Are Clorox Wipes Really Effective at Killing Bacteria?

Introduction:

Given the COVID-19 pandemic, we, more than ever, have been frantically sanitizing the objects we use every day to prevent the growth of pathogens on these objects. Antibacterial wipes are often used for this purpose, and specifically, Clorox wipes. We wanted to put the efficacy of these antibacterial wipes to the test, so we chose to compare the effectiveness of Clorox wipes vs wet paper towels on removing bacteria from everyday surfaces.

Statistical Question:

Are Clorox wipes more effective than a wet paper towel at removing bacteria from a surface?

Hypotheses:

$H_0: \mu_d = 0$

$H_A: \mu_d > 0$

$\mu_d = \mu_p - \mu_c$

μ_p = mean number of bacterial colonies on a surface that has been cleaned by a wet paper towel

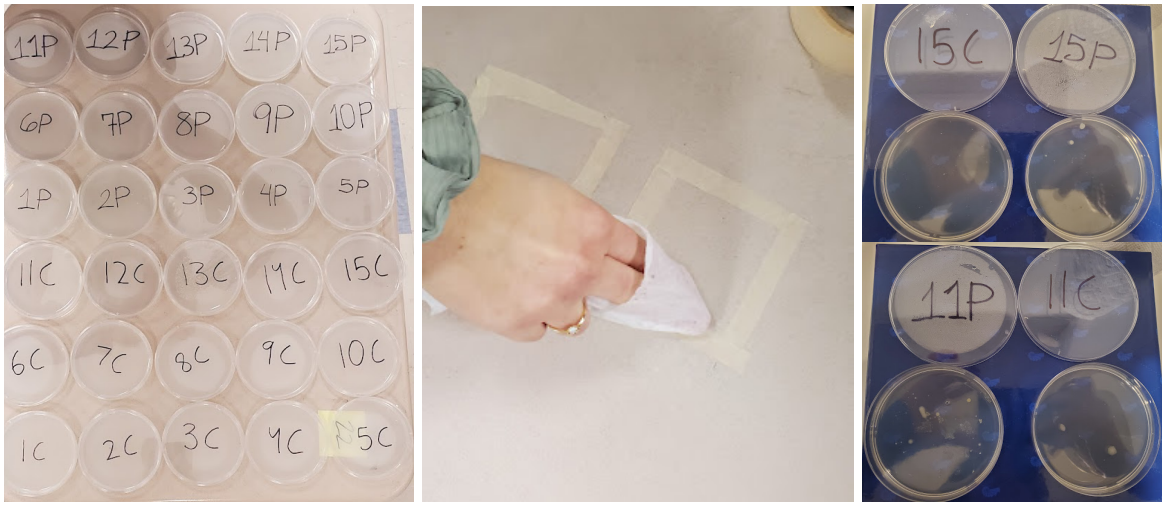
μ_c = mean number of bacterial colonies on a surface that has been cleaned by a Clorox wipe

Data Collection:

We decided to run a matched pairs test, in which we would test two patches of area next to each other on the same surface, cleaning one with a Clorox wipe and the other with a wet paper towel,

and measuring the difference between the amount of bacteria obtained from these two patches on multiple surfaces.

To do this, we chose 15 surfaces across our school which consisted of tabletops, books, calculators, trash bins, benches, shoes, and other locations. On each surface, we used two patches of area, each a square of 3 inches in length. The left patch was randomly assigned to be wiped once by either a Clorox wipe or wet paper towel by flipping a virtual coin. Heads was a Clorox wipe and tails was a paper towel. The right patch was assigned the other cleaning method. We would then wipe down the left patch with the selected cleaning method once. Then we used a q tip to swipe once along the patch and then once into a prepared agar plate. Then we repeated this process with the right patch and the other cleaning method. We repeated this process for all 15 surfaces. We used the same brand of Clorox wipe for each surface. We also used the same type of paper towel, and wet them to equal amounts. We saturated them with water and then drained them fully with our hands. All 30 q tips and agar plates were identical. The agar plates were labeled with a number and P or C depending if a paper towel or Clorox wipe was used to clean it. The numbers were to keep the plates from the same surface together. The agar plates were all placed in the same environment for 24 hours. After 24 hours, the number of bacterial colonies in each plate were recorded. We chose to record by number and not size, since using numbers would be a more objective measure of bacteria growth that would also be easier to measure. This also means that the data we collect would be discrete.

