

Analyzing the Carriage Rate of the SPA Toxin Gene Among Healthcare Workers and Non-Healthcare Workers

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Abstract

Staphylococcus aureus is a commensal, opportunistic pathogen that can be commonly found in nasal mucosa and is associated with diseases like Toxic Shock Syndrome and Septic Arthritis. Within this study, nasal swabs from the CSP community were taken in order to be isolated for *S. aureus* to figure out what proportion of the population carries *S. aureus* in their nasal microbiome. From that point the isolated *S. aureus* can be characterized for many different traits, one being the presence of the SPA toxin gene. It was found that out of the 142 *S. aureus* samples that were genetically sequenced the carriage rate of the SPA protein gene is 8% higher in healthcare workers compared to nonhealthcare workers.

Background Information

S. aureus is a common commensal bacteria which often colonizes the nasal mucosa. However, *S. aureus* is an opportunistic bacteria which can lead to many serious health conditions like Toxic Shock Syndrome Septic Arthritis, and Osteomyelitis. This is because *S. aureus* has many virulence factors that help *S. aureus* survive in the human body. One important virulence factors for osteomyelitis is the spa protein. In order to have a complete understanding of the carriage rate of *S. aureus* and its different virulence factor genes like SPA this staph study is being preformed. In this study the first thing that is done is collecting samples of nasal microbiomes from willing participants. These samples are then streaked on to a MSA plate to be grown and isolated to single bacterial strain (figure 2 describes this process). After a bacterial strain is isolated, it then undergoes a series of tests to determine if this isolated strain is *S. aureus*. The tests used determine if the isolated strain is a mannitol fermenter, beta hemolysis positive, catalase positive, DNase positive, coagulase positive, and is a gram-positive cocci that grows in clusters. Once *S. aureus* is isolated it can be further characterized through more tests and it can be genetically sequenced to figure out specific traits like if that strain of bacteria has the SPA protein gene.

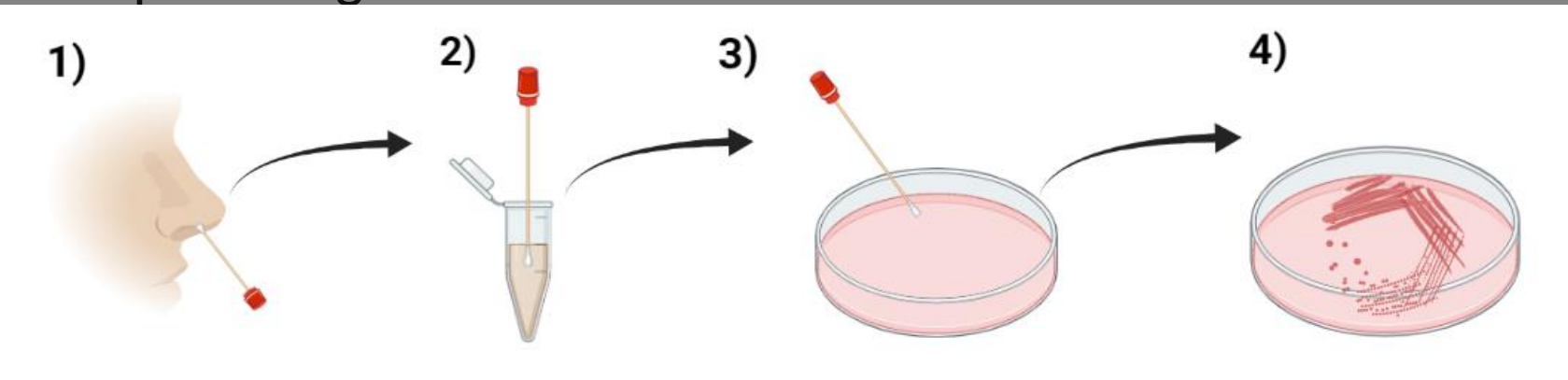


Figure 2. Collection of nasal swabs and isolating them for *Staphylococcus aureus*. 1) The first step to isolating *Staphylococcus aureus* is to obtain nasal swabs from willing participants. 2) those nasal swab are to place into TSB media to let them grow. 3) That growth is streaked onto a MSA plate. 4) If something grows on the MSA plate then the bacteria is continuously streaked onto MSA plates until a single strain of bacteria is on the plate. Once that is achieved then that isolated strain of bacteria undergoes culture testing to see if it is *Staphylococcus aureus*.

The carriage rate of the SPA protein gene is 8% higher in healthcare workers versus people who do not work in healthcare.

