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Editorial

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Mini review section – *Laboratory Methods for Accurate Identification*

Standard diagnostic methods, such as culture-based identification, are often the first step. Clinical samples like blood, urine, wound swabs, or respiratory secretions are cultured on fungal media. If colonies of *Candida* are found, they're typically passed through automated identification systems like VITEK, API 20C AUX, or BD Phoenix.

Current Trends section – Healthcare facility floors and sink drains and other wastewater drainage sites are universally contaminated with potential pathogens. There are plausible mechanisms by which organisms in these sites can be disseminated to environmental surfaces that are commonly touched and to patients and personnel. One factor that has hindered progress in addressing floors and sinks has been the lack of practical and effective measures to reduce the risk for dissemination of organisms from these sites.

In Profile Scientist – In the long history of cell biology, certain names stand out for discoveries that fundamentally reshaped our understanding of life at the microscopic level. Among them is **Richard Altmann (1852–1900)**, a German pathologist whose pioneering work laid the conceptual groundwork for what we now know as **mitochondria**, the organelles central to cellular respiration and energy production. Though he lived a relatively short life and published his major work in an era when cell biology was still defining itself, Altmann's insights were far ahead of his time. Today, he is remembered as one of the key figures who bridged the gap between early microscopic observations and modern molecular biology.

Bug of the month – *Naegleria fowleri*, often sensationalized in the media as the “brain-eating amoeba,” is a free-living protozoan that has captured global attention due to the severe and often fatal infection it can cause in humans. While cases are extremely rare, the organism's biology, ecology, and clinical impact make it an important emerging pathogen to understand from a public health perspective. This essay provides an overview of the amoeba, how it infects humans, why it is so dangerous, and what can be done to reduce risk.

Did You Know? When we recall something familiar or explore a new situation, the brain does not always use the same communication routes. An international study led by Claudio Mirasso at the Institute for Cross-Disciplinary Physics and Complex Systems (IFISC), a joint center of the Spanish National Research Council (CSIC) and the University of the Balearic Islands (UIB), and Santiago Canals at the Institute for Neurosciences (IN), a joint center of the CSIC and the Miguel Hernández University (UMH) of Elche, has discovered how the brain flexibly changes its communication pathways by modulating the balance between two fundamental inhibitory circuits.

Best Practices – Our daily life revolves around the internet, from work to education and even talking with friends. The more online accounts and devices you have, the greater the scope for cybercriminals to cause you harm. That's why it's now ever more essential to understand internet safety rules which protect you and your family from threats that may harm your data and devices.

Tickle yourself to enjoy the jokes in our **Relax Mood section**.

Our JHS team is thankful to all our readers for their ever-increasing appreciation that has served as a reward & motivation for us. Looking forward to your continuous support.

The most critically harmful fungi to humans: How the rise of *Candida. auris* was inevitable II

Diagnosis

Laboratory Methods for Accurate Identification

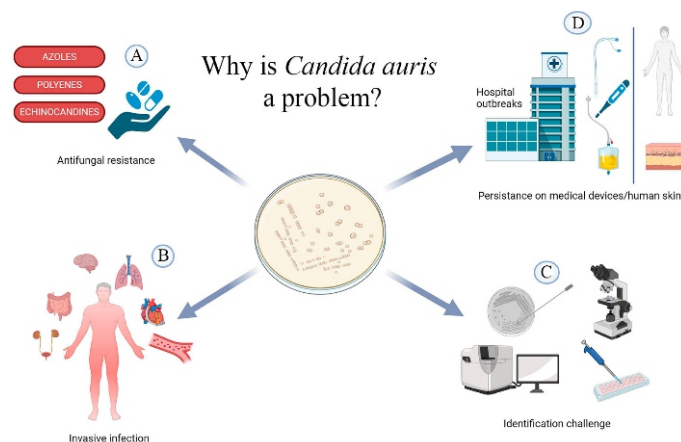
Standard diagnostic methods, such as culture-based identification, are often the first step. Clinical samples like blood, urine, wound swabs, or respiratory secretions are cultured on fungal media. If colonies of *Candida* are found, they're typically passed through automated identification systems like VITEK, API 20C AUX, or BD Phoenix.



To confirm *C. auris* definitively, we now rely on advanced diagnostic tools, such as **MALDI-TOF mass spectrometry** a sophisticated technique that matches the unique protein fingerprint of a microbe against a curated database.

Alternatively, molecular methods such as **PCR (polymerase chain reaction)** or **real-time nucleic acid amplification tests** can directly detect *C. auris* DNA from patient samples or environmental swabs. These are increasingly being deployed in hospitals during outbreaks, because they allow for quicker identification and faster containment.

Whole genome sequencing, the gold standard for confirming the identity of *C. auris* and for tracing the clade or strain involved in a specific outbreak. But sequencing is time-consuming, expensive, and not available in most frontline healthcare settings.