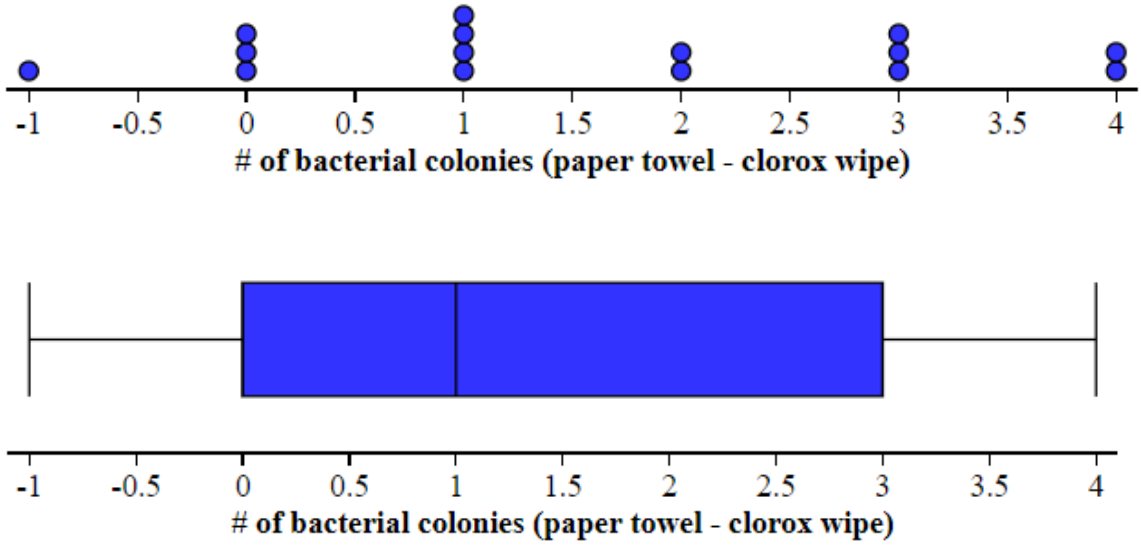


Images showing labeled agar plates, cleaning of a surface, and two examples of plates after incubation for 24 hours

Data Display:

Plate Number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Paper Towel	1	0	2	2	2	0	8	0	1	7	6	1	7	0	4
Clorox Wipe	0	1	0	1	0	0	5	0	0	4	3	0	3	0	0
Difference (P - C)	1	-1	2	1	2	0	3	0	1	3	3	1	4	0	4

Table depicting the number of a plate (meaning location number), the number of bacterial colonies on the agar plate collected from the patch on that location cleaned by a paper towel, the number of bacterial colonies on the agar plate collected from the patch on that location cleaned by a Clorox wipe, and the difference between these two values for each location



Dotplot and boxplot of the differences

Data Analysis:

Of the distribution of the difference between the number of bacterial colonies on the agar plate collected from the surface cleaned by the wet paper towel and the number of bacterial colonies on the agar plate collected from the surface cleaned by the Clorox wipe, the mean is 1.6, the median is 1, the standard deviation is 1.549, and the IQR is 3. The distribution is unimodal and shows no skewness or outliers.

