Instituto de Investigación Sanitaria La Fe

Instituto Médico Valenciano
IMV

Reservorio marino y zoonótico de *Candida auris:* cribado ambiental y megafauna marina como vector de transmisión al humano en la Comunidad Valenciana

Grupo de Investigación en Infección Grave

Emergence of a new multi-drug resistant pathogen

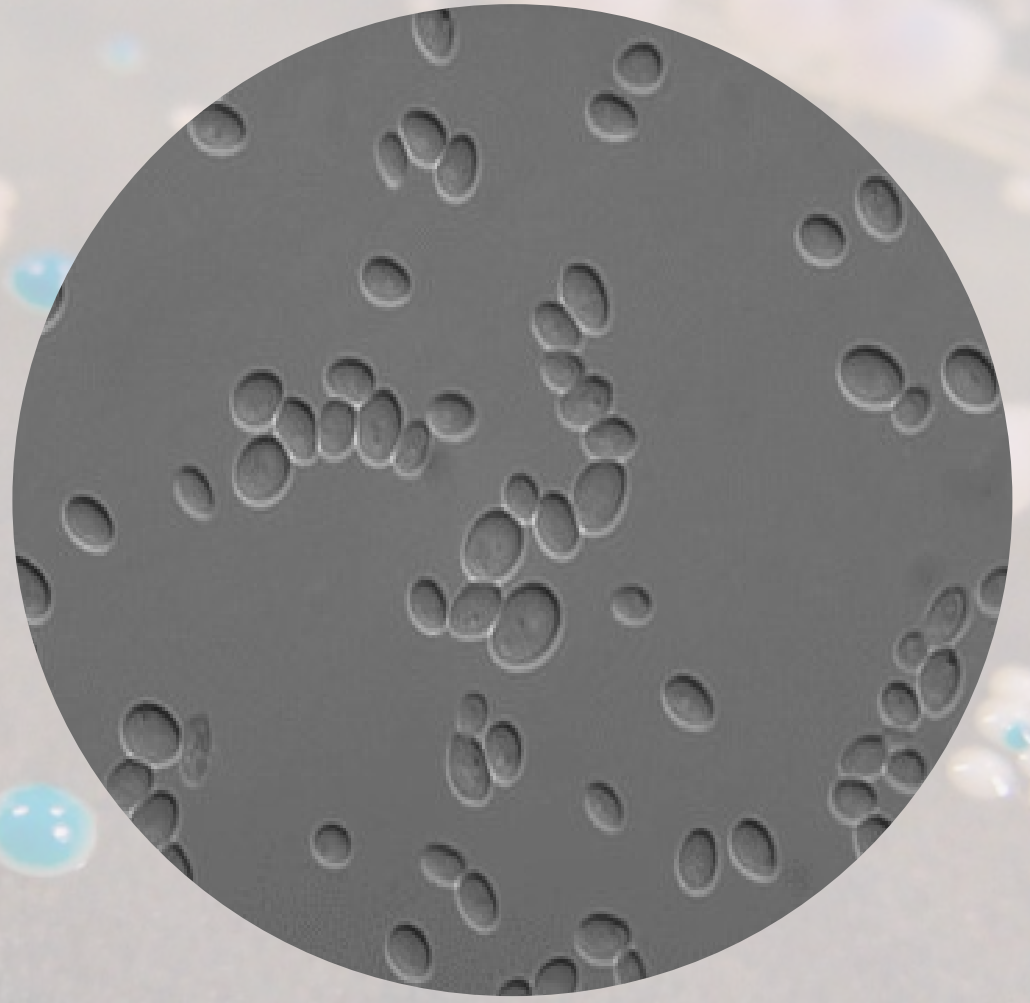
› Microbiol Immunol. 2009 Jan;53(1):41-4. doi: 10.1111/j.1348-0421.2008.00083.x.

ORIGINAL ARTICLE

Candida auris sp. nov., a novel ascomycetous yeast isolated from the external ear canal of an inpatient in a Japanese hospital

Kazuo Satoh[1,2], Koichi Makimura[1,3], Yayoi Hasumi[1], Yayoi Nishiyama[1], Katsuhisa Uchida[1] and Hideyo Yamaguchi[1]

[1]Teikyo University Institute of Medical Mycology, 359 Otsuka, Hachioji, Tokyo 192-0395, [2]Japan Health Sciences Foundation, 13-4 Nihonbashi-Kodenmacho, Chuo-ku, Tokyo 103-0001 and [3]Genome Research Center, Graduate School of Medicine and Faculty of Medicine, Teikyo University, Otsuka 359, Hachioji, Tokyo 192-0395, Japan

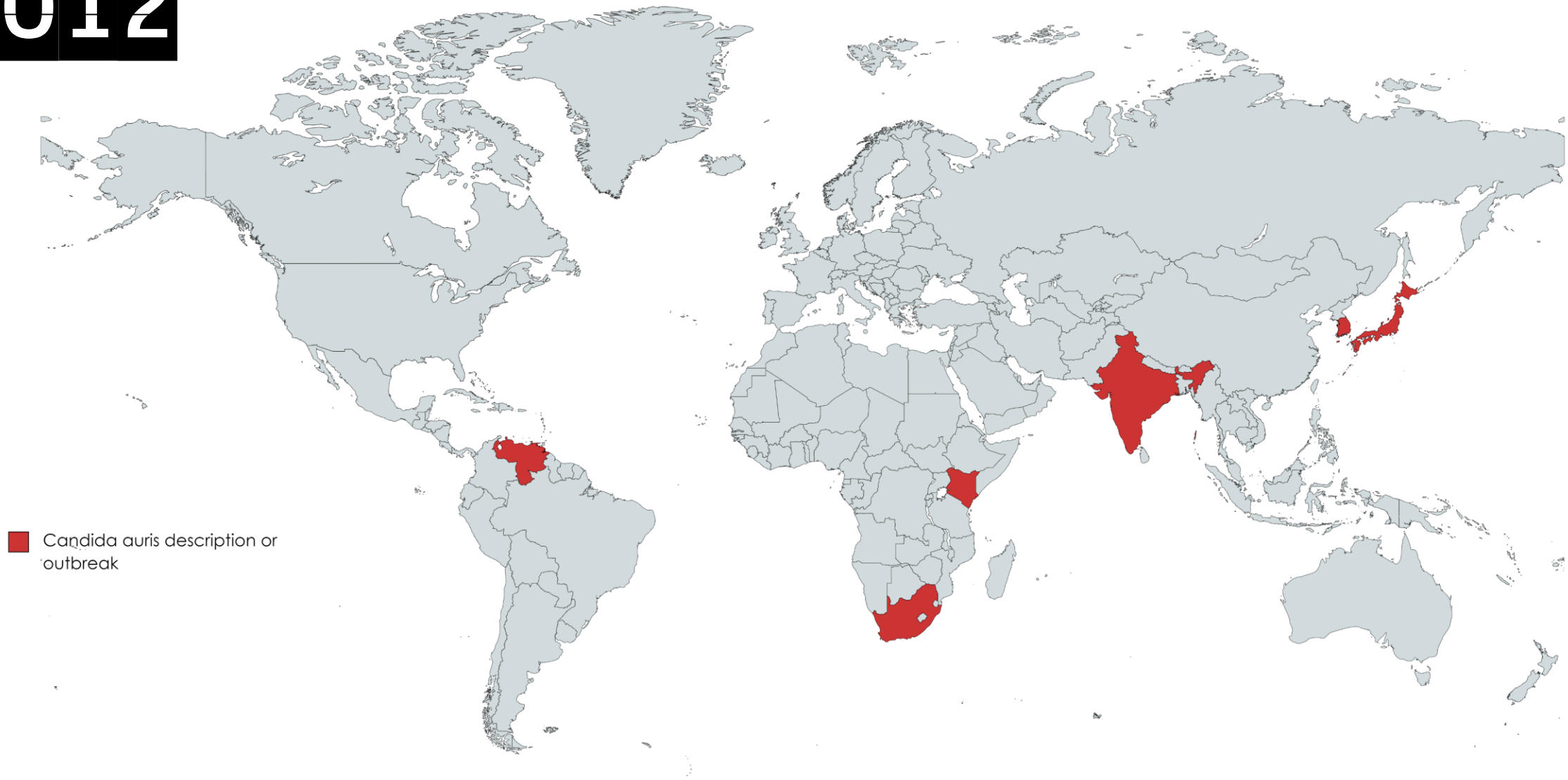


2009

2009

2010

2012



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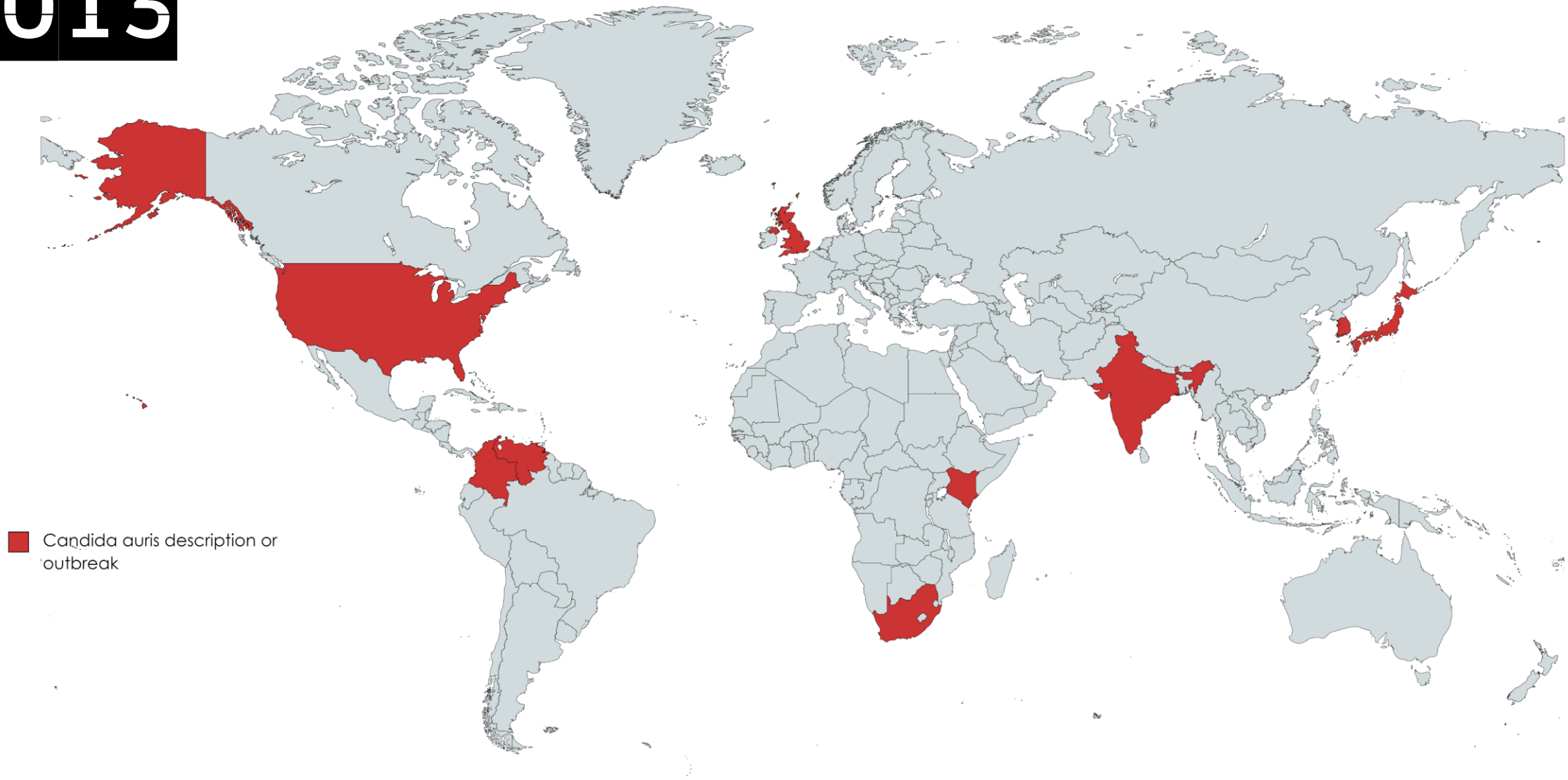

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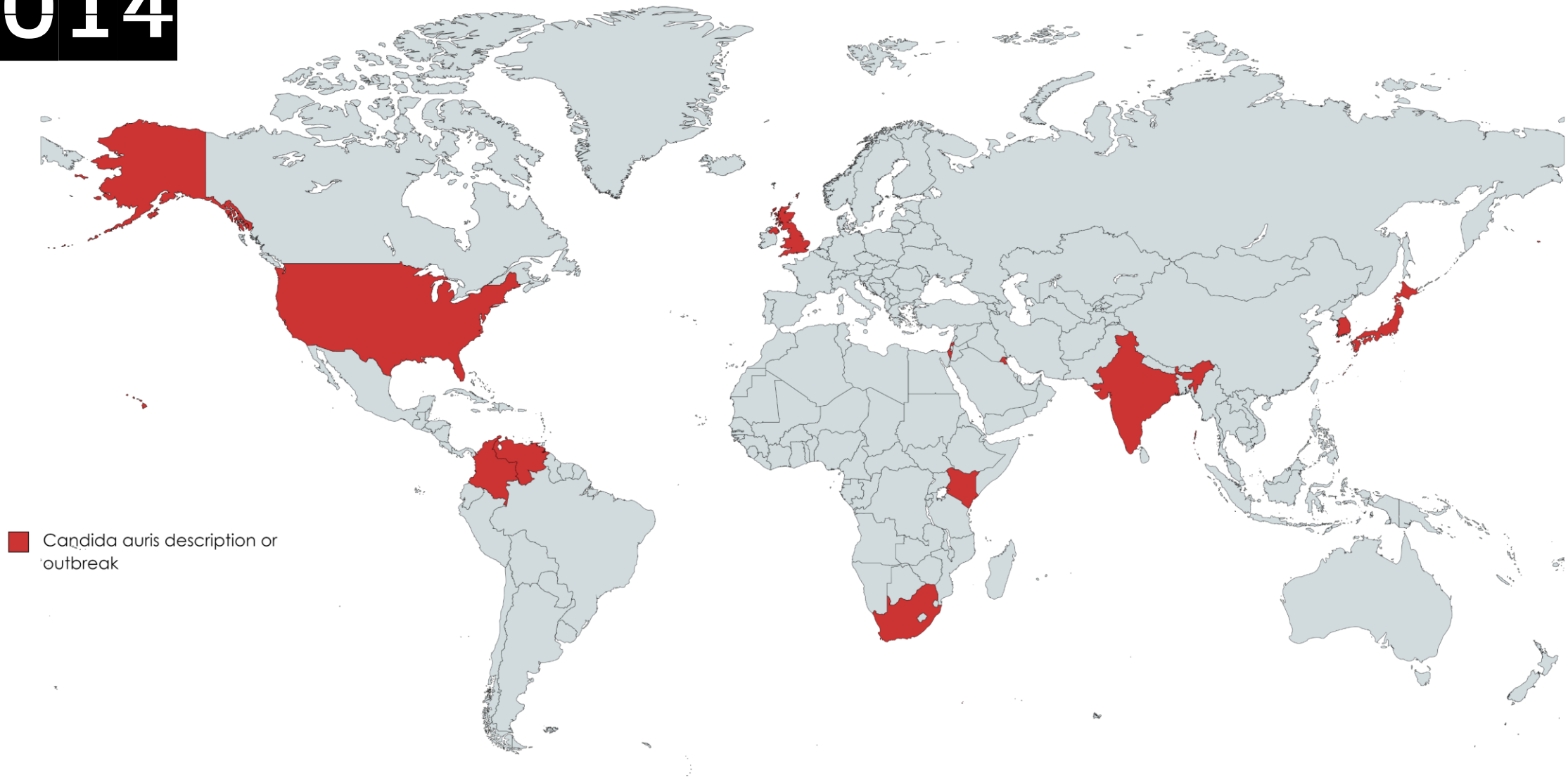

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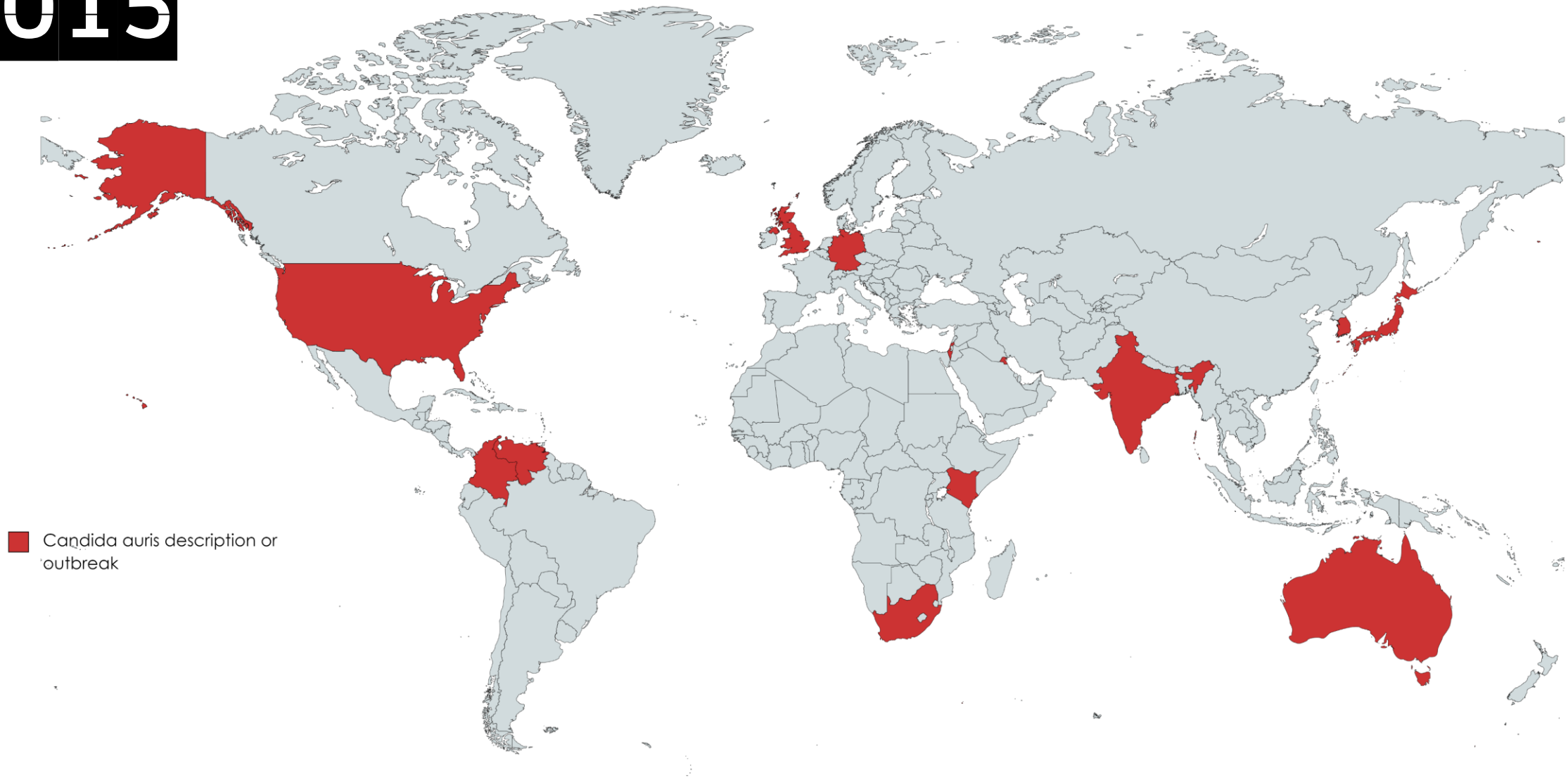