Treatment

Current Antifungal Therapies and Their Effectiveness

Typically, the first-line treatment for *C. auris* infections is an echinocandin, such as micafungin, anidulafungin, or caspofungin. These drugs inhibit the synthesis of a key component of the fungal cell wall, and they're generally effective against most *C. auris* strains at least for now. However, resistance to echinocandins is increasingly being reported, especially in regions where the drug is used extensively or misused.

When echinocandins don't work or if the patient isn't improving clinicians may escalate to lipid-formulated amphotericin B, a more potent but also more toxic option. Amphotericin B acts by disrupting the fungal cell membrane, but its use is often limited by side effects such as kidney damage, electrolyte disturbances, and infusion-related reactions. In other words, it works but it comes at a cost.

There's also **fluconazole**, a commonly used azole antifungal. But here's the catch: most *C. auris* isolates are intrinsically resistant to fluconazole, making it unreliable as a treatment option. Other azoles like voriconazole or posaconazole might show better activity in some cases.

Emerging Treatment Options and Research

One of the most promising new antifungal agents is **ibrexafungerp**, a glucan synthase inhibitor that acts similarly to echinocandins but with a different molecular structure. Early studies have shown that it retains activity against some echinocandin-resistant *C. auris* isolates, which makes it a potential game-changer for difficult cases.

Another compound in development is **fosmanogepix**, a novel agent that inhibits a fungal enzyme involved in cell wall assembly. It has shown broad-spectrum activity, including against multidrug-resistant fungi like *C. auris*.

Researchers are also exploring the use of combination therapies for example, echinocandins plus azoles, or echinocandins plus amphotericin B to enhance efficacy or prevent the emergence of resistance.

Immunotherapy is another frontier. Scientists are investigating whether monoclonal antibodies or immune modulators could help the body better recognize and fight *Candida auris*, especially in immunocompromised individuals.

Infection Control and Prevention

Strategies to Prevent Spread in Healthcare Facilities

The cornerstone of *C. auris* prevention is early identification and isolation. As soon as a patient is confirmed or even suspected to carry *C. auris*, they must be placed under strict contact precautions. This includes assigning them a single room, preferably with dedicated equipment that won't be shared with other patients' stethoscopes, thermometers, even blood pressure cuffs.

In outbreak scenarios, cohorting infected patients in a designated unit or wing may be necessary to prevent hospital-wide spread.

The second line of defence is the environment, *Candida* species that primarily inhabit mucosal surfaces, *C. auris* is a skin colonizer and a surface survivor. It can persist on bed rails,

curtains, floors, IV poles, and even mobile workstations for days or weeks, resisting many commonly used disinfectants.

Hand hygiene remains critical, but even this has its caveats. Alcohol-based hand sanitizers, while effective against many microbes, may be less reliable for eradicating *C. auris* from contaminated hands especially if glove use is inconsistent. Soap and water followed by proper drying and careful glove removal is emphasized in high-risk units.

Staff awareness, Nurses, physicians, environmental services staff everyone needs to know what *C. auris* is, how it spreads, and what measures are non-negotiable.

Guidelines for Hygiene and Sanitation

The CDC and WHO have both issued guidelines for *C. auris* control. Key recommendations include:

- Rigorous environmental disinfection using sporicidal agents.
- Daily and terminal cleaning of patient rooms with agents known to kill *C. auris*.
- Screening of close contacts and high-risk patients (e.g., transfers from affected facilities)
- Cohorting of staff and equipment where feasible.
- Clear signage indicating contact precautions.

Advances in Diagnostic Tools and Treatments

One of the most promising developments has been the commercial availability of next-generation PCR assays that can detect *C. auris* directly from skin swabs in under two hours a major improvement over older systems that took days and required pure culture growth. These rapid diagnostics are now being rolled out in high-risk facilities, particularly in ICUs and long-term care settings, where early detection is most critical.

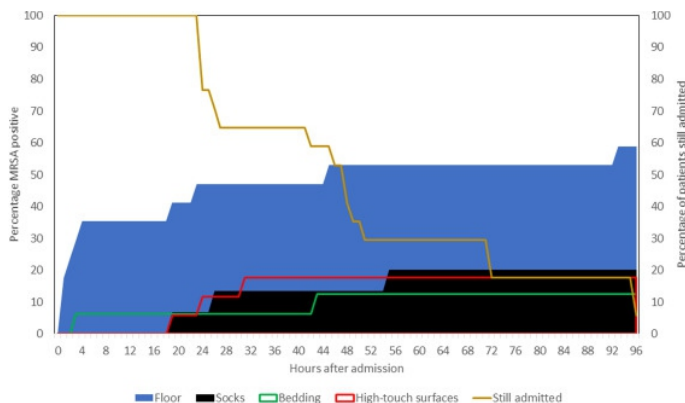
FDA granted emergency use authorization for a novel antifungal compound: **MYC-113**, a first-in-class agent targeting fungal lipid metabolism. Opening the door to combination therapy regimens that are both potent and less toxic.

