

# **The Tale of a Bacteria Battle**

*A study on Staphylococcus Aureus, its prevalence, clinical possibilities and  
our fighting tools*

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Final draft



# Acknowledgements

I would like to thank Margarita Martínez, professor at the *Universitat de Girona*'s Microbiology Department, as well as Olga Sánchez, professor and researcher at the *Universitat Autònoma de Barcelona*'s Department of Genetics and Microbiology for their help with certain aspects of this project.

I would also like to acknowledge the magnificent work that the L<sup>A</sup>T<sub>E</sub>X community does to give the scientific community an incredible piece of software with which to write, as well as to Mark Olson for making his KOMA-Script T<sub>E</sub>X template open source, allowing anyone and everyone to use it and modify it for free. On that note, I'd also like to thank my friend Gabriela, for helping me fix a weird issue with the bibliography system. But most importantly, I'd like to thank Núria Feliu, Imma Garcia and the rest of the science department for their monumental help which without this project could not have existed; as well as the subjects who volunteered to get their samples taken for this research.



# **Abstract**

Insert abstract here



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# **Research context**

This research project will study the effects of *Staphylococcus Aureus* on the human body, as well as the ways humanity has developed to defeat it. Experimentally, the goal is to find the prevalence amongst the students in the school and recreate virtually a virus used to defeat this bacteria.

The investigation question is “*What is the prevalence of Staphylococcus Aureus in the high school?*“



# 1

## Theoretical context

Each source that I read, I would look through the bibliography and the footnotes, and use that as a map for the next thing I would read.

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Alexander Chee

### §1.1 Bacteria and bacterial infections

**Bacteria** are prokaryote organisms, generally single-celled, which are part of the Monera animal kingdom. Their sizes range from between 30  $\mu\text{m}$  and 100  $\mu\text{m}$  and are ubiquitous<sup>1</sup> organisms. This form of life is believed to be the first one to have ever appeared on Earth, as well as the one responsible for the oxygen-rich atmosphere the Earth currently has. Some species are hard to culture in a laboratory environment, but generally, those that can be cultured in a controlled environment are grown in agar plates[1].

Agar is used as a place to grow bacteria due to the fact that it is indigestible for the majority of bacteria, yet keeps them humid. Together with growth mediums, such as Lysogeny Broth, bacteria thrive in this environment, allowing them to proliferate and create colonies, which can be observed without the need of optic magnifying equipment. Sometimes, together with the growth medium, additives such as mannitol or salt are added. These are used to improve or impede bacterial growth, modify their conditions so they develop differently or as an identification tool. For example, *Staphylococcus Aureus* ferments the mannitol, producing acid, which in turn generates an acid and decolorates the plate's integrated pH indicator from red to yellow, whilst the salt prevents the growth of bacteria that are not of interest to the study[2].

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<sup>1</sup>Ubiquitous: found everywhere

**Pathogenic bacteria** are bacteria that have the ability to cause disease<sup>2</sup>. These are not the most common type of bacteria, as the majority of them are either harmless or beneficial to the human body through symbiosis, such as the bacteria that help with digestion in the stomach[1].

## §1.2 The enemy: *Staphylococcus aureus*

*Staphylococcus aureus* (also known as Staph) is a GRAM-positive bacteria, the most studied and prevalent<sup>3</sup> of its genus. Staph bacteria are usually harmless. However, they can cause serious infections that, in some cases, can lead to sepsis or death. Some of its distinctive characteristics include having a very thick glycopeptide wall, which allows it to withstand extreme temperatures and osmotic pressures, therefore rendering most classic methods of food conservation (such as cooking, smoking, freezing or salting<sup>4</sup>) completely useless against said bacteria; a protein A capsid, which binds to many eukaryote organisms; as well as thermo-resistant enterotoxins. It's an extremely resistant (and thus ubiquitous) bacteria. It can be found in human skin and mucous surfaces (such as the mouth or the nose), as well as in certain foods such as ham (cooked or curated), eggs, raw and cooked dough, as well as in poultry.

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<sup>2</sup>A disease is a particular abnormal condition that negatively affects the structure or function of all or part of an organism, and that is not immediately due to any external injury[3].

<sup>3</sup>"The degree to which something is prevalent: the percentage of a population that is affected with a particular disease at a given time"[4]

<sup>4</sup>citation needed

Staphylococcus Aureus has three main parts to its virulence: its cell wall, its membrane-bound factors and its secreted factors. Staph's **cell wall** is made up of three parts, going from inside to the outside of the cell: a plasma membrane, a peptidoglycan layer and a slime (sometimes also called capsule) layer. The plasma membrane consists of a lipid bilayer that is semipermeable<sup>5</sup>, which regulates the transport of materials entering and exiting the cell. Integrated inside them are a type of integral protein called penicillin-binding protein (PBP), amongst other proteins such as protein channels. We will only talk about PBPs because they are the Achilles's Heel of bacteria, as long as you know how to exploit it. Whilst the name implies PBPs are only sensible to penicillin, the name actually comes because that's how they were discovered, and in fact could be resistant to it but sensible to other antibiotic agents. Variations in this protein may lead in some cases to antibiotic resistance, such as MRSA (*Methicillin-Resistant Staphylococcus Aureus*), a variation of Staph that is the result of a variation in this protein called PBP2A. The different variations of *Staphylococcus Aureus* will be discussed in more detail in a following section.

*Staphylococcus aureus*, like all other members of the *Staphylococcus* family, have very thick peptidoglycan layers. This grants them protection from extreme temperatures and high osmotic pressures, which means these bacteria can colonise cooked food and food that has been salted. The most notable example is ham, either cooked, smoked or cured.

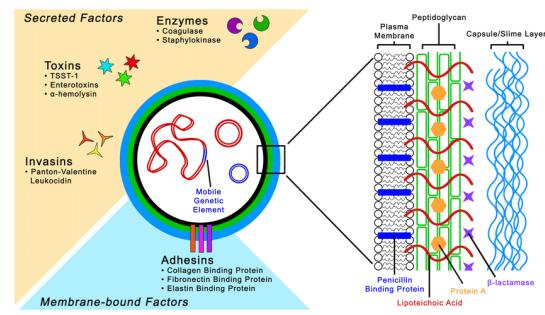


Figure 1.1: Parts of Staphylococcus aureus.  
Source: PLoS Pathogens

<sup>5</sup>Semipermeable: it lets water and ions through, but not other molecules. This transport will always be in favour of the pressure gradient, which means that it cannot insert any kind of substance into an environment that has a higher pressure than the other side

## §1.3 The enemy's attacks

*Staphylococcus Aureus* is a species that can cause a handful of different diseases, ranging from, most frequently, skin and respiratory tract infections to infective endocarditis, toxic shock syndrome or osteomyelitis. Several variations of this pathogen exist, with increasing levels of antibiotic resistance: MSSA (*Methicillin-Sensitive Staphylococcus Aureus*), having no resistance; MRSA (*Methicillin-Resistant Staphylococcus Aureus*); and VRSA (*Vancomycin-Resistant Staphylococcus Aureus*), the latter the latter for which no antibiotic concoction that can eradicate the infection is known, and the patients have to use experimental treatments. VISA (*Vancomycin-intermediate Staphylococcus Aureus*) is a variation that has medium resistance to vancomycin, being an intermediate step between MRSA and VRSA. VISA and VRSA are what we would call a superbug, a microbe that has developed resistance to more quantity of antibiotic than is safe to consume. Studies have discovered that this genetic factor has been developed by different lineages separately, indicating that there is not a common ancestor of MRSA strains. This case is the bacteria equivalent of carcinisation, the discovery that several species have coevolved into crabs; as well as the bacteria equivalent of tree leaves, which were developed independently by several species at the same time, in completely different parts of the world.

One of Staph's most notorious abilities is using the body's own proteins to disguise itself and thus avoid detection and phagocytosis by the host's immune system. It accomplishes this task by using enzymes called coagulases, which enable the transformation of fibrinogen<sup>6</sup> to fibrin<sup>7</sup>[1]. Only 11 other *Staphylococcus* family members are coagulase-positive. To test for this enzyme in the laboratory there are two main methods which are usually combined: culture of the sample on a Baird-Parker agar medium, a selective and differential medium which contains lithium chloride and tellurite as to inhibit the growth of other microbes. It also includes pyruvate and glycine, which promote the growth of *Staphylococci* colonies, showing in colour black and with an opaque zone

<sup>6</sup>A glycoproteic complex produced in the liver and present in the blood of all vertebrates.

<sup>7</sup>fibrinogen after being stimulated by either thrombin or *staphylothrombin*, the result of a molecular pathway stimulated by coagulase. It helps in clotting the blood in the event of vascular or tissue injury

around the colony. This opaque zone represents the effect of the coagulase. Another way to test for coagulase is to perform a coagulase test. This test generally requires a small quantity (generally 2 mL) of sheep blood serum, which will gelatinise if coagulase is present.

*Staphylococcus Aureus* contains an important quantity of **toxins**, which grants it most of its pathogenicity. Many of its virulence factors can be described as such. Toxins are usually defined as poisonous substances, which, in our case, means that they have the capacity to mess with the host body directly, without need of a mediating entity. This category doesn't include, for example, those molecules intended to combat the host's defence mechanisms or scavenge reactive oxygen. We'll also exclude those situated on its membrane for the purpose of cell binding. Staph has several kinds of toxin in its arsenal: membrane-damaging toxins (which can be receptor-mediated or not), receptor-interfering toxins (not membrane-damaging), enzymes, and pathway blockers.

- Membrane-damaging toxins. Several of *Staphylococcus aureus*' toxins target the cytoplasmic membrane of the host's cells. These lead to pore formation in it, which provokes the outflux of vital molecules of the cell which, in turn, leads to cytosis<sup>8</sup>.
  - Receptor-mediated. Many of the cytolytic toxins of *Staphylococcus aureus* have been shown to require receptor interaction for their lytic activity. The best-known toxin of this kind is Alpha-toxin, also known as Alpha-hemolysin, which is its major cytotoxic agent, and is lytic to red blood cells and certain leukocytes, but not to neutrophils. Whilst at low concentrations it has been shown to be dependent on the interaction with cells' ADAM10 receptors, in higher concentrations of this toxin, this interaction is no longer necessary. Other toxins of this type include PVL (Panton-Valentine Leucocidin) and Gamma-toxin.
  - Non-receptor-mediated. In 2007, a toxin family that includes the Delta-toxin called the Phenol-Soluble Modulins (PSMs). PSMs trigger an inflammatory response by interacting with the FPR2 receptor, however they can carry cytolytic activity independently from FPR2 interaction. Delta-toxin has been linked to allergic skin

<sup>8</sup>Cell bursting due to osmotic pressure imbalance between the inside and the outside of it

sease and atopic dermatitis by degrading mast cells. This kind of toxin contributes to neutrophil lysis after phagocytosis, which might partly explain why the development of *Staphylococcus Aureus* vaccines that work by enhancing a type of phagocytosis have failed so far.

- Receptor-function-interfering toxins. The toxins that fall into this category are enterotoxins<sup>9</sup> These typically cause vomit and diarrhoea. *S. aureus* strains can produce a wide array (around 20) of entero and entero-like toxins. The most famous *Aureus* superantigen<sup>10</sup>, the 22-kD toxic shock syndrome toxin (TSST), belongs to this group. TSS is a very severe and potentially fatal disease. *Staphylococcus aureus* also secretes a series of proteins that interfere with leukocyte receptors to evade recognition and thus activation of the immune system. CHIPS (Chemotaxis Inhibitory Protein of *Staphylococcus aureus*), which binds to the C5aR and FPR receptors, impairing the recognition of bacterial formylated peptides by the FPR receiver and blocking the activation of leukocytes via C5aR. *S. aureus* also has other proteins that work similarly to these, such as FLIPr.
- Enzymes. Many enzymes secreted by *Staphylococcus Aureus* either degrade host molecules or interfere with its metabolic or signalling cascades. A few of them are proteases, which some non-specific ones have the ability to degrade host proteins in a broad proteins, leading to tissue destruction and necrosis, but may also have some more specific effects, for example the destruction of insulin B. Its two coagulases (staphylocoagulase and Willebrand factor) fall into this category.

## §1.4 Our weapons

The tools we have at our disposal to fight off this infection fall into two main categories: chemical factors and biological factors.

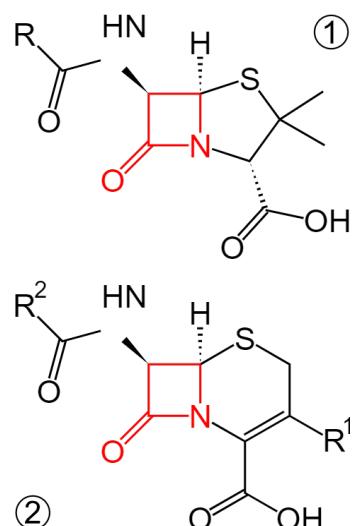
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<sup>9</sup>Enterotoxins are those toxins that target the intestines.