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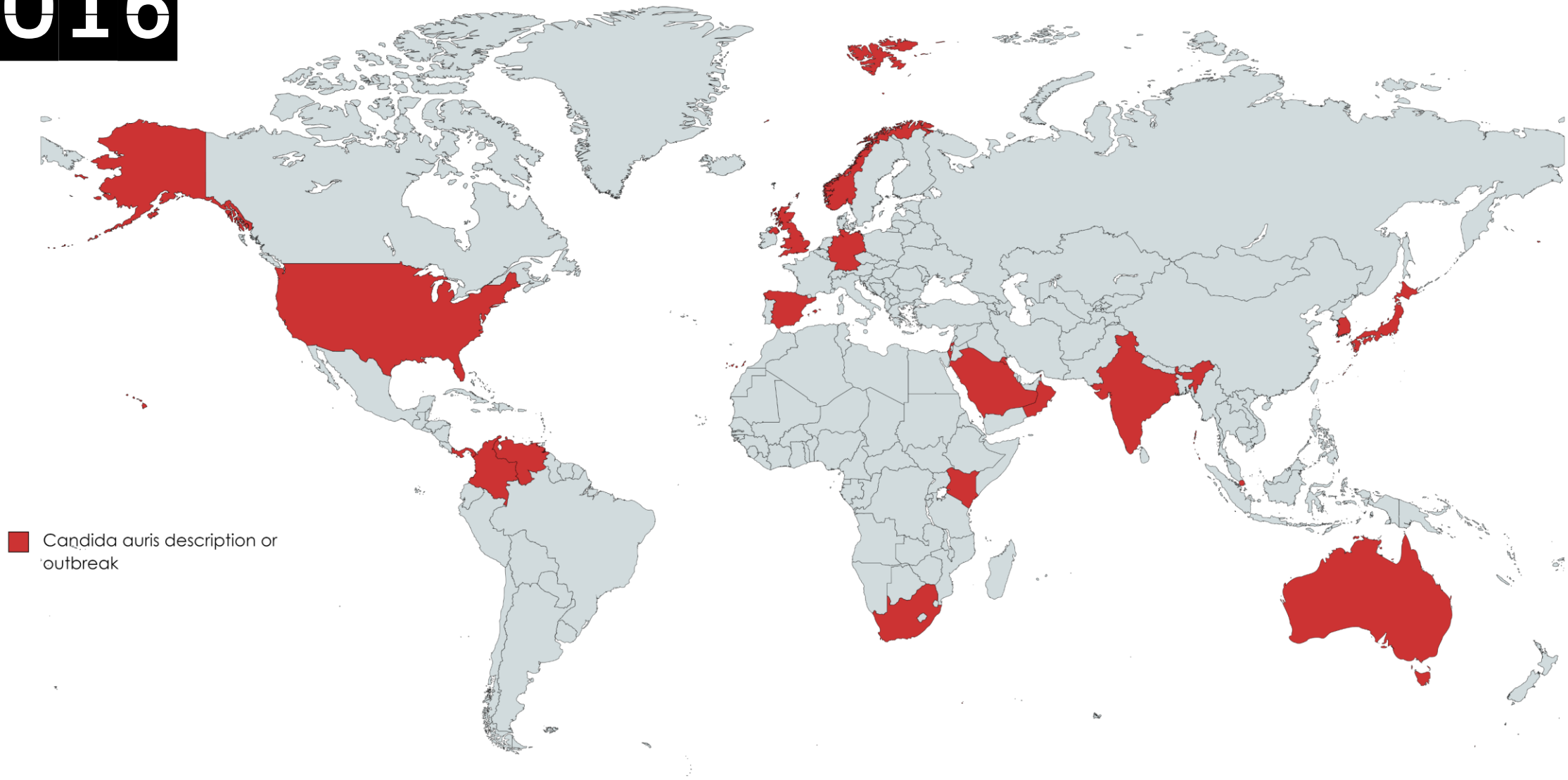

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Revista Iberoamericana de Micología
Volume 34, Issue 1, January–March 2017, Pages 23-27

Original article

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Fungemia nosocomial por *Candida auris:* primeros cuatro casos en Europa continental

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NVH

This is an official CDC HEALTH ALERT

Emergence of a new multi-drug resistant pathogen

CDC alerts in 2016:

- Emergent multi-drug resistant fungal pathogen

Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™

Clinical Alert to U.S. Healthcare Facilities - June 2016

Global Emergence of Invasive Infections Caused by the Multidrug-Resistant Yeast *Candida auris*

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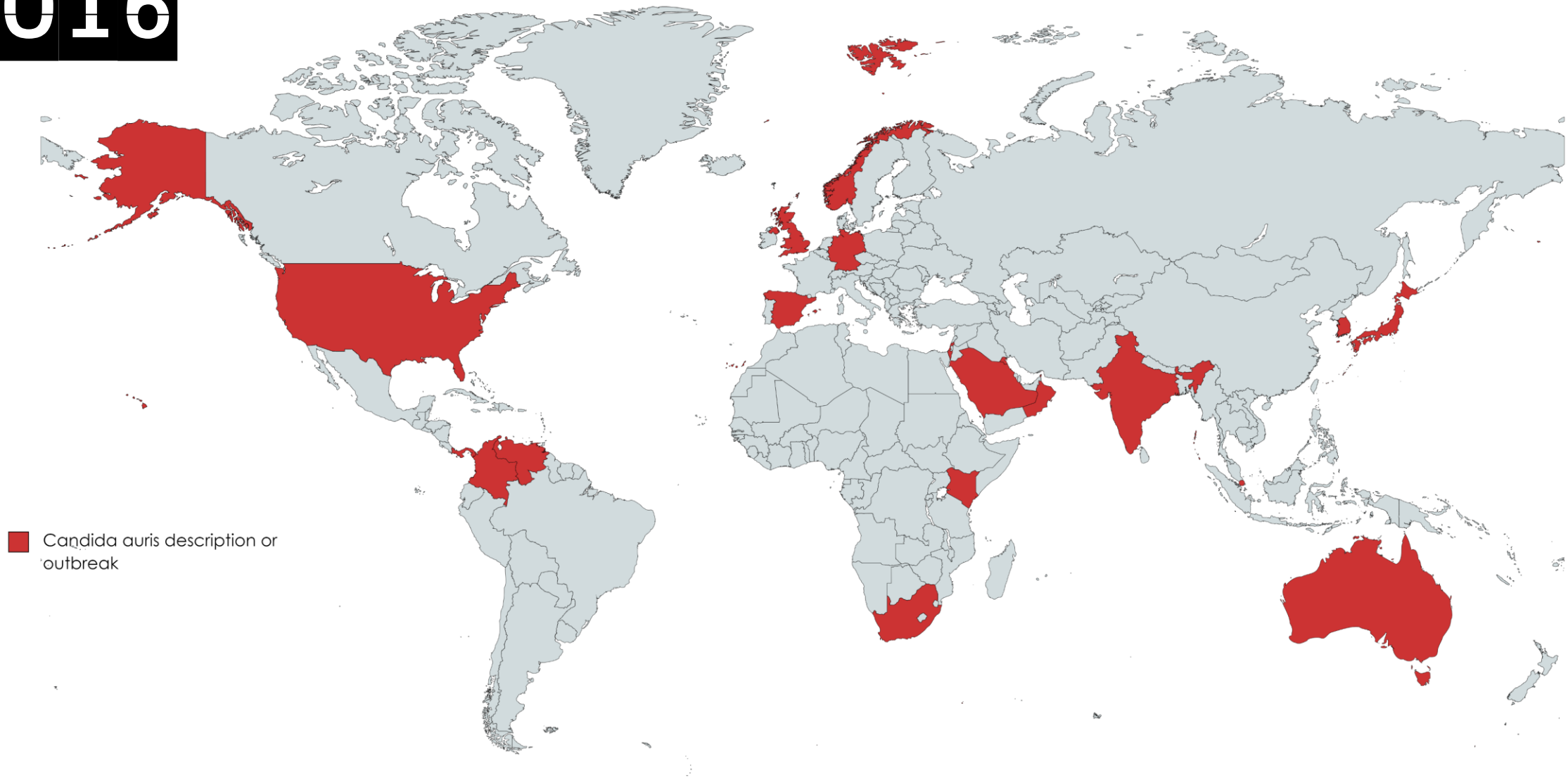
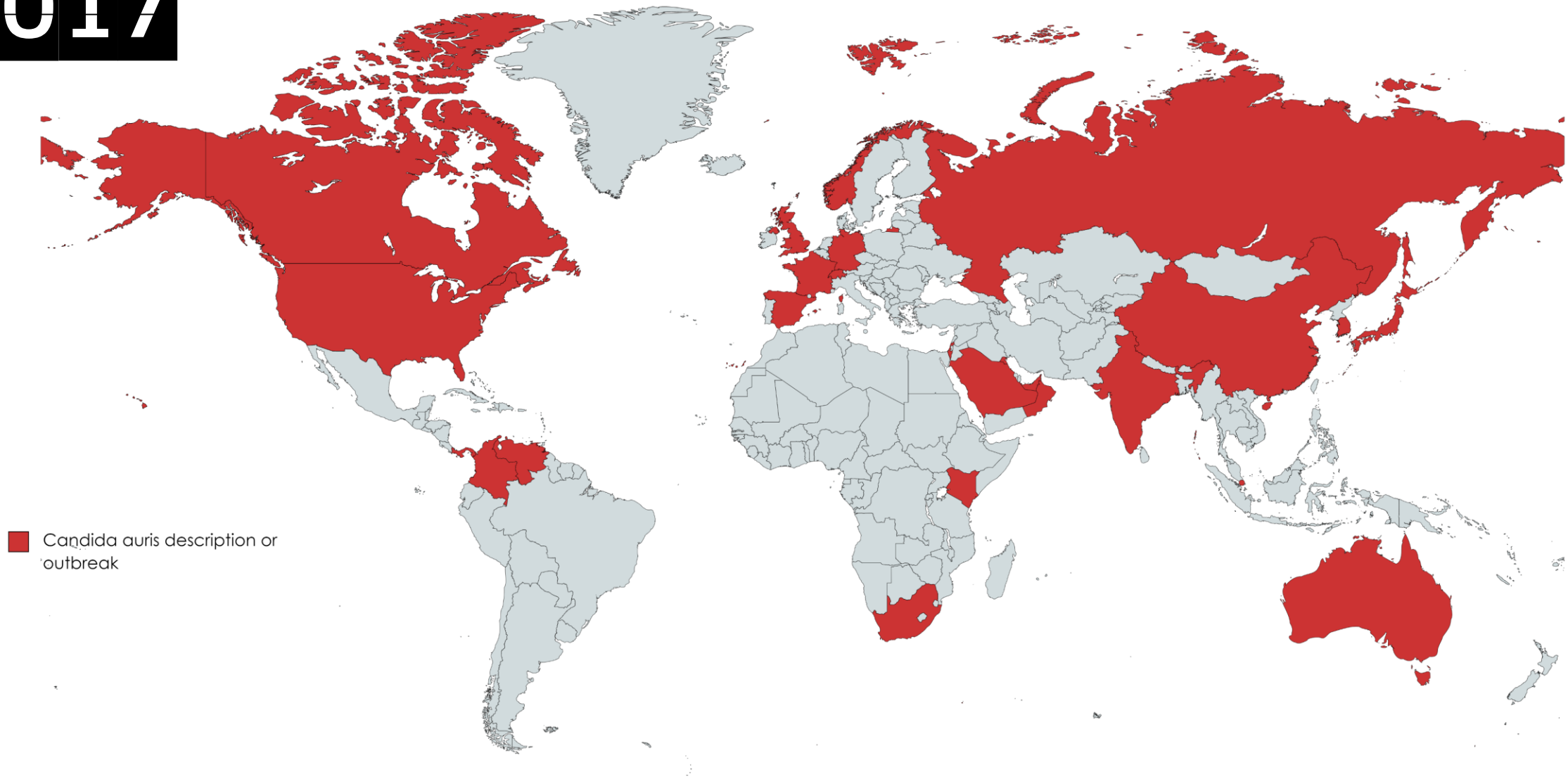
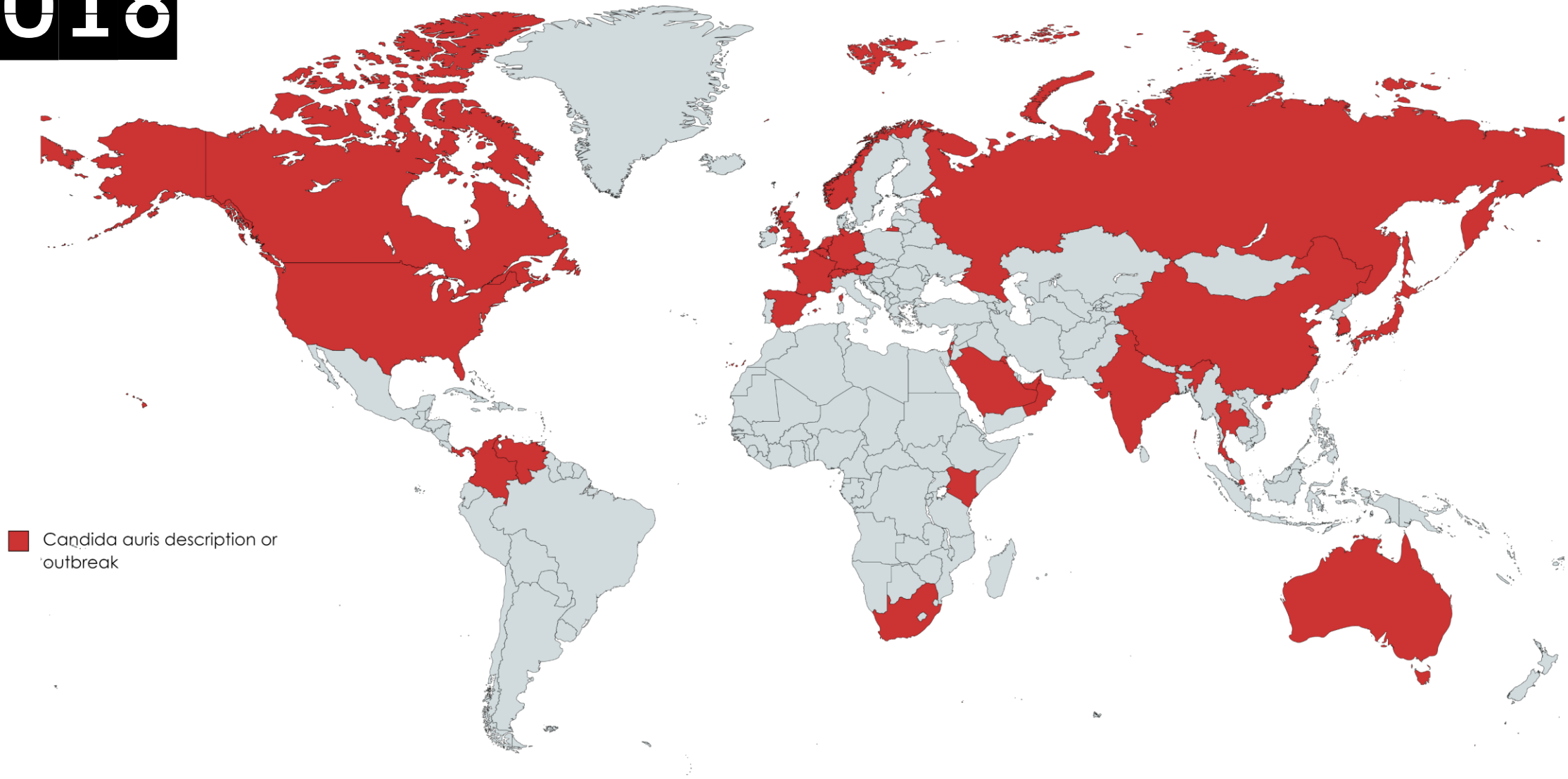


2017



2018



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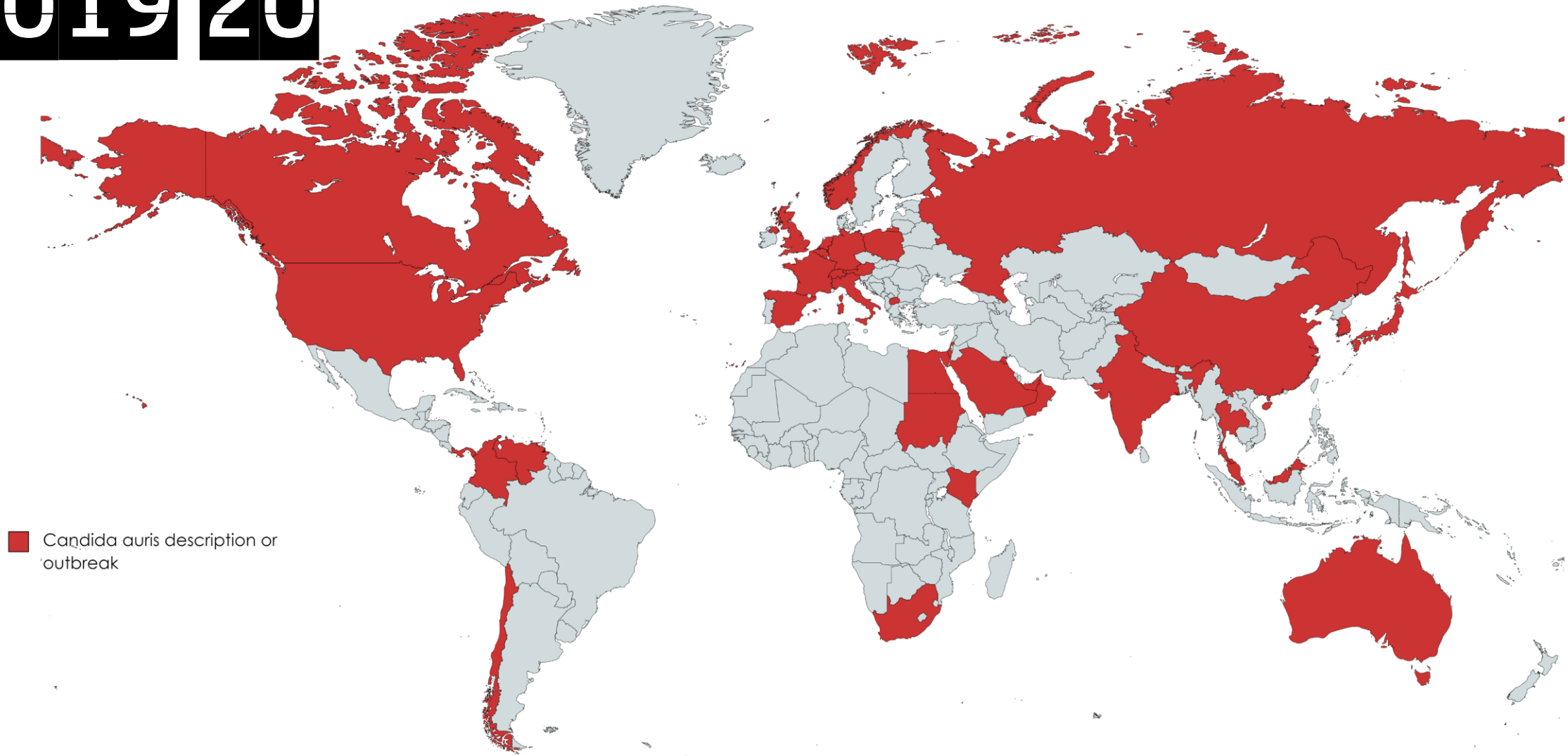

Emergence of a new multi-drug resistant pathogen

Global health threat:

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ANTIBIOTIC RESISTANCE THREATS IN THE UNITED STATES

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

2019

Urgent Threats

- Carbapenem-resistant *Acinetobacter*
- *Candida auris (C. auris)*
- *Clostridioides difficile (C. difficile)*
- Carbapenem-resistant Enterobacteriaceae (CRE)
- Drug-resistant *Neisseria gonorrhoeae (N. gonorrhoeae)*

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- Increase with the COVID-19 pandemic

ANTIBIOTIC RESISTANCE THREATS IN THE UNITED STATES

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ANTIBIOTIC RESISTANCE THREATS IN THE UNITED STATES

Candida auris: The new superbug on the block

By Lena Ciric
BBC News

17 August 2019

Emergence of a new multi-drug resistant pathogen

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Candida Auris Outbreaks: CDC Reports How This 'Superbug' Fungus Has Become More Dangerous

Bruce Y. Lee Senior Contributor
Healthcare
I am a writer, journalist, professor, systems modeler, computational and digital health expert, avocado-eater, and entrepreneur, not always in that order.