At the same time, global health agencies have begun investing in real-time fungal surveillance systems, powered by AI-driven analytics. These platforms can detect unusual resistance trends across hospital networks, helping to anticipate outbreaks before they spiral.

There's also growing momentum behind fungal vaccine research, long a neglected area. While no vaccine for *Candida auris* exists yet, early-stage trials using mRNA platforms (inspired by COVID-19 vaccine success) are underway. These vaccines aim to prime the immune system against a broad set of fungal surface proteins, potentially offering cross-protection against multiple *Candida* species.

Update on potential interventions to reduce the risk for transmission of healthcare-associated pathogens from floors and sinks

Healthcare facility floors and sink drains and other wastewater drainage sites are universally contaminated with potential pathogens. There are plausible mechanisms by which organisms in these sites can be disseminated to environmental surfaces that are commonly touched and to patients and personnel. One factor that has hindered progress in addressing floors and sinks has been the lack of practical and effective measures to reduce the risk for dissemination of organisms from these sites.



FLOORS

Evidence that floors are a potential source of pathogen dissemination

In microbial culture surveys conducted in healthcare facilities, floors are typically heavily contaminated with healthcare-associated pathogens, often including *Clostridioides difficile* spores and multi-drug-resistant organisms (MDROs).

Evidence supporting the potential for transfer of pathogens from floors to patients include:

- (1) Shoes of personnel and socks commonly worn by patients often become contaminated with pathogens present on floors.
- (2) Many items come in contact with the floor in patient rooms and touching these objects can transfer pathogens to hands.
- (3) In a simulation study, a live virus inoculated on to floors in hospital rooms frequently disseminated to the footwear and hands of patients, to surfaces in the room, to adjacent rooms, and to nursing stations and
- (4) Shoes that physicians and nurses wear home from healthcare facilities are often contaminated with healthcare associated pathogens, providing a potential vector for the transfer of these pathogens to the community.

Healthcare-associated pathogens, including methicillin-resistant *Staphylococcus aureus* (MRSA), *C. difficile*, and vancomycin-resistant enterococci (VRE), were initially recovered from the floor followed in a subset of patients by detection on sock bottoms, bedding, and high-touch surfaces.

MRSA contamination on floors of MRSA colonized long term care facility residents was frequently transferred by shoes and wheels of wheelchairs to floors in adjacent rooms. Bacteriophage MS2 inoculated on to the floor in index rooms was also frequently

transferred to floors in adjacent rooms and nursing stations as well as to high-touch surfaces in the index room, adjacent rooms, and nursing stations.

Whole genome sequencing has demonstrated that *C. difficile* isolates on shoes of healthcare personnel are often genetically related to isolates causing infections in patients. 18% of shoes of personnel caring for patients with *C. difficile* infection were contaminated with *C. difficile*, and most isolates from shoes matched concurrent patient isolates.

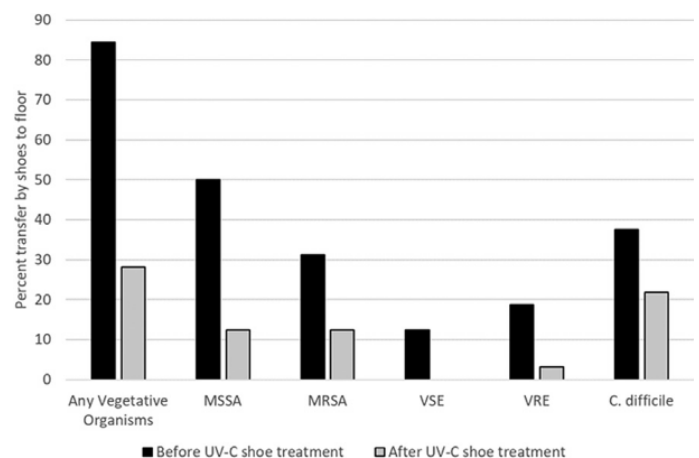
Manual cleaning and disinfection

Floors in hospital rooms were more contaminated than high-touch surfaces, and paradoxically floors had a higher bacterial burden after versus before manual cleaning. These findings demonstrate that the effectiveness of floor cleaning and disinfection may vary considerably in different facilities. Using the same mop heads for multiple room scan result in transfer of pathogens from room to room.

At a minimum, mop heads should be replaced between each room to avoid transfer of pathogens from room to room. Failure to follow recommended cleaning and disinfection protocols can potentially result in contamination of detergents or in some cases in-use quaternary ammonium disinfectants. Microfiber mops are recommended as microfiber has demonstrated superior microbial removal compared with cotton string mops when used with a detergent cleaner.

Ultraviolet-C(UV-C) light and electrostatic spray technologies

UV-C light room decontamination devices are commonly used as an adjunct to manual cleaning and disinfection in healthcare facilities. UV-C room decontamination device was effective in reducing floor contamination in laboratory testing and also reduced residual MRSA contamination on floors in patient rooms.



