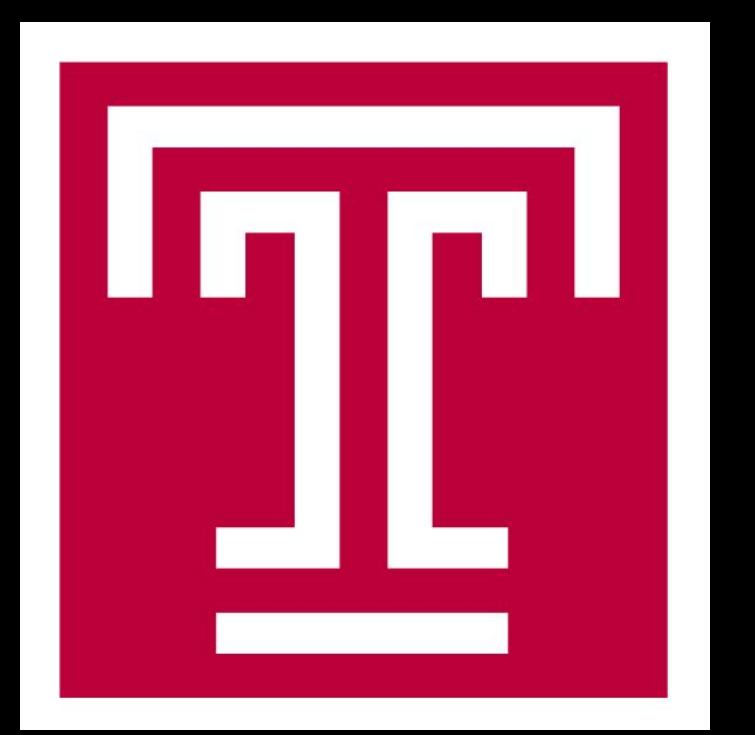# Evaluating the Change in Surface Contamination with Distance During Restorative Procedures

Nihad Sehic, DDS, Mega Manchanda, DDS, Sara Dworkin, DDS; Temple University Hospital – Pediatric Dental Residency Program

Introduction

When the Covid-19 pandemic began, dental practitioners were limited to providing emergency services because of the uncertainty in the risk of spreading disease. Dental offices utilize equipment such as