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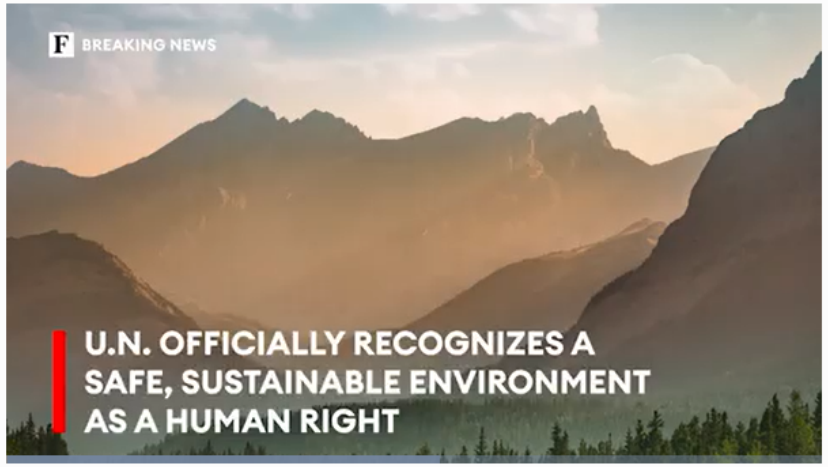

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DEADLY GERMS, LOST CURES

A Mysterious Infection, Spanning the Globe in a Climate of Secrecy

The rise of Candida auris embodies a serious and growing public health threat: drug-resistant germs.

Bruce Y. Lee Senior Contributor

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Outbreaks of Untreatable, Drug-Resistant Fungus Spread in 2 Cities

For the first time, the C.D.C. identified several cases of Candida auris that were resistant to all drugs, in two health facilities in Texas and a long-term care center in Washington, D.C.

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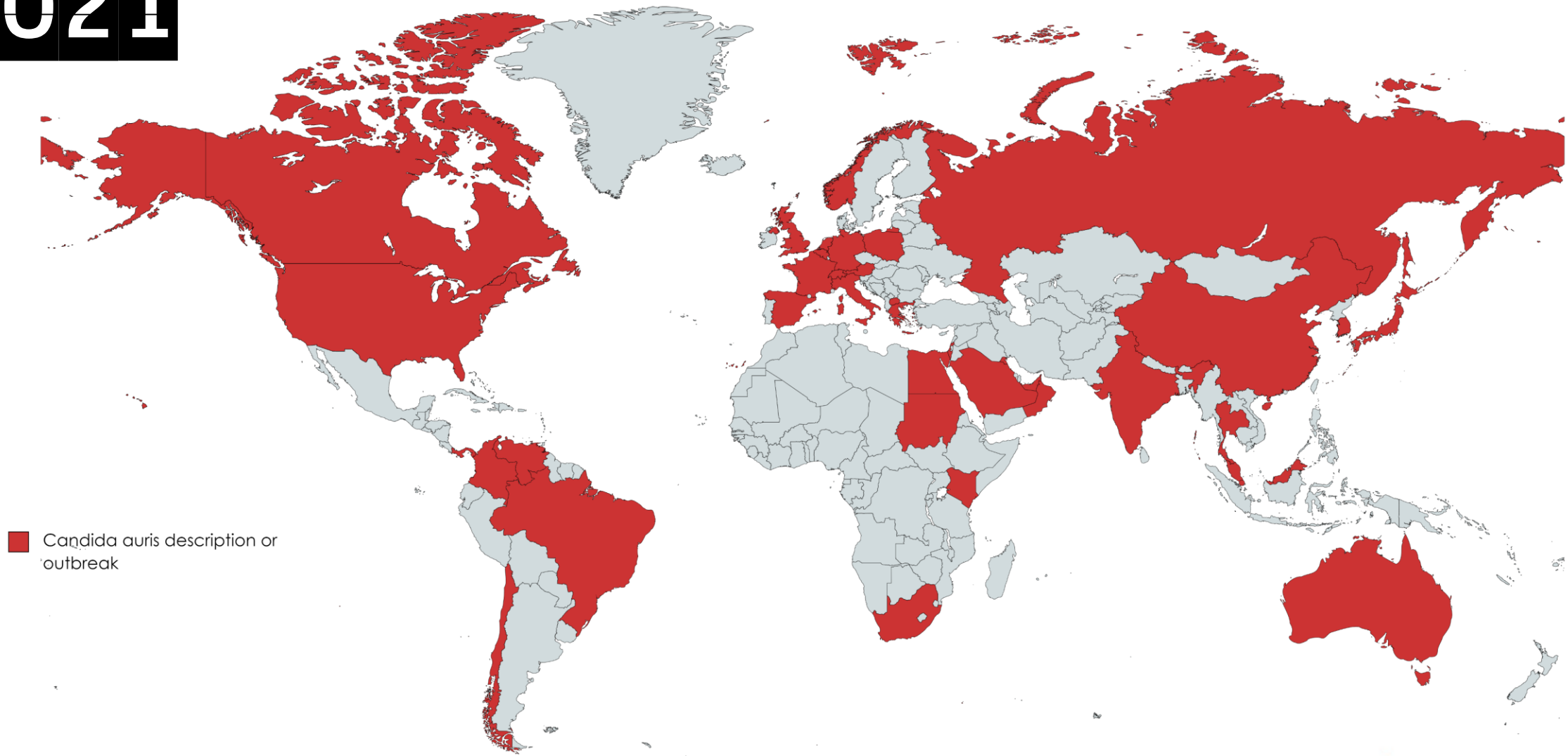
BBC News

17 August 2019

2021



Countries from which *Candida auris* cases have been reported, as of February 15, 2021

This map is no longer being updated given how widespread *C. auris* has become.

Why does it represent a public health challenge? Why is it different?

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Morphogenetic plasticity

- Different phenotypes – different behaviors

Dificulties in identification

Virulence

- Limited and diverse evidence
- Non-aggregative phenotypes more pathogenic
- Virulence factors

High mortality in susceptible patients

- 40-60% mortality of candidemia

High transmissibility and persistence

Extraordinary multi-drug resistance

- Some isolates resistant to azoles, amphotericin and candines

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MINIREVIEW
Therapeutics and Prevention
July/August 2019 Volume 4 Issue 4 e00458-19
https://doi.org/10.1128/mSphere.00458-19

Combined Antifungal Resistance and Biofilm Tolerance: the Global Threat of *Candida auris*

Ryan Kean[a], Gordon Ramage[b]

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(39)	United Kingdom[a] (119-128)	CLSI
(72)	India[*] (123)	CLSI
(11)	India (90)	CLSI
(14)	Colombia (87)	CLSI, Etest for AMB
(13)	United Kingdom[#] (73-79)	SYO
(32)	India (74)	CLSI
(10)	Spain (73)	EUCAST
(2)	Korea[#] (61)	CLSI
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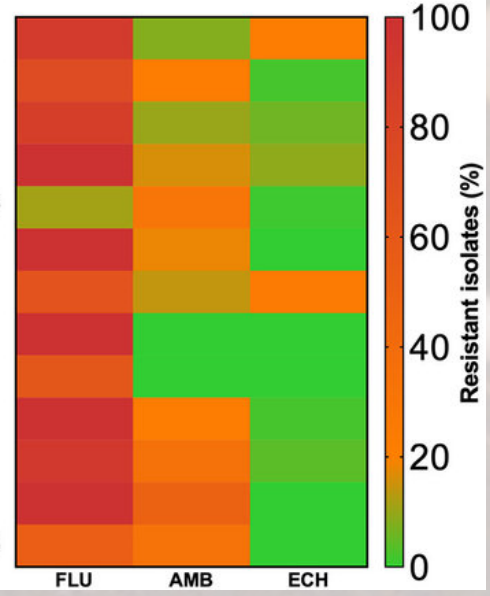

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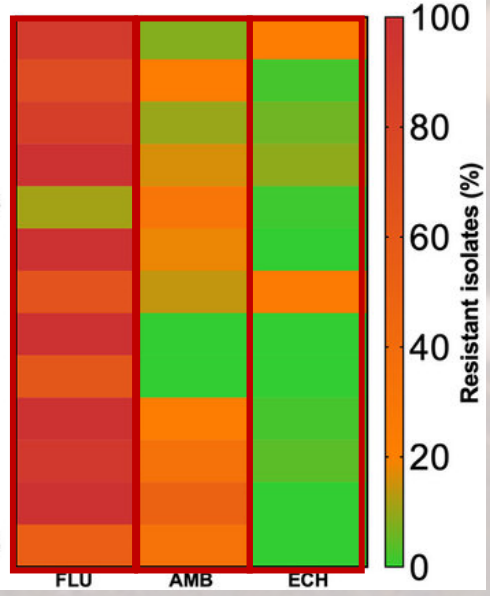
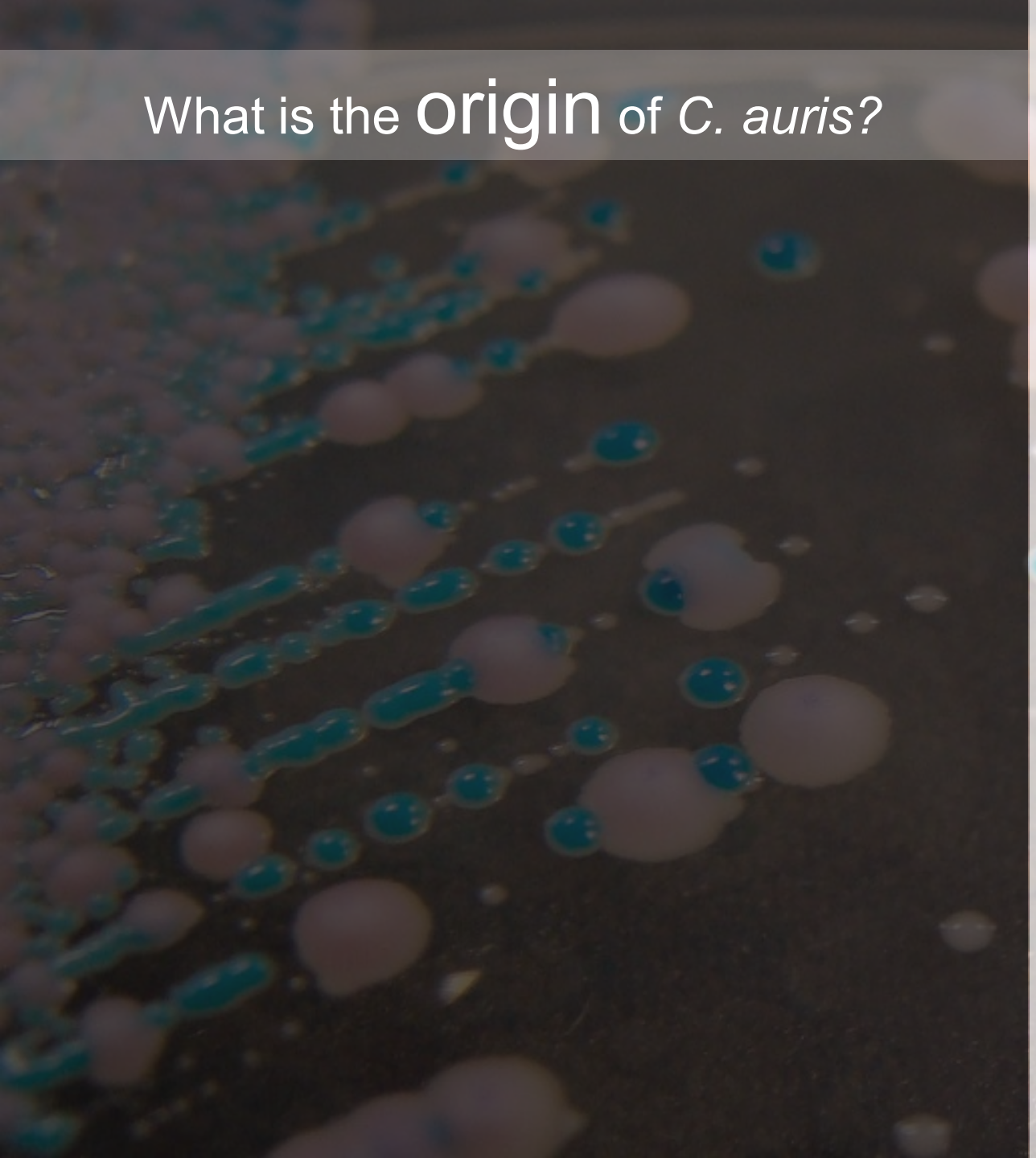


What is the origin of *C. auris?*



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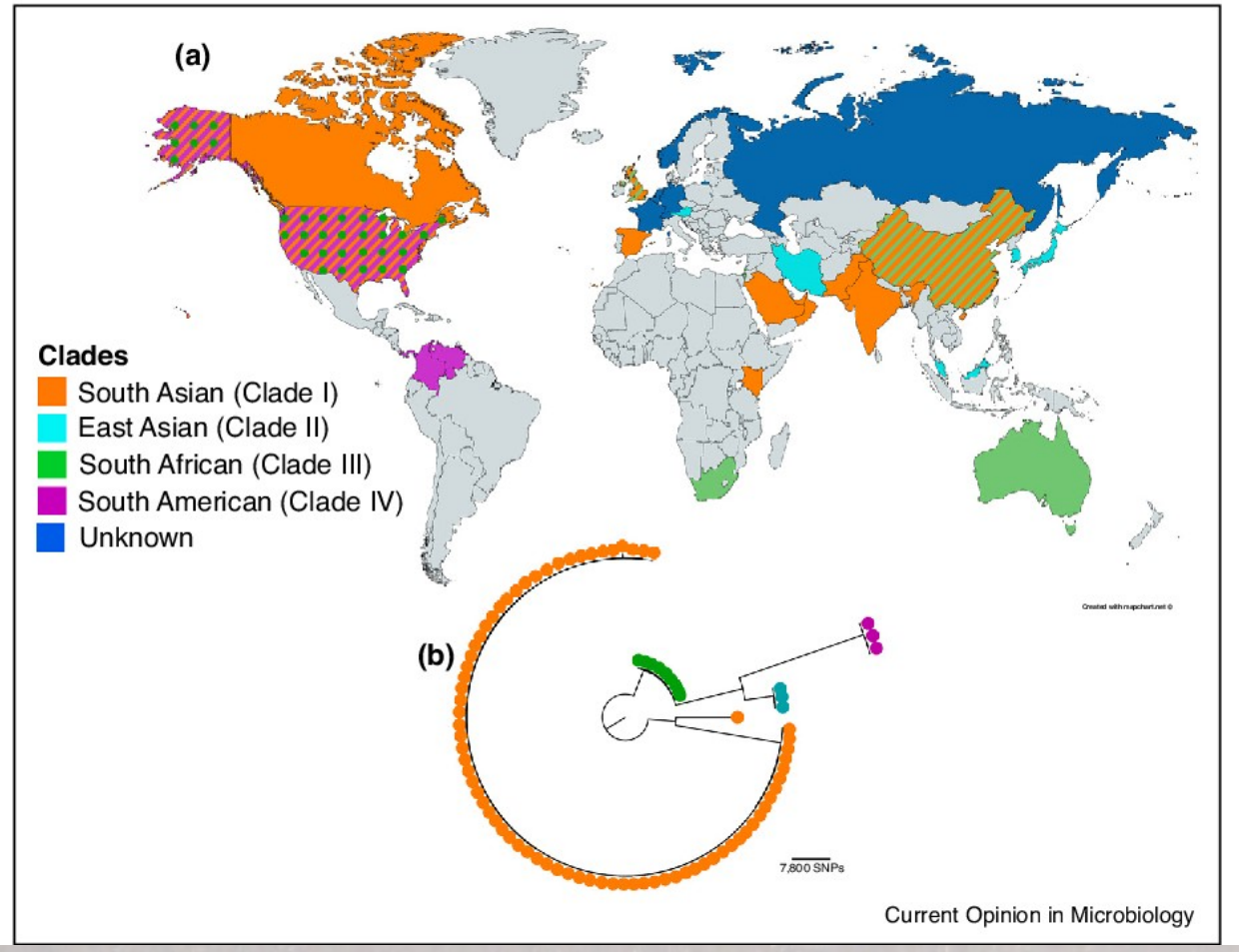
Chow et al. Emerg Infect Dis. 2019 Sep;25(9):1780-1781.

