# Bacterial Contamination of Cannabis Pipes and How To Avoid Sharing Germs

Published by
Moose Labs LLC May 2019

# Table of Contents

Abstract..... 3
- Hypothesis
- Method
- Testing Procedures
- Results
- Conclusion

The Study..... 5
- Introduction
- Method of Testing
- Testing Procedures
- Data & Findings
- Research on Cleaning with Rubbing Alcohol
- Context
- Conclusion

Tables & Figures..... 12
- Figure 1 - Bacteria Testing - Test 1
- Figure 2 - Bacteria Testing - Test 2
- Table 1 - Various Pipe Tests
- Table 2 - Various Surface Tests
- Table 3 - Various Consumption and Cleaning Method Tests
- Data Set

Endnotes..... 21

Acknowledgments..... 22

# Abstract

01

## Hypothesis

An excessive and harmful amount of bacteria is passed between cannabis consumers who share cannabis pipes, vaporizers, and joints both at home and at cannabis consumption events.

## Method

Using an ATP Monitoring System, various cannabis pipes, as well as neutral objects, were tested to determine the levels of bacteria present.

## Objective

To assess bacteria contamination levels of cannabis pipes, both at home and at social consumption events and determine if the use of a sanitary smoking device, such as the MouthPeace, helps prevent or stops the spread of germs.

# Testing Procedures

Testing took place at two social consumption cannabis events in California. At each event, a pipe was placed on the table and 100 participants (200 total) were asked to consume cannabis through said pipe. Using an A/B testing method against baseline results, the first 50 participants at each event were given a MouthPeace, a sanitary smoking device, and instructed to use it when smoking from the pipe. The MouthPeace device is made of silicone and provides a personal and universal mouthpiece for pipes, vaporizers, and joints, preventing direct human contact. The following 50 participants were given no instruction and were not provided MouthPeaces. At predetermined intervals the pipe's mouthpiece was swabbed, the swab was tested using the ATP Monitoring System and the results were recorded.

Additional tests were performed on randomly selected pipes, vaporizers, and joints, as well as neutral objects, such as public restroom toilet seats, ATM keypad buttons, shopping carts, etc. The latter was done to establish real-world comparisons.

# Results

An astounding level of bacteria was found on cannabis pipes, vaporizers, and joints; significantly higher than what was initially expected. In fact, it was difficult to find a neutral object in daily life that was as contaminated as **a cannabis pipe,** which **has on average, almost one and a half times more bacteria than a public toilet seat.**

It was observed that very few cannabis consumers take precautions when it comes to sharing pipes, as only 5% of participants used available alcohol wipes to clean the pipe prior to consumption. However, utilizing alcohol wipes as a quick, sanitary solution at cannabis events has been shown to be ineffective in significantly lowering the bacteria level of a cannabis pipe.

# Conclusion

Social consumption of cannabis can lead to excessive and unnecessary bacterial contamination and transfer. **Sanitary devices, such as the MouthPeace, are proven to dramatically decrease the spread and amount of bacteria on a pipe by more than 5924%.** Cannabis consumers should take precautions, especially in environments where social sharing among large groups is encouraged.

While it is true that bacteria is all around us, most people tend to take preventative measures to avoid intentional contamination. Cannabis users seem to completely disregard common sense health and safety practices when it comes to consuming cannabis both in public and privately at home. Any government or licensing board that is considering the viability of social consumption lounges or events should consider this study when implementing health and safety protocols and best practices.

# The Study

02

## Introduction

The consumption of cannabis has always been a social activity where people not only smoke and consume together, but pass a single pipe or joint around the circle from person to person. The advancement of legalized cannabis across the United States, Canada, and other countries means more people are smoking and sharing than ever before.

With this new found freedom new businesses are popping up to serve consumers, much like after prohibition ended in 1933. Cannabis lounges and events, akin to bars, wine tastings, or hookah lounges, are beginning to be permitted in major cities. Cannabis events, such as the High Times Cannabis Cup, have been taking place in increasingly visible forms since 1988. Initially, these types of cannabis events took place only once a year in places like Amsterdam or Jamaica; today large and small events occur daily across the United States. With the growth in cannabis users, and social consumption on the rise, it is important to consider the side-effects of the social consumption culture. Users are being exposed to excessive amounts of germs and bacteria from the shared devices at home, in lounges, and at cannabis consumption events.

**Until now, no research has been conducted on the topic and consumers are dangerously unaware or naive of the high levels of bacteria these cannabis devices harbor.**

A state-of-the-art ATP Monitoring instrument from Hygiena called the EnSURE Luminometer Monitoring System[1] with Super Snap Test Swabs[2] was used to measure the bacterial contamination of various pipes and other surfaces. This device is commonly utilized in the food and hospital industries to assess the bacterial contamination of surfaces in professional kitchens and on surgical equipment.

# Method of Testing

Adenosine Triphosphate (ATP) is a nucleotide present in all organic material.[3] ATP can only be produced by living organisms such that its presence is a direct indication of any and all kinds of biological matter (microorganisms, biofilm, and other biological residues) that are invisible to the naked eye.[4] It has been known for some time that ATP is proportional to bacterial contamination.[5] As such, it is a convenient way to monitor bacterial presence and growth.[6]

The Hygiena Luminometer, used in conjunction with ATP swabs, uses bioluminescence to measure a biochemical reaction that produces light in the luciferin-luciferase system.[4] Residual ATP on the swab interacts with luciferase to generate light. The luminometer system takes advantage of this biochemical reaction and reads the amount of light generated, converts it into numeric relative light units (RLUs), and displays the result on the instrument screen.

The amount of light generated is proportional to the amount of ATP present – an indication of the total biological contamination present.

For each test completed, the surface of interest is wiped thoroughly with a specially prepared swab and inserted in the luminometer.

It is a reliable test with obvious applications in rapid hygiene monitoring. In fact, an independent food testing and safety laboratory tested five commercial ATP systems and found Hygiena's products to be superior in accuracy, repeatability, sensitivity, and linearity.[7]

# Testing Procedures

Booth space was acquired at two cannabis consumption events in southern California in October and November of 2018. A standard glass pipe, used for smoking cannabis, was set up at the booth and event attendees consumed cannabis through the pipe to participate in the study.

