

Valvular Heart Disease



Epidemiology

Maurice E. Sarano, MD
Mayo Clinic, Rochester, MN

VHD in the 20th century

A resolved public-health problem

- mostly rheumatic
- of declining incidence
- easily treated in young patients by valve replacement

Valvular Diseases in the 21st Century

**What is the current
epidemiology of
Valvular Diseases ?**

In other words,

**Do we know how many people have a
valvular disease ?**

Burden of valvular heart diseases: a population-based study



Vuyisile T Nkomo, Julius M Gardin, Thomas N Skelton, John S Gottdiener, Christopher G Scott, Maurice Enriquez-Sarano

Background Valvular heart diseases are not usually regarded as a major public-health problem. Our aim was to assess their prevalence and effect on overall survival in the general population.

Methods We pooled population-based studies to obtain data for 11911 randomly selected adults from the general population who had been assessed prospectively with echocardiography. We also analysed data from a community study of 16 501 adults who had been assessed by clinically indicated echocardiography.

Findings In the general population group, moderate or severe valve disease was identified in 615 adults. There was no difference in the frequency of such diseases between men and women ($p=0.90$). Prevalence increased with age, from 0.7% (95% CI 0.5–1.0) in 18–44 year olds to 13.3% (11.7–15.0) in the 75 years and older group ($p<0.0001$). The national prevalence of valve disease, corrected for age and sex distribution from the US 2000 population, is 2.5% (2.2–2.7). In the community group, valve disease was diagnosed in 1505 (1.8% adjusted) adults and frequency increased considerably with age, from 0.3% (0.2–0.3) of the 18–44 year olds to 11.7% (11.0–12.5) of those aged 75 years and older, but was diagnosed less often in women than in men (odds ratio 0.90, 0.81–1.01; $p=0.07$). The adjusted mortality risk ratio associated with valve disease was 1.36 (1.15–1.62; $p=0.0005$) in the population and 1.75 (1.61–1.90; $p<0.0001$) in the community.

Interpretation Moderate or severe valvular diseases are notably common in this population and increase with age. In the community, women are less often diagnosed than are men, which could indicate an important imbalance in view of the associated lower survival. Valve diseases thus represent an important public-health problem.

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See [Comment](#) page 969

Mayo Clinic, Rochester, MN,

USA (V T Nkomo MD,

C G Scott MS,

Prof M Enriquez-Sarano MD);

St John Medical Center, Detroit,

MI, USA

(Prof J M Gardin MD); University

of Mississippi Medical Center,

Jackson, MS, USA

(Prof T N Skelton MD); and

University of Maryland,

Baltimore, MA, USA

(Prof J S Gottdiener MD)

Correspondence to:

Prof Maurice Enriquez-Sarano,

Division of Cardiovascular

Diseases and Internal Medicine,

Mayo Clinic, Rochester,

VHD Prevalence

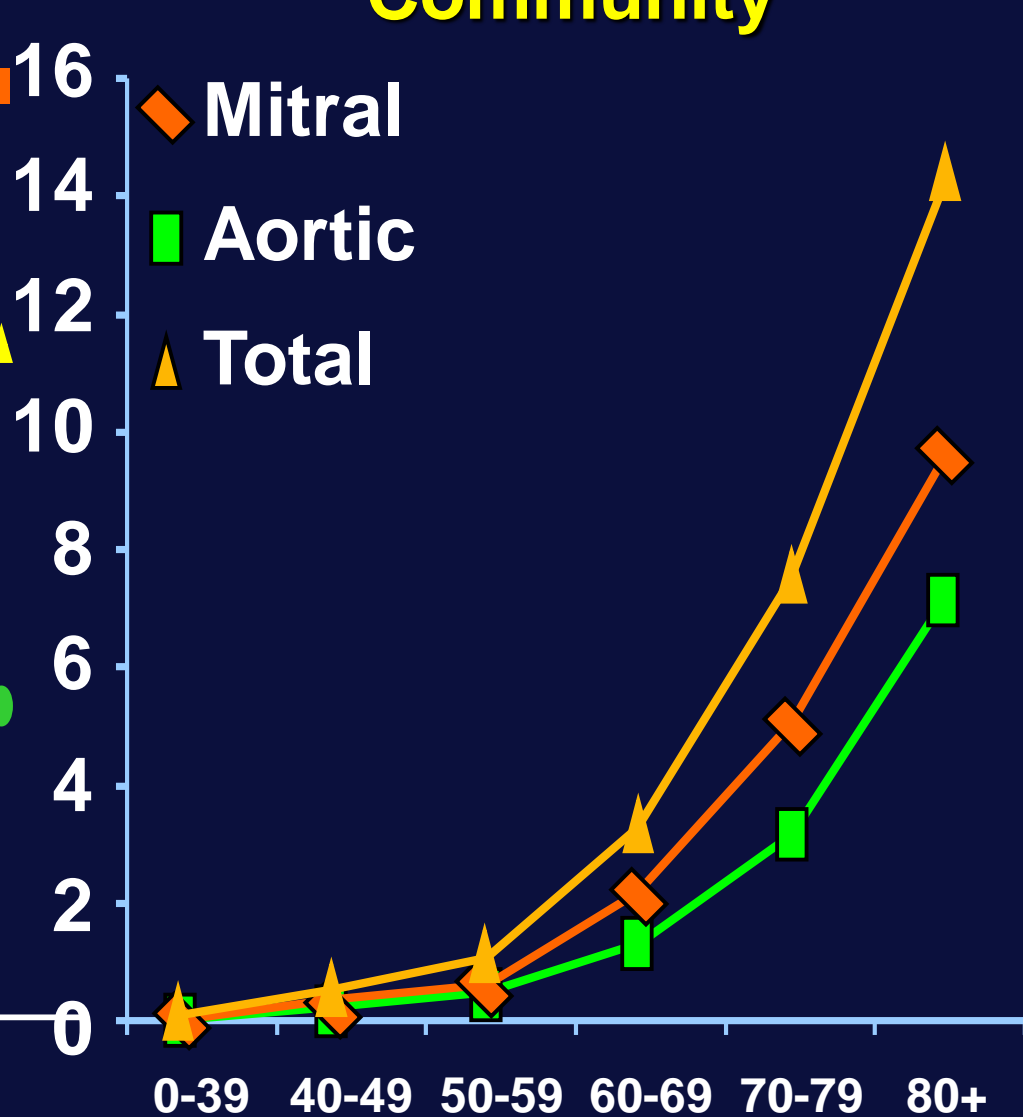
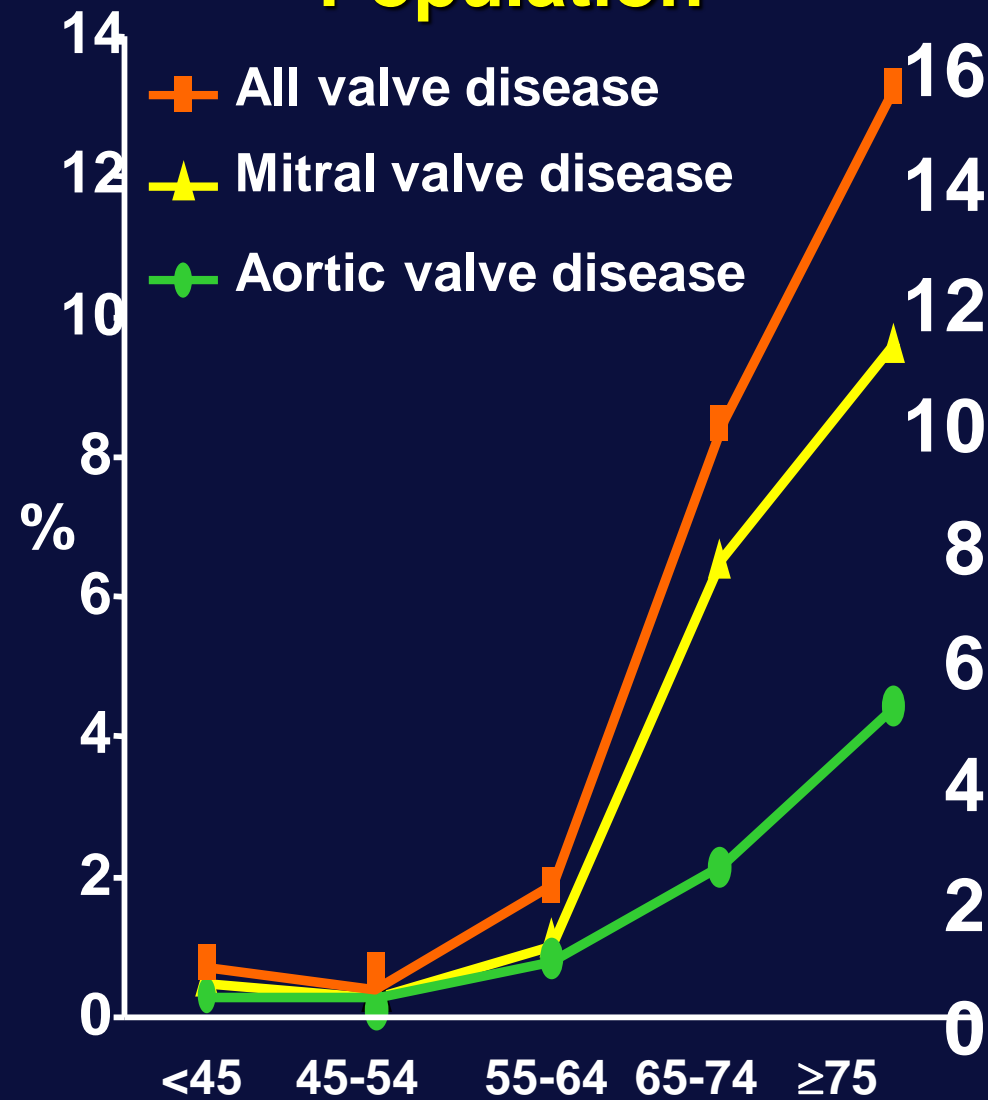
Overall: 2.5% of the adult population

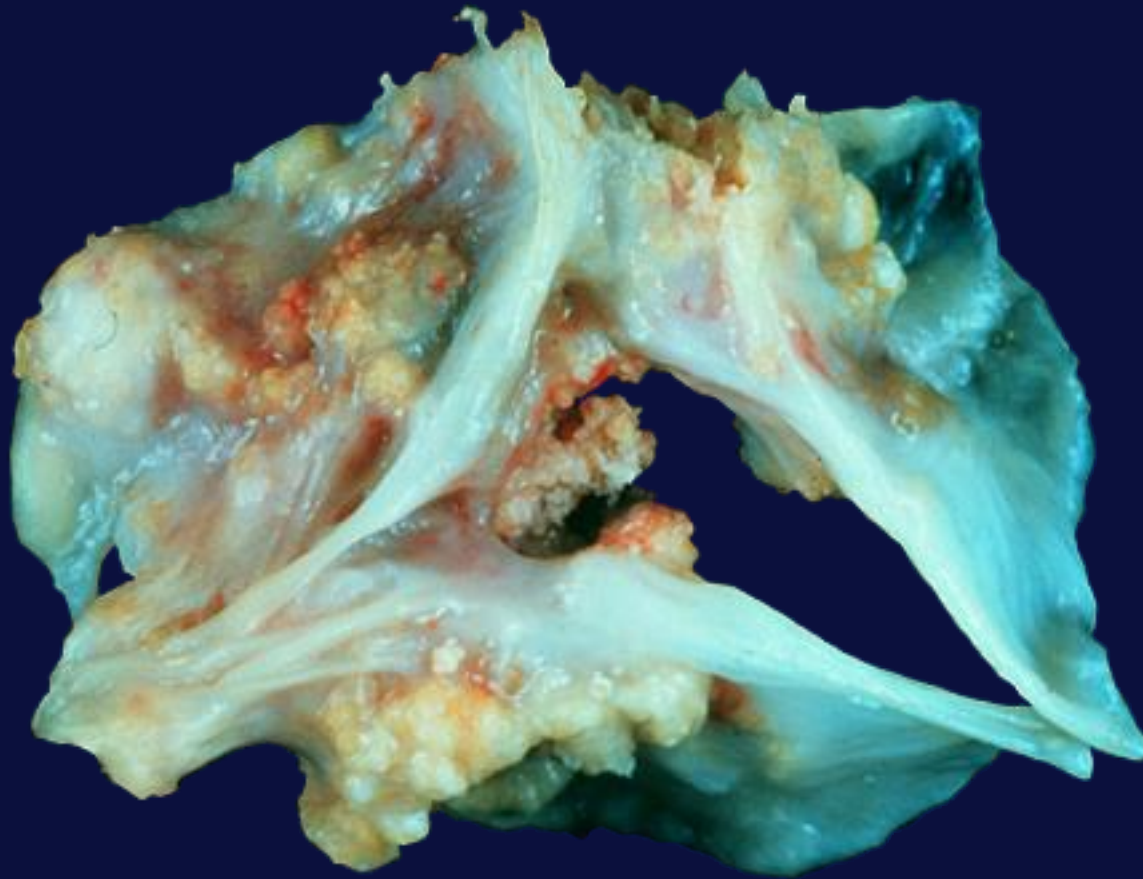
Clinically detected by Echo: 1.8% of the adult population

Prevalence of Valve Diseases

Population

Community







A prospective survey of patients with valvular heart disease in Europe: The Euro Heart Survey on Valvular Heart Disease

Bernard Jung^{a*}, Gabriel Baron^b, Eric G. Butchart^c, François Delahaye^d, Christa Gohlke-Bärwolf^e, Olaf W. Levang^f, Pilar Tornos^g, Jean-Louis Vanoverschelde^h, Frank Vermeerⁱ, Eric Boersma^j, Philippe Ravaud^b, Alec Vahanian^a

^a *Cardiology Department, Bichat Hospital, AP-HP, Paris, France*

^b *Epidemiology, Biostatistic, and Clinical Research Department, Bichat Hospital, AP-HP, Paris, France*

^c *Cardiac Surgery Department, University Hospital, Wales, Cardiff, UK*

^d *Cardiology Department, Hopital Cardiologique, Lyon, France*

^e *Cardiology Department, Heart Centre, Bad Krozingen, Germany*

^f *Cardiac Surgery Department, St. Elizabeth Hospital, Trondheim, Norway*

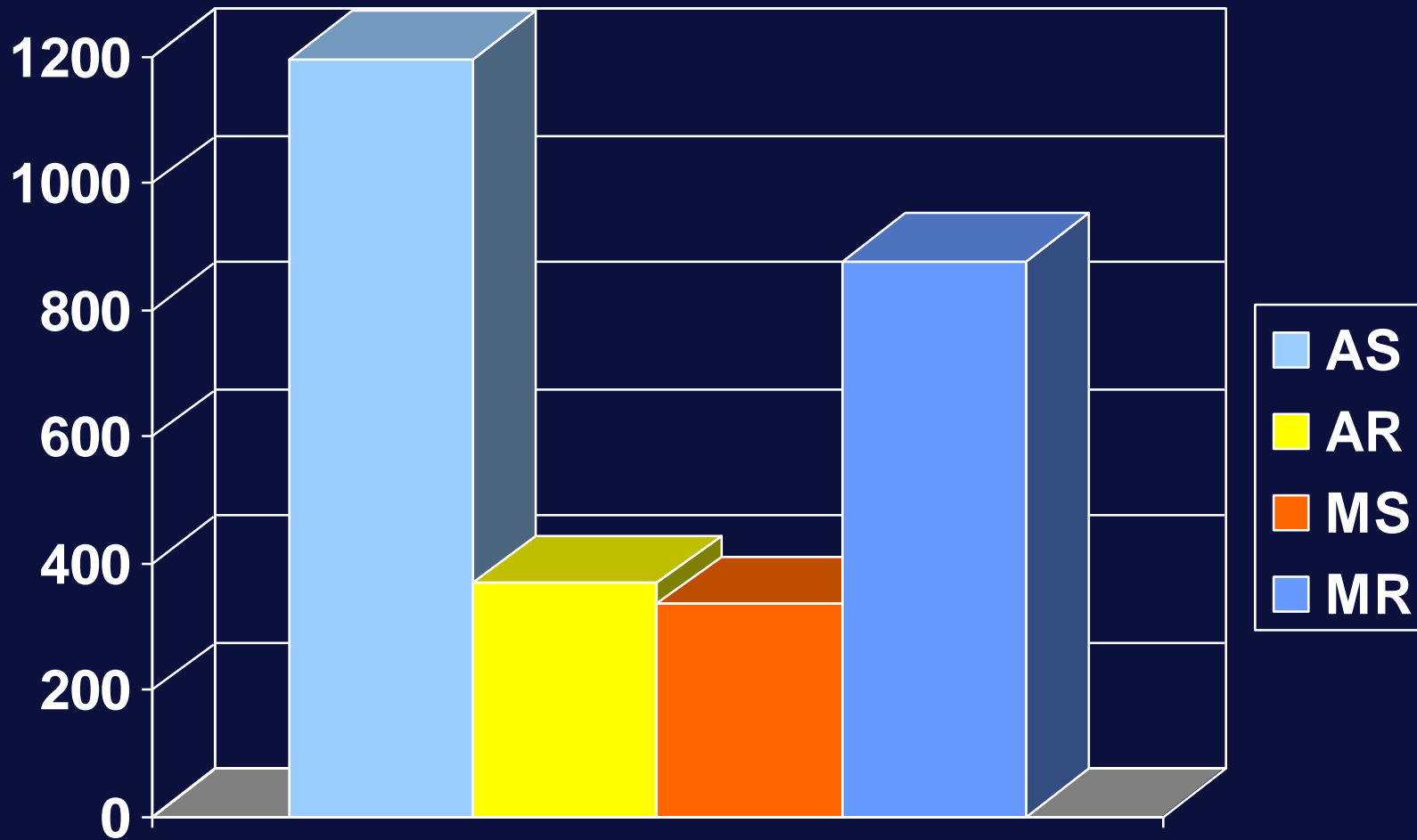
^g *Cardiology Department, Vall d'Hebron Hospital, Barcelona, Spain*