Current Opinion in Microbiology
Volume 52, December 2019, Pages 84-89

Global epidemiology of emerging *Candida auris*

Johanna Rhodes, Matthew C Fisher



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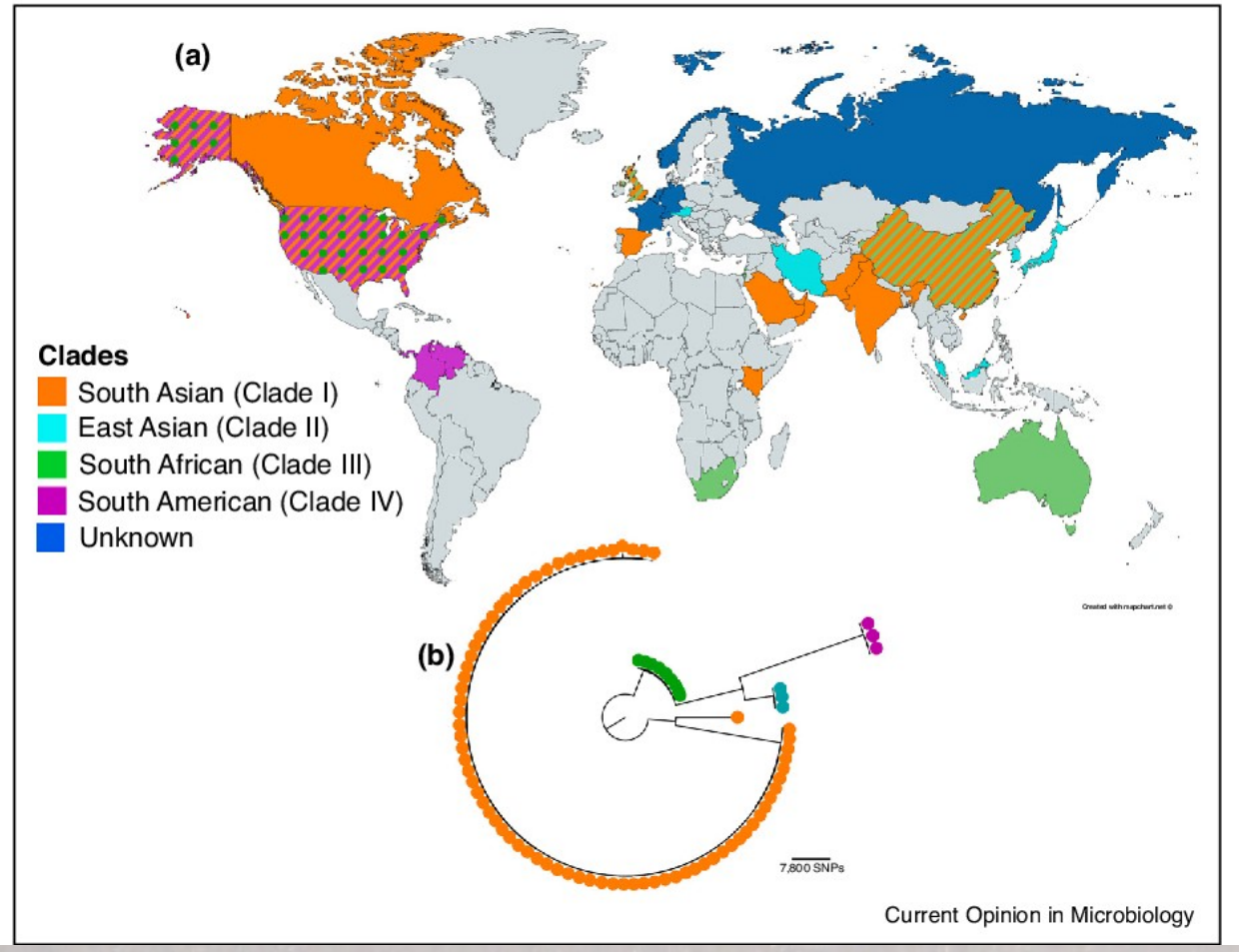

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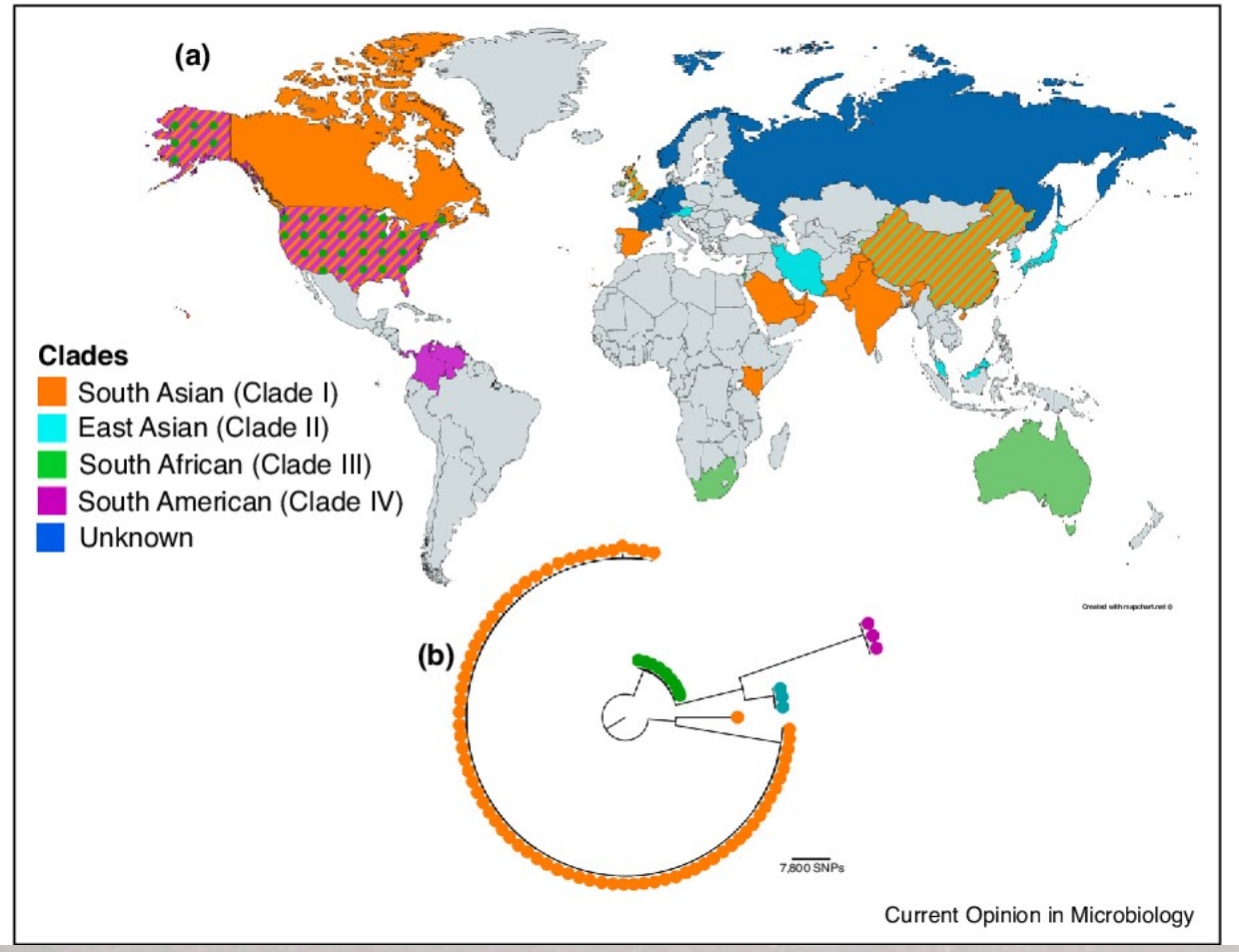
RESEARCH ARTICLE
Ecological and Evolutionary Science
March/April 2020 Volume 11 Issue 2 e03364-19
https://doi.org/10.1128/mBio.03364-19

Tracing the Evolutionary History and Global Expansion of *Candida auris* Using Population Genomic Analyses



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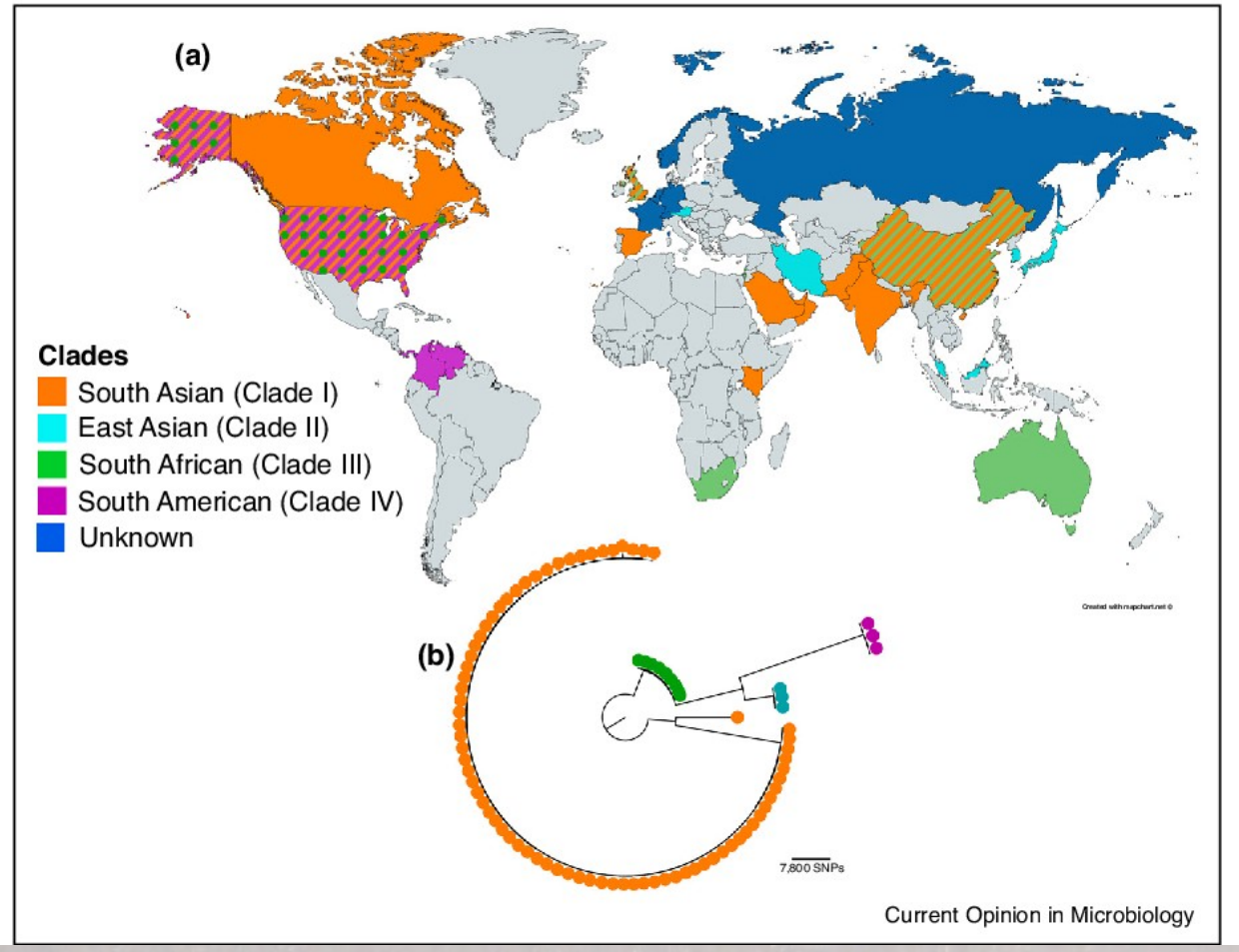

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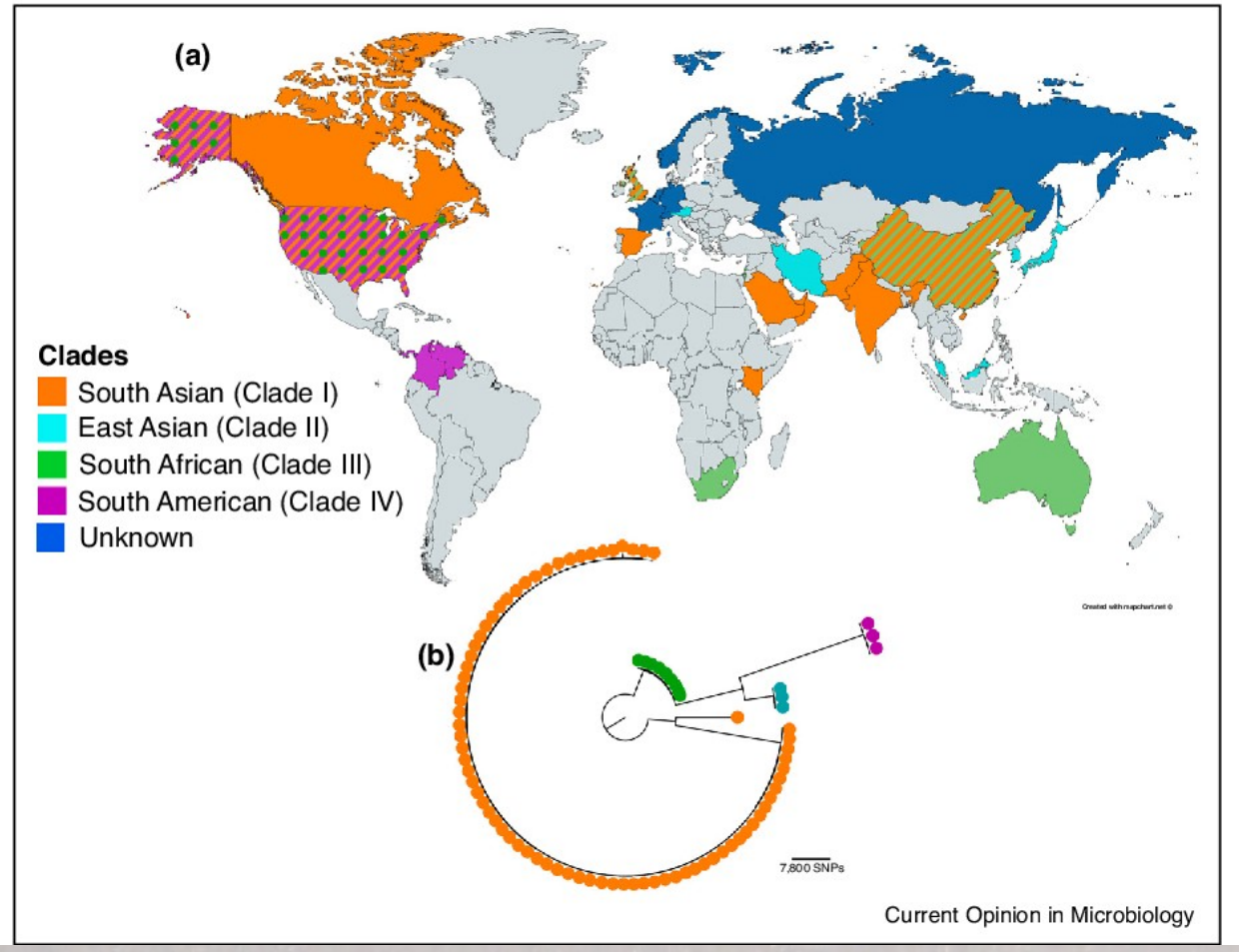

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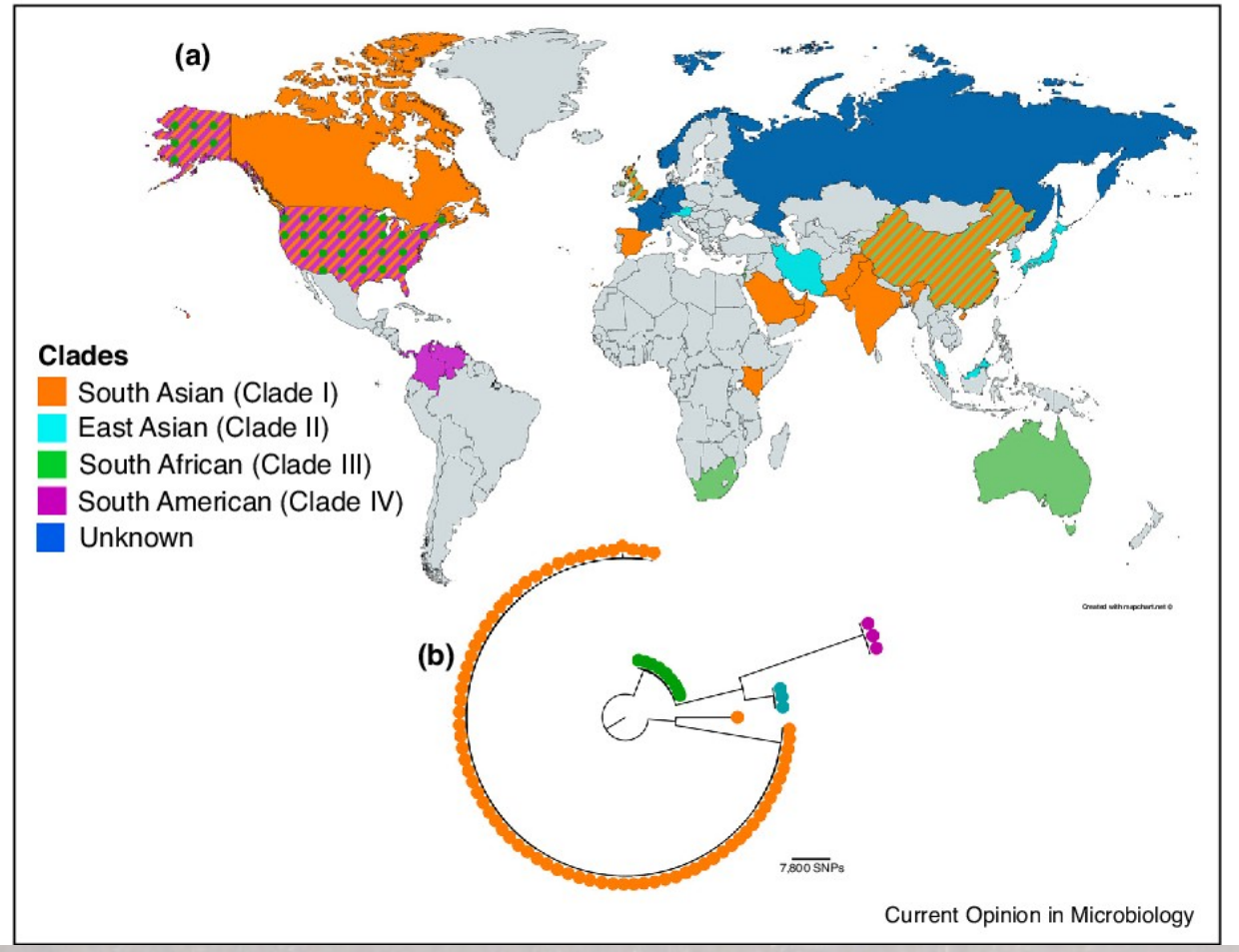

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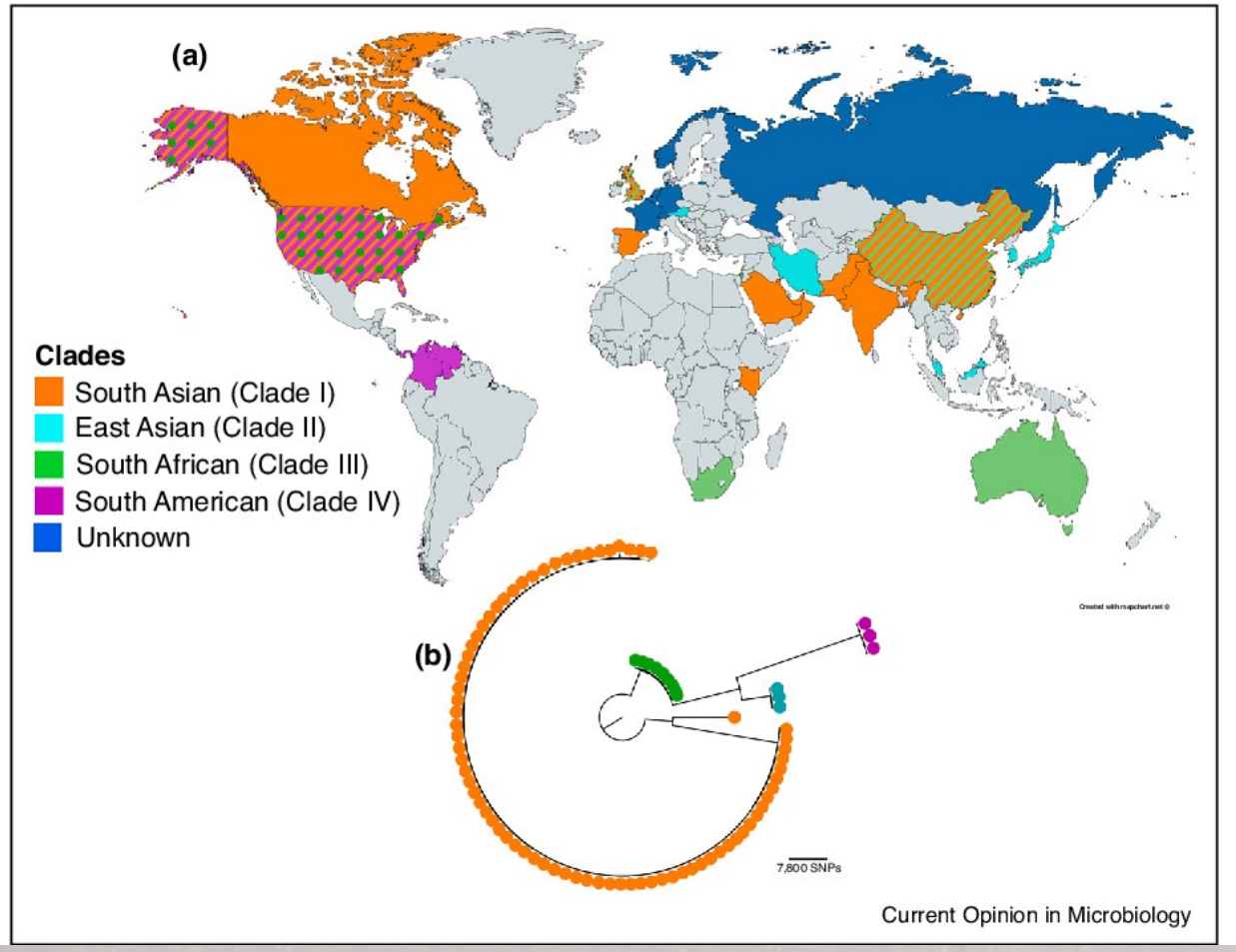

The global warming hypothesis

- 148.000 fungal species described
- 5.1 million fungal species estimated

REVIEW | Open Access

New scientific discoveries: Plants and fungi

Martin Cheek, Eimear Nic Lughadha, Paul Kirk, Heather Lindon, Julia Carretero, Brian Looney
... See all authors

Am J Bot. 2011 Mar;98(3):426-38. doi: 10.3732/ajb.1000298. Epub 2011 Mar 2.