<sup>10</sup>Superantigen: type of antigens that results in excessive activation by the immune system

The chemical factors are drugs, and they depend both in quantity and type on the variation a particular case falls in. It is **extremely important** to find out the level of antibiotic resistance that specific infection has before administering any antibiotic, as this treatment course will cause side effects such as killing gut bacteria, diminishing defense system capabilities, and increasing the possibility to develop yet more resistant infections. Generally, a large-spectrum antibiotic has an adequate risk-to-benefits ratio of causing the latter, so they may be used before switching to a more specific treatment.

Starting with the treatment to the least resistant strains of *Staphylococcus Aureus*, a -lactam antibiotic (such as methicillin, oxacillin, cloxacillin and penicillin) is the weapon of choice to fight against an MSSA infection. This is because this specific chemical part (just a -lactam ring does nothing by itself) has the ability to inhibit cell wall biosynthesis on the bacterial intruder's body. But once the -lactam ring is cut by an enzyme secreted by the bacteria itself, this type of antibiotic suddenly loses effect against them.



That's where Vancomycin comes in. It is a type of glycopeptide antibiotic, just like -lactam and works by blocking the construction of a cell wall, as all of its type do. This treatment is extremely invasive and only indicated for the treatment of extremely serious life-threatening infections by Gram-positive bacteria that have shown to be unresponsive to other antibiotics.

It can be taken as a pill or as an injectable fluid, which proves it to be much more effective. This treatment is incompatible with aminoglycosides, a type of antibiotic that inhibit

Figure 1.2: Organic chemistry structure of penicillin (top) and cephalexin (bottom). -lactam ring in red.  
Source: WikiMedia

protein synthesis, as it can lead to nephrotoxicity<sup>11</sup> and ototoxicity<sup>12</sup>. Vancomycin can induce platelet-reactive antibodies in the patient, leading to severe thrombocytopenia and bleeding with petechial hemorrhages on the tongue and bruises. Unfortunately, even with use of Vancomycin, *Staphylococcus Aureus* can develop resistance. In this case, no other option than using a biological factor is left. There has been one study in 2020 that discovered that by modifying the bacteria with a cationic oligopeptide<sup>13</sup>, vancomycine resistance could be bypassed. This could be a good solution temporarily as we wait for phage therapy to get approved, if it was a sufficiently studied option, which is not. This was discovered in 2020, while bacteriophage trials have been ongoing since the mid 2000s.



Figure 1.3: Organic chemistry structure of vancomycin. Source: Wikimedia

The biological factor is a bacteriophage, called P68. It comes from the *Caudovirales* order, which means that it is a bacteriophage with tail. This treatment is still in testing, but it appears to be effective and lead to low adverse results. If possible, it would be preferable to use bacteriophage therapy (shortened to phage therapy) instead of going for antibiotics, as can lead to less side effects than antibiotics, as it only attacks a specific bacteria. This means, unfortunately, that the infection has to be pinpointed with extreme accuracy. The use of this treatment also negates the risk of bacteria developing antibiotic resistance. It is, however, unclear whether the bacteriophage could mutate into a dangerous strain. This class of virii has been studied since the late 19th century after being discovered by accident in

water from a river in India. This research, however, was dropped due to penicillin being discovered and put into effect, as the main purpose of this research was to use it on war casualties as to reduce mortality due to infections.

<sup>11</sup>Nephrotoxicity: damage to the kidneys

<sup>12</sup>Ototoxicity: damage to hearing

<sup>13</sup>Cationic oligopeptide: sequence of two or more aminoacids that is positively charged

Bacteriophages work in an interesting manner. They work by detecting one very specific bacteria, just like any other virus does with the type of cell they evolved for, then bind to it and inject their genetic material, which then in turn the bacteria considers as its own, inserts it into its own genetic sequence and starts producing the proteins the virus requires, but it doesn't eject them. Once the bacteria is full with phages, a special lytic compound is released which bursts the cell membrane in such a way that it resembles an explosion, but instead of heating up everything in a radius, spreads millions more of bacteriophages, which then bind to other bacteria and the cycle repeats until there's no more bacteria left. The fight from the bacteria point of view consists mostly on trying to outnumber and outreproduce the phages as to have a chance of survival, even if minimal. There is no known bacteria that shows resistance to phages. That is probably because unlike the chemical factors, phages can evolve and improve with each generation.

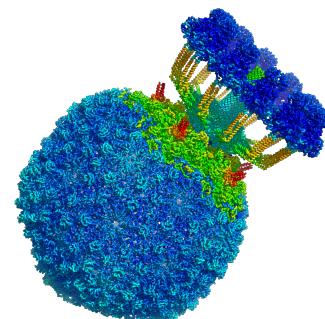


Figure 1.4: P68 structure.

Source: Own results

## §1.5 Ethical considerations

This study requires taking samples from live human subjects. This is a one-off sampling process: they are required only once. The results are then communicated to the subjects via e-mail or by being delivered a physical piece of paper. They are informed previously on the process they are going to go through, as well as the purpose of the experiment. Each subject must read and agree to two documents: an informed consent which explains everything about the experiment<sup>14</sup> and a GDPR notice which documents the use of their data as well as an expected timeline for data anonymisation and destruction<sup>15</sup>. All participants were screened to be over the age of 16, in order to ease the process and require no previous authorisation by parental figures on data

<sup>14</sup>Can be found at <https://biblio.peiphy.xyz/TDR-IC.pdf>

<sup>15</sup>Can be found at <https://biblio.peiphy.xyz/GDPR-notice.pdf>

collection. The experimentation followed has no effect on the subjects, and they were monitored during the process in order for them not to feel any kind of stress.

Since bacteria were used, some aspects of the experiment must be clarified and discussed. Previously to starting the experiment, I read profusely the WHO's Laboratory Biosafety Manual and Associated Monographs (4th Edition) as to mitigate any possible risk. During the experimentation there were 0 accidents or incidents. All plates were accounted for and controlled closely. No person other than me was allowed to come in contact with a plate that had been cultivated or with the used cotton swabs that were in the process of being disinfected. The cultivated plates were considered Biosecurity Level 2. All possibly infected material was disposed of taking into account the risks that the bacteria in question posed, using bleach.

Before starting the experimentation, I had an interview with my coordinator in order to solidify the fact that there was no alternative to taking cutaneous samples from human beings, as well as a discussion on bacteria and the risks that this experiment implies.

# 2 Physical experimentation

A scientist in his laboratory is not a mere technician: he is also a child confronting natural phenomena that impress him as though they were fairy tales.

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Marie Curie

## §2.1 Description

This experiment looks at finding out the prevalence of *Staphylococcus Aureus* in a sample of students from the school. The process used involves extracting a sample from underneath a subject's nalis by swabbing, cultivating that sample and then observing the results of said culture to determine the presence or not of *Staphylococcus Aureus* as part of the subject's resident bacterial flora. Each iteration of the process took less than two minutes to complete. However, all the safety measures and actions taken need more time to be taken care of properly.

## §2.2 Protocol followed

The protocol followed was designed based on a similar protocol used in the many university laboratories[5], modified to fit the needs of this research paper, and peer-reviewed by Olga Sánchez, and uploaded to the Protocols.io platform, to make it easier to follow the days of that the experiment took place in. This protocol underwent 9 different revisions[6]. It can also be read below:

- 1) Prepare yourself for the experimentation: wash your hands, put on gloves, put on the lab coat, mask and goggles. Wash your hands again (gloves still on). Set up the work area; the Bunsen burner should be turned on in such a way that it can cover an acceptable surface to work. Turn it on and wash your hands again.
- 2) Divide each Petri dish between 2 parts. A guide should be used for this part. Get your subject to wash their hands. Observe their hands. If they are extremely short, it may be worth it to take the sample nasally.
- 3) Note down their information, crack open a sterile swab, dip it in Ringer solution and swab away at under their nails or nose. Then, populate the dish with this sample.
- 4) Incubate for 32-48h and observe the results.
- 5) Observe the bacteria under a microscope after GRAM tinction.

## §2.3 Bill of materials

The materials used, as well as the quantities used can be found in the following table. On the left, laboratory equipment and, on the right, reagents, tinction agents, and consumables used:

Qty	Material/consumable	Qty	Reagent
x80	Sterile cotton swabs	~30mL	Bleach
x1	Kolle handle	~10mL	Methyl violet
x1	Optic microscope	~10mL	Iodine
x1	Binocular magnifier	~10mL	Alcoholic safranin
x1	Dissection tray	~10mL	Methanol
x1	Bunsen burner	<1mL	Ether
x1	Lab coat	x40	Agar MSA plates
x1	Lab goggles	>1L	Ringer solution (9% saline)
x8	Non-powdered gloves		
x10	Slides and slide covers		

## §2.4 Biosecurity and risk mitigation

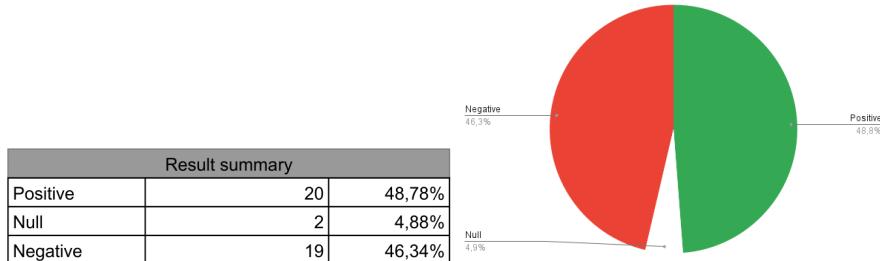
Staph is considered a Biosecurity Level (BSL) 2 pathogenic bacteria[7]. This means that it is associated with a human disease that can pose a moderate human health hazard. In a laboratory where BSL-2 pathogens are handled, regular lab rules should be followed (mechanical pipetting only, hand washing, prohibition of the consumption of food and drinks in the lab, proper PPE use...), as well as avoiding splashes or aerosols, adhering biohazard warning signs present on all material used, as well as proper surface and material disinfection via the use of autoclave or proper alternative decontamination method[8].

The risks associated with this bacteria were assessed following the protocol designated by the World Health Organisation, and proper security measures were followed at all times when handling biohazardous material. No incidents occurred during the research part of this project, and the protocol defined previous to the start was followed extremely closely. While the laboratory used may not be the most ideal type of laboratory for this type of research, it was certainly adequate enough to perform a research project like this one, especially after the temporary signage that was temporarily installed.

## §2.5 Results and analysis

The results obtained can be found as Annex II in the form of a raw data table with personal identificative data removed following GDPR regulations. The data was then recounted and graphed into the following pie chart:

As we can see, almost 50% of the samples taken tested positive for *Staphylococcus Aureus*, compared to the expected 30%[9]. We can, however, see in the UK's Public



(a) Counts of the result cases. Own data.  
 (b) Pie graph of the result cases. Own data.

Health bactaeremia data that Staph infections have been on the rise lately, so it may not be a case of wrong data[10]. On top of that, both of my advisers, Olga and Margarita, have also found themselves getting more prevalence than usual of this bacteria, and are finding cases that were once negative but turned positive in the last few years.<sup>1</sup>

There may be several reasons for the infection rate and thus natural prevalence to be increasing. One of them could be that since antibiotic abuse is growing with each passing year, the usual resident microbiota is getting killed, leaving more resources for Staph to thrive in that environment. To confirm this theory we will look at the infection rates of a country that is facing extreme antibiotic abuse (the United States of America) and compare it to another that is controlling their antibiotics a bit better (the United Kingdom). They have seen a 210% increase in *Staphylococcus Aureus* cases since 2006. However, superfluous antibiotic prescriptions have increased by barely 1%[11]. In the United Kingdom,

The other could be climate change. An increase of ambient temperatures could mean a better breeding ground for this specific species and thus leading to a higher-than-usual prevalence. *Staphylococcus Aureus*' optimal breeding temperature is between 35°C and 37°C. The global average temperature has increased by 1,1°C[12] in the last 120 years. And *Staphylococcus aureus* has a specific temperature growth curve, just like any other bacteria:

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<sup>1</sup>insert table

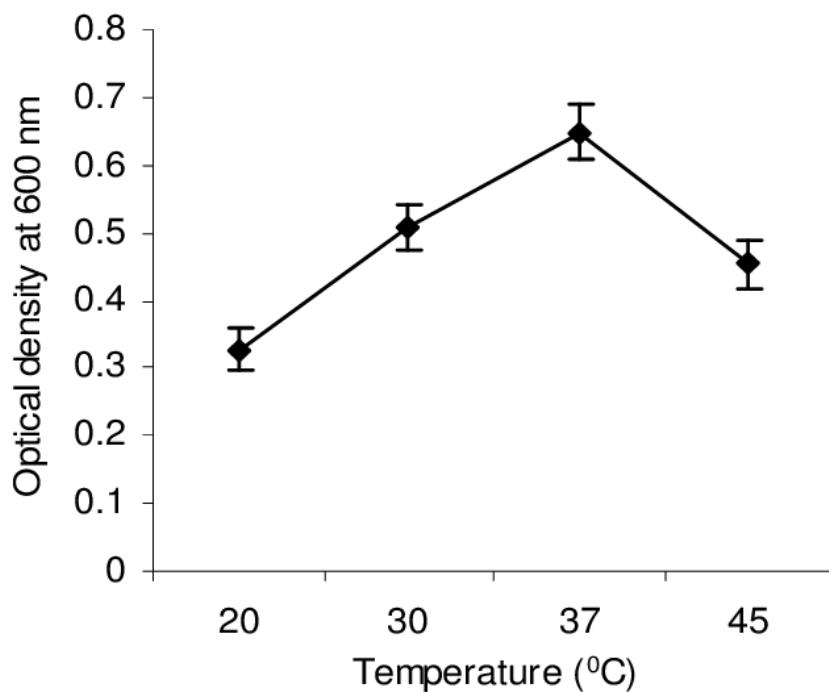


Figure 2.2: *Staphylococcus Aureus* growth curve by temperature [FigEffectTemperature]

So, this correlation may not be completely incorrect, and in fact some scientists warn about an increased number of infectious diseases resurging due to climate change. One only data point is not enough significant data, so further study is needed on this front.