^h *Division of Cardiology, Catholic University of Louvain, Brussels, Belgium*

ⁱ *Laurentius Ziekenhuis Roermond, Netherlands*

^j *Thoraxcentre, Rotterdam, Netherlands*

Received 9 January 2003; revised 7 March 2003; accepted 12 March 2003



VHD Distribution

Symptomatic 70%

Severe CHF symptoms 40%

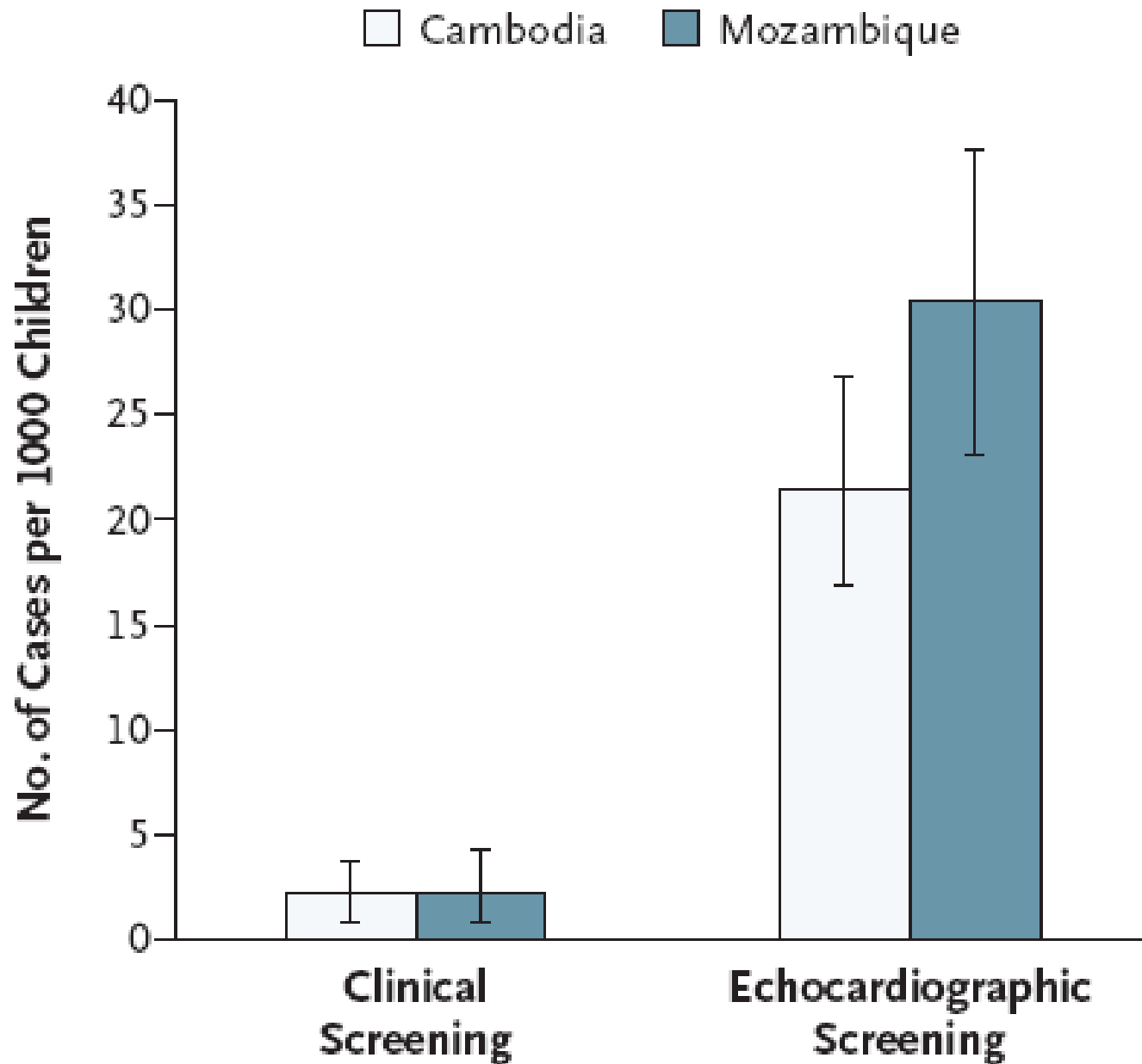
What about the rest of the World ?

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Prevalence of Rheumatic Heart Disease Detected by Echocardiographic Screening

Eloi Marijon, M.D., Phalla Ou, M.D., David S. Celermajer, Ph.D., F.R.A.C.P.,
Beatriz Ferreira, M.D., Ph.D., Ana Olga Mocumbi, M.D., Dinesh Jani, M.D.,
Christophe Paquet, M.D., M.P.H., Sophie Jacob, Ph.D., Daniel Sidi, M.D., Ph.D.,
and Xavier Jouven, M.D., Ph.D.



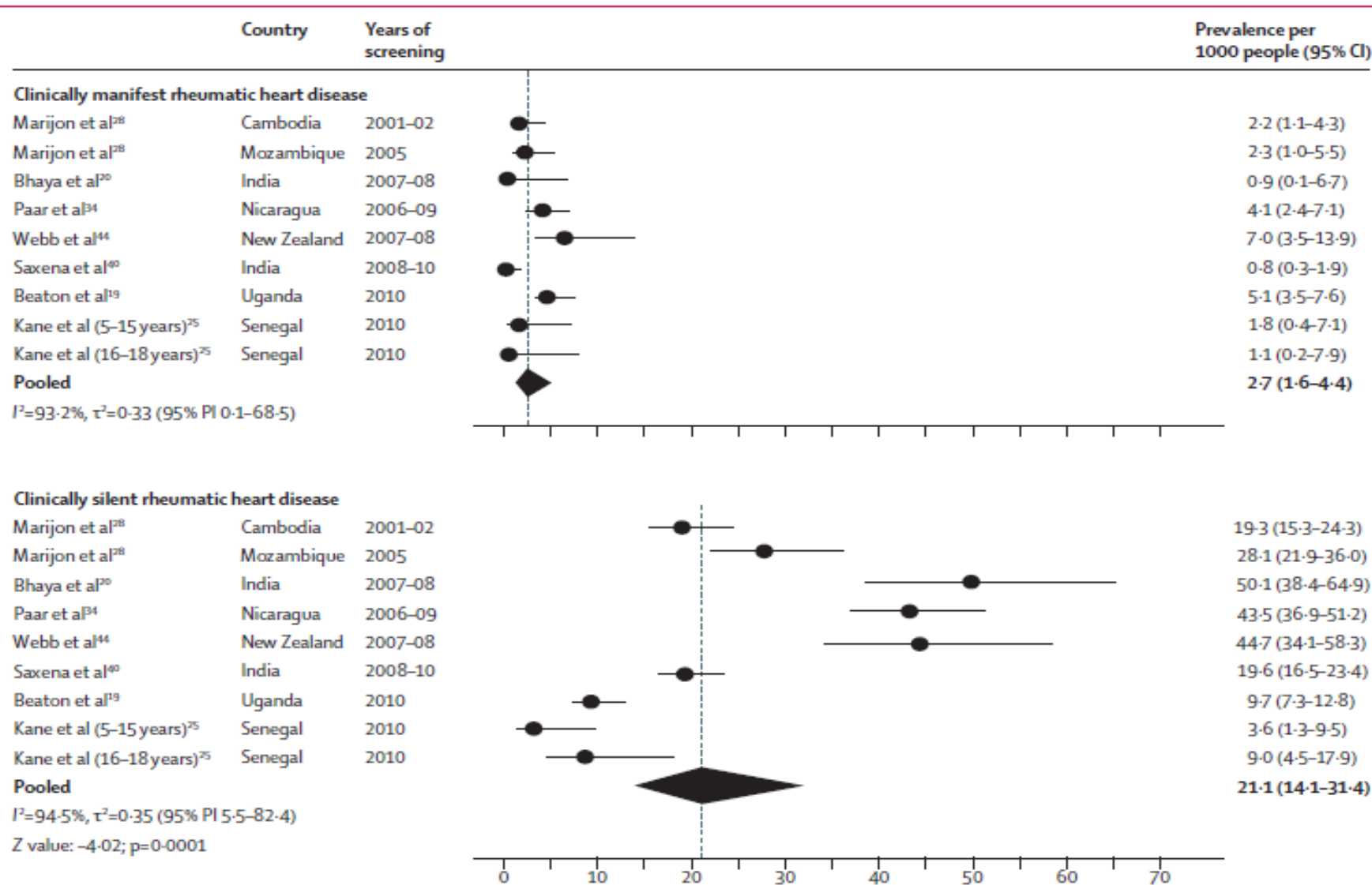
Active surveillance for rheumatic heart disease in endemic regions: a systematic review and meta-analysis of prevalence among children and adolescents



Martino
Peter Jü

Sumr
Backgr

2014;



Characteristics, complications, and gaps in evidence-based interventions in rheumatic heart disease: the Global Rheumatic Heart Disease Registry (the REMEDY study)

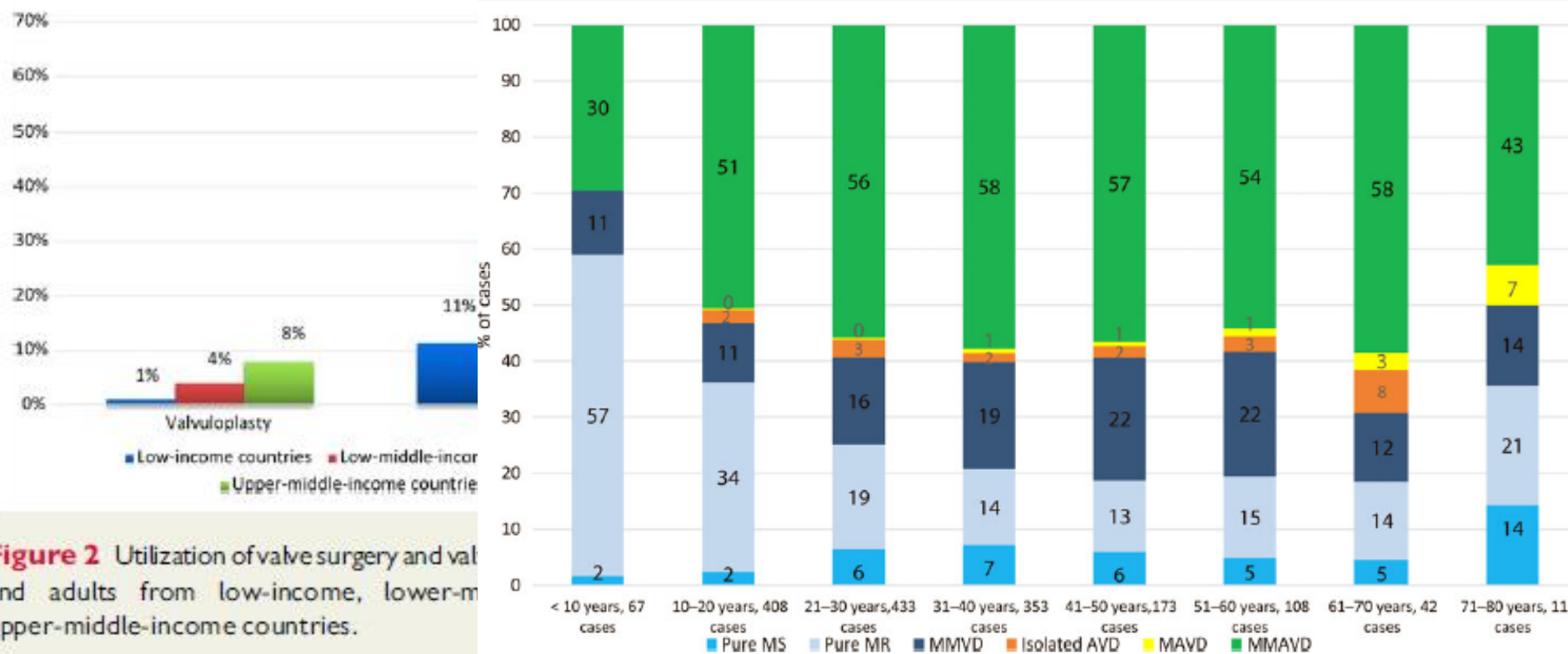
Liesl Zühlke^{1,2}, Mark E. Engel¹, Ganesan Karthikeyan³, Sumathy Rangarajan⁴,

Table 1 Demographic characteristics of 3343 children and adults with rheumatic heart disease

	Low-income	Lower-middle-income	Upper-middle-income	P	Total
	Low-income countries (N 1110) N (%)	Lower-middle-income countries (N 1370) N (%)	Upper-middle-income countries (N 863) N (%)		P
New York Heart Association Functional Class III & IV	306 (27.6)	384 (29.1)	119 (13.9)		0.24
Medical history					
Acute rheumatic fever	247 (22.3)	593 (44.3)	500 (59.0)		0.06
Congestive heart failure	476 (43.0)	285 (21.0)	349 (40.6)		0.06
Pulmonary hypertension	329 (29.9)	465 (34.2)	163 (19)		0.5
Stroke	58 (5.2)	52 (3.8)	125 (14.5)		<0.01
Infective endocarditis	25 (2.3)	59 (4.36)	49 (5.7)		0.1
Major Bleeding	21 (1.9)	38 (2.8)	30 (3.5)		0.61
Peripheral embolism	3 (0.3)	3 (0.2)	19 (2.2)		<0.001
Cardiovascular complications ^a	96 (8.7)	137 (10.1)	191 (22.2)		0.02
Atrial fibrillation	163 (17.9)	241 (22.0)	182 (22.7)		0.49

Characteristics, complications, and gaps in evidence-based interventions in rheumatic heart disease: the Global Rheumatic Heart Disease Registry (the REMEDY study)

Liesl Zühlke^{1,2}, Mark E. Engel¹, Ganesan Karthikeyan³, Sumathy Rangaraian⁴.



World Hemodynamic VHD Prevalence

Currently overall:

~2.5% of the population

Clinical detection:

Poor

**Valvular Diseases are Frequent
and Clinically Significant**

**Do VHD represent a
Public Health
Burden ?**

VHD Burden

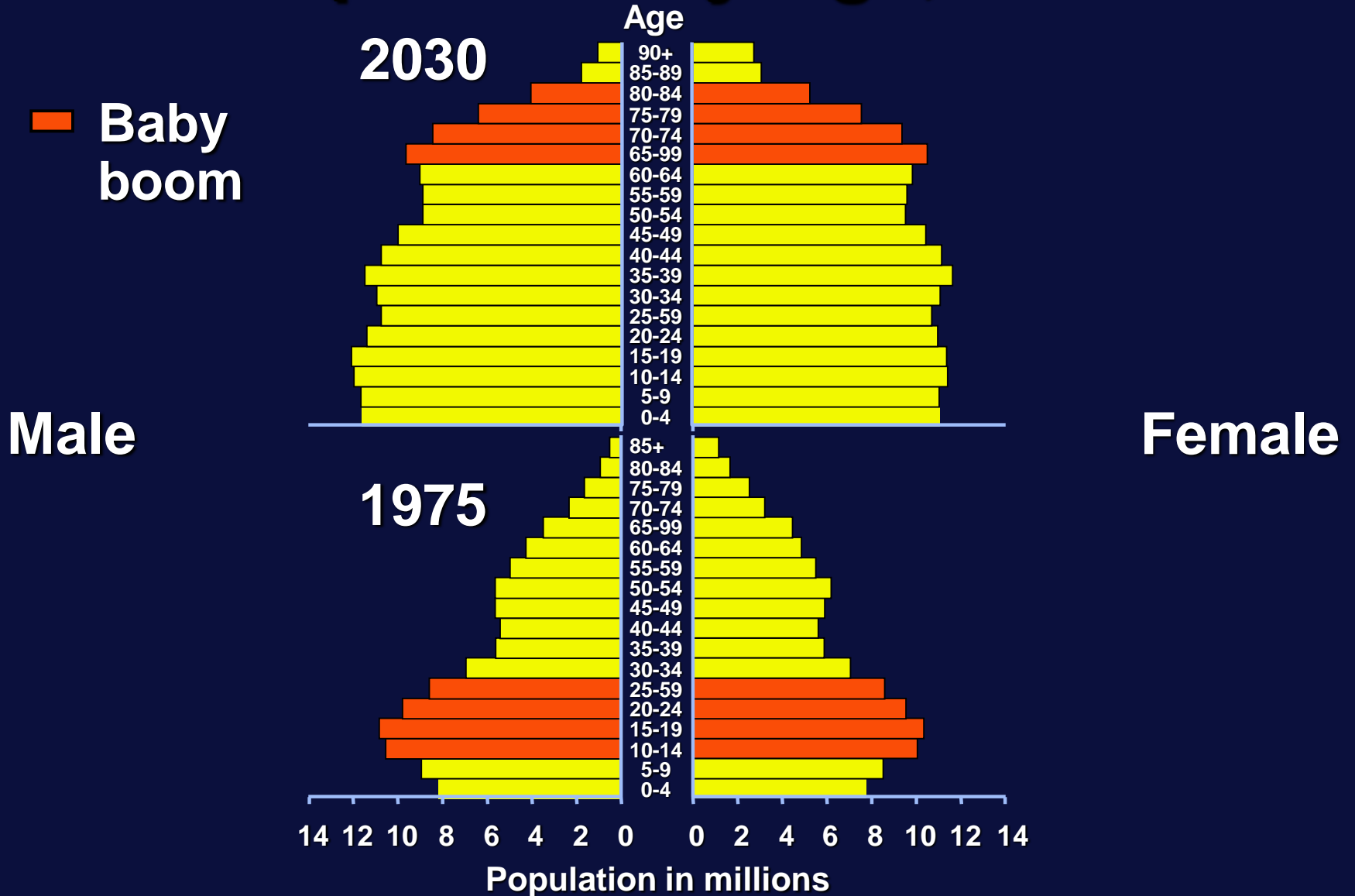
World population

~7,000,000,000

Currently affected by VHD

~175,000,000

The Graying of the World Population by Age, Sex



Burden of valvular heart diseases: a population-based study



Vuyisile T Nkomo, Julius M Gardin, Thomas N Skelton, John S Gottdiener, Christopher G Scott, Maurice Enriquez-Sarano

Background Valvular heart diseases are not usually regarded as a major public-health problem. Our aim was to assess their prevalence and effect on overall survival in the general population.