**Round 1 of testing involved having 50 participants smoke from the pipe using their own MouthPeace, or one that was provided for them.** The only instruction given was that a MouthPeace, or similar sanitary smoking device, must be used. At predetermined intervals of participants (5,10, 20, 30, 40, 50) the pipe's mouthpiece was swabbed and tested using the calibrated luminometer. RLUs were recorded and the instrument was recalibrated for the next measurement.

**During Round 2 of testing an additional 50 participants were asked to smoke from the pipe but were not given a MouthPeace to use.** They were given no instruction and were permitted to use their own MouthPeace, if they had one. At the same predetermined intervals used in Round 1, the swabbing/ testing process was repeated.

Alcohol wipes, commonly used for disinfection, were placed in front of the pipe and made available to all test participants at all times to use at their discretion. Data from 200 participants total was collected - 100 in Test 1 at one event, and an additional 100 participants in Test 2 at another event.

Additional luminometer measurements were made to establish the level of contamination found in everyday objects, as discussed later in this study.

An additional 20 tests were performed at these events where in-use pipes were swabbed at other booths. Another 5 tests were performed on pipes that were considered "personal use" or "clean from home".

A round of neutral tests was also completed to develop a basis for comparison. This round of testing is detailed in the Common Surface Tests table and reviews items that would generally be considered unsanitary, such as public toilet seats, ATM keypad buttons, and shopping cart handles.

Many other rounds of testing were completed and are detailed with their results in the Data and Findings sections.

These tests were all completed in the same manner with the ATP Swab and luminometer testing unit.

## How We Cleaned

The pipe used in the two tests conducted at the cannabis consumption events was meticulously cleaned prior to each round, as recommended by Hygiena[8]. To clean the pipe the mouthpiece was thoroughly wiped with a 70% alcohol wipe, allowing it to air dry for 60 seconds. The mouthpiece of the pipe was then heated with a butane blow torch for 20 seconds and allowed to cool completely before starting each round of testing. As shown by the base tests conducted in each round **(Figures 1 and 2)**, the pipe is still not completely free of bacteria. This cleaning process is beyond excessive and most cannabis users would not be this thorough, particularly at a cannabis event.

# Data & Findings

Beyond initial base tests, results are immediately clear; participants that used a MouthPeace when consuming cannabis had a much lower risk of coming in contact with bacteria compared to participants that did not use a MouthPeace. Tests showed that at its highest level, **MouthPeace usage resulted in a reading of 678 RLU.** Compared to the highest reading of **non-MouthPeace usage, 8254 RLU**, using a MouthPeace clearly results in dramatically lower transmission and distribution of bacteria among cannabis consumers.

**Figure 1**

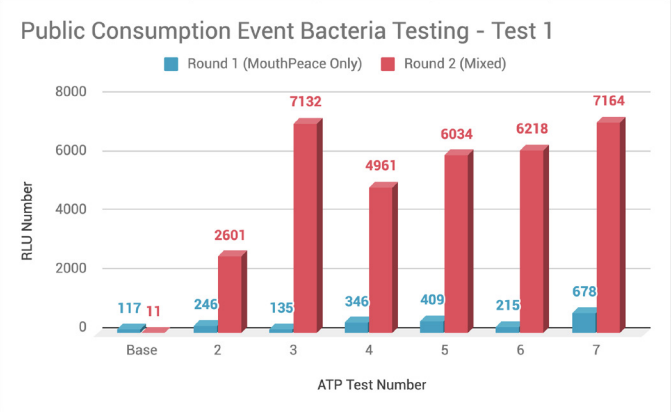
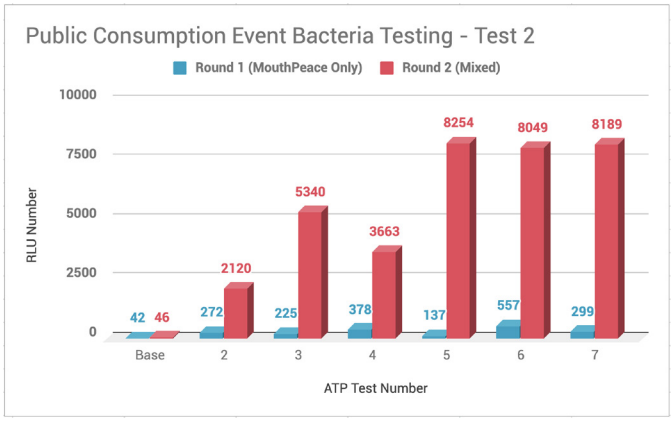



**Figure 2**




In the neutral round of testing, everyday items such as **gas station and fast food restaurant toilet seats (average 2350 RLU), dog food dishes (average 248.5 RLU), ATM keypad buttons (average 1819 RLU)** and other items generally regarded as unsanitary were tested **(for more detail see Table 2)**. Some highlights from comparing the results from the Various Pipe Tests **(Table 1)** to the Common Surface Tests **(Table 2)** are noted below.

**Surprisingly, none of the common surfaces tested harbored as much bacteria as some of the pipes tested.**

## The Average Cannabis Pipe Has:

**1304%** more bacteria than an average dog food bowl

**530%** more bacteria than an average cell phone screen

**92%** more bacteria than an average ATM keypad

**90%** more bacteria than inside an average dumpster

**62%** more bacteria than an average shopping cart handle

**49%** more bacteria than an average public toilet seat

# Data & Findings (cont.)

Additionally, **a vaporizer,** after 5 hits, **produced a 7883 RLU reading, 235% higher than the average public toilet tested.** A cannabis **joint filter tested at 8569 RLU** after being smoked from start to finish by one person. Harmful bacteria can multiply from person to person, and this information clearly shows the hazardous level of bacterial contamination associated with unprotected cannabis consumption.

