Aspergillosis – new data and challenges

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Agenda

How many patients are there with serious fungal infection?

SAFS

Diagnostics – progress and gaps

Voriconazole TDM

600 different fungi are human pathogens

Resistance and Virulence changes

Globalization

More species extinction due to fungi than bacteria or viruses

Chytridiomycosis in amphibian spp

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Tackling Human Fungal Infections

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FUNGI INFECT BILLIONS OF PEOPLE EVERY YEAR, YET THEIR CONTRIBUTION TO THE GLOBAL BURDEN of disease is largely unrecognized. Most are "relatively" minor infections, but millions contract diseases that kill at least as many people as tuberculosis or malaria. Although true mortality rates are unknown because of a lack of good epidemiological data, the incidence of invasive fungal infections is rising as a result of modern medical interventions and immu-

Online

sciencemag.org

Podcast interview (http://scim.ag/ed_6082) with author Gordon D. Brown.

The size of the problem

Over 300 million people affected by serious Fungal Infection worldwide

www.fungalresearchtrust.org/HowCommonareFungalDiseases5.pdf

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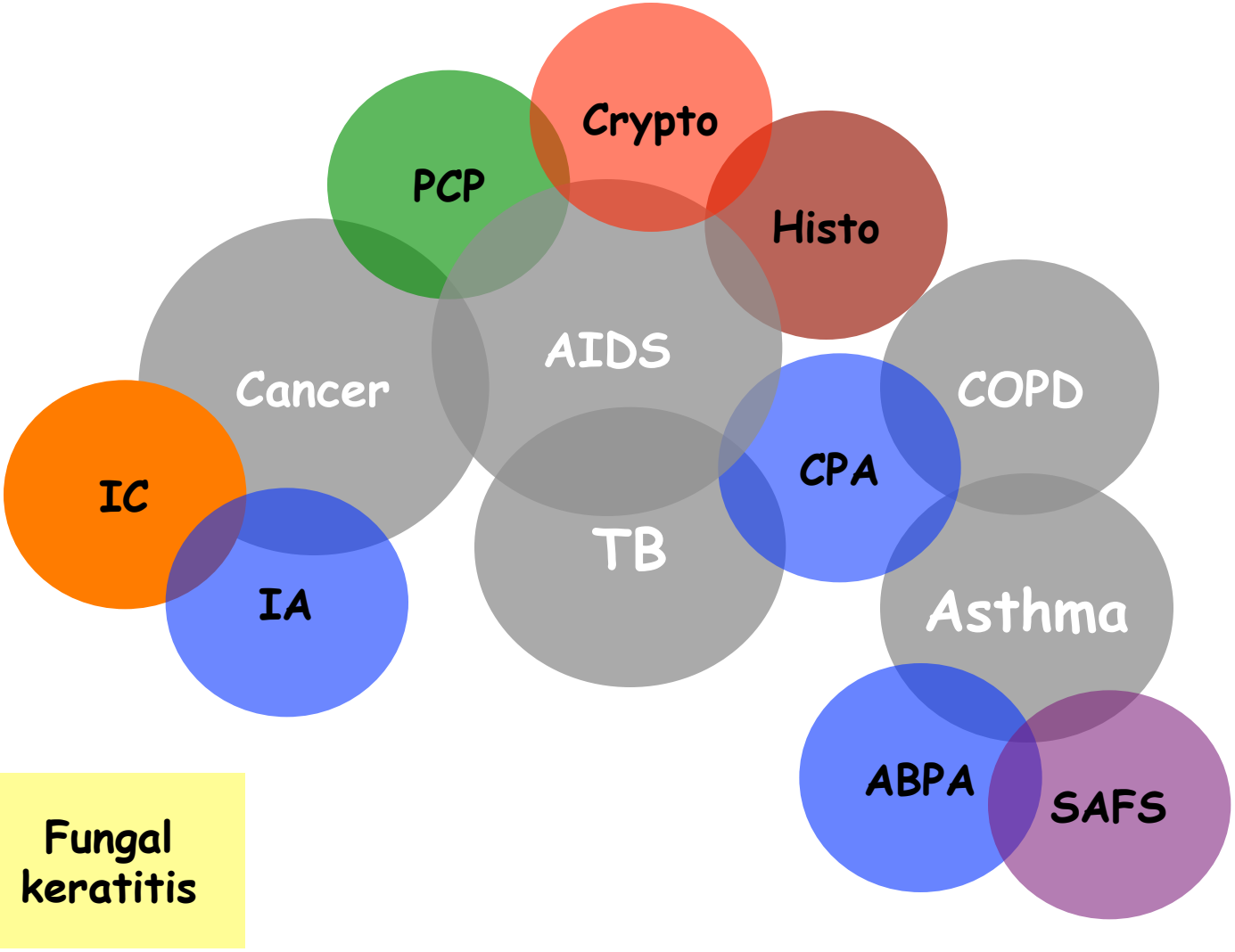
Disease **Most common species**	**Location**	**Estimated Life-Threatening Infections / Year at that Location**[a]	**Mortality Rates** (% in infected populations)[a]
Opportunistic Systemic Mycoses			
Aspergillosis *Aspergillus fumigatus*	worldwide	>200,000	30 - 95%
Candidiasis *Candida albicans*	worldwide	>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.*

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



The size of the problem

Fungal Infection	Global burden of serious fungal infection (estimates by underlying disease)				
	None	HIV/AIDS	Respiratory	Immune deficit / Cancer	Critical care
Cryptococcal meningitis					
Pneumocystis pneumonia					
Invasive aspergillosis					
Chronic pulmonary aspergillosis					
Fungal eye infection					
Fungal hair infection					

The size of the problem

Fungal Infection	Global burden of serious fungal infection (estimates by underlying disease)				
	None	HIV/AIDS	Respiratory	Immune deficit / Cancer	Critical care
Cryptococcal meningitis	1,000's	1,000,000		1,000's	
Pneumocystis pneumonia		>200,000		>100,000	
Invasive aspergillosis			>100,000	>50,000	>50,000
Chronic pulmonary aspergillosis			3,000,000		
Fungal eye infection	1,000,000				
Fungal hair infection	200 million				

