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Editorial

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Mini review section – The skin is an ecosystem composed of 1.8 m^2 of diverse habitats with an abundance of folds, invaginations and specialized niches that support a wide range of microorganisms, that train and support the immune system and fend off pathogenic threats. Typically, a person has around 1,000 species of bacteria on their skin. The primary role of the skin is to serve as a physical barrier, protecting our bodies from potential assault by foreign organisms or toxic substances. The skin is also an interface with the outside environment and, as such, is colonized by a diverse collection of microorganisms including bacteria, fungi and viruses as well as mites.

Current Trends section – In most biomedical applications, the sterility of the hydrogels is an essential requisite to minimize the risk of infections. The sterilization of sensitive materials such as hydrogels is one of the most difficult tasks to complete, due to their sensitivity to temperature and radiation and the presence of water in their structure. Conventional methods, such as steam sterilization, gamma and e-beam irradiation, ethylene oxide (EO), hydrogen peroxide, must be considered.

In Profile Scientist – Katalin Karikó and Drew Weissman were jointly awarded the 2023 Nobel Prize in Physiology or Medicine for their discoveries concerning nucleoside base modifications that enabled the development of effective mRNA (messenger ribonucleic acid) vaccines against COVID-19. The ground-breaking discoveries made by two Nobel Laureates played a pivotal role in the rapid development of effective mRNA vaccines during the COVID-19 pandemic. Their findings revolutionized our comprehension of how mRNA interacts with the immune system, significantly contributing to the unprecedented speed of vaccine development during a major threat to human health.

Bug of the month – *Mycoplasma pneumoniae* is a species of very small-cell bacteria that lack a cell wall, in the class Mollicutes. M. pneumoniae is a human pathogen that causes the disease Mycoplasma pneumonia, a form of atypical bacterial pneumonia related to cold agglutinin disease. It is one of the smallest self-replicating organisms and its discovery traces back to 1898 when Nocard and Roux isolated a microorganism linked to cattle pneumonia. This microbe shared characteristics with pleuropneumonia-like organisms (PPLOs), which were soon linked to pneumonias and arthritis in several animals.

Did You Know? – In a new study, scientists have delineated the molecular process that causes these small pieces to break off in such large quantities. Since hitting the market 75 years ago, plastic has become ubiquitous—and so, presumably, have nano plastics. As it turns out, the qualities that make plastic strong and flexible also make it prone to forming nano plastics—this is true for 75–80% of all plastics used, which are termed as semicrystalline polymers in the community.

Best Practices – The rapid increase in diabetes cases is now a significant concern. This trend is linked to increased sedentary lifestyles and higher carbohydrate intake, contributing to rising obesity and hypertension rates. Therefore, managing diabetes is essential to prevent it from leading to serious health complications.

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.

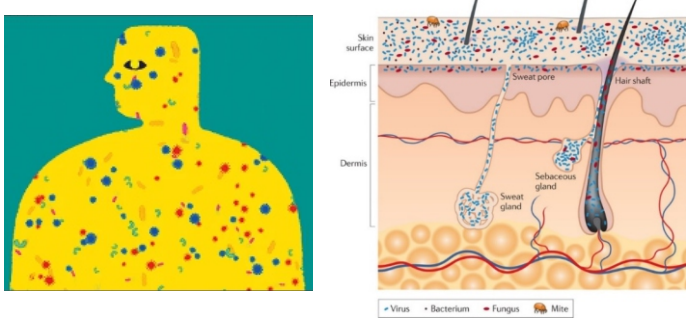
The Skin Microbiome

In contrast to the gut, which offers a near-ideal habitat for the growth of fermentative bacteria, the skin is an inhospitable expanse. Much of the epidermal layer that protects humans from the elements is dry, salty, acidic and nutrient-poor. The exceptions are the oases around lipid-rich hair follicles.

The skin is an ecosystem composed of 1.8 m^2 of diverse habitats with an abundance of folds, invaginations and specialized niches that support a wide range of microorganisms, that train and support the immune system and fend off pathogenic threats. Typically, a person has around 1,000 species of bacteria on their skin.

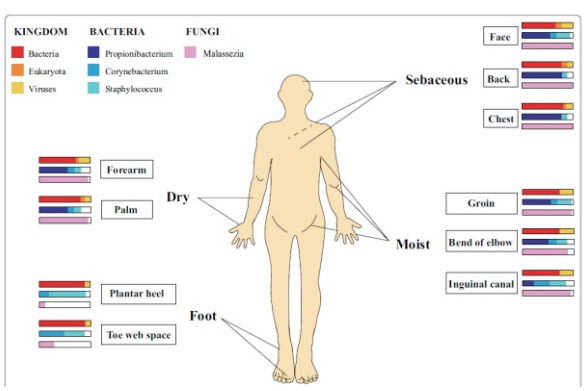
The primary role of the skin is to serve as a physical barrier, protecting our bodies from potential assault by foreign organisms or toxic substances. The skin is also an interface with the outside environment and, as such, is colonized by a diverse collection of microorganisms including bacteria, fungi and viruses as well as mites.

The perception of the skin as an ecosystem — composed of living biological and physical components occupying diverse habitats — can advance our understanding of the delicate balance between host and microorganism. Disruptions in the balance on either side of the equation can result in skin disorders or infections.