handpieces, ultrasonic scalers, and air water syringes, that produce aerosols and could potentially spread infectious agents.
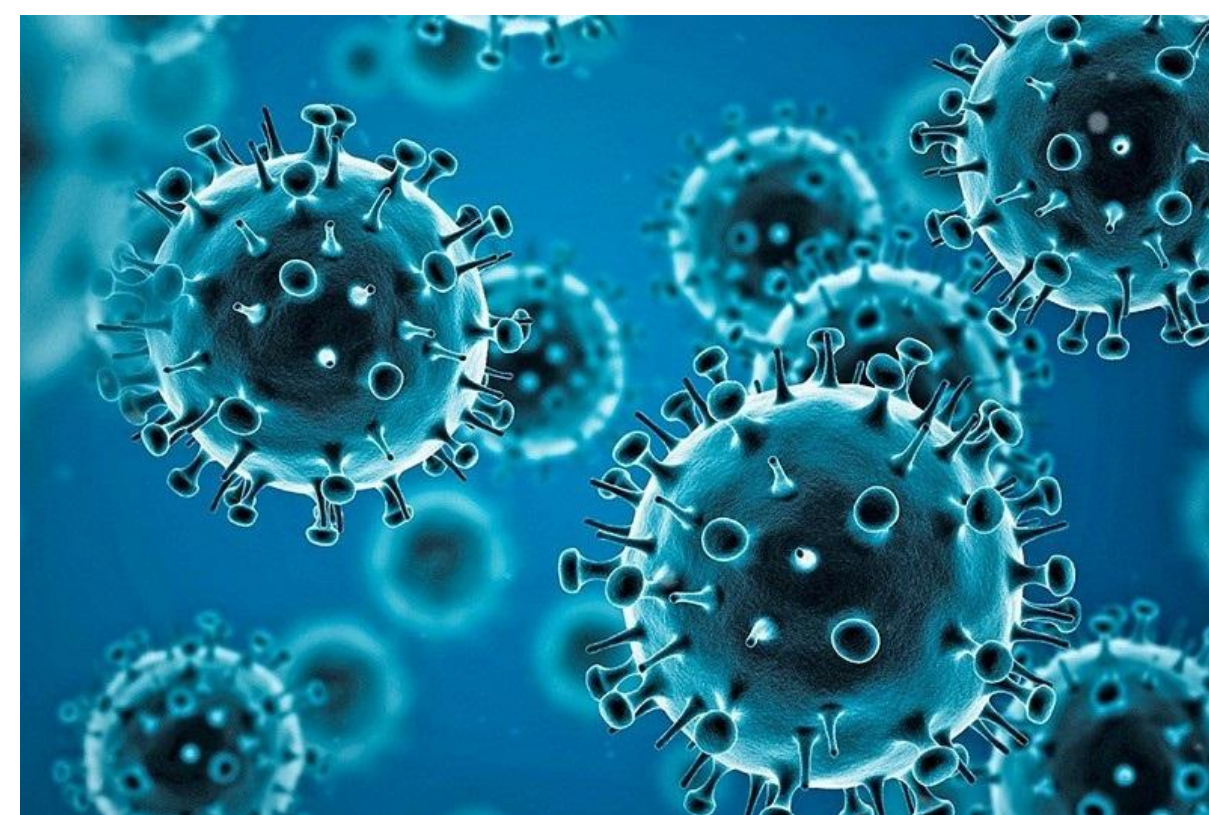
This study aims to determine surface contamination from aerosols, with increasing distance and change in direction from the mouth, during restorative dental procedures. Knowing the distance and direction of contamination can help develop best practices and lower exposure to potentially infectious aerosols.