The size of the problem

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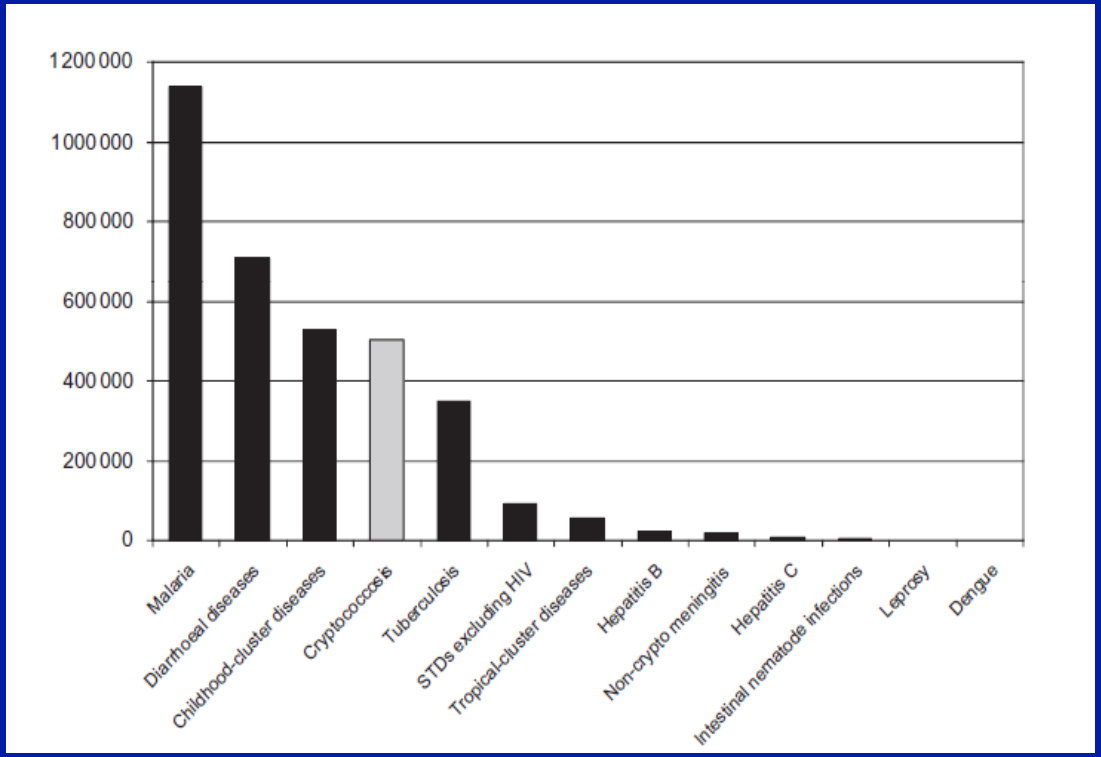
Chronic pulmonary aspergillosis			3,000,000		
Fungal eye infection	1,000,000				
Fungal hair infection	~~200 million~~				

Topic 5: The tremendous burden of cryptococcal meningitis in sub-Saharan Africa in persons with HIV/AIDS

Incidence 3,2%, 720,000 cases (144,000-1,3 million)
90d fatality: 90%



Park BJ et al. AIDS 2009

Comparison of deaths in sub-Saharan Africa due to HIV-related cryptococosis, and common infectious diseases excluding HIV, as estimated by WHO

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

The size of the problem

Fungal Infection	Global burden of serious fungal infection (estimates by underlying disease)				
	None	HIV/AIDS	Respiratory	Immune deficit / Cancer	Critical care
Candida infections					
Oral thrush		9,500,000	100,000's	millions	
Oesophageal candidasis		2,000,000			
Candida vaginitis 4x/yr	>75 million				
Candidaemia				100,000	200,000
Candida peritonitis					75,000

The size of the problem

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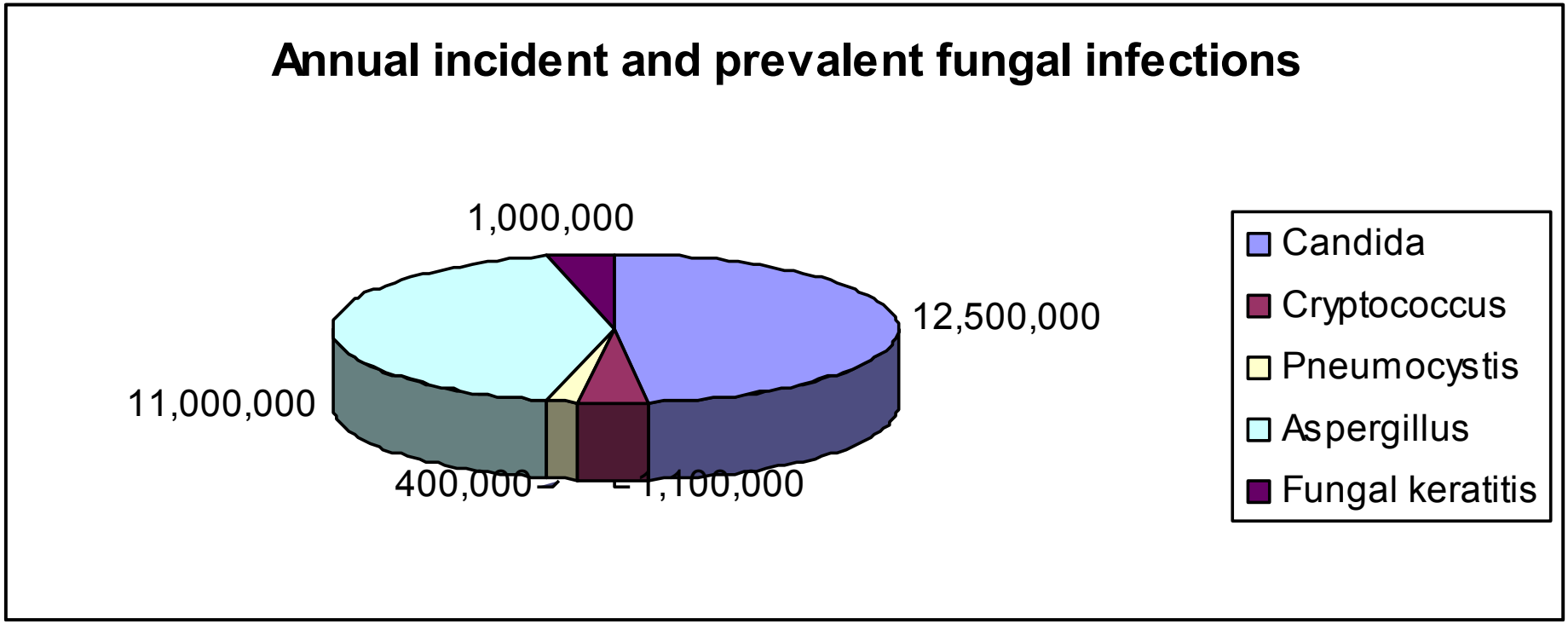
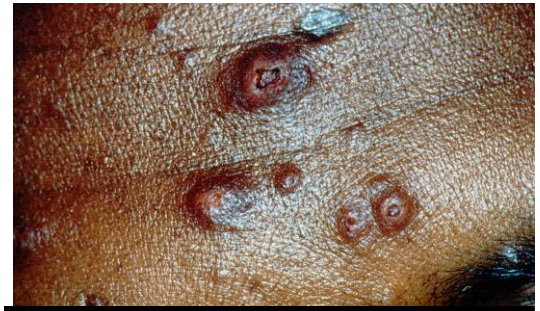
The size of the problem

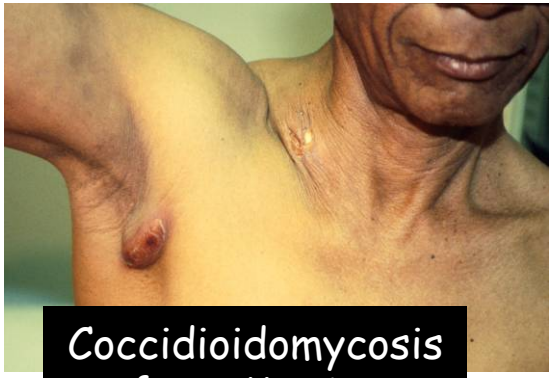
~24 million patients affected each year



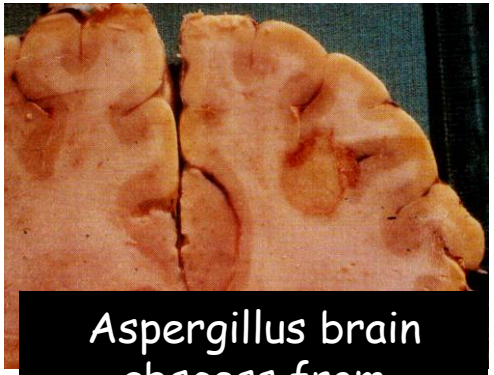
Some fungal infections



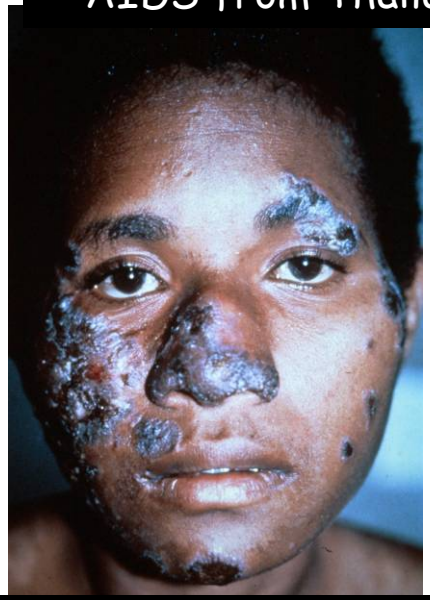
Disseminated *Penicillium marneffei* infection in AIDS from Thailand



