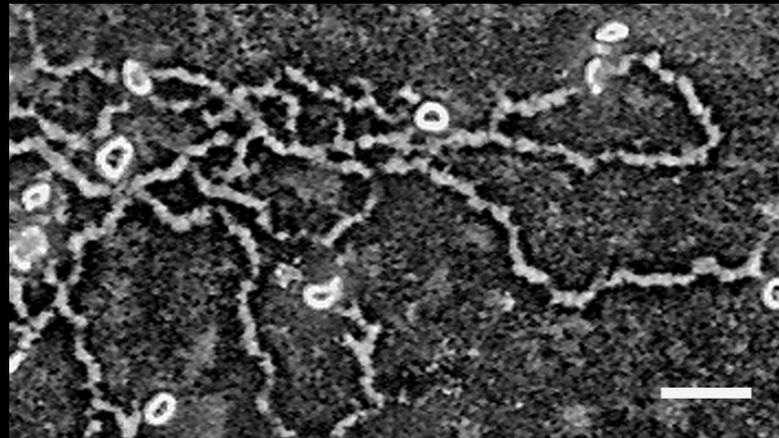


# Resistance of *Acanthamoeba* Cysts to Disinfection in Multiple Contact Lens Solutions



S. P. Johnston, R. Sriram, Y. Qvarnstrom, S. Roy, and GS.Visvesvara

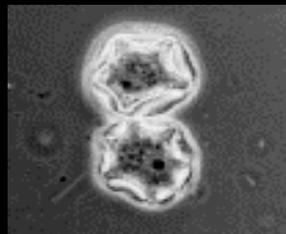
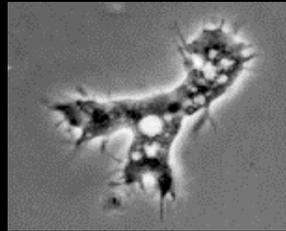
Division of Parasitic Diseases, CDC, Atlanta, GA

# Isolation of *Acanthamoeba* From:

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- ♣ Fresh & Frozen Antarctic Water, Brackish & Sea Water
- ♣ Swimming Pools, Hot Springs, Spa, Hot Tubs
- ♣ Power Plant Effluents
- ♣ **Toxic waste dumpsites with high levels of pesticides, herbicides, pharmaceuticals, heavy metals, PCBs**
- ♣ Dust in the air
- ♣ HVAC
- ♣ Ocean Sediments, Sewage, Soil, Compost
- ♣ Vegetables, Mushrooms
- ♣ Fish, Reptiles, Birds, Mammals
- ♣ Medicinal Pools, Dental Equipment, Gastric Washings, IUCD
- ♣ Cell Cultures, Human Nasal Sinuses, Throat, Intestines, Cornea, Skin Lesions, CNS
- ♣ Contact Lens Paraphernalia