We chose to perform a paired sample t-test on this data with a $\alpha = 0.05$ significance level to test our hypotheses. As a reminder, here are our hypotheses:

$H_0: \mu_d = 0$

$H_A: \mu_d > 0$

$\mu_d = \mu_p - \mu_c$

μ_p = mean number of bacterial colonies on the agar plate that has been acquired from the patch on a surface that has been cleaned by a wet paper towel

μ_c = mean number of bacterial colonies on the agar plate that has been acquired from the patch on a surface that has been cleaned by a Clorox wipe

Each pair (for the matched pairs) consisted of the two petri dishes acquired from the two patches on the same surface. For our analysis, we used the difference between the number of bacterial colonies on the agar plate acquired from patch of the surface cleaned by the paper towel and the number of bacterial colonies on the agar plate acquired from the patch of the surface cleaned by the Clorox wipe.

Conditions for Test:

The treatments of Clorox wipes and paper towels were randomly assigned to either the left or right patch on the surface. All variables were controlled in the experiment, as both surfaces were wiped the same amount, and the bacteria was collected with identical qtips in identical agar plates stored in identical conditions for the same amount of time.

Each trial collected was independent. Fresh materials were used for every trial ensuring that previous data collected would not influence future data collected.

We can assume normality of the sampling distribution since the sample data shows no skewness or outliers, and is approximately normal.

With the conditions met, we can perform our test.

We obtain a t statistic of $\frac{1.6}{1.549/\sqrt{15}} = 4$

We have 14 degrees of freedom

This gives us a p value of <0.001

Conclusion:

Our p value of <0.001 is less than our significance level of 0.05, so we reject our null hypothesis that there is no difference in the number of bacterial colonies on surfaces cleaned by a wet paper towel and a Clorox wipe. This means we have evidence to suggest that surfaces cleaned by Clorox wipes will have less bacterial colonies obtained from them than surfaces cleaned by wet paper towels. This is evidence to prove that Clorox wipes really are more effective than wet paper towels at removing bacteria from surfaces!

This experiment proves to us the efficacy and importance of using sanitizing tools like Clorox wipes to disinfect surfaces that we use every day, and shows that simply wiping something down with a paper towel is not nearly as effective as an antibacterial wipe when it comes to actual cleaning and disinfection.

Reflection on Process:

After arriving at our idea for this experiment, it seemed like a fairly simple procedure. A member of our group had already done a similar experiment recently (growing bacteria in agar in a different context) so, with their expertise, we utilized a similar procedure to grow the bacteria in agar. Collecting data from surfaces across our school went smoothly but problems arose when it

came to growing the bacteria. The agar plates, after many days sitting in a group member's room, did not show any sign of bacteria growth. We hypothesized that the storage conditions may not have been favorable for bacteria growth, so we redid the experiment and, this time, immediately placed the agar plates into an incubator (oven set to 100-150 degrees Fahrenheit). After 10 hours in the incubator, the bacteria still showed no signs of growth. We were quite confused at this point. There was clearly bacteria placed into the agar plates (some even had visible dirt from when we collected the bacteria) but no colonies were growing in the agar itself. We realized that the problem was in the agar itself. The agar appeared to be extremely nutrient poor, meaning no bacteria could grow in the agar itself. Apart from writing a strongly worded review to Amazon, the group ordered a new brand of agar, and redid the entire experiment for a third time. This time, with the new agar and being placed in an incubator, bacterial colonies finally grew on the agar plates. Each time the experiment was redone, the materials were completely new and control was maintained across all trials. For example, petri dishes used for the agar plates were fully cleaned and sanitized between each attempt at the experiment.

We have many ideas for future study. We would like to possibly add a control group to get an absolute estimate of the efficacy of different cleaning methods when compared to absolutely no cleaning on the surface. We would also like to test the efficacy of different brands of wipes to see if some are more effective than others. We could also test different surfaces (all 'dirtied' to the same amount) to see if bacteria is more easily removed from certain surfaces than others. If we have full control over the 'dirtying' of a surface, we could also compare different types of bacteria and see how easily removable they are from surfaces.

Works Cited:

https://www.wikihow.com/Grow-Bacteria-in-a-Petri-Dish

Special thanks to our stats teacher Ms. Dobashi for teaching us the concepts we utilized in this project.