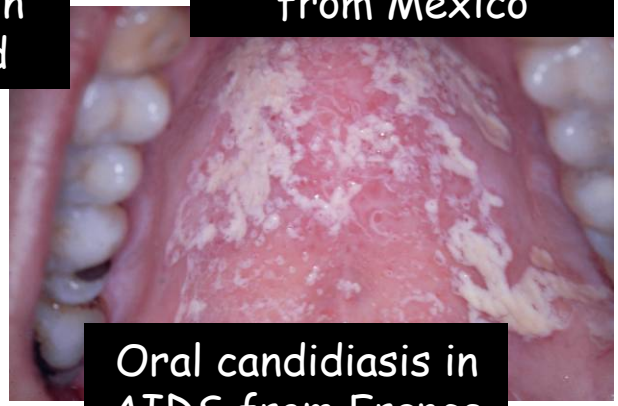
Coccidioidomycosis from Mexico



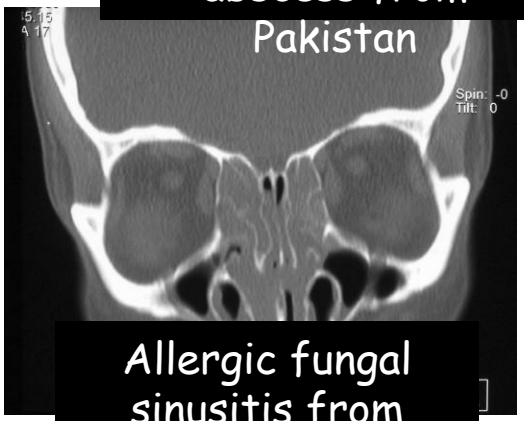
Aspergillus brain abscess from Pakistan



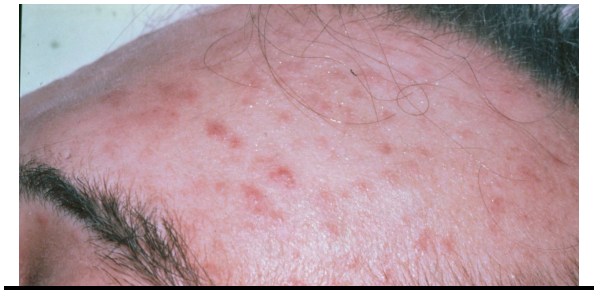
Chromoblastomycosis from PNG



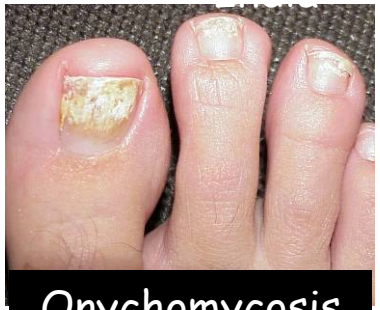
Oral candidiasis in AIDS from France



Allergic fungal sinusitis from

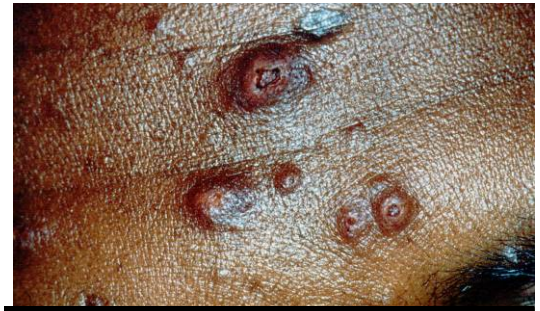


Disseminated histoplasmosis in AIDS



Onychomycosis from UK

Some fungal infections



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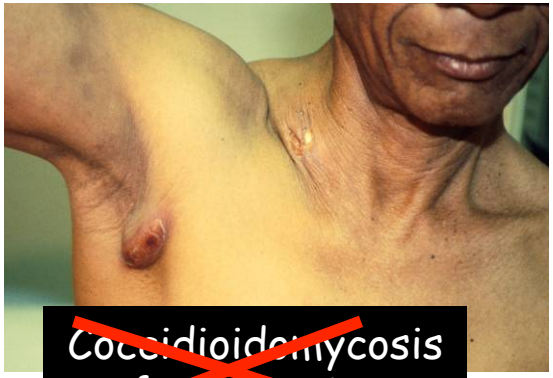

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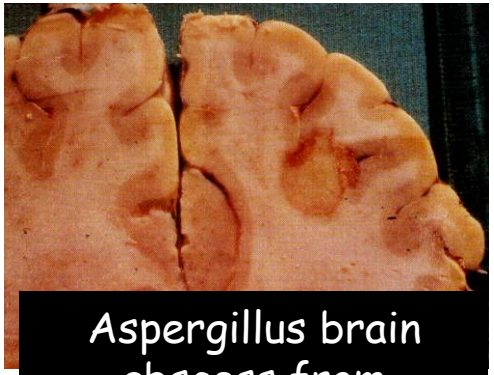

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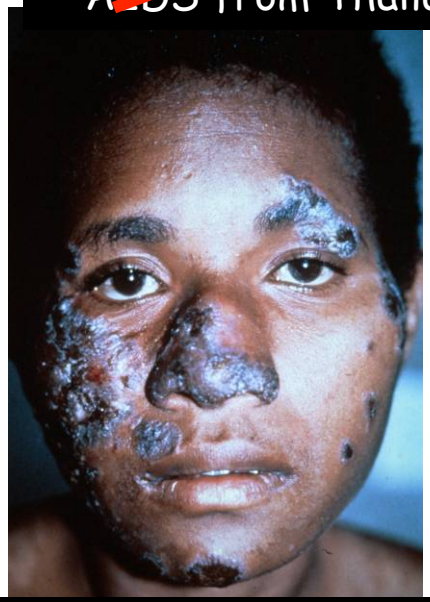

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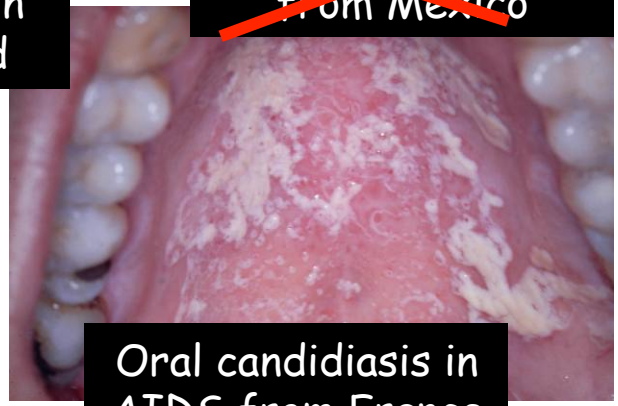