Interactions between microbiota and human skin

Human skin tissue surface covers approximately 1.8 m^2. Together with hair follicles, sebaceous glands and other associated appendages, human skin provides a habitat for > 1010 microbes, with 1 million microbes present per 1 cm^2. Based on the key conditions and the composition of skin microbiota, human skin can be divided into four types of environments: dry, moist, sebaceous (oil) and foot. Most skin diseases are proved to be associated with the dysbiosis and imbalance of the skin microbiome.



Colonization and dynamics of skin microbiota

Microorganisms that colonize the skin include bacteria, eukaryotes and viruses, and their distribution critically depends on the environmental conditions on the skin surface.

At the kingdom level, bacteria are the most dominant. At the genus level, *Propionibacterium*, *Corynebacterium* and *Staphylococcus* represent the three most dominant microbes in the skin microbiota, each contributing positively to human health. Since sebaceous glands secrete lipid-rich sebum, sebaceous sites are dominated by *P. acnes* and other lipophilic *Propionibacterium* species. The *Staphylococcus*, *Corynebacterium*, and other humidity loving species are abundant in moist areas. Among fungi, *Malassezia* species dominates thecore-body and arm sites. Foot sites, the major sites of fungal infection, harbor complex fungal communities composed of *Malassezia*, *Aspergillus*, *Cryptococcus*, *Rhodotorula*, *Epicoccum* and other species.

After birth, the skin environment undergoes dynamic structural and functional changes, including shifts in pH, water content, trans-epidermal water loss, and sebum production, all of which may influence the maturation of the skin microbiota.

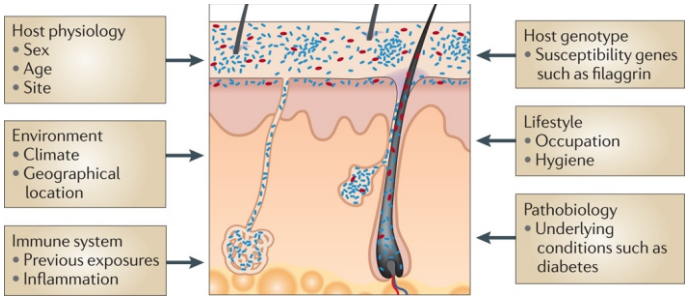
The second dramatical change happens at adolescence stage. During puberty and sexual maturation, sebum secretion is exuberant, which supports extensive proliferation of lipophilic bacteria in the skin microbiota. After these two phases, healthy adults maintain skin microbiota in a dynamic balance, despite the skin microbiota exposure to the environment and other individuals.

Skin microbiome and associated diseases

Table 1 Skin microbiome and associated diseases

Disease type	Key Points	Major findings
Acne vulgaris	*P. acnes*	Although the relative abundances of *P. acnes* were similar, certain strains were highly associated with acne and healthy skin
	S. epidermidis	*S. epidermidis* mediates fermentation to inhibit the growth of *P. acnes*, which can be implications of probiotics in acne vulgaris
	S. epidermidis & *P. acnes*	*S. epidermidis* and *P. acnes* are thought to contribute to the disease but they are also known to promote health by inhibiting the growth and invasion of pathogens
	Dysbiosis & Balance	The mere presence of disease-associated strains, as well as the balance between metagenomic elements shapes the overall virulence property of the skin microbiota. Dysbiosis is the process leading to a disturbed skin barrier and disequilibrium of the cutaneous microbiome
	Androgen hormone activity	Increases sebum production inside the pilosebaceous follicle, adjusting the environment for *P. acnes* which triggers inflammation
Psoriasis	Diversity & Stability	Psoriasis induces physiological changes both at the lesion site and at the systemic lever, with increased diversity and reduced stability compared to the healthy skin microbiome
	Skin microbiome	Increased abundance of *Corynebacterium*, *Staphylococcus*, and *Streptococcus*, and decreased abundance of *Malassezia*, *Propionibacterium*, *Cutibacterium* genera versus controls
	Gut microbiome	The gut microbiome composition in psoriasis patients has been altered markedly, and the ratio of *Firmicutes* and *Bacteroidetes* was perturbed in psoriatic individuals compared to healthy controls
Atopic dermatitis	*S. aureus*	AD has long been associated with *S. aureus* skin colonization or infection, and increases in *Streptococcus*, *Propionibacterium*, and *Corynebacterium* species were observed following therapy
Chronic wound	*S. aureus* & *P. aeruginosa*	*S. aureus* and *Pseudomonas aeruginosa* are the most common bacteria isolated from chronic wounds
Skin and soft tissue infection	*Cutibacterium acne*	*C. acnes* has the potential to directly and indirectly cause inflammation and tissue damage

Factors contributing to variation in the skin microbiome



The habitat of the skin defined

The physical and chemical features of the skin select for unique sets of microorganisms that are adapted to the niche they inhabit.

Invaginations and appendages

Cutaneous invaginations and appendages, including sweat glands (eccrine and apocrine), sebaceous glands and hair follicles, are likely to be associated with their own unique microbiota. Sebaceous glands are relatively anoxic and support the growth of facultative anaerobes such as *Propionibacterium acnes*, a common skin commensal bacterium. Many common pathogens, such as *Staphylococcus aureus* and *Streptococcus pyogenes,* are inhibited by an acidic pH, thus the growth of coagulase- negative *Staphylococci* and *Corynebacteria* is favoured.