The fungi: 1, 2, 3 … 5.1 million species?

Meredith Blackwell [1]

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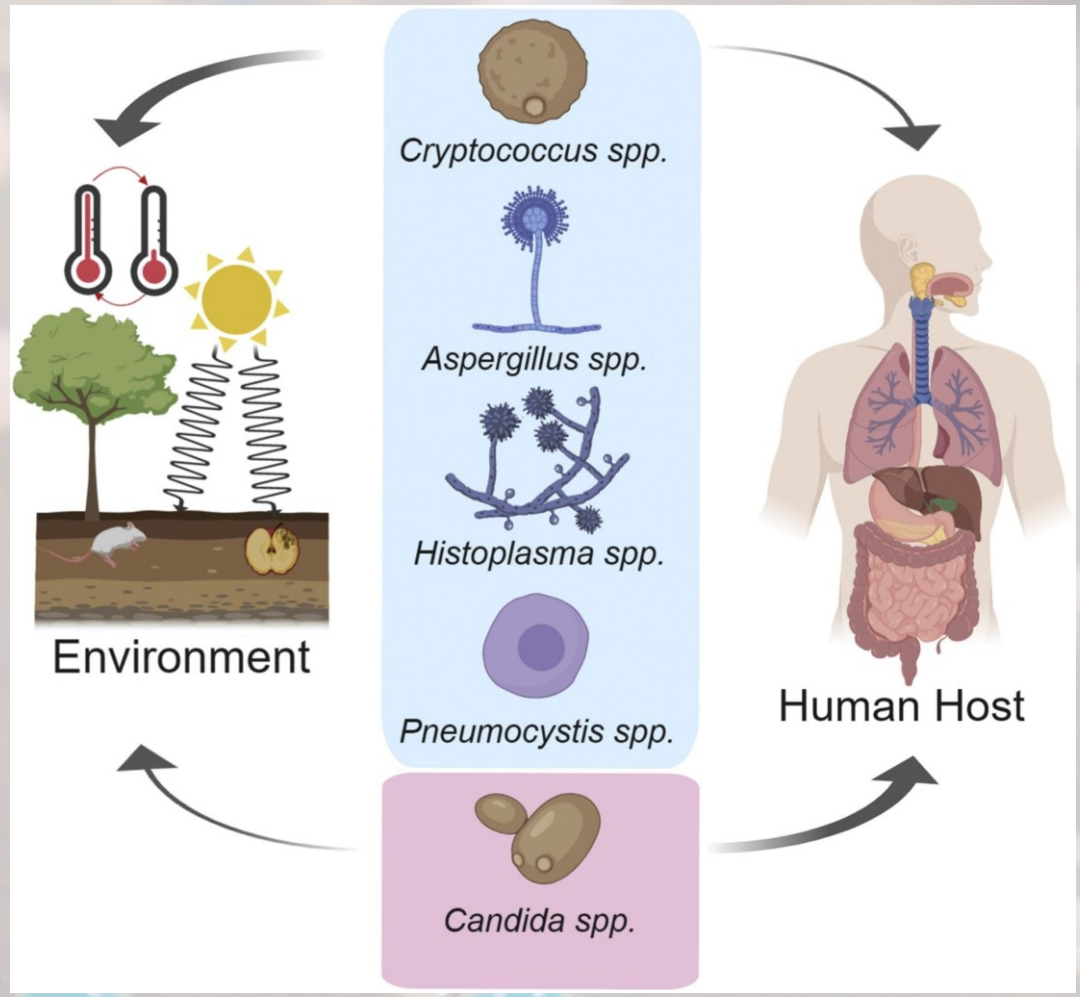

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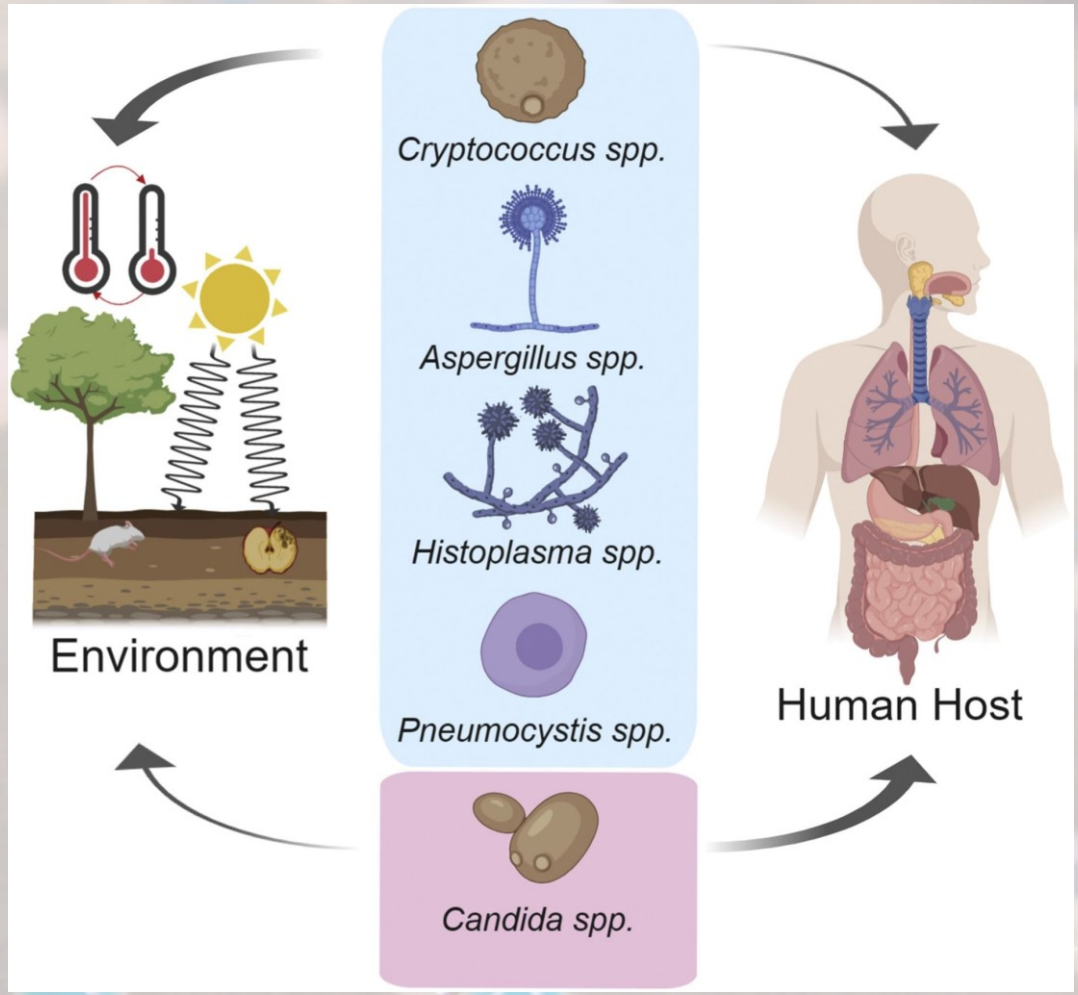
adaptative immunity

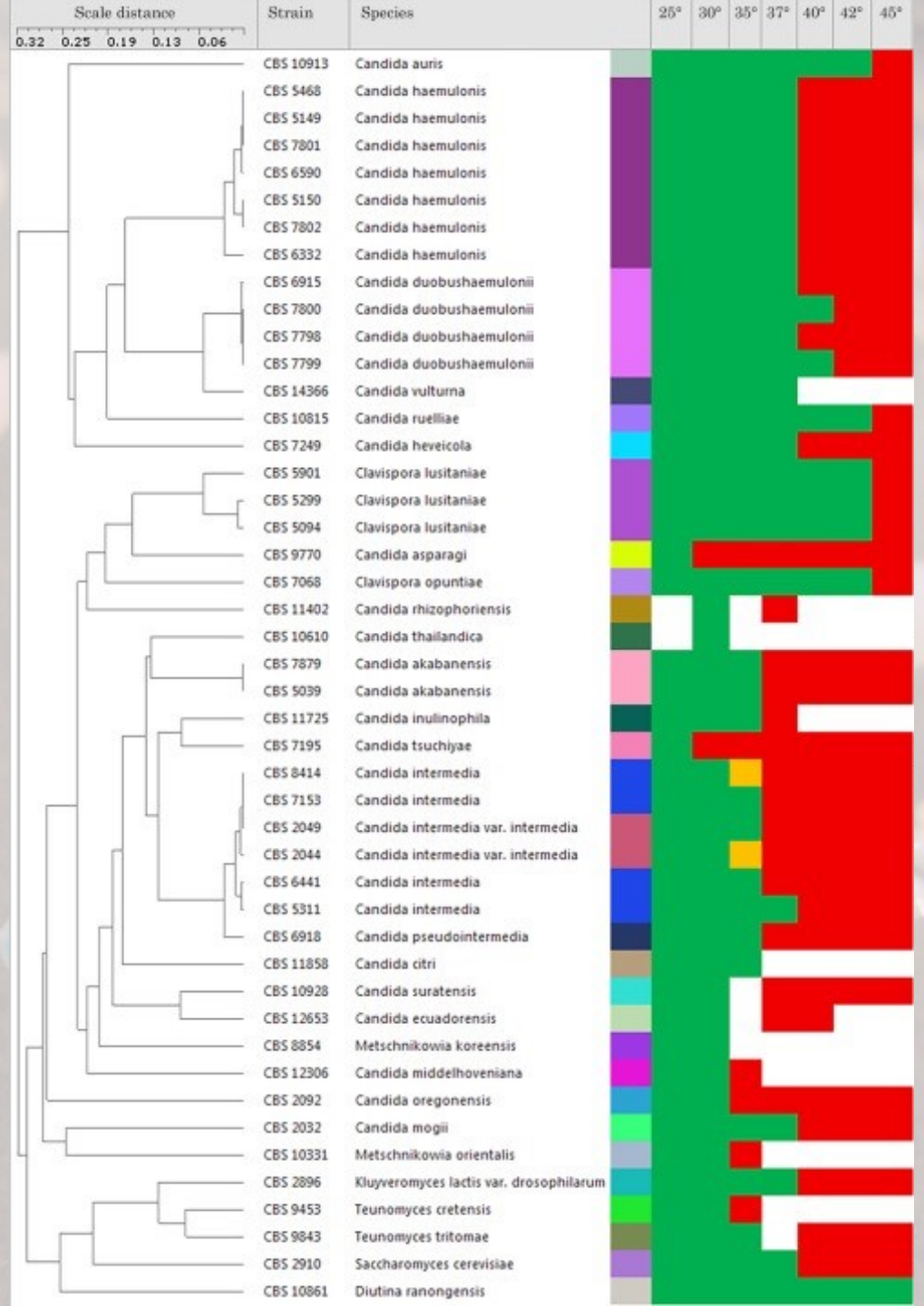


PLoS Pathog. 2012;8(8):e1002808. doi: 10.1371/journal.ppat.1002808. Epub 2012 Aug 16.

Fungi and the rise of mammals

Arturo Casadevall [1]

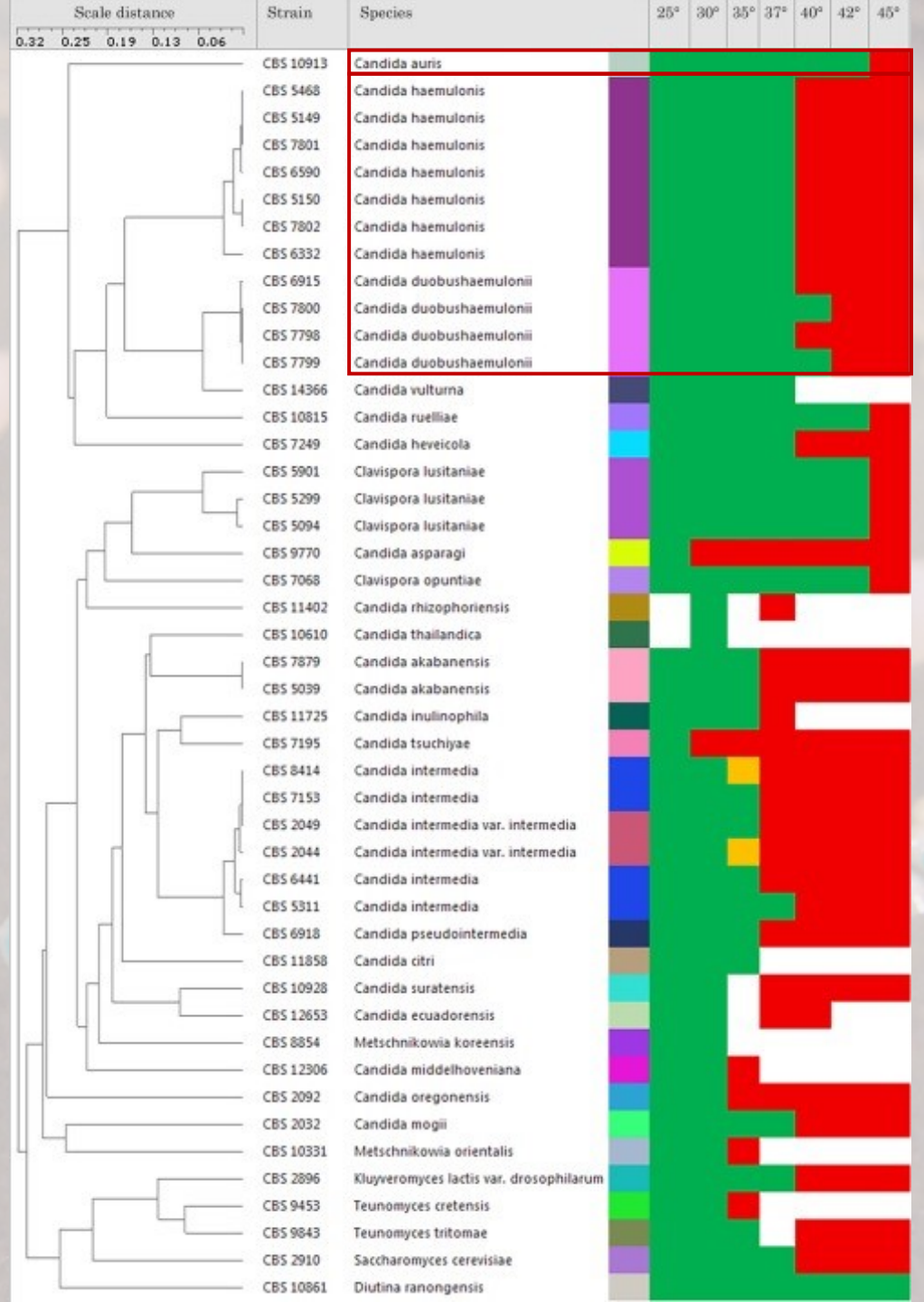
The global warming hypothesis



Casadevall et al. mBio . 2019 Jul 23;10(4):e01397-19

The global warming hypothesis

C. auris is halotolerant and termal tolerant



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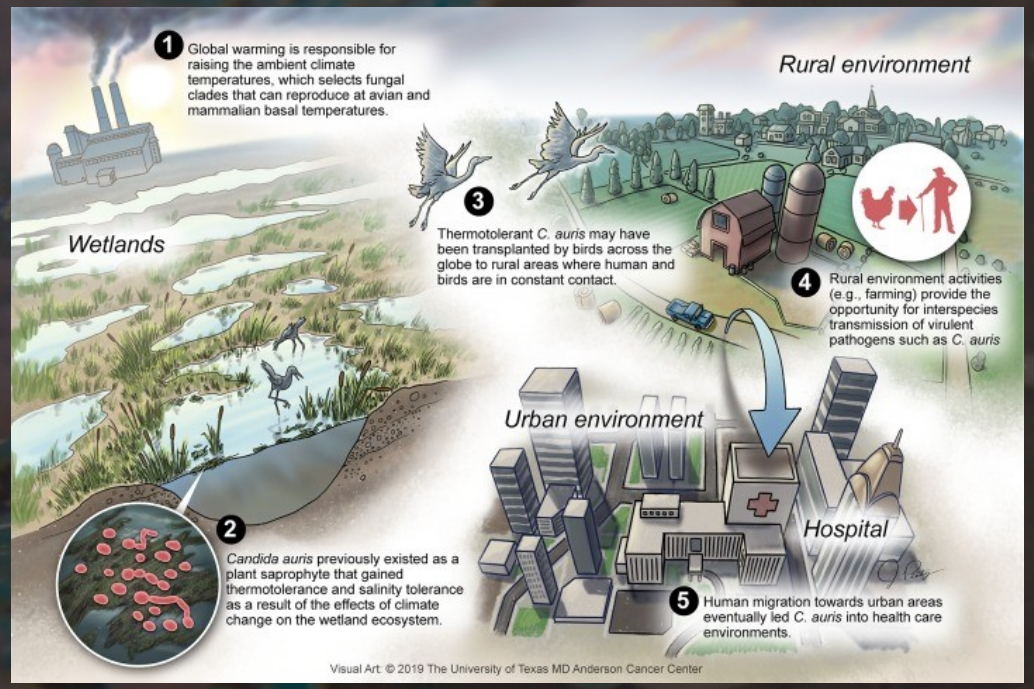

