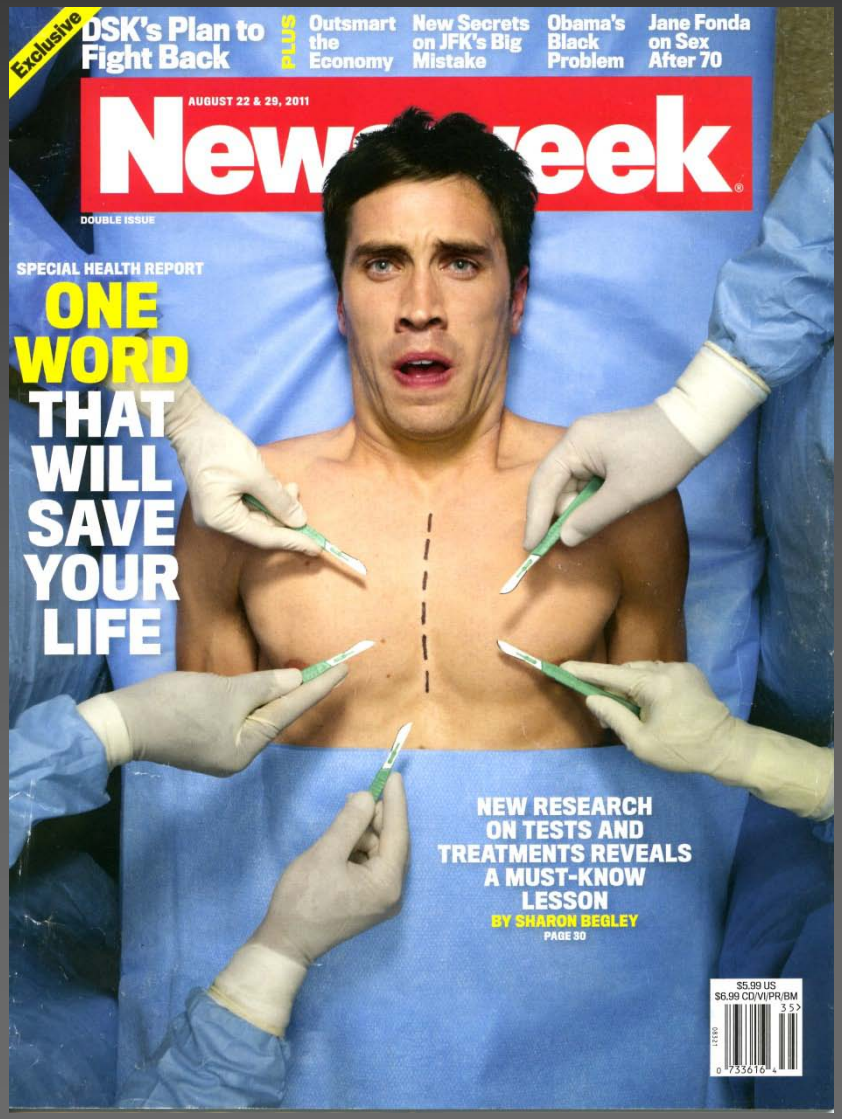
- Weil ich mich damit auskenne
- Neu
- Sehr öffentlichkeitswirksam
- Für viele ein Musterbeispiel für Fehlentwicklungen in der Medizin

# Warum Herz CT?

- Wanderer zwischen den Disziplinen
  - Radiologie / Kardiologie / Medizin
  - Turf battles?
  - Früh den Anforderungen anderer Disziplinen bzgl. Evidenz unterworfen
- Nutzen radiologischer Vefahren ist intuitiv
- … aber häufig unzureichend belegt
- Lehren für andere bildgebende Verfahren

# Herz CT: The Good…

# Herz CT: The Bad…



# Herz CT - … And the Ugly

USA TODAY

Home | News | Travel | Money | Sports | Life | Tech | We

News » Health & Behavior ▪ Fitness & Nutrition ▪ Your Health: Kim Painter ▪ Medical Resourc

## Study: Unnecessary CT scans exposing patients to excessive radiation

Updated 11/29/2007 7:55 AM | Comment | Recommend

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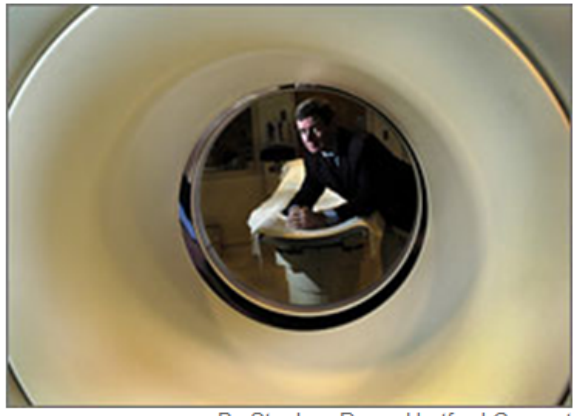

Enlarge

By Stephen Dunn, Hartford Courant via AP

Neurologist Peter Wade is framed by the new Dual Source CT Scan machine in St. Francis Hospital's radiology department in Hartford, Conn. It revealed five blocked arteries when Wade volunteered to be tested. "This machine saved my life," he said. But scans can be dangerous for children, researchers say.

**By Steve Sternberg, USA TODAY**

Overuse of diagnostic CT scans may cause as many as 3 million excess cancers in the USA over the next two to three decades, doctors report today.

Researchers say they're not trying to discourage all use of CT scans -- CT stands for computed tomography -- which superimpose multiple X-ray images to make 3-D pictures. Rather, they say, CT scanning is an invaluable tool in many cases. The problem is that doctors too often overlook its risks.

"About one-third of all CT scans that are done right now are medically unnecessary," says David Brenner of Columbia University, lead author of the study reported in today's *New England Journal of Medicine*.

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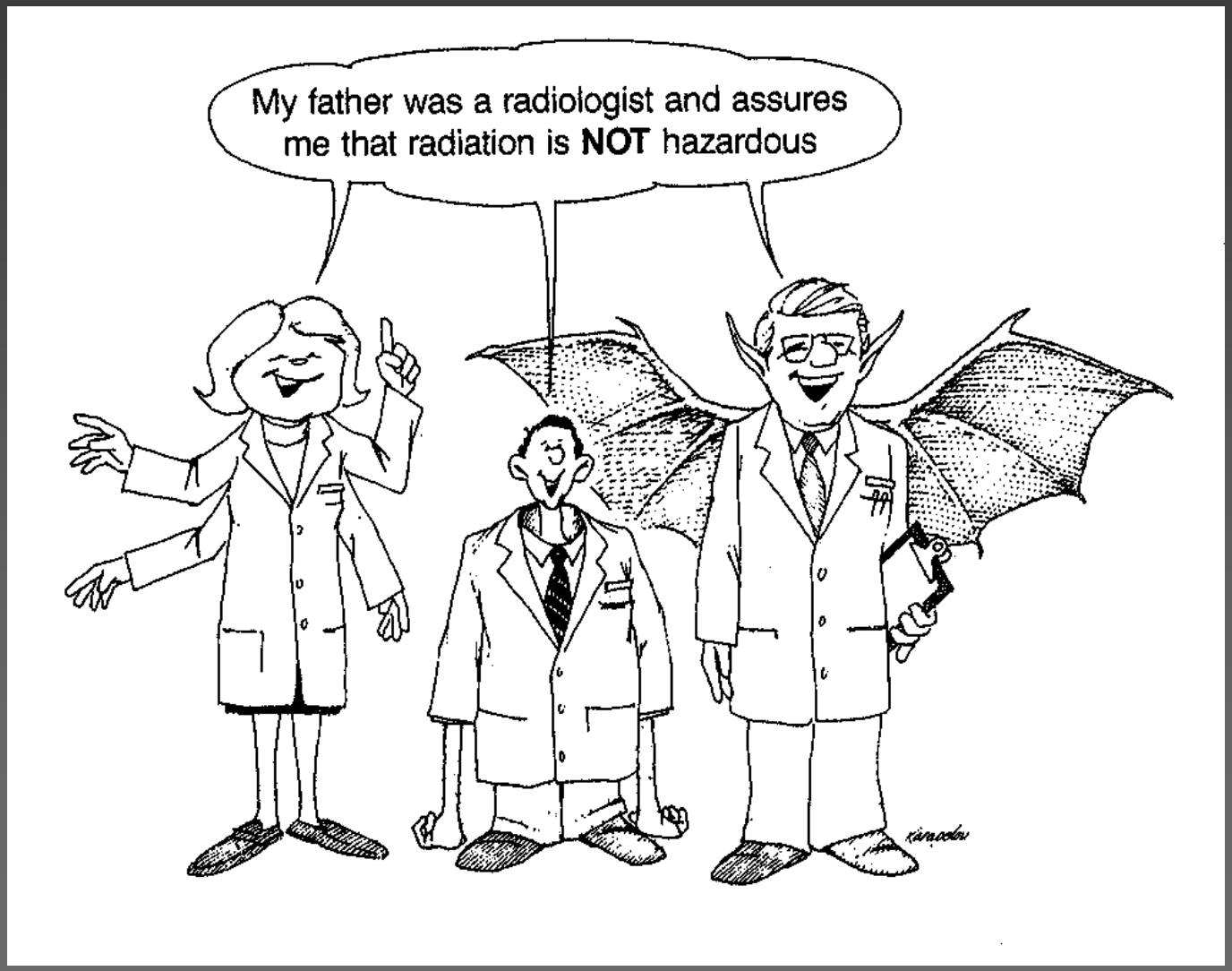
# Gesellschaftliche Trends: Strahlenexposition



RSNA HOT TOPIC

October 2007 • Volume 17, Number 10

RSNA News

# Physicians Warned of Cardiac CT Radiation Risk for Young Patients

## Estimating Risk of Cancer Associated With Radiation Exposure From 64-Slice Computed Tomography Coronary Angiography

Andrew J. Einstein, MD, PhD

Milena J. Henzlova, MD, PhD

Sanjay Rajagopalan, MD

**"Krebs Risiko von Herz CT 1 in 114"**

(Reprinted) JAMA, July 18, 2007—Vol 298, No. 3 **317**

# Öffentliche Wahrnehmung

"Raven Knickerbocker, then an X-ray technologist at Mad River Community Hospital in Arcata, Calif., activated a CT scan 151 times on the same area of the head of 2 ½-year-old Jacoby Roth, investigators concluded."