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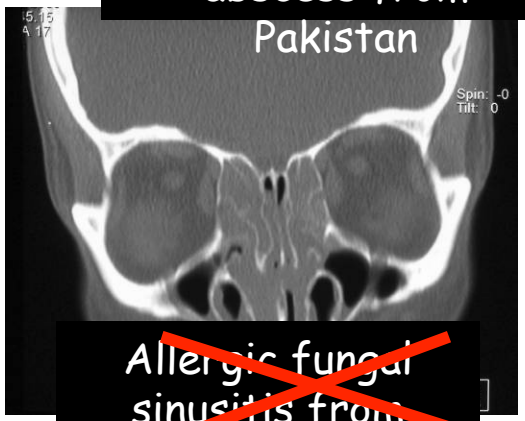

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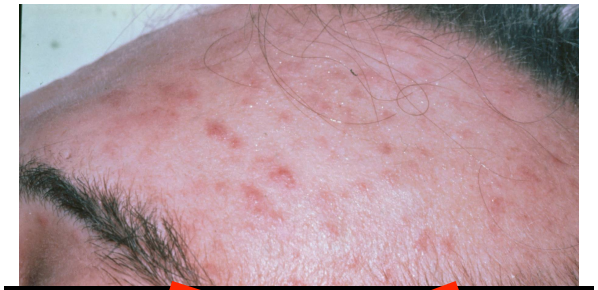

Disseminated histoplasmosis in AIDS

Onychomycosis from UK

The severity of the problem

Deaths per year

- Cryptococcal meningitis – 10% death rate in the USA, >80% in Africa. 600,000 deaths.
- Invasive aspergillosis – 50% mortality treated, 100% if not. >100,000 deaths
- Chronic pulmonary aspergillosis – 15% annual mortality, 450,000 deaths.
- Pneumocystis pneumonia - ~15% mortality in AIDS, ~50% non-AIDS, >80,000 deaths.
- Candida bloodstream infection - ~40% mortality, 120,000 deaths
- SAFS – increased risk of asthmatic death (estimated to be 100,000 annually worldwide)

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Reality check with TB

	TB (2008)	Fungal Infection
Incident cases	**9-10 million**	**>14 million**
Prevalent cases	**10-13 million**	**~285 million**
HIV related deaths	**~550,000**	**~650,000**
Non-HIV related deaths	**~1,500,000**	**>700,000**

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Chronic fungal infections

Fungal Infection	Global burden of serious fungal infection (estimates by underlying disease)				
	None	HIV/AIDS	Respiratory	Immune deficit / Cancer	Critical care
Cryptococcal meningitis	1,000's	1,000,000		1,000's	
Pneumocystis pneumonia		>200,000		>100,000	
Invasive aspergillosis			>100,000	>50,000	>50,000
Chronic pulmonary aspergillosis			3,000,000		
Fungal eye infection	1,000,000				
Fungal hair infection	200 million				

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Recurrent and chronic fungal infections

Fungal Infection	Global burden of serious fungal infection (estimates by underlying disease)				
	None	HIV/AIDS	Respiratory	Immune deficit / Cancer	Critical care
Candida infections					
Oral thrush		9,500,000	100,000's	millions	
Oesophageal candidasis		2,000,000			
Candida vaginitis 4x/yr	>75 million				
Candida bloodstream infection				100,000	200,000
Allergic lung disease					
ABPA			4,000,000		
SAFS			>3,500,000		

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The severity of the problem

Ill health and morbidity

- Oral and oesophageal thrush – unpleasant, reduced food intake and weight loss.
- Candida vaginitis – anxiety and impaired sex life
- ABPA and SAFS – breathlessness with severe asthma, reducing work capability
- Chronic pulmonary aspergillosis – progressive breathlessness and weight loss
- Fungal eye infection – unilateral blindness
- Fungal hair infection – psychological problems and contagious

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Asthma and Aspergillus

79 adult asthmatics and 14 controls

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

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

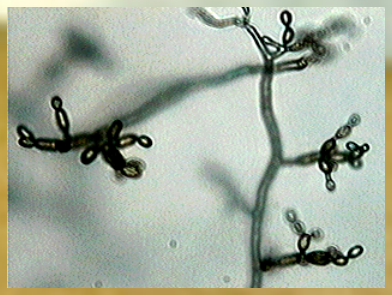
SAFS results

2

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

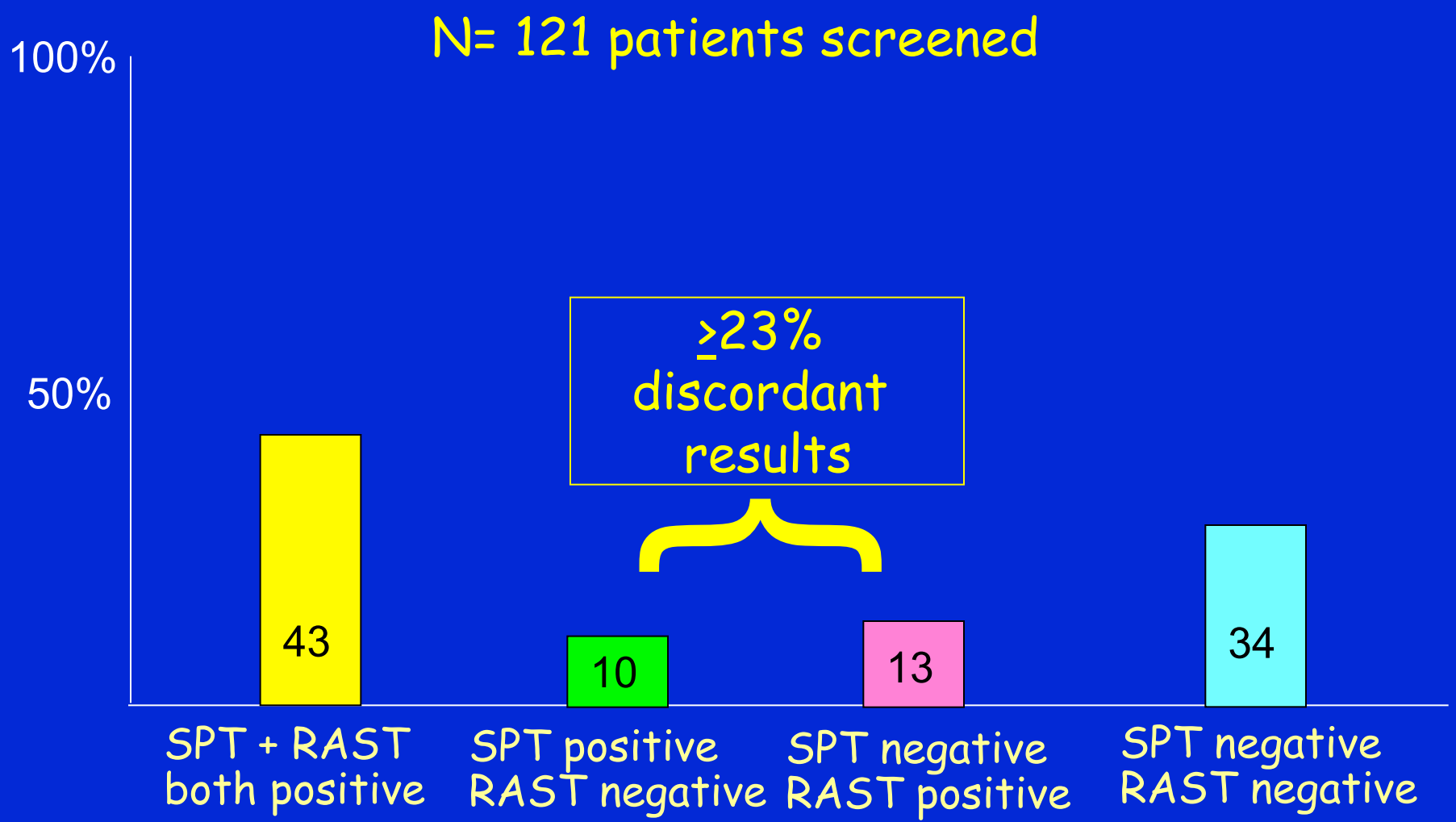
Skin prick testing – example of SAFS result

