

# Comparing adenosine triphosphate (ATP) luminescence technology to contact plate-based microbiologic sampling for the assessment of cleanliness of the patient care environment

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## INTRODUCTION

- Environmental surfaces and shared noncritical care equipment in hospitals may serve as reservoirs for pathogens.
- Assessment of the cleanliness of the patient care environment and equipment may identify deficits in cleaning effectiveness and opportunities to reduce the risk of HAIs.
- Adenosine triphosphate (ATP) luminescence technology is increasingly used in hospitals to monitor the cleanliness of the patient care environment.
- ATP luminescence technology measures the amount of organic material on a surface as a proxy for overall cleanliness.
- Manufacturer recommended cut-off values are used to determine if a surface “passes” or “fails” a cleanliness test; however, microbiological data to support these cut-off values are limited.

## OBJECTIVES

- To examine the relationship between ATP concentration and bacterial burden on environmental surfaces in the hospital.
- To generate local data to support educational efforts related to environmental cleaning and disinfection in hospitals.

## METHODS

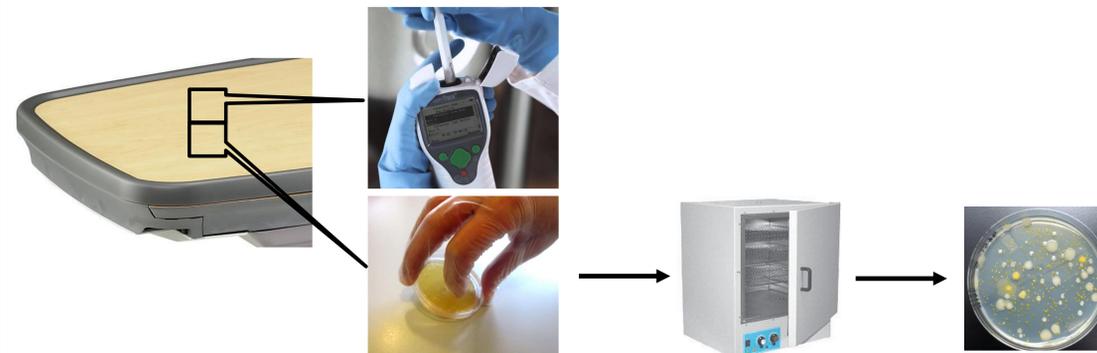
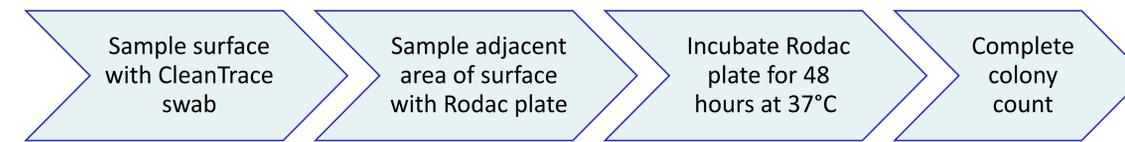
- From 11/2015 to 3/2016, 5 environmental surfaces in occupied patient rooms and other patient care areas were sampled using two techniques:
  - ATP burden** The 3M Clean-Trace Clinical Hygiene Monitoring System was used to quantify surface ATP concentration in “Relative Light Units” or RLU. The manufacturer recommended cut-off value for a “clean” surface was  $\leq 250$  RLU.
  - Bacterial burden** BD BBL™ Rodac contact plates were used to quantify bacterial concentration in colony forming units (CFU) per  $\text{cm}^2$ .
- To capture a range of contamination levels, each surface was first sampled with a CleanTrace swab to assess the RLU value to ensure ~20 samples in each of these ranges were collected:
 

0-125 RLU	251-500 RLU	501-1,000 RLU	>1,000 RLU
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## METHODS

### Sampling:

- CleanTrace swabs were rolled over 16 inches<sup>2</sup> of the surface and were immediately tested.
- Rodac plates were gently placed on each surface for 30 seconds, lifted perpendicularly off the surface, and immediately covered. Plates were incubated for 48 hours at 37 degrees Celsius before colony counts were completed.
- Rodac contact plates with >200 CFU were considered too numerous to count and recorded as 200 CFU for analysis.



### Statistical analysis

- To assess the relationship between RLU and CFU, Spearman and Pearson correlations were calculated and a negative binomial model was selected.
- To determine an appropriate RLU cut-off value, logistic regression and an ROC curve were completed.
  - Surfaces were considered to be “clean” if they had  $<1$  CFU/ $\text{cm}^2$ .<sup>1</sup>

## RESULTS

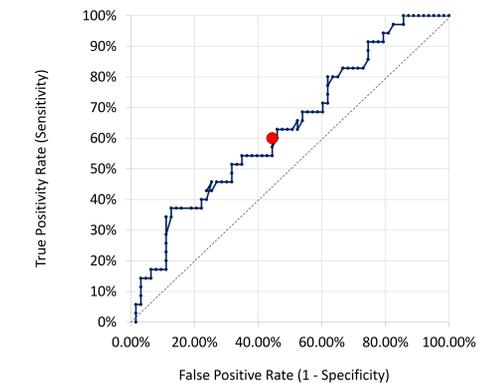
- 98 surfaces were sampled in 4 inpatient units at an acute care hospital in New York, NY. Of the 98 surfaces, 37 were in occupied patient rooms.
- Surfaces : nursing station countertop ( $n = 28$ ), glucometer ( $n = 19$ ), overbed table ( $n = 19$ ), mobile computer ( $n = 8$ ), visitor chair ( $n = 9$ ), and toilet seat ( $n = 9$ ).
- The median RLU value was 372 (13-139,021) and median CFU count was 0.7 colonies per  $\text{cm}^2$  (0-7.8).

## RESULTS

### Correlation between RLU and CFU

- The Pearson and Spearman correlations between CFU and log-transformed RLU were 0.23 and 0.30, respectively.
- Under the negative binomial model, RLU was a statistically significant predictor for CFU ( $p=0.0080$ ). In this model, if the RLU value increased 100%, the mean CFU count increased 15.7%.
- On ROC curve analysis, the RLU cut-off value that maximized sensitivity and specificity was 384; however, the area under the curve was 0.63.

ROC Curve - RLU as a Proxy for Microbial Cleanliness ( $<1$  CFU/ $\text{cm}^2$ )



Maximum sensitivity and specificity  
**RLU = 384**  
Sensitivity: 54.3%  
Specificity: 55.6%

Manufacturer recommendations  
**RLU < 250**  
Sensitivity: 68.6%  
Specificity: 44.4%  
**RLU < 200**  
Sensitivity: 71.4%  
Specificity: 38.1%

## CONCLUSIONS

- While ATP luminescence technology monitoring is not equivalent to microbiologic testing of environmental surfaces:
  - A correlation exists between RLU and CFU.**
  - This analysis generally supports the manufacturer recommended cut-off values, demonstrating reasonably high sensitivity but rather low specificity for the presence of viable bacteria on surfaces at these values.**
- Given its ease and ability to provide real time data, ATP luminescence technology may serve as a useful proxy for microbial contamination in the hospital environment; however, more accurate methods for assessment of environmental cleaning practices are needed and more data on the clinical significance of bacterial pathogenicity would be helpful.

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<sup>1</sup>Dancer SJ. How do we assess hospital cleaning? A proposal for microbiological standards for surface hygiene in hospitals. J Hosp Infect. 2004 Jan;56(1):10-5.