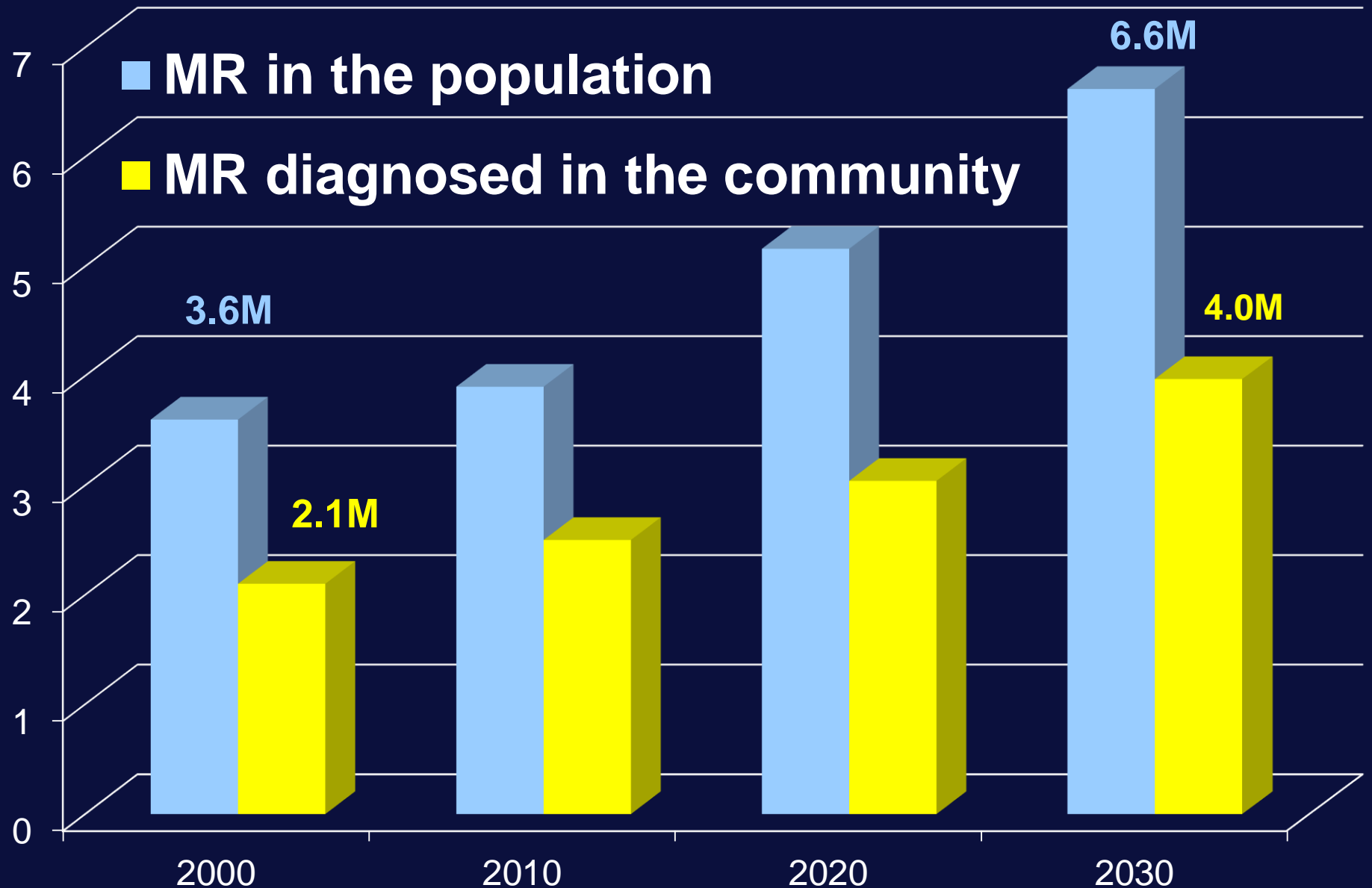
Lancet 2006; 368: 1005-11
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 DOI:10.1016/S0140-6736(06)69208-8
 See Comment page 969
 Mayo Clinic, Rochester, MN,

Methods We pooled population-based studies to obtain data for 11911 randomly selected adults from the general population who had been assessed prospectively with echocardiography. We also analysed data from a community study of 16 501 adults who had been assessed by clinically indicated echocardiography.

	Population					p value for trend	Frequency adjusted to 2000 US adult population
	Age (years)	18-44	45-54	55-64	65-74		
Participants (n)	4351	696	1240	3879	1745	..	209 128 094
Male, n (%)	1959 (45%)	258 (37%)	415 (33%)	1586 (41%)	826 (47%)	..	100 994 367 (48%)
Mitral regurgitation (n=449)	23, 0.5% (0.3-0.8)	1, 0.1% (0-0.8)	12, 1.0% (0.5-1.8)	250, 6.4% (5.7-7.3)	163, 9.3% (8.1-10.9)	<0.0001	1.7% (1.5-1.9)
Mitral stenosis (n=15)	0, 0% (0-0.1)	1, 0.1% (0-0.8)	3, 0.2% (0.1-0.7)	7, 0.2% (0.1-0.4)	4, 0.2% (0.1-0.6)	0.006	0.1% (0.02-0.2)
Aortic regurgitation (n=90)	10, 0.2% (0.1-0.4)	1, 0.1% (0-0.8)	8, 0.7% (0.3-1.3)	37, 1.0% (0.7-1.3)	34, 2.0% (1.4-2.7)	<0.0001	0.5% (0.3-0.6)
Aortic stenosis (n=102)	1, 0.02% (0-0.1)	1, 0.1% (0-0.8)	2, 0.2% (0.6-1.9)	50, 1.3% (1.0-1.7)	48, 2.8% (2.1-3.7)	<0.0001	0.4% (0.3-0.5)

	Community					p value for trend
	Age (years)	18-44	45-54	55-64	65-74	
Residents, n	49 957	16 306	10 241	6 686	6 663	..
Residents examined, n (% men)	4 310 (38%)	2 737 (48%)	2 847 (53%)	2 798 (53%)	3 851 (41%)	..
Mitral regurgitation (n=874)	57, 0.1% (0.1-0.2)	62, 0.4% (0.3-0.5)	93, 0.9% (0.7-1.1)	186, 2.8% (2.4-3.3)	476, 7.1% (6.5-7.8)	<0.0001
Mitral stenosis (n=33)	5, 0.01% (0-0.02)	3, 0.02% (0-0.05)	3, 0.03% (0.01-0.1)	8, 0.1% (0.05-0.2)	14, 0.2% (0.1-0.4)	<0.0001
Aortic regurgitation (n=282)	55, 0.1% (0.08-0.1)	38, 0.2% (0.2-0.3)	33, 0.3% (0.2-0.5)	41, 0.6% (0.4-0.8)	115, 1.7% (1.4-2.1)	<0.0001
Aortic stenosis (n=547)	51, 0.1% (0.08-0.1)	35, 0.2% (0.2-0.3)	57, 0.6% (0.4-0.7)	96, 1.4% (1.2-1.8)	308, 4.6% (4.1-5.2)	<0.0001

MR in the US Adult Population



Burden of AS

Will AS prevalence
increase because of **aging**
of the population ?

Or

Will AS prevalence
decrease because of
decline of atherosclerosis?

Valvular Heart Disease

Temporal Trends in the Incidence and Prevalence of Aortic Stenosis

A Nationwide Study

Andreas M...

AS in the population

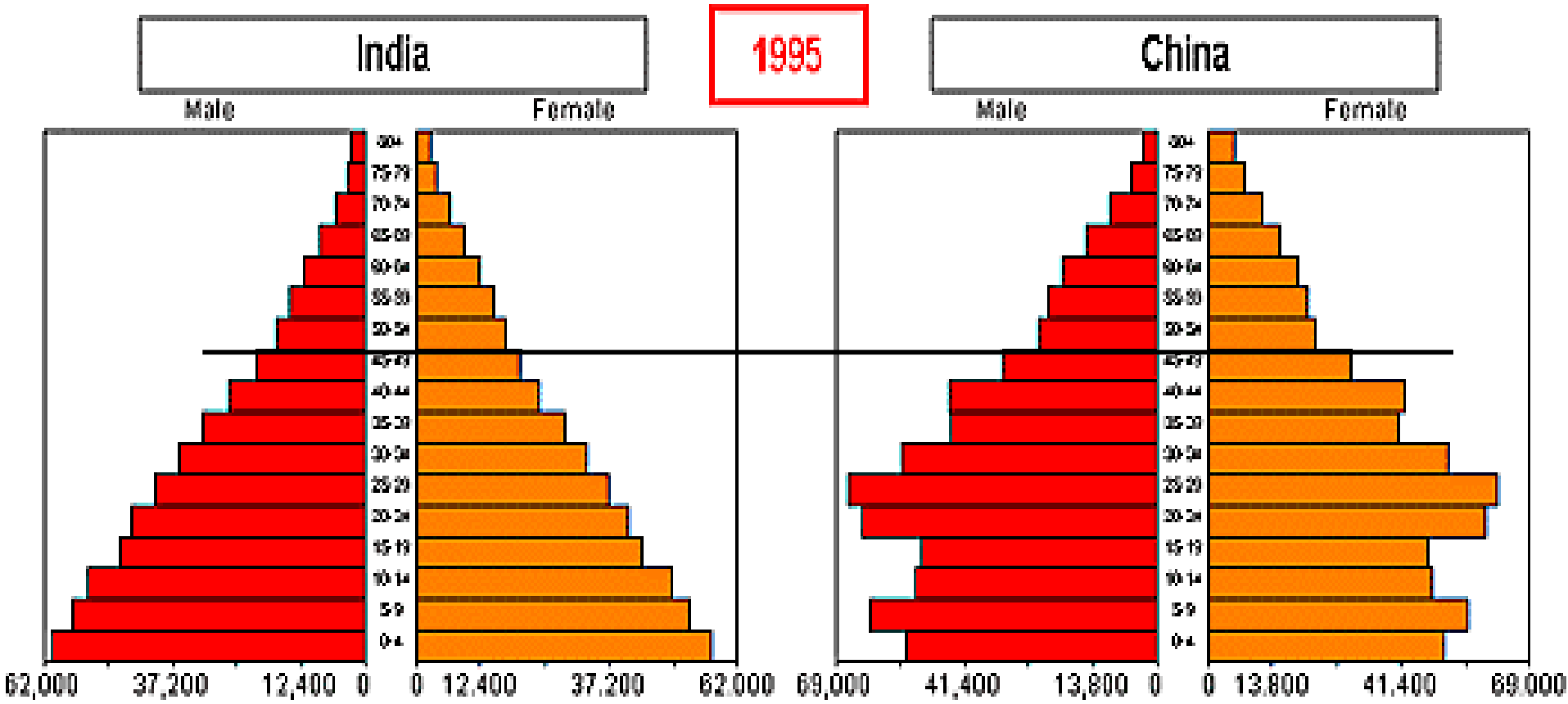
Without imaging it is doubtful that we can affirm whether AS incidence is changing

Men	76	77	78	78	79	79	54.7
Women	76	77	78	78	79	79	45.3
Crude AS incidence rate							
Men	23.5 (22.5–24.4)	26.3 (25.4–27.3)	22.3 (21.5–23.2)	20.0 (19.2–20.8)	19.1 (18.4–19.9)	20.2 (19.5–21.0)	22.1 (21.1–23.7)
Women	20.1 (18–21.5)	23.4 (22.5–24.2)	19.5 (18.7–20.2)	19.5 (18.7–20.3)	17.2 (16.5–17.9)	16.8 (16.2–17.5)	19.0 (18–19.4)
Age-adjusted AS incidence rate							
Men	15.0 (14.4–15.6)	15.7 (15.2–16.3)	12.6 (12.1–13.1)	10.7 (10.3–11.1)	9.9 (9.5–10.3)	10.3 (9.9–10.7)	11.4 (11.0–11.8)
Women	9.8 (9.4–10.2)	10.5 (10.1–10.9)	8.1 (7.7–8.4)	7.5 (7.2–7.8)	6.6 (6.3–6.9)	6.4 (6.2–6.7)	7.1 (6.8–7.4)

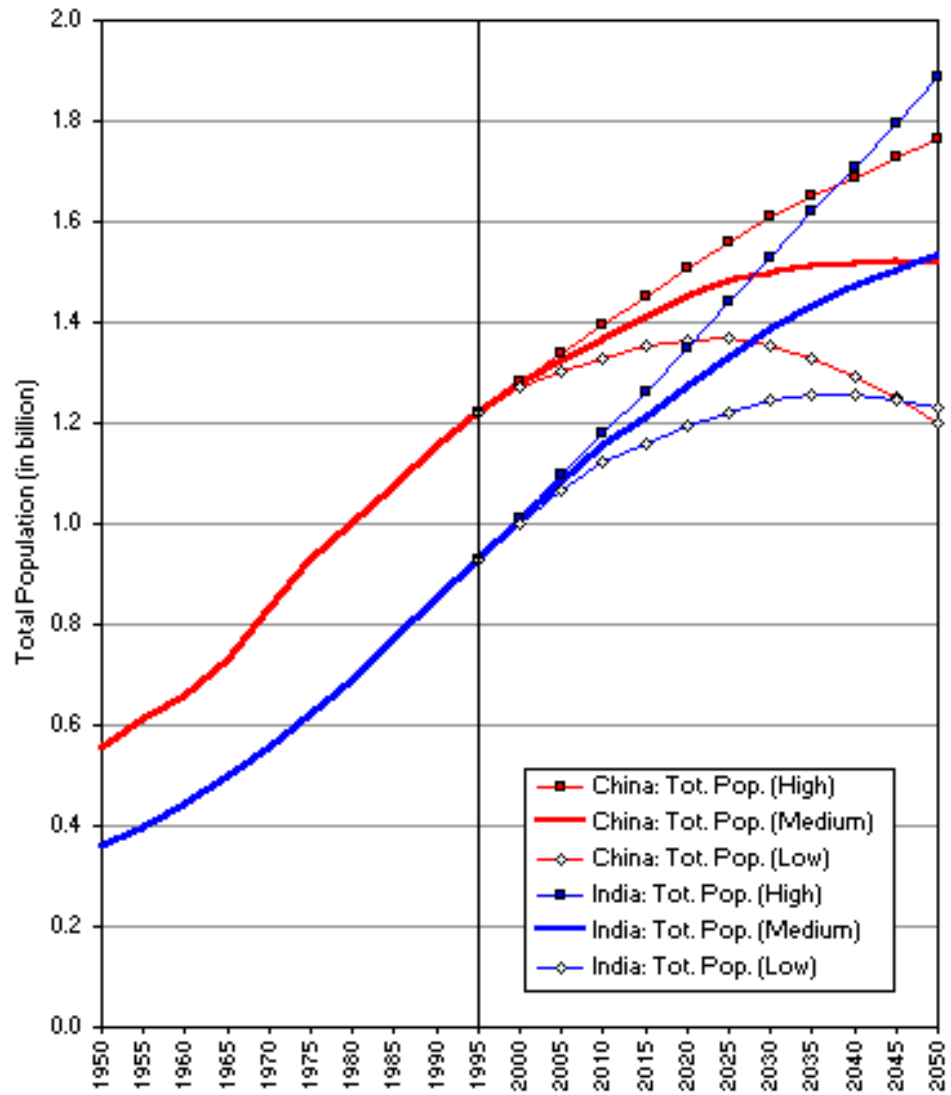
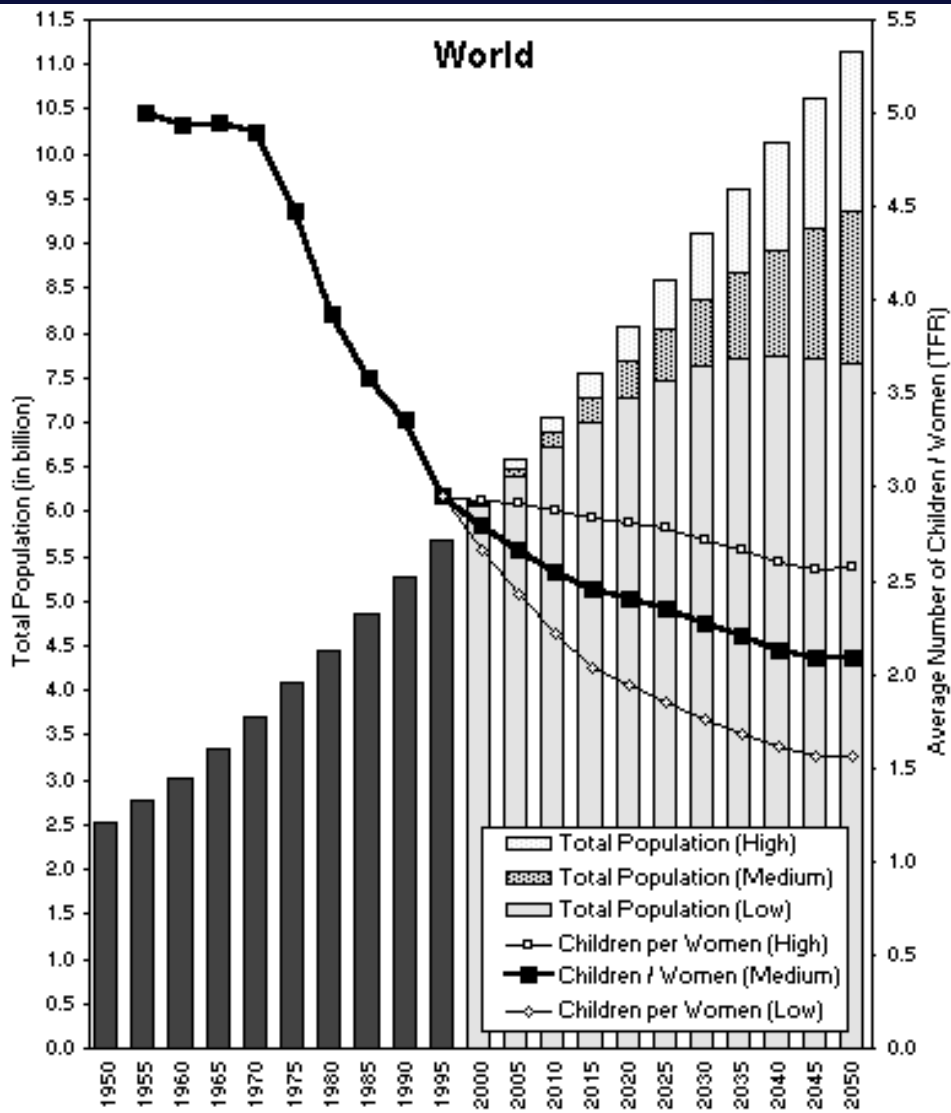
Valvular Diseases in the 21st Century

Will increased VHD in the developed world be compensated by declines in the developing world due to RHF prevention ?