The New York Times

# Öffentliche Wahrnehmung

**“H. Michael Heuser lost clumps of hair and had other problems after receiving a radiation overdose at Cedars-Sinai Medical Center in Los Angeles. Mr. Heuser, a 52-year-old executive producer of films, received CT perfusion scans after exhibiting stroke symptoms.”**

The New York Times

# Missverständnisse…

**Deterministisches**
*(etwas wird passieren)*

**versus**

**Stochastisches**
*(etwas könnte passieren)*

**Risiko**

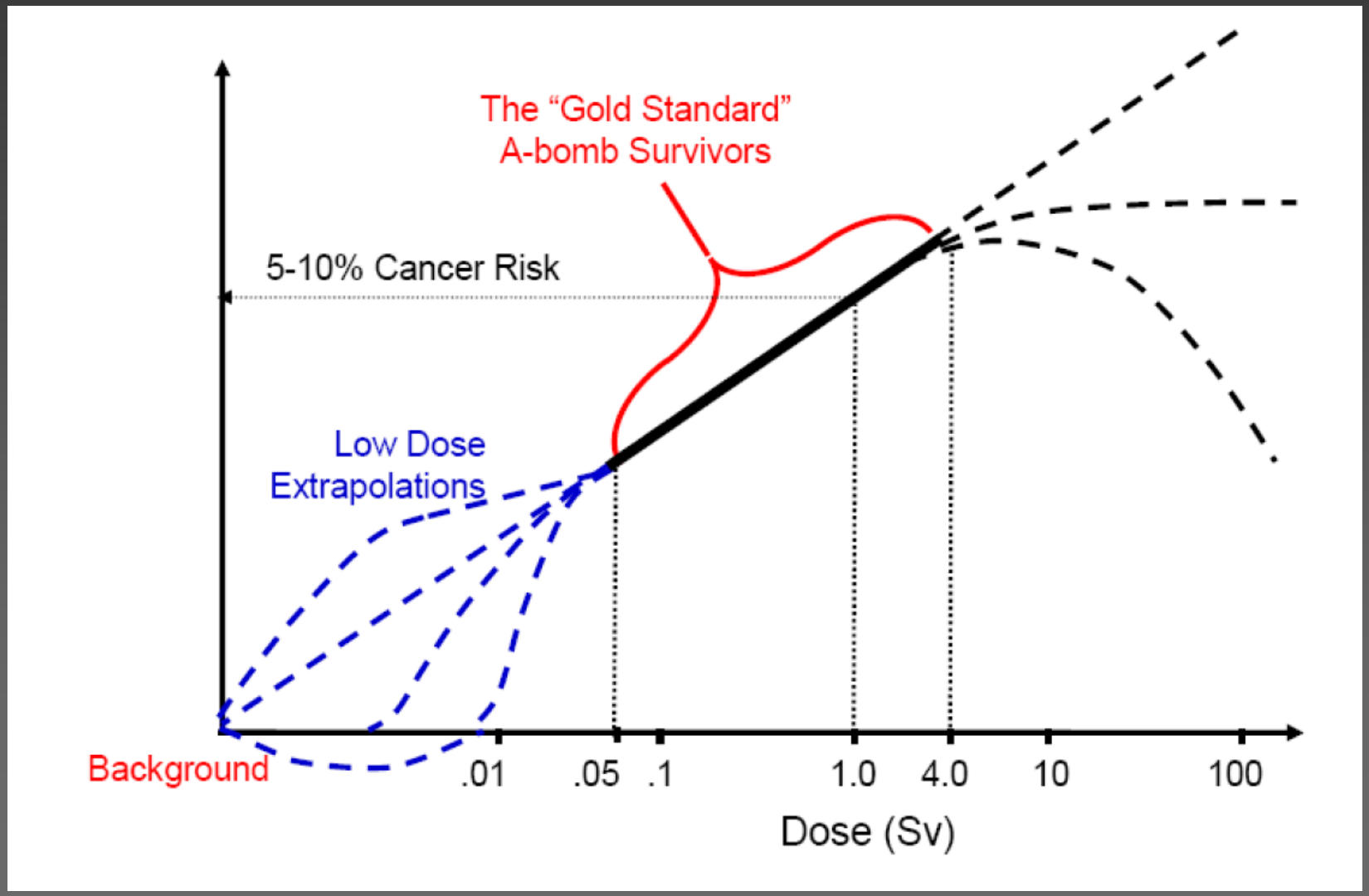
# Radiologen: Schreckgespenster der Medizin?

# Realistische Daten zur Strahlenexposition

- >100 konsekutive Patienten an der MUSC (65% ♂)
- 10. Perz. 41 Jahre, Median 59 Jahre,
  90. Perz. 72 Jahre
- 10. Perz. 69 kg, Median 91 kg,
  90. Perz. 116 kg
- Strahlenrisiko für einen typischen Patienten
  Krebsinzidenz 0.12%,
  Krebsmortalität 0.10%

Huda W, Schoepf UJ et al. AJR 2011; 196:W159-65

# Große Unsicherheiten…




W. Huda

The American Association of Physicists in Medicine

Hom
Con

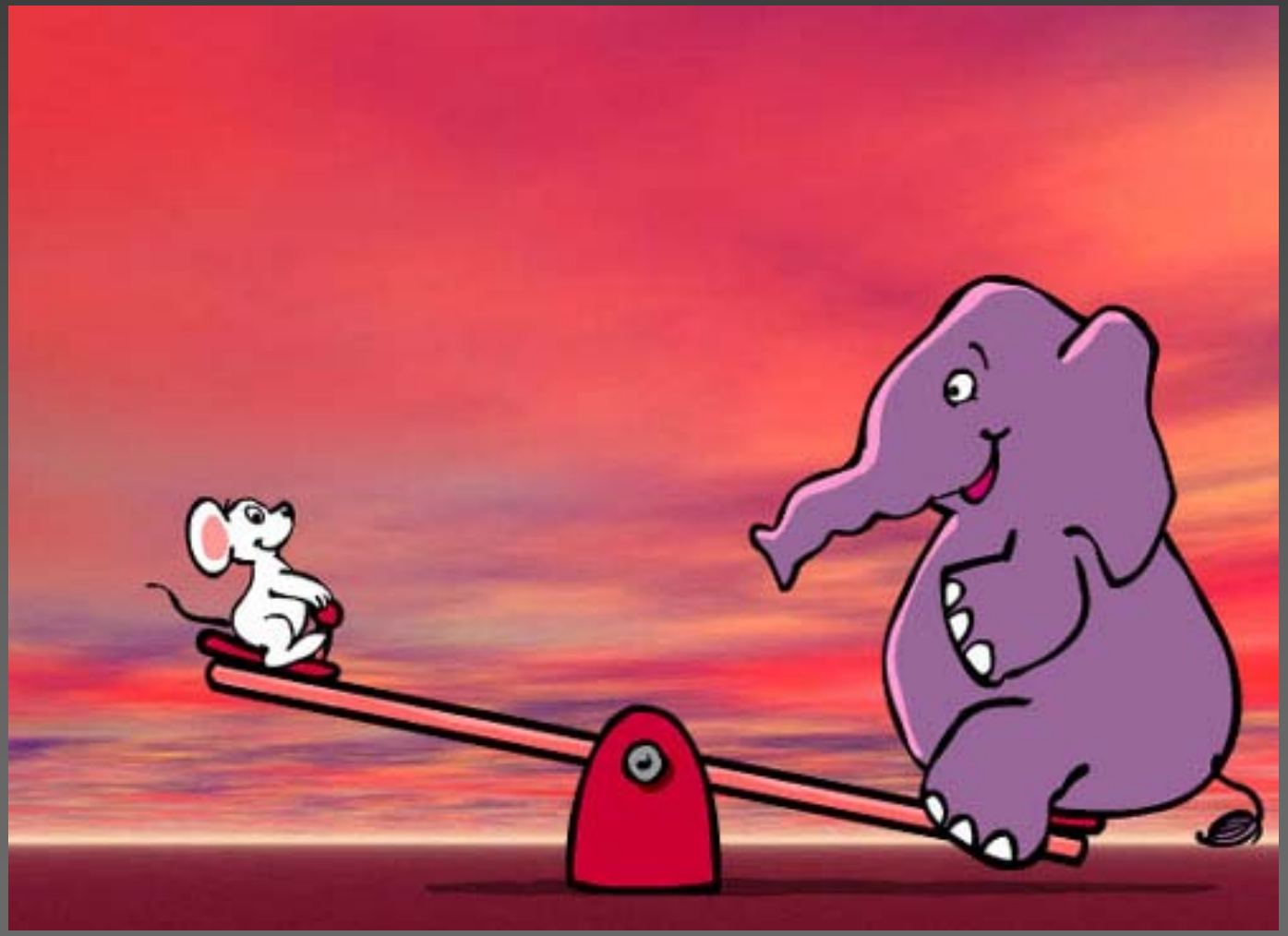
Home

## AAPM Position Statement on Radiation Risks from Medical Imaging Procedures

December 13, 2011

The American Association of Physicists in Medicine (AAPM) acknowledges that medical imaging procedures should be appropriate and conducted at the lowest radiation dose consistent with acquisition of the desired information. Discussion of risks related to radiation dose from medical imaging procedures should be accompanied by acknowledgement of the benefits of the procedures. Risks of medical imaging at effective doses below 50 mSv for single procedures or 100 mSv for multiple procedures over short time periods are too low to be detectable and may be nonexistent. Predictions of hypothetical cancer incidence and deaths in patient populations exposed to such low doses are highly speculative and should be discouraged. These predictions are harmful because they lead to sensationalistic articles in the public media that cause some patients and parents to refuse medical imaging procedures, placing them at substantial risk by not receiving the clinical benefits of the prescribed procedures.

