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Review Article

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Relevance of ATP Bioluminescence Detection and Microbial Culture Methods in Evaluation of Cleaning and Disinfection: A Review

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Abstract

ATP bioluminescence detection plays an increasingly important role in evaluating the cleanliness of environmental surfaces owing to its rapid and sensitive characteristics. Although conventional microbial culture methods remain the "gold standard" for assessing cleanliness and disinfection, they are time-consuming and cannot meet the need for real-time on-site intervention. By comparing synchronous measurement results from ATP detection and microbial culture methods, this review systematically examines the core principles of ATP bioluminescence technology, elucidates the correlation between the ATP reduction rate and the microbial inactivation rate, identifies the key factors affecting consistency between the two methods and focuses on applications in healthcare settings, infectious disease epidemic foci and public health emergencies. The findings indicate that ATP detection technology can serve as an effective auxiliary tool for evaluating cleanliness and disinfection.

Keywords: ATP bioluminescence detection; Disinfection; Evaluation; Relative Light Units (RLU); Microbial culture method

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Introduction

Cleaning and disinfecting environmental surfaces serve as critical measures to interrupt pathogen transmission and safeguard public health [1]. The assessment of disinfection efficacy has predominantly relied on conventional microbial culture techniques. However, the inherently lengthy turnaround time of these traditional methods significantly hinders the timeliness of on-site evaluations. Given the frequent occurrence of public health emergencies and the growing demands for infection prevention and control, the rapid on-site assessment of cleaning and disinfection has become increasingly urgent [2]. As an emerging rapid detection technology, Adenosine Triphosphate (ATP) bioluminescence quantifies the level of organic residue on environmental surfaces within seconds by Relative Light Units (RLU), thereby compensating for the limited timeliness of conventional culture-based methods. Although ATP bioluminescence serves as a practical surrogate indicator of surface cleanliness, it complements rather than replaces culture-based verification. Therefore, its applicability for the rapid on-site assessment of disinfection efficacy warrants further investigation.

Conventional microbial culture is widely recognized as the "gold standard" for evaluating the effectiveness of environmental cleaning and disinfection practices, playing an indispensable role in infection control and sanitary supervision. Environmental surface samples are collected, inoculated onto specialized culture media and quantified using colony counting methods to assess the degree of microbial contamination. Among these techniques, plate counting and coliform paper strip methods are commonly applied to monitor microbial loads in healthcare facilities, food processing and drinking water safety, providing fundamental quantitative data for assessing hygienic

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quality [3,4].

Conventional microbial culture methods are subject to several practical limitations. First, the turnaround time is prolonged; standard cultures require a minimum of 24-48 h and fastidious microorganisms may necessitate even longer incubation periods [5]. This delay undermines the ability of the results to reflect the real-time hygienic status of the sampled site. Consequently, disinfection interventions are typically delayed relative to contamination events and the optimal window for intervention may be missed [6]. Second, the detection range of conventional culture methods is limited. Many microorganisms in nature exist in a Viable But Non-Culturable (VBNC) state and cannot grow or multiply under routine culture conditions; thus, conventional methods tend to underestimate the actual microbial load of samples [7,8]. Furthermore, the accurate detection of microorganisms with stringent growth requirements or slow growth rates remains difficult, further complicating the comprehensive evaluation of disinfection efficacy.

Conventional microbial culture is operationally cumbersome, requiring multiple steps including sample collection, inoculation, incubation and colony counting [9]. Furthermore, the method demands a high level of technical proficiency from operators, rendering it unsuitable for large-scale, high-frequency and rapid on-site screening. Although culture-based confirmation remains the gold standard for field evaluation, its lengthy turnaround time, limited sensitivity and unidimensional assessment approach increasingly fail to meet the detection requirements of modern precision disinfection and rapid responses to public health emergencies [10].