Cladosporium +ve



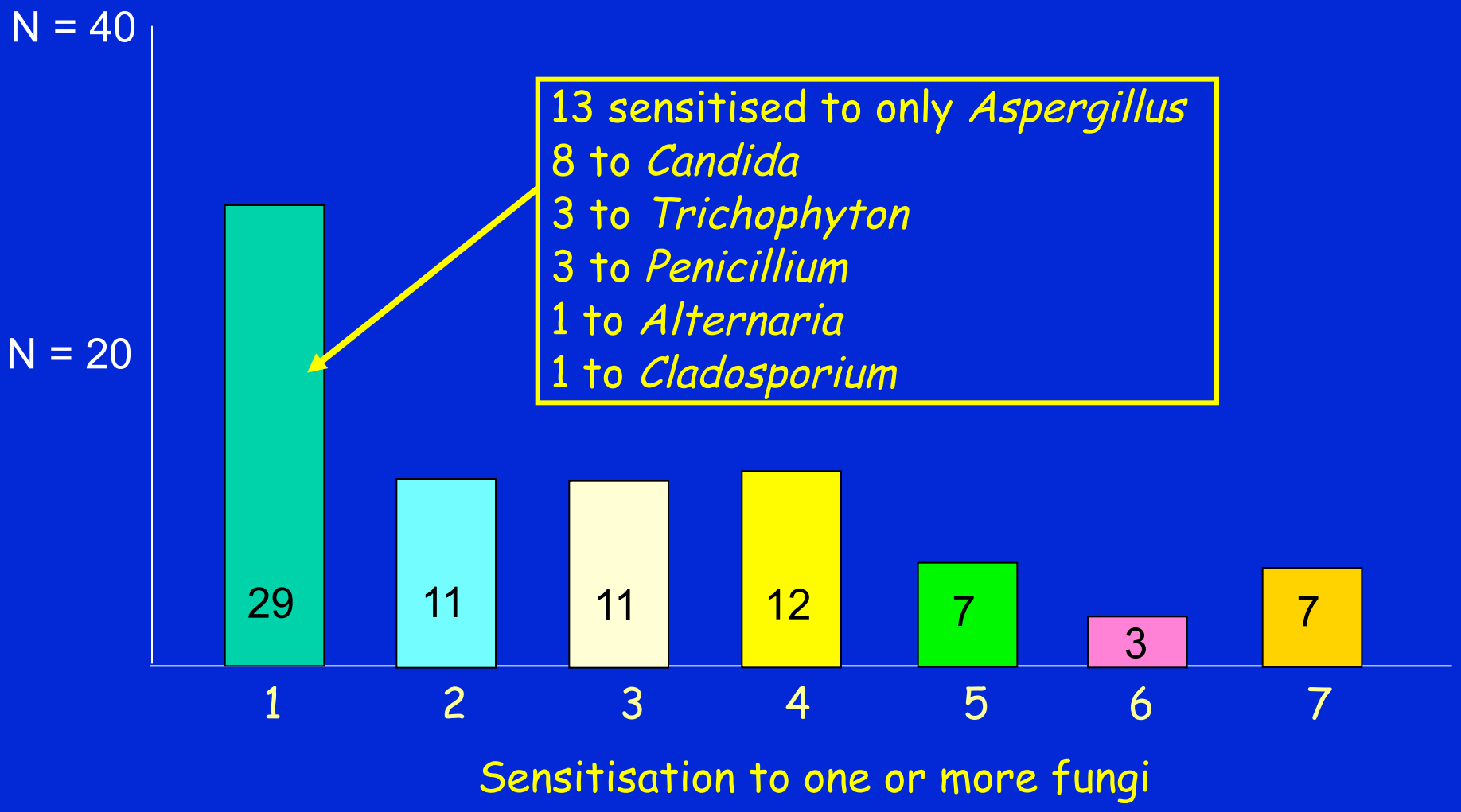
O' Driscoll, unpublished

Fungal sensitisation in severe asthma – skin prick test or RAST for diagnosis?



O' Driscoll et al, Clin Exp Allergy. In press

Fungal sensitisation in severe asthma - number sensitised to one or more fungi



O' Driscoll et al, Clin Exp Allergy. In press

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)	

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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	N/T	N/T	88.9% (8/9)	90.9% (20/30)	100% (2/2)
A. fumigatus	37.7% (40/106)	93.8% (15/16)	96.9% (94/97)	78.8% (41/52)	90.9% (20/30)
Alternaria alternata	10.0% (1/10)	100% (10/10)	77.5% (55/71)	32.5% (13/40)	47.4% (9/19)
C. albicans	33.3% (3/9)	90.0% (9/10)	81.4% (57/70)	37.5% (15/25)	52.6% (10/19)
Cladosporium herbarum	20.0% (2/10)	80.0% (8/10)	70.4% (50/71)	24.4% (10/41)	35.5% (6/17)
Penicillium chrysogenum	27.3% (3/11)	100% (10/10)	85.3% (58/68)	30.0% (12/40)	43.8% (7/16)
Trichophyton mentagrophyte	33.3% (2/6)	100% (3/3)	65.2% (30/46)	25.0% (9/36)	23.1% (3/13)