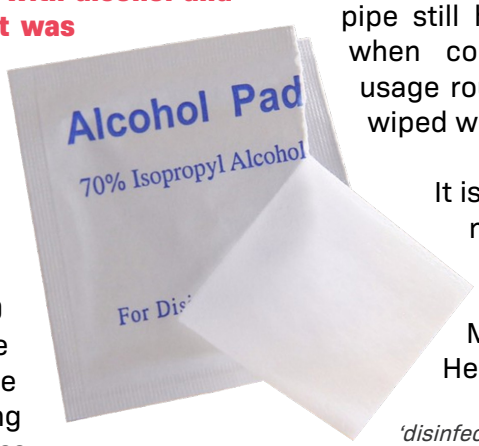
Beyond public event tests, several tests were completed to simulate at home consumption either personally or with friends. These tests were all done without the use of a sanitary smoking device **(noted in Table 3)**. **A ten-minute smoke session between four friends shows that the amount of contamination present can increase by a factor of 600 very quickly.** Another round of testing took place where various cleaning procedures again demonstrate the benefit of using a MouthPeace to lower the risk of contamination.

| Smoking & Pipe Cleaning Procedure | RLU |
|---|---|
| **3 min immersed in 91% ISO alcohol, 3 min air dried** | **14** |
| 1 inhalation each taken by 2 people | 1501 |
| **Mouth piece cleaned with lighter, 2 passes** | **441** |
| 3 min immersed in 91% ISO alcohol, 3 min air dried | 8 |
| **10 minute smoking session with 4 friends** | **4873** |
| Sealed in plastic bag for 7 days | 5 |
| **1 inhalation taken by 1 person** | **2165** |
| 91% ISO alcohol on paper towel, 3 min air dried | 86 |
| **1 inhalation each taken by 2 people** | **3088** |
| Wiped mouth piece with t-shirt | 411 |

**Table 3. Various Consumption and Cleaning Method Tests**

## Research on Cleaning with Rubbing Alcohol

Additional tests were performed on a recently smoked pipe. The mouthpiece was wiped with an alcohol swab and then tested roughly 5 seconds later. This is about the time most people at events wait before consuming. **The result from the initial test was 1824 RLU. After wiping with alcohol and waiting 5 seconds the test result was 1100 RLU.** As expected, the RLUs were reduced after using an alcohol wipe, however, the pipe was still far from bacteria free.




Furthermore, out of 200 tested participants, only 5% (10 participants) used an alcohol wipe prior to placing their mouth on the pipe **(noted in Data Set)**. After speaking to 20 vendors at these events, less than 50% used an alcohol wipe after each consumer to clean the pipe, 45% made alcohol wipes available for consumers to use at their discretion, and 10% did not have any alcohol wipes available **(Table 1)**. Of those 10 consumers and 9 vendors who were witnessed using an alcohol wipe, none of them wiped thoroughly enough or waited the recommended 10-60 seconds to allow the alcohol to work and kill the bacteria.[9] It should be noted that none of the available alcohol wipes were used by test participants during the MouthPeace usage rounds of Tests 1 or 2 **(see Data Set)**. However, the pipe still hosted significantly fewer bacteria when compared to the non-MouthPeace usage round of testing, where the pipe was wiped with alcohol 10 times.


It is interesting to note that alcohol use may not be as useful as previously thought. In a 2015 study published by the US National Library of Medicine and National Institutes of Health, researchers concluded

*'disinfection of semi-critical health care products with alcohol 70%, or in an approximate concentration, is not generally safe, with regards to the possibility of exposing patients to microorganisms (bacteria and viruses) which remain in those instruments even after they are disinfected.'*[10]

Greater benefit was shown from the use of a MouthPeace as seen in Figures 1 and 2. MouthPeace use consistently decreased the contamination present on the device.

# Data & Findings (cont.)

Taken together, the data shows that using a MouthPeace provides significant benefits. When used in conjunction with proper cleaning methods it significantly reduces contamination present when sharing pipes, joints, and vaporizers by up to 10 times.

# Context

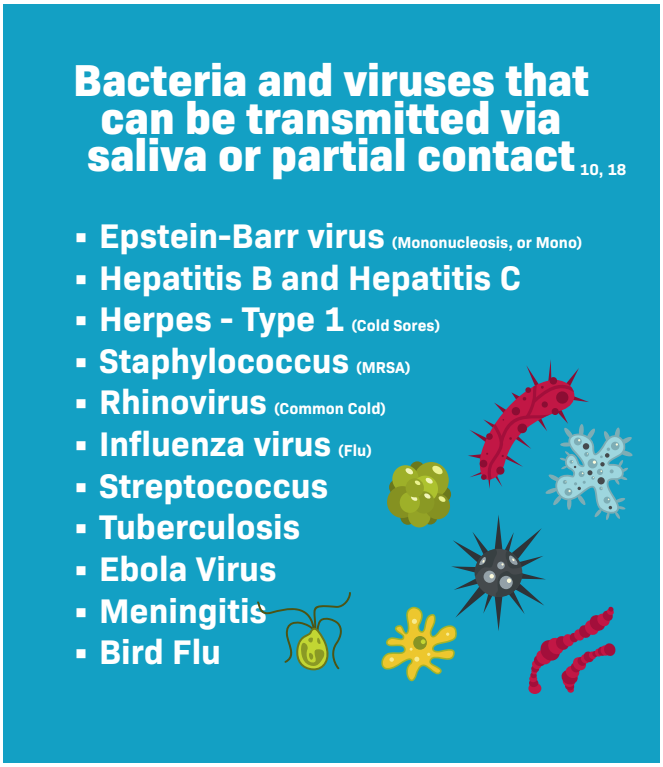
Surface hygiene is commonly measured in food and hospital industries to ensure that consumer and patient health is not compromised due to insufficient cleaning processes. As a basis for comparison, most **food and hospital organizations use an upper limit of 25 RLU to indicate a 'failed' test.** It is reasonable to assume that those industries err on the side of caution. However, **the average cannabis pipe returns a test result of 3497 RLU, 13,888% higher than this upper limit.**

Many viruses and bacteria can be transmitted simply by sharing pipes amongst friends and roommates, not to mention being at a public event sharing with hundreds or thousands of people from different states and countries. **Viruses, such as influenza, can survive on surfaces for up to eight hours.**[11]

In the controlled tests, out of 200 participants, 19 participants coughed directly on the pipe, and 128 participants made hand contact with the mouthpiece of the pipe while consuming. Besides direct mouth contact, coughing and hand contact are clear and obvious ways that pathogens are spread among cannabis consumers.