# Risiko – Nutzen Analyse…



# Die Antwort: Dosisreduktion

26-Jul-2011 13:31

Ward: A1CP
Physician:
Operator: em / 18g in rt ac

Total mAs 1270 Total DLP 60 mGycm

| | Scan | kV | mAs / ref. | CTDIvol mGy | DLP mGycm | TI s | cSL mm |
|---|---|---|---|---|---|---|---|
| Patient Position F-SP | | | | | | | |
| Topogram | 1 | 80 | 36 mA | | | 4.2 | 0.6 |
| PreMonitoring | 2 | 120 | 40 | 2.04 | 2 | 0.28 | 10.0 |
| Contrast Monitoring | 3 | 120 | 40 | 18.33 | 18 | 0.28 | 10.0 |
| Last scan no. | 11 | | | | | | |
| Contrast FI_ChestPain | 12D | 80 | 312 | 1.52 | 40 | 0.28 | 0.6 |

| Medium | Type | Iodine Conc. mg/ml |
|---|---|---|
| Contrast | Ultravist | 370 |

# Mit einfachen Mitteln weit kommen…

**42-jährige ♀, Thoraxschmerz, Uneindeutige SPECT, 80 kV Prospektives Triggering kein Padding ≈ 0.5 mSv**

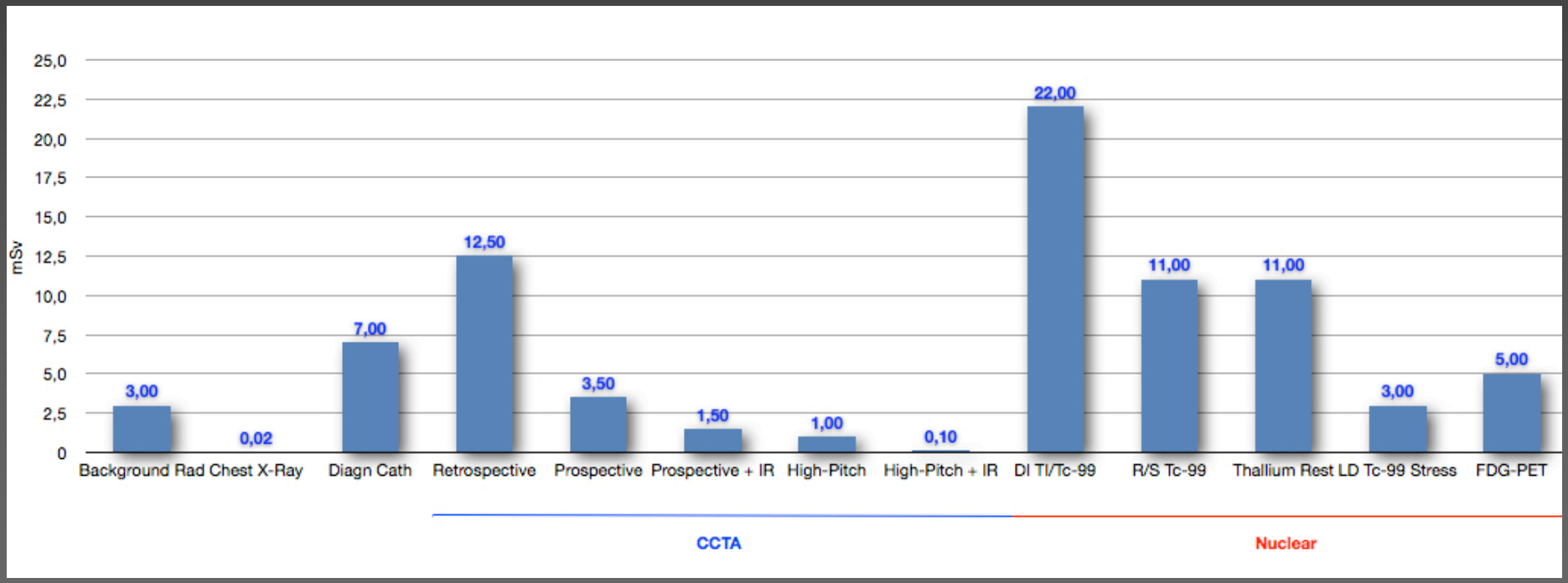
11-Nov-2011 11:07

Ward: A1CP
Physician:
Operator: cm

Total mAs 1413 Total DLP 100 mGycm

| | Scan | kV | mAs / ref. | CTDIvol mGy | DLP mGycm | TI s | cSL mm |
|---|---|---|---|---|---|---|---|
| Patient Position F-SP | | | | | | | |
| Topogram | 1 | 80 | 36 mA | | | 3.0 | 0.6 |
| DS_CaScSeq | 2D | 120 | 76 / 80 | 2.89 | 40 | 0.17 | 1.2 |
| PreMonitoring | 6 | 120 | 40 | 2.01 | 2 | 0.28 | 10.0 |
| Contrast | | | | | | | |
| Monitoring | 7 | 120 | 40 | 18.07 | 18 | 0.28 | 10.0 |
| Last scan no. | 15 | | | | | | |
| Contrast | | | | | | | |
| DS_CorAdSeq | 16D | 80 | 284 | 2.91 | 40 | 0.17 | 0.6 |
| Last scan no. | 19 | | | | | | |

# Herz CT: Evolution der Strahlendosis




*C.N. De Cecco et al., Circulation, in press*

# Fazit: Strahlenexposition

- Herz CT kam früh unter Beschuss
- Mittlerweile alle Verfahren betroffen
- Keine Daten bzgl. Risiko bei Erwachsenen
- Einzigartige Verringerung der Strahlendosis in der Herz CT
- Jedoch sind diese Fakten bei Patienten und Überweisern weitgehend unbekannt
- Focus auf den Nutzen bildgebender Verfahren!
- Bessere Öffentlichkeitsarbeit notwendig!

# Evidenz: Diagnostische Genauigkeit

| Analysis and Parameter | ≥50% Stenosis | ≥70% Stenosis |
|---|---|---|
| Per segment* | | |
| Accuracy | 96.1 (793/825) [94.4, 97.2] | 97.7 (806/825) [96.2, 98.5] |
| Sensitivity | 81.9 (50/61) [70.0, 90.6] | 68.6 (24/35) [50.7, 83.1] |
| Specificity | 97.1 (743/765) [95.6, 98.1] | 97.6 (782/791) [94.8, 98.4] |
| PPV | 69.4 (50/72) [57.4, 79.7] | 72.7 (24/33) [54.4, 86.7] |
| NPV | 98.5 (743/754) [97.4, 99.2] | 98.6 (782/793) [97.5, 99.3] |
| Per vessel† | | |
| Accuracy | 90.9 (150/165) [85.4, 94.8] | 94.6 (156/165) [89.9, 97.4] |
| Sensitivity | 88.8 (32/36) [73.9, 96.8] | 80.9 (17/21) [58.0, 94.5] |
| Specificity | 91.5 (118/129) [85.2, 95.6] | 96.5 (139/144) [92.0, 98.8] |
| PPV | 74.4 (32/43) [58.8, 86.4] | 77.2 (17/22) [54.6, 92.1] |
| NPV | 96.7 (118/122) [91.8, 99.1] | 97.2 (139/143) [92.9, 99.2] |
| Per patient ($n = 55$) | | |
| Accuracy | 89.1 (49/55) [77.7, 95.8] | 94.6 (52/55) [84.8, 98.8] |
| Sensitivity | 100 (19/19) [85.4, 100] | 100 (13/13) [79.4, 100] |
| Specificity | 83.3 (30/36) [67.1, 93.6] | 92.9 (39/42) [80.5, 98.5] |
| PPV | 76.0 (19/25) [54.8, 90.6] | 81.2 (13/16) [54.3, 95.9] |
| NPV | 100 (30/30) [90.5, 100] | 100 (39/39) [92.6, 100] |

**2004: 64-Slice CT**

*Herzog C. et al. Radiology 2007*

# Evidenz: Diagnostische Genauigkeit

| Author | Scanner type | Number of patients | Sensitivity (%) | Specificity (%) | PPV (%) | NPV (%) |
|---|---|---|---|---|---|---|
| Ehara | 64-MDCT | 69 | 90 | 94 | 89 | 95 |
| Mollet | 64-MDCT | 52 | 99 | 95 | 76 | 99 |
| Oncel | 64-MDCT | 80 | 96 | 98 | 91 | 99 |
| Raff | 64-MDCT | 70 | 8[illegible] | 95 | 66 | 98 |
| Ropers | 64-MDCT | 84 | 93 | 97 | 56 | 100 |
| Leschka | 64-MDCT | 67 | 94 | 97 | 87 | 99 |
| Fine | 64-MDCT | 66 | 95 | 96 | 97 | 92 |
| Brodoefel | DSCT | 100 | 91 | 92 | 75 | 97 |
| Ropers | DSCT | 100 | 92 | 97 | 68 | 99 |
| Johnson | DSCT | 3[illegible] | [illegible]3 | 98 | 78 | 99 |
| Weustink | DSCT | 100 | 95 | 95 | 75 | 99 |

