Aspergillosis - Spectrum of disease

David W. Denning
National Aspergillosis Centre
University Hospital of South Manchester
The University of Manchester

Agenda

How many patients are there with serious fungal infection and aspergillosis?

Allergic aspergillosis

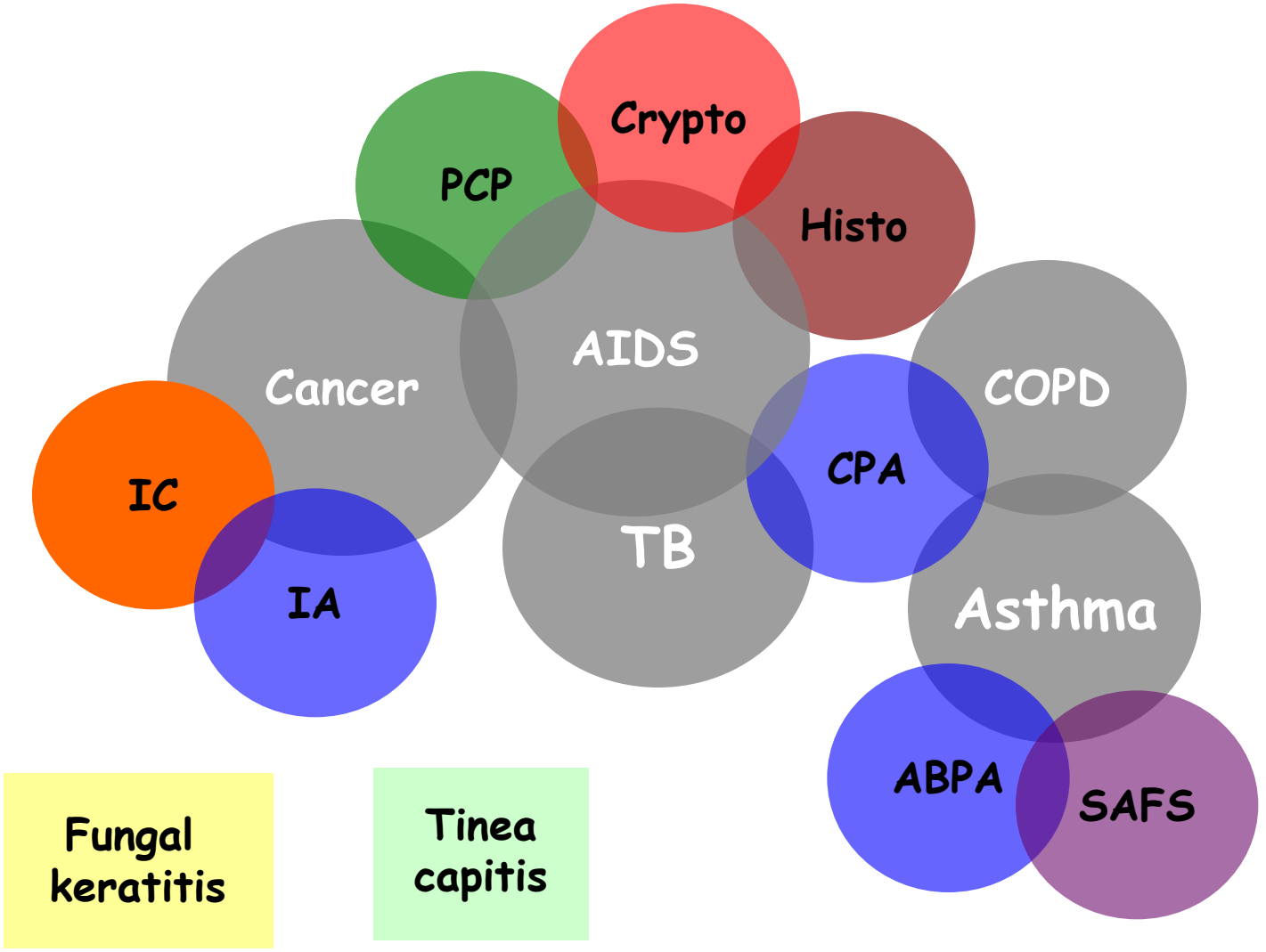
Aspergillosis in CF

Aspergillus bronchitis

Chronic pulmonary aspergillosis

Sputum cultures for fungus

The intersection of serious fungal diseases with TB, AIDS, cancer, asthma and COPD



The size of the problem

Over 300 million people affected by serious Fungal Infection worldwide

Exclude 75 million women with rVVC
Exclude 200 million children with tinea capitis

25 million with life-threatening and major morbidity

www.fungalresearchtrust.org/HowCommonareFungalDiseases5.pdf

LIFE
LEADING INTERNATIONAL FUNGAL EDUCATION

Reality check with TB

	TB (2008)	Fungal Infection
Incident cases	**9-10 million**	**>14 million**
Prevalent cases	**10-13 million**	**~11 million**
HIV related deaths	**~550,000**	**~650,000**
Non-HIV related deaths	**~1,500,000**	**>700,000**

LEADING INTERNATIONAL FUNGAL EDUCATION

Disease **Most common species**	**Location**	**Estimated Life-Threatening Infections / Year at that Location**[a]	**Mortality Rates** (% in infected populations)[a]
Opportunistic Systemic Mycoses			
Aspergillosis *Aspergillus fumigatus*	worldwide	>200,000	30 - 95%
Candidiasis *Candida albicans*	worldwide	>400,000	46 - 75%
Cryptococcosis *Cryptococcus neoformans*	worldwide	>1,000,000	20 - 70%
Mucormycosis *Rhizopus oryzae*	worldwide	>10,000	30 – 90%
Pneumocystis *Pneumocystis jirovecii*	worldwide	>400,000	20 - 80%
Endemic Dimorphic Mycoses			
Blastomycosis *Blastomyces dermatitidis*	Midwestern and Atlantic U.S.	~3,000	<2% - 68%
Coccidioidomycosis *Coccidioides immitis*	Southwestern U.S.	~25,000	<1% - 70%
Histoplasmosis *Histoplasma capsulatum*	Midwestern U.S.	~25,000	28 – 50%
Paracoccidioidomycosis *Paracoccidioides brasiliensis*	Brazil	~4,000	5 – 27%
Penicilliosis *Penicillium marneffei*	SouthEast Asia	>8,000	2 – 75%

Human fungal infections: the hidden killers

Brown, Denning, Gow, Levitz, Netea and White (2012) *Sci. Trans. Med.*

How common is ABPA in asthma?

Aspergillus hypersensitivity in asthmatics in Cape Town

S. R. BENATAR, G. A. KEEN *and* W. DU TOIT NAUDE

Clinical Allergy, 1980, Volume 10, pages 285–291

13/500 (2.6%)

Period Prevalence of Allergic Bronchopulmonary Mycosis in a Regional Hospital Outpatient Population in Ireland 1985-88*

S. C. Donnelly, *H. McLaughlin, C. P. Bredin

*The Diagnostic Laboratories, Department of Pathology, University College, Dublin, and Department of Respiratory Medicine, Regional Hospital, and University College, Cork.

10/1390 (0.72%)

Allergic Bronchopulmonary Aspergillosis in the Asthma Clinic*

A Prospective Evaluation of CT in the Diagnostic Algorithm

Tam Eaton, MB, ChB; Jeffrey Garrett, MB, ChB; David Milne, MB, ChB; Anthony Frankel, MB, ChB; and Athol U. Wells, MB, ChB

9/255 (3.5%)

RESPIRATORY MEDICINE (2001) 95, 341–347
doi:10.1053/rmed.2001.1047, available online at http://www.idealibrary.com on IDEAL®

Allergic bronchopulmonary mycosis in patients with asthma: period prevalence at a university hospital in Saudi Arabia

A. F. AL-MOBEIREEK*, M. O. GAD. EL-RAB†, S. S. A. AL-HEDAITHY†, K. ALASALI*, S. AL-MAJED* AND I. JOHARJY‡

6/264 (2.3%)

+ 5/200 (2.5%) China

Donnelly, Irish J Med Sci 1991;160:288; Eaton, Chest 2000;118:66; Al-Mobeireek, Resp Med 2001;98:341

Research

Bull World Health Organ 2011;89:864–872

Global burden of chronic pulmonary aspergillosis as a sequel to pulmonary tuberculosis

David W Denning,[a] Alex Pleuvry[b] & Donald C Cole[c]

1,170,000 patients (5 year period prevalence)

375,000 annual incident cases

~15% annual mortality

Aspergillosis burden in Europe

Type of aspergillosis	Predominant risk groups	Risk population size (000's)	Aspergillosis rate	Annual aspergillosis burden (000's)
ABPA	Asthma	35,474	2.5%	887 (248 – 1,242)
	Cystic fibrosis	29	15%	4.3
SAFS	Severe asthmaa	3,547	33%	1,170 (886 – 1,774)
Chronic pulmonary aspergillosis	COPD, TB, sarcoidosis, ABPA, Pneumothorax	>13,600	1-10%	240
Invasive aspergillosis	Myeloid leukaemia, Other haematological HSCT	44 11.4	7%	3.1 3.1 0.8
	COPD hospital admissions	3,600	1.2%	34
	Solid organ transplantation	30	0.75%	0.25
	Medical ICU	1,100 (all ICU)	2%	22
Total aspergillosis annual burden	All	-	-	**2,364.55**

Denning & Kleinkauf, submitted

Aspergillus allergy

What is normal?

US cross sectional survey of IgE reactivity – NHANES 2005-2006, age 6+; Atopy 42.5%

Specific IgE	Prevalence (%)	95% CI
Rye grass (*Lolium perenne*)	19.5	(17.0, 22.3)
Dust mite *Dermatophagoides pteronyssinus*	18.8	(17.0, 20.9)
Dust mite *Dermatophagoides farinae*	18.5	(16.8, 20.3)
Ragweed (*Ambrosia elatior*)	15.6	(13.6, 17.8)
Bermuda grass (*Cynodon dactylon*)	15.0	(13.0, 17.2)
Cat dander	12.0	(10.7, 13.4)
Dog dander	11.8	(10.7, 12.9)
Oak (*Quercus alba*)	11.4	(9.8, 13.1)
Russian thistle (*Salsola kali*)	10.7	(8.9, 12.7)
Cockroach (*Blatella germanica*)	10.3	(9.2, 11.4)
Birch (*Betula verrucose*)	9.9	(8.7, 11.3)
Alternaria alternata	8.6	(7.6, 9.6)
Aspergillus fumigatus	6.4	(5.8, 7.0)
Rat urine proteins	1.2	(0.8, 1.8)
Mouse urine proteins	1.1	(0.8, 1.4)