ATP Bioluminescence Detection and Conversion with Colony-Forming Units (CFU)

ATP bioluminescence detection

ATP is the primary energy-carrying molecule in all living cells. Its relatively stable intracellular concentration makes it an ideal biomarker for evaluating cell viability and biomass load. ATP bioluminescence relies on the biochemical mechanism underlying firefly light emission. In the presence of Mg^{2+}, oxygen and ATP, luciferase catalyzes the oxidative decarboxylation of D-luciferin to yield oxyluciferin, emitting light at approximately 560 nm [11]. This enzymatic reaction exhibits high sensitivity and specificity; within a certain range, luminescence intensity demonstrates a linear correlation with ATP concentration on a logarithmic scale. Photon signals are captured by a photomultiplier tube or a charge-coupled device and converted into electrical signals, from which RLU are calculated to indirectly reflect the biomass in the sample. Operationally, ATP bioluminescence detection generally involves 4 steps: Sampling, lysis, reaction and reading [12]. A swab is utilized to sample a specified surface, after which it is placed into a reaction tube pre-loaded with cell lysis buffer and luciferase reagent. The lysis buffer disrupts cellular structures and releases intracellular ATP, which immediately reacts with the reagent to produce a luminescence signal. Subsequently, the reaction tube is placed in a dedicated luminometer to measure signal intensity, with results displayed within seconds. The reading procedure is typically completed within 1 min.

RLU is the core metric output by ATP bioluminescence instruments. Its significance lies in characterizing the luminescence intensity of total ATP in a sample rather than directly indicating microbial counts [13,14]. Because ATP detectors from different manufacturers vary in photodetector performance, optical path design, reagent formulation and signal amplification factor the RLU values measured for the same standard ATP concentration can differ markedly among instruments. RLU is not a unit with an absolute physical dimension but a relative, instrument-specific optical quantification metric [15]. Within a given instrument and reagent system, RLU values are highly correlated with the ATP concentration in the sample under defined conditions, reflecting the sample's biomass load, including microbial counts and organic residue levels.

Conversion between RLU and CFU

The conversion of RLU to CFU is premised on the assumption that the intracellular ATP content remains relatively constant in viable microbial cells. Existing studies have reported that the average ATP content per bacterial cell during the exponential growth phase is approximately 10^{-15} to 10^{-16} mol. Based on these calculations, a standard curve can be constructed to facilitate the mathematical conversion between RLU and CFU [16]. A study on the enumeration of total bacteria on eggshell surfaces demonstrated a strong positive correlation between ATP bioluminescence and the plate count method, further validating the feasibility of converting RLU to CFU [17]. Similarly, a well-fitted mathematical model has been established between ATP luminescence values and the logarithm of bacterial concentration, enabling the real-time estimation of airborne bacterial contamination during microbial monitoring [18].

However, the conversion of RLU to CFU lacks universal applicability across all scenarios. ATP bioluminescence quantifies “total biomass” by measuring ATP from all sources, including bacteria, fungi, somatic cells, biofilms and free organic matter. In contrast, CFU reflects only the number of viable organisms capable of forming visible colonies under specific culture conditions. Consequently, these two metrics differ fundamentally in their physical meaning [19]. When substantial non-microbial organic residues (*e.g.,* blood, secretions) are present on environmental surfaces, RLU values may be markedly elevated while CFU values remain low, thereby introducing bias into the conversion. Scientifically, RLU is more appropriately interpreted as a composite indicator of

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"surface cleanliness" or "biological contamination risk" [19]. Therefore, any conversion must be based on empirical evidence derived from specific scenarios. Only by establishing context-specific correlation models can RLU thresholds be assigned clear hygienic significance [20].

Feasibility of the ATP Reduction Rate as an Indicator for Evaluating Cleaning and Disinfection

ATP reduction rate

In the evaluation framework for cleaning and disinfection, the core focus has shifted from absolute contamination levels to the degree of contamination removal, with the ATP reduction rate emerging as a core evaluation indicator that is both operationally feasible and scientifically sound. This indicator not only offsets systematic differences in baseline RLU values across various instrument systems but also eliminates assessment bias caused by varying initial contamination levels on environmental surfaces. Existing research demonstrates that standardized and effective cleaning and disinfection can markedly reduce post-disinfection ATP values [21,22].

The viability of adopting the ATP reduction rate as a benchmark for cleaning and disinfection is anchored in its direct correlation with microbial inactivation rates. Disinfectants not only inactivate microorganisms but also reduce the organic load on target surfaces. When evaluating the cleaning and disinfection efficacy of medical devices, the ATP reduction rate demonstrates strong synchronization with both residual protein removal rates and bacterial inactivation rates [23]. In studies assessing the cleaning and disinfection efficacy of animal transport vehicles, comparative analyses have validated that RLU decrease proportionally with microbial detection rates, enabling researchers to establish cleanliness grading standards based on the ATP reduction rate [24,25].