In addition, to UV-C devices, electrostatic spray technologies may potentially be used to reduce floor contamination. Adjunctive UV-C light treatment and a dilute (0.25%) sodium

hypochlorite solution delivered via the electrostatic sprayer were similarly effective in significantly reducing residual contamination on floors and high-touch surfaces. The electrostatic spray technology required less overall time until the room was ready to be occupied by another patient than the UV-C device. The product left minimal to no residue and there was no evidence of damage to surfaces. These suggest that the electrostatic sprayer technology or UV-C could provide effective and efficient adjunctive decontamination of floors and touched surfaces.

UV-C shoe decontamination

One strategy to address floor contamination is cleaning and/or disinfection of shoes prior to entry into patient rooms or care areas to reduce transfer of pathogens. UV-C devices have been developed that are designed to decontaminate the soles of shoes. An 8-second treatment of shoe soles with a UV-C

decontamination device significantly reduced the frequency of transfer of vegetative pathogens. The UV-C device could potentially be used to reduce transfer of pathogens into patient rooms or other patient care areas.

Wearing slippers to reduce acquisition of pathogens on feet

Having hospitalized patients wear slippers could reduce contamination of socks and subsequently on hands and high-touch surfaces.

A benign virus inoculated on the floor was frequently acquired on socks or feet of patients and transferred to high touch surfaces and hands. Acquisition of the virus was significantly reduced in patients randomized to wear slippers whenever out of bed. These suggest that having patients wear slippers could provide a simple and low-cost intervention to decrease the risk for acquisition of pathogens from floors. Encouraging patient hand hygiene after contact with slippers or socks may also be beneficial.

Richard Altmann: The Scientist Who Brought “Bioblasts” to Life



In the long history of cell biology, certain names stand out for discoveries that fundamentally reshaped our understanding of life at the microscopic level. Among them is **Richard Altmann (1852–1900)**, a German pathologist whose pioneering work laid the conceptual groundwork for what we now know as **mitochondria**, the organelles central to cellular respiration and energy production. Though he lived a relatively short life and published his major work in an era when cell biology was still defining itself, Altmann’s insights were far ahead of his time. Today, he is remembered as one of the key figures who bridged the gap between early microscopic observations and modern molecular biology.

Early Life and Academic Formation

Altmann was born on March 12, 1852, in Leipzig, Germany, a city known for its vibrant scientific and cultural environment. Leipzig University, where he later studied medicine, was one of the leading centers of anatomical and physiological research in Europe. Under the influence of strong mentors and a rapidly evolving scientific atmosphere, Altmann developed a deep interest in pathology, specifically cellular pathology, the groundbreaking framework introduced by Rudolf Virchow only a few years earlier.

After completing his medical degree, Altmann pursued research in histology and pathology. He eventually became a lecturer and then an associate professor, focusing much of his work on improving microscopic techniques to visualize the fine structures of cells. At a time when staining methods were rudimentary and microscopy depended heavily on hand-crafted lenses and chemical dyes, Altmann’s technical precision became one of his strongest assets.

The Quest to See the Cell More Clearly

One of the central challenges in late 19th-century biology was the limited ability to differentiate cellular components. Scientists could see nuclei and general cytoplasmic texture, but finer internal structures were often invisible or poorly defined. Altmann believed that improvements in preparation and staining techniques could reveal a world of subcellular detail that was previously overlooked.

To accomplish this, he developed a new staining method using **acid fuchsin and picric acid**, which produced much sharper images under the microscope. This method allowed him to observe small, granular bodies distributed throughout the cytoplasm of many types of cells. He became convinced that these granules were not artifacts or incidental debris but distinct, living components with functional significance.

Bioblasts: Altmann’s Vision of Fundamental Living Units

In 1890, Altmann published his influential work *Die Elementarorganismen* (“The Elementary Organisms”). In this book, he presented his observations on the tiny granules he had studied and proposed a revolutionary idea: these structures—which he named **bioblasts**—were the true elementary units of life.

Unlike many contemporaries who placed the nucleus at the center of cellular life, Altmann suggested that bioblasts were semi-autonomous living entities, somewhat analogous to bacteria, existing within the cell. He believed that each bioblast had its own metabolic activity and played a crucial role in vital cellular processes.

Though today we know that bioblasts correspond to **mitochondria**, Altmann lacked the biochemical tools to verify this. Still, his interpretation was remarkably prescient. He recognized that:

- bioblasts were present in nearly all eukaryotic cells,
- they had internal structure,
- they behaved consistently across diverse tissues, and
- they appeared essential for cellular activity.

This was decades before the discovery of mitochondrial respiration, ATP production, or the organelle’s unique DNA.