Gergen et al, J Allerg Clin Immunol 2009;124:447

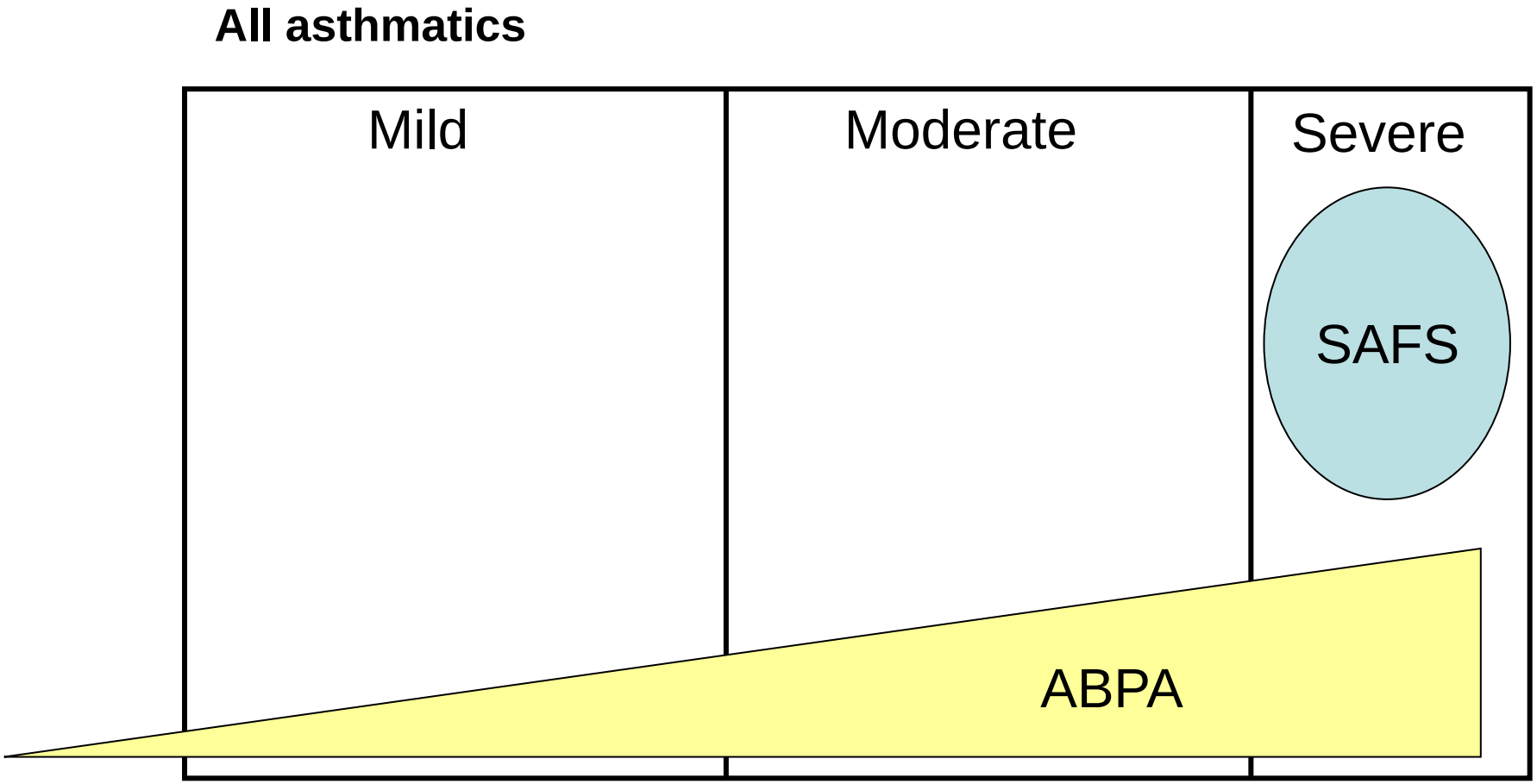
Italian cohort study of adult allergy referrals; Atopy 71%

Asp f 1 reactivity = 0.5% of all referrals.

Scala et al, Clin Exp Allergy 2010;40:411

Allergic bronchopulmonary aspergillosis
and
Severe asthma with fungal sensitisation

ABPA, SAFS and asthma



Asthma and Aspergillus

<u>79 adult asthmatics and 14 controls</u>

Patients sensitised to *A. fumigatus* compared with non-sensitised asthmatics had:

lower lung function (% pred. FEV1 68% vs 88% $p < 0.05$), more bronchiectasis (68% versus 35% $p < 0.05$) and more sputum neutrophils (80.9% vs 49.5% $p < 0.01$).

Fairs et al, Am J Respir Crit Care Med 2010; July 16

Severe asthma and aspergillosis in ICU

57 of 357 (16%) admitted ICU with acute asthma

Compared with 755 outpatients with asthma

Aspergillus skin prick test used to screen for aspergillus hypersensitivity, if positive IgE etc for ABPA checked

	Aspergillus positive	ABPA
Asthma in ICU	29/57 (51%)	22/57 (39%)
Outpatient asthma	90/755 (39%)	155/755 (21%)
P value	0.01	0.001

Agarwal et al, Mycoses 2009 Jan 24th

Aspergillus sensitisation and bronchiectasis

Severe asthma service

133 referrals, 111 with an abnormal high resolution CT

Bronchial wall thickening 41.3%

Bronchiectasis 35.3%

Air trapping 20.3%

Bronchial dilatation 16.5%

A. fumigatus sensitisation associated with bronchietasis - HR 2.01 p=0.005

Menzies, Allergy 2011;66: 679;

Severe asthma with fungal sensitisation (SAFS)

Criteria for diagnosis

- Severe asthma (BTS step 4 or 5)

AND

- RAST (IgE) positive for any fungus

OR

- Skin prick test positive for any fungus

AND

- Exclude ABPA (ie total IgE <1,000 iu/mL)

Denning et al, Eur Resp J 2006; 27;27:615

Comparison of ABPA and SAFS serology

ABPA results

Patient 1

		normal range	date 1	date 2
Total IgE	KIU/l	(0.1-100.0)	1900.0	3000.0
aspergillus.f	KUa/l	(0-0.4)	41.6	49.2

SAFS results

2

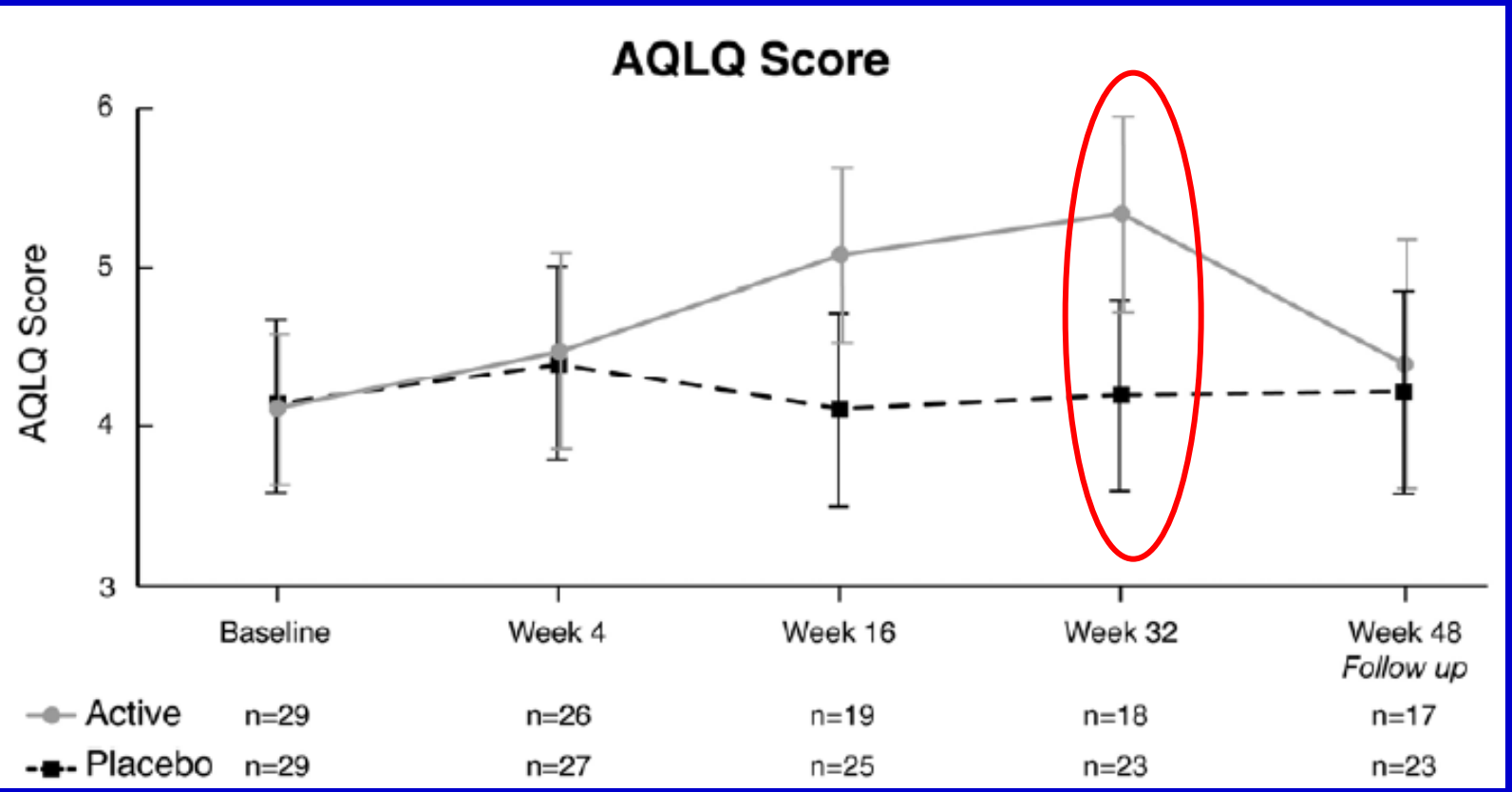
Total IgE	KIU/l	(0.1-100.0)	200.0	260.0
aspergillus.f	KUa/l	(0-0.4)	4.5	5.2

