



# A Quantitative Assessment of Cleanliness in the Operating Room

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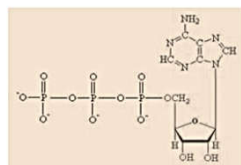
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## INTRODUCTION

Adenosine triphosphate (ATP) is an enzyme that is present in all living cells, and an ATP monitoring system can detect the amount of organic matter that remains after cleaning an environmental surface, a medical device or a surgical instrument.<sup>1</sup>

A quick and convenient method of assessing surface cleaning in the operating room (OR) is desirable. We determined adenosine triphosphate bioluminescence (ATP-B) and compared relative light units (RLU) to aerobic colony counts before and after between-case cleaning.



## METHODS

Twelve surfaces in two ORs, including the anesthesia keyboard, anesthesia cart, anesthesia controls, intravenous infusion pole, overhead lamp, bed control, Bair hugger control, floor, nurse's mouse, cautery power control, inside door surface and Mayo stand, were cultured before and after between-case cleaning with 25 cm<sup>2</sup> contact agar plates (Remel). ATP-B testing was conducted simultaneously with the sampling of surfaces (25 cm<sup>2</sup> area), using the ATP Complete Contamination Monitoring System (Ruhof) according to manufacturer instructions. Relative light units (RLU) were compared to colony counts after incubation at 35°C for 48 h. A value < 45 RLU has been established by Ruhof to be "clean"<sup>2</sup>. Colonies were isolated and stored at 6° C, following standard procedure. Isolates were later identified by Microscan, following instrument procedure guidelines. A total of 132 before and 132 after cleaning cultures and ATP-B measurements were ascertained, involving 11 clean wound class cases in 2 operating rooms in a community-teaching hospital.



## RESULTS

### BEFORE CLEAN

Environmental Surfaces	Relative Light Units	Colony Forming Units/25cm <sup>2</sup>	Isolates
Floor	180	4	<i>S. epidermidis</i>
	113	9	<i>S. hominis subsp. hominis</i>
	120	5	Diptheroids
	89	3	<i>Micrococcus species</i>
Overhead Lamp Handle*	4522	15	<i>S. epidermidis</i> <i>S. hominis subsp. hominis</i> <i>Micrococcus species</i> <i>S. cohnii subsp. cohnii</i> Gram positive bacilli (non-hemolytic)
Anesthesia Keyboard	87	2	<i>S. epidermidis</i>

Among 132 surfaces involving 11 clean cases in 2 ORs, only 6 surfaces (4.5%) were "dirty" before cleaning.

In all cases, no more than 15 cfu/25cm<sup>2</sup> were recovered from these 6 surfaces.

\*The overhead lamp, which was grossly bloody, yielded the highest reading.

### AFTER CLEAN

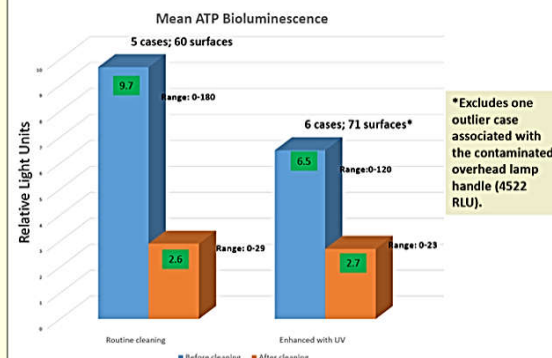
Environmental Surfaces	Relative Light Units	Colony Forming Units/25cm <sup>2</sup>	Isolates
Floor	3	2	<i>S. saprophyticus</i> Diptheroids <i>Micrococcus species</i>
	23 <sup>1</sup>	4	
	10 <sup>1</sup>	0	
	17	5	
Overhead Lamp Handle	6 <sup>1</sup>	0	
Anesthesia Keyboard	0	1	<i>S. epidermidis</i>

1. Denotes surfaces treated with UV disinfection following cleaning.

No *S. aureus*, *Enterococcus sp.* or Gram negative bacteria were isolated from environmental surfaces in our ORs.

## RESULTS

The mean surface ATP-B prior to cleaning for 60 surfaces in 5 cases was 9.7 RLU (range 0-180). After cleaning, the mean ATP-B was 2.6 RLU (range 0-29). When enhanced with UV, the mean ATP for 71 surfaces\* in 6 cases prior to cleaning was 6.5 RLU (range 0-120) and mean ATP-B after cleaning was 2.7 RLU (range 0-23). In contrast to aerobic colony counts<sup>3</sup>, there was no significant difference in mean surface ATP-B between routine cleaning and when cleaning was enhanced by pulsed-xenon UV disinfection.



## CONCLUSIONS

ATP-B provides a quick and convenient method to assess OR cleanliness and can be used to ensure that environmental surfaces are clean before the next case. It has the advantage of providing quantitative data which can be acted on before putting a patient at risk. No culture yielded more than 2.5 CFU/cm<sup>2</sup>, below the proposed microbiologic criteria classified as clean<sup>4</sup>. All environmental isolates recovered from surfaces represent skin flora. Since ATP-B detects organic material, an acceptable reading provides further reassurance that blood and body fluids have been removed from surfaces. Based on both ATP-B readings and aerobic colony counts, our OR is clean.

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References: 1. [http://www.infectioncontroltoday.com/posted\\_12/07/2010/](http://www.infectioncontroltoday.com/posted_12/07/2010/); 2. Ruhof ATP Complete package insert; 3. Bruno-Murtha LA, et al. Decreasing Operating Room Contamination of Surfaces and Air with Pulsed-Xenon Ultraviolet Disinfection (PX-UVD). Abstract #2-259, APIC 2013, Ft. Lauderdale, FL; 4. Sherlock O, et al. J Hosp Infect 2009;72:140-146.