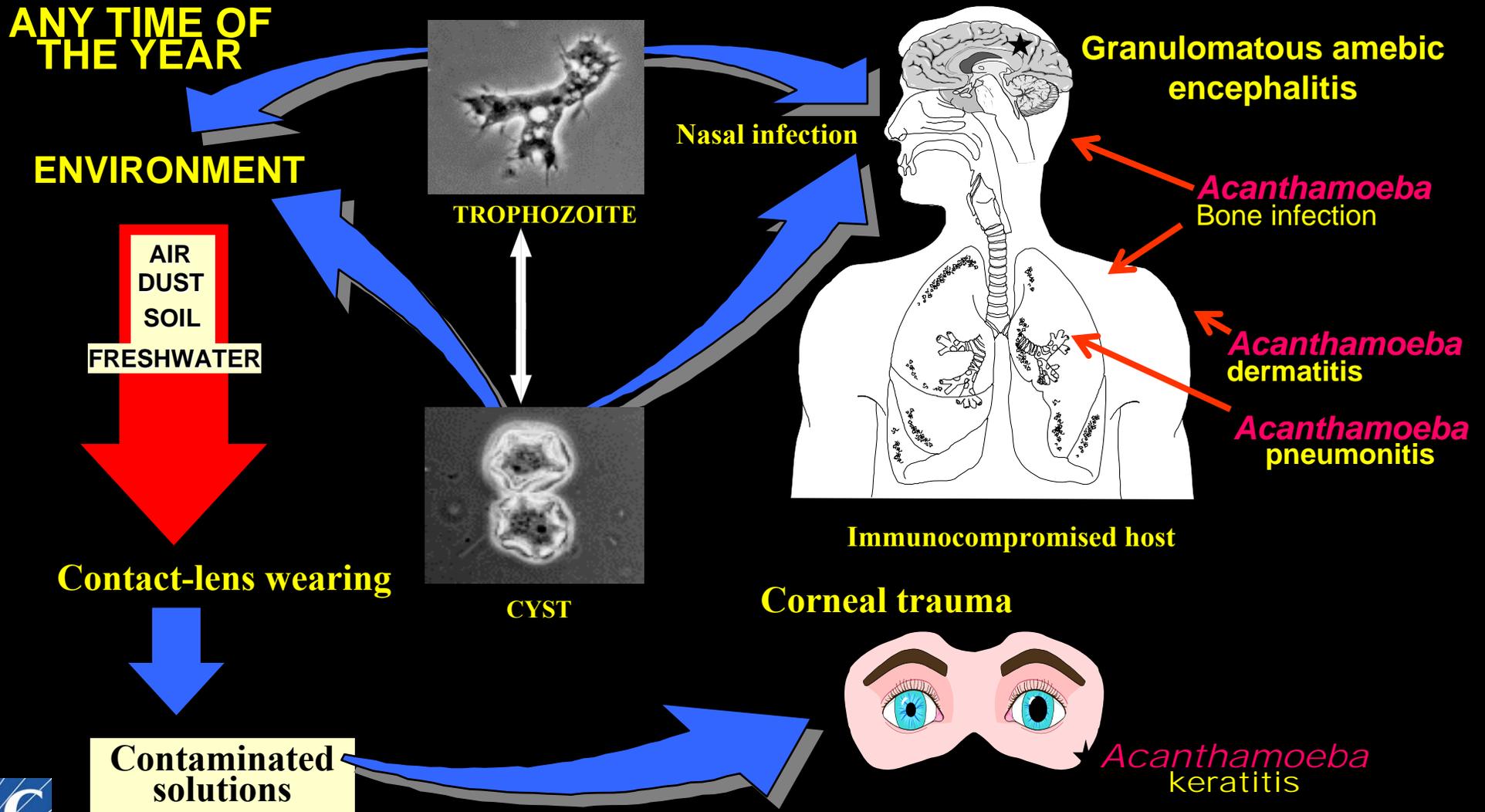
TROPHOZOITE



CYST

**Bacteria  
Feeder**

# Infections Due to *Acanthamoeba* spp.



# *Acanthamoeba* Keratitis

- ♣ *Acanthamoeba* keratitis (AK) is a painful, vision-threatening infection
- ♣ Leads to ulceration of the cornea, loss of visual acuity, and eventually blindness and enucleation



# *Acanthamoeba Keratitis (AK)*

- ♣ **AK occurs in immunocompetent individuals**
- ♣ **Associated with trauma to the cornea or commonly in contact lens wearers as a result of poor lens care hygiene**
- ♣ **The first case of AK in the United States occurred in 1973 in a south Texas rancher following trauma to his right eye**
- ♣ **Both trophozoites and cyst stages of *Acanthamoeba polyphaga* were demonstrated in corneal sections**
- ♣ **Cases have continued to increase sporadically since 1985 due to the popularity of daily wear or extended wear soft contact lenses**

# *Acanthamoeba Keratitis (AK)*

- ♣ **A recent study indicated a dramatic increase in AK cases in the Chicago, IL area during May 1, 2003 and September 15, 2006**
- ♣ **CDC conducted a survey of 22 ophthalmology centers in February 2007, which revealed a national increase in the number of AK cases starting in 2004 and continuing through 2007**
- ♣ **A subsequent investigation identified the use of Advanced Medical Optics Complete® Moisture Plus™ multipurpose contact lens solution as a primary risk factor leading to an international recall by the manufacturer  
(Joslin 2007; Verani – MMWR 2007)**