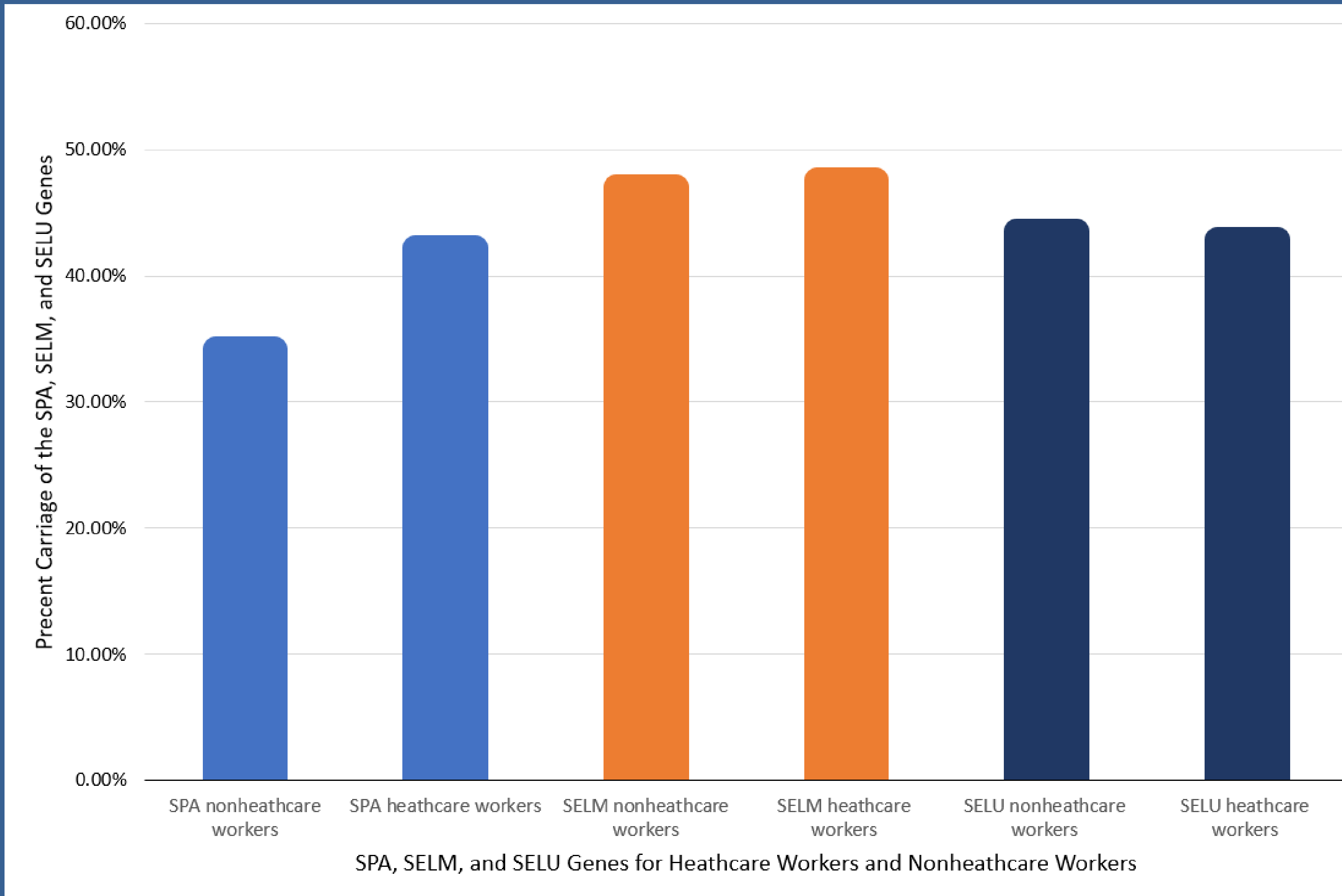


Figure 1. Percent Carriage Rate for the SPA, SPA, SELU Genes in Healthcare Workers and Nonhealthcare Workers. The carriage rates for different *Staphylococcus aureus* genes tends to be very similar between healthcare workers and nonhealthcare works. This can be seen with the genes for the toxins SELM and SELU having a one percent difference between healthcare workers and non healthcare workers. One notable difference is that the healthcare workers had a 8% high carriage rate of the SPA gene compared to nonhealthcare workers.

If Someone Does or Doesn't Carry a gene	Genes					
	SPA Healthcare Workers	SPA Nonhealthcare Workers	SELM Healthcare Workers	SELM Nonhealthcare Workers	SELU Healthcare Workers	SELU Nonhealthcare Workers
Has the gene	9	40	10	55	9	51
Does not have the gene	12	77	11	62	12	66

Table 1. Number of Healthcare Workers and Nonhealthcare Workers who carry the SPA, SELM, and SELU Genes. The raw data from figure 1. This data was obtained form the 138 *Staphylococcus aureus* stains that were genetically sequenced by the University of Minnesota.