Unpublished

Randomised studies of antifungals and ABPA and/or asthma

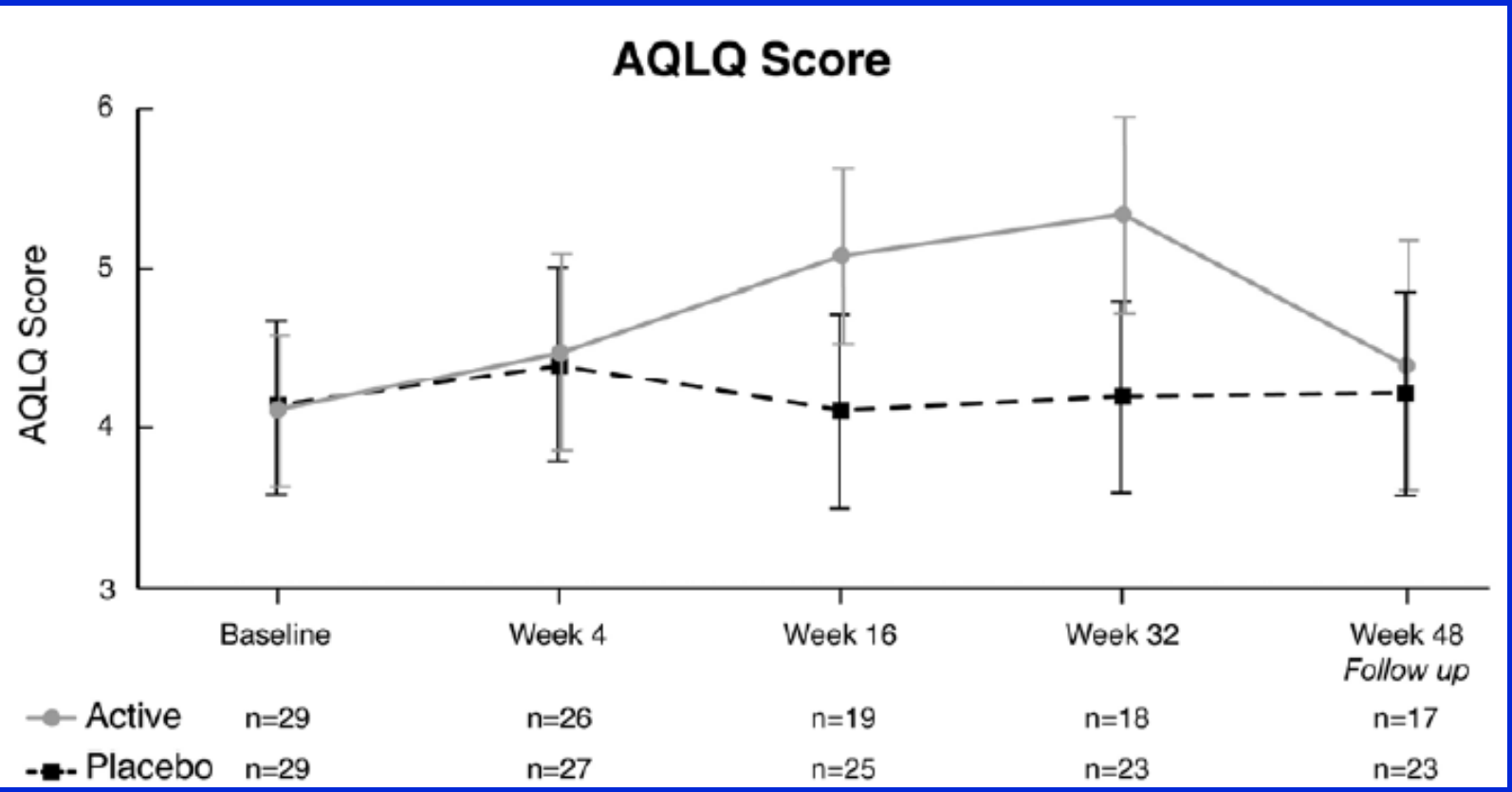
Disease	Antifungal, duration	Benefit?	Author, year
ABPA	Natamycin inh, 52 wks	No	Currie, 1990
ABPA	Itraconazole, 32 wks	Yes	Stevens, 2000
ABPA	Itraconazole, 16 wks	Yes	Wark, 2003
"Trichophyton" asthma	Fluconazole, 20 wks	Yes	Ward, 1999
SAFS	Itraconazole, 32 wks	Yes	Denning, 2009

Therapy of allergic aspergillosis

Therapy	Typical dose	Typical duration	Objectives of therapy	Monitoring	Comments
Prednisone (prednisolone)	Adults 40-50 mg qd Pediatrics 0.5-1 mg/kg/day	10 days - 6 weeks, depending on response. Convert to alternate day prednisone after 1-2 weeks for longer term treatment.	Improvement of wheeze and allows resolution of mucoid impactions.	Chest radiograph and clinical. IgE slow to fall; expected to decline by 33% in 6 weeks. Blood glucose.	Attempt to stop in all patients; sometimes not possible.
Inhaled corticosteroids	Variable	Long term.	Asthma control. Of no proven value for exacerbation of ABPA.	PF, FEV-1, symptoms.	Interactions with itraconazole, increasing exposure.
Hypertonic saline, nebulized	5mL, 6% or 7% qd or bid	Exacerbations or long term.	Reduce viscosity of sputum to ease expectoration.	Sputum thickness, ease of expectoration and dyspnea.	Always challenge first dose under supervision, as bronchospasm an issue. Beware those with FEV-1 <1.0 L/sec.
Azithromycin	Adults 250 mg qd or 3x weekly	Long term.	Airway anti-inflammatory action.	Cough frequency and nocturnal wakening. Sputum production.	If no effect after ~2-3 months, should be stopped.
Omaluzimab	75-600 mg SC 2-4 weekly	Long term, if effective at 16 weeks.	Reduction in IgE-mediated asthma.	Asthma control.	Limited experience in ABPA.

Knutsen et al. J All Clin Immunol 2012;129:280

Proof of concept RCT of itraconazole Rx in Severe Asthma with Fungal Sensitisation – quality of life improvement



P= 0.014

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

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

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- 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.
- 6/23 (26%) patients on voriconazole had AEs requiring discontinuation before 6 months compared to none on posaconazole (p=0.15).
- 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]

Fungal Infection Impact

No studies assessing:

Disability Adjusted Life Years (DALY)
Quality Adjusted Life Years (QALY)
Quality-adjusted life expectancy (QALE)
Population health-related quality of life (HRQOL)

Diagnostic improvements in fungal diagnosis in last 20 years

- Aspergillus antigen testing
- Susceptibility testing of Candida and Aspergillus
- Chromagar
- CT scanning of the chest
- PCR for Pneumocystis, Aspergillus, Candida and Trichophyton
- Molecular identification of fungi and discovery of numerous cryptic species
- Direct identification from blood culture or agar plates
- Rapid dip-stick test for cryptococcal meningitis

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

Voriconazole TDM

The Effect of Therapeutic Drug Monitoring on Safety and Efficacy of Voriconazole in Invasive Fungal Infections: A Randomized Controlled Trial

Wan Beom Park,[1] Nak-Hyun Kim,[1] Kye-Hyung Kim,[1,a] Seung Hwan Lee,[2] Won-Seok Nam,[2] Seo Hyun Yoon,[2] Kyoung-Ho Song,[1] Pyoeng Gyun Choe,[1] Nam Joong Kim,[1] In-Jin Jang,[2] Myoung-don Oh,[1] and Kyung-Sang Yu[2]

[1]Department of Internal Medicine, and [2]Department of Clinical Pharmacology and Therapeutics, Seoul National University College of Medicine, Republic of Korea

110 patients randomised;
14% poor metabolizers [2C19A],
mean age 55 years,
77% hematologic disease