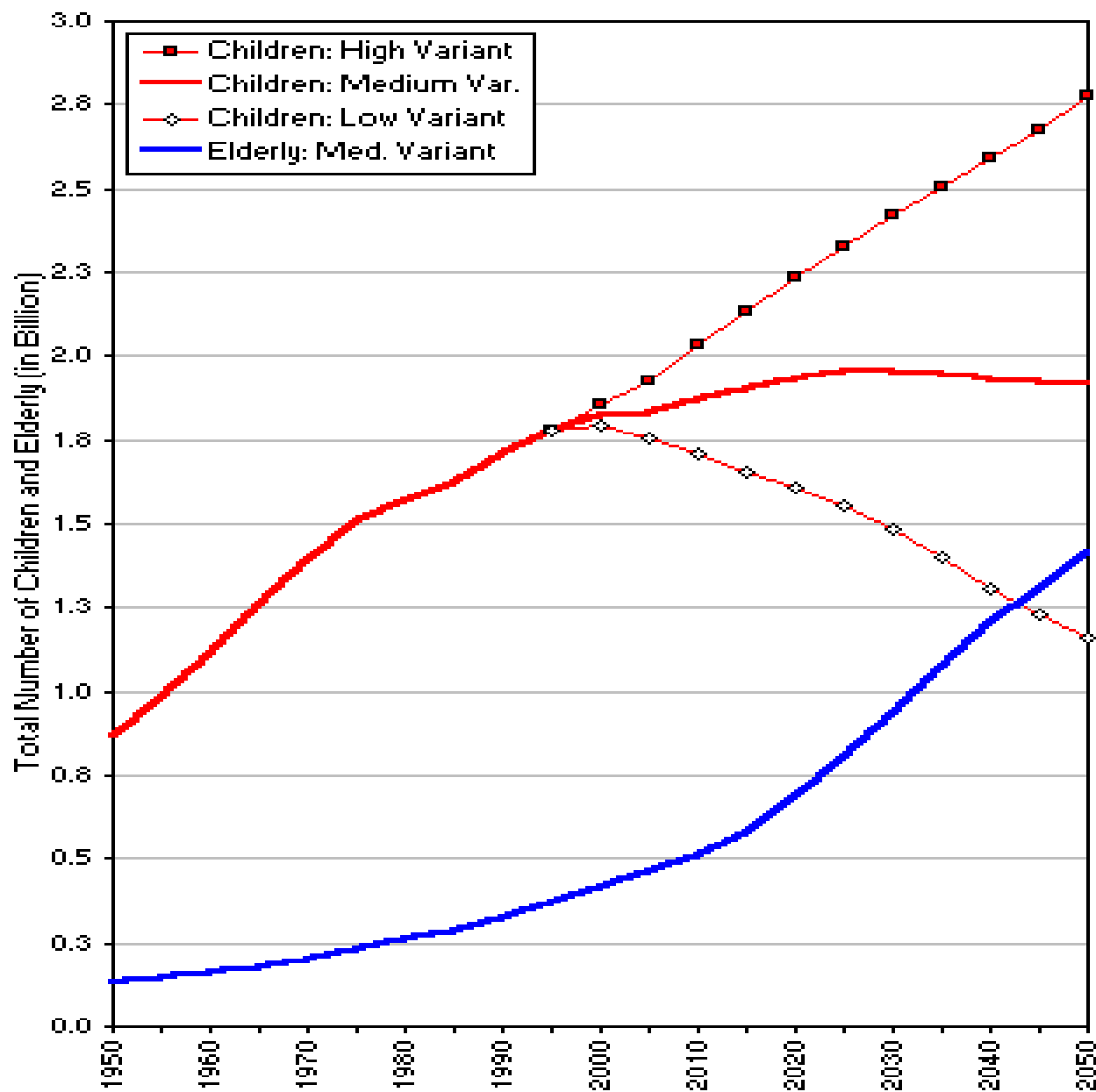
Age distribution in Asia



World Population growth



World Population Change



VHD Burden

**In 2030, worldwide
the burden of
hemodynamic VHD
is estimated to
become 200 to 250M**

World VHD Burden

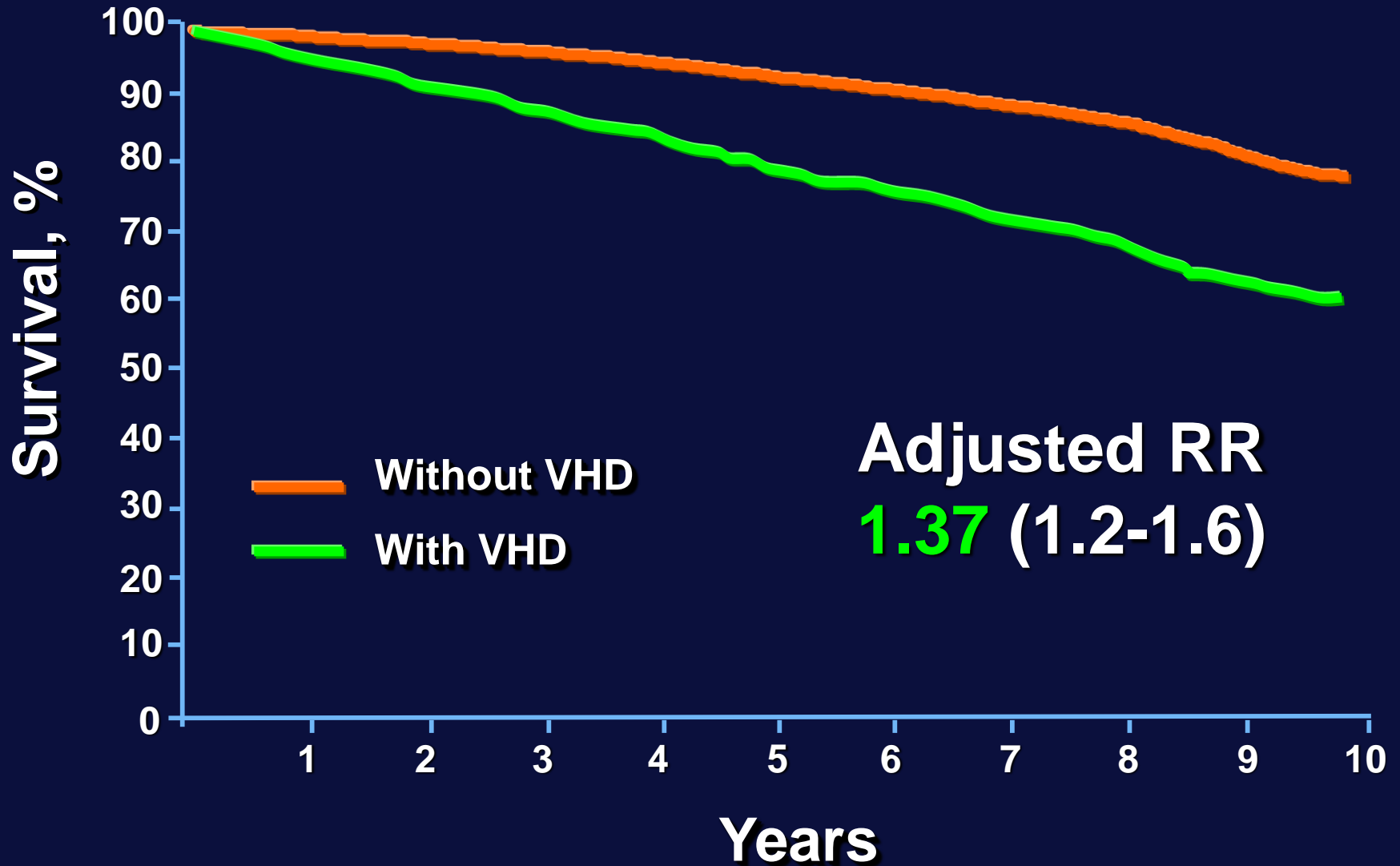
- With population increase and aging in the **developed world**, **VHD burden is expected to double in 2030**
- With population aging in the **developing world**, **VHD burden is expected to persist** despite efforts to reduce Rheumatic disease

Valvular Diseases are Frequent

**Does that represent
a clinically
significant
observation ?**

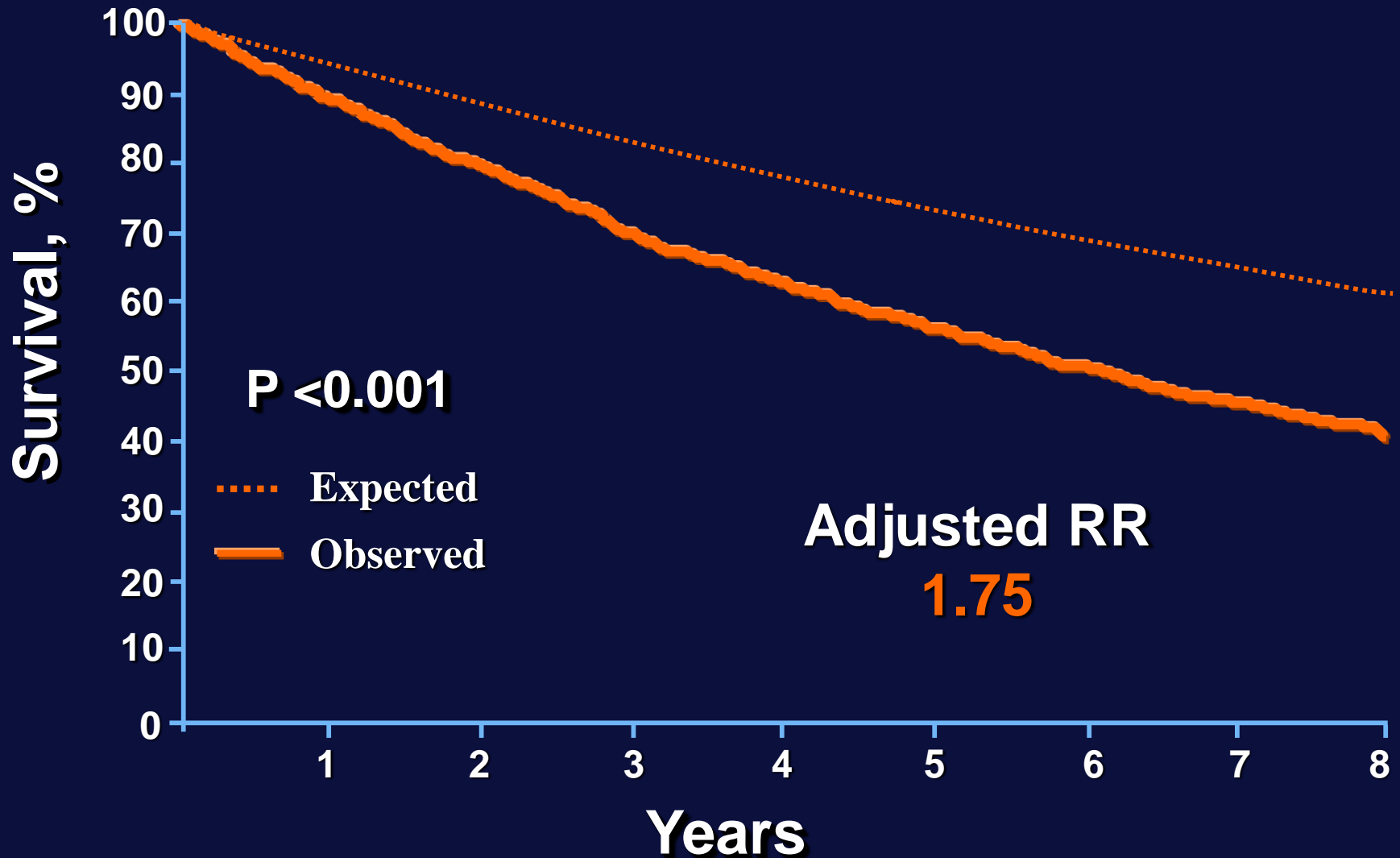
Survival with Valvular Heart Disease

NIH Cohort



Survival with Valvular Heart Disease

Olmsted County



Valvular Diseases in the 21st Century

**What do we learn
about VHD by
community
studies ?**

AS in the community

All cases diagnosed in Olmsted County

Aortic valve disease and its outcome

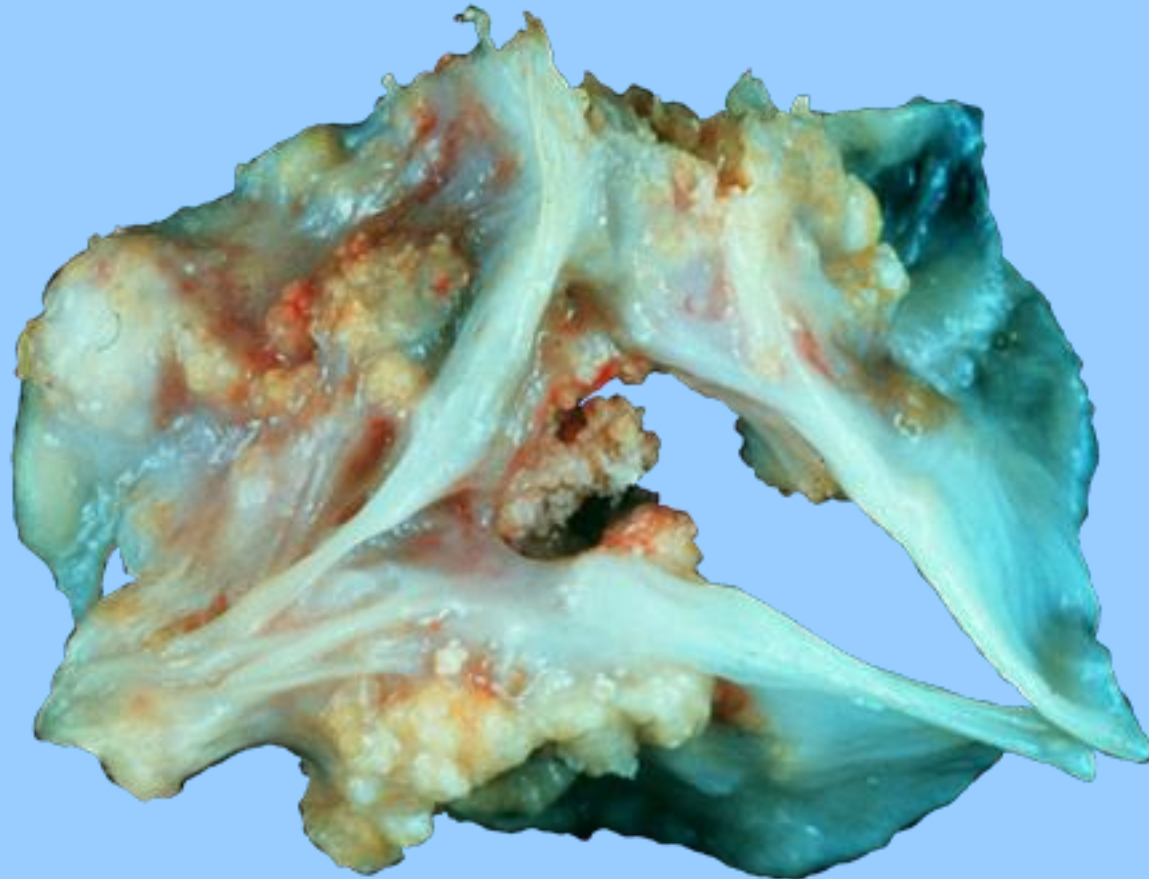
Joseph Malouf
Christopher S

Objective:
after diagnosis

Methods:
1988 to 1995
tation at
criteria for

Results:
AS severity
had low
dependence
and heart
or an ejection
area of less
95% CI,
aortic valve
failure (r

Conclusion:
high frequency
benefit. In
comes, in
those who
ovase Su



Determinants of

and, MD,^b

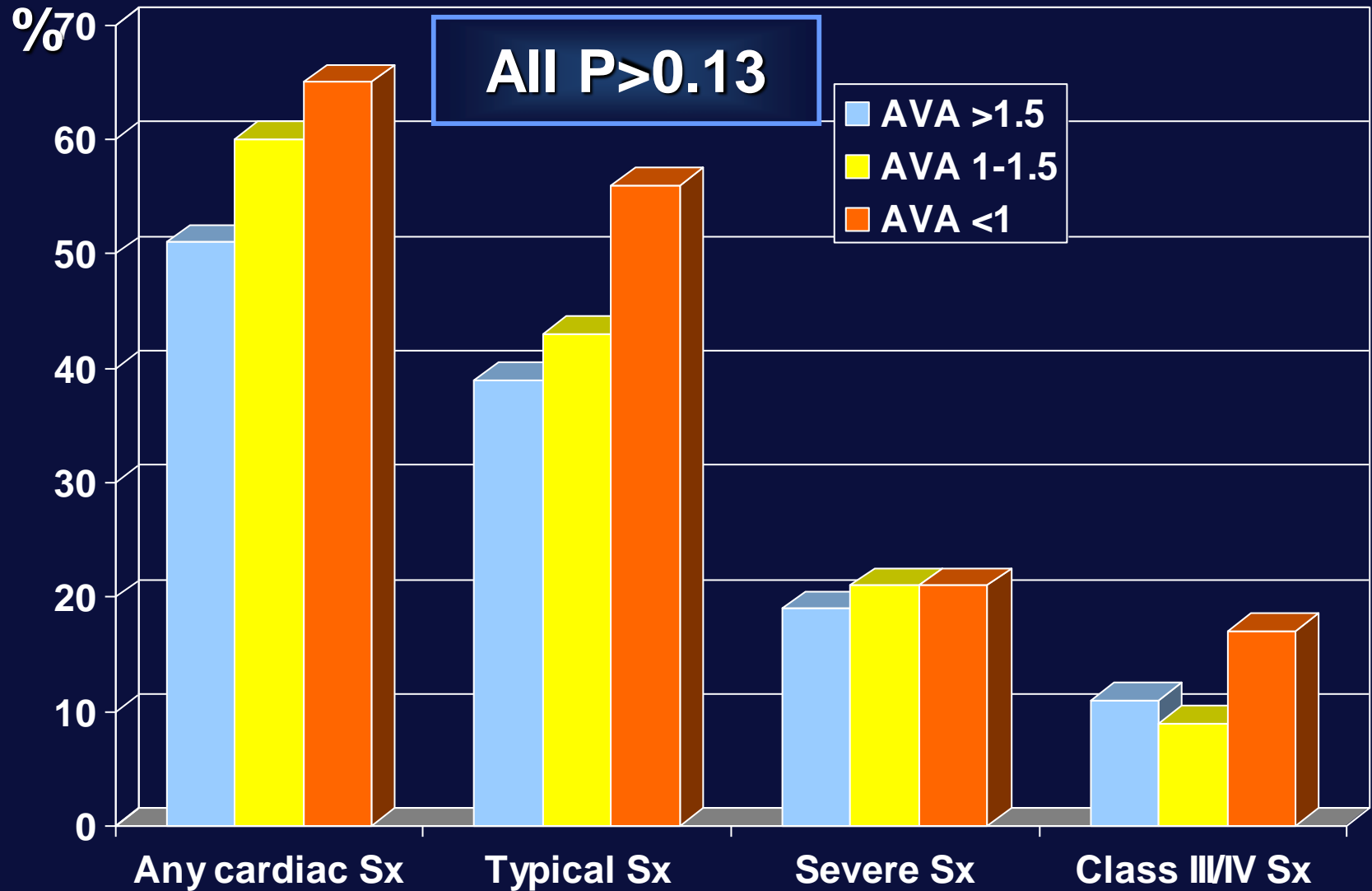
linked to survival

AS diagnosed from
controlled. The presence
of guideline-based

associated with the
than 1.0 cm², 67%
objective measure in-
1.19–2.70; $P < .01$)
low-gradient AS and/
with an aortic valve
ms (risk ratio, 1.65;
% of those with an
 $P = .02$) and heart

enging owing to the
symptoms are fre-
quently its considerable
or unfavorable out-
evaluation to detect
n. (J Thorac Cardi-