# 3 Conclusions

## §3.1 Experimental conclusions

This study has concluded that the prevalence of *Staphylococcus Aureus* in our high school is 48,8%, 150% of the expected results. As explored previously, this could mostly be due to climate change or antibiotic abuse, however there may also be other reasons for why this is happening.

It has also managed to produce a 3D printed figure of the bacteriophage that can help eradicate *Staphylococcus Aureus*, regardless of antibiotic resistance, as well as discovering how the proteins bind to the surface of a bacterium, injects its DNA and then proceeds to its hosted reproduction.

## §3.2 Bibliographic conclusions

While *Staphylococcus Aureus* is a dangerous bacteria given the right conditions, most of the times, the immunitary system can get rid of it before it becomes too large of a problem. However, in some cases, when the entire body gets infected and the infection stops being localised then that's when there is a problem. There are several strains of *Staphylococcus Aureus*, classified by their resistance to antibiotics: MSSA (sensitive to meticillin), MRSA (resistant to meticillin), VISA (intermediate resistance to vancomycin) and VRSA (resistant to vancomycin). While there is no antibiotic that can deal with VRSA, an alternative in the form of a bacteriophage virus, P-68, of the order of the *Caudovirales*

### §3.3 Strengths and weaknesses

This research was not without its strengths, but neither was it without its weaknesses.

**Strengths** The protocol was adapted fairly well to the environment it was run in, and no incidents took place during the realisation of the experimentation.

**Weaknesses** While the Agar plates used were definitely adequate for the purpose they were used for, a much more appropriate growth medium called Baird-Parker (BP) could've been used.

### §3.4 Possible improvements

This research could've been improved by running an antibiogram on the samples, thus checking for antibiotic resistance. While this is fairly safe if adequate protections are taken, it is yet another point that could fail and result in a biosafety incident.



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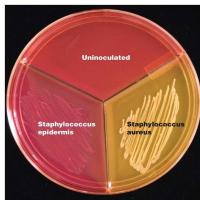


# I

## Appendix



# **Annex 1 - Protocol as published in protocols.io**



# Staphylococcus Aureus Sampling V.10

Mar Roca Cugat<sup>1</sup>, Olga Sánchez<sup>2</sup>

<sup>1</sup>Institut Jaume Vicens Vives; <sup>2</sup>Universitat Autònoma de Barcelona

Olga Sánchez: Peer review;

Version 10 ▾

Sep 19, 2022

[dx.doi.org/10.17504/protocols.io.81wgb6pk1lpk/v10](https://dx.doi.org/10.17504/protocols.io.81wgb6pk1lpk/v10)



Mar Roca Cugat

Institut Jaume Vicens Vives, Universitat de Girona

## DISCLAIMER

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## ABSTRACT

This protocol is intended to study the affection of *Staphylococcus Aureus*, including the MRSA, VISA and VRSA variants, even if it makes the test more difficult to perform. It outlines the basic protocol for a multi-subject study, while using basic and minimal resources found in almost every biology lab.

## DOI

[dx.doi.org/10.17504/protocols.io.81wgb6pk1lpk/v10](https://dx.doi.org/10.17504/protocols.io.81wgb6pk1lpk/v10)

## PROTOCOL CITATION

Mar Roca Cugat, Olga Sánchez 2022. Staphylococcus Aureus Sampling.  
**protocols.io**  
<https://protocols.io/view/staphylococcus-aureus-sampling-cguctwsw>  
Version created by [Mar Roca Cugat](#)

## KEYWORDS

Microbiology, sampling, swab, staphilococcus aureus

LICENSE



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CREATED

Jan 12, 2022

LAST MODIFIED

Sep 19, 2022

PROTOCOL INTEGER ID

70244

GUIDELINES

This protocol is intended to study the affection of *Staphylococcus Aureus*, which is a Biosecurity Level 2 bacterial agent. As such, the laboratory should be adequately to those standards or take measures in order to prevent infection, cross-contamination, or leaks.

MATERIALS TEXT

**PPE**

- Face shield or protective goggles
- FFP2/KN95 or higher-rated mask
- Latex, non-powdered gloves
- Lab coat

**Sampling material**

- Clean and sterile cotton swabs ( $n+n/10$  being n the number of tests required)
- MSA Agar Petri dishes ( $n/(2 \text{ to } 4)$  being n the number of dishes required)
- Sterile Ringer solution
- Permanent marker

**Support material**

- Bunsen burner
- Incubator
- Ethanol: >80%
- Bleach solution at 50%v in water.
- Reagents to make LB
- Inactivation buffer
- Photospectrometer

SAFETY WARNINGS

This protocol requires interaction with people, possibly infected with a pathogen (especially in 2022, when this protocol was written and put into practice, as COVID-19 was still going strong). As such, there is a risk of infection which can be minimized with proper PPE use.

Proper ventilation is recommended at all times, even when the pandemic situation is over. However, the sterile field must be preserved at all costs, so try to direct the airflow in order for it not to affect the results.

DISCLAIMER:

DISCLAIMER – FOR INFORMATIONAL PURPOSES ONLY; USE AT YOUR OWN RISK

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Preparation

1h

10m



Wash your hands with soap. Put on your lab coat, your mask, and your goggles or face shield. Make sure your mask is airtight and air cannot escape through the sides.

- 1.1 Prepare the area where you are going to work. Disinfect the surfaces with the bleach solution.

The subjects should not be able to walk behind you, only to the side or to the front. Make sure to leave enough distance between the sampler and the subject, but not enough distance as for the sampling to be uncomfortable. The environment should be comfortable, within the following range of temperatures: **20 °C – 35 °C**

You should have a plastic, sealable box to your side or on the table to store the sampled Petri dishes.

The Bunsen burner should be to the front of you, within a hand of distance. The fresh swabs and Petri dishes should never be accessible by the subjects.

- 1.2 Using a permanent marker, divide each plate into two to four equal parts. You should help yourself by using a guide, such as a ruler.

- 2 Observe the subject's hands. If their nails are longer than 1-4 mm (the white part of the nail that can overgrow).  
Bitten-down nails could lead to invalid results. Too long nails could lead to cross-contamination.  
Ask the subject for their identificative and contact information if this has not been done previously.
- 3 Place a Petri dish on the side of the Bunsen burner. The burner will be the center of our sterile field.



Watch out so as not to break the sterile field

Step 3 includes a Step case.

### Nail sampling

### Nose sampling

---

step case

---

### Nail sampling

For cases where the nails are 3-6mm long

- 4 Ask the subject to wash their hands thoroughly and below the nails with soap and lukewarm water. Note their subject ID on the bottom (agar side) of the Petri dish.
  - 4.1 Bring the subject's hands below the sterile area generated by the Bunsen burner. Open the Ringer solution and soak the swab. Proceed by swabbing below every nail in both hands. Once done, the subject can be dismissed.
  - 4.2 "Paint" one half of the Petri dish with the swab, softly so as not to break the agar but firmly as to get the sample to transfer to the plate.

5



1d

### ⌚ Repeat n times

Once the plate has 3 samples, place it in the full plates box.

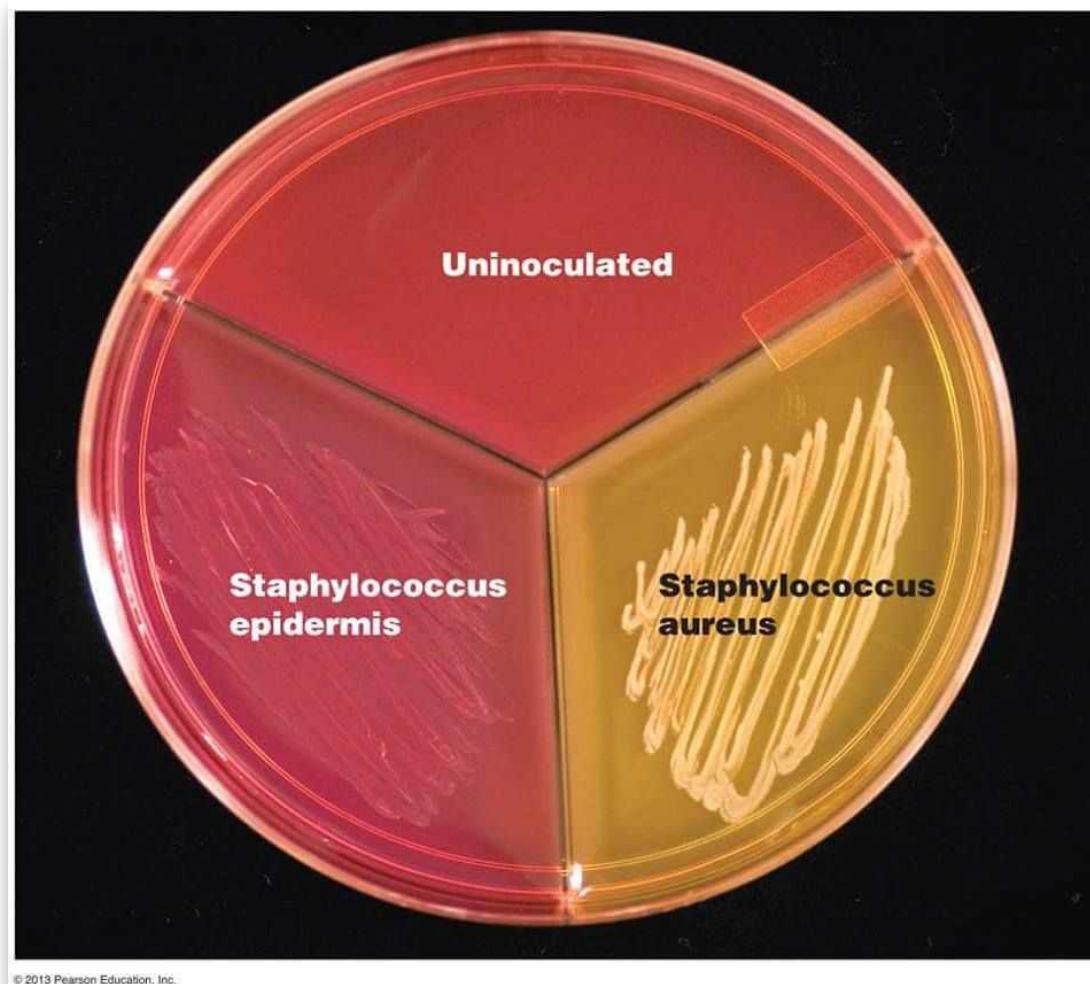
Once there are 20 plates in the box, group them together with tape, write an identificative group number and place it in the incubator.

The incubator should be set to **⌚ 37 °C** and left to incubate for **⌚ 24:00:00**.

Study

1d 2h

6



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It is expected to one of these results. A bright red colour means the sample was uninoculated. A pinkish colour with translucent streaks means there is *Staphylococcus epidermidis* present. A faint yellow colour or a bright yellow colour means there is *Staphylococcus aureus* present

The samples should be taken out of the incubator, the results introduced into the database and communicated to the subject.

7



Using one of the extra MSA Agar plates, culture and purify a sample of *Staphilococcus Aureus*. This can then be treated with GRAM tinture in order to observe it under an optical microscope (ideally at x1000-x1200).