# Materials & Methods

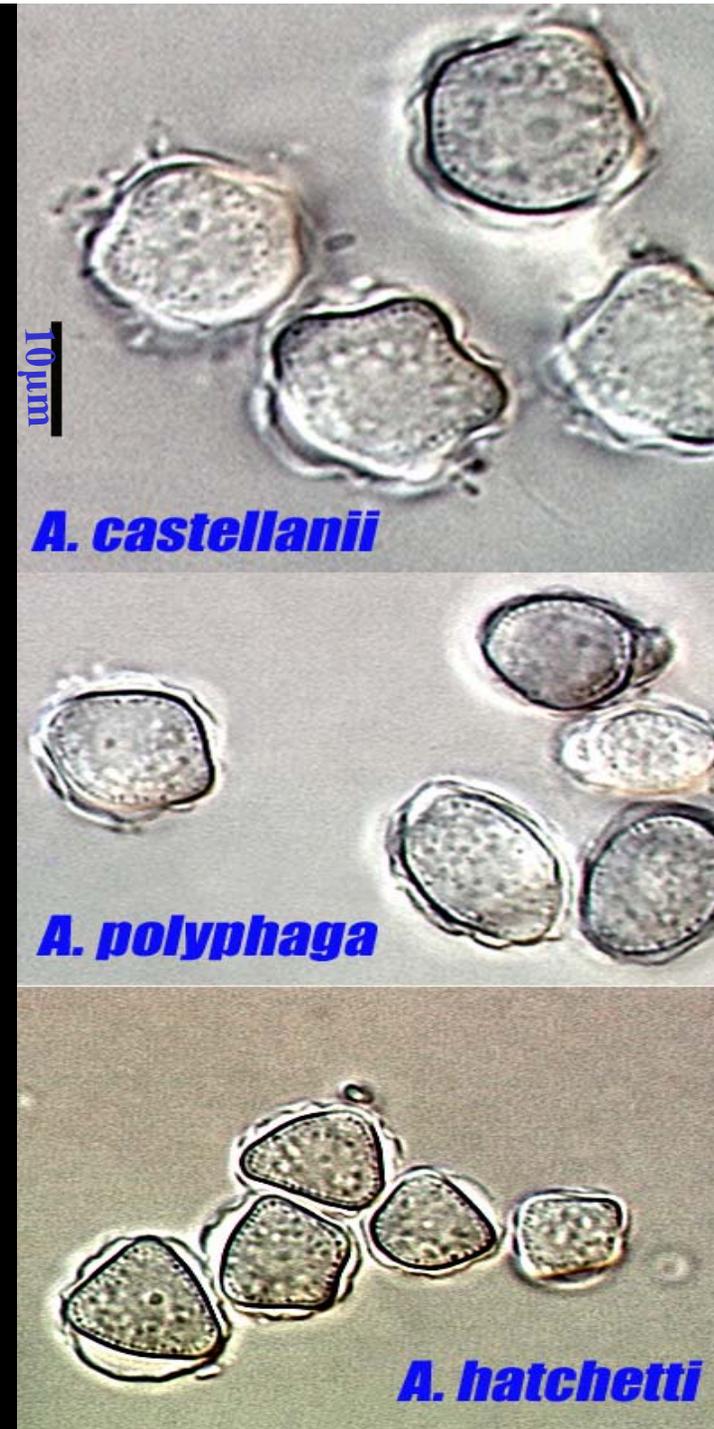
## ♣ Eleven different contact lens solutions

- ♣ Alcon OPTI-CLEAN® II
- ♣ Alcon OPTI-FREE® *Express*
- ♣ Alcon OPTI-FREE® Replenish
- ♣ AMO Complete® Moisture Plus
- ♣ AMO UltraCare®
- ♣ B&L Boston Simplus®
- ♣ B&L ReNu MoistureLoc®
- ♣ B&L ReNu MultiPlus®
- ♣ CibaVision ClearCare®
- ♣ Ciba Vision AQuify®
- ♣ Kirkland Signature Multi-Purpose Solution

All purchased from retail stores in the Atlanta area

# Materials & Methods

- ♣ Three species of *Acanthamoeba* (*A. castellanii*, *A. polyphaga*, and *A. hatchetti*) all belonging to Genotype T4 (Images A-C) were used in this study
- ♣ All isolated from specimens collected during a 2007 outbreak of *Acanthamoeba* keratitis