Comparison of synchronous detection between the two methods across different scenarios

A comparative analysis of ATP bioluminescence detection and conventional microbial culture counting for evaluating disinfection efficacy constitutes a critical foundational step in validating the practical applicability of ATP bioluminescence technology. In synchronized detection across diverse scenarios, the correlation between the two methods has demonstrated remarkable complexity.

In the assessment of disinfection efficacy, the shift in focus from the "absolute level of contamination" to the "degree of contamination removal" has made the ATP reduction rate a more practical and scientifically robust evaluation indicator [26]. Studies have shown that effective cleaning and disinfection can remove most of the biofilm on surfaces, resulting in a significant reduction in ATP values after disinfection. A study conducted in a hospital environment demonstrated that ATP values after disinfection were significantly lower than those before disinfection. Similarly, when evaluating hand hygiene efficacy, the reduction rates for ATP RLU and aerobic cultures reached 92.49% and 80.86%, respectively, after handwashing with antibacterial soap, reflecting the antimicrobial effect of hand hygiene [27].

Numerous studies have validated that these two methods demonstrate consistency in overall hygienic quality assessment. When applied to hospital environmental surface monitoring, despite a statistically significant difference in their disinfection qualified rates, the methods yielded highly consistent detection results regarding pre- and post-disinfection contamination trends, accurately capturing the improvement in cleanliness following disinfection. In assessing the cleaning efficacy of medical devices, ATP bioluminescence results generally aligned with those of other methods, collectively identifying inadequately cleaned devices. As ATP detection encompasses non-microbial organic residues, its sensitivity is typically higher than that of conventional bacterial culture.

In food contact surface monitoring, the negative detection rate of the coliform paper strip method exceeded the pass rate of the ATP method, suggesting that the ATP method can detect a broader range of active-substance contamination missed by conventional culture. Existing studies have predominantly relied on agreement tests to assess the concordance between the two methods. A study examining tableware in cafeteria settings found moderate to high agreement between the two approaches; however, their agreement decreased notably on rough tableware surfaces [28]. In the context of cosmetic microbial limit testing, the ATP bioluminescence method and the traditional plate count method showed no statistically significant differences, further validating the equivalence of the ATP method to conventional methods under specific testing conditions [29].

The results of the two methods may diverge markedly in specific application scenarios. In evaluating the cleaning efficacy of operating room environmental surfaces, existing studies have reported weak correlations between the two methods, with results sometimes diverging such that ATP values remain persistently high while microbial culture counts decline over time [30]. This phenomenon occurs because ATP detection measures organic residues that remain stable in the environment, whereas microorganisms gradually lose viability under dry conditions. When evaluating the cleaning efficacy of da Vinci surgical robot manipulator arms, the compliance rate obtained by the ATP method was lower than that obtained by magnifying glass visual inspection [31]. Further

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residual protein testing of instruments with inconsistent results demonstrated that all were non-compliant, indicating that the ATP method employs stricter criteria than visual inspection and differs from microbial culture in the dimension of contamination assessed.

Application and Threshold

Application in healthcare settings

Healthcare facilities constitute the primary frontline for infection prevention and control. The cleanliness of environmental surfaces directly impacts the safety of both patients and healthcare workers, as well as the reliability of experimental results. Consequently, healthcare settings represent a comparatively mature application scenario for ATP detection [32]. Within these facilities, Intensive Care Units (ICUs), operating rooms and high-touch surfaces in patient environments are priority targets for ATP monitoring [33]. In underutilized areas, such as radiology departments, a pass threshold of <200 RLU has been adopted for environmental cleaning, whereas <100 RLU serves as the benchmark for excellent performance. Continuous monitoring increased the cleaning pass rate from 82%-92% [34].

Across multiple hospitals in the Netherlands and Belgium, an RLU value exceeding 1000 was classified as "not clean" and utilized for cross-sectional comparisons of hygiene status among healthcare facilities [35,36]. Regarding the monitoring of medical device cleaning and disinfection, ATP pass thresholds (*e.g.,* <2000 RLU/device or <5000 RLU/device) for complex instruments detect residual contamination more sensitively than conventional visual inspection, thereby significantly improving the sensitivity of cleaning quality monitoring [31]. In endoscope cleaning monitoring protocols, researchers have established validated ATP bioluminescence thresholds and confirmed their efficacy for the rapid screening of residual contamination following the high-level disinfection of endoscopes [37].