Watch out for impurities/contaminations



## **Annex 2 - Raw data table (data anonimised)**

## Result summary

Positive	20	48,78%
Null	2	4,88%
Negative	19	46,34%

## **Annex 3 - Bibliography consulted**

---

## Weekly Epidemiological Record, 2020, vol. 96, 05/06 [full issue]

**Type** Journal Article

**Author** World Health Organization = Organisation mondiale de la Santé

**Date** 2021-02-05

**Language** en

**Library Catalog** WHO IRIS

**URL** <https://apps.who.int/iris/handle/10665/339321>

**Accessed** 9/25/2022, 1:02:33 PM

**Extra** Place: Geneva = Genève Publisher: World Health Organization = Organisation mondiale de la Santé Section: 12 p

**Volume** 96

**Pages** 33-44

**Publication** Weekly Epidemiological Record = Relevé épidémiologique hebdomadaire

**Issue** 05/06

**Date Added** 9/25/2022, 1:02:34 PM

**Modified** 9/26/2022, 6:36:47 PM

### Tags:

No DOI found, Epidemiology, Smallpox, Vaccinia virus

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## Viruses: Molecular Hijackers

**Type** Video Recording

**Director** Professor Dave Explains

**Abstract** Most of us know about viruses, and that they spread disease. But what is a virus exactly? Is it alive? How does it infect a host? There's a lot to discuss here! Take a look. Watch the whole Biology/Genetics playlist: <http://bit.ly/ProfDaveBio> General Chemistry Tutorials: <http://bit.ly/ProfDaveGenChem> Organic Chemistry Tutorials: <http://bit.ly/ProfDaveOrgChem> Biochemistry Tutorials: <http://bit.ly/ProfDaveBiochem> Anatomy & Physiology Tutorials: <http://bit.ly/ProfDaveAnatPhys> Biopsychology Tutorials: <http://bit.ly/ProfDaveBiopsych> Microbiology/Infectious Diseases Tutorials: <http://bit.ly/ProfDaveMicrobio> Pharmacology Tutorials: <http://bit.ly/ProfDavePharma> History of Drugs Videos: <http://bit.ly/ProfDaveHistoryDrugs> EMAIL► ProfessorDaveExplains@gmail.com PATREON► <http://patreon.com/ProfessorDaveExplains> Check out "Is This Wi-Fi Organic?", my book on disarming pseudoscience! Amazon: <https://amzn.to/2HtNpVH> Bookshop: <https://bit.ly/39cKADM> Barnes and Noble: <https://bit.ly/3pUjmmr> Book Depository: <http://bit.ly/3aOVDIT>

**Date** 2017-10-19

**Short Title** Viruses

**Library Catalog** YouTube

**URL** [https://www.youtube.com/watch?v=wUgEhfo\\_qxU](https://www.youtube.com/watch?v=wUgEhfo_qxU)

**Accessed** 11/29/2021, 7:17:12 PM

**Running Time** 10:01

**Date Added** 11/29/2021, 7:17:12 PM

**Modified** 11/29/2021, 7:17:15 PM

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## Targeting Staphylococcus aureus Toxins: A Potential form of Anti-Virulence Therapy

**Type** Journal Article

**Author** Cin Kong

**Author** Hui-min Neoh

**Author** Sheila Nathan

**Abstract** Staphylococcus aureus is an opportunistic pathogen and the leading cause of a wide range of severe clinical infections. The range of diseases reflects the diversity of virulence factors produced by this pathogen. To establish an infection in the host, S. aureus expresses an inclusive set of virulence factors such as toxins, enzymes, adhesins, and other surface proteins that allow the pathogen to survive under extreme conditions and are essential for the bacteria's ability to spread through tissues. Expression and secretion of this array of toxins and enzymes are tightly controlled by a number of regulatory systems. S. aureus is also notorious for its ability to resist the arsenal of currently available antibiotics and dissemination of various multidrug-resistant S. aureus clones limits therapeutic options for a S. aureus infection. Recently, the development of anti-virulence therapeutics that neutralize S. aureus toxins or block the pathways that regulate toxin production has shown potential in thwarting the bacteria's acquisition of antibiotic resistance. In this review, we provide insights into the regulation of S. aureus toxin production and potential anti-virulence strategies that target S. aureus toxins.

**Date** 2016-03-15

**Language** eng

**Short Title** Targeting Staphylococcus aureus Toxins

**Library Catalog** PubMed

**Extra** PMID: 26999200 PMCID: PMC4810217

**Volume** 8

**Pages** E72

**Publication** Toxins

**DOI** 10/f8tnpx

**Issue** 3

**Journal Abbr** Toxins (Basel)

**ISSN** 2072-6651

**Date Added** 2/27/2022, 9:35:57 AM

**Modified** 9/26/2022, 6:36:46 PM

**Tags:**

Animals, Anti-Bacterial Agents, anti-virulence therapy, *Caenorhabditis elegans*, Humans, regulatory system, *Staphylococcus aureus*, toxins, Toxins, Biological, Virulence, virulence factors, Virulence Factors

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Structure and genome ejection mechanism of *Staphylococcus aureus* phage P68

**Type** Journal Article

**Author** Dominik Hrebík

**Author** Dana Štveráková

**Author** Karel Škubník

**Author** Tibor Füzik

**Author** Roman Pantůček

**Author** Pavel Plevka

**Abstract** Phages infecting *Staphylococcus aureus* can be used as therapeutics against antibiotic-resistant bacterial infections. However, there is limited information about the mechanism of genome delivery of phages that infect Gram-positive bacteria. Here, we present the structures of native *S. aureus* phage P68, genome ejection intermediate, and empty particle. The P68 head contains 72 subunits of inner core protein, 15 of which bind to and alter the structure of adjacent major capsid proteins and thus specify attachment sites for head fibers. Unlike in the previously studied phages, the head fibers of P68 enable its virion to position itself at the cell surface for genome delivery. The unique interaction of one end of P68 DNA with one of the 12 portal protein subunits is disrupted before the genome ejection. The inner core proteins are released together with the DNA and enable the translocation of phage genome across the bacterial membrane into the cytoplasm.

**Date** 2019-10

**Language** eng

**Library Catalog** PubMed

**Extra** PMID: 31663016 PMCID: PMC6795507

**Volume** 5

**Pages** eaaw7414

**Publication** Science Advances

**DOI** 10/gm742z

**Issue** 10

**Journal Abbr** Sci Adv

**ISSN** 2375-2548

**Date Added** 7/27/2022, 11:26:05 AM

**Modified** 9/26/2022, 6:36:46 PM

**Tags:**

Bacteriophages, Capsid Proteins, Cell Membrane, Cytoplasm, DNA, Viral, Genome, Viral, *Staphylococcus aureus*, Virion

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Structure and genome ejection mechanism of *Staphylococcus aureus* phage P68

**Type** Journal Article

**Author** Dominik Hrebík

**Author** Dana Štveráková

**Author** Karel Škubník

**Author** Tibor Füzik

**Author** Roman Pantůček

**Author** Pavel Plevka

**Abstract** Cryo-EM reveals the genome ejection mechanism of bacteriophage P68, a potential phage therapy agent against *Staphylococcus aureus*. Phages infecting *Staphylococcus aureus* can be used as therapeutics against antibiotic-resistant bacterial infections. However, there is limited information about the mechanism of genome delivery of phages that infect Gram-positive bacteria. Here, we present the structures of native *S. aureus* phage P68, genome ejection intermediate, and empty particle. The P68 head contains 72 subunits of inner core protein, 15 of which bind to and alter the structure of adjacent major capsid proteins and thus specify attachment sites for head fibers. Unlike in the previously studied phages, the head fibers of P68 enable its virion to position itself at the cell surface for genome delivery. The unique interaction of one end of P68 DNA with one of the 12 portal protein subunits is disrupted before the genome ejection. The inner core proteins are released together with the DNA and enable the translocation of phage genome across the bacterial membrane into the cytoplasm.

**Date** 2019-10-16

**Library Catalog** PubMed Central

**URL** <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6795507/>

**Accessed** 9/25/2022, 8:23:50 PM

**Extra** PMID: 31663016 PMCID: PMC6795507

**Volume** 5

**Pages** eaaw7414

**Publication** Science Advances

**DOI** 10/gm742z

**Issue** 10

**Journal Abbr** Sci Adv

**ISSN** 2375-2548

**Date Added** 9/25/2022, 8:23:50 PM  
**Modified** 9/26/2022, 6:36:46 PM

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## Staphylococcus aureus toxins | Elsevier Enhanced Reader

**Type** Web Page  
**Date** 1970-1-1  
**Language** en  
**URL** <https://reader.elsevier.com/reader/sd/pii/S1369527413002191?token=A32ABB40B09CB72E7261B7B00541C8BF22151150B0A7472A8940E817C2FA3E3B775F6FBC6E4C33F4B5EB99BA32CA69A0&originR=west-1&originCreation=20211215173133>  
**Accessed** 12/15/2021, 6:31:43 PM  
**Extra** DOI: 10.1016/j.mib.2013.11.004  
**Date Added** 12/15/2021, 6:31:43 PM  
**Modified** 9/14/2022, 6:19:53 PM

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## Staphylococcus aureus in Healthcare Settings | HAI | CDC

**Type** Web Page  
**Date** 2020-12-10T04:04:39Z  
**Language** en-us  
**URL** <https://www.cdc.gov/hai/organisms/staph.html>  
**Accessed** 9/20/2022, 7:34:04 PM  
**Date Added** 9/20/2022, 7:34:04 PM  
**Modified** 9/20/2022, 7:34:04 PM

---

## Staphilococcus Aureus Sampling V10

**Type** Journal Article  
**Author** Pol Roca Cugat  
**Author** Olga Sánchez  
**Abstract** This protocol is intended to study the affection of Staphilococcus Aureus, including the MRSA variant. It outlines the basic protocol for a multi-subject study.  
**Date** 19/09/2022  
**Language** en  
**Library Catalog** DOI.org (Crossref)  
**URL** [dx.doi.org/10.17504/protocols.io.81wgb6pk1lpk/v10](https://dx.doi.org/10.17504/protocols.io.81wgb6pk1lpk/v10)  
**Accessed** 2/1/2022, 12:33:41 PM  
**Extra** DOI: dx.doi.org/10.17504/protocols.io.81wgb6pk1lpk/v10  
**Volume** 8  
**Publication** protocols.io  
**DOI** 10/gqwest  
**Journal Abbr** PLoS ONE-Protocols.io  
**Date Added** 2/1/2022, 12:33:41 PM  
**Modified** 9/26/2022, 6:36:46 PM

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## Staphilococcus Aureus Sampling

**Type** Web Page  
**Abstract** A secure platform for developing and sharing reproducible methods.  
**Language** en  
**URL** <https://www.protocols.io/view/staphilococcus-aureus-sampling-b6v6re9e>  
**Accessed** 3/30/2022, 10:55:20 AM  
**Website Title** protocols.io  
**Date Added** 3/30/2022, 10:55:20 AM  
**Modified** 3/30/2022, 10:55:20 AM

---

## Safety of bacteriophage therapy in severe Staphylococcus aureus infection

**Type** Journal Article  
**Author** Aleksandra Petrovic Fabjan  
**Author** Ruby C. Y. Lin  
**Author** Josephine Ho  
**Author** Susan Maddocks  
**Author** Nouri L. Ben Zakour  
**Author** Jonathan R. Iredell

**Author** Westmead Bacteriophage Therapy Team  
**Author** Ali Khalid  
**Author** Carola Venturini  
**Author** Richard Chard  
**Author** Sandra Morales  
**Author** Indy Sandaradura  
**Author** Tim Gilbey  
**Date** 2020-03-02  
**Language** en  
**Library Catalog** DOI.org (Crossref)  
**URL** <http://www.nature.com/articles/s41564-019-0634-z>  
**Accessed** 7/27/2022, 11:26:34 AM  
**Volume** 5  
**Pages** 465-472  
**Publication** Nature Microbiology  
**DOI** 10/gqbj7f  
**Issue** 3  
**Journal Abbr** Nat Microbiol  
**ISSN** 2058-5276  
**Date Added** 7/27/2022, 11:26:34 AM  
**Modified** 9/26/2022, 6:36:45 PM

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Resistència antibòtica en les poblacions de lactobacils, estafilococs i entreococs aïllats de productes lleugerament fermentats.