Topography

Some regions of the skin are partially occluded, such as the groin, axillary vault and toe web. These regions are higher in temperature and humidity, which encourages the growth of microorganisms that thrive in moist conditions (for example, Gram-negative bacilli, coryneforms and *S. aureus*). Areas with a high density of sebaceous glands, such as the face, chest and back, encourage the growth of lipophilic microorganisms (for example, *Propionibacterium* spp. and *Malassezia* spp.)

Host factors

Factors specific to the host, such as age, location and sex, contribute to the variability seen in the microbial flora of the skin. Age has a great effect on the microenvironment of the skin and, thus, on the colonizing microbiota.

Environmental factors

Environmental factors specific to the individual, such as occupation, clothing choice and antibiotic usage, may modulate colonization by the skin microbiota. Cosmetics, soaps, hygienic products and moisturizers are also potential factors contributing to the variation of skin microbiota.

Skin microbiota plays essential roles in skin disease occurrence and development. Therefore, modulation of skin microbiota is one of the best strategies used for skin disease treatment. The skin microbiota modulation strategy will not only relieve the occurrence and development of skin diseases, but also improve the appearance and maintain physical and mental health.

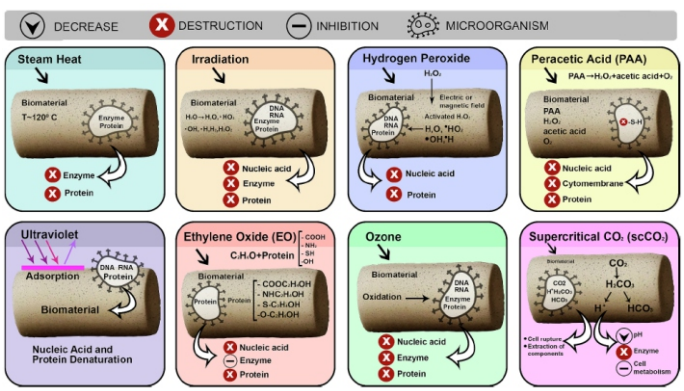
A review of conventional and emerging technologies for hydrogels sterilization II

Hydrogel Sterilization

In most biomedical applications, the sterility of the hydrogels is an essential requisite to minimize the risk of infections. The sterilization of sensitive materials such as hydrogels is one of the most difficult tasks to complete, due to their sensitivity to temperature and radiation and the presence of water in their structure. conventional methods, such as steam sterilization, gamma and e-beam irradiation, ethylene oxide (EO), hydrogen peroxide, must be considered.

Main sterilization mechanisms of selected methods used on hydrogels: -

- *Heat sterilization (steam and dry heat)*
- *Radiation sterilization (gamma irradiation, e-beams, ultraviolet)*
- *Gas sterilization (ethylene oxide, hydrogen peroxide, peracetic acid)*
- *New emerging techniques (ozone, supercritical Co_2)*
- *Aseptic processing*



Heat sterilization (steam and dry heat)

Steam heat is the most used method of sterilization and the recommended one. It takes place in an autoclave, combining high temperatures and high humidity that destroy essential cells' metabolic and structural components, killing the microorganisms. This process generally occurs at temperatures between 121° and 130°C for short periods, 15–20 min. This process is usually validated using *Bacillus stearothermophilus* spores as a biologic indicator.

Radiation sterilization (gamma irradiation, e-beams, ultraviolet)

Another method, widely used as an alternative method of sterilization for heat-sensitive materials in the medical and pharmaceutical field is ionizing radiation, in the form of gamma rays (γ) or electron beams (e- beams). The standard radiation dose is 25 kGy and the sterilization occurs either by direct ionization of vital cell molecules, such as DNA, or indirectly by the reaction of free radicals produced in the cell fluid, with additional damage to cell membranes and enzymes involved in nucleic acid repair. *Bacillus pumilus* spores are the recommended biological indicator for this method.

Gas sterilization (ethylene oxide, hydrogen peroxide, peracetic acid)

Typically used gases are ethylene oxide, hydrogen peroxide, and peracetic acid, among others. Ethylene oxide (EO) is regularly used, as an alternative to moist heat, in the sterilization of medical devices that cannot withstand high temperatures. The gas causes irreversible alkylation reactions in cell molecules, resulting in changes in cell metabolism, and denaturation of proteins, enzymes and nucleic acids. The efficiency of sterilization depends on several factors, such as exposure time, concentration, temperature and humidity. In addition, the size of the material to be sterilized, its conditioning and affinity for the gas can influence sterilization. Sterilization takes place in closed stainless-steel chambers, for several hours, at temperatures between 40 and 50°C and relative humidity between 40 and 80 %, with a gas concentration between 400 and 1000.

New emerging techniques (ozone, supercritical Co_2)

Ozone sterilization is a newly emerging technique with the potential to sterilize medical devices. This gas has strong oxidative powers that can inactivate the microorganisms. The process occurs at low temperatures making it suitable for heat-sensitive materials, and gas concentration, humidity and processing time can be adapted to the type of material to be sterilized. Besides, the gas has a great penetration power when compared to others and has no toxic residues associated

Aseptic processing

Aseptic processing is only the choice when the final package/product is not possible to sterilize by final sterilization methods. In this case, the ISO 13408–1:2008 standard should be followed. Aseptic processing is a complex procedure that requires high standards of hygiene and cleanliness as well as specific training of the personnel working in clean areas. One example of aseptic processing application is the development of advanced therapy medicinal products (based on genes, tissues or cells), which usually cannot be terminally sterilized.