Primary outcome was a reduction in adverse events

Park et al, Clin Infect Dis 2012;55:advanced access

RCT of voriconazole TDM

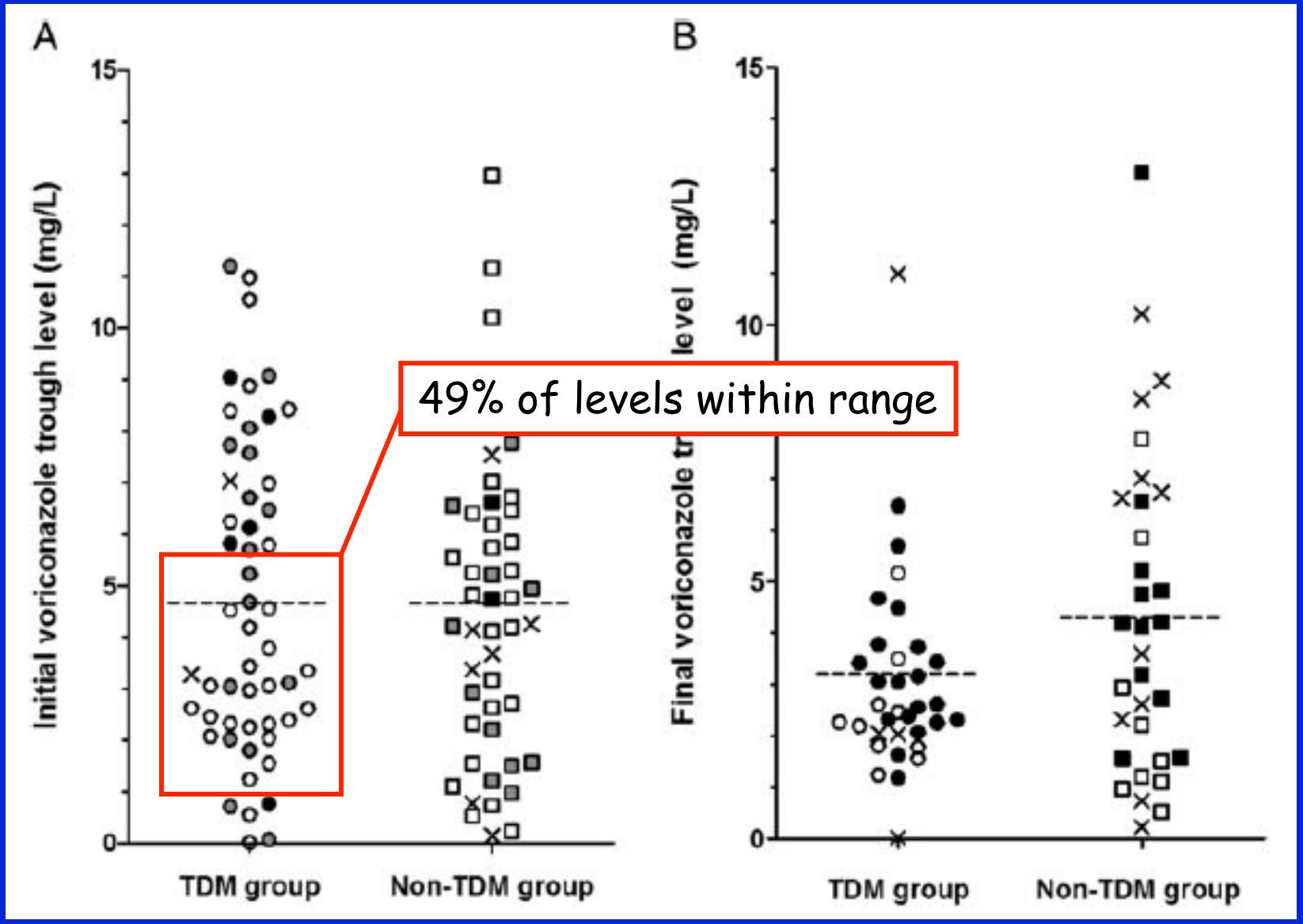
Prospective, assessor-blinded RCT with a 3 year enrolment
15 years +, enrolled with 4d of starting Vori [6mg/Kg x2 loading then 4mg/Kg 12hourly oral or IV] to

a. blood sampling on d4 and dose adjustment
b. no TDM

If TDM, target trough level was 1.0-5.5mg/L.
If <1.0mg/L, dose increased by 100%
If >10mg/L, 1 dose missed and dose reduced by 50%
If >5.5mg/L with an adverse event, same as >10mg/L
If >5.5mg/L with no adverse event, dose reduced by 50%
A switch to oral, or an interacting drug given TDM repeated after 4d

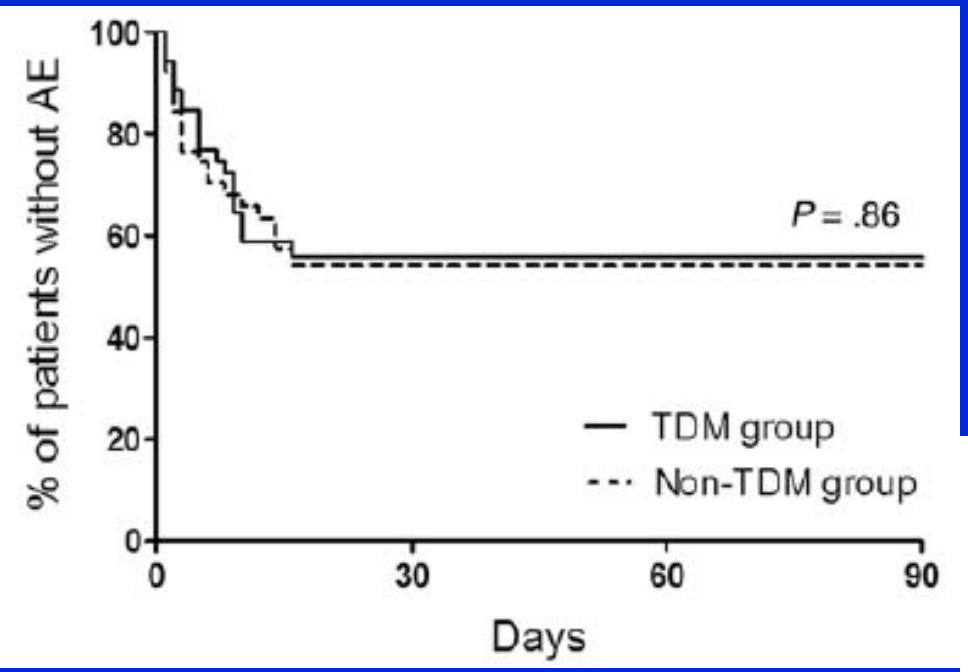
Park et al, Clin Infect Dis 2012;55:advanced access

RCT of voriconazole TDM



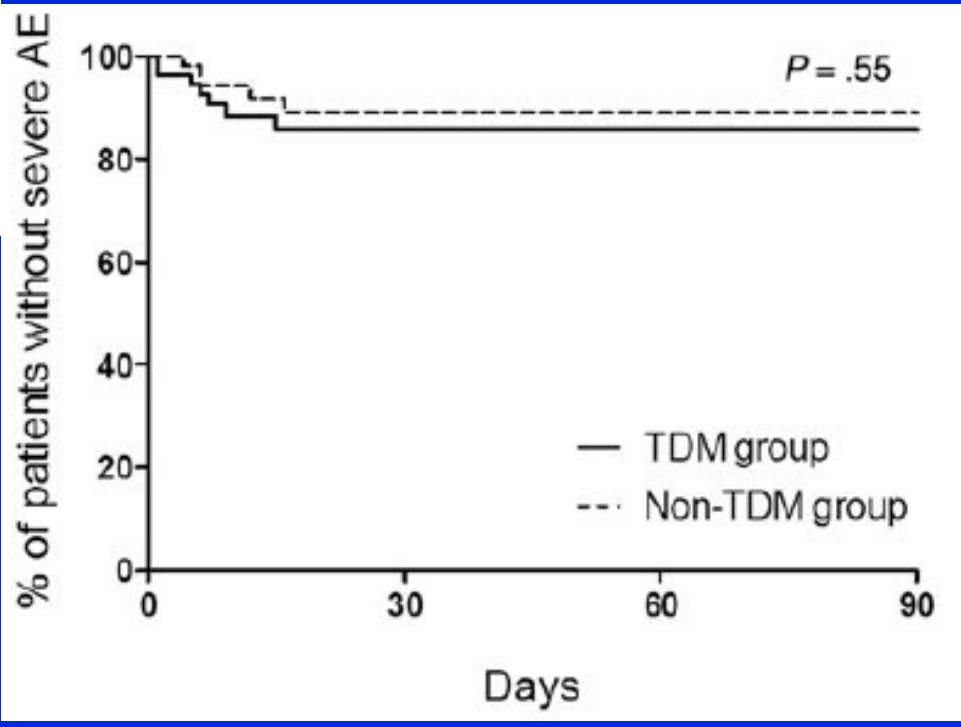
Park et al, Clin Infect Dis 2012;55:advanced access