Altmann’s Legacy and the Mitochondrial Revolution

With the rise of biochemistry in the early 20th century, mitochondria became recognized as the site of **cellular respiration**. By mid-century, the advent of electron microscopy confirmed that these organelles had intricate structures: outer and inner membranes, cristae, and enclosed internal compartments. Even more astonishing was the discovery of **mitochondrial DNA** in the 1960s, which suggested an evolutionary origin connected to ancient bacteria. This finding aligned remarkably well with the autonomy Altmann had sensed in his bioblasts decades earlier.

Altmann’s work anticipated several major ideas in modern cell biology:

1. Subcellular Complexity

He demonstrated that cytoplasm is not a uniform gel but a landscape of organized, functional structures.

2. Energy-Generating Units

Although he could not measure ATP or oxygen consumption, Altmann believed bioblasts were the engines of the cell.

3. **Symbiotic Origins (indirectly)**

His proposal that bioblasts were “elementary organisms” echoes what would later become the endosymbiotic theory.

4. **Methodological Precision**

His staining methods paved the way for more sophisticated histochemical and fluorescent techniques used today.

Altmann died on December 8, 1900, at the age of just 48. His career, though brief, produced insights that reverberate through biology classrooms and research laboratories even today. Like many scientists whose work was ahead of its time, his contributions were fully recognized only decades after his death.

Mitochondria are now central to fields such as metabolism, genetics, aging, immunology, neurobiology, and cancer research. From mitochondrial diseases to energy metabolism disorders to the role of mitochondria in programmed cell death, contemporary biology continually builds on foundations that Altmann helped establish.

His belief that the cell contained microscopic, active units of life was a radical idea—one that reshaped how scientists understood living systems. Today, mitochondria are no longer mysterious granules but recognized as powerhouse organelles that drive the energy economy of nearly every eukaryotic cell.



Jokes



I finally joined a gym last month.
So far I've lost... twenty dollars.
That's the fee I paid and never went.
Great results, zero sweat.

The weather app said it would be sunny.
So I hung my clothes outside.
Then it started raining immediately.
Even the clouds have trust issues.

The dentist asked if I floss daily.
I told him I floss "often enough."
He laughed like it was a joke.
Then charged me like it was a lie.

I told the optician I couldn't see very far.
He asked, "How bad is it?"
I said, "I still believe my boss will give me a raise."
He whispered, "Yeah... that's blindness."

I started a new diet yesterday.
It said, "Follow your cravings, but spiritually."
So I sat with a cake, reflected deeply...
and then ate it to release the attachment.

The waiter asked, "How's the food?"
I said, "Delicious!"
Then he brought the bill.
Suddenly, I wasn't hungry anymore.

Naegleria fowleri: The “Brain-Eating Amoeba”



Naegleria fowleri, often sensationalized in the media as the “brain-eating amoeba,” is a free-living protozoan that has captured global attention due to the severe and often fatal infection it can cause in humans. While cases are extremely rare, the organism’s biology, ecology, and clinical impact make it an important emerging pathogen to understand from a public health perspective. This essay provides an overview of the amoeba, how it infects humans, why it is so dangerous, and what can be done to reduce risk.

Naegleria fowleri is a thermophilic, single-celled amoeba belonging to the phylum Percolozoa. It naturally inhabits warm freshwater bodies such as ponds, lakes, hot springs, and poorly maintained swimming pools. It thrives particularly well in temperatures between 25°C and 45°C, making warm climates and heated water sources conducive to its growth. Unlike many disease-causing amoebae, *N. fowleri* is not normally parasitic; it primarily feeds on bacteria in the environment. Human infection occurs accidentally, when conditions allow the amoeba to enter the body.

The organism exists in **three forms**:

1. **Trophozoite (active feeding stage):** This is the infectious and reproductive form that moves using pseudopodia and feeds aggressively.
2. **Flagellate form:** A temporary, motile form that develops when the amoeba is exposed to a sudden drop in nutrients.
3. **Cyst:** A dormant, protective form that helps the organism survive harsh conditions, although cysts are not commonly found in human infections.

The trophozoite stage is responsible for disease in humans. Infection occurs only when contaminated water enters the nasal passages. From there, the trophozoites migrate through the olfactory nerve, cross the cribriform plate, and reach the brain. They begin feeding on brain tissue by releasing destructive enzymes, leading to widespread inflammation and necrosis.

Importantly:

- **You cannot get infected by drinking contaminated water**, because the organism cannot survive in the stomach.
- **It does not spread from person to person.**
- **Only certain environmental conditions allow it to infect humans**, making the disease extremely rare despite the amoeba being widespread in nature.

Primary Amoebic Meningoencephalitis (PAM)

The disease caused by *Naegleria fowleri* is known as **Primary Amoebic Meningoencephalitis (PAM)**. It is an acute, fulminant infection of the central nervous system.