Advantages and disadvantages of sterilization methods.

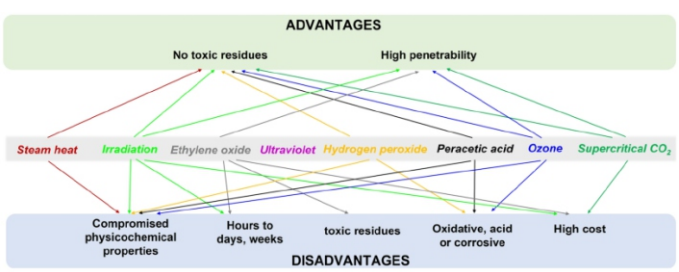


Fig. 4. Advantages and disadvantages of sterilization methods.

Hydrogels present ideal properties for application in the biomedical field. They have been successfully applied in tissue engineering, wound dressing, drug delivery and contact lenses. their application in biomedicine requires proper sterilization. Due to hydrogels' nature, they present a high sensitivity to terminal sterilization. Commonly used sterilization techniques

may compromise hydrogels properties such as aspect, colour, chemical structure, swelling behaviour, viscosity and mechanical properties. Novel sterilization techniques seem promising, namely $scCO_2$, that presents a low impact on hydrogels' properties.

All sterilization techniques can cause chemical and physical modifications on the hydrogel's networks (ex: polymer chain breaking or decrosslinking/crosslinking, crosslinks reorganization, side groups modification, etc), impacting properties (such as mechanical and rheological properties, degradation rate, swelling rate, etc) that ultimate can invalidate hydrogels intended applications or even lead to hydrogel's physical disintegration.

Hydrogels present ideal properties for application in the biomedical f field. They have been successfully applied in tissue engineering, wound dressing, drug delivery and contact lenses. Due to hydrogels' nature, they present a high sensitivity to terminal sterilization. Commonly used sterilization techniques may compromise hydrogels properties such as aspect, colour, chemical structure, swelling behaviour, viscosity and mechanical properties. Novel sterilization techniques seem promising, namely $scCO_2$, that presents a low impact on hydrogels' properties.

Katalin Karikó & Drew Weissman

Katalin Karikó is a Hungarian-born biochemist renowned for her pioneering work in RNA biology, particularly messenger RNA (mRNA) technology. Born in 1955 in Szolnok, Hungary, she pursued her studies at the University of Szeged, where she earned a Ph.D. in biochemistry. Her early research focused on RNA, an area that was underexplored and often overlooked by mainstream science at the time.

Karikó's scientific journey has been marked by persistence and innovation. After moving to the United States in the 1980s, she began working at Temple University and later at the University of Pennsylvania. There, she focused on the therapeutic potential of mRNA, a concept met with skepticism by much of the scientific community. Karikó faced numerous setbacks, including grant rejections and professional demotions, but continued to believe in the transformative potential of mRNA.

One of her key scientific achievements was discovering how to modify synthetic mRNA to prevent it from triggering inflammatory immune responses. By introducing chemically altered nucleosides, she was able to make mRNA more stable and less immunogenic, paving the way for its use in therapeutics. This breakthrough addressed a significant barrier in RNA medicine and laid the groundwork for the use of mRNA in vaccines and other treatments.

Beyond her laboratory achievements, Karikó has become a symbol of scientific perseverance. Her work extends to applications in cancer immunotherapy, protein replacement therapies, and other genetic disorders. She has held positions at BioNTech and continues to contribute to RNA research as an advisor and academic.

Karikó's story exemplifies the value of long-term scientific vision and the importance of supporting basic research. Her career reflects how dedication to an idea, even in the face of doubt and adversity, can ultimately reshape the future of medicine.

Drew Weissman is an American physician and immunologist whose pioneering research in RNA biology has significantly advanced the field of molecular medicine. Born on September 7, 1959, in Lexington, Massachusetts, Weissman developed an early interest in science, influenced by his father's work in engineering. He pursued his undergraduate and master's studies in biochemistry and enzymology at Brandeis University, graduating in 1981. He then earned both his M.D. and Ph.D. in immunology and microbiology from Boston University in 1987. Following his residency at Beth Israel Deaconess Medical Center, he completed a fellowship at the National Institutes of Health under Dr. Anthony Fauci, focusing on HIV research.

In 1997, Weissman joined the University of Pennsylvania's Perelman School of Medicine, where he began exploring the therapeutic potential of messenger RNA (mRNA). His collaboration with biochemist Katalin Karikó led to groundbreaking work in modifying mRNA to reduce its immunogenicity. In 2005, they published a seminal study demonstrating that incorporating modified nucleosides into mRNA could prevent its degradation by the immune system, thereby enhancing its stability and effectiveness as a therapeutic agent

Weissman's laboratory further advanced mRNA technology by developing lipid nanoparticle (LNP) delivery systems, which protect mRNA molecules and facilitate their entry into target cells. This innovation has been instrumental in the development of mRNA-based vaccines and therapies. Beyond vaccines, his research encompasses mRNA applications in treating various diseases, including Zika virus, herpes simplex, hepatitis C, norovirus, and genetic disorders. His team is also working on gene therapies targeting specific cells and organs, such as the lungs, heart, brain, and bone marrow stem cells

Weissman holds the position of Roberts Family Professor in Vaccine Research and serves as the Director of the Penn Institute

for RNA Innovation. Committed to global health equity, he collaborates with institutions like Chulalongkorn University in Thailand to develop accessible mRNA vaccines for low- and middle-income countries.