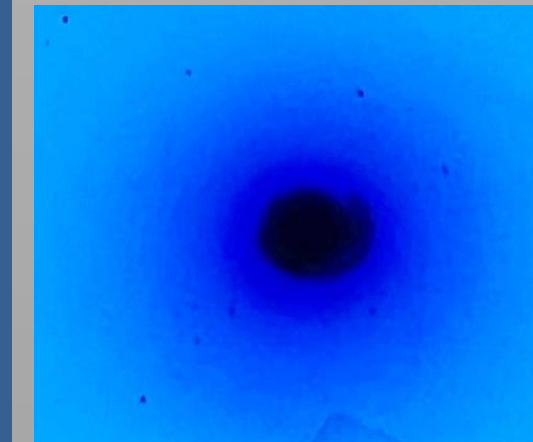
Methodology



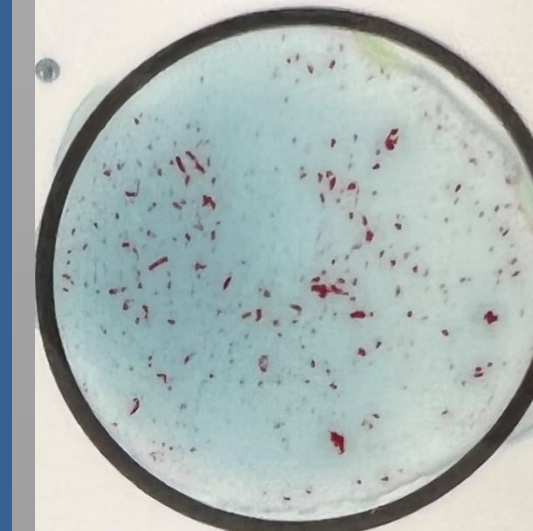
MSA: *S. aureus* is a mannitol fermenter. This occurs when *S. aureus* is streaked onto a MSA plate where it ferments the mannitol on the MSA plate turning it yellow.



CNA: *S. aureus* can lyse the blood cells in the CNA plate resulting in a yellow halo called beta hemolysis.



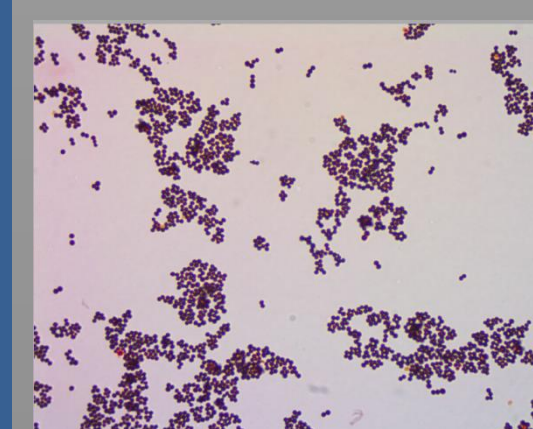
DNase: *S. aureus* has the DNase enzyme which makes it able to degrade DNA. When *S. aureus* is put onto a plate containing DNA it can degrade it leaving a visible purple halo.



Coagulase: *S. aureus* has the enzyme coagulase which can be detected by using a latex reagent. Using *S. aureus* on this reagent will lead to the aggregation of red partials and a blue background.



Catalase: *S. aureus* is a catalase positive bacteria meaning it contains the enzyme catalase. As a result of this when *S. aureus* is mixed with hydrogen peroxide bubbles are created.



Gram stain: *S. aureus* is a gram-positive cocci bacteria that grows in clusters. This is detected by preforming a gram stain

Conclusion

S. aureus is a opportunistic pathogen that can be found in the nasal mucosa of many people. *S. aureus* contains many virulence factors that help the bacteria survive and evade the human immune system. One virulence factor that plays a prominent role in the development of osteomyelitis is the spa protein. In this staph study *S. aureus* is isolated from samples of nasal mucosa from willing participants. These *S. aureus* samples where then further characterized, and it was found that the carriage rate for the SPA gene is 8% higher for healthcare workers.

Acknowledgements/ References

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 Widaa, Amro, et al. "Staphylococcus Aureus Protein A Plays a Critical Role in Mediating Bone Destruction and Bone Loss in Osteomyelitis." PLoS One, vol. 7, no. 7, Public Library of Science, 2012, pp. e40586-e40586, <https://doi.org/10.1371/journal.pone.0040586>.