64-Slice CT

> 64-Slice CT

# Genauigkeit?

**Table 1** Patient-Based Evaluation of Significant (>50% or ≥50%) Stenosis

| First Author (Reference) | Number of Patients | Sensitivity n/N | Sensitivity (%) | Specificity n/N | Specificity (%) |
|---|---|---|---|---|---|
| Tier 1 | | | | | |
| Raff[5] | 70 | 38/40 | (95) | 27/30 | (90) |
| Mollett[6] | 51 | 38/38 | (100) | 12/13 | (92) |
| Pugliese[7] | 35 | 25/25 | (100) | 9/10 | (90) |
| Ehara[8] | 67 | 59/60 | (98) | 6/7 | (86) |
| Herzog[9] | 55 | 19/19 | (100) | 30/36 | (83) |
| Nikolaou[17] | 68 | 38/39 | (97) | 23/29 | (79) |
| Leber[18] | 45 | 22/25 | (88) | 17/20 | (85) |
| Total | 391 | 239/246 | (97) | 124/145 | (86) |
| Tier 2 | | | | | |
| Ropers[22] | 81 | 25/26 | (96) | 50/55 | (91) |
| Meijboom[23] | 104 | 88/88 | (100) | 12/16 | (75) |
| Meijboom[27] | 402 | 251/253 | (99) | 125/149 | (84) |
| Hacker[28] | 30 | 11/13 | (85) | 10/17 | (59) |
| Oncel[31] | 80 | 62/62 | (100) | 18/18 | (100) |
| Pundziute[32] | 100 | 53/54 | (98) | 42/46 | (91) |
| Shabestari[33] | 138 | 104/108 | (96) | 20/30 | (67) |
| Schuijf[37] | 60 | 29/31 | (94) | 28/29 | (97) |
| Leschka[39] | 74 | 35/36 | (97) | 33/38 | (87) |
| Xiao[40] | 216 | 112/115 | (97) | 91/101 | (90) |
| Leschka[43] | 67 | 47/47 | (100) | 20/20 | (100) |
| Fine[44] | 66 | 62/66 | (94) | 0/0 | |
| Total | 1418 | 879/899 | (98) | 449/519 | (87) |
| Tier 3 | | | | | |
| Ghostine[45] | 66 | 28/29 | (97) | 35/37 | (95) |
| Meijboom[46] | 70 | 18/18 | (100) | 48/52 | (92) |
| Scheffel[47] | 50 | 13/13 | (100) | 37/37 | (100) |
| Plass[48] | 50 | 40/40 | (100) | 9/10 | (90) |
| Total | 236 | 99/100 | (99) | 129/136 | (95) |
| All Tiers | 2045 | 1217/1245 | (98) | 702/800 | (88) |

## Meta-Analysen

*Mowatt G et al.,*
*Health Technol Assess. 2008*

# Wahrnehmung in Fachkreisen - Evidenz

**ACCURACY Multicenter Studie – Hersteller betrieben**
**230 Patienten mit niedrigem oder mittelgradigem KHK Risiko**

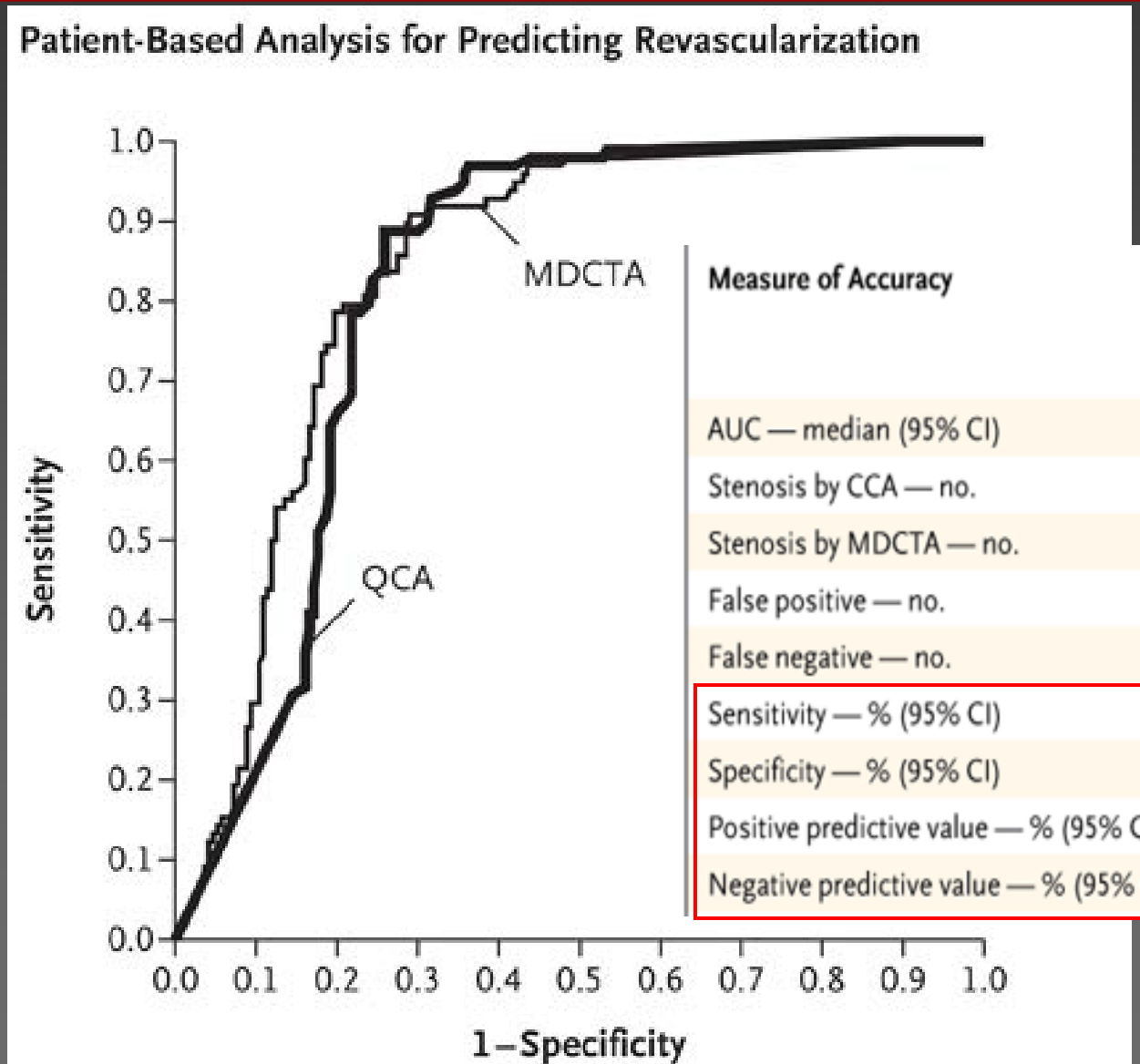
**Table 2** Patient-Based Analysis

| | Estimate, % | 95% CI, % | Subjects in Group, n | Subjects Correct by CCTA, n |
|---|---|---|---|---|
| ≥50% stenosis | | | | |
| Sensitivity | 95 | 85–99 | 55 | 52 |
| Specificity | 83 | 76–88 | 172 | 142 |
| PPV | 64 | 53–75 | 81 | 52 |
| NPV | 99 | 96–100 | 143 | 142 |
| ≥70% stenosis | | | | |
| Sensitivity | 94 | 79–99 | 31 | 29 |
| Specificity | 83 | 77–88 | 196 | 162 |
| PPV | 48 | 35–62 | 60 | 29 |
| NPV | 99 | 96–100 | 164 | 162 |

*Budoff MJ et al. JACC 2008*

# Wahrnehmung in Fachkreisen - Evidenz

**Core 64 Studie – 291 Patienten Hersteller betrieben**




| Measure of Accuracy | Patient-Based Detection | |
|---|---|---|
| | Quantitative MDCTA (N=291) | Visual MDCTA (N=291) |
| AUC — median (95% CI) | 0.93 (0.90–0.96) | 0.93 (0.89–0.95) |
| Stenosis by CCA — no. | 163 | 163 |
| Stenosis by MDCTA — no. | 152 | 146 |
| False positive — no. | 13 | 11 |
| False negative — no. | 24 | 28 |
| Sensitivity — % (95% CI) | 85 (79–90) | 83 (76–88) |
| Specificity — % (95% CI) | 90 (83–94) | 91 (85–96) |
| Positive predictive value — % (95% CI) | 91 (86–95) | 92 (87–96) |
| Negative predictive value — % (95% CI) | 83 (75–89) | 81 (73–87) |

Miller JM et al. NEJM 2008

# Core 64 Multi-Center Studie

- Einzelner Hersteller, daher Informationen nur über die Leistung eines 64-Zeilen CT Systems, nicht unbedingt auf andere übertragbar.
- Hohe prä-Test-Wahrscheinlichkeit, nicht repräsentativ für die klinische Routine.
- Verschiedene Zentren mit unterschiedlicher Erfahrung (Südostasien, Lateinamerika).
- Selten durchgeführt (im Mittel 2 Patienten / Monat eingeschlossen).
- Ungewöhnliche statistische Auswertung

The NEW ENGLAND JOURNAL of MEDICINE

## Pay Now, Benefits May Follow — The Case of Cardiac Computed Tomographic Angiography

Rita F. Redberg, M.D., and Judith Walsh, M.D., M.P.H.