Throughout his career, Weissman has received numerous accolades for his contributions to science, including the Lasker–DeBakey Clinical Medical Research Award and the Breakthrough Prize in Life Sciences. His work continues to influence the development of novel therapeutics and vaccines, underscoring the transformative potential of mRNA technology in modern medicine.

Katalin Karikó and Drew Weissman were jointly awarded the 2023 Nobel Prize in Physiology or Medicine for their discoveries concerning nucleoside base modifications that enabled the development of effective mRNA (messenger ribonucleic acid) vaccines against COVID-19.

The ground-breaking discoveries made by two Nobel Laureates played a pivotal role in the rapid development of effective mRNA vaccines during the COVID-19 pandemic. Their findings revolutionized our comprehension of how mRNA interacts with the immune system, significantly contributing to the unprecedented speed of vaccine development during a major threat to human health.

Two of the swiftest and most efficacious COVID-19 vaccines were formulated using this innovative mRNA technology. Although the concept of utilizing mRNA for vaccination and delivering therapeutic proteins in vivo was introduced more than 30 years ago, numerous challenges needed to be surmounted to transform this idea into clinical reality.

Initial experiments revealed that in vitro transcribed mRNA triggered undesirable inflammatory responses and inefficient protein production in cells and tissues. A pivotal moment occurred with the discovery by Karikó and Weissman, demonstrating that mRNA, when produced with modified nucleoside bases, could evade innate immune recognition and enhance protein expression.

These breakthroughs, coupled with the development of efficient in vivo mRNA delivery systems, the stabilization of the SARS-CoV-2 spike antigen, and unprecedented investments, culminated in the approval of two highly successful mRNA-based COVID-19 vaccines in late 2020.

The contribution of Karikó and Weissman were instrumental in rendering the mRNA vaccine platform clinically viable precisely when it was most urgently needed, marking an extraordinary advancement in medicine and laying the groundwork for future applications of mRNA technology.

Sri Lanka was one of the Advance Market Commitment countries under the WHO-led COVAX facility that received the COVID-19 vaccines for 20% of its population (4.2 million doses of vaccines) free of charge. This included over 2.3 million doses of mRNA vaccines (Pfizer BioNTech and Moderna) which were developed, and emergency user listed in record time with the aid of the innovative mRNA in vivo technologies.

Jokes

Teacher: "Kids, what does the chicken give you?"
Student: "Meat!"
Teacher: "Very good! Now what does the pig give you?"
Student: "Bacon!"
Teacher: "Great! And what does the fat cow give you?"
Student: "Homework!

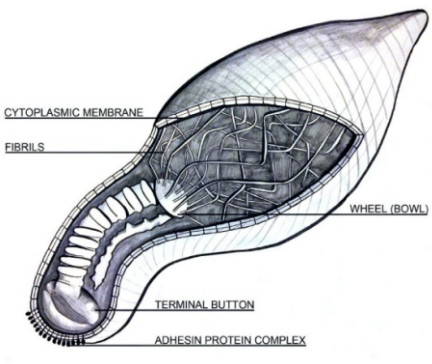
Math Teacher: "If I have 5 bottles in one hand and 6 in the other hand, what do I have?"
Student: "A drinking problem."

Teacher: "Which book has helped you the most in your life?"
Student: "My father's check book!"

A: I have the perfect son.
B: Does he smoke?
A: No, he doesn't.
B: Does he drink whiskey?
A: No, he doesn't.
B: Does he ever come home late?
A: No, he doesn't.
B: I guess you really do have the perfect son. How old is he?
A: He will be six months old next Wednesday.

Brunette: "Where were you born?"
Blonde: "The United States."
Brunette: "Which part?"
Blonde: "My whole body."

Mycoplasma pneumoniae



A longitudinal schematic depicting the cellular architecture of Mycoplasma pneumoniae

Mycoplasma pneumoniae is a species of very small-cell bacteria that lack a cell wall, in the class Mollicutes. *M. pneumoniae* is a human pathogen that causes the disease Mycoplasma pneumonia, a form of atypical bacterial pneumonia related to cold agglutinin disease.

It is one of the smallest self-replicating organisms and its discovery traces back to 1898 when Nocard and Roux isolated a microorganism linked to cattle pneumonia. This microbe shared characteristics with pleuropneumonia-like organisms (PPLOs), which were soon linked to pneumonias and arthritis in several animals. A significant development occurred in 1944 when Monroe Eaton cultivated an agent thought responsible for human pneumonia in embryonated chicken eggs, referred to as the "Eaton agent." This agent was classified as a bacteria due to its cultivation method and because antibiotics were effective in treating the infection, questioning its viral nature. In 1961, a researcher named Robert Chanock, collaborating with Leonard Hayflick, revisited the Eaton agent and posited it could be a mycoplasma, a hypothesis confirmed by Hayflick's isolation of a unique mycoplasma, later named *Mycoplasma pneumoniae*. Hayflick's discovery proved *M. pneumoniae* was responsible for causing human pneumonia.