**An influenza pandemic can occur when a new subtype of virus arises which means humans have little or no immunity to it.** The virus spreads easily and rapidly from person to person through sneezing or coughing, and can cause serious illness worldwide. With past flu pandemics, the virus reached all parts of the globe within six to nine months. With the speed of air travel and the growing international middle class, public health experts believe an influenza pandemic could spread much more quickly.[12] The SARS epidemic that occurred in China in 2003 spread, in a matter of weeks, from 1 person to 8,000 people across 26 countries and 5 continents.[13]

The economic impact of SARS has been estimated at between US$30–140 billion[14], largely as a consequence of reduced travel and investment in Asia. SARS also showed how inadequate surveillance and response capacity in a single country can have an impact upon global public health security.[15]
However, the argument can be made that bacteria is everywhere and is impossible to avoid. For instance, Staphylococcus is found virtually everywhere and is generally not harmful in daily exposure[16]. However, people do take routine steps to curtail contamination in their daily lives. They wash their hands, don't share cups or utensils with strangers, and use hand sanitizer more than ever before[17]. Generally, people avoid putting random objects in and around their mouths unless they are sure it is clean. It would be considered strange and unacceptable by most accounts to go to a bar and pass around one beer glass, or go out to dinner and share one fork amongst a group of friends.



# Context (cont.)

**Data shows that cannabis consumers seem to ignore standard hygiene practices when it comes to sharing pipes, as documented by the lack of test participants who used an alcohol wipe to clean a pipe.**

Pathogens at these levels put cannabis consumers at a much higher risk of contracting viruses and infectious diseases compared to non-cannabis smokers. This is doubly true for those medical marijuana patients with immunodeficiencies who cannot risk bacterial contamination.

# Conclusion

**Awareness of the level of bacteria commonly found on surfaces used in the cannabis culture must increase.** The sharing of pipes from mouth to mouth is extremely unsanitary and can potentially cause the spread of infection. Germs – as contamination is commonly referred to – are truly everywhere and anything a consumer can do to control or limit contact with them is good practice. Sharing a pipe is essentially the same as sharing a food utensil, and **sharing pipes with others leaves you vulnerable to contracting a basic cold or flu, or more sinister viruses like Herpes, Hepatitis B or C, or even Tuberculosis.** While it is unlikely to contract a serious disease, it is not impossible, and every time you share a pipe, joint, or vaporizer with another person you do run a risk. Using a MouthPeace for germ-free smoking clearly lowers the bacterial count on pipes and other surfaces, while also significantly reducing the consumer's risk of contracting harmful pathogens.

To the researchers knowledge, **this is the first study of contamination on shared pipes and other smoking devices in the cannabis community.** The measurements taken on everyday items illustrates that bacterial contamination is everywhere **(Table 2)**. However, it was astounding to see the large difference between items that are commonly assumed to be dirty (a public toilet seat or dumpster) but actually carry much lower levels of bacteria than a cannabis pipe/joint/vaporizer, which people put directly to their lips.

Figures 1 and 2 clearly illustrate the benefit of using a MouthPeace. In tests where the MouthPeace was used, the RLUs are much lower in comparison to the absence of MouthPeace use, even when some participants used an alcohol wipe to clean the pipe. It was also found that a minority of participants (5%) who were offered an alcohol cleaning wipe actually used one prior to putting their mouth to the pipe.

**In tests where the MouthPeace is used consistently, the highest RLU found was 678 RLU. Without the MouthPeace being used, the highest reading was 8254 RLU.** Up to **52 times less contamination is present when the MouthPeace is used in Test 1 (Figure 1)**, and up to 60 times less contamination is present in Test 2 **(Figure 2)**, with a typical benefit of around 10 times less contamination in both rounds. It can be said with certainty that use of the MouthPeace can reduce or even prevent contamination much better than using rubbing alcohol alone.

Use of a MouthPeace clearly translates to better health, leads to fewer infections and can suppress the potential for outbreaks among cannabis consumers. Any person with an infection can spread those pathogens among other cannabis consumers when not using a sanitary device. The data supports the theory that the MouthPeace should be used widely in the cannabis field. This study should be strongly considered by lounge and event owners, as well as town councils and state cannabis boards, when implementing ordinances and bylaws pertaining to communal cannabis consumption, to ensure public health and sufficient safety standards.

This study should not be misconstrued and interpreted in such a way as to imply that social smoking must be avoided. It is simply to provide evidence-based data that consumers should be smart and use common sense sanitary practices when sharing and consuming with others.