RCT of voriconazole TDM



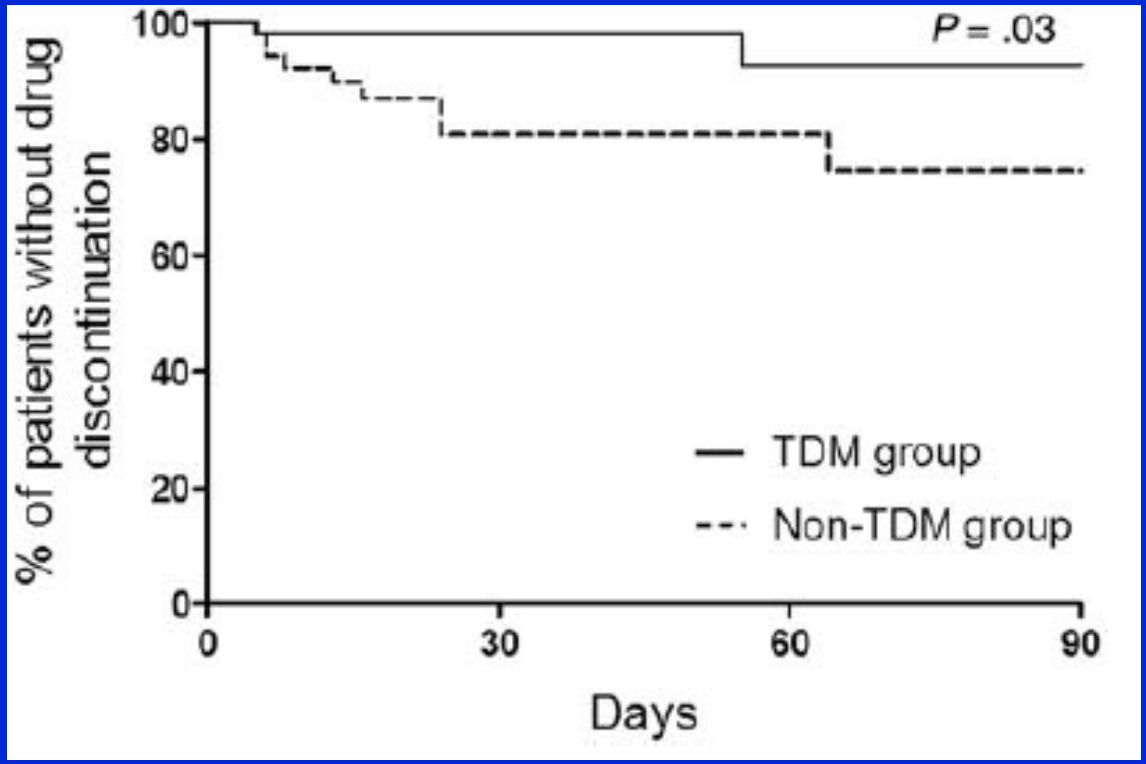
Any adverse event

Severe adverse event



Park et al, Clin Infect Dis 2012;55:advanced access

RCT of voriconazole TDM



Discontinuations

Park et al, Clin Infect Dis 2012;55:advanced access

RCT of voriconazole TDM

	TDM (n = 37)	Non-TDM (n = 34)	*P* Value
Treatment success	30 (81)	20 (59)	.04
Complete response	21 (57)	13 (38)	.12
Partial response	9 (24)	7 (21)	.71
Stable response	1 (3)	2 (6)	.60
Treatment failure	6 (16)	12 (35)	.07

Survival

	6 weeks	12 weeks	
TDM	80%	76%	
Non -TDM	66%	60%	p=0.14

Park et al, Clin Infect Dis 2012;55:advanced access

Lower level and treatment success

Voriconazole trough level (mg/L)	Sensitivity (%)	Specificity (%)
≥ 0.5	100	18
≥ 1.0	95	27
≥ 1.5	88	36
≥ 2.0	73	46
≥ 2.5	55	82

Park et al, Clin Infect Dis 2012;55:advanced access

Upper level and adverse events

Voriconazole trough level (mg/L)	Sensitivity (%)	Specificity (%)
≥ 4.5	85	38
≥ 5.0	80	51
≥ 5.5	80	62
≥ 6.0	75	71
≥ 6.5	70	80

Park et al, Clin Infect Dis 2012;55:advanced access

Challenging Recommended Oral and Intravenous Voriconazole Doses for Improved Efficacy and Safety: Population Pharmacokinetics–Based Analysis of Adult Patients With Invasive Fungal Infections

Andres Pascual,[1,a] Chantal Csajka,[2,4,a] Thierry Buclin,[2] Saskia Bolay,[1] Jacques Bille,[3] Thierry Calandra,[1] and Oscar Marchetti[1]

[1]Infectious Diseases Service, [2]Division of Clinical Pharmacology and Toxicology, Department of Medicine, and [3]Institute of Microbiology, Centre Hospitalier Universitaire Vaudois, University of Lausanne, and [4]Department of Pharmaceutical Sciences, University of Geneva, Switzerland

Population PK (NONMEM) analysis on 505 samples in 55 patients receiving voriconazole

Suggest a minimum target of 1.5mg/L (>85% chance of response) and maximum of 4.5mg/L (<15% chance of neurotoxicity)

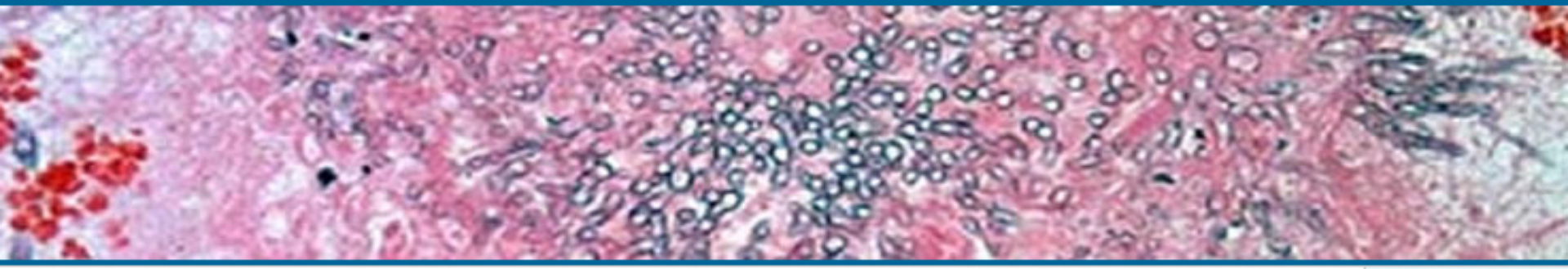
IV doses OK, with TDM

Oral doses should be higher: 300-400mg twice daily, with TDM

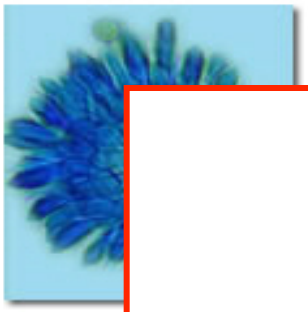
Pascual et al, Clin Infect Dis 2012;55:381

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

13 years and counting

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

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- Latest art
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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

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MANCHESTER 1824 The University of Manchester