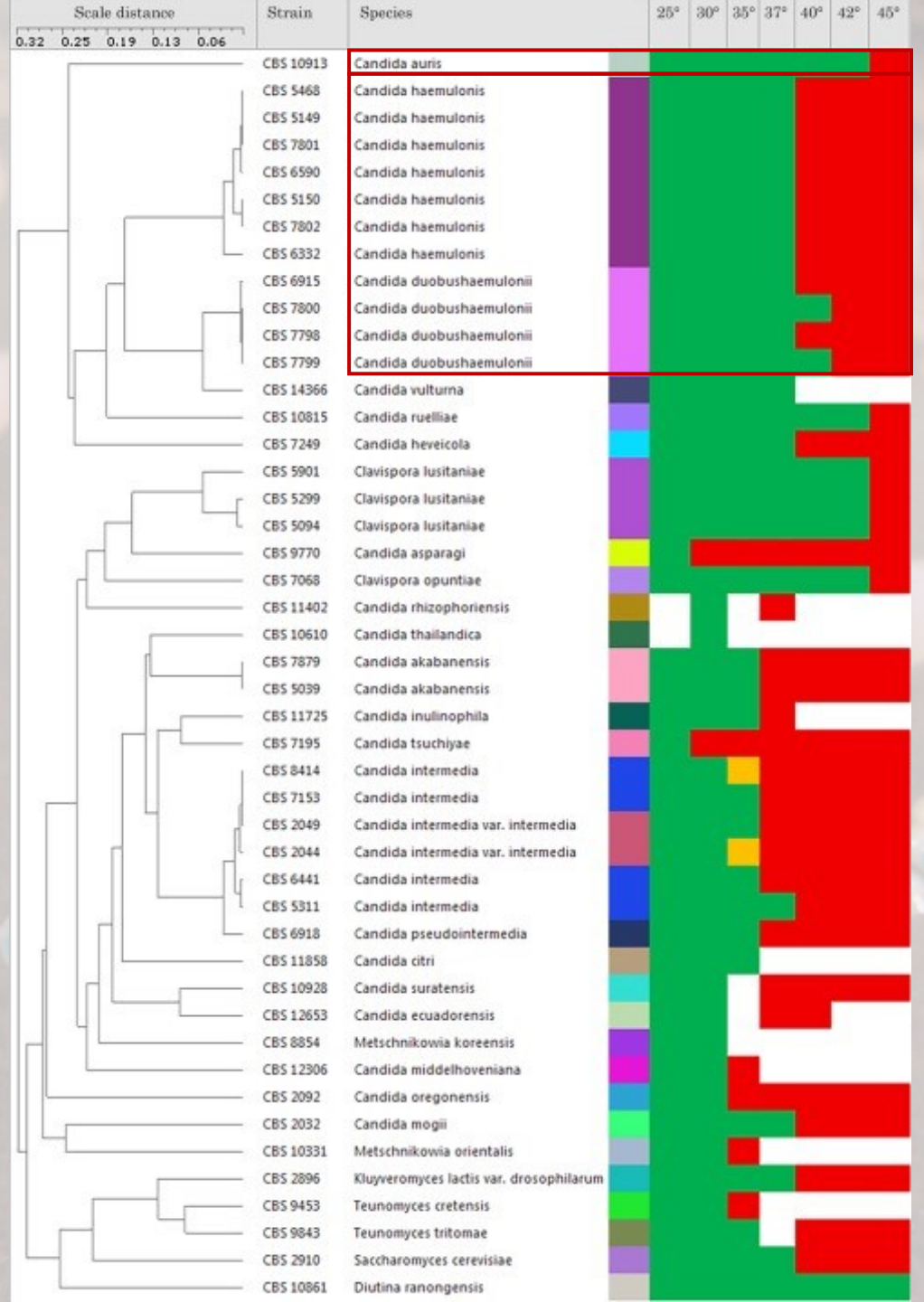

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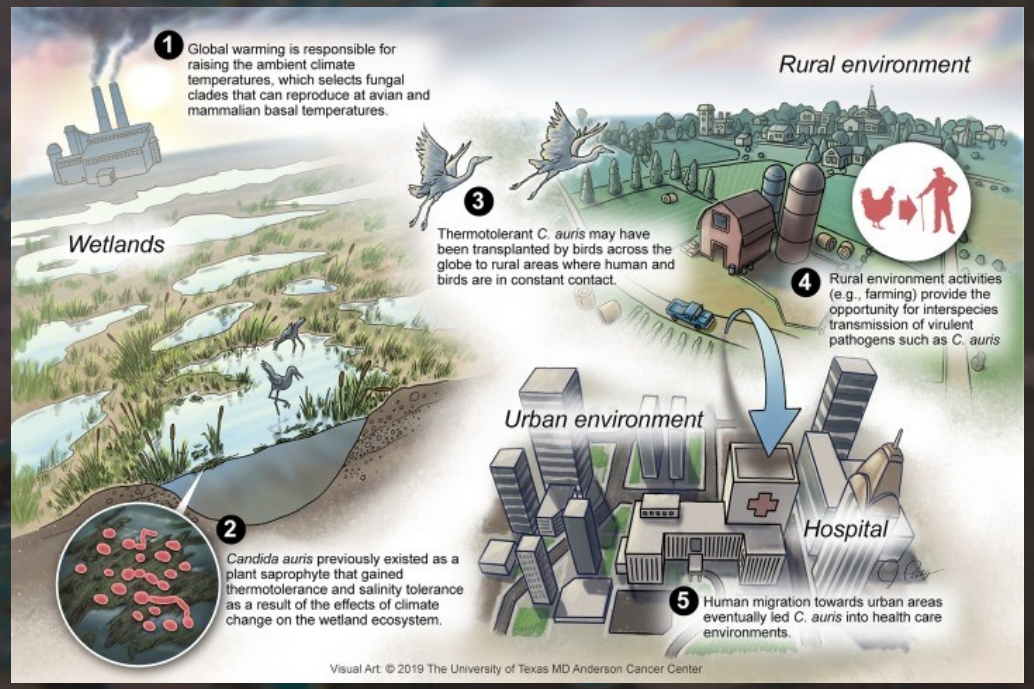

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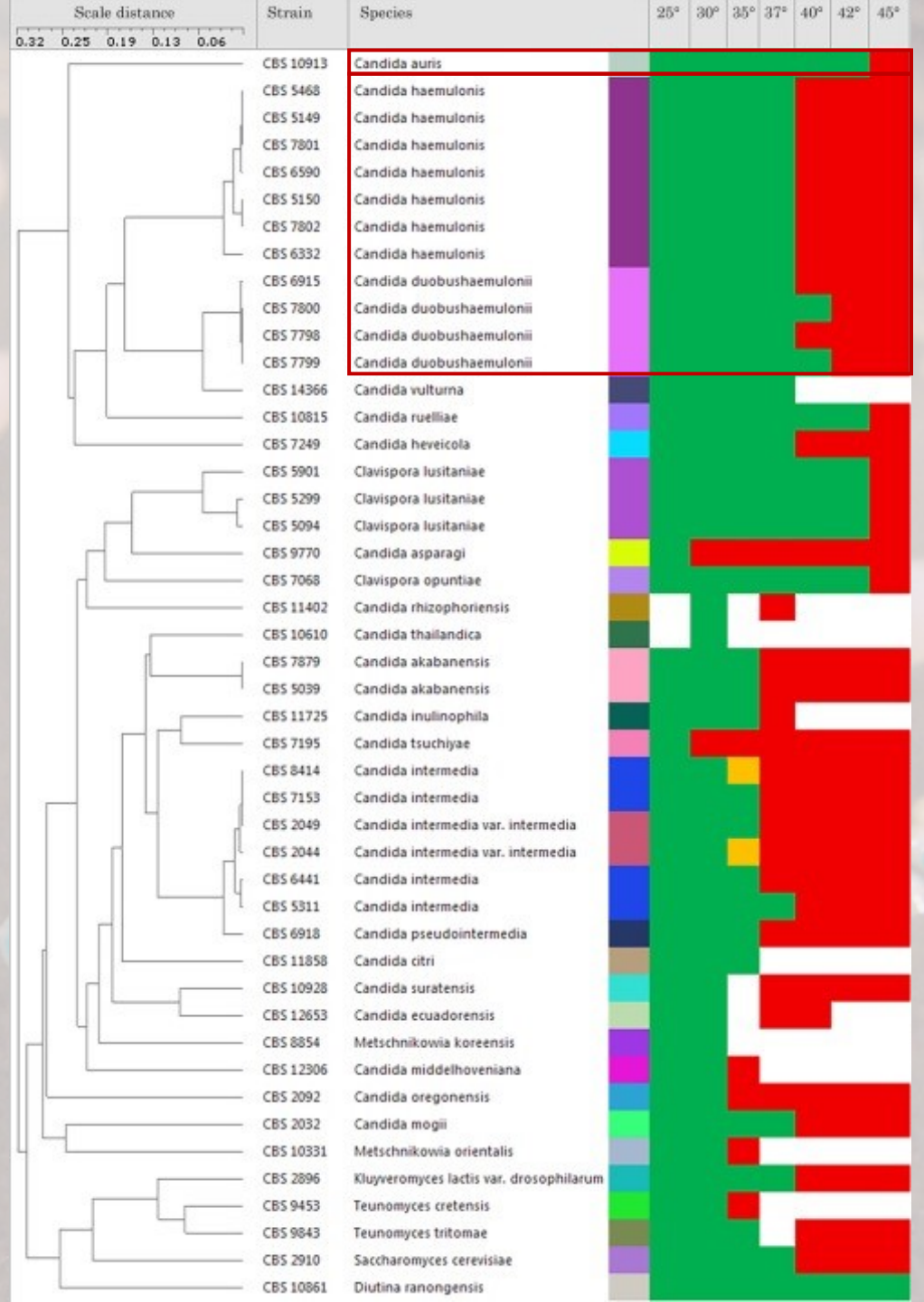

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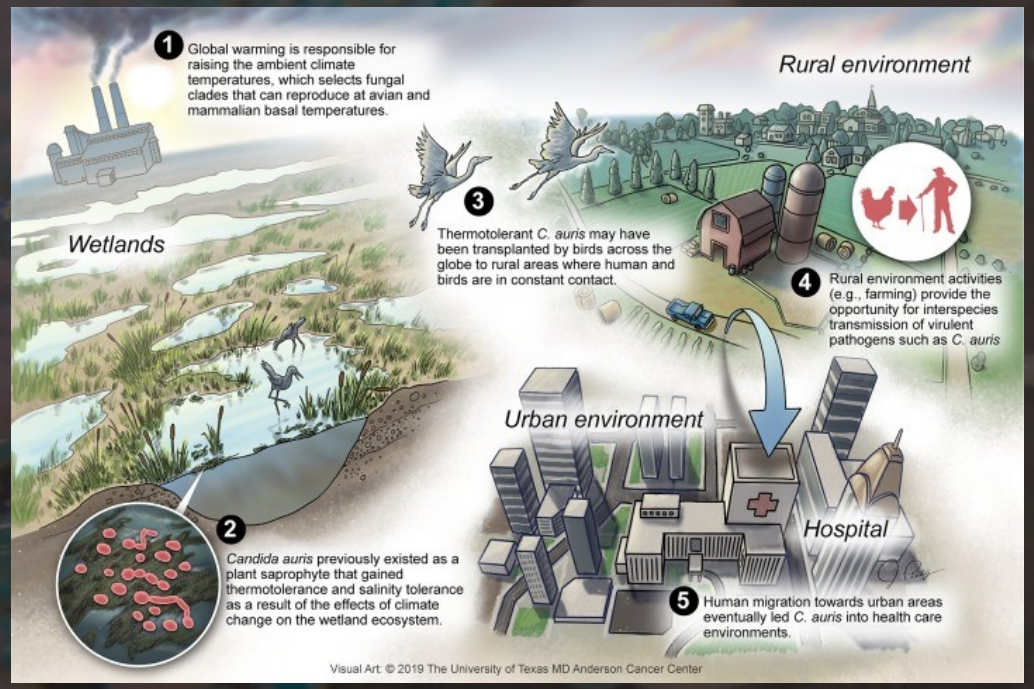

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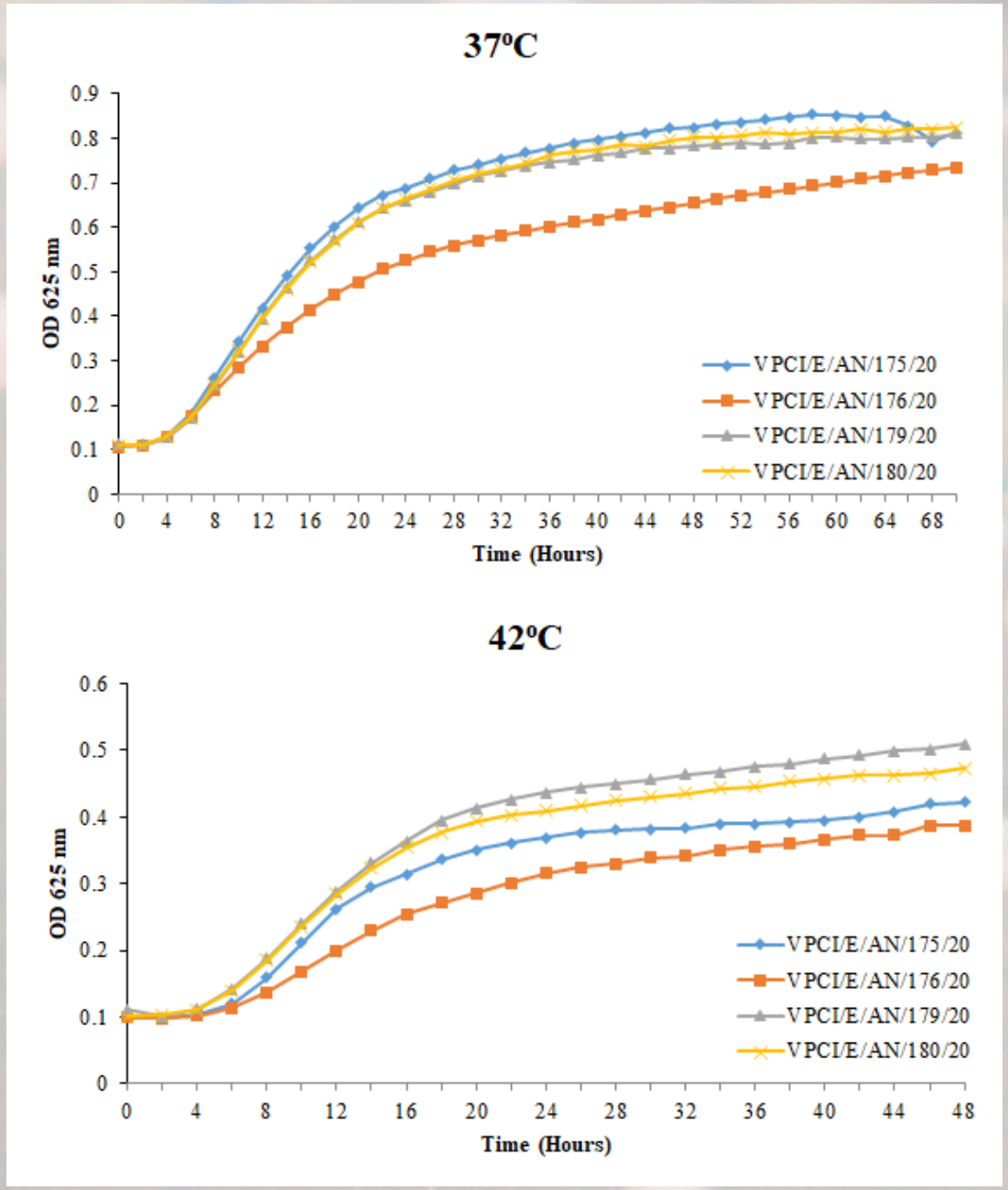

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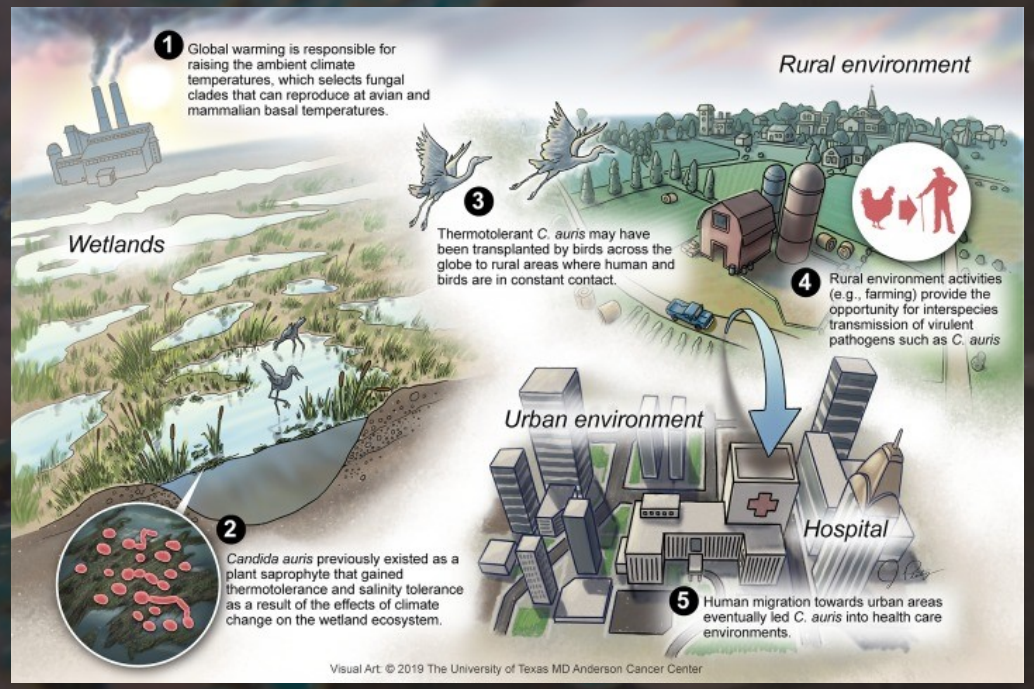

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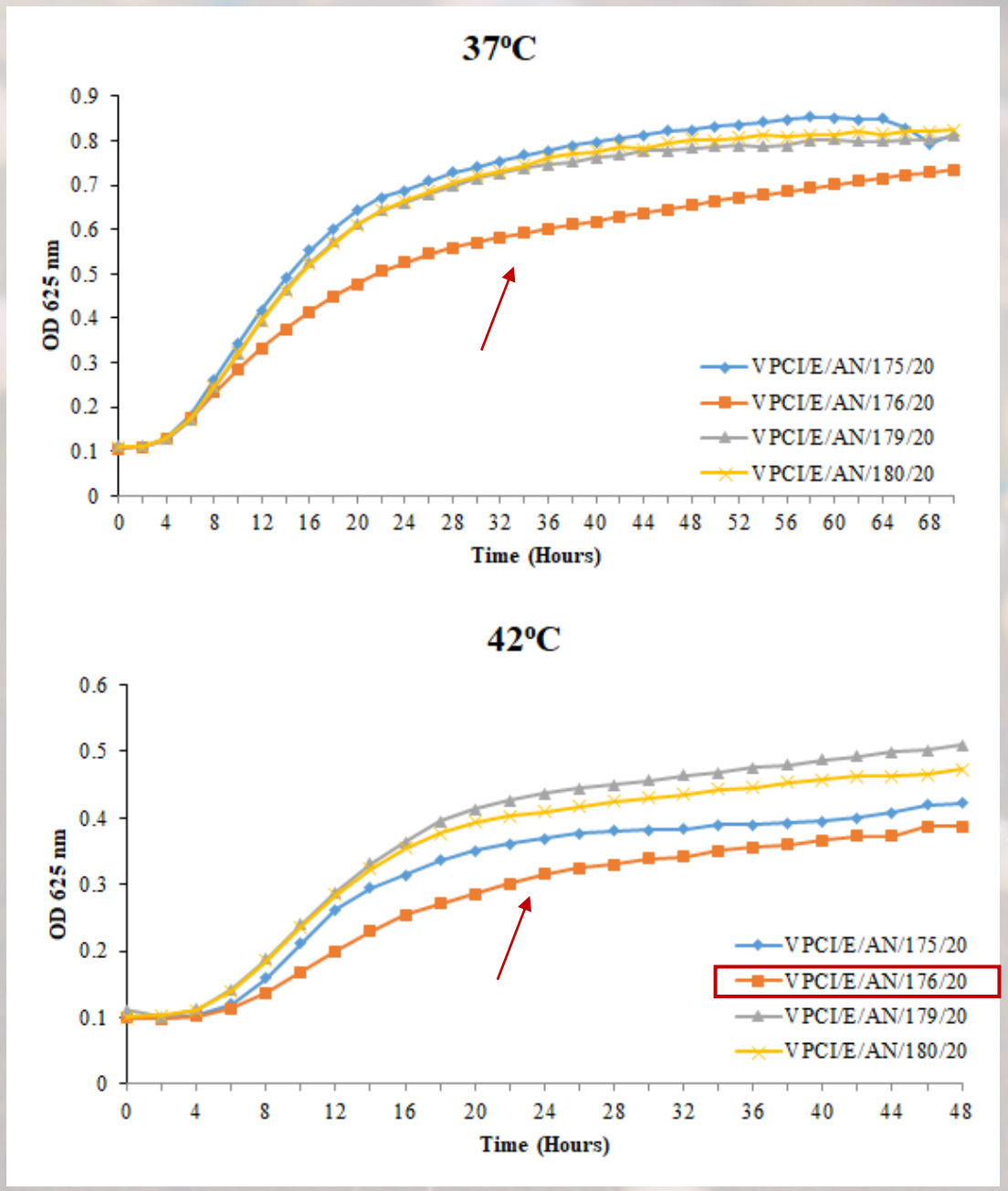

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The global warming hypothesis

Less termal tolerant
Less multi-drug resistant

The global warming hypothesis

Less termal tolerant
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More termal tolerant
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The global warming hypothesis

Less termal tolerant
Less multi-drug resistant

More termal tolerant
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Unknown other
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Marine fungus?