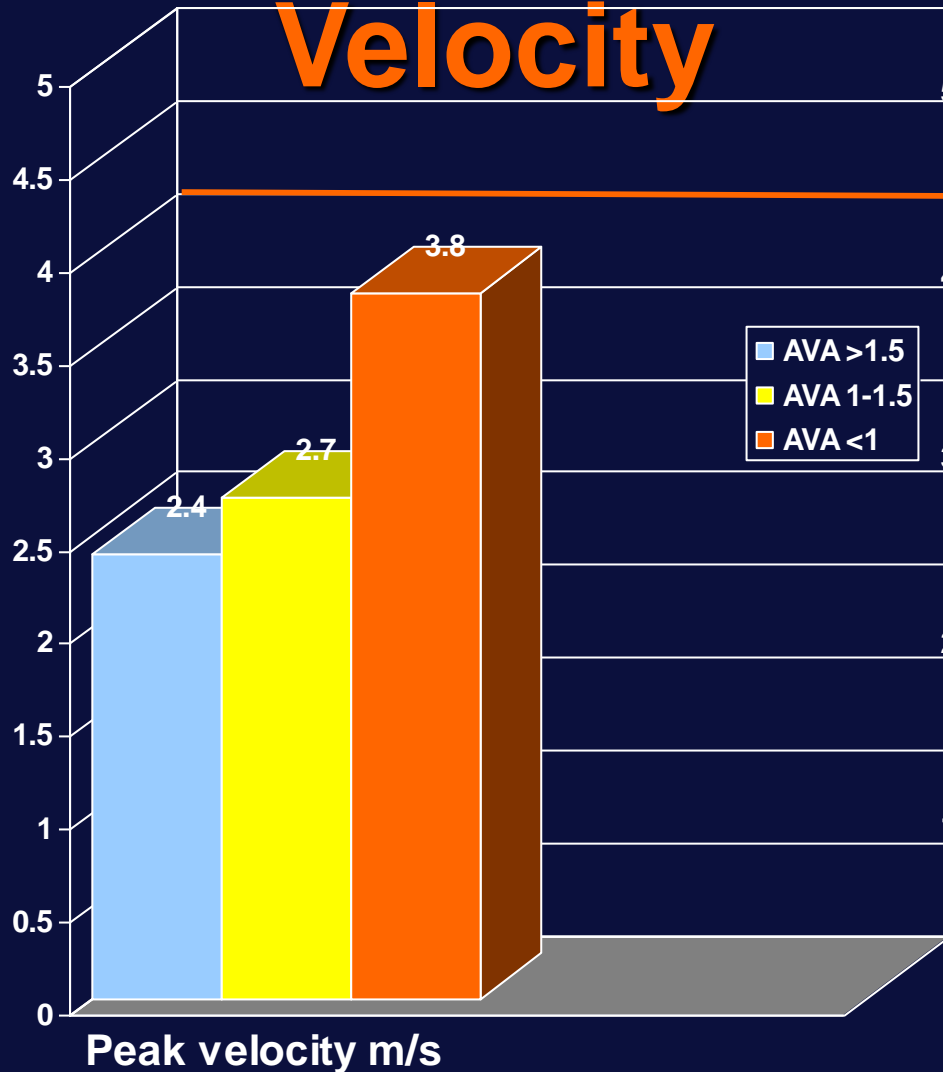
AS in the community



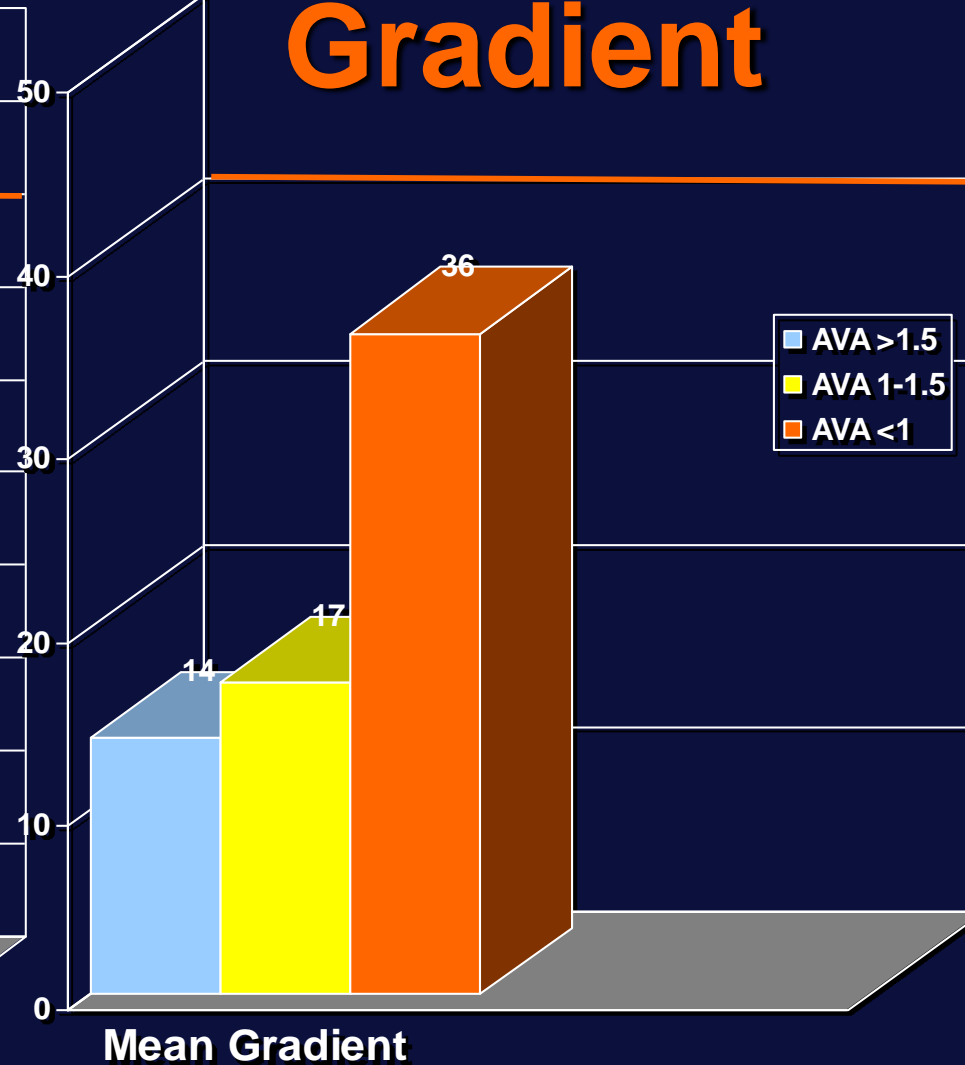
AS in the community

Challenging Presentation

Velocity

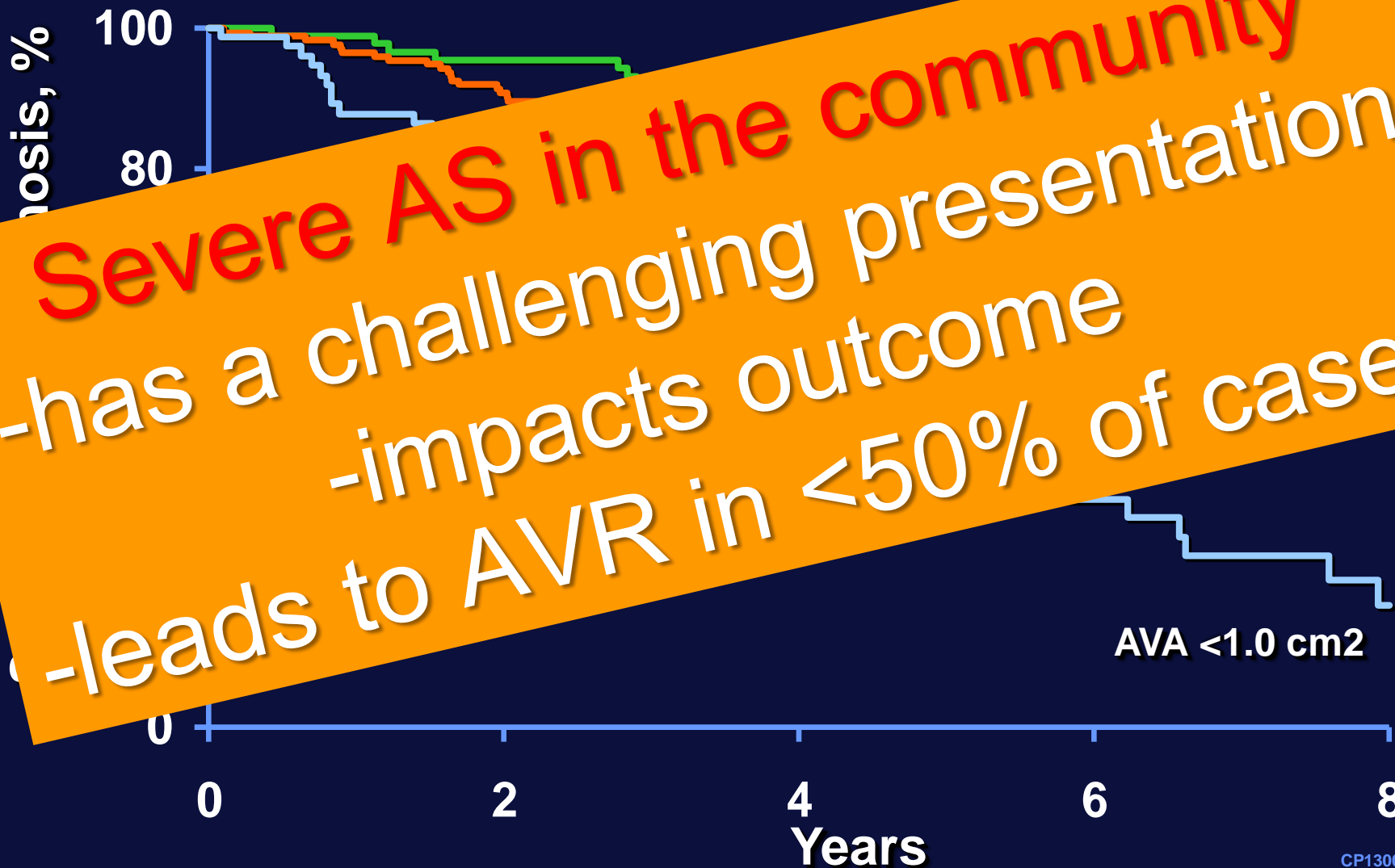


Gradient



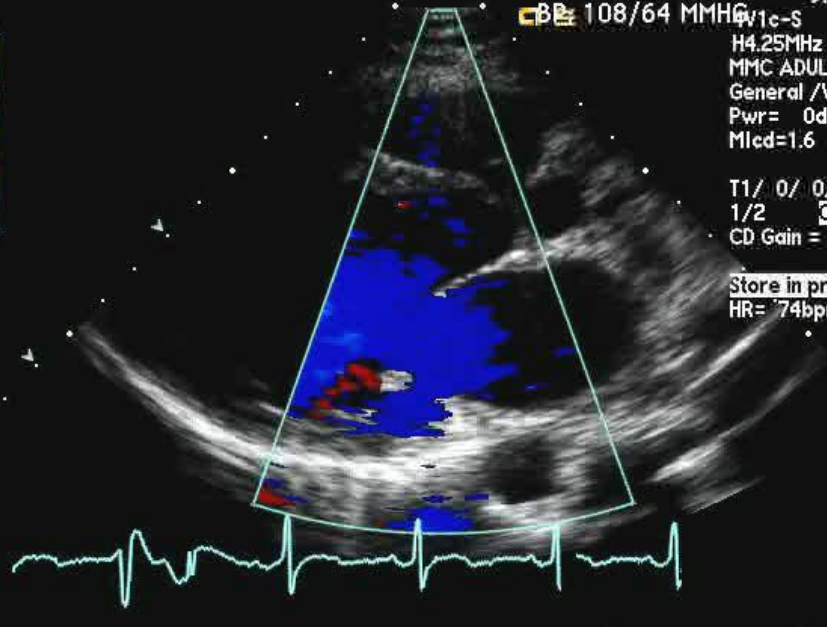
Survival after the diagnosis of AS

AVA < 1.0 cm² best predicts survival





11:06:03 am
 3V2c 17Hz
 H3.5MHz 368mm
 MMC ADULT
 General
 Pwr= 0dB
 Mlcd=1.8 TIS=1.9
 T1/ 0/ 0/VV:1
 1/2 CD:2.0MHz
 CD Gain = 46
 S-82 S38
 0:15:12
 HR= 57bpm

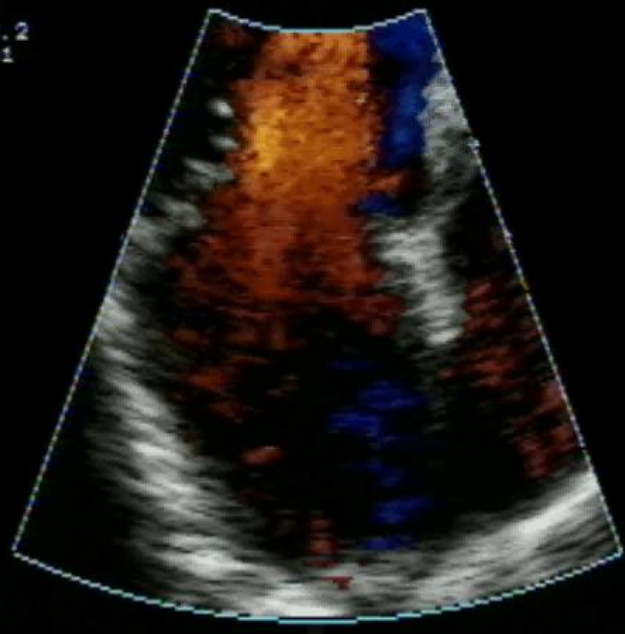


9:15:39 am
 BP: 108/64 MMHG
 W1c-S 20Hz
 H4.25MHz 120mm
 MMC ADULT
 General /V
 Pwr= 0dB
 Mlcd=1.6 TIS=2.3
 T1/ 0/ 0/VV:1
 1/2 CD:2.0MHz
 CD Gain = 53
 Store in progress
 HR= 74bpm