Figure 1. SARS-CoV-2 virus. (World Health Organization)

Materials and Methods

15 patients were selected that met the following criteria:
- Ages 6-18 years old
- Frankl score 3-4
- Required multiple class II restorations (using air driven handpiece, isovac isolation) that lasts at least 12 minutes
- Informed consent obtained from parent or guardian

At the beginning of the procedure, filter paper was placed at measured locations from the oral cavity
- Patient bib: 6 inches, 12 inches, 18 inches
- Overhead light: 24 inches
- Operatory wall: 52 inches

The filter paper was collected after 12 minutes and tested using the Kikkoman Lumitester, which uses ATP to measure microbial contamination. The system uses a luminescent reagent that reacts with ATP and produces bioluminescence that is then measured in relative light units (RLU). Unused filter paper was swabbed and used as the control.
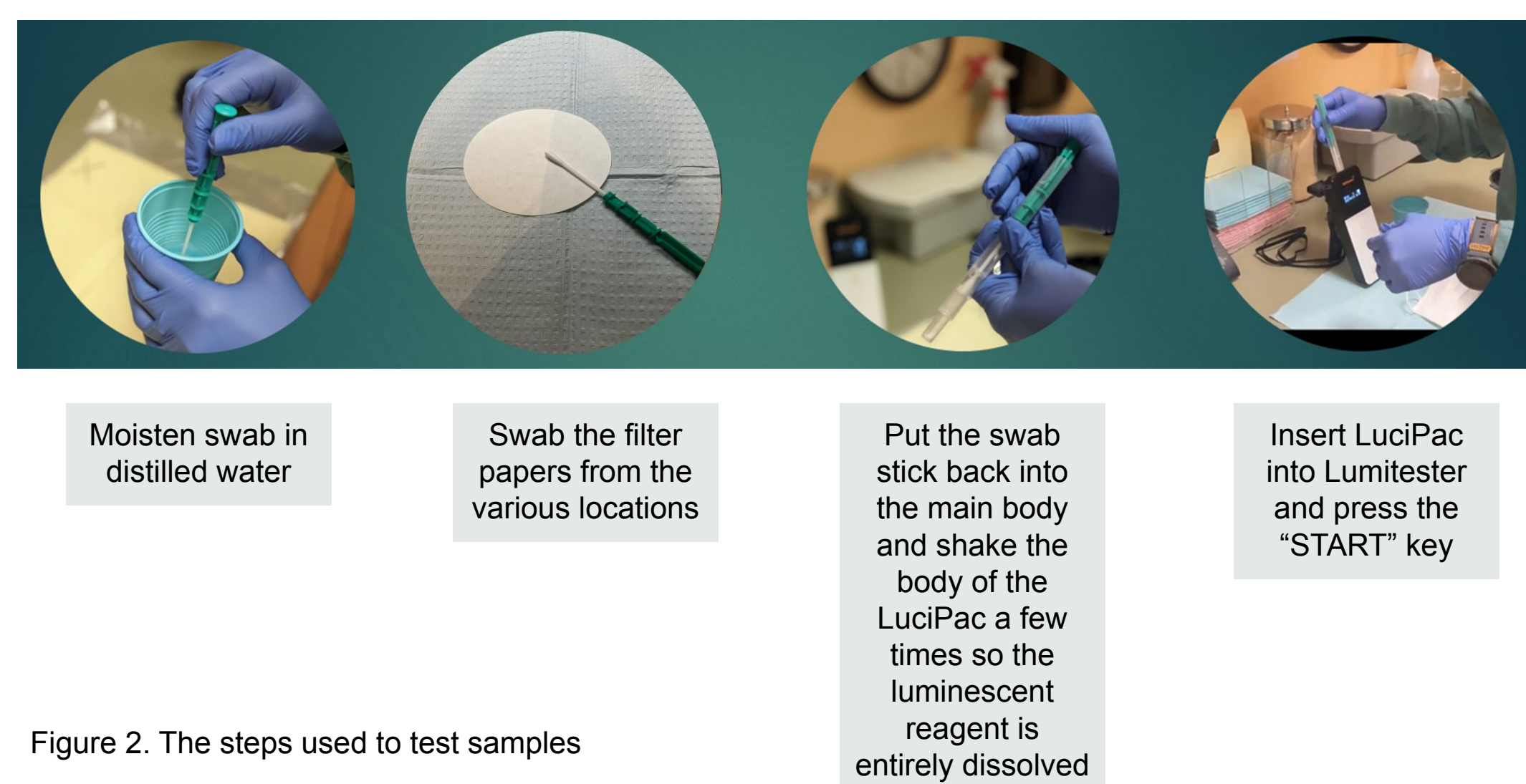
Moisten swab in distilled water

Swab the filter papers from the various locations

Put the swab stick back into the main body and shake the body of the LuciPac a few times so the luminescent reagent is entirely dissolved

Insert LuciPac into Lumitester and press the "START" key

Figure 2. The steps used to test samples

Data and Statistical Analysis

One-way analysis of variance (ANOVA) was used to compare the surface contamination at the five different sites and the control