**"… Worse, cardiac CT angiographic equipment bombards patients with radiation many orders of magnitude greater than that of traditional radiographs — posing a risk that has never been studied in depth. Brenner and Hall estimated that 1.5 to 2.0% of all cases of cancers in the United States may be attributable to CT radiation."**

The New York Times

## Cardiologists Debate Expensive Heart Scans

By RONI CARYN RABIN
Published: December 1, 2008

**"… in an accompanying commentary, Dr. Rita Redberg … said the study had failed to address the most important question about CT scans: whether they improve patient outcomes."**

**"The last thing we needed was another study on diagnostic accuracy," she said. "What I'm wondering is, if I use it for my patients, will my patients do better?"**

# Wahrnehmung in Fachkreisen: Evidenz

## Multizentrische, herstellerübergreifende Studie mit 360 Patienten

| | Prevalence of Disease, % | n | Sensitivity, % | Specificity, % | PPV, % | NPV, % |
|---|---|---|---|---|---|---|
| Patient-based analysis | 68 | 360 | 99 (98–100) | 64 (55–73) | 86 (82–90) | 97 (94–100) |
| Stable angina pectoris | 63 | 233 | 99 (98–100) | 64 (53–74) | 82 (76–88) | 98 (95–100) |
| Non–ST-segment elevation acute coronary syndrome | 79 | 127 | 99 (97–100) | 63 (45–81) | 91 (85–96) | 94 (84–100) |
| Men | 76 | 245 | 99 (97–100) | 66 (53–78) | 90 (86–94) | 95 (88–100) |
| Women | 51 | 115 | 100 (100–100) | 63 (50–75) | 74 (64–83) | 100 (100–100) |
| Typical angina pectoris | 70 | 151 | 99 (97–100) | 67 (54–81) | 87 (81–93) | 97 (91–100) |
| Atypical angina pectoris | 50 | 82 | 100 (100–100) | 61 (46–76) | 72 (60–84) | 100 (100–100) |
| Unstable angina pectoris | 75 | 77 | 98 (95–100) | 68 (48–89) | 90 (83–98) | 93 (79–100) |
| Non–ST-segment elevated myocardial infarction | 84 | 50 | 100 (100–100) | 50 (15–85) | 91 (83–99) | 100 (100–100) |

Meijboom WB et al. JACC 2008

Journal of the American College of Cardiology
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EDITORIAL COMMENT

# Limitations of Computed Tomography Coronary Angiography*

Steven E. Nissen, MD, MACC
*Cleveland, Ohio*

Nissen SE JACC 2008

**"CT Angiography: A Step Backward."**

**"…it is not surprising that CT angiography performed poorly in the current study."**

**"…large radiation dosages are used…"**

**"Recent studies suggest a small but important risk of inducing malignancy, ranging as high as 1 in 150…"**

**"Does [cCTA] prolong life or improve quality of life?"**

# Die richtigen Fragen stellen…

- Herz CT wird an anderen Standards gemessen als andere Modalitäten der (Herz-) Bildgebung
- Bildgebung beeinflusst nie direkt das Management von Patienten
- Entscheidungen, die auf Bildgebung beruhen, ändern das Management der Patienten
- Das Outcome von Bildgebung ist unweigerlich abhängig von der Qualität der darauf folgenden klinischen Patientenversorgung

Auch aus Steinen, die einem in den Weg gelegt werden, kann man Schönes bauen...

Goethe

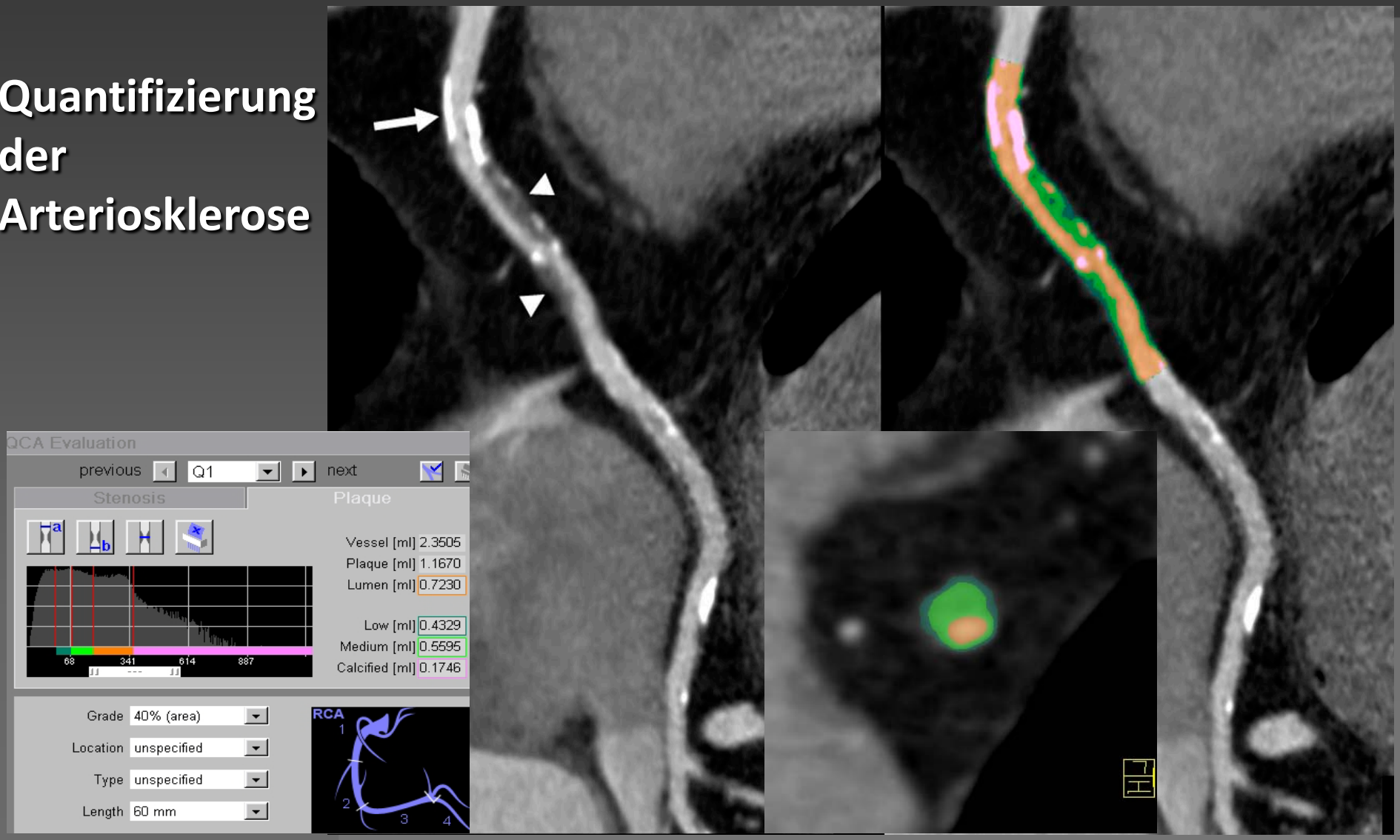
# Verbessert Herz-CT das Outcome?

Prospektive randomisierte Multi-Center Studien angelaufen:

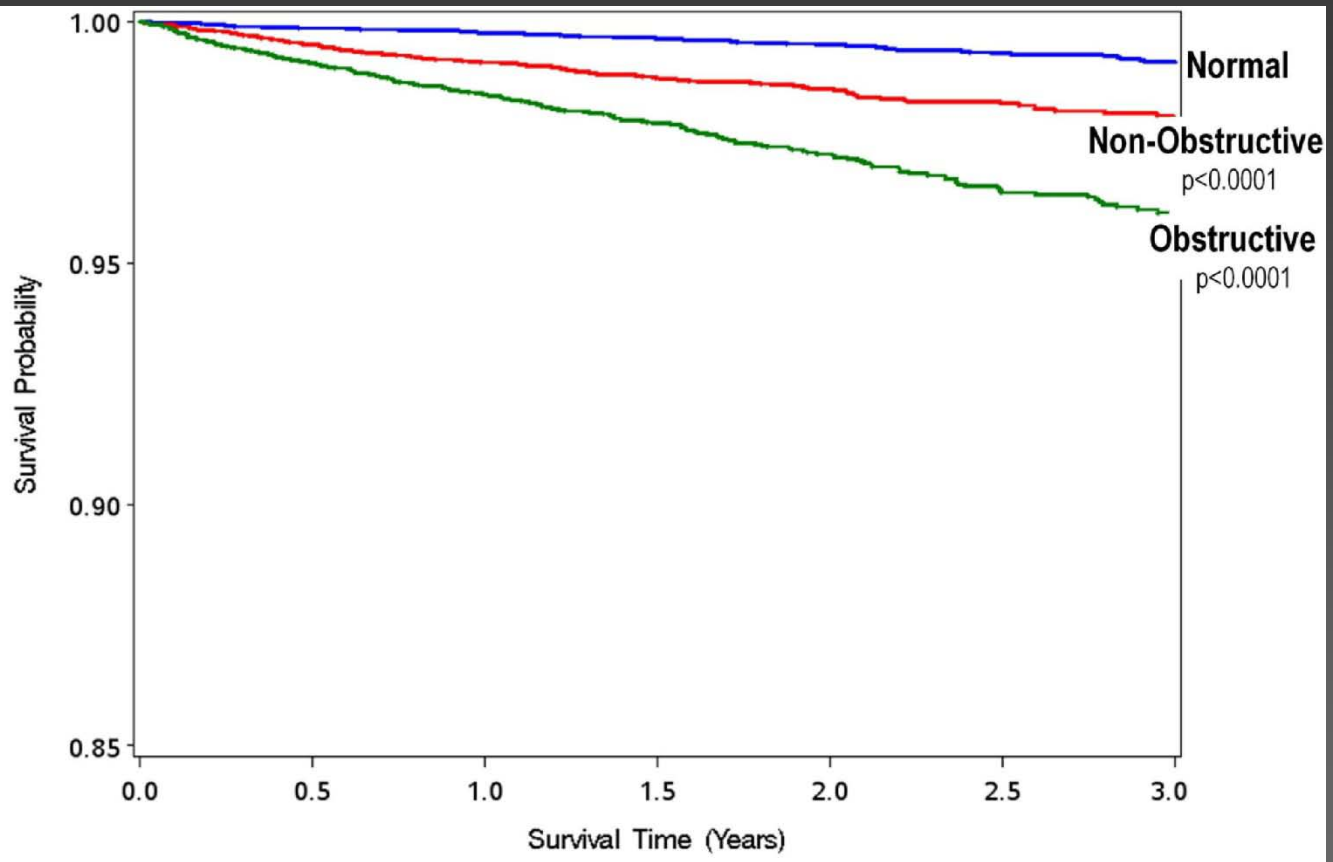
- RESCUE
- PROMISE
- ISCHEMIA

# Outcome: Prognostischer Wert

**Quantifizierung der Arteriosklerose**



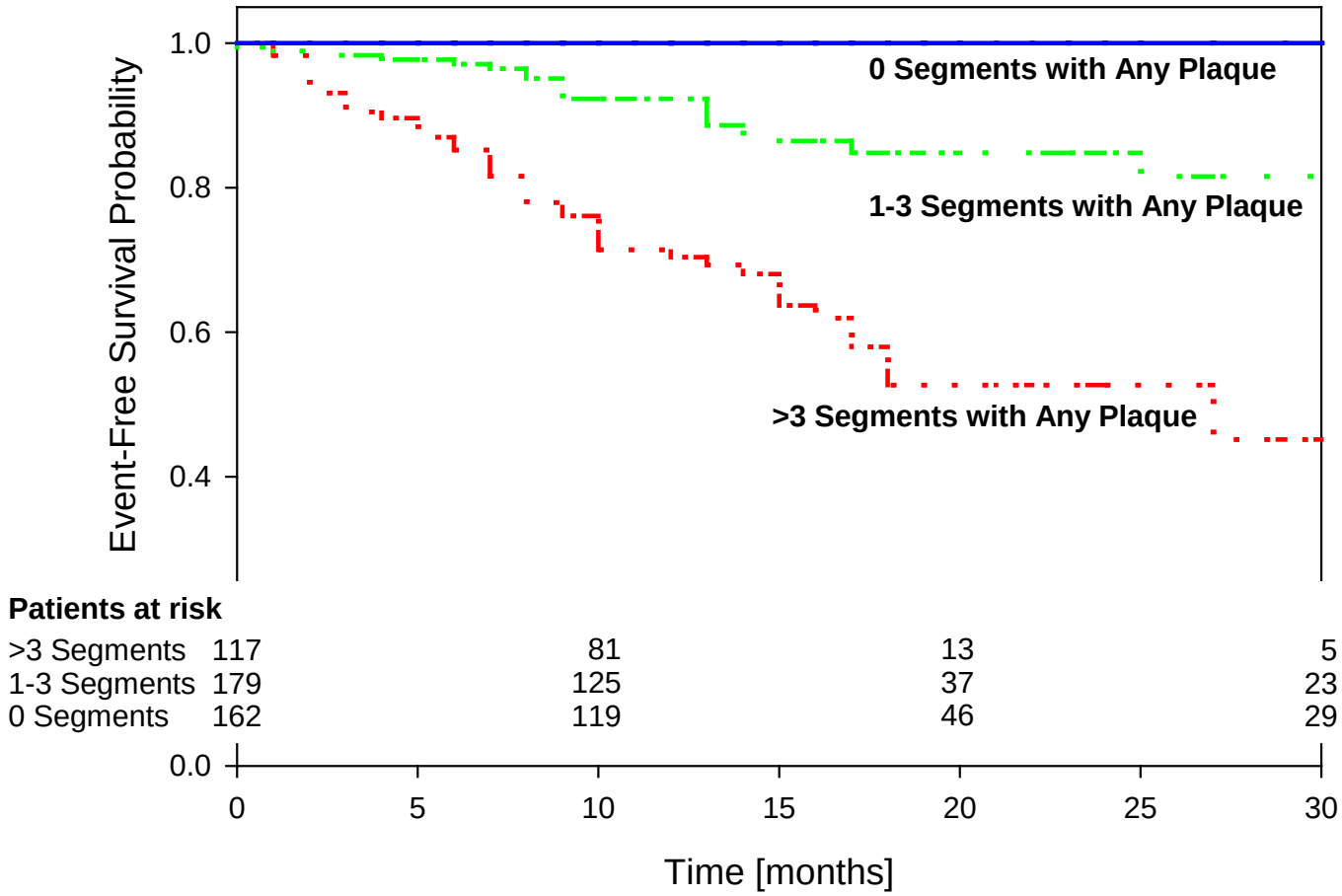
# Outcome: Prognostischer Wert




| At Risk | Year 0 | Year 1 | Year 2 | Year 3 |
|---|---|---|---|---|
| Normal | 10146 | 9357 | 5800 | 2907 |
| Non-Obstructive (1-49%) | 8114 | 7437 | 4081 | 1930 |
| Obstructive (≥50%) | 5594 | 5135 | 3153 | 1430 |