# Figures & Tables

03

**Figure 1. Bacteria Testing - Test 1**

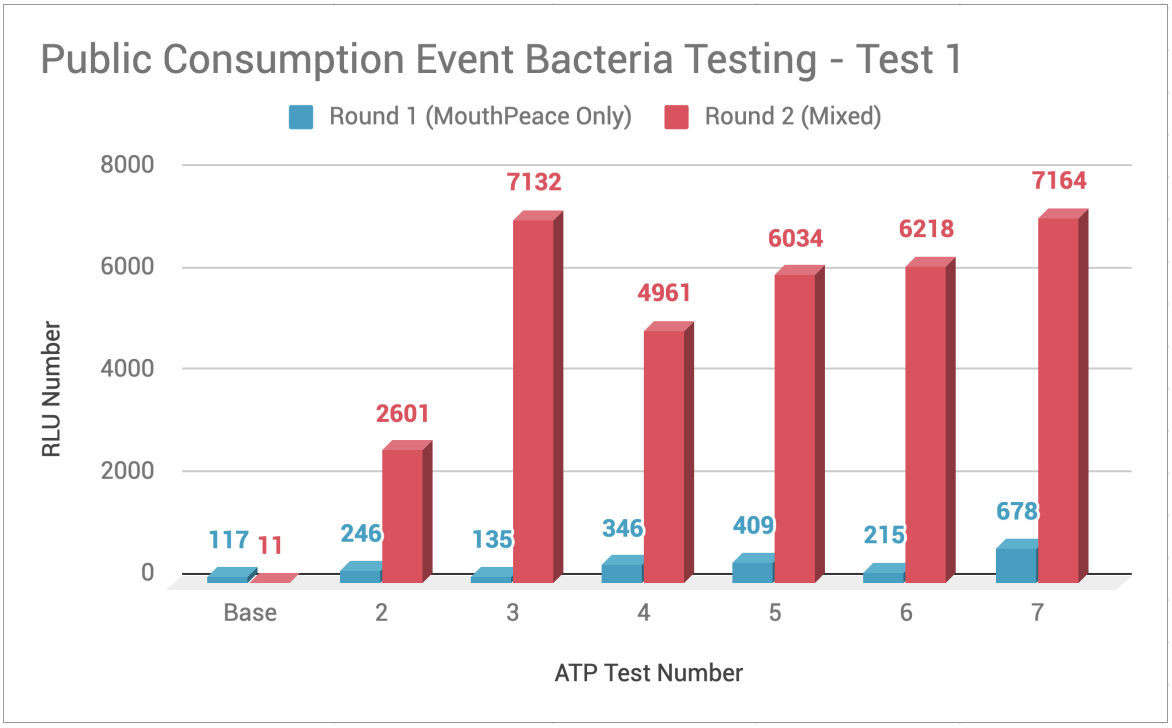
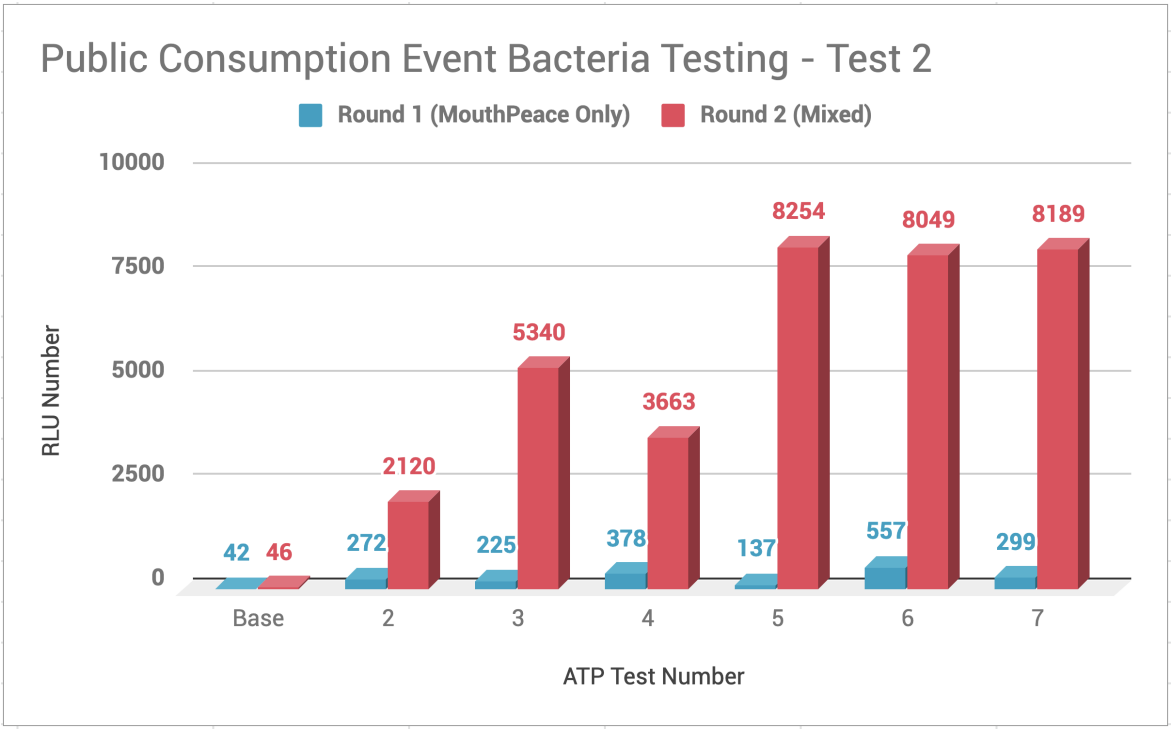



**Figure 2. Bacteria Testing - Test 2**



# Figures & Tables (cont.)

**Table 1. Various Pipe Tests**

| Pipe Location | RLU # | Alcohol Wipe Used? |
|---|---|---|
| Event 1 | 178 | Available for use |
| **Event 1** | **1824** | **Yes** |
| Event 1 | 6352 | Available for use |
| **Event 1** | **999** | **Yes** |
| Event 1 | 5536 | Available for use |
| **Event 1** | **386** | **Yes** |
| Event 1 | 2403 | Available for use |
| **Event 1** | **3811** | **Yes** |
| Event 1 | 5546 | Yes |
| **Event 1** | **5511** | **Available for use** |
| Event 1 | 3525 | Available for use |
| **Event 1** | **1740** | **Yes** |
| Event 2 | 7038 | No |
| **Event 2** | **431** | **Yes** |
| Event 2 | 6063 | No |
| **Event 2** | **5694** | **Available for use** |
| Event 2 | 1325 | Yes |
| **Event 2** | **853** | **Yes** |
| Event 3 | 3981 | Available for use |
| **Event 3** | **7495** | **Available for use** |
| Home Use | 4728 | NA |
| **Home Use** | **3088** | **NA** |
| Home Use | 1501 | NA |
| **Home Use** | **2165** | **NA** |
| Home Use | 5241 | NA |
| **AVERAGE** | **3496.56** | |