Skin prick testing – example of SAFS result

Cladosporium +ve

O' Driscoll, unpublished

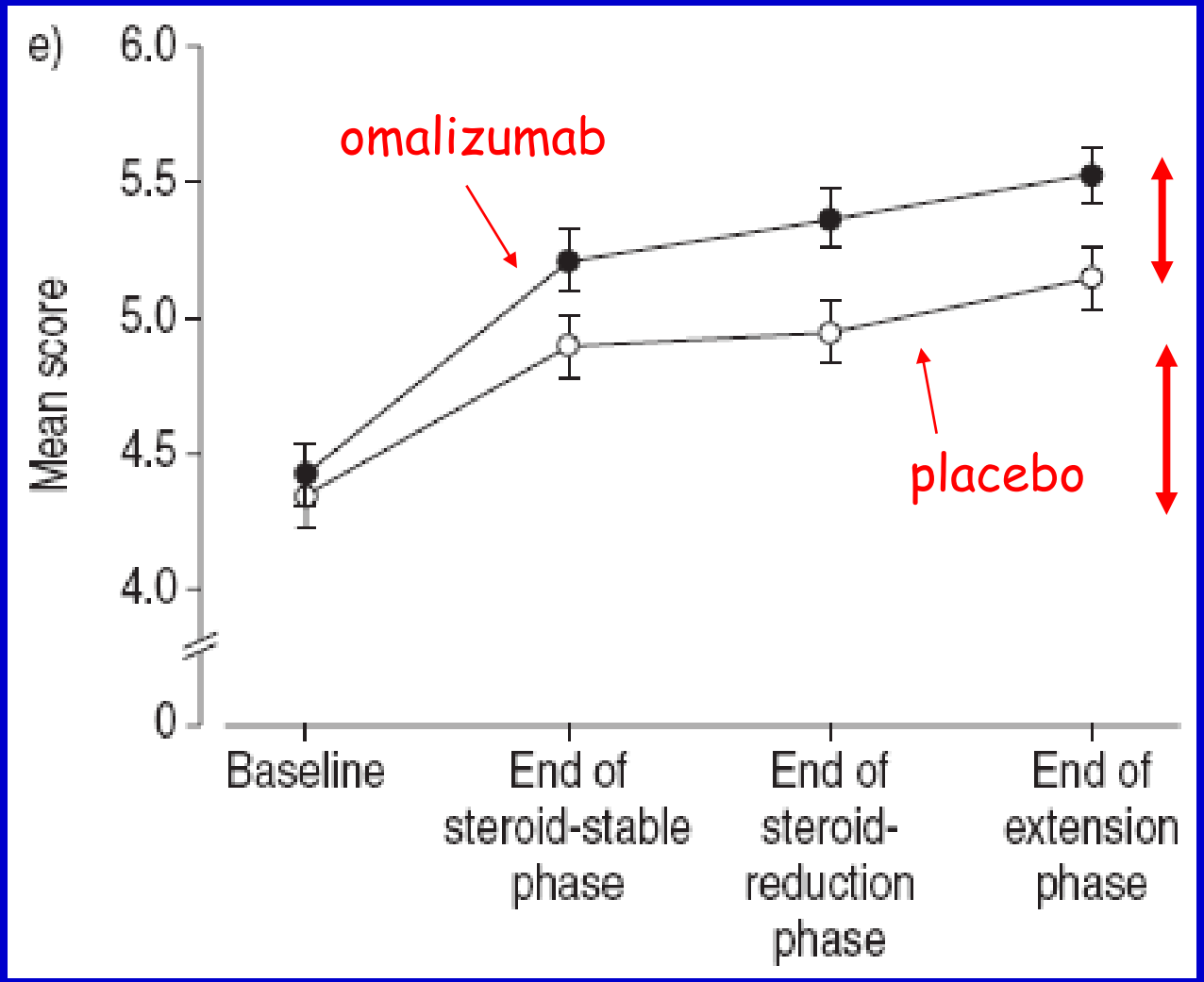
Proof of concept RCT of antifungal Rx in SAFS - AQLQ change



P= 0.014

Denning et al, Am J Resp Crit Care Med 2009; 179:11

RCT of anti-IgE (omalizumab) v. placebo, moderate and severe asthma – quality of life



Omalizumab mprovement in AQLQ = ~0.4

Steroids improvement in AQLQ = ~0.6

Buhl et al Eur Resp J 2002;20:1088

Second and third line antifungal therapy for ABPA and/or asthma

- 26 patients, ABPA (n = 21) or SAFS (n = 5).
- All patients had failed itraconazole (n=14) or developed adverse events (AEs) (n=12)
- 34 courses of therapy, 25 with voriconazole and 9 with posaconazole.
-

Chishimba et al, J Asthma 2012;49:423

Impact of voriconazole and posaconazole on ABPA and SAFS - retrospective

		Clinical outcome of courses of therapy (%)		
		3 months	6 months	12 months
ABPA				
Voriconazole	Improved	13/20 (65)	11/15 (73)	9/13 (69)
	Stable	2/20 (10)	2/15 (13)	2/13 (15)
	Failure	1/20 (5)	0/15	2/13 (15)
	Discontinued (AEs)	4/20 (20)	2/15 (13)	0/13
Posaconazole	Improved	7/9 (78)	7/9 (78)	7/9 (78)
	Stable	2/9 (22)	2/9 (22)	0/9
	Failure	0/9	0/9	2/9 (22)
	Discontinued (AEs)	0/9	0/9	0/9
SAFS				
Voriconazole	Improved	4/5 (80)	4/5 (80)	3/4 (75)
	Stable	1/5 (20)	1/5 (20)	1/5 (20)
	Failure	0/5	0/5	0/5
	Discontinued (AEs)	0/5	0/5	0/5

Notes: AEs, adverse events; ABPA, allergic bronchopulmonary aspergillosis; SAFS, severe asthma with fungal sensitization. () indicates %.

Chishimba L J Asthma 2012;49:423

Second and third line antifungal therapy for ABPA and/or asthma

- 26 patients, ABPA (n = 21) or SAFS (n = 5).
- All patients had failed itraconazole (n=14) or developed adverse events (AEs) (n=12)
- 34 courses of therapy, 25 with voriconazole and 9 with posaconazole.

- 18/24 (75%) discontinued oral corticosteroids, 12 of them within 3 months of starting antifungal therapy

- 4 relapsed (57%), 1 at 3 months and 3 at 12 months after discontinuation.

Chishimba et al, J Asthma 2012;49:423

Itraconazole inhaled steroid interaction

- Itraconazole reduces the metabolism of inhaled steroids
- Documented for beclomethasone, fluticasone
- Ciclosenide probably not
- No interaction with prednisolone, dexamethasone, hydrocortisone
- Reduces metabolism of methylprednisolone
- [Voriconazole reduces prednisolone metabolism, but probably no interaction with inhaled steroid]

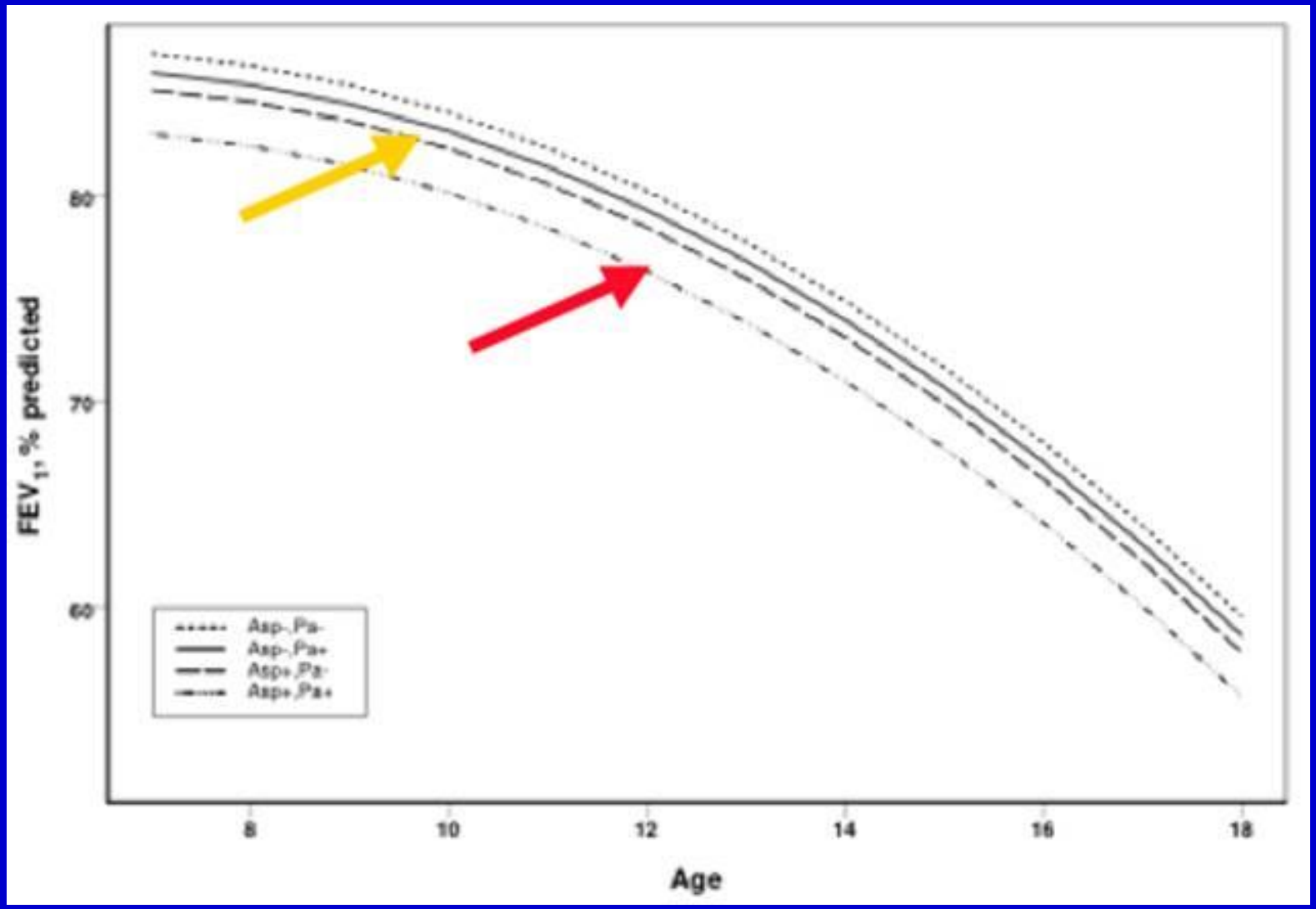
CF and aspergillosis

- Allergic bronchopulmonary aspergillosis (ABPA)
- Aspergillus sensitisation
- Aspergillus colonisation
- Aspergillus bronchitis
- Aspergilloma
- Invasive aspergillosis

CF and Aspergillus cultures

Reference, location	Patients, *n*	Age (where available), mean (range)	*Aspergillus*-positive, *n* (%)
Nelson *et al.*,[2] Rochester, USA	37	14.2 (5–46)	21 (57)
Laufer *et al.*,[4] Wisconsin, USA	55	14.2 (2–34)	5 (9)
Schoenheyder *et al.*,[5] Copenhagen, Denmark	150	13 (2–35)	75 (50)
Penketh *et al.*,[3] London, UK	288	(12–51)	27 (9.4)
Bauernfeind *et al.*,[1] Munich, Germany	102	16 (4–31)	6 (5.9)
Mroueh and Spock,[11] Durham, USA	236	14.5 (1–41)	60 (25)
Becker *et al.*,[6] Seattle, USA	49	25.8 (18–50)	8 (16)
Milla *et al.*,[15] Delaware, USA	370	17.2	45 (12.2)
Burns *et al.*,[7] USA, different centres	465	21.2 (6–63)	108 (3.2)

CF and Aspergillus colonisation or infection



Amin, Chest 2010;137:171

CF and Aspergillus cultures

Baxter, unpublished

Processing CF sputum for culture and PCR - with dithiothreitol at 37°C for 30 mins and sonication

	PCR Positive	PCR Negative
Culture Positive	33	0
Culture Negative	48	30

p= < 0.0001

Baxter, J Microbiol Meth 2011;85:75.