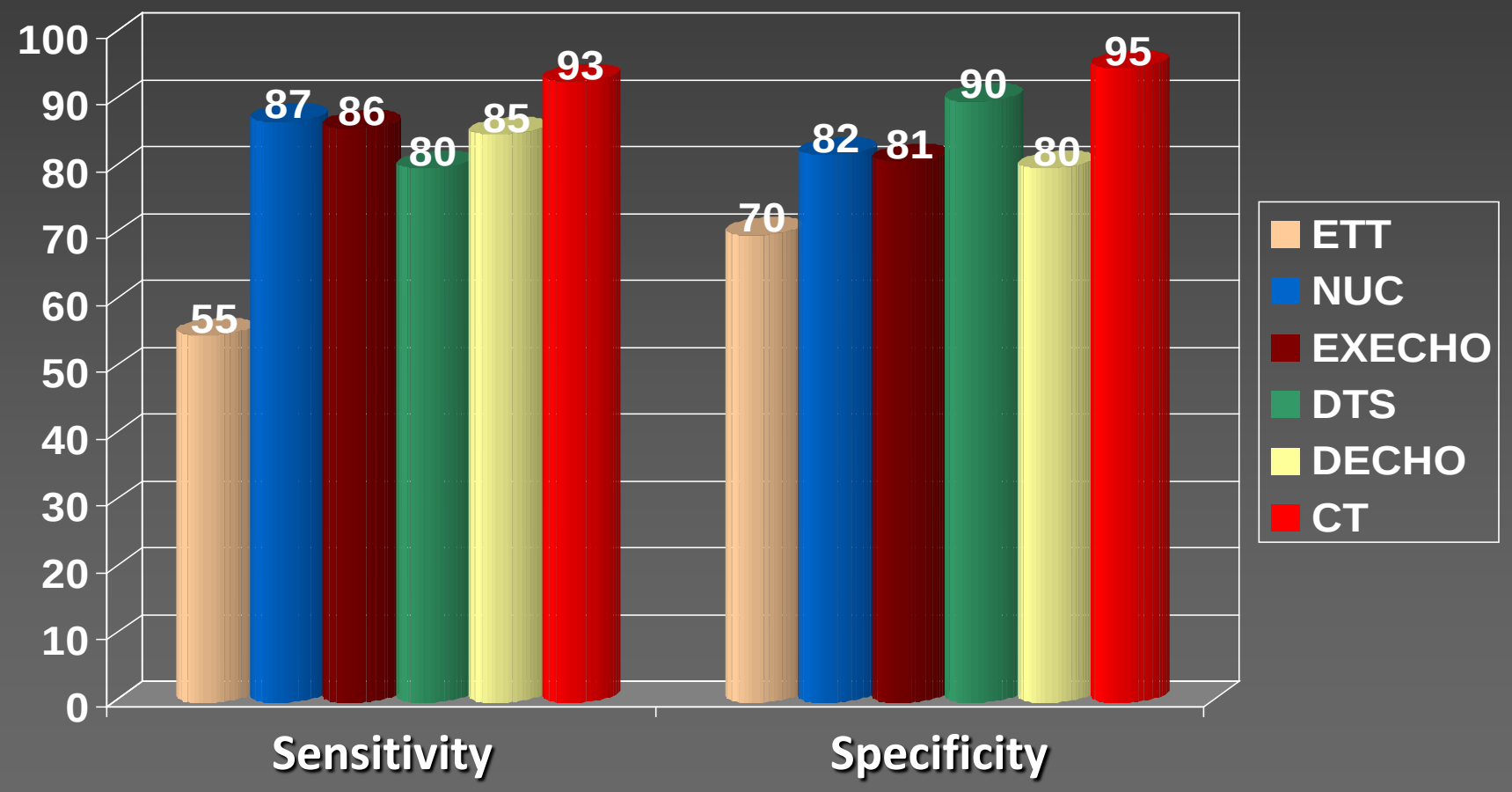
*CONFIRM Registry JACC 2011*

# Prognose: MUSC Outcomes in 458 Patienten




*Nance et al. Radiology 2012*

# Effektivität: Diagnostische Genauigkeit



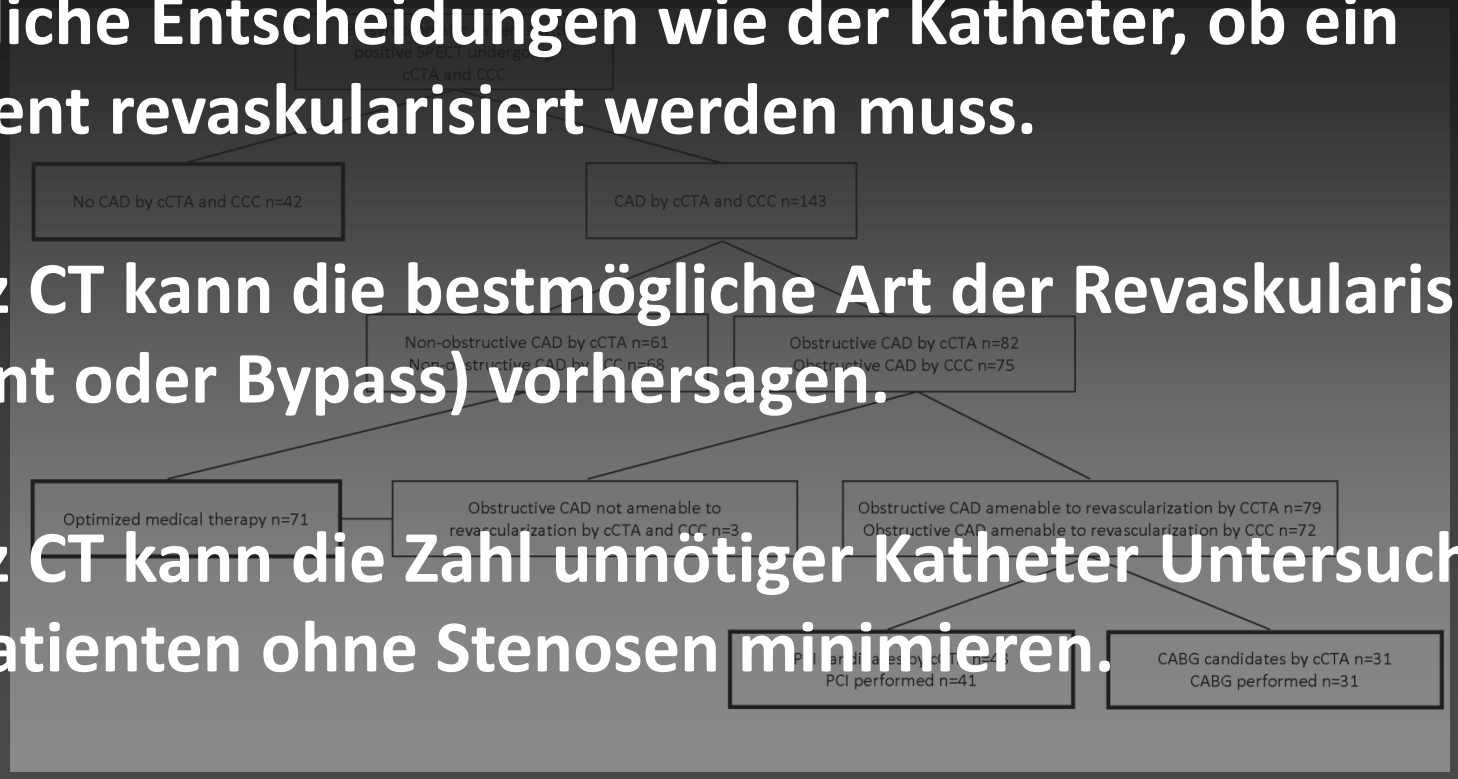

CT und andere nicht-invasive Verfahren bei KHK

# Effektivität: Nichtinvasives Management

**In Hochrisiko-Patienten ermöglicht die Herz CT ähnliche Entscheidungen wie der Katheter, ob ein Patient revaskularisiert werden muss.**

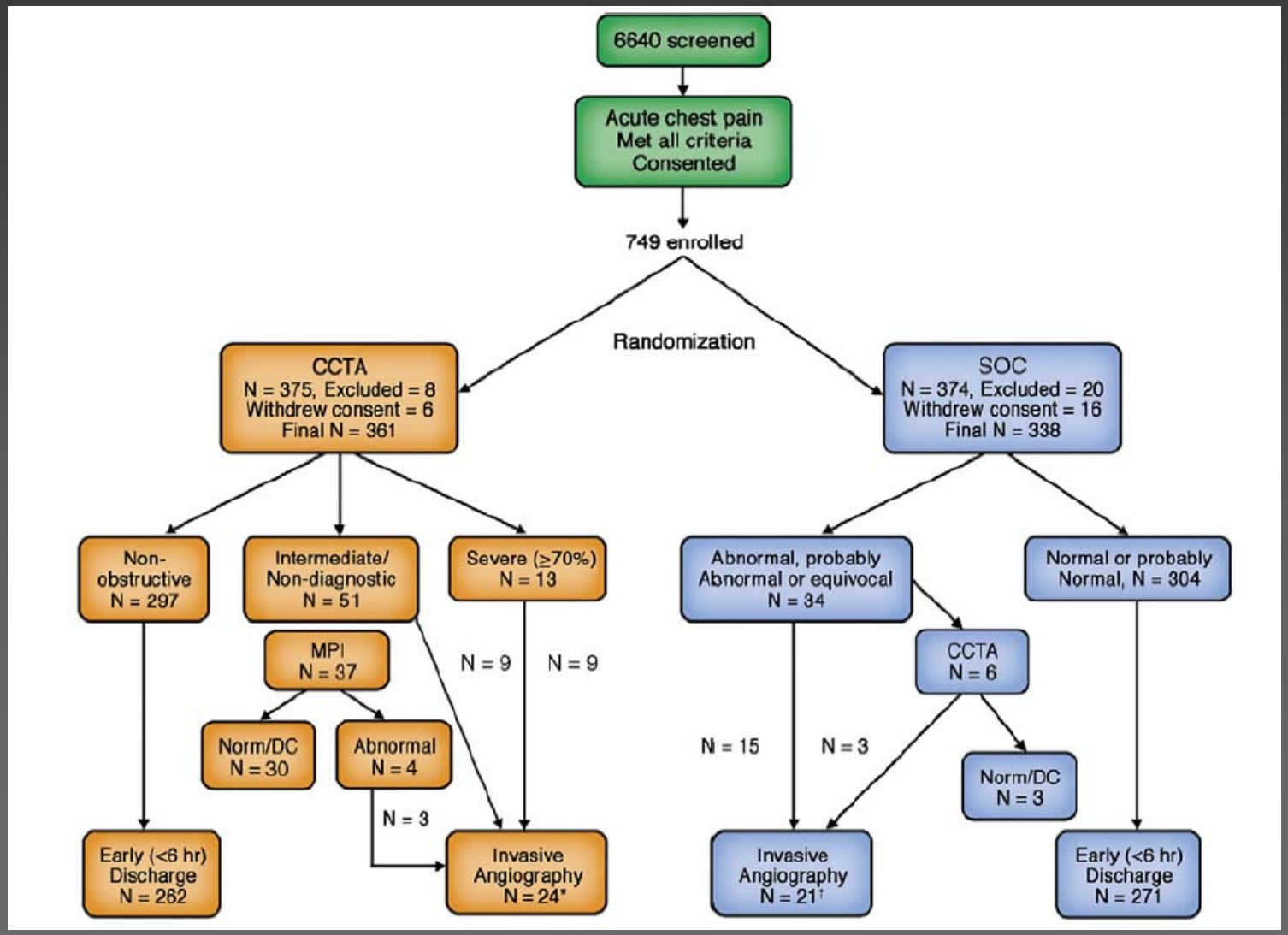
**Herz CT kann die bestmögliche Art der Revaskularisierung (Stent oder Bypass) vorhersagen.**

**Herz CT kann die Zahl unnötiger Katheter Untersuchungen in Patienten ohne Stenosen minimieren.**




Moscariello A, Vliegenthart R, Schoepf UJ, Nance JW Jr, Zwerner PL, Meyer M, Townsend JC, Fernandes V, Steinberg DH, Fink C, O'Brien TX, Henzler T. Radiology 2012

# Effektivität: Notfall-Diagnostik




Goldstein, Raff et al. JACC , 2011

# Notfall-Diagnostik - Evidenz: CT-STAT

| | CCTA Group N=361 | MPI Group N=338 | p Value |
|---|---|---|---|
| Time-to-diagnosis (hours) Median (25th, 75th percentile) | 2.9 (2.1, 4.0) | 6.2 (4.2, 19.0) | <0.0001 |
| Total ED costs (dollars) | 2137$ (1660, 3077) | 3458$ (2900, 4297) | <0.0001 |
| MACE events in patients with normal index test | 2/268 (0.8%) | 1/266 (0.4%) | 0.29 |

Goldstein, Raff et al. JACC , 2011

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

# CT Angiography for Safe Discharge of Patients with Possible Acute Coronary Syndromes

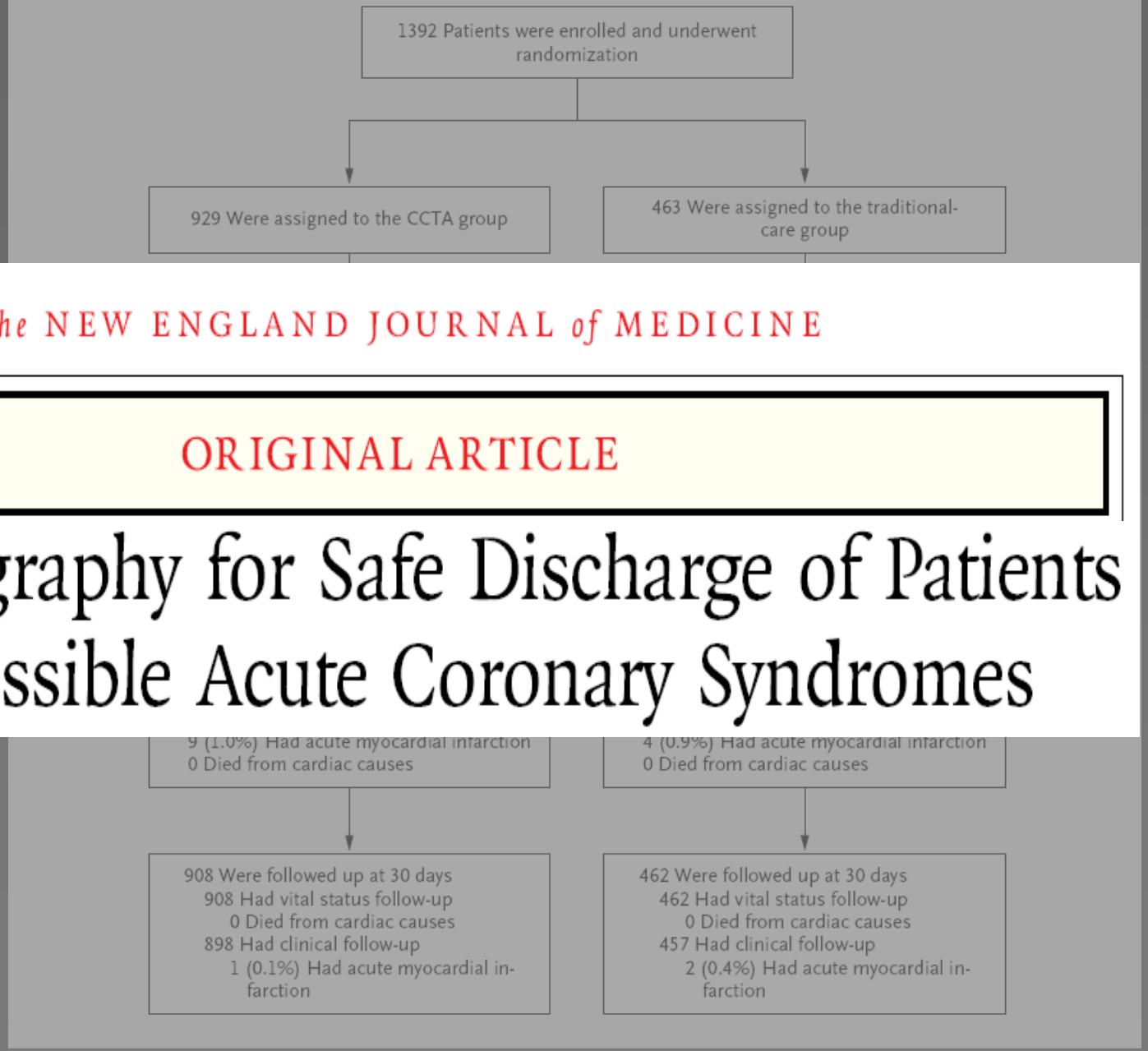



Figure 1. Enrollment, Randomization, Treatment, and Follow-up of the Study Patients.