# Figures & Tables (cont.)

**Table 2. Common Surface Tests**

| Item Tested | RLU # |
|---|---|
| Public Toilet Seat - Apartment Complex | 2904 |
| **Public Toilet Seat - Venice Beach** | **3528** |
| Fast Food Restaurant Toilet Seat 1 | 1094 |
| **Fast Food Restaurant Toilet Seat 2** | **2042** |
| Fast Food Restaurant Toilet Seat 3 | 5368 |
| **Gas Station Toilet Seat 1** | **843** |
| Gas Station Toilet Seat 2 | 669 |
| **Dog Food Dish 1** | **203** |
| Dog Food Dish 2 | 294 |
| **ATM Enter Button 1** | **2188** |
| ATM Enter Button 2 | 1450 |
| **Public Transportation Scooter Handle 1** | **2320** |
| Public Transportation Scooter Handle 2 | 4901 |
| **Shopping Cart 1** | **3466** |
| Shopping Cart 2 | 862 |
| **Cell Phone** | **555** |
| Dumpster | 1845 |
| **Shoe in Dumpster Room** | **6211** |
| Weight Room Dumbell | 910 |
| **Bus Stop Bench** | **2920** |
| Cannabis Joint | 8569 |
| **Cannabis Vaporizer** | **7883** |

# Figures & Tables (cont.)

**Table 3. Various Consumption and Cleaning Method Tests**

| Smoking & Pipe Cleaning Procedure | RLU # |
|---|---|
| **3 min immersed in 91% ISO alcohol, 3 min air dried** | **14** |
| 1 inhalation each taken by 2 people | 1501 |
| **Mouth piece cleaned with lighter, 2 passes** | **441** |
| 3 min immersed in 91% ISO alcohol, 3 min air dried | 8 |
| **10 min smoking session with 4 friends** | **4873** |
| Sealed in plastic bag for 7 days | 5 |
| **1 inhalation taken by 1 person** | **2165** |
| 91% ISO alcohol on paper towel, 3 min air dried | 86 |
| **1 inhalation each taken by 2 people** | **3088** |
| Wiped mouth piece with t-shirt | 411 |

# Figures & Tables (cont.)

## Data Set

***Round 1 - With MouthPeace // Round 2 - Mixed Use***

| Test # | Round # | Participant # | Alcohol Wipe Used | Multiple Contact w/ Mouth | MouthPeace Used | Coughed on Pipe | Hand Contact with Pipe Mouthpiece |
|---|---|---|---|---|---|---|---|
| **Base ATP Test Post Cleaning - 117 RLU** | | | | | | | |
| 1 | 1 | 1 | | | x | x | x |
| 1 | 1 | 2 | | | x | | |
| 1 | 1 | 3 | | | x | | x |
| 1 | 1 | 4 | | | x | | x |
| 1 | 1 | 5 | | | x | | x |
| **ATP Test - 246 RLU** | | | | | | | |
| 1 | 1 | 6 | | | x | | x |
| 1 | 1 | 7 | | | x | | x |
| 1 | 1 | 8 | | | x | | |
| 1 | 1 | 9 | | | x | | |
| 1 | 1 | 10 | | | x | | x |
| **ATP Test - 135 RLU** | | | | | | | |
| 1 | 1 | 11 | | | x | x | x |
| 1 | 1 | 12 | | | x | | |
| 1 | 1 | 13 | | | x | | x |
| 1 | 1 | 14 | | | x | | x |
| 1 | 1 | 15 | | | x | | x |
| 1 | 1 | 16 | | | x | x | x |
| 1 | 1 | 17 | | | x | | x |
| 1 | 1 | 18 | | | x | | |
| 1 | 1 | 19 | | | x | | x |
| 1 | 1 | 20 | | | x | | |
| **ATP Test - 346 RLU** | | | | | | | |
| 1 | 1 | 21 | | | x | | |
| 1 | 1 | 22 | | | x | | |
| 1 | 1 | 23 | | | x | | x |
| 1 | 1 | 24 | | | x | | |
| 1 | 1 | 25 | | | x | | x |
| 1 | 1 | 26 | | | x | | x |
| 1 | 1 | 27 | | | x | x | x |
| 1 | 1 | 28 | | | x | | x |
| 1 | 1 | 29 | | | x | | x |
| 1 | 1 | 30 | | | x | | |
| **ATP Test - 409 RLU** | | | | | | | |
| 1 | 1 | 31 | | | x | x | x |
| 1 | 1 | 32 | | | x | x | x |
| 1 | 1 | 33 | | | x | | x |
| 1 | 1 | 34 | | | x | | x |
| 1 | 1 | 35 | | | x | | x |
| 1 | 1 | 36 | | | x | | x |
| 1 | 1 | 37 | | | x | x | x |
| 1 | 1 | 38 | | | x | | x |
| 1 | 1 | 39 | | | x | | x |
| 1 | 1 | 40 | | | x | | x |
| **ATP Test - 215 RLU** | | | | | | | |