Aspergillus bronchitis in non-CF patients

ANNALS OF THE NEW YORK ACADEMY OF SCIENCES
Issue: *Advances Against Aspergillosis*

Aspergillus bronchitis without significant immunocompromise

Ales Chrdle,[1,6] Sahlawati Mustakim,[2] Rowland J. Bright-Thomas,[3] Caroline G. Baxter,[1,4] Timothy Felton,[1,4] and David W. Denning[1,4]

[1]The National Aspergillosis Center, University Hospital of South Manchester, Manchester, UK. [2]Pathology Department, Hospital Sungai Buloh, Selangor Darul Ehsan, Malaysia. [3]Cystic Fibrosis Unit, The University Hospital of South Manchester,

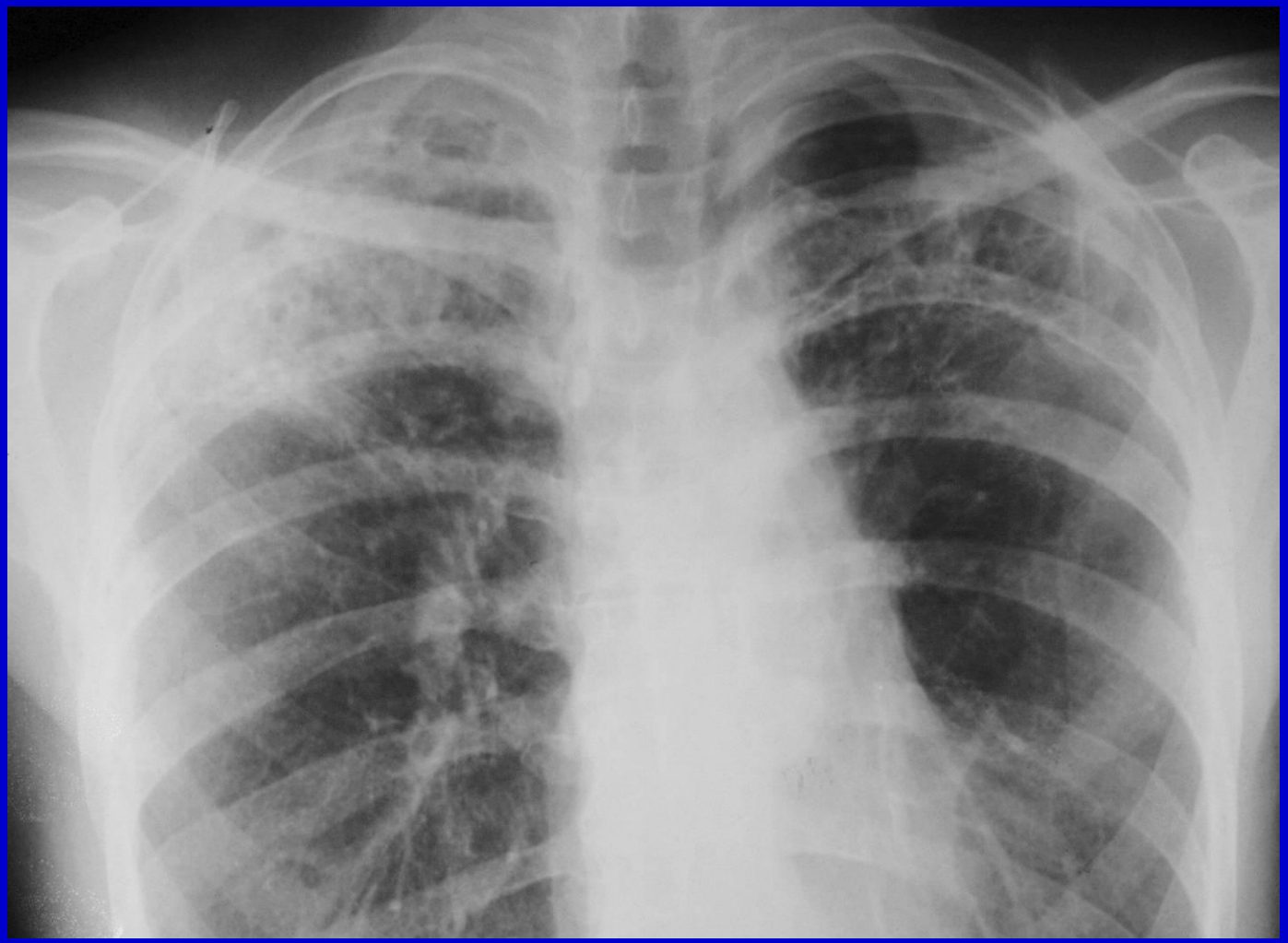
Underlying diseases	Number affected (%)
Pulmonary disease	$n = 17$
COPD[a]	6 (35)
Asthma[a]	4 (23)
Bronchiectasis[b]	12/14 (86)
Mucus impaction[b]	2 (12)
Lung cancer	1 (6)
Oral corticosteroids >10 mg/day	3 (18%)
Oral corticosteroids <10 mg/day	3 (18%)
Infliximab	1 (6%)
Inhaled corticosteroids	12 (70%)
No comorbidity	2 (12%)

Chronic pulmonary aspergillosis

Chronic cavitary pulmonary aspergillosis – CT reconstruction

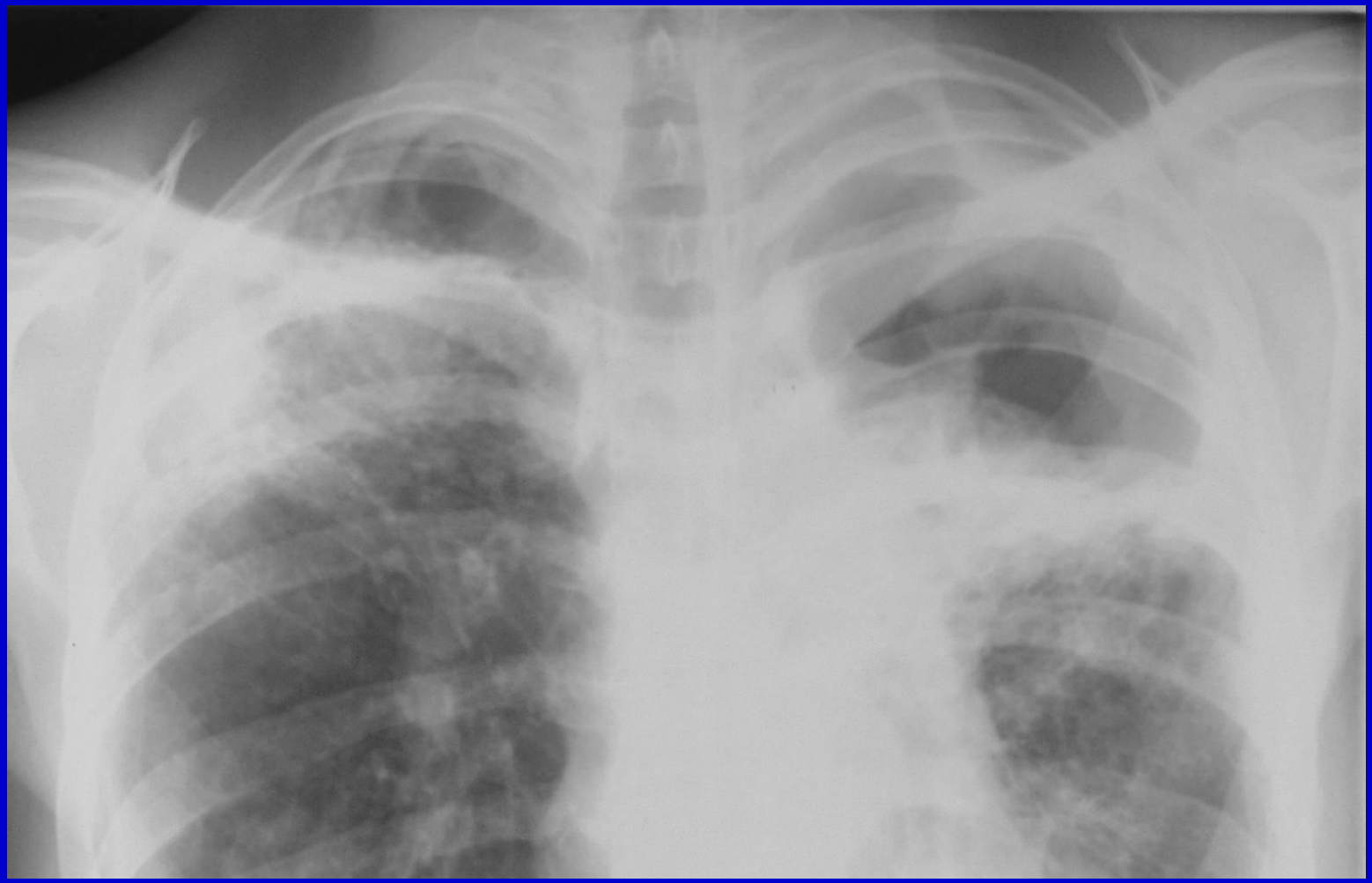
Chronic Cavitary Pulmonary Aspergillosis