TIS: 1.2
 03
 28 AUG 01



TIS: 1.1
 03 1.6/3.2
 01 NOV 01



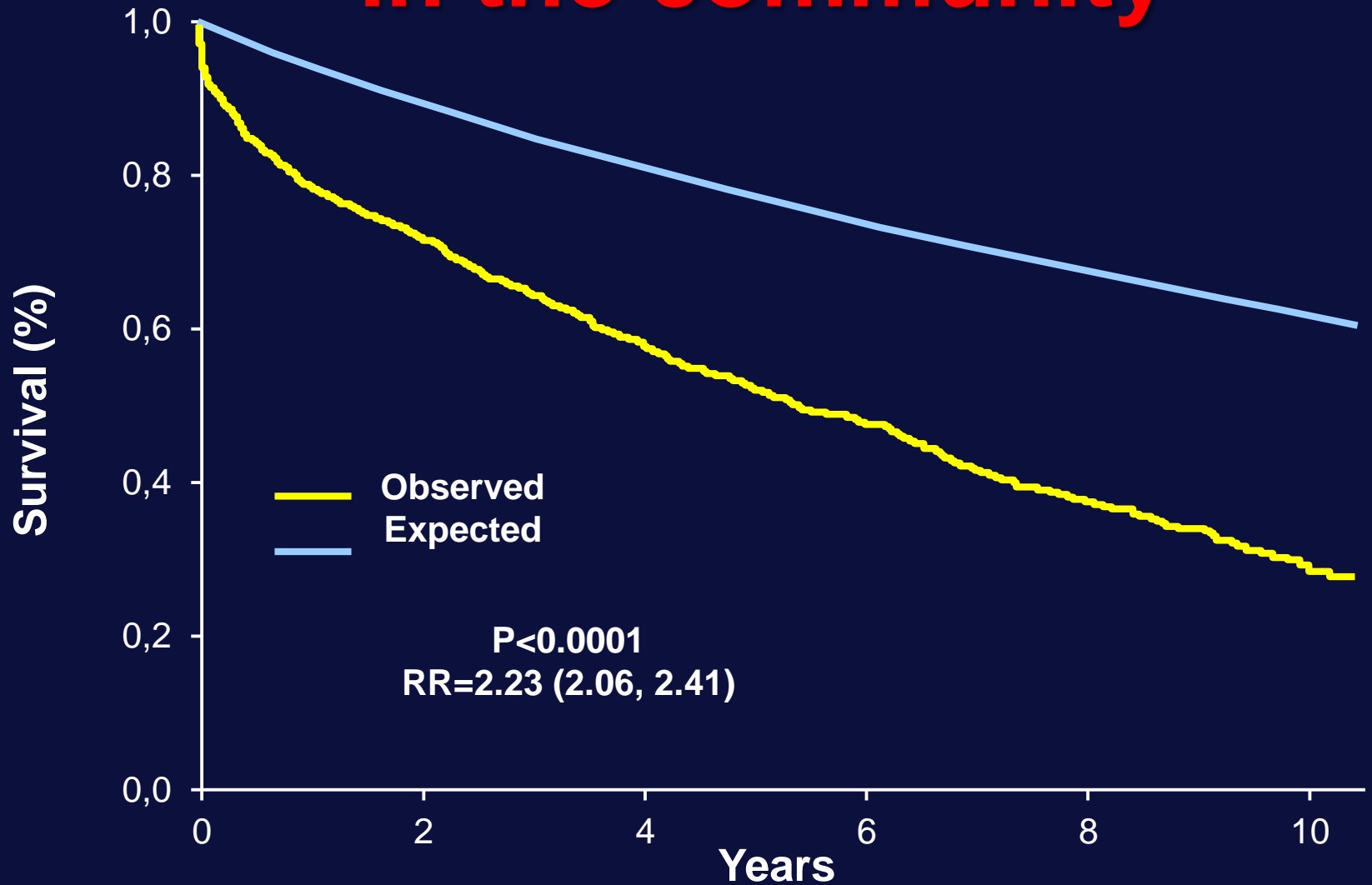
CD Pan
 CD Pos/Size

Isolated MR

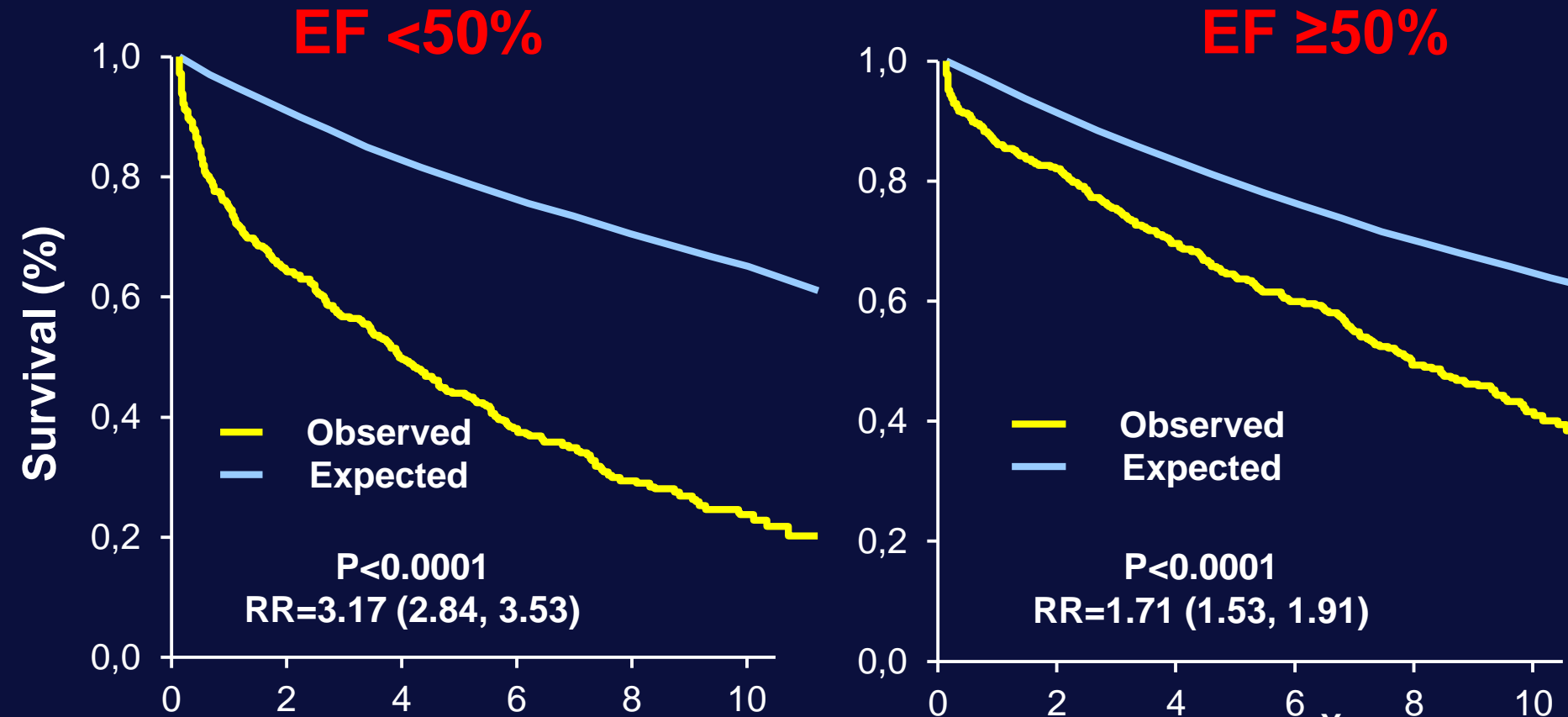
Among 29,000 county residents examined by Echo 2000-2010, 1294 had isolated MR

	overall	EF<50	EF>=50	p-value
N	1294	538	756	-
(%)	(100%)	(42%)	(58%)	
clinical characteristics				
Age, years	73±17	74±15	72±19	0.045
Sex, males, %	47	58	40	<0.0001

Survival of Isolated MR in the community



Outcome of Isolated MR in the community



Mitral surgery

	overall	EF <50%	EF $\geq 50\%$
Any Mitral Treatment	198 (15%)	28 (5%)	170 (22%)
Repair, n (%)	149 (75%)	18 (64%)	131 (66%)
Replacement, n (%)	49 (25%)	10 (36%)	39 (20%)

Burden of Left-sided VHD

**Analyzed in the community,
the burden of mitral and aortic
VHD is:**

- **Enormous**
- **Highly impactful for outcome**
 - **Seriously undertreated**

Effect of Availability of Transcatheter Aortic-Valve Replacement on Clinical Practice

Jochen Reinöhl, M.D., Klaus Kaier, Ph.D., Holger Reinecke, M.D.,
Claudia Schmoor, Ph.D., Lutz Frankenstein, M.D., Werner Vach, Ph.D.,
Alain Cribier, M.D., Friedhelm Beyersdorf, M.D., Christoph Bode, M.D.,
and Manfred Zehender, M.D., Ph.D.

A Patients ≥ 85 Yr of Age



B Patients



Percutaneous treatment of VHD partially alleviates the VHD undertreatment. More needs to be done.

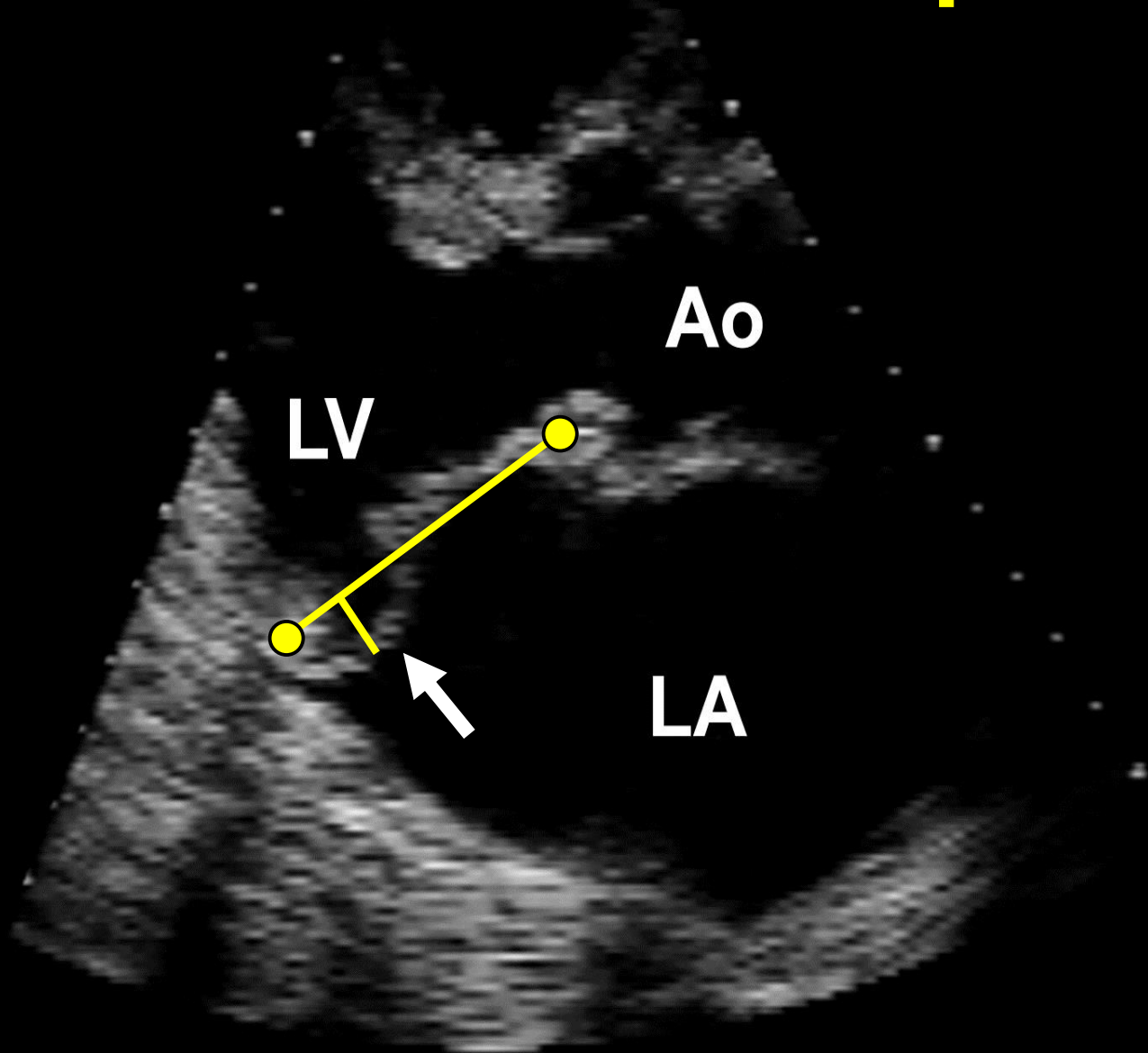
VHD Prevalence

In the US population

~2.5% with hemodynamic VHD

~2.5% with MVP

Mitral Valve Prolapse



MVP in the community

All cases diagnosed in Olmsted County

Natural History of Asymptomatic Mitral Valve Prolapse in the Community

Jean-François Avierinos, MD; Bernard J. Gersh, MB, ChB, DPhil; L. Joseph Melton III, MD;
Kent R. Bailey, PhD; Clarence Shub, MD; Rick A. Nishimura, MD;
A. Jamil Tajik, MD; Maurice Enriquez-Sarano, MD

Background—The outcome of mitral valve prolapse (MVP) is controversial, with marked discrepancies in reported complication rates.

Methods and Results—We conducted a community study of all Olmsted County, Minn, residents first diagnosed with asymptomatic MVP between 1989 and 1998 (N=833). Diagnosis, motivated by auscultatory findings (n=557) or incidental (n=276), was always confirmed by echocardiography with the use of current criteria. End points analyzed during 4581 person-years of follow-up were mortality (n=96, 19±2% at 10 years), cardiovascular morbidity (n=171), and MVP-related events (n=109, 20±2% at 10 years). The most frequent primary risk factors for cardiovascular mortality were mitral regurgitation from moderate to severe (P=0.002, n=131) and, less frequently, ejection fraction <50% (P=0.003, n=31). Secondary risk factors independently predictive of cardiovascular morbidity were slight mitral regurgitation, left atrium ≥40 mm, flail leaflet, atrial fibrillation, and age ≥50 years (all P<0.01). Patients with only 0 or 1 secondary risk factor (n=430) had excellent outcome, with 10-year mortality of 5±2% (P=0.17 versus expected), cardiovascular morbidity of 0.5%/y, and MVP-related events of 0.2%/y. Patients with ≥2 secondary risk factors (n=250) had mortality similar to expected (P=0.20) but high cardiovascular morbidity (6.2%/y, P<0.01) and notable MVP-related events (1.7%/y, P<0.01). Patients with primary risk factors (n=153) showed excess 10-year mortality (45±9%, P=0.01 versus expected), high morbidity (18.5%/y, P<0.01), and high MVP-related events (15%/y, P<0.01).

Conclusions—Natural history of asymptomatic MVP in the community is widely heterogeneous and may be severe. Clinical and echocardiographic characteristics allow separation of the majority of patients with excellent prognosis from subsets of patients displaying, during follow-up, high morbidity or even excess mortality as direct a consequence of MVP. (*Circulation*. 2002;106:1355-1361.)

Asymptomatic MVP

Risk Stratification

Primary Risk Factors (mort)

- $EF < 50\%$
- $MR \geq$
moderate

Secondary Risk Factors (morb)

- Age ≥ 50 years
- A Fib
- Slight MR
- Flail leaflet
- LA ≥ 40 mm

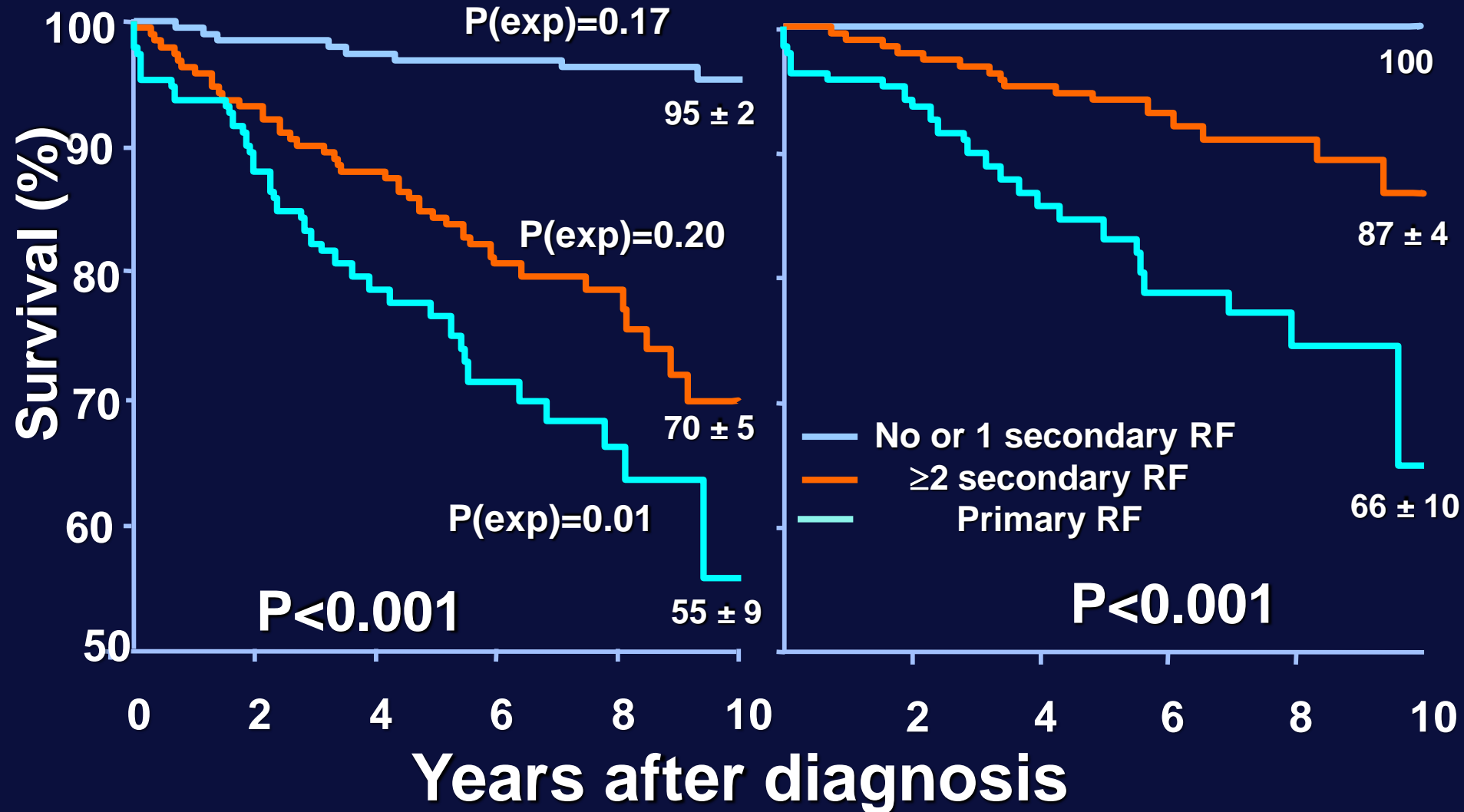
Outcome of MVP – Risk Stratification

3 groups	No.	%
No or 1 secondary RF	430	52
≥2 secondary RF	250	30
Primary RF	153	18
• MR ≥ moderate	131	
• EF <50%	31	

Outcome of Asymptomatic MVP

Overall Survival

Cardiac Survival



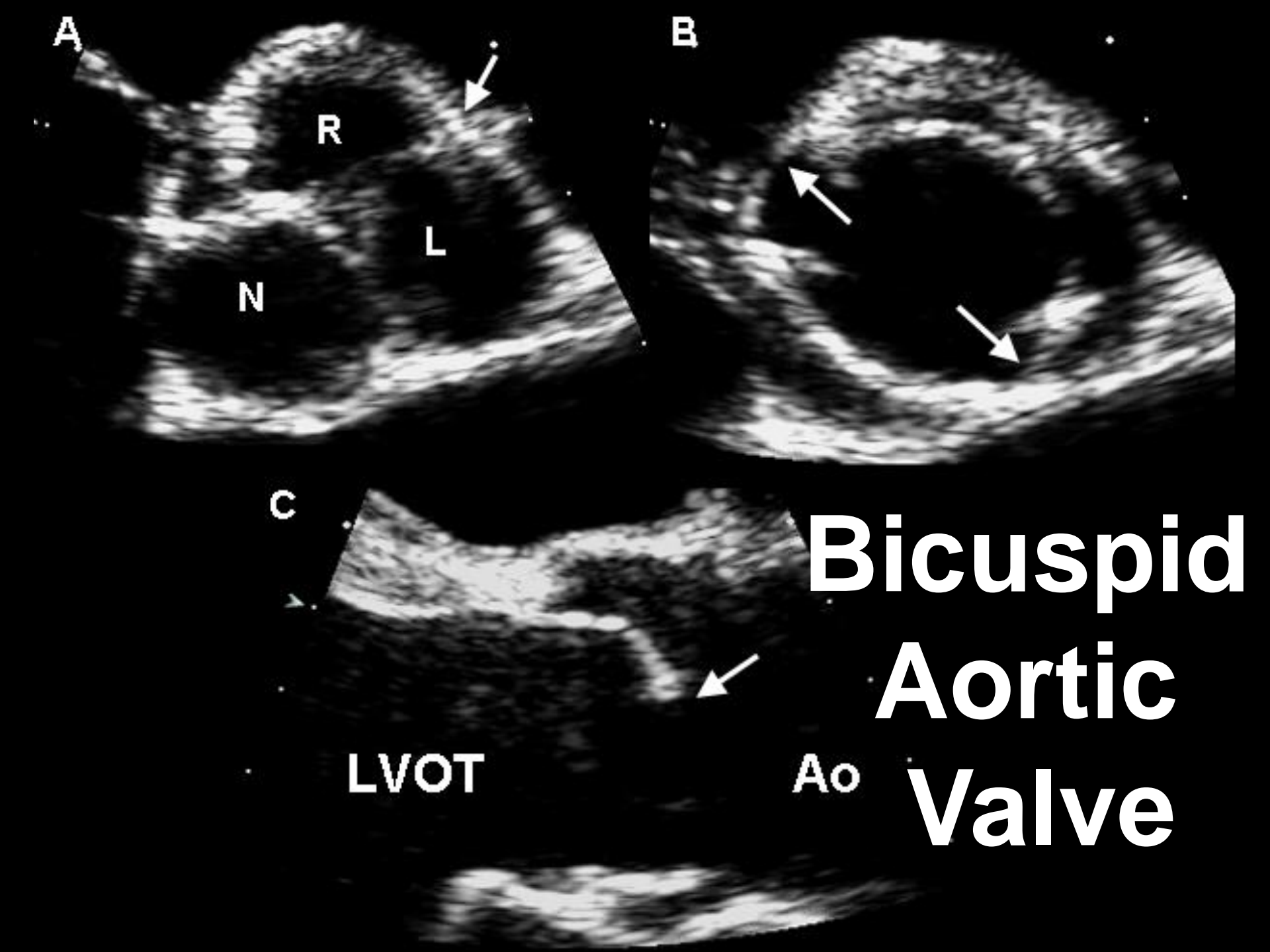
VHD Prevalence

In the US population

~2.5% with hemodynamic VHD

~2.5% with MVP

~1.4% with BAV



BAV in the community

All cases diagnosed in Olmsted County

Natural History of Asymptomatic Patients With Normally Functioning or Minimally Dysfunctional Bicuspid Aortic Valve in the Community