**Type** Thesis  
**Author** Anna Claret i Coma  
**Date** Maig 2004  
**Language** Català  
**Archive** Biblioteca UDG - Campus Montilivi  
**Library Catalog** CDR TR CLARET  
**Place** Girona  
**Type** Projecte/Treball de Final de Carrera  
**University** Universitat de Girona  
**Date Added** 12/15/2021, 7:00:46 PM  
**Modified** 12/15/2021, 7:02:34 PM

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Renforcer la résilience du système de santé pour instaurer la couverture sanitaire universelle et la sécurité sanitaire pendant et après la COVID-19 : exposé de la position de l'OMS

**Type** Report  
**Author** Organisation mondiale de la Santé  
**Date** 2021  
**Language** fr  
**Short Title** Renforcer la résilience du système de santé pour instaurer la couverture sanitaire universelle et la sécurité sanitaire pendant et après la COVID-19  
**Library Catalog** WHO IRIS  
**URL** <https://apps.who.int/iris/handle/10665/346531>  
**Accessed** 9/25/2022, 1:02:33 PM  
**Extra** Section: xii, 39 p. WHO/UHL/PHC-SP/2021.01  
**Place** Genève  
**Institution** Organisation mondiale de la Santé  
**Date Added** 9/25/2022, 1:02:34 PM  
**Modified** 9/25/2022, 1:02:34 PM

#### Tags:

Disease Outbreaks, Betacoronavirus, COVID-19, Health Planning, National Health Programs, Primary Health Care, Risk Management, Security Measures, Universal Health Insurance

---

Renforcement de la sécurité biologique en laboratoire

**Type** Report  
**Author** 74 Assemblée mondiale de la Santé  
**Date** 2021  
**Language** fr  
**Library Catalog** WHO IRIS

**URL** <https://apps.who.int/iris/handle/10665/358270>

**Accessed** 9/25/2022, 1:02:33 PM

**Extra** Section: 7 p. A74/18

**Place** Genève

**Institution** Organisation mondiale de la Santé

**Date Added** 9/25/2022, 1:02:34 PM

**Modified** 9/25/2022, 1:02:34 PM

**Tags:**

Containment of Biohazards, Laboratories, Laboratory Infection, Safety Management

---

Pruebas de laboratorio para el virus de la viruela símica: orientaciones provisionales, 23 de mayo de 2022

**Type** Report

**Author** Organización Mundial de la Salud

**Date** 2022

**Language** es

**Short Title** Pruebas de laboratorio para el virus de la viruela símica

**Library Catalog** WHO IRIS

**URL** <https://apps.who.int/iris/handle/10665/357787>

**Accessed** 9/25/2022, 1:02:33 PM

**Extra** Section: 7 p. WHO/MPX/Laboratory/2022.1

**Place** Ginebra

**Institution** Organización Mundial de la Salud

**Date Added** 9/25/2022, 1:02:34 PM

**Modified** 9/25/2022, 1:02:34 PM

**Tags:**

Laboratories, diagnosis, Diagnostic Techniques and Procedures, Disease Outbreaks, Guideline, Monkeypox, Monkeypox virus

---

Promoting biosecurity by professionalizing biosecurity

**Type** Web Page

**Date** 1970-1-1

**Language** en

**URL** <https://www.science.org/doi/epdf/10.1126/science.aba0376>

adobe\_mc=MCMID%3D34422769753108397802497074084661275174%7CMCORGID%3D242B6472541199F70A4C98A6%2540AdobeOrg%7C1

**Accessed** 12/15/2021, 6:25:10 PM

**Extra** DOI: 10.1126/science.aba0376

**Date Added** 12/15/2021, 6:25:10 PM

**Modified** 9/14/2022, 6:19:55 PM

---

Programme Budget Performance Assessment: 2020–2021

**Type** Report

**Author** World Health Organization. Regional Office for South-East Asia

**Abstract** Consistent with WHO's results and accountability frameworks, this Working Paper provides information on the programmatic and financial implementation of the Programme Budget 2020–2021 in the South-East Asia Region based on the end-of-biennium assessment. The 'WHO Results Report Programme Budget 2020–2021 – For a safer, healthier and fairer world' was presented at the Seventy-fifth World Health Assembly. The Thirteenth General Programme of Work, 2019–2023, marked a new strategic direction for WHO. Measurable impact in countries lies at the heart of this strategy. The tenure of the Thirteenth General Programme of Work (GPW13) was extended to 2025 by the Seventy-fifth World Health Assembly in May 2022 to intensify and strengthen the support to countries in recovering from the impact of the pandemic and accelerate progress towards the achievement of the Sustainable Development Goals. Programme Budget 2020–2021 is the first of the Programme Budgets implemented under the Thirteenth General Programme of Work (GPW13) 2019–2023, which provided a new strategic direction for WHO. With the publishing of the Results Report for Programme Budget 2020–2021, progress towards the 'Triple Billion' targets, outcomes and outputs has been presented to Member States based on the GPW13 Results Framework. The SDG-based Triple Billion targets for healthier populations, universal health coverage and health emergencies define how WHO would help countries attain these targets through leadership, global public health goods/technical products and country support. The overall goal is to continuously improve WHO's accountability for results. This generates trust on the part of those the Organization serves and those who support WHO, and creates a virtuous cycle reinforcing WHO's leadership function 'to act as the directing and coordinating authority on international health work'. Structured methodologies, both quantitative and qualitative, were used for measuring and analysing the achievements and challenges thereto, and these include country and impact case studies to exemplify how the Organization's work is driving health impacts at the country level, where it matters most. Although battling the COVID-19 pandemic took centrestage in 2021, the Organization's achievements in that year go beyond how WHO responded to the COVID-19 pandemic. The outbreak of the coronavirus disease (COVID-19) pandemic early in 2020 posed unprecedented health and economic challenges worldwide and placed new and urgent demands on the Organization. Nonetheless, the Organization was able to respond and maintain its focus on the effective implementation of programmatic activities with the help of partners and stakeholders. The achievements of the Secretariat against each of the Outputs are assessed through six dimensions using the Output Scorecard. The Scorecard is refined further with experiences gained from the mid-term review (MTR) of PB 2020–21 and feedback received from various consultations and focus group discussions. The WHO Results Report complements the Financial Report; both are integral parts of the transparent presentation of the Organization's work in 2020–2021. The Detailed Results

Report is available online at <https://www.who.int/about/accountability/results/who-results-report-2020-2021>. The ‘WHO Results Report Programme Budget 2020–2021 – For a safer, healthier and fairer world’ was presented to the Seventy-fifth World Health Assembly and noted by it. On the financial front, the 2020–2021 biennium saw the highest levels of financing (US\$ 7916 million) and implementation (US\$ 6640 million) across the Organization. The total amount of distributed resources for the biennium for the South-East Asia Region was US\$ 515.1 million and implementation (expenditure) was US\$ 476.3 million, which amounts to 92% of the distributed resources. The approved Programme Budget was funded at 115% and its implementation was 107%. This report was presented to the Fifteenth Meeting of the Subcommittee on Policy and Programme Development and Management (SPPDM), for its review and recommendations. The SPPDM meeting reviewed the paper and made the following recommendations for consideration by the Seventy-fifth Session of the Regional Committee: Actions by Member States (1) Continue engaging in and facilitating collaborative approaches for successful implementation of programmes at the country level. (2) Build on the progress made and lessons learnt from the COVID-19 pandemic to achieve national targets and contribute to global and regional targets, namely the Thirteenth General Programme of Work and the Sustainable Development Goals. Actions by WHO (1) Ensure continued focus on effective Programme Budget implementation, country priorities and results, in alignment with the Regional Flagship Priority Programmes and the Thirteenth General Programme of Work. (2) Continue to monitor technical and financial implementation and strategic resource allocation according to priorities agreed with the Member States. This Working Paper, along with the SPPDM recommendations, is submitted to the Seventy-fifth Session of the WHO Regional Committee for South-East Asia for its consideration.

**Date** 2022

**Language** en

**Short Title** Programme Budget Performance Assessment

**Library Catalog** WHO IRIS

**URL** <https://apps.who.int/iris/handle/10665/361147>

**Accessed** 9/25/2022, 1:02:34 PM

**Extra** SEA/RC75/4

**Place** New Delhi

**Institution** World Health Organization. Regional Office for South-East Asia

**Date Added** 9/25/2022, 1:02:34 PM

**Modified** 9/25/2022, 1:02:34 PM

#### Tags:

Governing Board

## Problemas que se plantean en el tratamiento de infecciones graves por S. Aureus / [editores]: G. Verger, Ll. Carbó

**Type** Document

**Author** G. Verger

**Author** Ll Carbó

**Author** Fundació Dr Antoni Esteve

**Date** 1986

**Language** spa

**Short Title** Problemas que se plantean en el tratamiento de infecciones graves por S. Aureus / [editores]

**Library Catalog** omnia.udg.edu

**Extra** Book Title: Problemas que se plantean en el tratamiento de infecciones graves por S. Aureus ISBN: 9788439882718 Place: Barcelona Series Number: 2 Series: Monografías Dr. Antonio Esteve

**Publisher** Fundación DrAntonio Esteve

**Date Added** 12/15/2021, 6:34:22 PM

**Modified** 12/15/2021, 6:34:22 PM

#### Tags:

Staphylococcus aureus, Infeccions per estafilococs, Malalties transmissibles

## Prevalence of Staphylococcus aureus nasal colonization in the United States, 2001–2002

**Type** Journal Article

**Author** Matthew J. Kuehnert

**Author** Deanna Kruszon-Moran

**Author** Holly A. Hill

**Author** Geraldine McQuillan

**Author** Sigrid K. McAllister

**Author** Gregory Fosheim

**Author** Linda K. McDougal

**Author** Jasmine Chaitram

**Author** Bette Jensen

**Author** Scott K. Fridkin

**Author** George Killgore

**Author** Fred C. Tenover

**Abstract** BACKGROUND: Staphylococcus aureus is a common cause of disease, particularly in colonized persons. Although methicillin-resistant S. aureus (MRSA) infection has become increasingly reported, population-based S. aureus and MRSA colonization estimates are lacking. METHODS: Nasal samples for S. aureus culture and sociodemographic data were obtained from 9622 persons > or = 1 year old as part of the National Health and Nutrition Examination Survey, 2001–2002. After screening for oxacillin susceptibility, MRSA and selected methicillin-susceptible S. aureus isolates were tested for antimicrobial susceptibility, pulsed-field gel electrophoresis clonal type, toxin genes (e.g., for Panton-Valentine leukocidin [PVL]), and staphylococcal cassette chromosome mec (SCCmec) type I–IV genes. RESULTS: For 2001–2002, national S. aureus and MRSA colonization prevalence estimates were 32.4%

(95% confidence interval [CI], 30.7%-34.1%) and 0.8% (95% CI, 0.4%-1.4%), respectively, and population estimates were 89.4 million persons (95% CI, 84.8-94.1 million persons) and 2.3 million persons (95% CI, 1.2-3.8 million persons), respectively. *S. aureus* colonization prevalence was highest in participants 6-11 years old. MRSA colonization was associated with age > or = 60 years and being female but not with recent health-care exposure. In unweighted analyses, the SCCmec type IV gene was more frequent in isolates from participants of younger age and of non-Hispanic black race/ethnicity; the PVL gene was present in 9 (2.4%) of 372 of isolates tested. CONCLUSIONS: Many persons in the United States are colonized with *S. aureus*; prevalence rates differ demographically. MRSA colonization prevalence, although low nationally in 2001-2002, may vary with demographic and organism characteristics.

**Date** 2006-01-15

**Language** eng

**Library Catalog** PubMed

**Extra** PMID: 16362880

**Volume** 193

**Pages** 172-179

**Publication** The Journal of Infectious Diseases

**DOI** 10/c8985p

**Issue** 2

**Journal Abbr** J Infect Dis

**ISSN** 0022-1899

**Date Added** 9/22/2022, 7:38:01 PM

**Modified** 9/26/2022, 6:36:46 PM

#### Tags:

Adolescent, Adult, Age Factors, Aged, Bacterial Toxins, Carrier State, Child, Child, Preschool, Community-Acquired Infections, DNA Fingerprinting, DNA, Bacterial, Electrophoresis, Gel, Pulsed-Field, Ethnicity, Female, Humans, Infant, Male, Methicillin Resistance, Microbial Sensitivity Tests, Middle Aged, Molecular Epidemiology, Nose, Prevalence, Sex Factors, Socioeconomic Factors, Staphylococcal Infections, Staphylococcus aureus, United States

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## Practical handbook of microbiology

**Type** Book

**Editor** William M. O'Leary

**Date** 1989

**Library Catalog** Library of Congress ISBN

**Call Number** QR72.5 .P73 1989

**Place** Boca Raton, Fla

**Publisher** CRC Press

**ISBN** 978-0-8493-3704-8

**# of Pages** 681

**Date Added** 2/26/2022, 8:38:26 PM

**Modified** 2/26/2022, 8:38:26 PM

#### Tags:

handbooks, Handbooks, manuals, etc, Microbiology

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## Plasma Membrane (Cell Membrane)

**Type** Web Page

**Date** 2022-9-12

**Language** en

**URL** <https://www.genome.gov/genetics-glossary/Plasma-Membrane>

**Accessed** 9/17/2022, 7:54:08 PM

**Website Title** Genome.gov

**Date Added** 9/17/2022, 7:54:08 PM

**Modified** 9/17/2022, 7:54:10 PM

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## Phage Therapy in the Twenty-First Century: Facing the Decline of the Antibiotic Era; Is It Finally Time for the Age of the Phage?