Normal 30 year female smoker



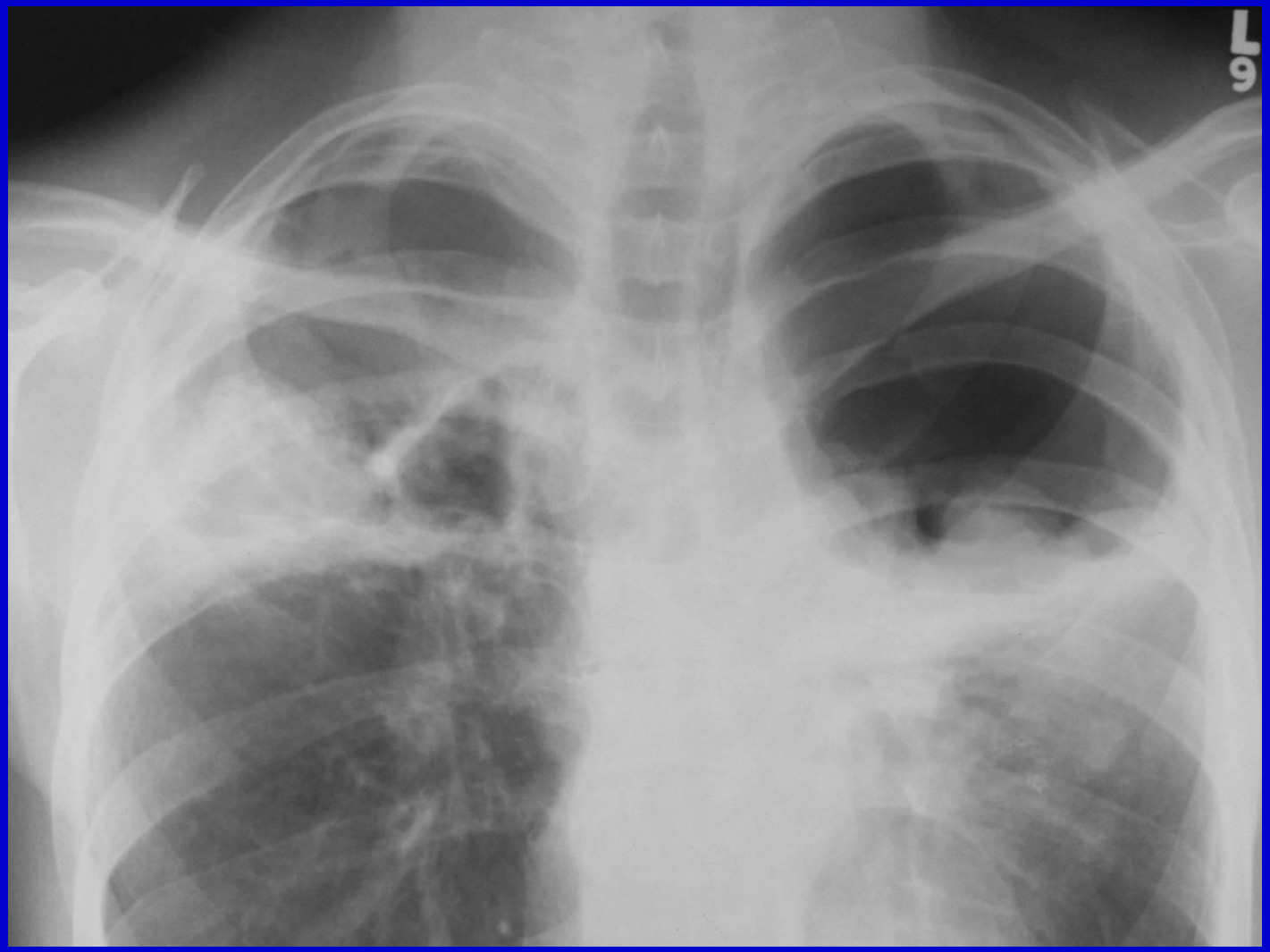
Patient JA
Jan 2001

Chronic Cavitary Pulmonary Aspergillosis



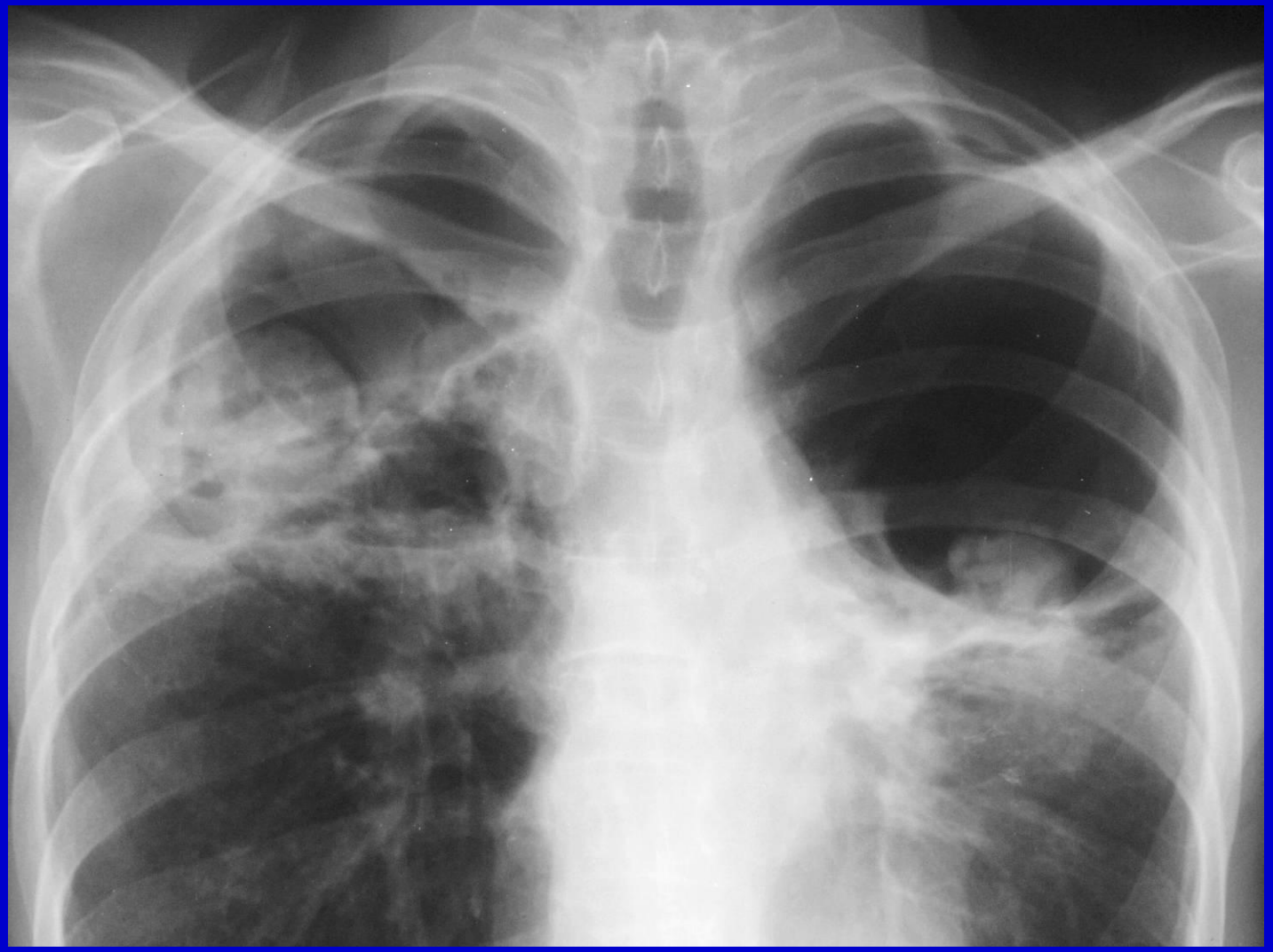
Patient JA
Feb 2002

Chronic Cavitary Pulmonary Aspergillosis



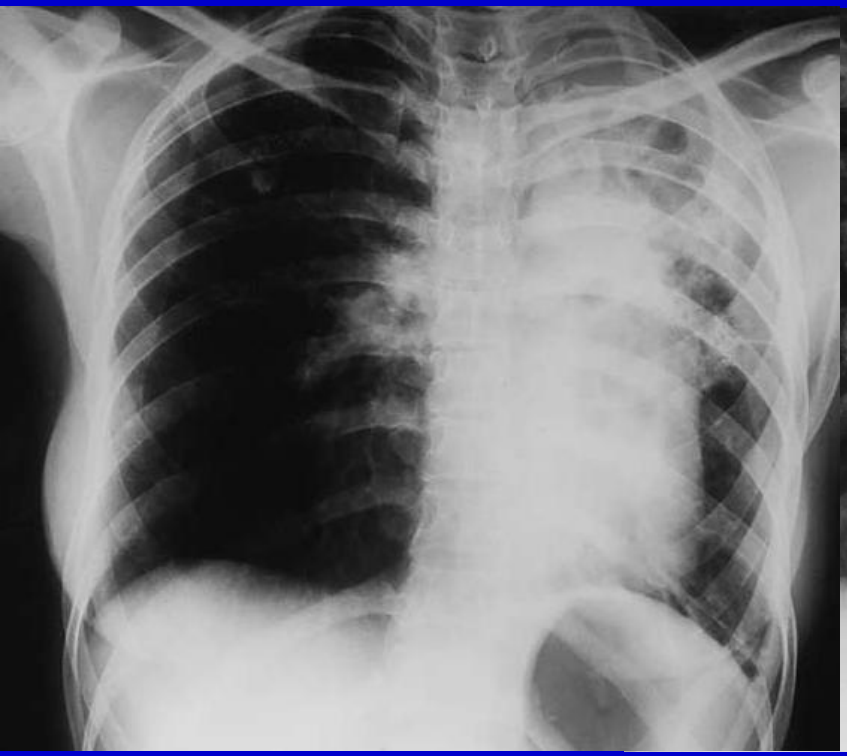
Patient JA
April 2003

Chronic Cavitary Pulmonary Aspergillosis



Patient JA
July 2003

Progression of CCPA

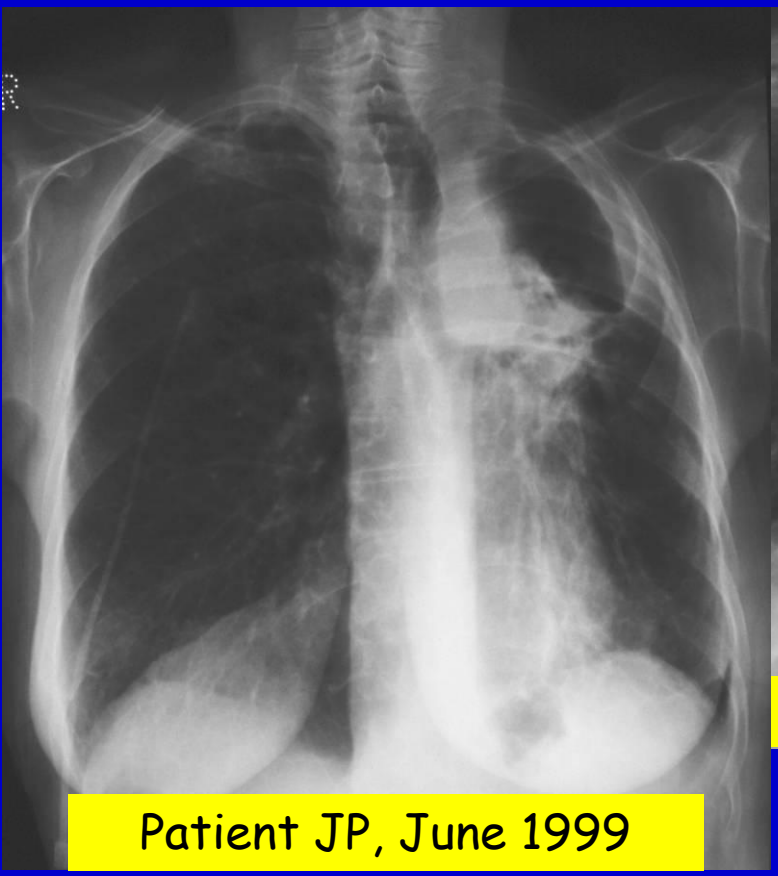


1992

1994 on no Rx

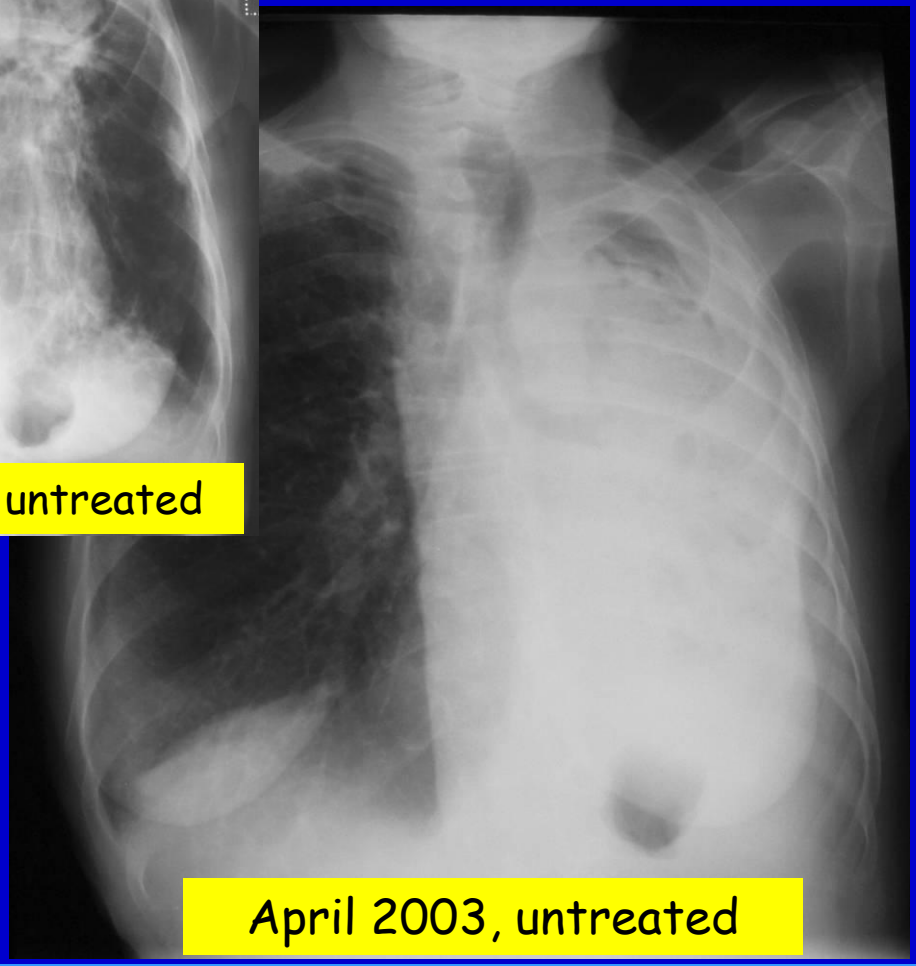
1997 still on no Rx

Chronic cavitary pulmonary aspergillosis transforming to fibrosing aspergillosis



Patient JP, June 1999

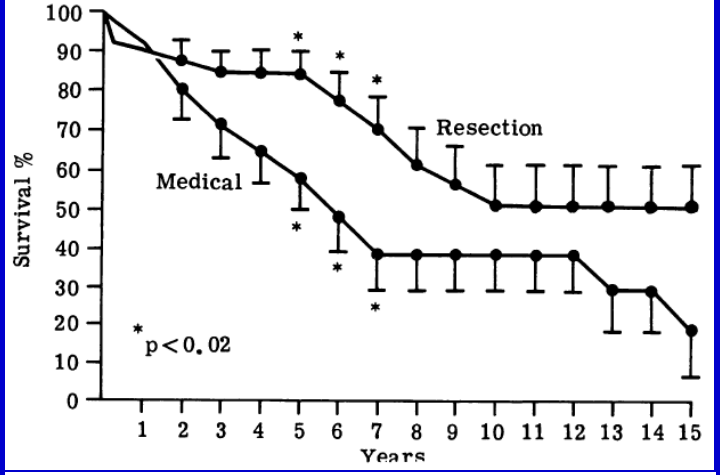
July 2001, untreated



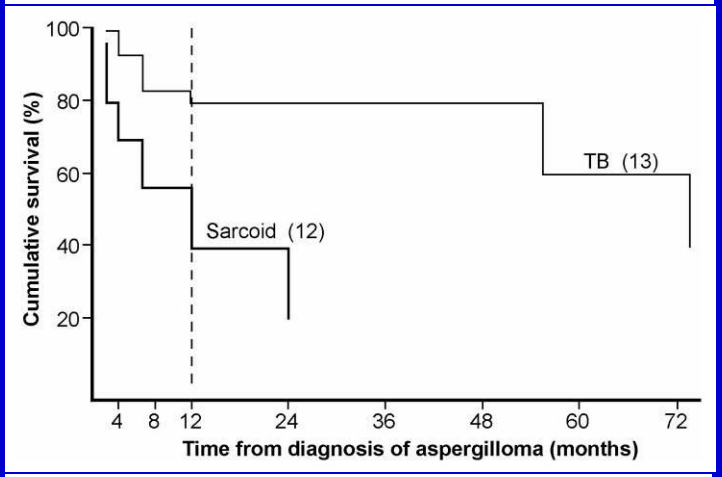
April 2003, untreated

Denning DW et al, Clin Infect Dis 2003; 37(Suppl 3):S265-80