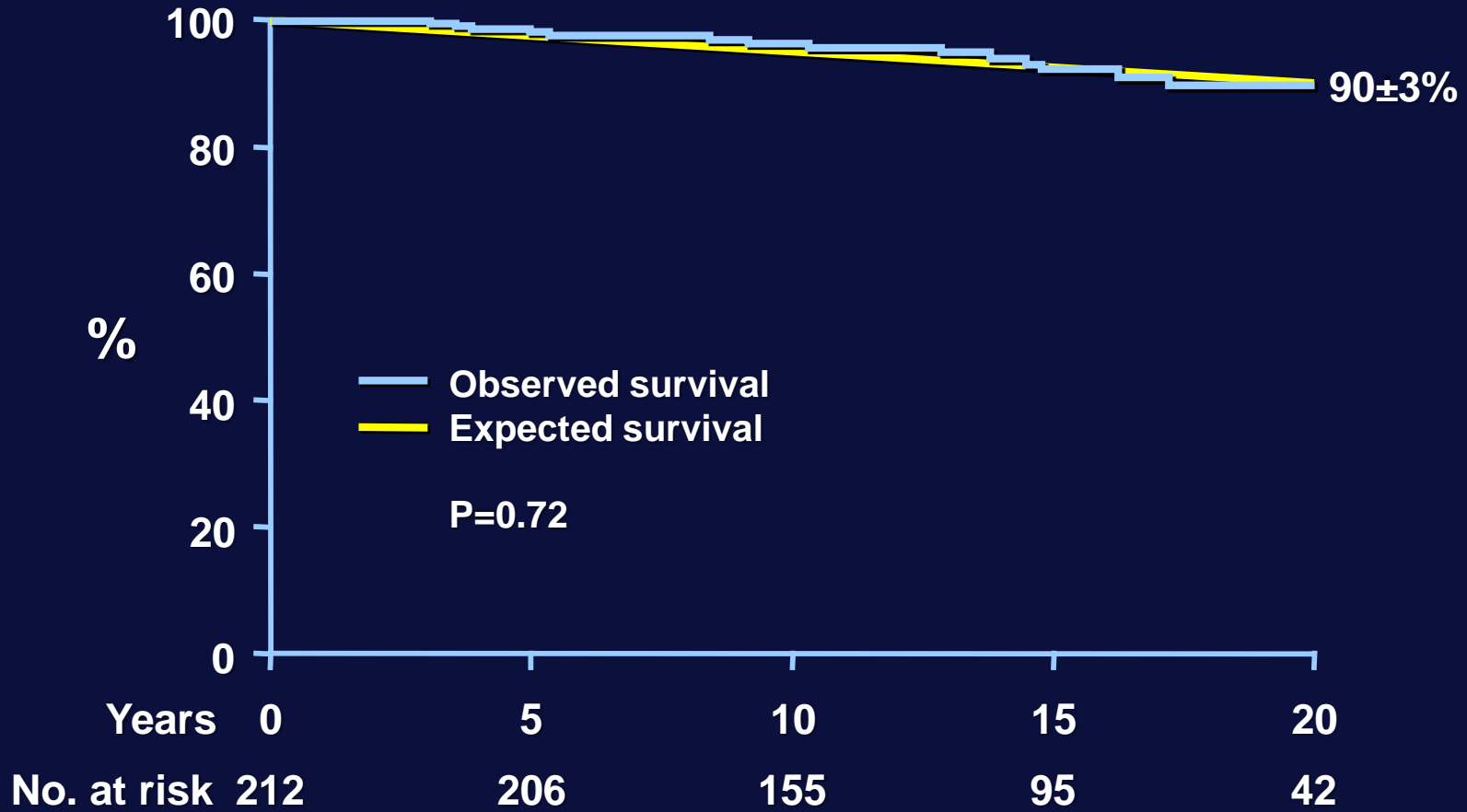
Hector I. Michelena, MD; Valerie A. Desjardins, MD; Jean-François Avierinos, MD; Antonio Russo, MD; Vuyisile T. Nkomo, MD; Thoralf M. Sundt, MD; Patricia A. Pellikka, MD; A. Jamil Tajik, MD; Maurice Enriquez-Sarano, MD

Background—Bicuspid aortic valve is frequent and is reported to cause numerous complications, but the clinical outcome of patients diagnosed with normal or mildly dysfunctional valve is undefined.

Methods and Results—In 212 asymptomatic community residents from Olmsted County, Minn (age, 32 ± 20 years; 65% male), bicuspid aortic valve was diagnosed between 1980 and 1999 with ejection fraction $\geq 50\%$ and aortic regurgitation or stenosis, absent or mild. Aortic valve degeneration at diagnosis was scored echocardiographically for calcification, thickening, and mobility reduction (0 to 3 each), with scores ranging from 0 to 9. At diagnosis, ejection fraction was $63 \pm 5\%$ and left ventricular diameter was 48 ± 9 mm. Survival 20 years after diagnosis was $90 \pm 3\%$, identical to the general population ($P=0.72$). Twenty years after diagnosis, heart failure, new cardiac symptoms, and cardiovascular medical events occurred in $7 \pm 2\%$, $26 \pm 4\%$, and $33 \pm 5\%$, respectively. Twenty years after diagnosis, aortic valve surgery, ascending aortic surgery, or any cardiovascular surgery was required in $24 \pm 4\%$, $5 \pm 2\%$, and $27 \pm 4\%$ at a younger age than the general population ($P<0.0001$). No aortic dissection occurred. Thus, cardiovascular medical or surgical events occurred in $42 \pm 5\%$ 20 years after diagnosis. Independent predictors of cardiovascular events were age ≥ 50 years (risk ratio, 3.0; 95% confidence interval, 1.5 to 5.7; $P<0.01$) and valve degeneration at diagnosis (risk ratio, 2.4; 95% confidence interval, 1.2 to 4.5; $P=0.016$; $>70\%$ events at 20 years). Baseline ascending aorta ≥ 40 mm independently predicted surgery for aorta dilatation (risk ratio, 10.8; 95% confidence interval, 1.8 to 77.3; $P<0.01$).

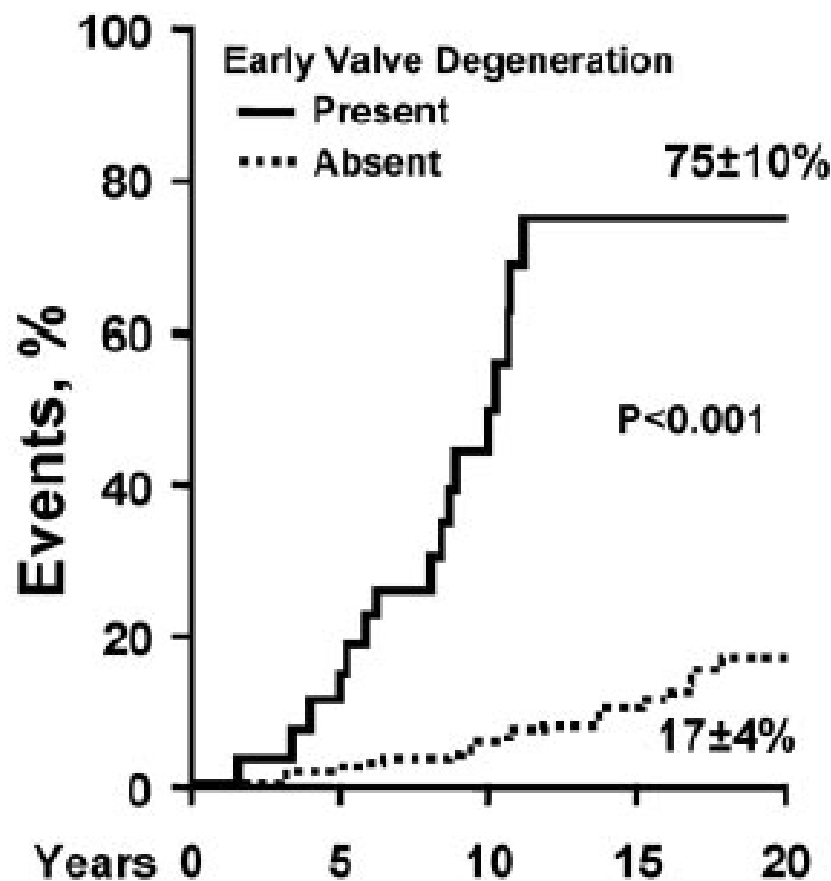
Conclusions—In the community, asymptomatic patients with bicuspid aortic valve and no or minimal hemodynamic abnormality enjoy excellent long-term survival but incur frequent cardiovascular events, particularly with progressive valve dysfunction. Echocardiographic valve degeneration at diagnosis separates higher-risk patients who require regular assessment from lower-risk patients who require only episodic follow-up. (*Circulation*. 2008;117:2776-2784.)