# **Materials & Methods**

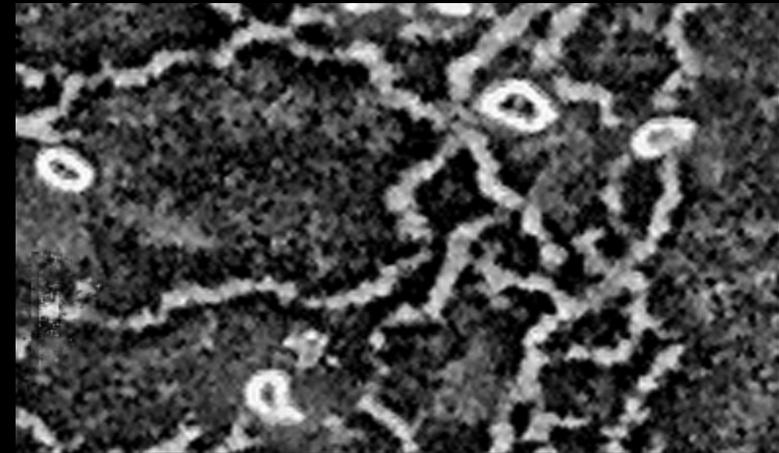
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- ♣ Amebae were grown on agar plates coated with bacteria
- ♣ Morphologic and Genotypic analysis performed and the amebae were allowed to differentiate into cysts
- ♣ Cysts were suspended in ameba saline and adjusted to yield 100 cysts per 10  $\mu$ l
- ♣ Ten microliters of the cyst-containing ameba saline was added to one ml of each Multipurpose CL solution (in triplicate)
- ♣ Incubated at 24°C for 4 or 6 (according to manufacturer's recommendations) and 24 hours

# Materials & Methods

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- ♣ Solutions were washed by centrifugation
- ♣ Inoculated on agar plates coated with *E. coli*
- ♣ Incubated at 24°C
- ♣ Plates examined daily for 2 weeks with inverted microscope for the presence of trophozoites or tracks
- ♣ Efficacy of solutions was scored qualitatively



## RESULTS

### **Efficacy of CL solutions Against *Acanthamoeba* spp.**

Contact Lens Solution	Active Ingredients	<i>A. castellanii</i>				<i>A. polyphaga</i>				<i>A. hatchetti</i>			
		Plates +		% +		Plates +		% +		Plates +		% +	
		4-6 h	24 h	4-6 h	24 h	4-6 h	24 h	4-6 h	24 h	4-6 h	24 h	4-6 h	24 h
Alcon OPTI-CLEAN® II	PolyQuad® 0.001%	3/3	100%	3/3	100%	3/3	100%	3/3	100%	3/3	100%	3/3	100%
Alcon OPTI-Free® Express	Polyquad® ALDOX®	3/3	100%	3/3	100%	3/3	100%	3/3	100%	3/3	100%	3/3	100%
Alcon OPTI-Free® Replenish	Propylene glycol PolyQuad® 0.001%ALDOX® 0.0005%	3/3	100%	3/3	100%	3/3	100%	3/3	100%	3/3	100%	3/3	100%

## RESULTS

### Efficacy of CL solutions Against *Acanthamoeba* spp.

Contact Lens Solution	Active Ingredients	<u><i>A. castellanii</i></u>				<u><i>A. polyphaga</i></u>				<u><i>A. hatchetti</i></u>			
		Plates + 4-6 h	% + 4-6 h	Plates + 24 h	% + 24 h	Plates + 4-6 h	% + 4-6 h	Plates + 24 h	% + 24 h	Plates + 4-6 h	% + 4-6 h	Plates + 24 h	% + 24 h
AMO Complete ® MoisturePlus	PHMB®0.0001 %, Polaxamer237	3/3	100%	3/3	100%	3/3	100%	3/3	100%	3/3	100%	3/3	100%
AMO UltraCare®	3% Hydrogen peroxide	3/3	100%	3/3	100%	3/3	100%	3/3	100%	3/3	100%	3/3	100%