**Type** Journal Article

**Author** Shayla Hesse

**Author** Sankar Adhya

**Abstract** Burgeoning problems of antimicrobial resistance dictate that new solutions be developed to combat old foes. Use of lytic bacteriophages (phages) for the treatment of drug-resistant bacterial infections is one approach that has gained significant traction in recent years. Fueled by reports of experimental phage therapy cases with very positive patient outcomes, several early-stage clinical trials of therapeutic phage products have been launched in the United States. Eventual licensure enabling widespread access to phages is the goal; however, new paths to regulatory approval and mass-market distribution, distinct from those of small-molecule antibiotics, must be forged first. This review highlights unique aspects related to the clinical use of phages, including advantages to be reaped as well as challenges to be overcome.

**Date** 2019-09-08

**Language** en  
**Short Title** Phage Therapy in the Twenty-First Century  
**Library Catalog** DOL.org (Crossref)  
**URL** <https://www.annualreviews.org/doi/10.1146/annurev-micro-090817-062535>  
**Accessed** 7/27/2022, 11:27:07 AM  
**Volume** 73  
**Pages** 155-174  
**Publication** Annual Review of Microbiology  
**DOI** 10/gqwess  
**Issue** 1  
**Journal Abbr** Annu. Rev. Microbiol.  
**ISSN** 0066-4227, 1545-3251  
**Date Added** 7/27/2022, 11:27:07 AM  
**Modified** 9/26/2022, 6:36:45 PM

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## Pathogenicity and virulence of *Staphylococcus aureus*

**Type** Journal Article  
**Author** Gordon Y. C. Cheung  
**Author** Justin S. Bae  
**Author** Michael Otto  
**Abstract** *Staphylococcus aureus* is one of the most frequent worldwide causes of morbidity and mortality due to an infectious agent. This pathogen can cause a wide variety of diseases, ranging from moderately severe skin infections to fatal pneumonia and sepsis. Treatment of *S. aureus* infections is complicated by antibiotic resistance and a working vaccine is not available. There has been ongoing and increasing interest in the extraordinarily high number of toxins and other virulence determinants that *S. aureus* produces and how they impact disease. In this review, we will give an overview of how *S. aureus* initiates and maintains infection and discuss the main determinants involved. A more in-depth understanding of the function and contribution of *S. aureus* virulence determinants to *S. aureus* infection will enable us to develop anti-virulence strategies to counteract the lack of an anti-*S. aureus* vaccine and the ever-increasing shortage of working antibiotics against this important pathogen.  
**Date** 2021-12  
**Language** eng  
**Library Catalog** PubMed  
**Extra** PMID: 33522395 PMCID: PMC7872022  
**Volume** 12  
**Pages** 547-569  
**Publication** Virulence  
**DOI** 10/gm3xqz  
**Issue** 1  
**Journal Abbr** Virulence  
**ISSN** 2150-5608  
**Date Added** 2/27/2022, 9:35:54 AM  
**Modified** 9/26/2022, 6:36:45 PM

### Tags:

Animals, Anti-Bacterial Agents, biofilm, Humans, immune evasion, infection, Methicillin-Resistant *Staphylococcus aureus*, Mice, mrsa, neutrophils, Quorum Sensing, quorum-sensing, Sepsis, Staphylococcal Infections, *Staphylococcus aureus*, toxins, virulence, Virulence, Virulence Factors

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## MSSA bacteraemia: annual data

**Type** Web Page  
**Author** Public Health England  
**Abstract** Annual counts and rates of meticillin susceptible *Staphylococcus aureus* (MSSA) bacteraemia by acute trust and clinical commissioning group (CCG).  
**Date** 15-09-2021  
**Language** en  
**Short Title** MSSA bacteraemia  
**URL** <https://www.gov.uk/government/statistics/mssa-bacteraemia-annual-data>  
**Accessed** 9/20/2022, 7:43:42 PM  
**Website Title** GOV.UK  
**Date Added** 9/20/2022, 7:43:42 PM  
**Modified** 9/23/2022, 6:12:51 PM

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## Modern genetic analysis

**Type** Book  
**Editor** Anthony J. F. Griffiths  
**Date** 2000  
**Language** eng

**Library Catalog** K10plus ISBN  
**Place** New York, NY  
**Publisher** W. H. Freeman  
**ISBN** 978-0-7167-3597-7 978-0-7167-3118-4 978-0-7167-3347-8  
**Edition** 3rd print  
**# of Pages** 675  
**Date Added** 2/26/2022, 8:38:01 PM  
**Modified** 2/26/2022, 8:38:01 PM

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## Microbiology/Infectious Diseases - YouTube

**Type** Web Page  
**Abstract** Gaudeix dels vídeos i la música que més t'agraden, penja contingut original i comparteix-lo amb els amics, la família i la resta del món a YouTube.  
**Date** 1970-1-1  
**Language** ca-ES  
**URL** [https://www.youtube.com/playlist?list=PLybg94GvOJ9HH55nqS\\_y\\_0ryk3foJ3kSX](https://www.youtube.com/playlist?list=PLybg94GvOJ9HH55nqS_y_0ryk3foJ3kSX)  
**Accessed** 11/29/2021, 7:18:48 PM  
**Date Added** 11/29/2021, 7:18:48 PM  
**Modified** 9/14/2022, 6:19:27 PM

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## Microbiología médica

**Type** Book  
**Author** Patrick R Murray  
**Author** Ken S Rosenthal  
**Author** Michael A Pfaller  
**Date** 2013  
**Language** Spanish  
**Short Title** Microbiología  
**Library Catalog** Open WorldCat  
**Extra** OCLC: 892210203  
**Place** Barcelona  
**Publisher** Elsevier  
**ISBN** 978-84-9022-411-3  
**Date Added** 6/16/2022, 9:08:02 AM  
**Modified** 6/16/2022, 9:08:26 AM

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## Mejora de la bioseguridad en los laboratorios

**Type** Report  
**Author** 74 Asamblea Mundial de la Salud  
**Date** 2021  
**Language** es  
**Library Catalog** WHO IRIS  
**URL** <https://apps.who.int/iris/handle/10665/358274>  
**Accessed** 9/25/2022, 1:02:34 PM  
**Extra** Section: 7 p. A74/18  
**Place** Ginebra  
**Institution** Organización Mundial de la Salud  
**Date Added** 9/25/2022, 1:02:34 PM  
**Modified** 9/25/2022, 1:02:34 PM

### Tags:

Containment of Biohazards, Laboratories, Laboratory Infection, Safety Management

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## Manual práctico de microbiología

**Type** Book  
**Author** Carlos Gamazo  
**Author** Ramón Díaz  
**Author** Ignacio López-Goñi  
**Date** 2010  
**Language** Spanish  
**Short Title** Manual práctico de microbiología  
**Library Catalog** Open WorldCat

**Extra** OCLC: 1025661170  
**Place** Barcelona  
**Publisher** Elsevier Masson  
**ISBN** 978-84-458-1519-9  
**Date Added** 11/30/2021, 7:52:51 PM  
**Modified** 12/3/2021, 10:07:48 PM

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## Light microscopy in biology: a practical approach

**Type** Book  
**Editor** Alan J. Lacey  
**Date** 1999  
**Language** eng  
**Short Title** Light microscopy in biology  
**Library Catalog** K10plus ISBN  
**Place** Oxford  
**Publisher** Oxford Univ. Press  
**ISBN** 978-0-19-963669-3 978-0-19-963670-9  
**Series** The practical approach series  
**Series Number** 195  
**Edition** 2. ed  
**# of Pages** 452  
**Date Added** 2/26/2022, 8:37:44 PM  
**Modified** 2/26/2022, 8:37:44 PM

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## Laboratory testing for the monkeypox virus: interim guidance, 23 May 2022

**Type** Report  
**Author** World Health Organization  
**Date** 2022  
**Language** en  
**Short Title** Laboratory testing for the monkeypox virus  
**Library Catalog** WHO IRIS  
**URL** <https://apps.who.int/iris/handle/10665/354488>  
**Accessed** 9/25/2022, 1:02:33 PM  
**Extra** Section: 6 p. WHO/MPX/Laboratory/2022.1  
**Place** Geneva  
**Institution** World Health Organization  
**Date Added** 9/25/2022, 1:02:34 PM  
**Modified** 9/25/2022, 1:02:34 PM

### Tags:

Laboratories, diagnosis, Diagnostic Techniques and Procedures, Disease Outbreaks, Guideline, Monkeypox, Monkeypox virus

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## Laboratory notebook · Benchling

**Type** Web Page  
**Abstract** Use Benchling's DNA editor to create your sequences.  
**Date** 1970-1-1  
**URL** <https://benchling.com/s/etr-sGhwNi3thI69pBb3Gw1g/edit?m=slm-1ZNe5iE4Txvx812cVgxw>  
**Accessed** 2/1/2022, 12:45:34 PM  
**Date Added** 2/28/2022, 12:50:44 PM  
**Modified** 9/14/2022, 6:19:46 PM

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## Laboratory biosafety manual

**Type** Book  
**Author** World Health Organization  
**Date** 2020  
**Language** en  
**Library Catalog** WHO IRIS  
**URL** <https://apps.who.int/iris/handle/10665/337956>  
**Accessed** 9/25/2022, 1:02:33 PM  
**Extra** Section: The Portuguese version is published by PAHO: <https://iris.paho.org/handle/10665.2/54521>  
**Place** Geneva  
**Publisher** World Health Organization

**ISBN** 978-92-4-001131-1  
**Series** Laboratory biosafety manual, fourth edition and associated monographs;  
**Edition** 4th ed  
**# of Pages** 101  
**Date Added** 9/25/2022, 1:02:34 PM  
**Modified** 9/25/2022, 1:02:34 PM

**Tags:**

Containment of Biohazards, Laboratories, Laboratory Infection, methods, Handbook, standards

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Joint external evaluation tool: International Health Regulations (2005)

**Type** Book  
**Author** World Health Organization  
**Date** 2022  
**Language** en  
**Short Title** Joint external evaluation tool  
**Library Catalog** WHO IRIS  
**URL** <https://apps.who.int/iris/handle/10665/357087>  
**Accessed** 9/25/2022, 1:02:33 PM  
**Extra** Section: v, 132 p.  
**Place** Geneva  
**Publisher** World Health Organization  
**ISBN** 978-92-4-005198-0  
**Edition** 3rd ed  
**Date Added** 9/25/2022, 1:02:34 PM  
**Modified** 9/25/2022, 1:02:34 PM

**Tags:**

Disease Outbreaks, Communicable Disease Control, Disease Notification, International Cooperation, International Health Regulations, Program Evaluation

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Interaction between Streptococcus pneumoniae and Staphylococcus aureus Generates ·OH Radicals That Rapidly Kill Staphylococcus aureus Strains

**Type** Web Page  
**Date** 1970-1-1  
**Language** en  
**URL** <https://journals.asm.org/doi/epub/10.1128/JB.00474-19>  
**Accessed** 12/15/2021, 6:29:46 PM  
**Extra** DOI: 10.1128/JB.00474-19 PMCID: PMC6779455 PMID: 31405914  
**Date Added** 12/15/2021, 6:29:46 PM  
**Modified** 9/26/2022, 6:37:08 PM

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Immunology - YouTube

**Type** Web Page  
**Date** multiple  
**Language** ca-ES  
**URL** <https://www.youtube.com/>  
**Accessed** 11/29/2021, 7:17:44 PM  
**Date Added** 11/29/2021, 7:17:44 PM  
**Modified** 9/23/2022, 6:11:54 PM

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How a long-forgotten virus could help us solve the antibiotics crisis | Alexander Belcredi

**Type** Video Recording  
**Director** TED  
**Abstract** Viruses have a bad reputation -- but some of them could one day save your life, says biotech entrepreneur Alexander Belcredi. In this fascinating talk, he introduces us to phages, naturally-occurring viruses that hunt and kill harmful bacteria with deadly precision, and shows how these once-forgotten organisms could provide new hope against the growing threat of antibiotic-resistant superbugs. Check out more TED Talks: <http://www.ted.com> The TED Talks channel features the best talks and performances from the TED Conference, where the world's leading thinkers and doers give the talk of their lives in 18 minutes (or less). Look for talks on Technology, Entertainment and Design -- plus science, business, global issues, the arts and more. Follow TED on Twitter: <http://www.twitter.com/TEDTalks> Like TED on Facebook: <https://www.facebook.com/TED> Subscribe to our channel: <https://www.youtube.com/TED>  
**Date** 2018