Symptoms

Symptoms typically begin 1–9 days after exposure and progress rapidly. Early symptoms resemble those of bacterial meningitis:

- Severe headache
- High fever
- Nausea and vomiting
- Stiff neck

As the disease progresses, neurological symptoms rapidly worsen:

- Seizures
- Altered mental status
- Hallucinations
- Coma

Death usually occurs within 3–7 days of symptom onset due to increased intracranial pressure and extensive brain damage.

Diagnosis

Diagnosing PAM is difficult because:

- It progresses rapidly.
- Symptoms resemble more common infections.
- Laboratory identification requires observing motile amoebae in cerebrospinal fluid or using specialized molecular tests.

Due to these challenges, diagnosis is often delayed, contributing to the high fatality rate.

Why Is It Called the “Brain-Eating Amoeba”?

The nickname stems from the amoeba’s mechanism of pathogenesis. Once inside the brain, *N. fowleri* destroys tissue by:

- Releasing cytolytic molecules and proteases
- Feeding directly on neurons
- Triggering massive inflammation

While the term “brain-eating” is dramatic, it accurately reflects the destructive impact of the amoeba’s invasion.

Despite the fear associated with *Naegleria fowleri*, infection is extremely rare—only a small number of cases are reported worldwide each year. Millions of people swim in warm freshwater annually, and most are never infected. Factors that contribute to its rarity include:

- The amoeba must enter specifically through the nose.
- The dose and conditions must be just right.
- Human nasal anatomy and immune defenses naturally limit infection.

This rarity is important to emphasize, as public perception often overestimates the risk.

Treatment

Treating PAM is challenging, but survival is possible with rapid diagnosis and aggressive therapy.

Current treatment protocols may include:

- **Amphotericin B**, an antifungal medication with anti-amoebic activity
- **Miltefosine**, an anti-leishmanial drug shown to be effective against the organism
- **Therapeutic hypothermia**, to reduce brain swelling
- **Steroids**, to control inflammation

Even with treatment, survival remains low. However, isolated cases of recovery have been documented when therapy begins early.

Environmental Factors and Climate

Global warming is believed to contribute to the increasing geographical spread of *N. fowleri*. Rising temperatures can:

- Increase water temperatures in lakes and rivers
- Expand habitats suitable for the amoeba
- Increase human recreational exposure

Additionally, poorly maintained water systems—such as warm tap water in regions with inadequate chlorination—have also been implicated in rare infections.

Prevention: Reducing the Risk

Complete avoidance of freshwater activities is unnecessary. Instead, simple precautions significantly reduce the already low risk of infection.

Recommended preventive measures:

- Avoid jumping or diving into warm freshwater, especially in hot weather.
- Use nose clips when swimming in lakes, ponds, or rivers.
- Avoid disturbing sediment in shallow warm freshwater.
- Ensure swimming pools and spas are properly chlorinated.
- Do not rinse nasal passages with unboiled tap water; always use sterile or distilled water for nasal irrigation.

These guidelines are particularly relevant during the hottest months when water temperatures are highest.

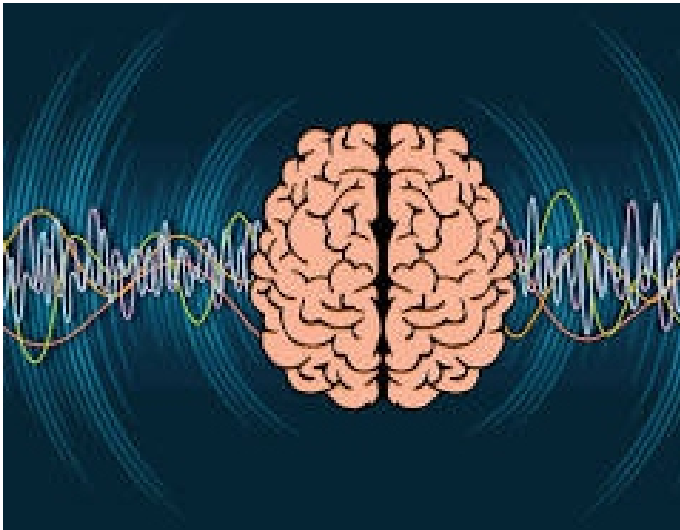
Public Health Awareness

Awareness is the key to preventing PAM. Public health organizations emphasize:

- Educating the public about safe water practices
- Updating water treatment guidelines in high-risk regions
- Improving diagnostic capabilities in hospitals
- Ensuring clinicians consider PAM in cases of meningitis with water exposure history

Better awareness has already led to earlier detection and improved survival in some cases.

Brain Rhythms Reveal a Secret Switch Between Old Memories and New Adventures



When we recall something familiar or explore a new situation, the brain does not always use the same communication routes. An international study led by Claudio Mirasso at the Institute for Cross-Disciplinary Physics and Complex Systems (IFISC), a joint center of the Spanish National Research Council (CSIC) and the University of the Balearic Islands (UIB), and Santiago Canals at the Institute for Neurosciences (IN), a joint center of the CSIC and the Miguel Hernández University (UMH) of Elche, has discovered how the brain flexibly changes its communication pathways by modulating the balance between two fundamental inhibitory circuits.