The global warming hypothesis

Unknown other ecological reservoirs

Marine fungus?

- Osmotolerance

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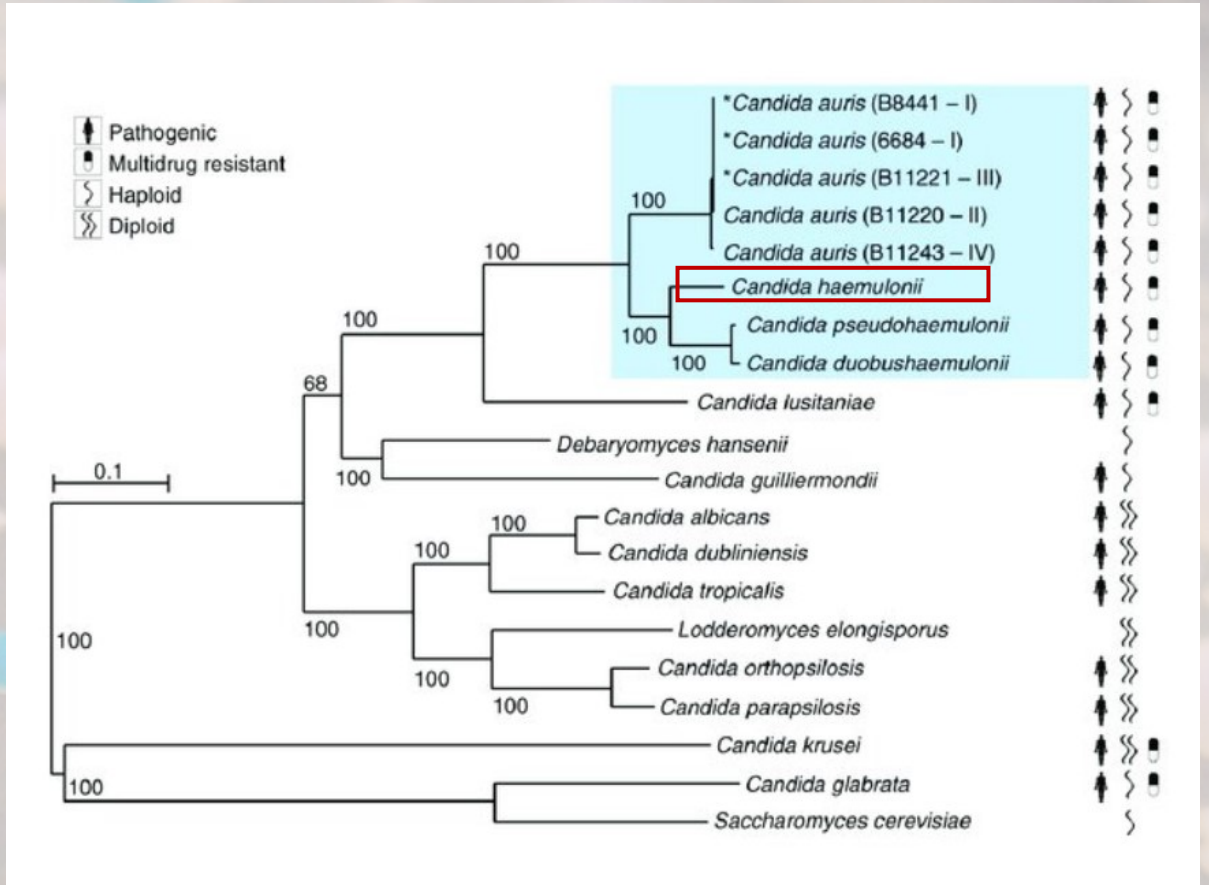
- Andaman's findings
- Colonisation sources
- Coastal outbreaks
- Phylogeny clues



C. haemulonii isolated in:

- Gut of *Haemulon sciurus*
- Portugal seawater (1962), Indian seawater (2011)
- Soft coral *Palythoa variabilis,* Brazil 2016
- Skin of a Dolphin (unknown species) in Suriname
- Pool with bottlenose dolphins (*Tursiops truncatus*)
- Aquaculture in shrimps

The global warming hypothesis

Unknown intermediate host

The global warming hypothesis

Unknown intermediate host

features of the hypothesized host?

The global warming hypothesis

Unknown intermediate host

features of the hypothesized host?

- Marine-related

The global warming hypothesis

Unknown intermediate host

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- Marine-related
- Migration routes

The global warming hypothesis

Unknown intermediate host

features of the hypothesized host?

- Marine-related
- Migration routes
- Basal temperature ≤ human

The global warming hypothesis

Unknown intermediate host

features of the hypothesized host?

- Marine-related
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- Basal temperature ≤ human
- Similar immunity

The global warming hypothesis

Unknown intermediate host

features of the hypothesized host?

- Marine-related
- Migration routes
- Basal temperature ≤ human
- Similar immunity
- Documented colonisation

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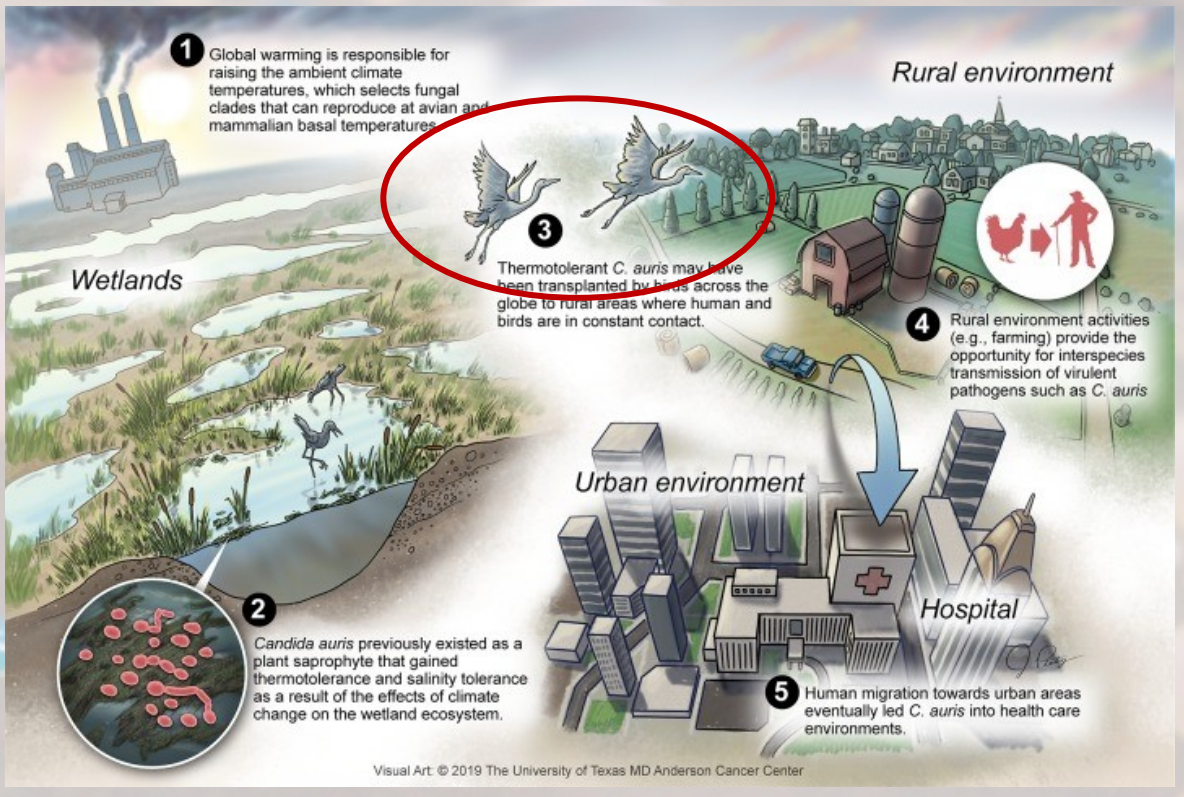

birds

The global warming hypothesis

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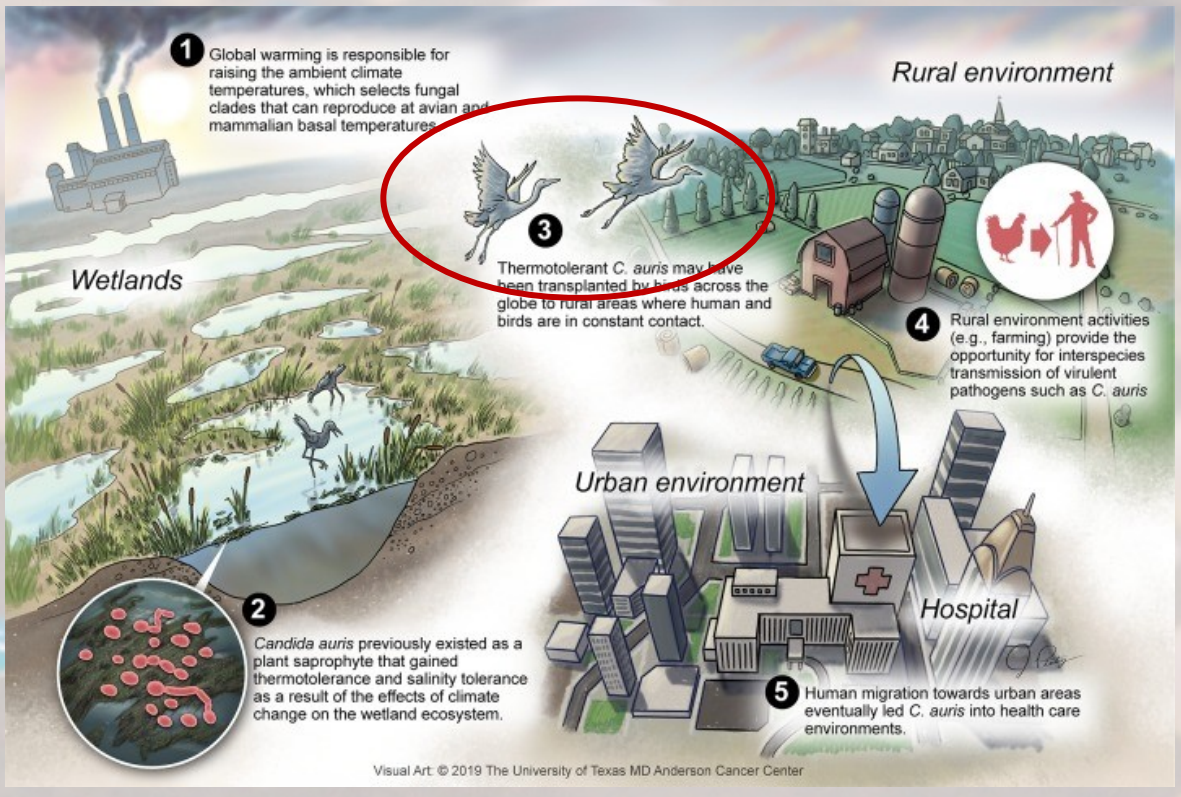

birds

Endocrinology of thermoregulation in birds in a changing climate

41.02 ± 1.29 °C

Suvi Ruuskanen [a], Bin-Yan Hsu [a], Andreas Nord [b]

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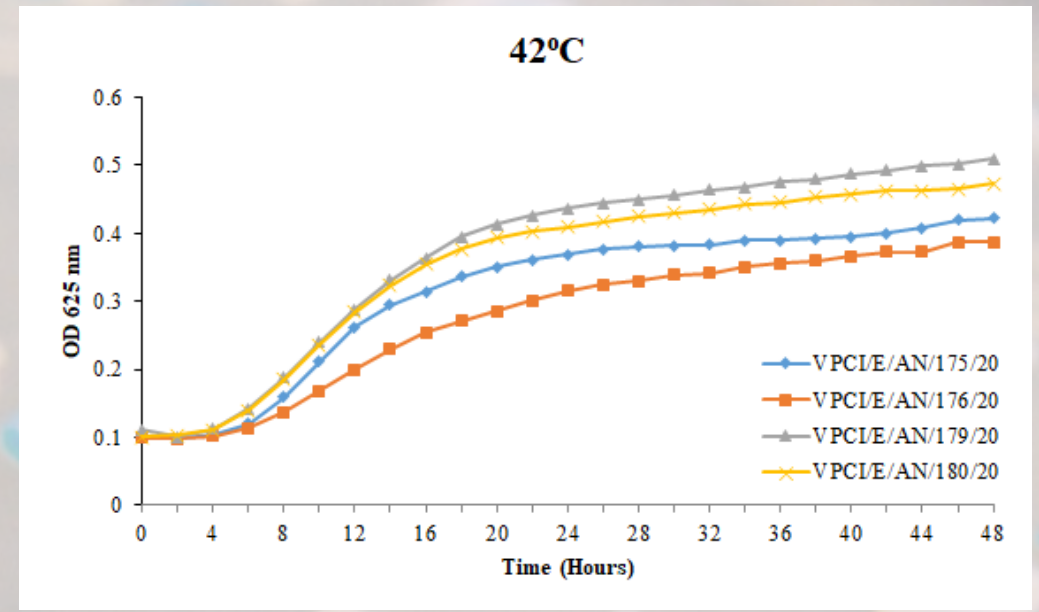

Arora et al. mBio 2021 Mar 16;12(2):e03181-20. doi: 10.1128/mBio.03181-20.

The global warming hypothesis

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- Marine-related
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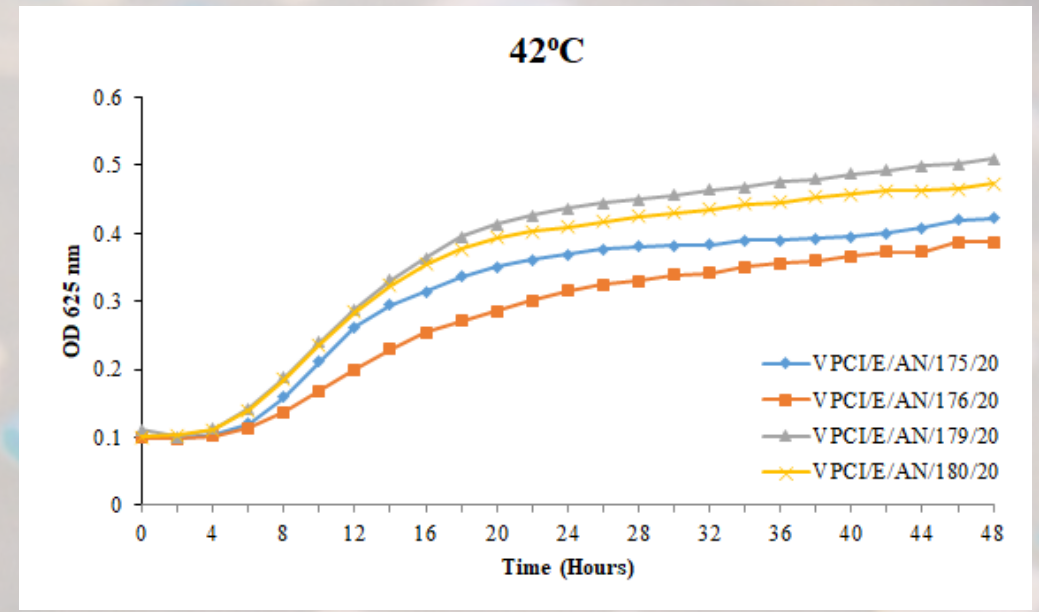
- Basal temperature > human
- Similar immunity
- Documented colonisation
- Documented interspecies transmission
- High evolutionary leap



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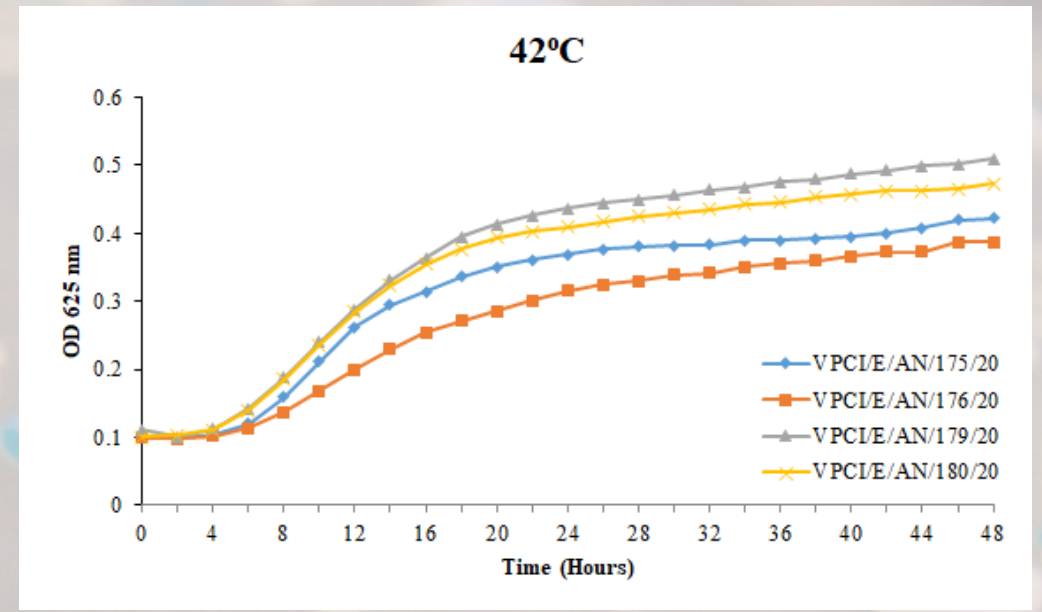

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From 380 – 36 years ago

Among clades: founder effect

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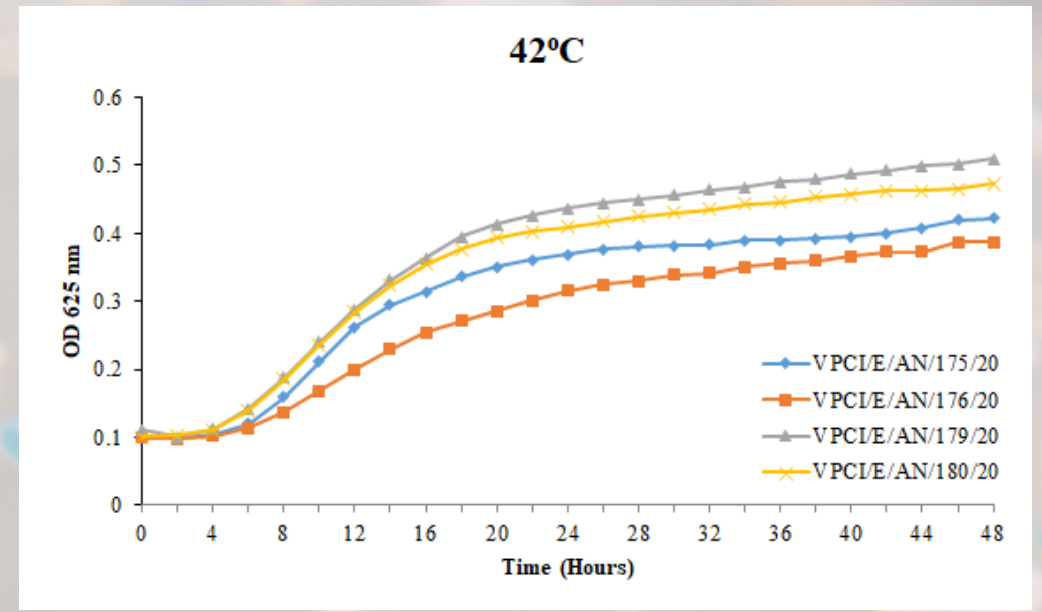