**Library Catalog** YouTube**URL** <https://www.youtube.com/watch?v=tFFYh9THuGo>**Accessed** 11/27/2021, 3:27:26 PM**Running Time** 11:13**Date Added** 11/27/2021, 3:27:26 PM**Modified** 11/27/2021, 3:27:26 PM**Highly accurate protein structure prediction with AlphaFold****Type** Journal Article**Author** John Jumper**Author** Richard Evans**Author** Alexander Pritzel**Author** Tim Green**Author** Michael Figurnov**Author** Olaf Ronneberger**Author** Kathryn Tunyasuvunakool**Author** Russ Bates**Author** Augustin Žídek**Author** Anna Potapenko**Author** Alex Bridgland**Author** Clemens Meyer**Author** Simon A A Kohl**Author** Andrew J Ballard**Author** Andrew Cowie**Author** Bernardino Romera-Paredes**Author** Stanislav Nikolov**Author** Rishabh Jain**Author** Jonas Adler**Author** Trevor Back**Author** Stig Petersen**Author** David Reiman**Author** Ellen Clancy**Author** Michał Zieliński**Author** Martin Steinegger**Author** Michał Pacholska**Author** Tamas Berghammer**Author** Sebastian Bodenstein**Author** David Silver**Author** Oriol Vinyals**Author** Andrew W Senior**Author** Koray Kavukcuoglu**Author** Pushmeet Kohli**Author** Demis Hassabis**Date** 2021**Volume** 596**Pages** 583–589**Publication** Nature**DOI** 10/gk7nfp**Issue** 7873**Date Added** 12/15/2021, 6:21:45 PM**Modified** 9/26/2022, 6:36:45 PM**Guidance framework for testing genetically modified mosquitoes****Type** Book**Author** World Health Organization**Date** 2021**Language** en**Library Catalog** WHO IRIS**URL** <https://apps.who.int/iris/handle/10665/341370>**Accessed** 9/25/2022, 1:02:33 PM**Extra** Section: xxvi, 165 p.**Place** Geneva**Publisher** World Health Organization**ISBN** 978-92-4-002523-3**Edition** 2nd ed**Date Added** 9/25/2022, 1:02:34 PM**Modified** 9/25/2022, 1:02:34 PM

**Tags:**

Animals, Genetically Modified, Dengue, genetics, Insect Vectors, Malaria, methods, Mosquito Control, prevention and control

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## Google Colaboratory - Alpha Fold 2

**Type** Web Page  
**Date** 1970-1-1  
**Language** en  
**URL** <https://colab.research.google.com/github/sokrypton/ColabFold/blob/main/AlphaFold2.ipynb#scrollTo=kOblAo-xetgx>  
**Accessed** 12/14/2021, 8:47:37 AM  
**Date Added** 12/14/2021, 8:47:37 AM  
**Modified** 9/14/2022, 6:19:07 PM

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## GMS: Annual Global Temperature, 1880-2015

**Type** Web Page  
**Author** NASA's GMS  
**Abstract** Earth's 2015 surface temperatures were the warmest since modern record keeping began in 1880, continuing a long-term warming trend. Most of the warming occurred in the past 35 years, with 15 of the 16 warmest years on record occurring since 2001. Last year was the first time the global average temperatures were more than 1 degree Celsius above the 1880-1899 average, a change largely driven by increased carbon dioxide and other human-made emissions into the atmosphere.  
**Date** 2016-01-20  
**Language** en  
**Short Title** GMS  
**URL** <https://svs.gsfc.nasa.gov/12133>  
**Accessed** 9/23/2022, 3:50:52 AM  
**Date Added** 9/23/2022, 3:50:52 AM  
**Modified** 9/23/2022, 3:50:52 AM

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## Global guidance framework for the responsible use of the life sciences: mitigating biorisks and governing dual-use research

**Type** Book  
**Author** World Health Organization  
**Date** 2022  
**Language** en  
**Short Title** Global guidance framework for the responsible use of the life sciences  
**Library Catalog** WHO IRIS  
**URL** <https://apps.who.int/iris/handle/10665/362313>  
**Accessed** 9/25/2022, 1:02:33 PM  
**Place** Geneva  
**Publisher** World Health Organization  
**ISBN** 978-92-4-005610-7  
**Date Added** 9/25/2022, 1:02:34 PM  
**Modified** 9/25/2022, 1:02:34 PM

**Tags:**

Research, Risk Management, Biological Science Disciplines, Biosecurity

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## Generating Triangulated Macromolecular Surfaces by Euclidean Distance Transform

**Type** Journal Article  
**Author** Dong Xu  
**Author** Yang Zhang  
**Editor** Markus J. Buehler  
**Date** 2009-12-2  
**Language** en  
**Library Catalog** DOL.org (Crossref)  
**URL** <https://dx.plos.org/10.1371/journal.pone.0008140>  
**Accessed** 12/14/2021, 12:15:46 PM  
**Volume** 4  
**Pages** e8140  
**Publication** PLoS ONE  
**DOI** 10/d6tf9f  
**Issue** 12  
**Journal Abbr** PLoS ONE

## Fundamentos del proceso de fermentación en el beneficio del café

Type Journal Article  
Author Gloria Inés Puerta Quintero  
Date 2012  
Series Title FNCC  
Publication Avances técnicos Cenicafé  
ISSN 0120-0178  
Date Added 8/9/2022, 11:09:32 AM  
Modified 8/9/2022, 11:13:19 AM

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Fig. 2. Effect of temperature on the growth of S. aureus.

Type Web Page  
Abstract Download scientific diagram | Effect of temperature on the growth of S. aureus. from publication: Characterization of a Thermostable Alkaline Protease from *Staphylococcus aureus* S-2 Isolated from Chicken Waste | In this study, the protease producing bacterium was isolated from chicken waste and characterized as *Staphylococcus aureus* through 16S rRNA ribotyping. The protease from *S. aureus* S-2 showed maximum activity of 360 U/mL. *S. aureus* S-2 showed optimum growth at 37°C and pH 7.... | Proteases, *Staphylococcus* Aureus and Azocasein | ResearchGate, the professional network for scientists.  
Date 2022-9-25  
Language en  
URL [https://www.researchgate.net/figure/Effect-of-temperature-on-the-growth-of-S-aureus\\_fig6\\_266137314](https://www.researchgate.net/figure/Effect-of-temperature-on-the-growth-of-S-aureus_fig6_266137314)  
Accessed 9/25/2022, 8:05:21 PM  
Website Title ResearchGate  
Date Added 9/25/2022, 8:05:21 PM  
Modified 9/26/2022, 12:03:37 PM

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## Estimating National Trends in Inpatient Antibiotic Use Among US Hospitals From 2006 to 2012

Type Journal Article  
Author James Baggs  
Author Scott K. Fridkin  
Author Lori A. Pollack  
Author Arjun Srinivasan  
Author John A. Jernigan  
Abstract The rising threat of antibiotic resistance and other adverse consequences resulting from the misuse of antibiotics requires a better understanding of antibiotic use in hospitals in the United States. To use proprietary administrative data to estimate patterns of US inpatient antibiotic use in recent years. For this retrospective analysis, adult and pediatric in-patient antibiotic use data was obtained from the Truven Health MarketScan Hospital Drug Database (HDD) from January 1, 2006, to December 31, 2012. Data from adult and pediatric patients admitted to 1 of approximately 300 participating acute care hospitals provided antibiotic use data for over 34 million discharges representing 166 million patient-days. We retrospectively estimated the days of therapy (DOT) per 1000 patient-days and the proportion of hospital discharges in which a patient received at least 1 dose of an antibiotic during the hospital stay. We calculated measures of antibiotic usage stratified by antibiotic class, year, and other patient and facility characteristics. We used data submitted to the Centers for Medicare and Medicaid Services Healthcare Cost Report Information System to generate estimated weights to apply to the HDD data to create national estimates of antibiotic usage. A multivariate general estimating equation model to account for interhospital covariance was used to assess potential trends in antibiotic DOT over time. During the years 2006 to 2012, 300 to 383 hospitals per year contributed antibiotic data to the HDD. Across all years, 55.1% of patients received at least 1 dose of antibiotics during their hospital visit. The overall national DOT was 755 per 1000 patient-days. Overall antibiotic use did not change significantly over time. The multivariable trend analysis of data from participating hospitals did not show a statistically significant change in overall use (total DOT increase, 5.6; 95% CI, -18.9 to 30.1; P = .65). However, the mean change (95% CI) for the following antibiotic classes increased significantly: third- and fourth-generation cephalosporins, 10.3 (3.1-17.5); macrolides, 4.8 (2.0-7.6); glycopeptides, 22.4 (17.5-27.3); β-lactam/β-lactamase inhibitor combinations, 18.0 (13.3-22.6); carbapenems, 7.4 (4.6-10.2); and tetracyclines, 3.3 (2.0-4.7). Overall DOT of all antibiotics among hospitalized patients in US hospitals has not changed significantly in recent years. Use of some antibiotics, especially broad spectrum agents, however, has increased significantly. This trend is worrisome in light of the rising challenge of antibiotic resistance. Our findings can help inform national efforts to improve antibiotic use by suggesting key targets for improvement interventions.  
Date 2016-11-01  
Library Catalog Silverchair  
URL <https://doi.org/10.1001/jamainternmed.2016.5651>  
Accessed 9/23/2022, 3:41:03 AM  
Volume 176  
Pages 1639-1648  
Publication JAMA Internal Medicine  
DOI 10/ggqsvf  
Issue 11  
Journal Abbr JAMA Internal Medicine  
ISSN 2168-6106  
Date Added 9/23/2022, 3:41:04 AM

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## Enhancement of laboratory biosafety

**Type** Report  
**Author** 74 World Health Assembly  
**Date** 2021  
**Language** en  
**Library Catalog** WHO IRIS  
**URL** <https://apps.who.int/iris/handle/10665/358263>  
**Accessed** 9/25/2022, 1:02:33 PM  
**Extra** Section: 6 p. A74/18  
**Place** Geneva  
**Institution** World Health Organization  
**Date Added** 9/25/2022, 1:02:34 PM  
**Modified** 9/25/2022, 1:02:34 PM

**Tags:**

Containment of Biohazards, Laboratories, Laboratory Infection, Safety Management

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## Dorlands Medical Dictionary:disease

**Type** Web Page  
**Date** 2010-04-11  
**Short Title** Dorlands Medical Dictionary  
**URL** [https://web.archive.org/web/20100411075617/http://www.mercksource.com/pp/us/cns/cns\\_hl\\_dorlands\\_split.jsp?pg=/ppdocs/us/common/dorlands/dorland/three/000030493.htm](https://web.archive.org/web/20100411075617/http://www.mercksource.com/pp/us/cns/cns_hl_dorlands_split.jsp?pg=/ppdocs/us/common/dorlands/dorland/three/000030493.htm)  
**Accessed** 6/18/2022, 10:20:50 AM  
**Date Added** 6/18/2022, 10:20:50 AM  
**Modified** 6/18/2022, 10:20:50 AM

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## Disinfection effects of undoped and silver-doped ceria powders of nanometer crystallite size

**Type** Journal Article  
**Author** Tzu-Sen Yang  
**Author** Dah-Shyang Tsai  
**Author** Yu-Sheng Huang  
**Author** Pei-Wen Peng  
**Author** Keng-Liang Ou  
**Abstract** Being endowed with an ability of capturing and releasing oxygen, the ceria surface conventionally assumes the role of catalyzing redox reactions in chemistry. This catalytic effect also makes possible its cytotoxicity toward microorganisms at room temperature. To study this cytotoxicity, we synthesized the doped and undoped ceria particles of 8-9 nm in size using an inexpensive precipitation method and evaluated their disinfecting aptitudes with the turbidimetric and plate count methods. Among the samples being analyzed, the silver-doped ceria exhibits the highest sterilization ability, yet the undoped ceria is the most intriguing. The disinfection effect of undoped ceria is moderate in magnitude, demanding a physical contact between the ceria surface and bacteria cell wall, or the redox catalysis that can damage the cell wall and result in the cell killing. Evidently, this effect is short-range and depends strongly on dispersion of the nanoparticles. In contrast, the disinfection effects of silver-doped ceria reach out several millimeters since it releases silver ions to poison the surrounding microorganisms. Additionally, the aliovalent silver substitution creates more ceria defects. The synergistic combination, silver poisoning and heterogeneous redox catalysis, lifts and extends the disinfecting capability of silver-doped ceria to a superior level.  
**Date** 2016-06-01

**Library Catalog** ResearchGate  
**Volume** 11  
**Pages** 2531  
**Publication** International Journal of Nanomedicine  
**DOI** 10/f8p99f  
**Journal Abbr** International Journal of Nanomedicine  
**Date Added** 9/23/2022, 3:54:32 AM  
**Modified** 9/26/2022, 6:36:43 PM

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## Diccionari enciclopèdic de medicina (DEMCAT). Versió de treball | TERMCAT