Bicuspid Aortic Valve Survival



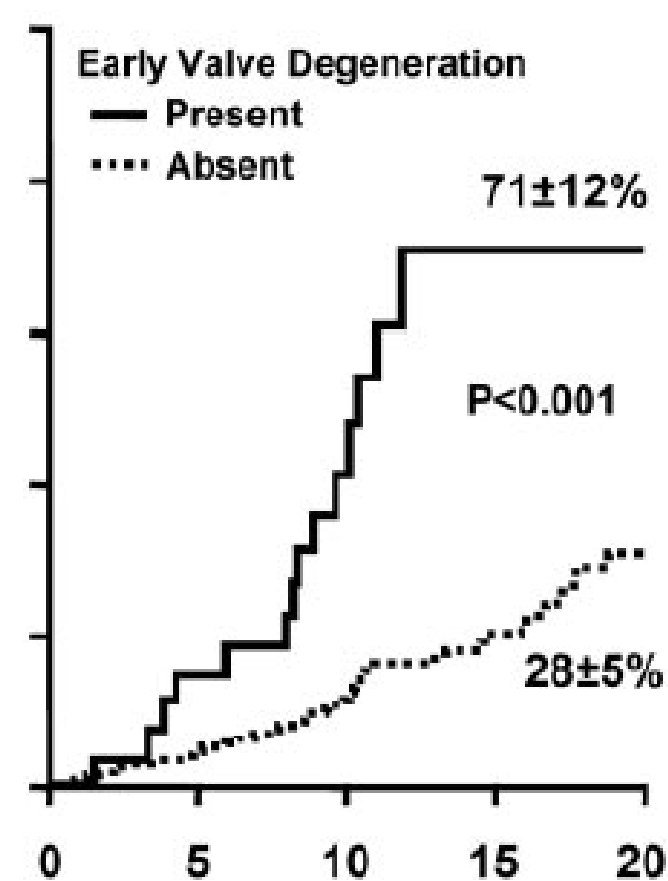


A Aortic Valve Surgery

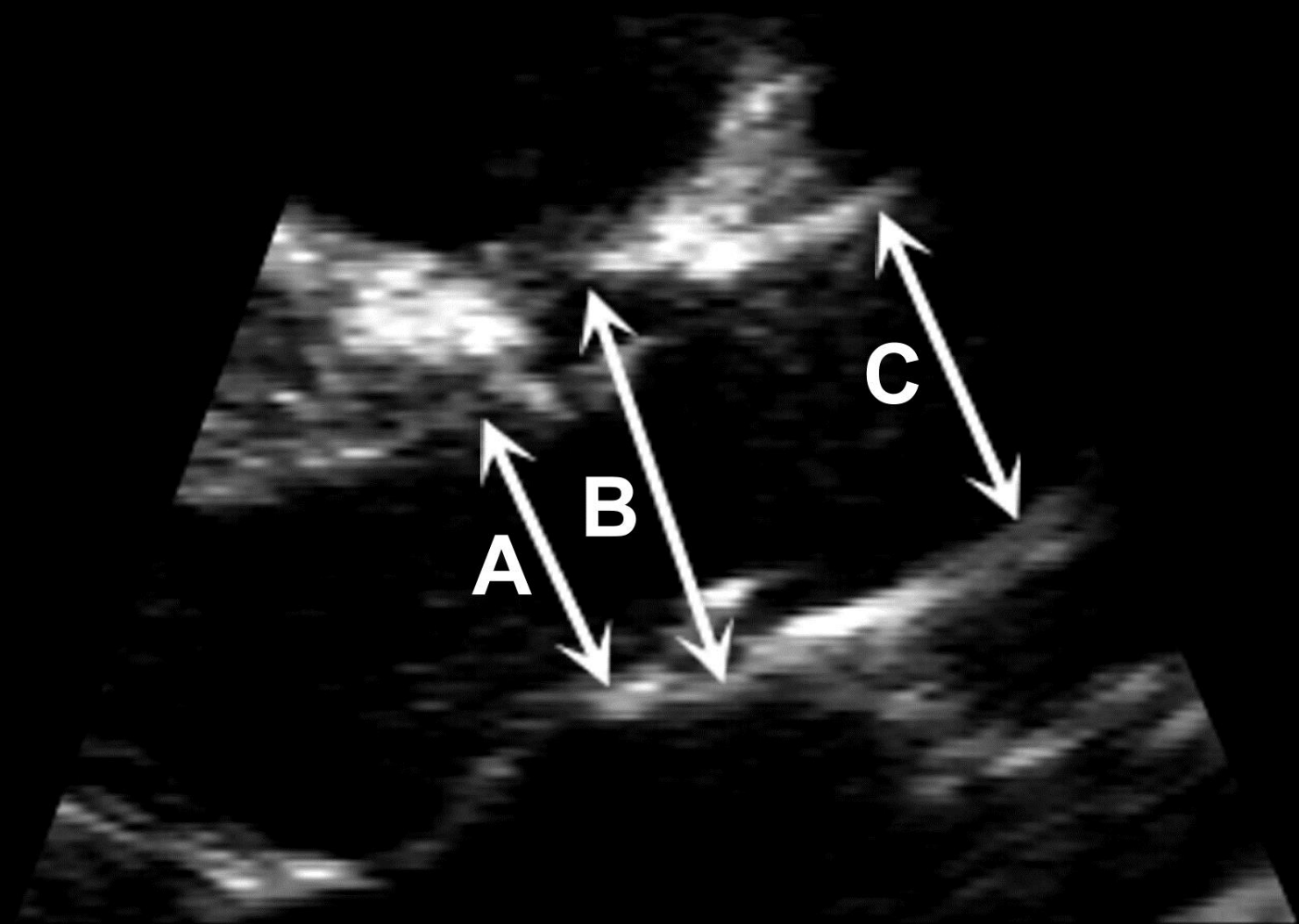


No.	—	28	23	9	2	2
at risk	- -	184	176	130	79	31

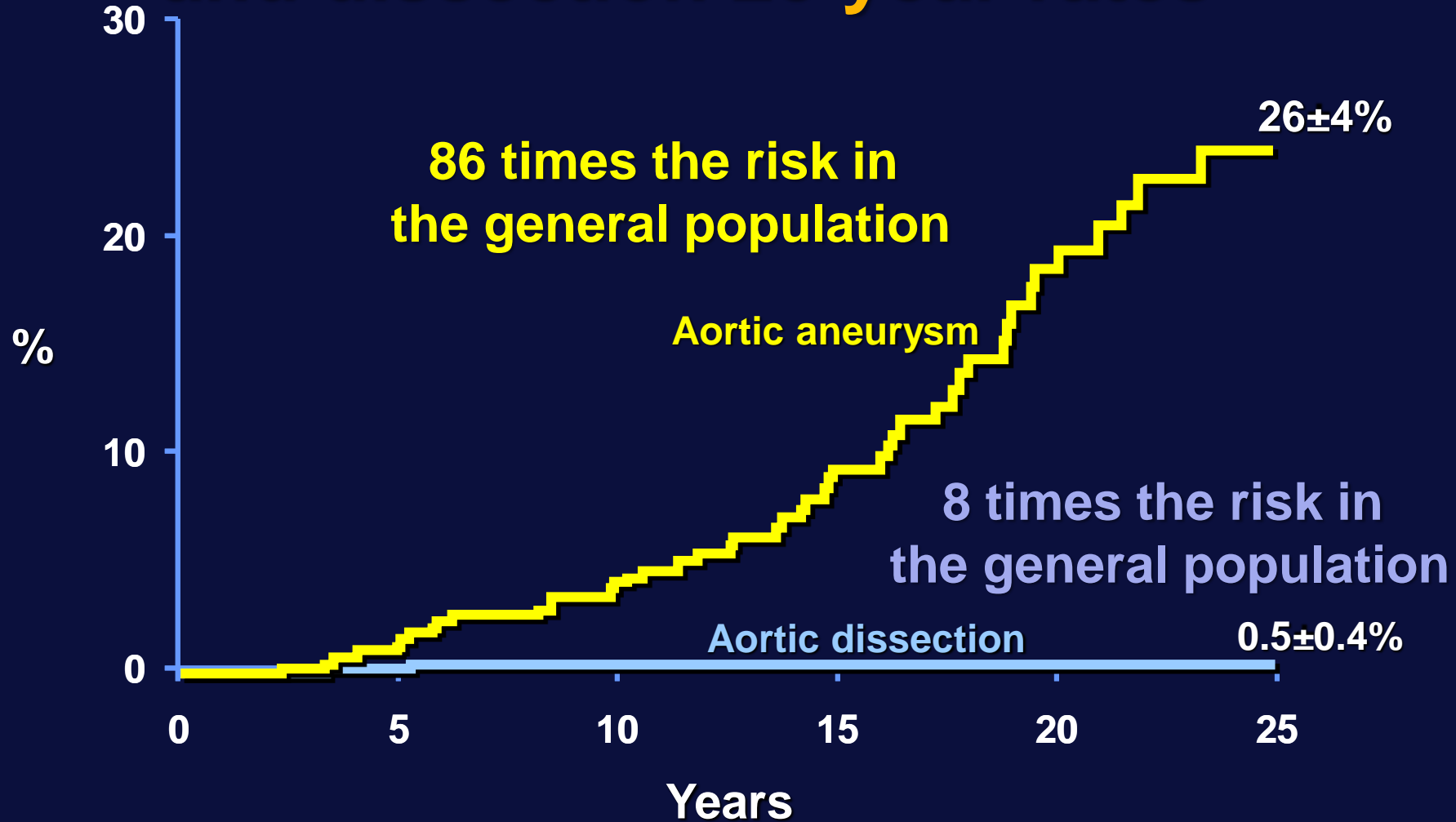
B Medical Events

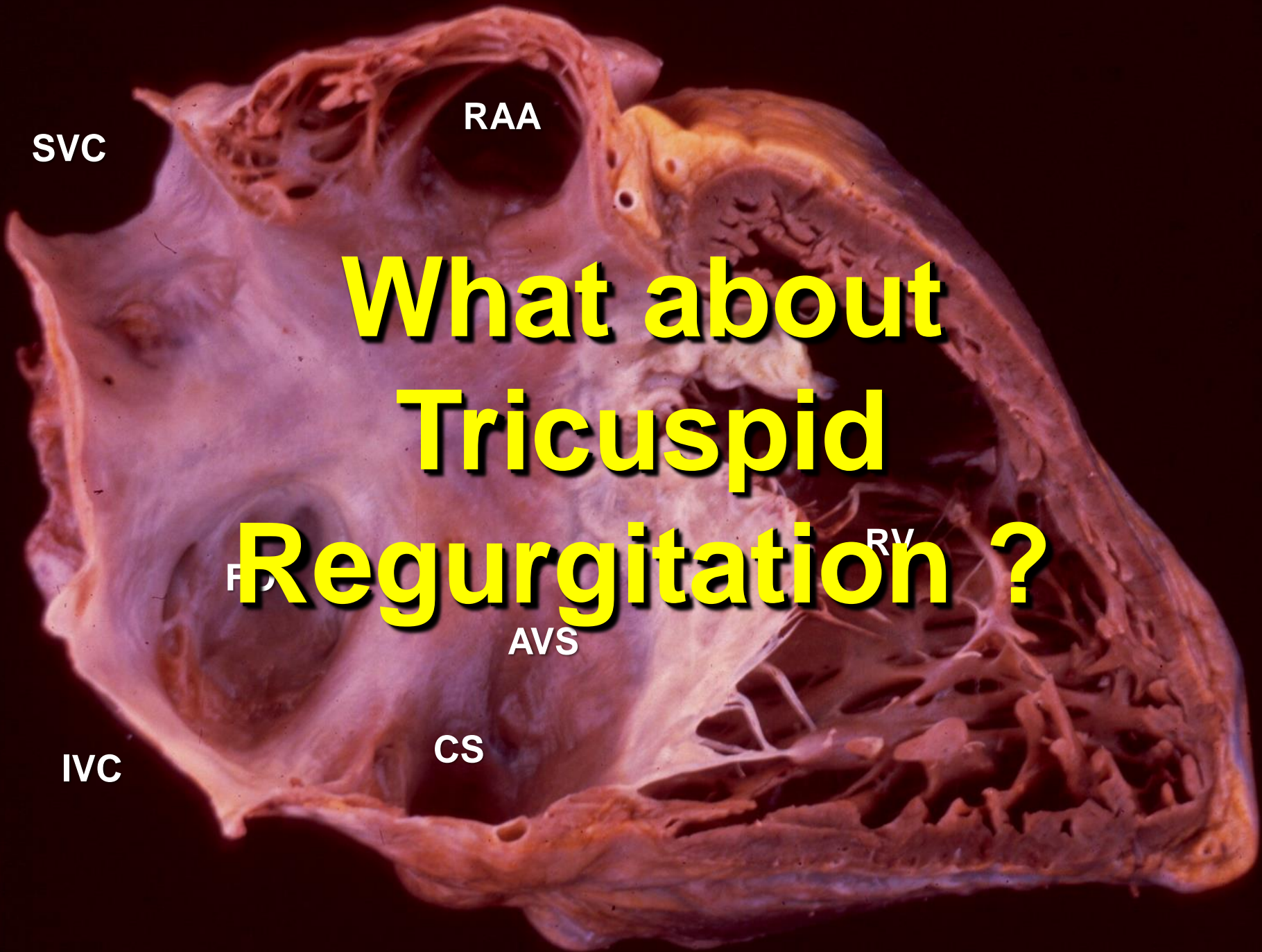


No.	—	28	23	11	3	2
at risk	- -	184	175	124	72	28



BAV in the community: Aortic aneurysm and dissection 25-year rates





SVC

RAA

What about Tricuspid Regurgitation ?

RV

FD

AVS

CS

IVC

VHD Prevalence

In the US population

~2.5% with hemodynamic VHD

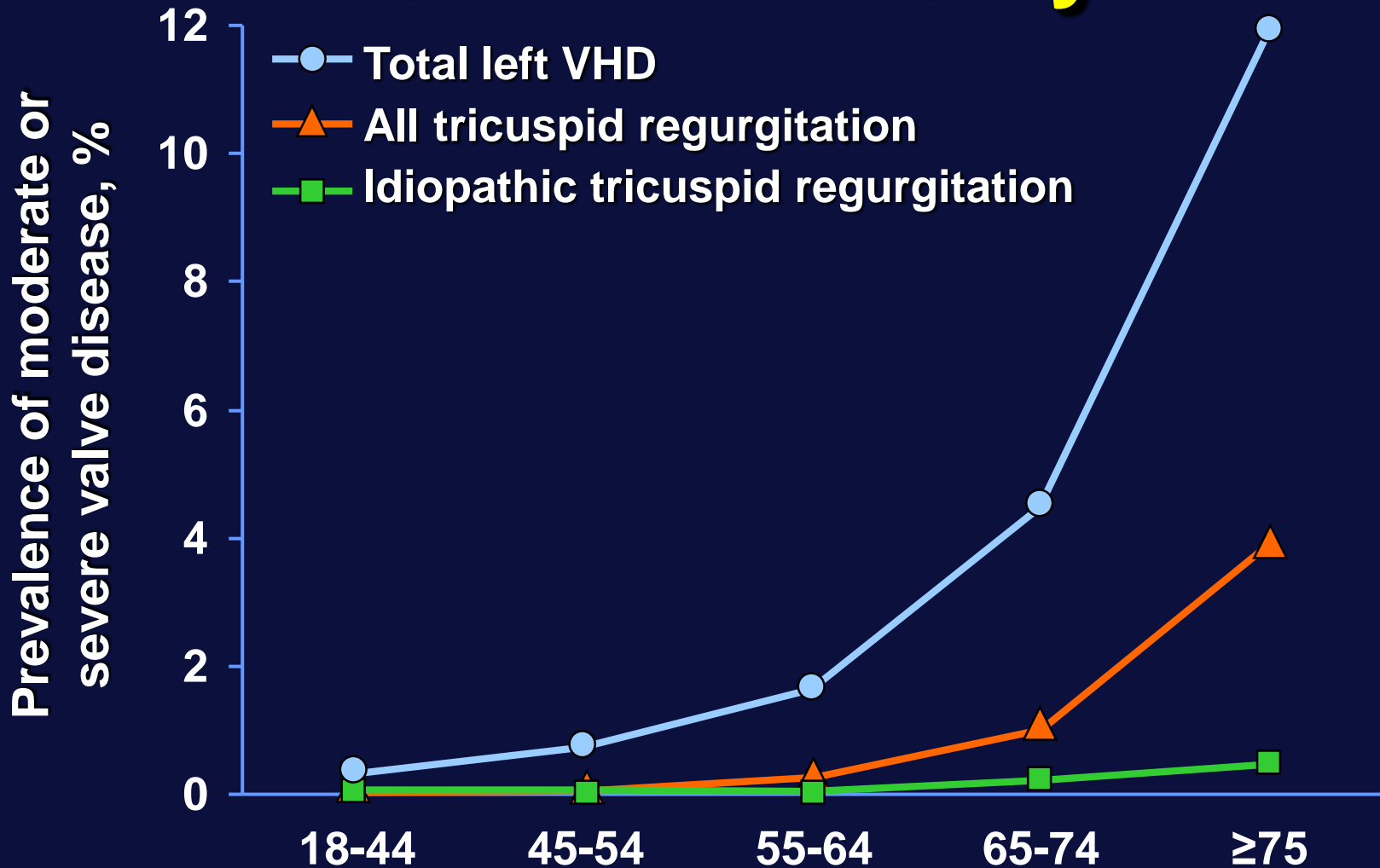
~2.5% with MVP

~1.4% with BAV

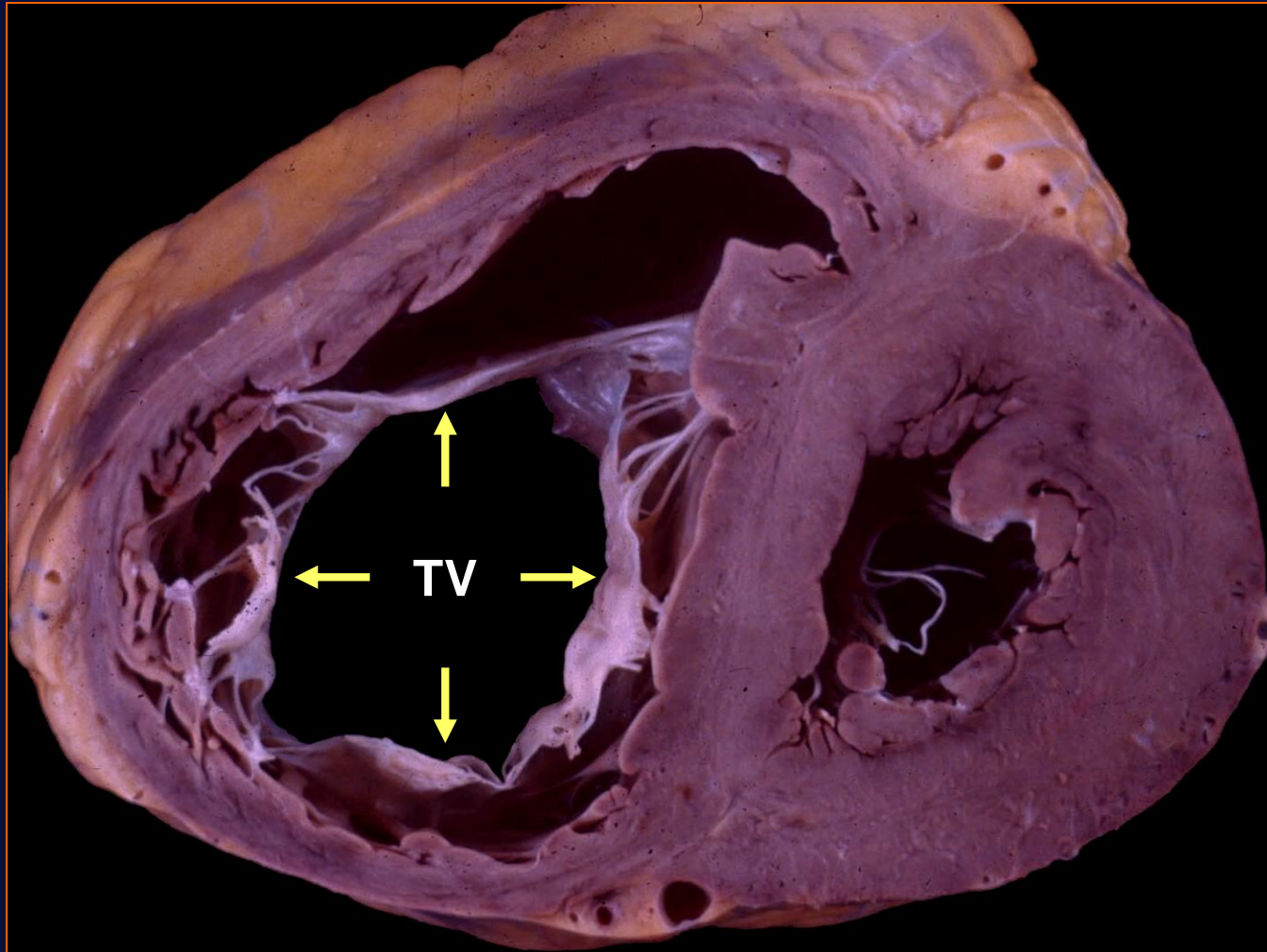
~1.3% with TR

Burden of Valve Diseases

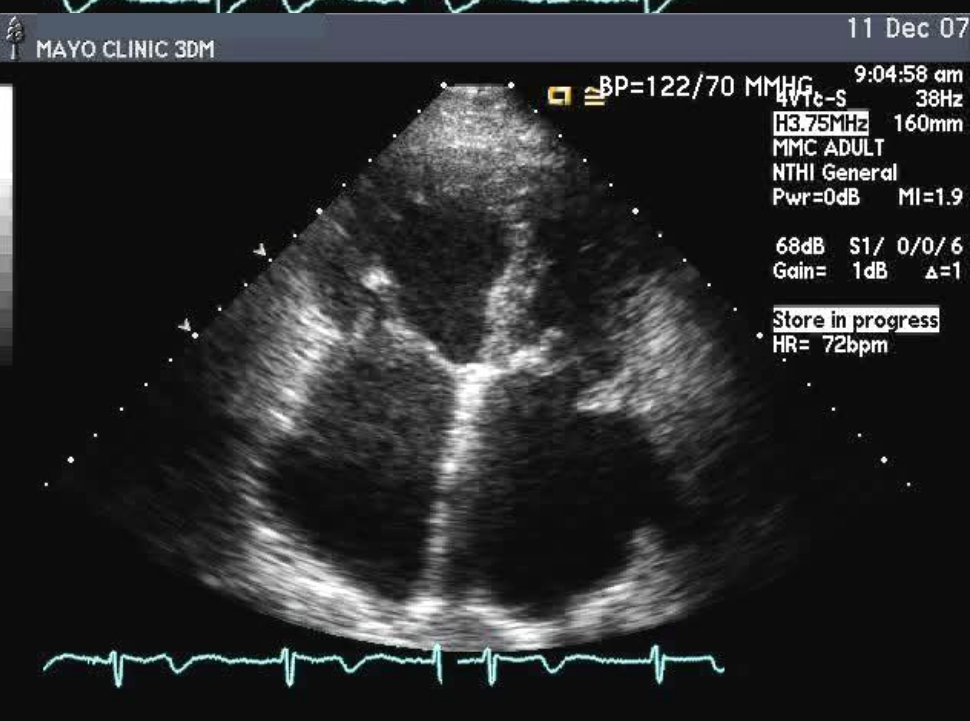
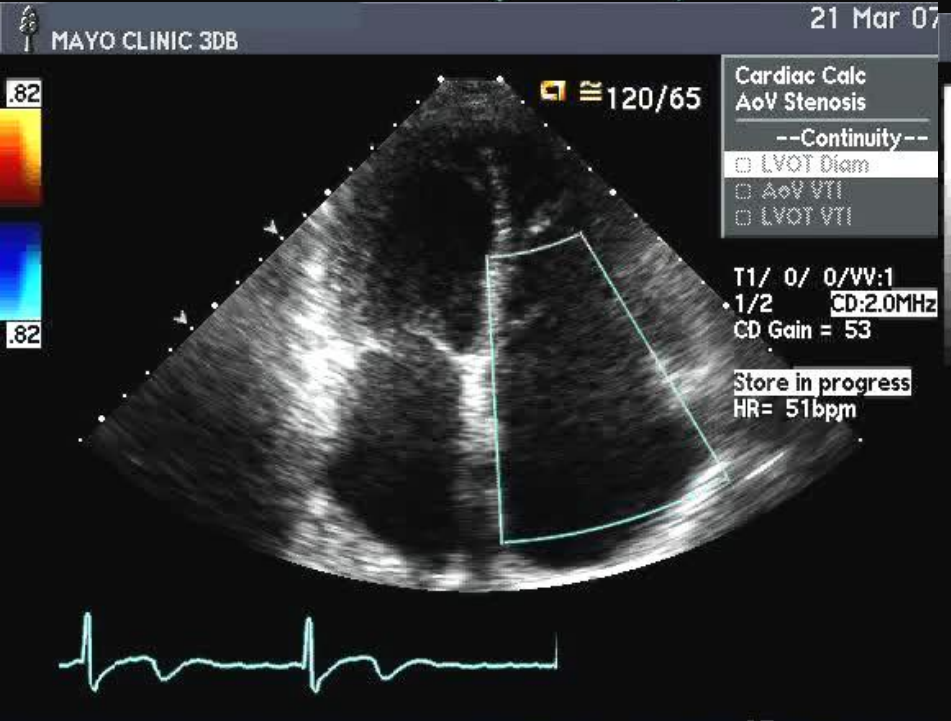
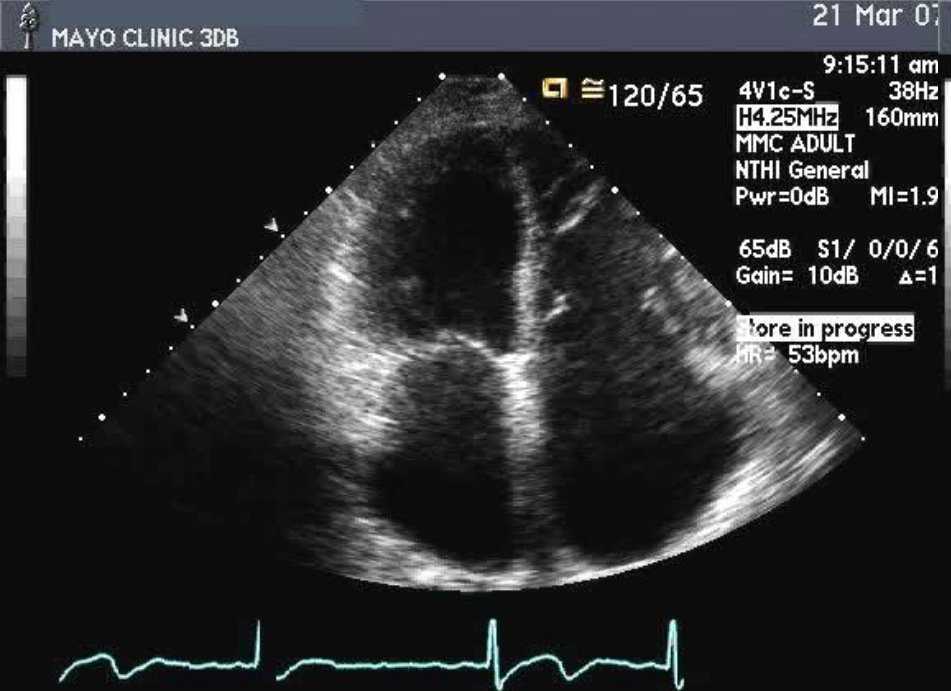
Olmsted County



Idiopathic Tricuspid Regurgitation Dilated Annulus



Autopsy Specimen



VHD Prevalence

In the US population

~2.5% with hemodynamic VHD

~2.5% with MVP

~1.4% with BAV

~1.3% with TR

500 Millions
in the world

25 Millions US residents
with VHD and growing
with population-aging

VHD in the 21st century

Considerable differences with
the 20th century

- VHD are less often rheumatic and mostly **degenerative or functional**
- VHD are strongly related to aging so that the concept of relying on **symptoms should be de-emphasized**
- **Presentation** is clinically challenging leading to frequent under-treatment

A tropical sunset scene with palm trees and the ocean, overlaid with the text "Thank You" in large orange letters. The background features a calm sea under a sky with soft, dark clouds, framed by the silhouettes of palm trees. The text is centered and rendered in a bold, sans-serif font with a slight drop shadow.

**Thank
You**