Taxonomically, *Mycoplasma pneumoniae* is part of the Mollicutes class, characterized by their lack of a peptidoglycan cell wall, making them inherently resistant to antibiotics targeting cell wall synthesis, such as beta-lactams. With a reduced genome and metabolic simplicity, mycoplasmas are obligate parasites with limited metabolic pathways, relying heavily on host resources. This bacterium uses a specialized attachment organelle to adhere to respiratory tract cells, facilitating motility and cell invasion. The persistence of *M. pneumoniae* infections even after treatment is associated with its ability to mimic host cell surface composition.

Pathogenic mechanisms of *M. pneumoniae* involve host cell adhesion and cytotoxic effects, including cilia loss and hydrogen peroxide release, which lead to respiratory symptoms and complications such as bronchial asthma and chronic obstructive pulmonary disease. Additionally, the bacterium produces a unique CARDS toxin, contributing to inflammation and respiratory distress. Treatment of *M. pneumoniae* infections typically involves macrolides or tetracyclines, as these antibiotics inhibit protein synthesis, though resistance has been increasing, particularly in Asia. This resistance predominantly arises from mutations in the 23S rRNA gene, which interfere with macrolide binding, complicating management and necessitating alternative treatment strategies.

Mycoplasma pneumoniae parasitizes the respiratory tract epithelium of humans. Adherence to the respiratory epithelial cells is thought to occur via the attachment organelle, followed by evasion of host immune system by intracellular localization and adjustment of the cell membrane composition to mimic the host cell membrane. *Mycoplasma pneumoniae* grows exclusively by parasitizing mammals. Reproduction, therefore, is dependent upon attachment to a host cell. According to Waites and Talkington, specialized reproduction occurs by "binary fission, temporally linked with duplication of its attachment organelle, which migrates to the opposite pole of the cell during replication and before nucleoid separation". Mutations that affect the formation of the attachment organelle not only hinder motility and cell division, but also reduce the ability of *M. pneumoniae* cells to adhere to the host cell.

Mycoplasma pneumoniae fuses with host cells and survive intracellularly. Thus it can evade host immune system detection, resist antibiotic treatment, and cross mucosal barriers,. In addition to the close physical proximity of *M. pneumoniae* and host cells, the lack of cell wall and peculiar cell membrane components, like cholesterol, may facilitate fusion. Internal localization may produce chronic or latent infections as *M. pneumoniae* is capable of persisting, synthesizing DNA, and replicating within the host cell even after treatment with antibiotics. The exact mechanism of intracellular localization is unknown, however the potential for cytoplasmic sequestration within the host explains the difficulty in completely eliminating *M. pneumoniae* infections in afflicted individuals.

In addition to evasion of host immune system by intracellular localization, *M. pneumoniae* can change the composition of its cell membrane to mimic the host cell membrane and avoid detection by immune system cells. *M. pneumoniae* cells possess a number of protein and glycolipid antigens that elicit immune responses, but variation of these surface antigens would allow the infection to persist long enough for *M. pneumoniae* cells to fuse with host cells and escape detection. The similarity between the compositions of *M. pneumoniae* and human cell membranes can also result in autoimmune responses in several organs and tissues.

Infections can be treated with oral antibiotics from the macrolide family, which work by inhibiting the Mycoplasma protein biosynthesis. Historically, erythromycin is the oldest drug. As first choice, azithromycin or clarithromycin are used, as they have more convenient pharmacokinetics than erythromycin : they only need to be taken once or twice and not four times a day and they have fewer side effects. Alternatively, tetracyclines (eg, doxycycline), and respiratory fluoroquinolones (eg, levofloxacin or moxifloxacin) can be used; they have an undesirable side effect profile in children. Beta-lactams such as penicillin are completely ineffective, because they target the cell wall synthesis.

Resistance to macrolides has been reported as early as 1967. Increased antibiotic usage has been followed by an increase in resistance since 2000. Resistance in the 2020s has been highest in Asia, as high as 100%, while rates in the United States have varied from 3.5% to 13%. A single base mutation in the V region of 23S rRNA, like A2063/2064G is responsible for more than 90% of the macrolide-resistant infections.

Since routine culture and susceptibility testing is not performed, as *M. pneumoniae* is difficult to grow, clinicians will select an antibiotic based on an estimate of local resistance, on treatment response and on other factors.

Scientists uncover process behind plastic's dangerous fragment shedding

The world is littered with trillions of micro- and nanoscopic pieces of plastic. These can be smaller than a virus—just the right size to disrupt cells and even alter DNA. Researchers find them almost everywhere they've looked, from Antarctic snow to human blood.

In a new study, scientists have delineated the molecular process that causes these small pieces to break off in such large quantities. Since hitting the market 75 years ago, plastic has become ubiquitous—and so, presumably, have nano plastics. As it turns out, the qualities that make plastic strong and flexible also make it prone to forming nano plastics—this is true for 75–80% of all plastics used, which are termed as semicrystalline polymers in the community.