**Type** Web Page  
**Date** 1970-1-1  
**URL** <https://www.termcat.cat/ca/diccionaris-en-linia/183>  
**Accessed** 6/20/2022, 9:24:49 AM  
**Date Added** 6/20/2022, 9:24:49 AM  
**Modified** 9/14/2022, 6:19:27 PM

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## Definition of PREVALENCE

**Type** Web Page  
**Abstract** the quality or state of being prevalent; the degree to which something is prevalent; especially : the percentage of a population that is affected with a particular disease at a given time... See the full definition  
**Date** 1970-1-1  
**Language** en  
**URL** <https://www.merriam-webster.com/dictionary/prevalence>  
**Accessed** 9/22/2022, 6:05:13 PM  
**Date Added** 9/22/2022, 6:05:13 PM  
**Modified** 9/22/2022, 6:05:15 PM

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Combination of pre-adapted bacteriophage therapy and antibiotics for treatment of fracture-related infection due to pandrug-resistant Klebsiella pneumoniae

**Type** Journal Article  
**Author** Anaïs Eskenazi  
**Author** Cédric Lood  
**Author** Julia Wubbolds  
**Author** Maya Hites  
**Author** Nana Balarjishvili  
**Author** Lika Leshkasheli  
**Author** Lia Askilashvili  
**Author** Leila Kvachadze  
**Author** Vera van Noort  
**Author** Jeroen Wagemans  
**Author** Marc Jayankura  
**Author** Nina Chanishvili  
**Author** Mark de Boer  
**Author** Peter Nibbering  
**Author** Mzia Kutateladze  
**Author** Rob Lavigne  
**Author** Maya Merabishvili  
**Author** Jean-Paul Pirnay  
**Abstract** Abstract A 30-year-old bombing victim with a fracture-related pandrug-resistant Klebsiella pneumoniae infection after long-term (>700 days) antibiotic therapy is treated with a pre-adapted bacteriophage along with meropenem and colistin, followed by ceftazidime/avibactam. This salvage therapy results in objective clinical, microbiological and radiological improvement of the patient's wounds and overall condition. In support, the bacteriophage and antibiotic combination is highly effective against the patient's K. pneumoniae strain in vitro, in 7-day mature biofilms and in suspensions.  
**Date** 12/2022  
**Language** en  
**Library Catalog** DOI.org (Crossref)  
**URL** <https://www.nature.com/articles/s41467-021-27656-z>  
**Accessed** 7/27/2022, 11:27:22 AM  
**Volume** 13  
**Pages** 302  
**Publication** Nature Communications  
**DOI** 10/hdbt  
**Issue** 1  
**Journal Abbr** Nat Commun  
**ISSN** 2041-1723  
**Date Added** 7/27/2022, 11:27:22 AM  
**Modified** 9/26/2022, 6:36:43 PM

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Case report of laboratory-acquired vaccinia virus infection in India – Cas d'infection en laboratoire par le virus de la vaccine en Inde

**Type** Journal Article  
**Author** World Health Organization = Organisation mondiale de la Santé  
**Date** 2021-02-05  
**Language** en  
**Library Catalog** WHO IRIS  
**URL** <https://apps.who.int/iris/handle/10665/339331>  
**Accessed** 9/25/2022, 1:02:33 PM  
**Extra** Place: Geneva = Genève Publisher: World Health Organization = Organisation mondiale de la Santé Section: 7 p  
**Volume** 96  
**Pages** 33-39  
**Publication** Weekly Epidemiological Record = Relevé épidémiologique hebdomadaire

**Issue** 05/06  
**Date Added** 9/25/2022, 1:02:34 PM  
**Modified** 9/26/2022, 6:36:47 PM

**Tags:**

— No DOI found, Smallpox, Vaccinia virus, variola

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## Bioinformatics: sequence and genome analysis

**Type** Book  
**Author** David W. Mount  
**Date** 2004  
**Short Title** Bioinformatics  
**Library Catalog** Library of Congress ISBN  
**Call Number** QH441.2 .M68 2004  
**Place** Cold Spring Harbor, N.Y  
**Publisher** Cold Spring Harbor Laboratory Press  
**ISBN** 978-0-87969-687-0 978-0-87969-712-9  
**Edition** 2nd ed  
**# of Pages** 692  
**Date Added** 2/26/2022, 8:38:15 PM  
**Modified** 2/26/2022, 8:38:15 PM

**Tags:**

Data processing, Amino acid sequence, Bioinformatics, Genetics, Nucleotide sequence

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## Biochemistry for dummies

**Type** Book  
**Author** John T. Moore  
**Author** Richard Langley  
**Date** 2011  
**Library Catalog** Library of Congress ISBN  
**Call Number** QP514.2 .M66 2011  
**Extra** OCLC: ocn697774569  
**Place** Hoboken, NJ  
**Publisher** Wiley Pub  
**ISBN** 978-1-118-02174-3  
**Series** --For dummies  
**Edition** 2nd ed  
**# of Pages** 340  
**Date Added** 2/28/2022, 12:50:44 PM  
**Modified** 2/28/2022, 12:50:44 PM

**Tags:**

Biochemistry

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## Biochemical Tests For Streptococcus pneumoniae | Bacteriology Notes

**Type** Web Page  
**Author** SAHIL BATRA  
**Abstract** Below is the list of these Enzymatic Reactions and various other biochemical tests for Streptococcus pneumoniae which have great importance in research and for knowledge but are not routinely employed:  
**Date** 2018-09-01T05:30:00+00:00  
**Language** en-US  
**URL** <https://paramedicsworld.com/streptococcus-pneumoniae-pneumococcus/biochemical-tests-for-streptococcus-pneumoniae/medical-paramedical-studynotes>  
**Accessed** 7/19/2022, 10:21:44 AM  
**Website Title** Paramedics World  
**Date Added** 7/19/2022, 10:21:44 AM  
**Modified** 7/19/2022, 10:21:44 AM

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## Biochemical Tests for Staphylococcus Aureus | Bacteriology Notes

**Type** Web Page

**Author** SAHIL BATRA

**Abstract** There are so many biochemical tests for *Staphylococcus aureus* but a few reactions are most commonly used and are medically important for distinguishing pathogenic *staphylococcus* i.e. *S. aureus* from other non- pathogenic *Staphylococci* which are as.....  
Biochemical tests *staphylococcus aureus*

**Date** 2018-09-06T17:08:52+00:00

**Language** en-US

**URL** <https://paramedicsworld.com/staphylococcus-aureus/biochemical-tests-staphylococcus-aureus/medical-paramedical-studynotes>

**Accessed** 7/19/2022, 10:21:41 AM

**Website Title** Paramedics World

**Date Added** 7/19/2022, 10:21:41 AM

**Modified** 7/19/2022, 10:21:41 AM

---

## BAM Chapter 12: *Staphylococcus aureus*

**Type** Journal Article

**Author** Center for Food Safety and Applied Nutrition

**Abstract** FDA's Bacteriological Analytical Manual (the BAM) is the agency's preferred laboratory procedures for the detection in food and cosmetic products of pathogens (bacterial, viral, parasitic, plus yeast and mold) and of microbial toxins.

**Date** Wed, 05/13/2020 - 17:33

**Language** en

**Short Title** BAM Chapter 12

**Library Catalog** www.fda.gov

**URL** <https://www.fda.gov/food/laboratory-methods-food/bam-chapter-12-staphylococcus-aureus>

**Accessed** 9/23/2022, 3:45:30 AM

**Extra** Publisher: FDA

**Publication** FDA

**Date Added** 9/23/2022, 3:45:30 AM

**Modified** 9/26/2022, 6:36:44 PM

### Tags:

No DOI found

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## BAIRD-PARKER Agar (Staphylococcus Selective Agar Base acc. to BAIRD-PARKER)

**Type** Web Page

**Date** 2008-05-01

**URL** [https://web.archive.org/web/20080501041929/http://www.emdchemicals.com/analytics/Micro\\_Manual/TEDISdata/prods/1\\_05406\\_0500.html](https://web.archive.org/web/20080501041929/http://www.emdchemicals.com/analytics/Micro_Manual/TEDISdata/prods/1_05406_0500.html)

**Accessed** 9/26/2022, 2:00:15 AM

**Date Added** 9/26/2022, 2:00:15 AM

**Modified** 9/26/2022, 2:00:15 AM

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## Apoptosis induced by *Staphylococcus aureus* toxins

**Type** Journal Article

**Author** Xiaopeng Zhang

**Author** Xiaomei Hu

**Author** Xiancai Rao

**Abstract** Apoptosis stimulated by bacterial toxins is common during infection and is now considered important in disease processes. As a major human pathogen, *Staphylococcus aureus* also causes apoptosis during infection. In some diseases such as atopic dermatitis and sepsis, the apoptosis induced by *S. aureus* influences the severity and outcome of diseases. *S. aureus* has various toxins, many of which have reportedly triggered apoptosis. In this review, we focused on the apoptosis-inducing toxins secreted by *S. aureus*, and their underlying mechanisms. Novel therapies for cancer that utilized the reconstructed *S. aureus* toxins were also discussed.

**Date** 2017-12

**Language** eng

**Library Catalog** PubMed

**Extra** PMID: 28942840

**Volume** 205

**Pages** 19-24

**Publication** Microbiological Research

**DOI** 10/gcf5pm

**Journal Abbr** Microbiol Res

**ISSN** 1618-0623

**Date Added** 2/27/2022, 9:36:01 AM

**Modified** 9/26/2022, 6:36:43 PM

### Tags:

Analyses en laboratoire pour la détection du virus de la variole du singe (orthopoxvirose simienne) : orientations provisoires, 23 mai 2022

**Type** Report  
**Author** Organisation mondiale de la Santé  
**Date** 2022  
**Language** fr  
**Short Title** Analyses en laboratoire pour la détection du virus de la variole du singe (orthopoxvirose simienne)  
**Library Catalog** WHO IRIS  
**URL** <https://apps.who.int/iris/handle/10665/358179>  
**Accessed** 9/25/2022, 1:02:33 PM  
**Extra** Section: 7 p. WHO/MPX/Laboratory/2022.1  
**Place** Genève  
**Institution** Organisation mondiale de la Santé  
**Date Added** 9/25/2022, 1:02:34 PM  
**Modified** 9/25/2022, 1:02:34 PM

**Tags:**

Laboratories, diagnosis, Diagnostic Techniques and Procedures, Disease Outbreaks, Guideline, Monkeypox, Monkeypox virus

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A review on nanosystems as an effective approach against infections of *Staphylococcus aureus*

**Type** Journal Article  
**Author** Kaixiang Zhou  
**Author** Chao Li  
**Author** Dongmei Chen  
**Author** Yuanhu Pan  
**Author** Yanfei Tao  
**Author** Wei Qu  
**Author** Zhenli Liu  
**Author** Xiaofang Wang  
**Author** Shuyu Xie  
**Abstract** *Staphylococcus aureus* (*S. aureus*) is an important zoonotic bacteria and hazardous for the health of human beings and livestock globally. The characteristics like biofilm forming, facultative intracellular survival, and growing resistance of *S. aureus* pose a great challenge to its use in therapy. Nanoparticles are considered as a promising way to overcome the infections' therapeutic problems caused by *S. aureus*. In this paper, the present progress and challenges of nanoparticles in the treatment of *S. aureus* infection are focused on stepwise. First, the survival and infection mechanism of *S. aureus* are analyzed. Second, the treatment challenges posed by *S. aureus* are provided, which is followed by the third step including the advantages of nanoparticles in improving the penetration and accumulation ability of their payload antibiotics into cell, inhibiting *S. aureus* biofilm formation, and enhancing the antibacterial activity against resistant isolates. Finally, the challenges and future perspective of nanoparticles for *S. aureus* infection therapy are introduced. This review will help the readers to realize that the nanosystems can effectively fight against the *S. aureus* infection by inhibiting biofilm formation, enhancing intracellular delivery, and improving activity against methicillin-resistant *S. aureus* and small colony variant phenotypes as well as aim to help researchers looking for more efficient nano-systems to combat the *S. aureus* infections.  
**Date** 2018  
**Language** eng  
**Library Catalog** PubMed  
**Extra** PMID: 30519018 PMCID: PMC6233487  
**Volume** 13  
**Pages** 7333-7347  
**Publication** International Journal of Nanomedicine  
**DOI** 10/gfp2z2  
**Journal Abbr** Int J Nanomedicine  
**ISSN** 1178-2013  
**Date Added** 2/27/2022, 9:35:59 AM  
**Modified** 9/26/2022, 6:36:42 PM

**Tags:**

Animals, Anti-Bacterial Agents, antibiotics, Biofilms, Humans, infection mechanism, Methicillin-Resistant *Staphylococcus aureus*, nanoparticles, Nanoparticles, resistance, Staphylococcal Infections, *Staphylococcus aureus*