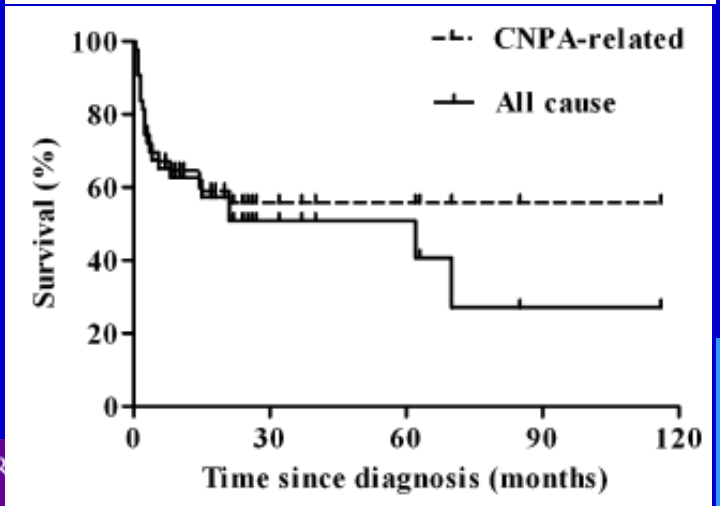
Prognosis



CPA + aspergilloma
UK (1956-80)



CPA + aspergilloma
USA (1987)



CPA + subacute IA
Korea (1995-2007)

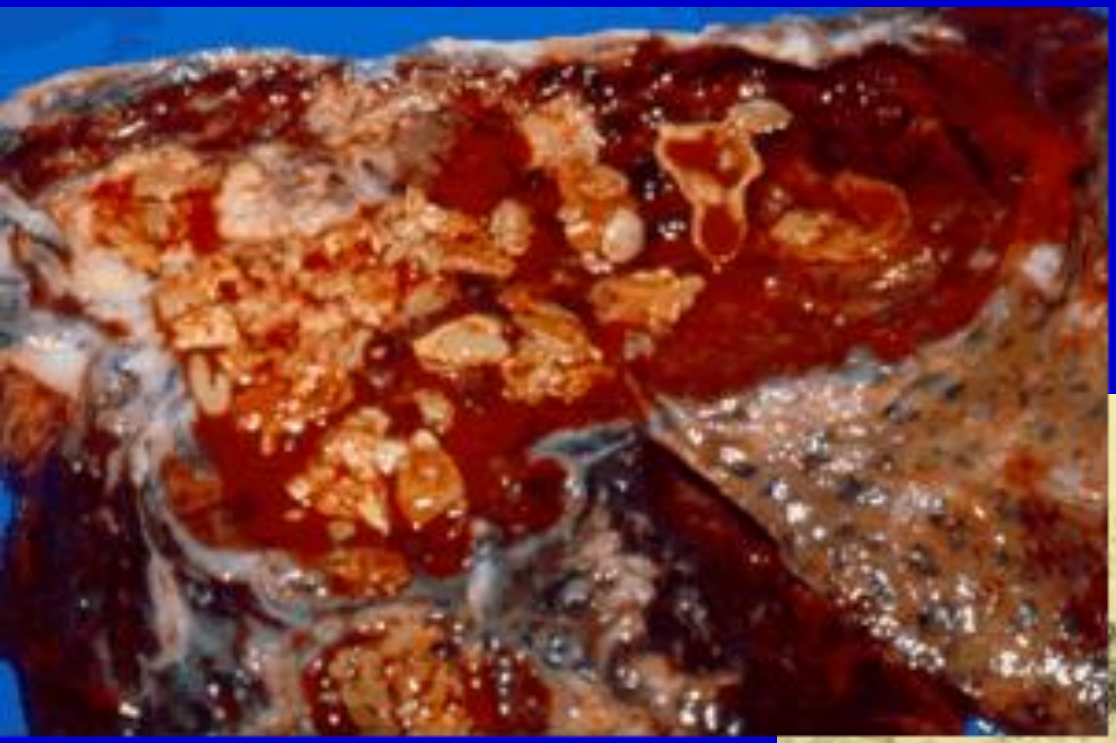
Jewkes, Thorax 1983;38:572;
Tomlinson, Chest 1987;92:505;
Nam Int J Infect Dis 2010;14:e479;

Underlying diseases in patients with CPA (%)

	Smith	Others
Classical tuberculosis	17	31-81
Atypical tuberculosis	16	?
ABPA	14	12
COPD/emphysema	33	42-56
Pneumothorax	17	12-17
Lung cancer survivor	10	?
Pneumonia	22	9-12
Sarcoidosis (stage II/III)	7	12-17
Thoracic surgery	14	8-11
Rheumatoid arthritis	4	2
Asthma / SAFS	12	6-12
Ankylosing spondylitis	4	2-11
None	1	15

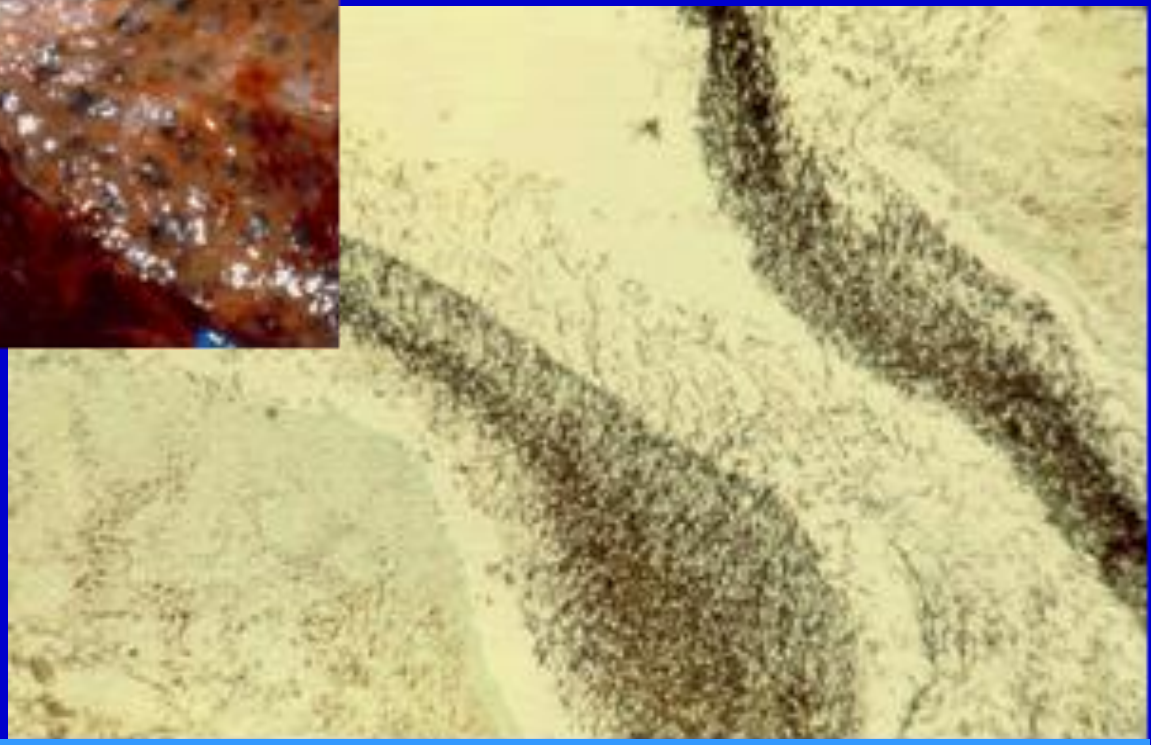
Smith, Eur Resp J 2011;37:865

Early Aspergillus infection of a pulmonary cavity – 'pre-aspergilloma'