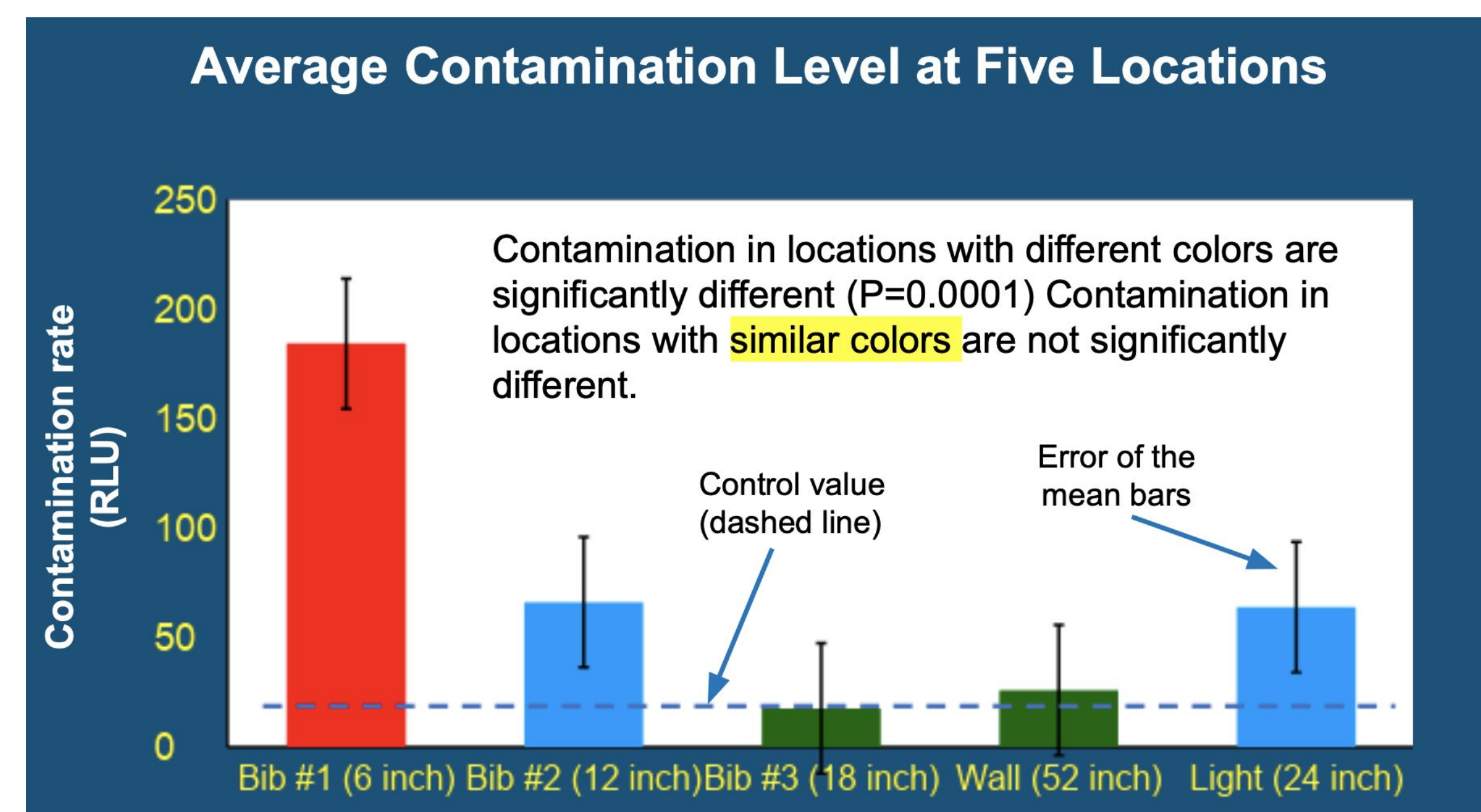Tukey test was used to compare each of the sites to the control and to each other

Average Contamination Level at Five Locations

Contamination in locations with different colors are significantly different ($P=0.0001$) Contamination in locations with similar colors are not significantly different.

Control value (dashed line)

Error of the mean bars

Y-axis: Contamination rate (RLU), 0 to 250

X-axis: Bib #1 (6 inch), Bib #2 (12 inch), Bib #3 (18 inch), Wall (52 inch), Light (24 inch)

Table 1. Shows the average contamination at the 5 different sites in relative light units (RLU)