Litt H et al.,
N Engl J Med 2012

**Table 4. Outcomes during the Index Visit.**

| Outcome | CCTA-Based Strategy (N=908) | Traditional Care (N=462) | Difference, CCTA-Based Strategy – Traditional Care (95% CI) |
|---|---|---|---|
| | | | *percentage points* |
| Disposition — no. (%) | | | |
| Discharge | 450 (50) | 105 (23) | 26.8 (21.4 to 32.2) |
| Admission or observation | 458 (50) | 357 (77) | |
| Length of stay — hr | | | |
| Overall* | | | |
| Median | 18.0 | 24.8 | |
| Interquartile range | 7.6 to 27.2 | 19.2 to 30.5 | |
| Patients with negative test* | | | |
| Median | 12.3 | 24.7 | |
| Interquartile range | 7.0 to 24.3 | 19.7 to 29.6 | |
| Cardiovascular events — no. (%) | | | |
| Death | 0 | 0 | 0 |
| Acute myocardial infarction | 9 (1) | 4 (1) | 0.1 (–5.5 to 5.7) |
| Acute coronary syndrome without acute myocardial infarction | 28 (3) | 7 (2) | 1.6 (–4.0 to 7.2) |
| Diagnosis of coronary disease | 82 (9) | 16 (3) | 5.6 (0 to 11.2) |
| Revascularization | 23 (3) | 4 (1) | 1.7 (–3.9 to 7.3) |

* $P<0.001$ for the comparison between the two groups.

Litt H et al., N Engl J Med 2012

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 JULY 26, 2012 VOL. 367 NO. 4

# Coronary CT Angiography versus Standard Evaluation in Acute Chest Pain

Udo Hoffmann, M.D., M.P.H., Quynh A. Truong, M.D., M.P.H., David A. Schoenfeld, Ph.D., Eric T. Chou, M.D., Pamela K. Woodard, M.D., John T. Nagurney, M.D., M.P.H., J. Hector Pope, M.D., Thomas H. Hauser, M.D., M.P.H., Charles S. White, M.D., Scott G. Weiner, M.D., M.P.H., Shant Kalanjian, M.D., Michael E. Mullins, M.D., Issam Mikati, M.D., W. Frank Peacock, M.D., Pearl Zakroysky, B.A., Douglas Hayden, Ph.D., Alexander Goehler, M.D., Ph.D., Hang Lee, Ph.D., G. Scott Gazelle, M.D., M.P.H., Ph.D., Stephen D. Wiviott, M.D., Jerome L. Fleg, M.D., and James E. Udelson, M.D., for the ROMICAT-II Investigators

**CONCLUSIONS**

In patients in the emergency department with symptoms suggestive of acute coronary syndromes, incorporating CCTA into a triage strategy improved the efficiency of clinical decision making, as compared with a standard evaluation in the emergency department, but it resulted in an increase in downstream testing and radiation exposure with no decrease in the overall costs of care.

# “Overdiagnosis”

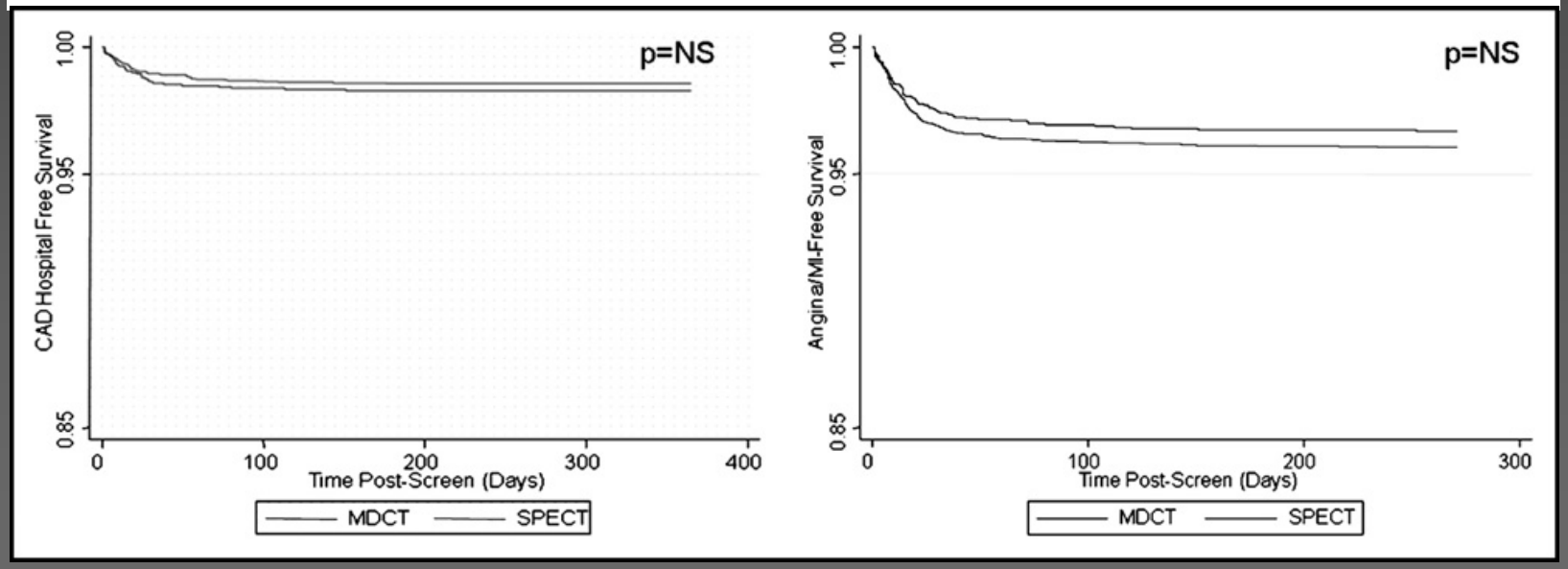
- Zunehmende Thematik
- Nicht isoliert auf die Herz CT:
  - Brustkrebs
  - Lungenkrebs
  - Lungenembolie
- „Overdiagnosis“ oder „Overtreatment“?

# Wirtschaftliche Trends: Kosteneffizienz

**cCTA vs SPECT**

## Costs and Clinical Outcomes in Individuals Without Known Coronary Artery Disease Undergoing Coronary Computed Tomographic Angiography from an Analysis of Medicare Category III Transaction Codes

James K. Min, MD[a,*], Leslee J. Shaw, PhD[b], Daniel S. Berman, MD[c], Amanda Gilmore, PhD,[d] and Ning Kang, MS[d]




**Total health care and CAD expenditures were 27% (p <0.001) and 33% (p <0.001) lower for CCTA compared with SPECT**

Min J.K. et al., Am J Cardiol 2008

# Evidenz: Kosteneffizienz

**CT Utilization for CAD Workup**

THE ECONOMIC IMPACT OF CORONARY CT ANGIOGRAPHY: DATA FROM THE CCTA DATA REGISTRY
JJ Fine, MS, PhD[1], M Ridner, MD[2], T Callister, MD[3], JH Cole, MD[4], J Hines, MD[5]

- 14,473 coronary CTA data registry
- 72% cCTA substitute for MPI — - $ 3,240,620
- 14% cCTA substitute for ICA after MPI — - $ 3,645,000
- 9% cCTA followed by ICA — - $ 405,544
- 4% cCTA followed by nucl. MPI — cost neutral
- 1% cCTA, MPI, ICA — + $ 148,000
- Average savings of $ 493 with reimbursement at $ 1,000

$ 7,143,164

Fine JJ et al. J Nucl Cardiol 2007

~~Was können wir in der Radiologie (Medizin) mit unseren Verfahren alles tun?~~

Was kostet das – und wer soll es bezahlen?

# Fazit: Evidenz

- Evidenz-basierte Medizin ist die Zukunft
- Evidenz wurde früh für die Herz CT gefordert
- Evidenz für die Herz CT wird rapide geschaffen
- Evidenz für andere bildgebende Tests oft mangelhaft
- Radiologie gilt as Kostentreiber
- Zunehmender Druck der Kosten-Effizienz
- Dringende Notwendigkeit, Evidenz für andere Bereiche der Bildgebung zu schaffen.

# Zusammenfassung

- War dieser Vortrag langweilig? Viele Zahlen, wenig hübsche Bilder…
- Radiologie ist Zukunft. Aber um ihre Bedeutung zu sichern, muss sie sich den Trends in der Medizin stellen.
- Herz CT wurde in die Welt dieser neuen Anforderungen geboren und hat gelernt, sich zu behaupten.
- Beispiel für andere Bereiche in der Bildgebung.
- Wahrnehmung durch die Öffentlichkeit und Fachkreise muss verbessert werden um Beschneidungen zu entgehen.

schoepf@musc.edu

Vielen herzlichen Dank!!