Sanat Kumar, Michael Bykhovsky and Charo Gonzalez-Bykhovsky, Professor of Chemical Engineering at Columbia Engineering, led the research effort.

If you look at a piece of plastic through a powerful microscope, you'll see alternating layers of hard material and soft material. In the hard layers, plastic molecules are rigidly organized in strong crystal structures. In the soft layers, the molecules lack structure and form a soft, amorphous mass. When thousands of these layers are stacked together, they create a material that's lightweight, durable, and extremely versatile. Importantly, these materials derive their unique properties through the connectivity between the soft and hard phases.

In their paper, the researchers explain how nano plastics form. They discovered that the process begins in the soft layers, which grow weaker over time due to environmental degradation and can break off even when the plastic is not under stress. By themselves, these soft pieces break down quickly in the environment. Problems arise when the failure of a soft layer allows hard layers to break off. These crystalline fragments are the nano- and microplastics that can persist in the environment for centuries and cause significant damage to living things, including humans.
In this interview, Kumar discusses this work.

How does this paper contribute to our understanding of nano plastics?
There is a lot of anecdotal evidence of nano plastics—people have found them all over the place and seen them form—but no one had determined the mechanisms behind how they form.

What did you discover?
75% of all plastic used has a brick-and-mortar structure. It's made of thin alternating layers: hard, soft, hard, soft, and so on. We've known since the 1950s that the soft stuff is holding the hard stuff together. What we show in the new study is how easily those soft connectors break even under quiescent conditions such as in a landfill. Once that layer fails, the hard segments have nowhere to go—they scatter into the environment.

Why is that a problem?
These pieces float around, and some end up in human bodies. The smallest pieces pass through cells and into the nucleus, where they can start messing with DNA. Nano- and microplastics, which seem to have similar sizes and shapes to asbestos, raise the potential that they could cause cancer, heart disease/stroke, and other diseases.

Is there an engineering solution to address this problem?
Our results suggest that engineering the architecture of the soft layers to be more resilient would decrease the number of crystalline fragments that break off. Clearly, focus needs to be placed on this point to reduce the amount of micro- and nano plastics created by normal polymer degradation.

How can better understanding nano plastics improve human health?
Only 2% of plastics are recycled, mostly because it's too expensive. But if you just throw plastic into the environment, it creates micro- and nano plastics that look like they are going to cause health problems. If you think about it that way, if you have to choose between the health problems that could be created by the nano plastics vs. the cost of recycling, then maybe it's cheaper to recycle.

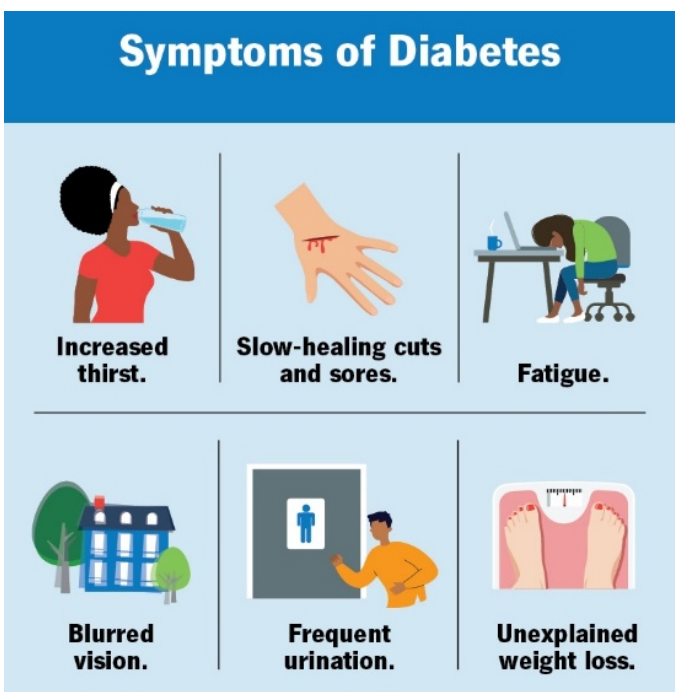
A Complete Guide to Understanding and Managing Your Diabetes Health

The rapid increase in diabetes cases is now a significant concern. This trend is linked to increased sedentary lifestyles and higher carbohydrate intake, contributing to rising obesity and hypertension rates. Therefore, managing diabetes is essential to prevent it from leading to serious health complications.

Understanding Diabetes Mellitus

Diabetes mellitus is a chronic condition that impacts your body's way of processing glucose, or sugar, in your food. Diabetes occurs when your body either doesn't produce enough insulin, the hormone that regulates blood sugar levels, or can't effectively use the insulin it produces.

- **Type 1 Diabetes:** The body doesn't make insulin. It generally appears in children or young adults, and the individual must take insulin injections throughout life.
- **Type 2 Diabetes:** The body either is insulin-resistant or not sensitive enough. The more common form of the disease, this type is very often linked to diet and lifestyle.



What Are the Symptoms of Diabetes Mellitus?

The most common symptoms include:

- Frequent urination
- Increased thirst
- Excessive hunger
- Unintentional loss of weight
- Fatigue
- Dimming of vision
- Long time to cure sores
- Frequent infection

Recognizing these symptoms early allows patients to start diabetes care and work toward minimizing long-term complications.