# Figures & Tables (cont.)

| Test # | Round # | Participant # | Alcohol Wipe Used | Multiple Contact w/ Mouth | MouthPeace Used | Coughed on Pipe | Hand Contact with Pipe Mouthpiece |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 41 | | | x | x | |
| 1 | 1 | 42 | | | x | | |
| 1 | 1 | 43 | | | x | | x |
| 1 | 1 | 44 | | | x | | x |
| 1 | 1 | 45 | | | x | x | x |
| 1 | 1 | 46 | | | x | x | x |
| 1 | 1 | 47 | | | x | | x |
| 1 | 1 | 48 | | | x | | x |
| 1 | 1 | 49 | | | x | | |
| 1 | 1 | 50 | | | x | | x |
| **Final ATP Test - 678 RLU** | | | | | | | |
| **Base ATP Test Post Cleaning- 11 RLU** | | | | | | | |
| 1 | 2 | 1 | x | x | | | |
| 1 | 2 | 2 | | x | | | |
| 1 | 2 | 3 | | x | | | |
| 1 | 2 | 4 | | | x | | |
| 1 | 2 | 5 | | | x | | x |
| **ATP Test - 2601 RLU** | | | | | | | |
| 1 | 2 | 6 | | | x | | |
| 1 | 2 | 7 | | x | | | x |
| 1 | 2 | 8 | | | x | | |
| 1 | 2 | 9 | | x | | | x |
| 1 | 2 | 10 | | x | | | |
| **ATP Test - 7132 RLU** | | | | | | | |
| 1 | 2 | 11 | | x | | | x |
| 1 | 2 | 12 | | x | | x | x |
| 1 | 2 | 13 | | x | | | x |
| 1 | 2 | 14 | | x | | x | x |
| 1 | 2 | 15 | | | | | x |
| 1 | 2 | 16 | | x | | x | x |
| 1 | 2 | 17 | | x | | | |
| 1 | 2 | 18 | | x | | | |
| 1 | 2 | 19 | x | x | | | |
| 1 | 2 | 20 | | x | | | |
| **ATP Test - 4961 RLU** | | | | | | | |
| 1 | 2 | 21 | | x | | x | x |
| 1 | 2 | 22 | | | | | x |
| 1 | 2 | 23 | | x | | | x |
| 1 | 2 | 24 | | | x | | x |
| 1 | 2 | 25 | | | x | | x |
| 1 | 2 | 26 | | | x | | x |
| 1 | 2 | 27 | | | x | | x |
| 1 | 2 | 28 | x | x | | | x |
| 1 | 2 | 29 | x | x | | | |
| 1 | 2 | 30 | | x | | | |
| **ATP Test - 6034 RLU** | | | | | | | |

# Figures & Tables (cont.)

| Test # | Round # | Participant # | Alcohol Wipe Used | Multiple Contact w/ Mouth | MouthPeace Used | Coughed on Pipe | Hand Contact with Pipe Mouthpiece |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 31 | | x | | | |
| 1 | 2 | 32 | | x | | | |
| 1 | 2 | 33 | | | x | | x |
| 1 | 2 | 34 | | | x | | x |
| 1 | 2 | 35 | | | x | | x |
| 1 | 2 | 36 | | | x | | x |
| 1 | 2 | 37 | | | x | | x |
| 1 | 2 | 38 | | | x | | x |
| 1 | 2 | 39 | | | x | | x |
| 1 | 2 | 40 | | | x | | x |
| **ATP Test - 6218 RLU** | | | | | | | |
| 1 | 2 | 41 | | | x | | x |
| 1 | 2 | 42 | | | x | | x |
| 1 | 2 | 43 | | | x | | x |
| 1 | 2 | 44 | x | x | x | | x |
| 1 | 2 | 45 | | x | | | x |
| 1 | 2 | 46 | | | x | | x |
| 1 | 2 | 47 | | x | | | x |
| 1 | 2 | 48 | | x | x | | x |
| 1 | 2 | 49 | | x | | x | x |
| 1 | 2 | 50 | | | x | | x |
| **Final ATP Test - 7164 RLU** | | | | | | | |
| **Base ATP Test Post Cleaning - 42 RLU** | | | | | | | |
| 2 | 1 | 1 | | x | x | | x |
| 2 | 1 | 2 | | x | x | | x |
| 2 | 1 | 3 | | | x | x | |
| 2 | 1 | 4 | | | x | | x |
| 2 | 1 | 5 | | | x | | x |
| **ATP Test - 272 RLU** | | | | | | | |
| 2 | 1 | 6 | | x | x | | x |
| 2 | 1 | 7 | | x | x | | x |
| 2 | 1 | 8 | | | x | | x |
| 2 | 1 | 9 | | x | x | | x |
| 2 | 1 | 10 | | x | x | | x |
| **ATP Test - 225 RLU** | | | | | | | |
| 2 | 1 | 11 | | x | x | x | x |
| 2 | 1 | 12 | | | x | | |
| 2 | 1 | 13 | | x | x | | x |
| 2 | 1 | 14 | | x | x | | x |
| 2 | 1 | 15 | | x | x | | |
| 2 | 1 | 16 | | x | x | | x |
| 2 | 1 | 17 | | x | x | | x |
| 2 | 1 | 18 | | x | x | x | |
| 2 | 1 | 19 | | x | x | | x |
| 2 | 1 | 20 | | | x | | x |
| **ATP Test - 378 RLU** | | | | | | | |

# Figures & Tables (cont.)

| Test # | Round # | Participant # | Alcohol Wipe Used | Multiple Contact w/ Mouth | MouthPeace Used | Coughed on Pipe | Hand Contact with Pipe Mouthpiece |
|---|---|---|---|---|---|---|---|
| 2 | 1 | 21 | | x | x | | x |
| 2 | 1 | 22 | | | x | | x |
| 2 | 1 | 23 | | x | x | | x |
| 2 | 1 | 24 | | | x | | |
| 2 | 1 | 25 | | x | x | | x |
| 2 | 1 | 26 | | x | x | | x |
| 2 | 1 | 27 | | | x | | x |
| 2 | 1 | 28 | | x | x | | |
| 2 | 1 | 29 | | x | x | | |
| 2 | 1 | 30 | | x | x | | |
| **ATP Test - 137 RLU** | | | | | | | |
| 2 | 1 | 31 | | x | x | | |
| 2 | 1 | 32 | | | x | | x |
| 2 | 1 | 33 | | | x | | x |
| 2 | 1 | 34 | | x | x | | |
| 2 | 1 | 35 | | | x | | |
| 2 | 1 | 36 | | | x | | |
| 2 | 1 | 37 | | | x | | x |
| 2 | 1 | 38 | | x | x | | x |
| 2 | 1 | 39 | | x | x | | x |
| 2 | 1 | 40 | | | x | | x |
| **ATP Test - 557 RLU** | | | | | | | |
| 2 | 1 | 41 | | | x | | |
| 2 | 1 | 42 | | | x | | |
| 2 | 1 | 43 | | x | x | | x |
| 2 | 1 | 44 | | | x | | x |
| 2 | 1 | 45 | | x | x | | x |
| 2 | 1 | 46 | | | x | | x |
| 2 | 1 | 47 | | | x | | |
| 2 | 1 | 48 | | x | x | | x |
| 2 | 1 | 49 | | x | x | | |
| 2 | 1 | 50 | | | x | | x |
| **Final ATP Test - 299 RLU** | | | | | | | |
| **Base ATP Test Post Cleaning - 46 RLU** | | | | | | | |
| 2 | 2 | 1 | | | x | | x |
| 2 | 2 | 2 | | x | x | | x |
| 2 | 2 | 3 | | x | | | x |
| 2 | 2 | 4 | x | x | | | |
| 2 | 2 | 5 | | x | | | x |
| **ATP Test - 2120 RLU** | | | | | | | |
| 2 | 2 | 6 | | x | x | | x |
| 2 | 2 | 7 | | x | x | | x |
| 2 | 2 | 8 | | x | x | | x |
| 2 | 2 | 9 | | x | | x | |
| 2 | 2 | 10 | | x | | | x |
| **ATP Test - 5340 RLU** | | | | | | | |