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marine megafauna

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Article

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Wen-Lin Wang [1,2], Pei-Lun Sun [3,4], Chi-Fei Kao [5,6], Wen-Ta Li [7], I-Jiunn Cheng [8] and Pin-Huan Yu [1,2,*]

Evidence of Fluconazole-Resistant *Candida* Species in Tortoises and Sea Turtles

Raimunda Sâmia Nogueira Brilhante · Pedro Henrique de Aragão Rodrigues ·

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John D. Buck,[1] Randall S. Wells,[1,2,5] Howard L. Rhinehart,[1] and Larry J. Hansen[3,4]

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Marnel Mouton,[1,3] Desray Reeb,[2] Alfred Botha,[1] and Peter Best[2]

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JOHN D. BUCK

Research Article

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C. haemulonii

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Objectives and methods

Determine a possible marine environmental reservoir of *C. auris* and its potential zoonotic transmission through marine megafauna

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Departamento de Microbiología y Ecología

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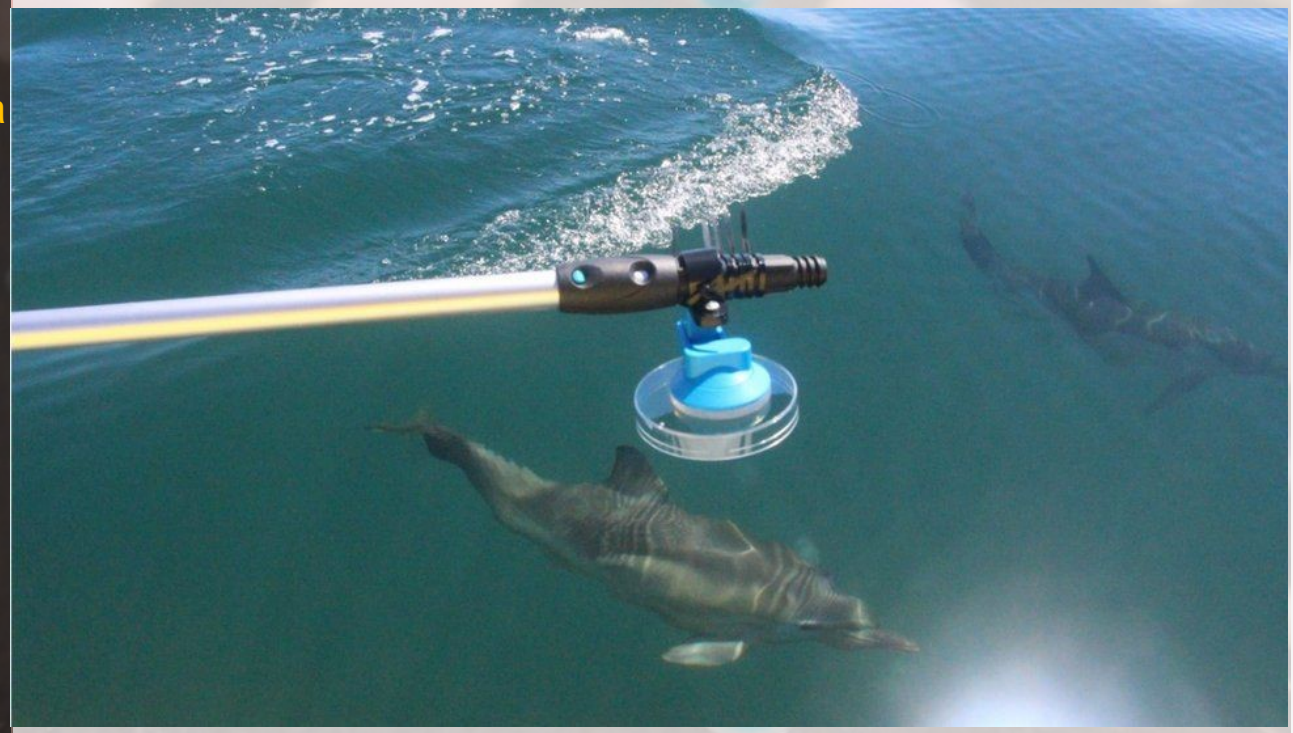

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FUNDACIÓN OCEANOGRÀFIC

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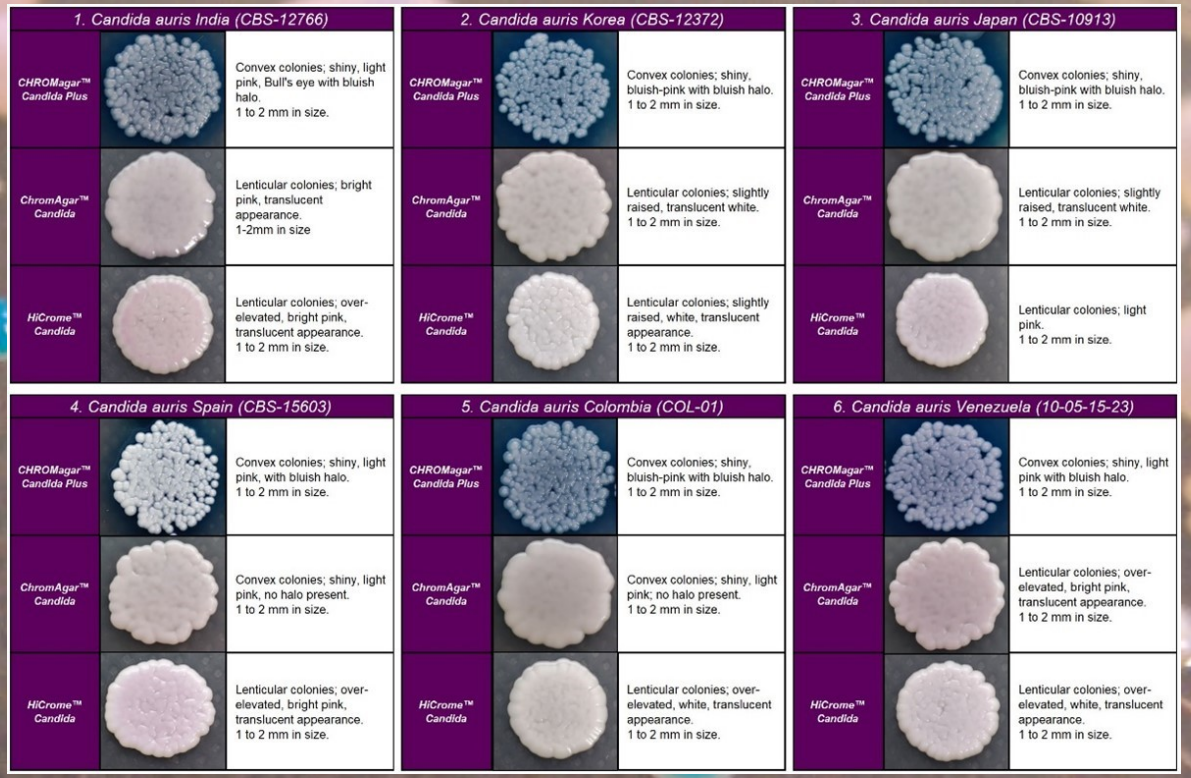
Objectives and methods

Microbiological identification

- Culture (fungal and chromogenic media)

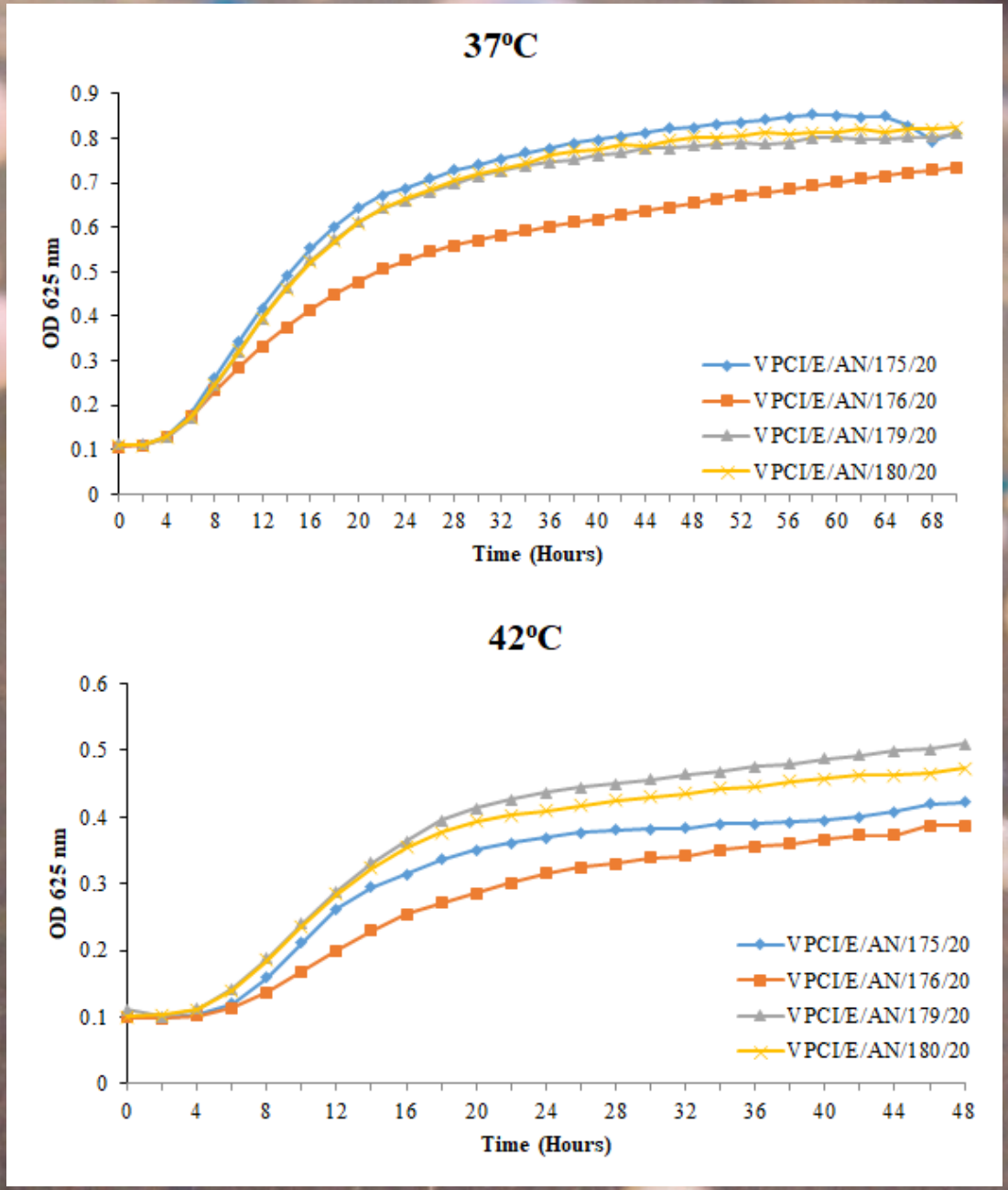


In search of a new marine zoonosis: ecological reservoir of *C. auris* from a One Health approach

Objectives and methods

Microbiological identification

- Culture (fungal and chromogenic media)
  - Differential thermic growth assays

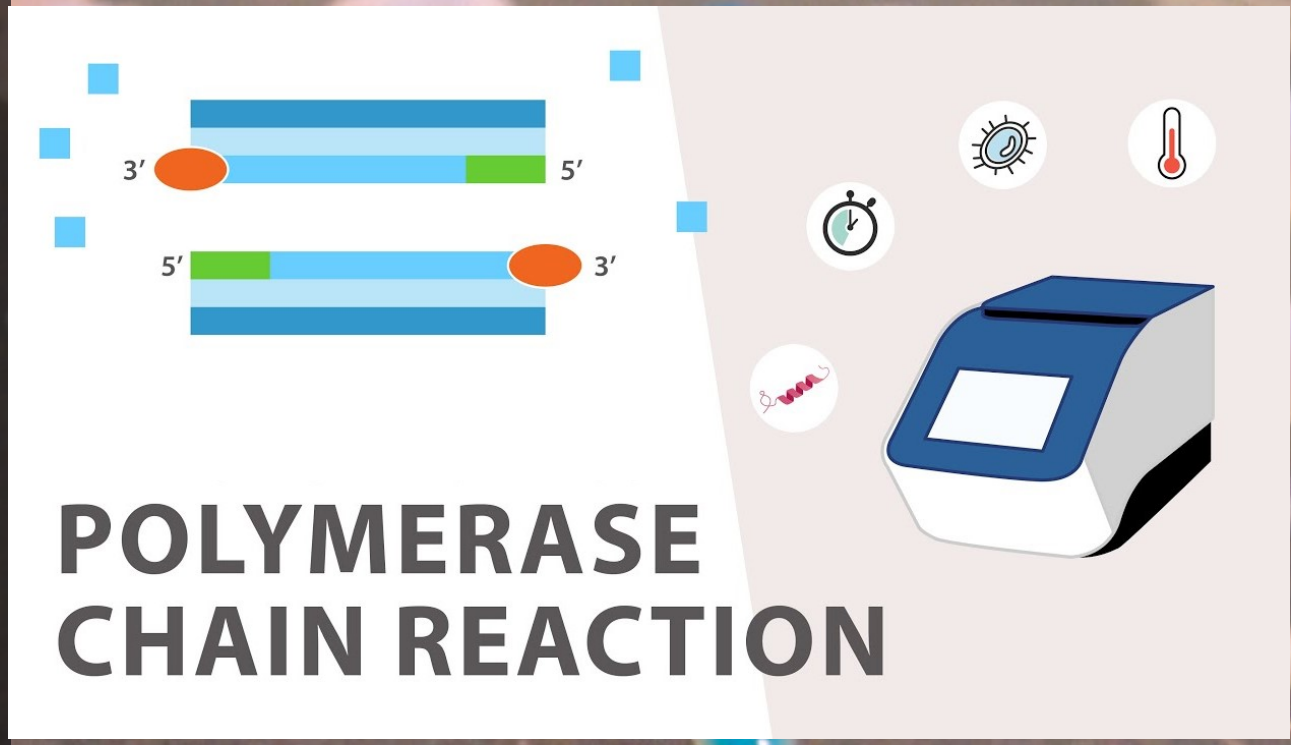


In search of a new marine zoonosis: ecological reservoir of *C. auris* from a One Health approach

Objectives and methods

Microbiological identification

- Culture (fungal and chromogenic media)
- PCR (screening)

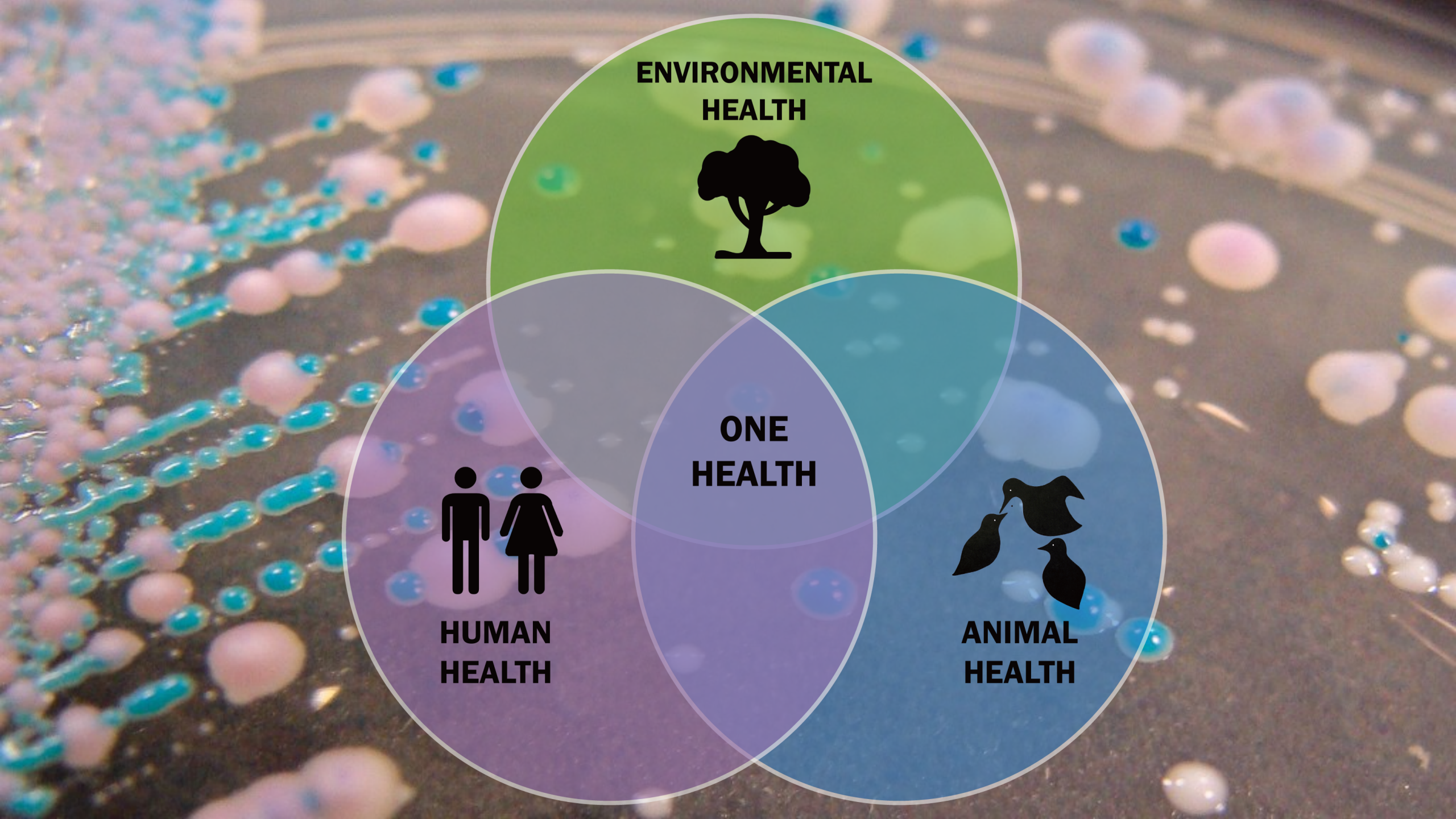


In search of a new marine zoonosis: ecological reservoir of *C. auris* from a One Health approach

Objectives and methods

Microbiological identification

- Culture (fungal and chromogenic media)
- PCR (screening)
- Gene sequencing and phylogenetic analysis


ENVIRONMENTAL HEALTH
ONE HEALTH
HUMAN HEALTH
ANIMAL HEALTH

Instituto de Investigación Sanitaria La Fe

Instituto Médico Valenciano
IMV

Reservorio marino y zoonótico de *Candida auris:* cribado ambiental y megafauna marina como vector de transmisión al humano en la Comunidad Valenciana

Grupo de Investigación en Infección Grave