Change in Contamination with Distance

$P < 0.0001$

$P < 0.0001$

$P < 0.006$

Y-axis: Contamination (RLU), 0 to 200

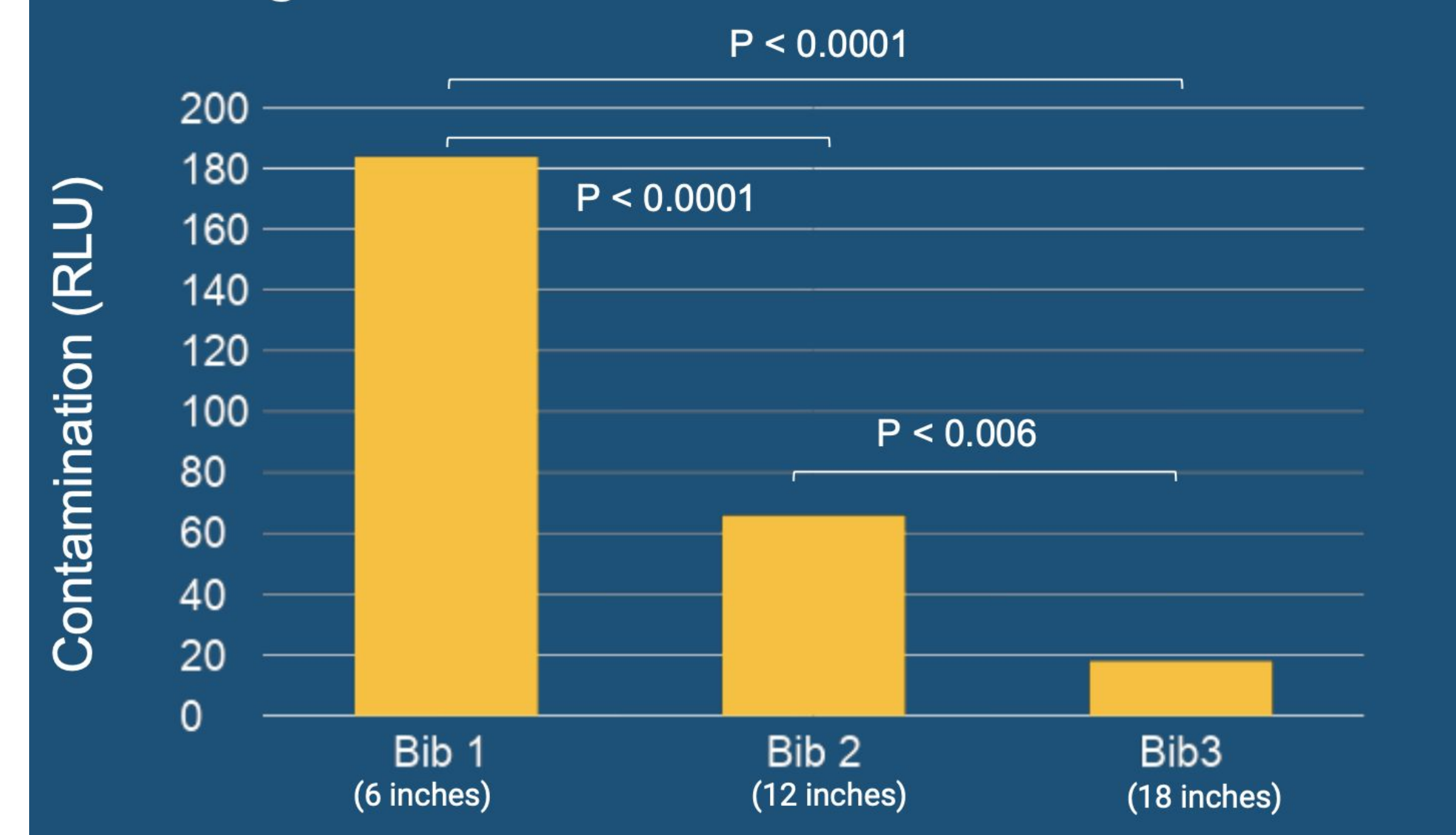X-axis: Bib 1 (6 inches), Bib 2 (12 inches), Bib3 (18 inches)

Table 2. Shows the change in contamination (in relative light units, RLU) with distance and the relative p values

Rate of Decline in Contamination with Distance

184

66

18

Equation of Line
Y = -14*X + 255
Slope = - 14 RLU per inch
Contamination decreases by 8% per inch horizontally