Various studies have established RLU thresholds ranging from tens to several thousand contingents upon the instrument model, reagent type and target cleanliness requirements. For instance, a study conducted in an Intensive Care Unit (ICU) established a threshold of 250 RLU, whereas another study defined a lower pass threshold for patient bed units within intensive care settings [33]. This inconsistency in thresholds stems from variations in infection risk tolerance across clinical scenarios, as well as differences in instrument calibration. Consequently, establishing an RLU threshold applicable to a specific context necessitates large-scale empirical field data. Furthermore, methods such as Receiver Operating Characteristic (ROC) curve analysis should be employed to determine the optimal cutoff that balances sensitivity and specificity. To ensure the scientific validity and applicability of the established threshold, sampling and evaluation protocols must be strictly followed.

Practice in cleanliness evaluation

Public places are characterized by dense crowds and high mobility, rendering them high-risk areas for cross-infection. However, baseline cleanliness data for such settings have long been relatively scarce and the extended application of ATP detection technology provides an efficient tool for establishing these baselines. In the catering industry, pass limits set for ATP bioluminescence (*e.g.,* RLU <100) can effectively identify hygienic blind spots and prevent cross-contamination during the monitoring of tableware and kitchen utensils. In clinical settings, ATP bioluminescence is applied for the rapid detection of bacterial contamination on medical surfaces and the evaluation of disinfection efficacy. In the food industry, it is utilized to monitor the cleanliness of production equipment, thereby ensuring food safety. In domestic scenarios, ATP bioluminescence can be employed to assess the cleanliness of kitchen utensils and tableware [28,38]. The hygiene quality of hotels and conference venues directly influences guest experience and public health safety. Conventional hygiene inspections have long relied primarily on visual assessment, a practice that is highly subjective and leaves considerable blind spots. ATP detection enables the quantitative assessment of high-touch surfaces in guest rooms, such as bed linens, remote controls, faucets, conference tables and chairs and microphones. In railway food safety supervision and tableware hygiene monitoring, ATP bioluminescence has proven to be a simple, sensitive and immediate rapid detection method that effectively compensates for the time-consuming nature of the conventional coliform paper strip method [3,39]. Existing research confirms that the ATP method and the coliform paper strip method exhibit a certain degree of correlation when applied to tableware hygiene assessment. Leveraging the inherent advantages of ATP detection, particularly its capability for rapid on-site screening, it has emerged as the preferred method for establishing cleanliness baselines in public environments.

On-site rapid detection in infectious disease foci and public health emergencies

In responding to infectious disease epidemic foci and public health emergencies, the rapid on-site assessment of environmental contamination levels and disinfection efficacy is critical for containing epidemic spread [40]. Although conventional laboratory-based confirmation methods are accurate, they are time-consuming and rely on complex experimental procedures, failing to meet the timeliness requirements of on-site emergency response. Consequently, ATP bioluminescence detection, serving as a rapid and portable on-site screening tool, has demonstrated significant value in public health emergency response. When decontaminating environments contaminated with highly pathogenic agents such as the Ebola virus, the timely evaluation of on-site disinfection efficacy is of critical importance. Although ATP detection cannot specifically identify a given pathogen, it can rapidly

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determine whether disinfection measures have effectively removed potentially infectious materials from the environment by evaluating the reduction rate of the overall biological load, thereby providing immediate feedback for prevention and control decisions [41].

In public health emergency settings, ATP detection is often combined with rapid molecular testing techniques (*e.g.,* real-time fluorescent quantitative RT-PCR and point-of-care testing) to form a complementary evaluation system [42]. Molecular testing is used to confirm the presence or absence of a specific pathogen, whereas ATP detection evaluates the thoroughness of overall cleaning and disinfection of environmental surfaces. During outbreaks of mass fever or acute gastroenteritis, on-site personnel can use an ATP luminometer to conduct swab tests on bed units, bathrooms and public corridors within the epidemic-stricken area. If RLU values remain high after disinfection, this indicates that enhanced disinfection procedures must be repeated until the pre-set cleanliness threshold is reached, after which the lockdown can be lifted [43]. This "test-disinfect-retest" cycle achieves targeted precision disinfection and prevents the adverse effects of excessive or insufficient disinfection [44].