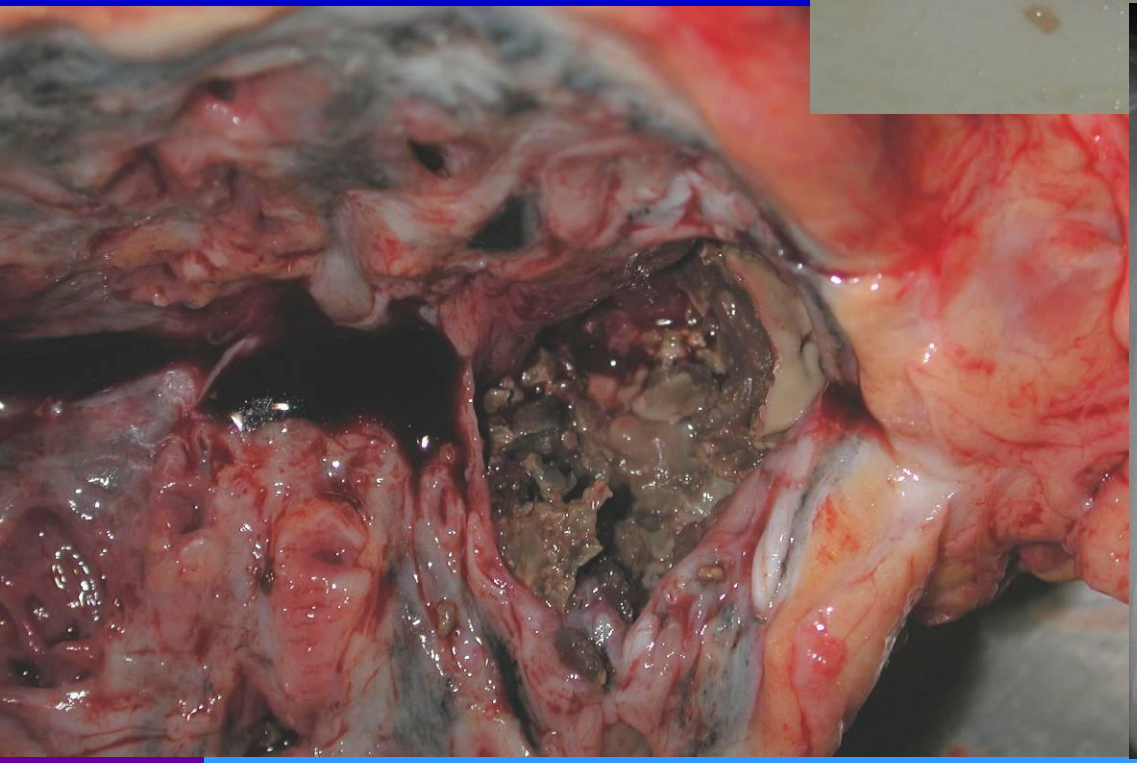


Aspergillus growth on the surface of a pulmonary cavity

Orderly hyphal growth on the inside of the cavity

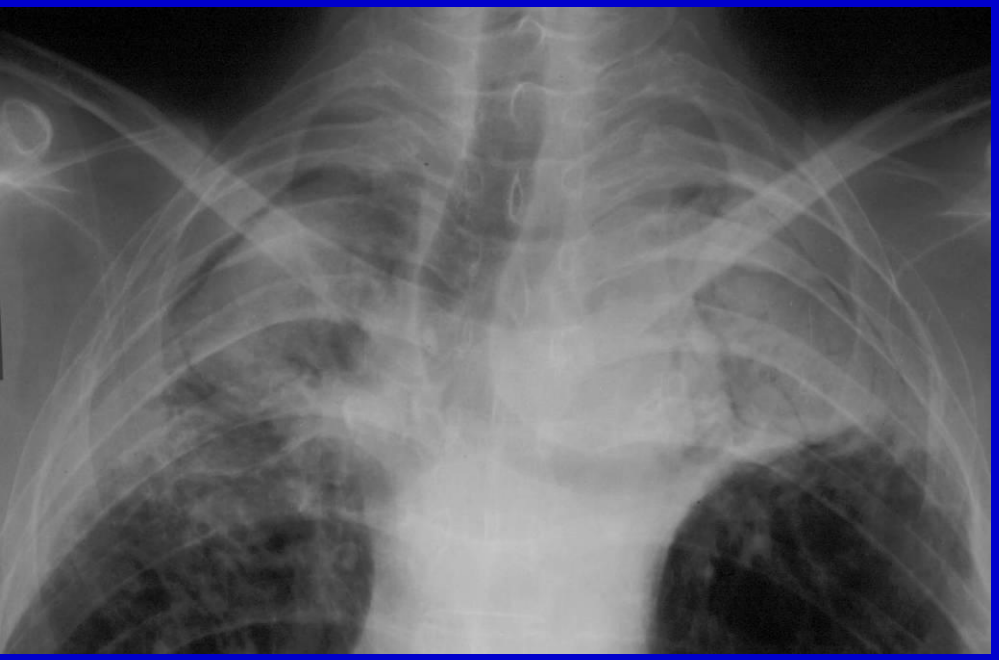


'Multicavity' disease is the hallmark of chronic cavitary pulmonary aspergillosis (CCPA)



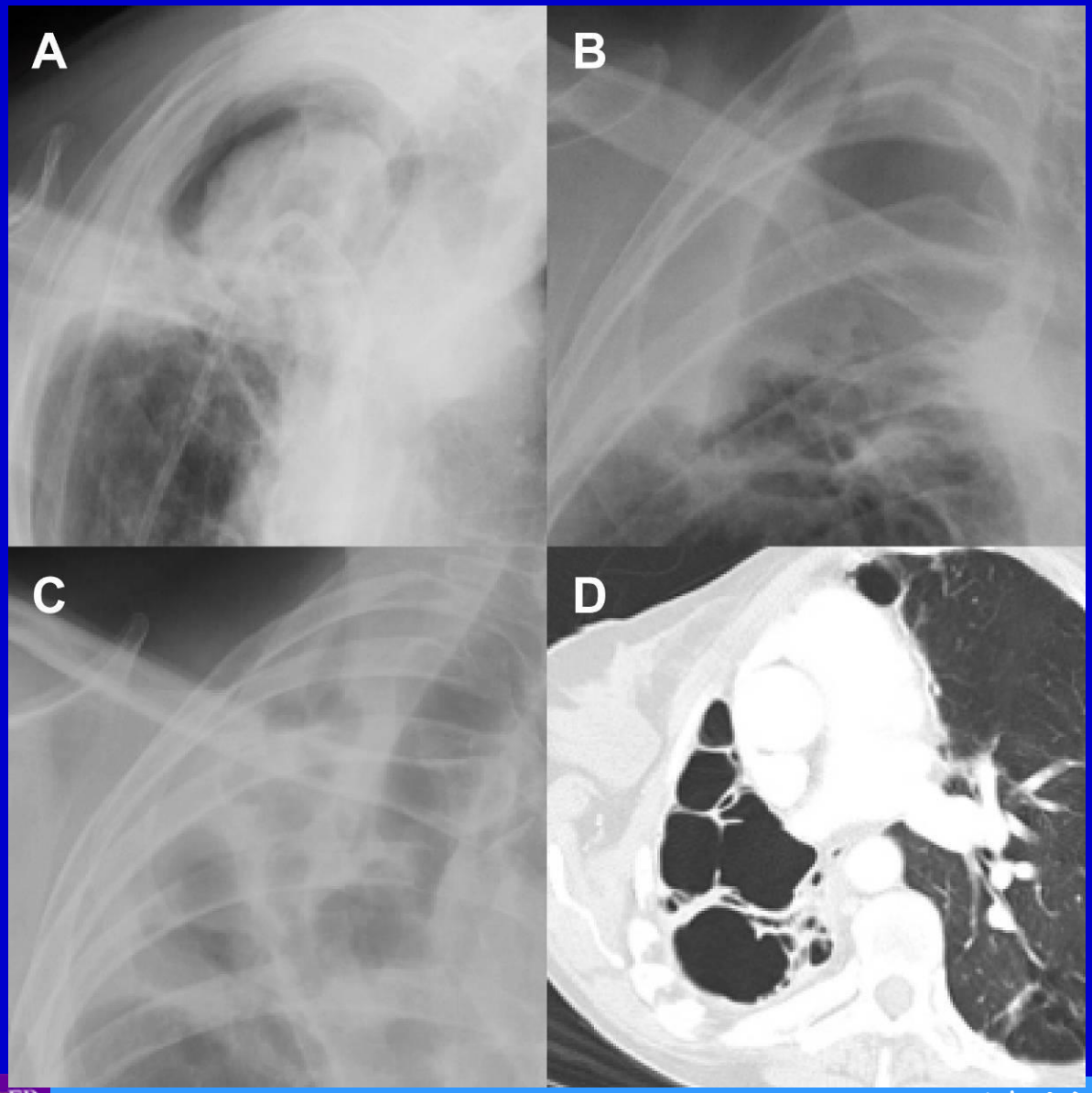
Chronic pulmonary aspergillosis

Chronic cavitary pulmonary aspergillosis complicating ABPA



Chronic cavitary pulmonary aspergillosis with bilateral aspergillomas complicating sarcoidosis

'Multicavity' disease is the hallmark of chronic cavitary pulmonary aspergillosis (CCPA)