These results, recently published show that this flexibility depends on the balance between two types of inhibitory mechanisms, which regulate the interaction between slow (theta) and fast (gamma) rhythms. Thanks to this mechanism, the brain can select different sources of information, such as sensory stimuli from the external environment or stored sensory experience from memory.

To reach these conclusions, the researchers combined computational models with experimental recordings in the hippocampus, a brain region crucial for memory and navigation. They observed that in familiar environments, where sensory experiences are already known, neurons favor a direct communication mode that facilitates transmission from the entorhinal cortex to the hippocampus. In this mode, the reactivation of established memory is prioritized. By contrast, when facing novelty, the brain activates another mode that integrates memory reactivation with novel sensory inputs. In this mode, memory updating is prioritized.

Until now, it was thought that the phase of slow brain rhythms organized the amplitude of faster activity; however, this study

demonstrates that the relationship is bidirectional: "This work provides a mechanistic explanation of how the brain flexibly changes communication channels depending on the context," says Dimitrios Chalkiadakis, first author of the study. "By adjusting the balance between different types of inhibition, circuits define which inputs to prioritize, whether from memory-related pathways or from new sensory information," highlights the researcher.

Through a theoretical framework integrating electrophysiological data from rats exploring new and familiar environments, the experts identified two modes of operation: in one, feedforward inhibition leads to gamma-to-theta interactions, while in the other, feedback inhibition produces theta-to-gamma interactions. Neuronal circuits in the brain naturally implement both modes of inhibitory connectivity. The study shows that the transition between them is continuous, and prioritizing one or the other depends solely on the strength of synaptic connections between neurons in the circuit. This allows the mode of operation to be flexibly adjusted to context and cognitive demands.

Beyond memory

The study suggests that this flexible form of coordination between brain rhythms could extend to other cognitive functions, such as attention. In fact, recent work in humans shows patterns consistent with the computational model. This points to a general principle of the brain: the balance between inhibitory circuits is key to directing information within its complex network of connections.

"Our results help unify opposing views on how brain rhythms of different frequencies interact," explains Mirasso. "Rather than being purely local or inherited from earlier regions, these rhythms emerge from the interaction between external inputs and local inhibitory dynamics. This dual mechanism enables the brain to optimize information processing under different conditions," adds Canals.

Beyond memory and navigation, the findings could extend to other cognitive functions. Looking ahead, the researchers intend to expand their model to include a greater diversity of neuronal types and architectures specific to each brain region. The aim is to better understand how this balance is altered in pathologies such as epilepsy, addiction, or Alzheimer's disease: "Studying these dynamics at a mechanistic level could ultimately inspire new therapeutic intervention strategies," both authors conclude.

This work was made possible thanks to funding from the Spanish Ministry of Science, Innovation, and Universities through the R&D Project Program (Knowledge Generation and Research Challenges) and from the Spanish State Research Agency through the Severo Ochoa Centers of Excellence and the María de Maeztu Units of Excellence Program.

Top 15 internet safety rules and what not to do online



Our daily life revolves around the internet, from work to education and even talking with friends.

The more online accounts and devices you have, the greater the scope for cybercriminals to cause you harm. That's why it's now ever more essential to understand internet safety rules which protect you and your family from threats that may harm your data and devices.

The Key Dangers of the Internet

When you and your family use the internet, you are (often unknowingly) exposing yourself to a wide range of potential online threats. Here is a list of just some of the biggest internet dangers you and your family need to watch out for:

- Identity theft.
- Data breaches.
- Malware and viruses.
- Phishing and scam emails.
- Fake websites.
- Online scams.
- Romance scams.
- Inappropriate content.
- Cyberbullying.
- Faulty privacy settings.

1. Essential Internet Safety Tips

When you go online in a public place and use a public Wi-Fi connection, you have no direct control over its security, which could leave you vulnerable to cyberattacks. So, if you are using public Wi-Fi, avoid carrying out personal transactions that use sensitive data, such as online banking or online shopping. Use a Virtual Private Network or VPN. A VPN will protect any of the data you send over an unsecured network via real-time encryption.

2. Choose strong passwords

Passwords are one of the biggest weak spots when it comes to cybersecurity. People often choose passwords that are easy to remember and, therefore, easy for hackers to crack with hacking software. In addition to this, using the same password for multiple sites puts your data at further risk. If hackers obtain your

credentials from one site, they can potentially access other websites which use the same login details.