Diabetes Management

Management of diabetes is much more than **checking** the levels of the blood sugar in the body. This involves an overall diabetes care plan that includes **medication**, dietary control, regular exercise, and health monitoring.

- The more closely you **monitor your blood sugar levels**, the better you will understand how your body is reacting to its food, medications, and activity patterns.
  Through regular monitoring of your blood sugar, you and your healthcare provider will be able to make changes to your diabetes care plan to control your blood sugars and optimize your quality of life.

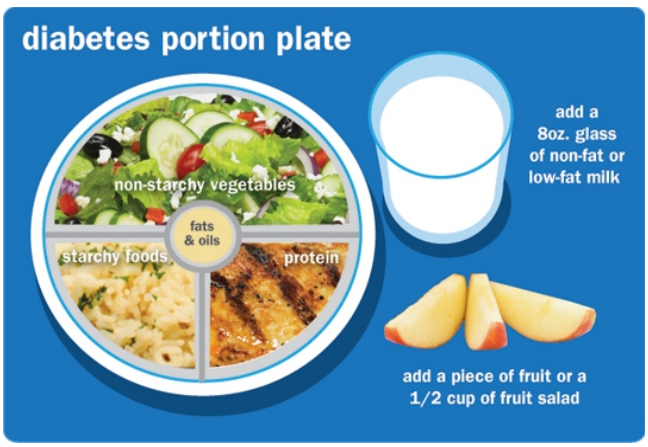
- **Medication** and Insulin for type 2 diabetes, medication may be required to help the body use more insulin. For type 1 diabetes, insulin therapy must be initiated. Always consult with your healthcare provider to ensure that you are on the right medication regimen.

Dietary Management of Diabetes Mellitus:

A well-balanced diet plays an important role in managing diabetes mellitus.

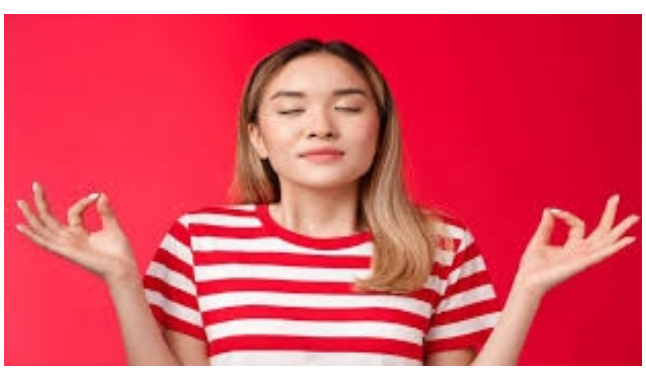
- **Whole grains:** Choose whole grains over refined carbohydrates to keep blood sugar in balance
- **Lean proteins and healthy fats:** Add sources of lean proteins (such as chicken, fish, and legumes) with healthy fats (such as nuts and seeds) that provide energy without spiking glucose.

- **Fruits and vegetables:** Incorporate several non-starchy vegetables and fruits rich in fibre, which slow the absorption of sugars.
- **Portion control:** Monitor your portion sizes to avoid overeating and maintain a healthy fluctuation of your blood sugar.



Physical Activity for Diabetes:
Adequate exercise is an integral component of diabetes management. Physical activity helps your body to make better use of insulin, decrease blood sugar, and enhance overall health. Achieve at least 150 minutes of moderate-intensity activity per week, which can be brisk walking, cycling, or swimming. Include other forms of resistance training, such as weightlifting or yoga.

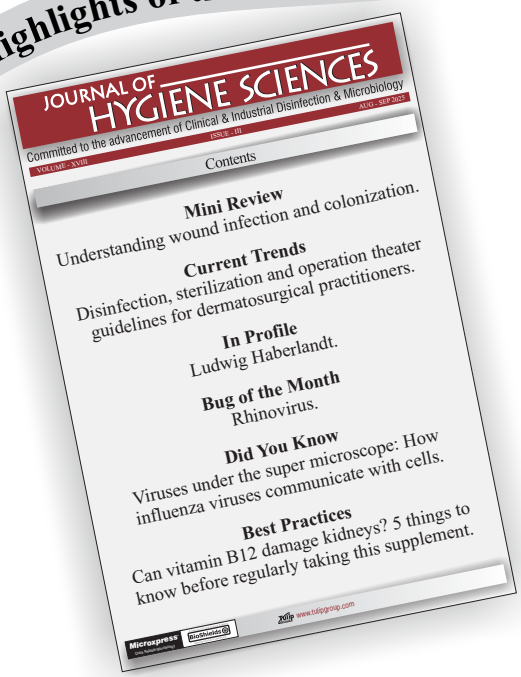
Stress Management:
Since stress raises blood sugar, incorporating stress-reducing activities like yoga, meditation, and deep breathing into your daily routine is essential.



Sleep and Hydration:
Seven to nine hours of quality sleep every night has been proven to increase the sensitivity of insulin, supporting the regulation of blood sugars. Other means of staying hydrated include drinking enough water, which allows for the removal of unwanted sugar in the blood.

Diabetes management is a way of life commitment, but with the proper tools and resources, you have more command over your health. Regular check-ups, dietetic support, and exercise advice will help you maintain your condition so that you can lead a healthy and productive life.

Highlights of the coming issue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