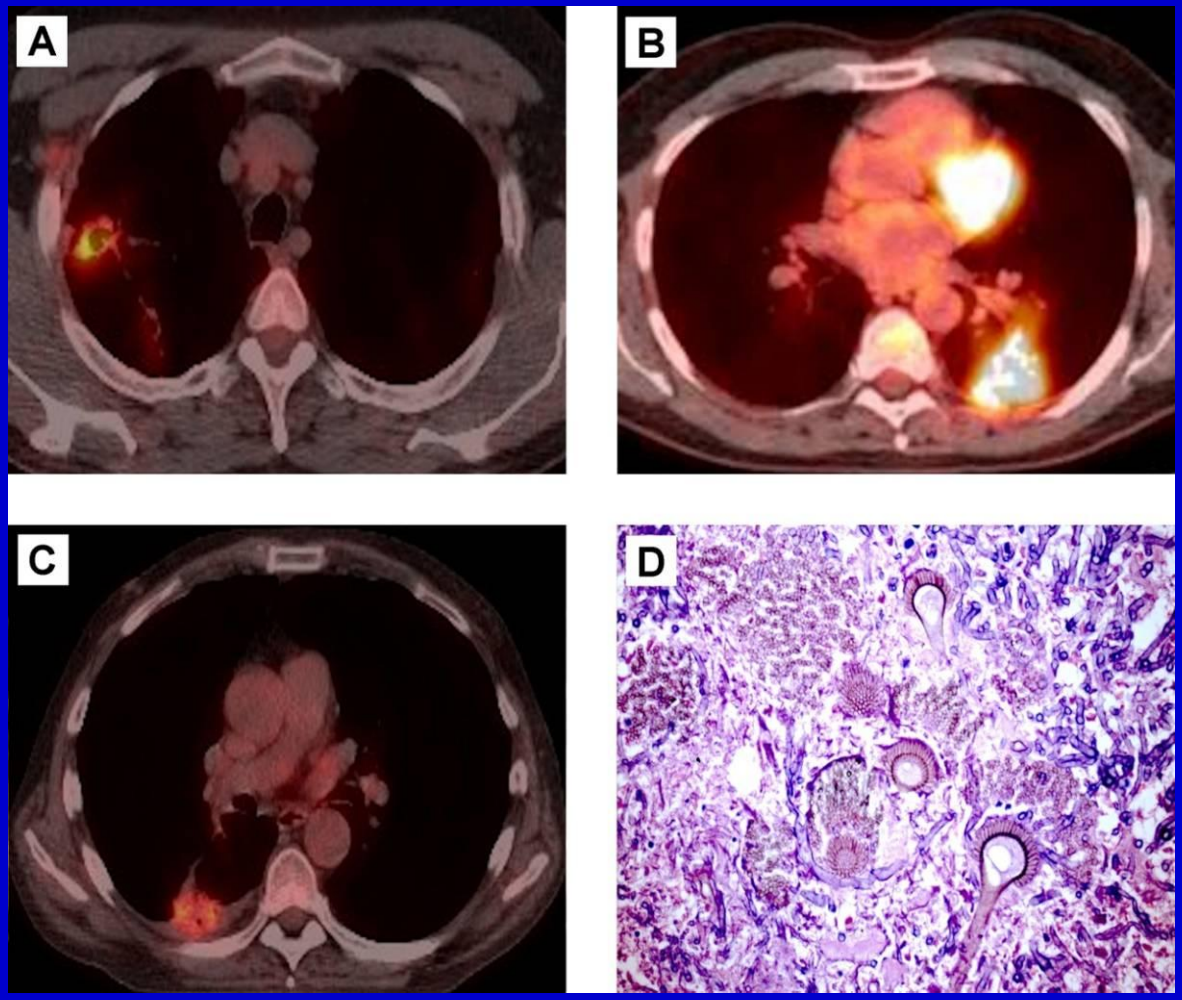


+ Aspergillus IgG antibodies

Only 25% have a fungal ball on CXR or CT

Smith & Denning. Eur Resp J 2011; 37:865

18F-FDG PET positive pulmonary nodules in aspergillosis – a differential diagnosis of lung cancer



10 patients

Presentations like lung cancer

1 subacute IPA

1 ABPA

1 aspergilloma

7 CPA

Aspergillus IgG 28 ->200 mg/L

All positive on histology

Baxter, Thorax 2011

Aspergillus IgG serology

Baxter, AAA 2010;Abstr 51

Summary of diagnosis for allergic and chronic pulmonary aspergillosis

Distinguishing different forms of aspergillosis

	Disease group				
	CCPA	ABPA + CCPA	ABPA	SAFS	SAFS
n	116	16	98	52	52
Median serum IgE level (IQR)	99.8 (26.4-350) (n=107)	2739 (1100-7500) (n=16)	2300 (1100-4550) (n=97)	370 (140-750) (n=52)	
Aspergillus specific IgG	93.6% (103/110)	81.3% (13/16)	65.4% (53/81)	35.9% (14/39)	
Positive fungal culture	25% (29/116)	25.0% (4/16)	23.5% (23/98)	21.2% (11/52)	

Unpublished

Distinguishing different forms of aspergillosis

	Disease group				
	CCPA	ABPA + CCPA	ABPA	SAFS	SAFS
n	116	16	98	52	52
Median serum IgE level (IQR)	99.8 (26.4-350) (n=107)	2739 (1100-7500) (n=16)	2300 (1100-4550) (n=97)	370 (140-750) (n=52)	
Aspergillus specific IgG	93.6% (103/110)	81.3% (13/16)	65.4% (53/81)	35.9% (14/39)	
Positive fungal culture	25% (29/116)	25.0% (4/16)	23.5% (23/98)	21.2% (11/52)	
Positive specific IgE					Positive SPT
Mixed mould			88.9% (8/9)	90.9% (20/30)	100% (2/2)
A. fumigatus			96.9% (94/97)	78.8% (41/52)	90.9% (20/30)
Alternaria alternata			77.5% (55/71)	32.5% (13/40)	47.4% (9/19)
C. albicans			81.4% (57/70)	37.5% (15/25)	52.6% (10/19)
Cladosporium herbarum			70.4% (50/71)	24.4% (10/41)	35.5% (6/17)
Penicillium chrysogenum			85.3% (58/68)	30.0% (12/40)	43.8% (7/16)
Trichophyton mentagrophyte			65.2% (30/46)	25.0% (9/36)	23.1% (3/13)

Unpublished

Direct detection of resistance mutations in clinical specimens, without positive cultures

Laboratory result	ABPA	CPA	Normals
Culture positive for *A. fumigatus*	0/19	7/42 (16.7%)	0/11
qPCR positive for *Aspergillus* spp	15/19 (78.9%)	30/42 (71.4%)	4/11 (36.4%)
A. fumigatus CYP51A mutation detected directly from qPCR positive sample	6/8 (75%)	12/24 (50%)	NT

Denning, Clin Infect Dis 2011;52:1123

Evaluation of processing methods for Aspergillus – sputa and bronchoscopy samples

Literature review

2 papers

Journal of Microbiological Methods 85 (2011) 75–81

Homogenisation of cystic fibrosis sputum by sonication — An essential step for *Aspergillus* PCR

Caroline G. Baxter [a,b,c,*], Andrew M. Jones [b,c], Kevin Webb [b,c], David W. Denning [a,c]

[a] *The National Aspergillosis Centre, University Hospital of South Manchester, Southmoor Road, Manchester, M23 9LT, UK*
[b] *Manchester Adult Cystic Fibrosis Unit, University Hospital of South Manchester, Southmoor Road, Manchester, M23 9LT, UK*
[c] *The University of Manchester and the Manchester Academic Health Science Centre, Oxford Road, Manchester, M13 9PL, UK*

Medical Mycology May 2012, **50,** 433–438

informa
healthcare

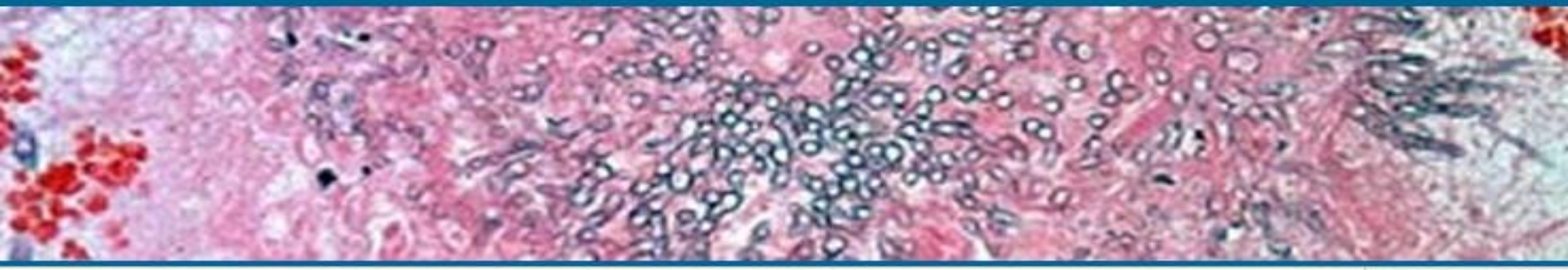
Routine processing procedures for isolating filamentous fungi from respiratory sputum samples may underestimate fungal prevalence

CATHERINE H. PASHLEY, ABBIE FAIRS, JOSEPH P. MORLEY, SHREEYA TAILOR, JOSHUA AGBETILE, MONA BAFADHEL, CHRISTOPHER E. BRIGHTLING & ANDREW J. WARDLAW

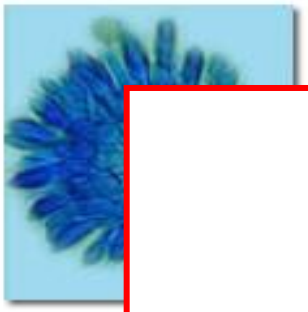
Institute for Lung Health, Department of Infection, Immunity and Inflammation, University of Leicester, Leicester, UK

Web www.aspergillus.org.uk

Patients | Scientific Information | Medical Information | Images | Educational Materials | Library



The Aspergillus Website



The **Aspergillus website** is a worldwide comprehensive resource providing a wide range of information about the **fungus Aspergillus** and the diseases - such as **Aspergillosis** that

WWW.aspergillus.org.uk

14 years ……

Over 2M pages read monthly in >125 countries

Supported by the Fungal Research Trust – 20 year anniversary in 2011

Aspergil… aspergillosis, ABPA, CPA and aspergilloma. Some asthma patients with very severe asthma may also be sensitised to fungi like aspergillus (SAFS). There is a section devoted to the needs of patients, friends and family suffering from the effects of Aspergillosis.

The UK's fi… centre is supported by the Regional Mycology Lab which also provides both air sampling and mould identification services for domestic and working environments.

New section on drug interactions which you can search very quickly

Aspergillosis may affect patients whose immune system may be compromised - including those with **leukaemia, chemotherapy patients or those on steroids, transplant patients, cystic fibrosis, HIV or AIDS, chronic obstructive pulmonary disease (COPD), chronic granulomatous disease (CGD), severe asthma with fungal sensitivity (SAFS) and many others.**

Aspergillus does not solely affect humans; **birds and animals can also develop aspergillosis**, and some plant

search

Useful links

- Site upda…
- What is a…
- Register …
- Passwor…
- Aspergill…
- Editorial …

…pular

- Patients …
- Latest art…
- Newslette…
- Blog
- Patients …
- Job adver…
- RSS new…

Headlines

A new database … discover any inter… other drugs a pati…
2011-06-10
Patients website

www.LIFE-Worldwide.org

HOME | ABOUT US | FUNGAL DISEASES | AWARENESS & ADVOCACY | MEDICAL COMMUNITY | MEDIA CENTRE | SUPPORT US | Search

LIFE LEADING INTERNATIONAL FUNGAL EDUCATION

Fungal Research Trust

FUNGAL DISEASES | AWARENESS & ADVOCACY | MEDICAL COMMUNITY

ACCESS TO LIFE SAVING FUNGAL DIAGNOSTICS IS FAR FROM UNIVERSAL.

THIS CAN CHANGE

GET THE FACTS >> VIEW

VISIT THE GALLERY >> VIEW

WELCOME TO LIFE

AWARENESS. EDUCATION. SAVING LIVES

Over 300 million people are acutely or chronically infected by fungi, leading to death, long term illness, blindness, psychological problems and reduced work capacity. Many recent improvements in diagnostics and treatment have not reached treating clinicians in all countries, and access to appropriate diagnostics and simple antifungal agents is far from universal. This needs to change.

LIFE is a growing organisation. It is led by Professor David Denning who has been caring for patients with fungal infection for 25 years. He leads the National Aspergillosis Centre, UK (the first national clinical centre devoted to any fungal disease) and manages a clinical and laboratory research team.

>> LEARN MORE

OUR SUPPORTERS

The Manchester Museum | Fungal Research Trust | MAHSC | NHS | UHSM Your Hospital | MANCHESTER 1824 The University of Manchester