# Figures & Tables (cont.)

| Test # | Round # | Participant # | Alcohol Wipe Used | Multiple Contact w/ Mouth | MouthPeace Used | Coughed on Pipe | Hand Contact with Pipe Mouthpiece |
|---|---|---|---|---|---|---|---|
| 2 | 2 | 11 | x | x | | | x |
| 2 | 2 | 12 | x | x | | | x |
| 2 | 2 | 13 | | | x | | x |
| 2 | 2 | 14 | | x | x | | |
| 2 | 2 | 15 | | x | | | x |
| 2 | 2 | 16 | x | x | | | |
| 2 | 2 | 17 | | x | | | |
| 2 | 2 | 18 | | x | | | |
| 2 | 2 | 19 | | x | | | |
| 2 | 2 | 20 | | | | | |
| **ATP Test - 3653 RLU** | | | | | | | |
| 2 | 2 | 21 | | x | | | x |
| 2 | 2 | 22 | | x | | | |
| 2 | 2 | 23 | | x | x | | x |
| 2 | 2 | 24 | | | | | |
| 2 | 2 | 25 | | x | | | x |
| 2 | 2 | 26 | | x | | | |
| 2 | 2 | 27 | | x | | | |
| 2 | 2 | 28 | | | x | | |
| 2 | 2 | 29 | | x | x | | x |
| 2 | 2 | 30 | | x | | | |
| **ATP Test - 8254 RLU** | | | | | | | |
| 2 | 2 | 31 | | | | | x |
| 2 | 2 | 32 | | x | | | |
| 2 | 2 | 33 | | x | | | |
| 2 | 2 | 34 | | x | | | |
| 2 | 2 | 35 | | x | | | |
| 2 | 2 | 36 | | x | | | |
| 2 | 2 | 37 | x | x | | | |
| 2 | 2 | 38 | | x | | | |
| 2 | 2 | 39 | | x | | | |
| 2 | 2 | 40 | | x | | | |
| **ATP Test - 8049 RLU** | | | | | | | |
| 2 | 2 | 41 | | x | | | |
| 2 | 2 | 42 | | x | | | |
| 2 | 2 | 43 | | | | | x |
| 2 | 2 | 44 | | | | | |
| 2 | 2 | 45 | | x | | | |
| 2 | 2 | 46 | | x | | | |
| 2 | 2 | 47 | | x | | | x |
| 2 | 2 | 48 | | | x | | x |
| 2 | 2 | 49 | | | x | | x |
| 2 | 2 | 50 | | | x | | x |
| **Final ATP Test - 8189 RLU** | | | | | | | |

# Endnotes

04


1 https://www.hygiena.com/other-products/ensure-other.html
2 https://www.hygiena.com/ensure-healthcare.html
3 Knowles, J. R. (1980). "Enzyme-catalyzed phosphoryl transfer reactions". Annu. Rev. Biochem. 49: 877–919. doi:10.1146/annurev.bi.49.070180.004305. PMID 6250450
4 https://livewelltesting.com/knowledge-center/all-about-atp
5 https://www.infectioncontroltoday.com/environmental-hygiene/using-atp-healthcare-settings-0
6 Roberto Mempin, Helen Tran, [...], and Sangwei Lu 'Release of extracellular ATP by bacteria during growth' in BMC Micro biology 2013 13 301.
7 'How Reliable Are ATP Bioluminescence Meters in Assessing Decontamination of Environmental Surfaces in Healthcare Settings?' in PLOS ONE June 2014 | Volume 9 | Issue 6 | e99951
8 https://www.hygiena.com/frequent-asked-questions-food-and-beverage.html
9 https://www.cdc.gov/infectioncontrol/guidelines/disinfection/disinfection-methods/chemical.html
10 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4623738/
11 http://www.cdss.ca.gov/agedblinddisabled/res/VPTC2/6%20Universal%20Precautions/Understanding_Common_Communicable_Diseases.pdf
12 https://www.webmd.com/cold-and-flu/what-are-epidemics-pandemics-outbreaks
13 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3145127/
14 Skowronski DA, Astell C, Brunham RC, Low DE, Petric M, Roper RL, Talbot PJ, Tam T, Babiuk L. Severe acute respiratory syndrome (SARS): a year in review. Annual Review of Medicine. 2005;56:357–381.
15 Heymann DL. The international response to the outbreak of SARS in 2003. Philosophical Transactions of the Royal Society of London B. 2004;359:1127–1129.
16 https://www.moldbacteria.com/bacteria/what-bacteria-are-really-in-indoor-environments.html
17 https://www.ibisworld.com/industry-insider/analyst-insights/10-us-industries-set-to-rise-and-fall-in-2017/
18 https://health.clevelandclinic.org/does-saliva-have-health-risks-3-ways-germs-can-spread/

The authors would like to extend special thanks to Hygiena LLC for allowing use of the testing system.

**Bacterial Contamination of Cannabis Pipes and How to Avoid Sharing Germs**

**Published:** May 2019

**Author:** Moose Labs LLC
**Scientific Consultant:** Deborah A Kallick, PhD
**Address:** Moose Labs LLC
PO Box 711
Lawndale, CA 90260
U.S.A.
**Phone:** +1.970.239.1209
**Web:** mooselabs.us