Select strong passwords that are harder for cybercriminals to crack. A strong password is:

- Long made up of at least 12 characters (ideally more).
- A mix of characters upper-case and lower-case letters plus symbols and numbers.
- Avoids the obvious such as using sequential numbers ("1234") or personal information that someone who knows you might guess (or that might already be online), such as your date of birth or a pet's name.
- Avoids memorable keyboard paths

3. Enable multi-factor authentication where you can

Multifactor authentication (MFA) is an authentication method that asks users to provide two or more verification methods to access an online account. For example, instead of simply asking for a username or password, multifactor authentication goes further by requesting additional information, such as:

- An extra one-time password that the website's authentication servers send to the user's phone or email address.
- Answers to personal security questions.
- A fingerprint or other biometric information, such as voice or face recognition.

4. Keep software and operating systems updated

Developers are constantly working to make products safe, monitoring the latest threats and rolling out security patches in case of vulnerabilities in their software. By using the latest versions of your operating systems and apps, you will benefit from the latest security patches. This is especially important for apps that contain payment, health or other sensitive information about a user.

5. Check that websites look and feel reliable

For any website you visit, especially ones you transact with (such as e-commerce sites), it's crucial that they are reliable. A key element to look out for is an SSL/security certificate. This means, lookout for URLs that start with "HTTPS" rather than "HTTP" (the "S" stands for "secure") and have a padlock icon in the address bar.

6. Review your privacy settings and understand privacy policies

Both web browsers and mobile operating systems have settings to protect your privacy online. Social media sites, such as Facebook, Twitter, Instagram, LinkedIn, amongst others, have privacy-enhancing settings that you can activate. Many of us accept privacy policies without reading them, but with so much data used for marketing and advertising (and hacking) purposes. It's a good idea to review the privacy policies of websites and apps you use, to understand how your data is collected and analysed.

7. Be careful of suspicious links and where you click

A careless click can expose your personal data online or infect your device with malware. It's essential to browse consciously

and avoid certain types of online content such as links from untrusted sources and spam emails, online quizzes, clickbait, 'free' offers or unsolicited ads. It's best to avoid opening untrusted emails at all. If you're not sure whether an email is legitimate or not, go directly to the source.

8. Make sure your devices are secure

With all your devices phones, computers, tablets, smartwatches, smart TVs, etc. it's good practice to use passwords or passcodes and other security options like fingerprint readers or face-scanning technology. These measures will reduce the likelihood of a cyberattack or your personal data being stolen by hackers.

9. Backup data regularly

It's important to backup important personal information on external hard drives and regularly create new backups. Backing up your data and your family's data helps mitigate the impact of a ransomware attack.

10. Close unused accounts

Over the years, many of us accumulate old accounts that we no longer use. These can be a weak link in terms of safety when using the internet not only are old accounts more likely to have weaker passwords, but some of those sites may have poor data protection policies. As a result, recommend closing your old online accounts and requesting that your data be deleted from the relevant third-party servers.

11. Be careful what you download

A top goal of cybercriminals is to trick you into downloading malware, which can be used to open a "backdoor" to your machine. Malware might be disguised as an app anything from a popular game to something that checks traffic or the weather. Or it could be hidden on a malicious website that attempts to install malware on your device. Think carefully before visiting a new website or downloading anything onto your device and only download content from trusted or official sources.

12. Be careful what you post and where

The internet does not have a delete key. Any comment or image you post online may stay online forever because removing the original won't remove any copies that other people may have made. There is no way for you to 'take back' a comment you wish you hadn't made or remove an embarrassing image you posted.

13. Be careful who you meet online

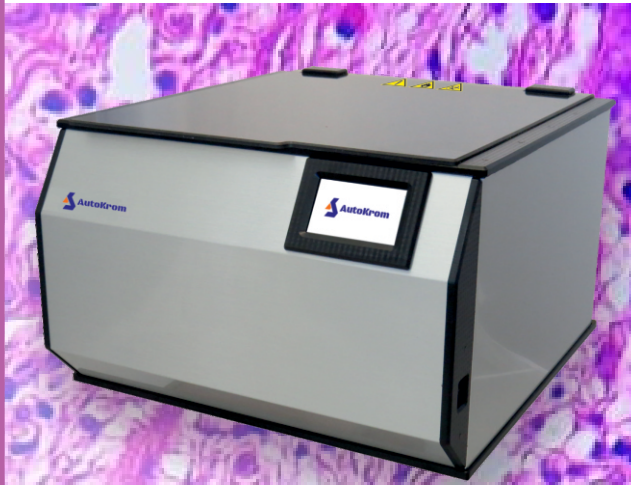
People you meet online are not always who they claim to be. Indeed, they may not even be real. Fake social media profiles are a popular way for hackers to groom unwary internet users and pick their cyber pockets.

14. Double check online information

Misinformation and disinformation are all present on the internet. It's easy to feel lost with the flood of information we're exposed to every day. If you read something you are unsure of, do your own research to establish the facts. Reliable websites will have references to the original information and source materials. Suspicious pages won't offer any references at all.

15. Use a good antivirus and keep it updated

It's essential to use a good quality antivirus provider. Internet security software guards your devices and data and blocks common threats like viruses and malware.



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