# RESULTS

## **Efficacy of CL solutions Against *Acanthamoeba* spp.**

Contact Lens Solution	Active Ingredients	<u><i>A. castellanii</i></u>		<u><i>A. polyphaga</i></u>				<u><i>A. hatchetti</i></u>					
		Plates + 4-6 h	% + 4-6 h	Plates + 24 h	%+ 24h	Plates + 4-6 h	% + 4-6 h	Plates + 24 h	% + 24 h	Plates + 4-6 h	% + 4-6 h	Plates + 24 h	% + 24 h
<b>Ciba Vision Clear Care®</b>	3% hydrogen peroxide	0/3	0%	0/3	0%	0/3	0%	0/3	0%	2/3	66%	0/3	0%
<b>Ciba Vision Aquify®</b>	Polyhexanide 0.0001%	3/3	100%	3/3	100%	3/3	100%	1/3	33%	3/3	100%	3/3	100%
<b>Kirkland Signature Multi-Purpose Solution®</b>	Polyaminopropy biguanide 0.0001%	3/3	100%	3/3	100%	3/3	100%	1/3	33%	3/3	100%	3/3	100%

# RESULTS

## **Efficacy of CL solutions Against *Acanthamoeba* spp.**

Contact Lens Solution	Active Ingredients	<u><i>A. castellanii</i></u>		<u><i>A. polyphaga</i></u>				<u><i>A. hatchetti</i></u>					
		Plates + 4-6 h	% + 4-6 h	Plates + 24 h	% + 24 h	Plates + 4-6 h	% + 4-6 h	Plates + 24 h	% + 24 h	Plates + 4-6 h	% + 4-6 h	Plates + 24 h	% + 24 h
<b>B&amp;L Boston Simplus®</b>	Chlorhexidine gluconate 0.03% Polyaminopropy biguanide 0.0005%	3/3	100%	1/3	33%	3/3	100%	2/3	66%	3/3	100%	2/3	66%
<b>B&amp;L ReNu MoistureLoc®</b>	Alexidine 0.00045%	3/3	100%	3/3	100%	3/3	100%	2/3	66%	3/3	100%	2/3	66%
<b>B&amp;L ReNu MultiPlus®</b>	DYMED 0.0001%	3/3	100%	3/3	100%	3/3	100%	3/3	100%	3/3	100%	3/3	100%

# Results

- ♣ One of the hydrogen peroxide containing solutions (**Ciba Vision Clear Care**) demonstrated the greatest inactivation of cysts of all 3 species of *Acanthamoeba*
- ♣ Of the 11 contact lens solutions, only 2 showed any activity against *A. castellanii* cysts
  - ♣ **Ciba Vision Clear Care** was **100% effective** in killing cysts at both 6 and 24 hours (0/6 plates positive)
  - ♣ **B&L Boston Simplus®** had no activity at 4 hours but was **66% effective at 24 hours** (1/3 plates positive)

# Results

♣ 4 other solutions demonstrated no activity in preventing excystation after 4 hours of contact but some activity after 24 hours

♣ **B&L Boston Simplus®** and **B&L ReNu MoistureLoc®** were 33% effective at killing cysts of *A. polyphaga* (2/3 plates positive)

♣ **Ciba Vision Aquify** and **Kirkland Signature MPS** were 66% effective at killing cysts of *A. polyphaga* (1/3 plates positive)

# Results

- ♣ None of the 11 solutions tested demonstrated 100% killing of *A. hatchetti* cysts after 4-6 hours
  - ♣ Only **Ciba Vision Clear Care** was 33% effective after 6 hours and **100% effective** after **24 hours** contact
  - ♣ **B&L Boston Simplus®** and **B&L ReNu MoistureLoc®** were 33% effective (2/3 plates positive) after 24 hours of contact

# Conclusions

♣ Of the 11 multipurpose solutions tested

- ♣ **Ciba Vision Clear Care** containing 3 % hydrogen peroxide was 100% effective against cysts of *A. castellanii* and *A. polyphaga* at both 6 and 24 hours of contact
- ♣ With cysts of *A. hatchetti*, however, this solution was 100% effective after 24 hours but only 33% effective after 6 hours of contact

# Conclusions

- ♣ Solutions without hydrogen peroxide had varying degrees of activity against cysts of all 3 species of *Acanthamoeba*, but none had activity at 4 hours of contact
- ♣ However, some solutions had activity after 24 of hours contact
- ♣ Most contact lens wearers do not soak lenses longer than 8-12 hours (overnight)

THANK YOU