Y-axis: Contamination (RLU), 0 to 200

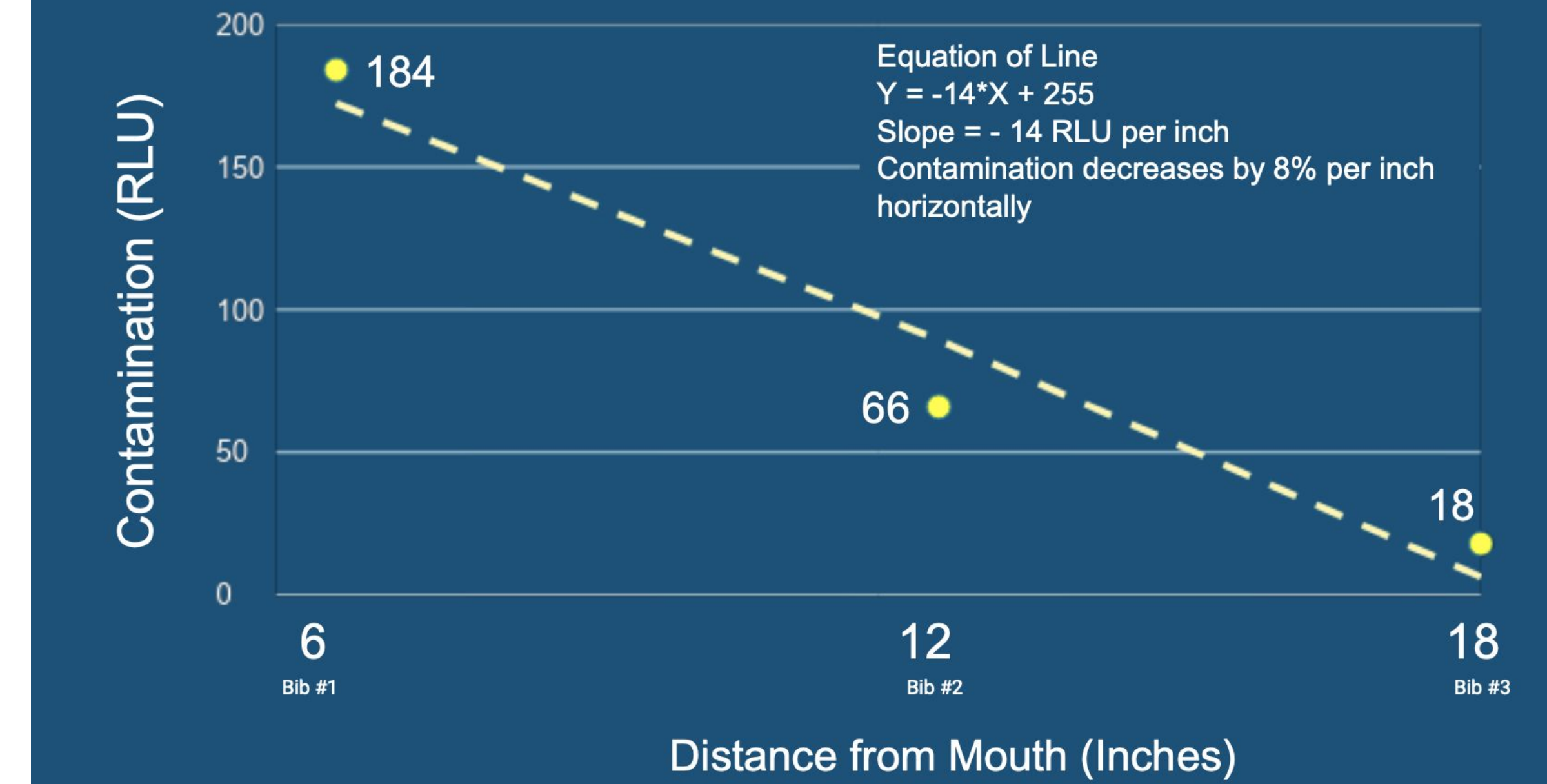X-axis: Distance from Mouth (Inches): 6 (Bib #1), 12 (Bib #2), 18 (Bib #3)

Table 3. Shows the decline of contamination (in relative light units, RLU) with distance from the mouth (in inches)

Results

After statistical analysis, the results of the study showed that:
- surface contamination decreases rapidly with increasing distance from the oral cavity
- moving away horizontally from the patient's oral cavity, there was almost no contamination at 18 inches
  - this could be a possible safe working distance
- more surface contamination is directed vertically than horizontally from the oral cavity

Potential Sources of Error

- Different providers have different techniques
  - use of magnification(i.e. loupes or no loupes)
  - pressure (i.e. amount of operator pressure on hand piece)
  - manner of use of air/water syringe
- Lack of calibration between operators
- Patient's movement (some were squirmy, others were not!)
- Oral hygiene of patient
- Possible operator bias in swabbing
- Restoration of maxillary teeth versus mandibular teeth

Limitations

- Relatively small number of patients included
- Only 5 sites tested
- Measure of surface contamination does not predict risk of infection and disease

Possible Follow Up Studies

- Examining magnitude of contamination with other types of dental procedures, such as ultrasonic scaling
- Testing the composition of the contaminants
- Comparing different time intervals and if they have an effect on magnitude of contamination
- Examining the impact of oral hygiene status on magnitude of contamination