However, the on-site application of ATP detection during public health emergencies faces specific challenges. First, field environments are often complex and contain large amounts of interfering substances, such as blood, vomit and soil; these matrices can significantly compromise the accuracy of ATP detection. Second, epidemic foci typically contain high concentrations of residual chemical disinfectants, which can inhibit the luminescence reaction or yield false-negative results [45]. Therefore, to effectively apply ATP detection in public health emergency practice, rigorous on-site operating procedures must be implemented. These include completely drying surfaces prior to sampling, utilizing interference-resistant detection reagents and establishing positive and negative controls. Furthermore, rapid on-site testing protocols for public health emergencies should be integrated with risk assessment tools to ensure the scientific interpretation of test results. ATP detection can provide reliable and actionable decision support in emergency scenarios, thereby enhancing the scientific rigor and efficacy of on-site disinfection [41].

Conclusions

Rapid ATP bioluminescence detection, characterized by its speed, sensitivity and portability, has demonstrated practical utility in evaluating cleaning and disinfection protocols. To a certain extent, the ATP reduction rate reflects trends in microbial inactivation, providing real-time data support for field applications. However, ATP detection and conventional microbial culture fundamentally differ in their analytical targets. The consistency between these two methods is influenced by multiple factors, including variations in instruments and reagents organic residues and chemical interference. Consequently, the ATP method cannot fully replace conventional microbial culture techniques but serves as an effective complement to existing evaluation systems.

Author Contributions

Chunai Tao: Investigation, methodology, project administration, supervision, visualization, writing and original draft.

Jinnan Chen: Investigation, writing, review & editing.

Yongxin Gan: Conceptualization, methodology, project administration, supervision, validation and visualization.

Conflict of Interest Statement

The authors declare no conflicts of interest.

Funding Declaration

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References

1. Boyce JM (2021) A review of wipes used to disinfect hard surfaces in health care facilities. American journal of infection control 49: 104-114. [Crossref] [Google Scholar] [Indexed]

2. Tseng W, Wang Y, Chen W, et al. (2025) Corrigendum to Utilizing an adenosine triphosphate bioluminescence assay as an indicator of instrument and environmental cleanliness in the radiology department: A pilot study. Infect Prev Pract 7: 100466. [Crossref] [Google Scholar] [Indexed]

3. Tang Y, Sun J, Dong D, et al. (2023) Comparison of coliform paper test and ATP bioluminescence assay for monitoring the disinfection of kitchen utensils in canteens of Hebei, China. Heliyon 9: e14839. [Crossref] [Google Scholar] [Indexed]

4. Ejsmentewicz T, Gonzalez-Stegmaier R, Asis F, et al. (2026) A PBMC-based assay detects residual pro-inflammatory response in endoscopes after high-level disinfection undetected by ATP bioluminescence: A pilot study. The Journal of Hospital Infection: S195-S6701. [Crossref] [Google Scholar] [Indexed]

5. Gur'Ev AS, Tigasson M, Shalatova OY, et al. (2022) Fast antibiotic susceptibility testing of urine microflora using a microbiological analyzer based on coherent fluctuation nephelometry. Brazilian Society for Microbiology 53: 195-204. [Crossref] [Google Scholar] [Indexed]

6. Mutschlechner M, Chisté D, Schöbel H (2024) Breaking the mold: Towards rapid and cost-effective microbial contamination detection in paints and cosmetics using ATP-bioluminescence. Applied Microbiology 4: 582-593. [Crossref] [Google Scholar]

7. Liu J, Yang L, Kjellerup BV, et al. (2023) Viable But Nonculturable (VBNC) state, an underestimated and controversial microbial survival strategy. Trends in Microbiology 31: 1013-1023. [Crossref] [Google Scholar] [Indexed]

8. İzgördü ÖK, Darcan C, Kariptaş E (2022) Overview of VBNC:

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A survival strategy for microorganisms. 3 Biotech 12: 307. [Crossref] [Google Scholar] [Indexed]

9. Lin W, Xie F, Li X, et al. (2023) Diagnostic performance of metagenomic next-generation sequencing and conventional microbial culture for spinal infection: A retrospective comparative study. European Spine Journal: Official Publication of the European Spine Society 32: 4238-4245. [Crossref] [Google Scholar] [Indexed]

10. Soffritti I, D'Accolti M, Cason C, et al. (2022) Introduction of probiotic-based sanitation in the emergency ward of a children's hospital during the COVID-19 pandemic. Infection and Drug Resistance 15: 1399-1410. [Crossref] [Google Scholar] [Indexed]

11. Liu S, Zhao J, Guo Y, et al. (2023) Application of ATP-based bioluminescence technology in bacterial detection: A review. The Analyst 148: 3452-3459. [Crossref] [Google Scholar] [Indexed]

12. Letsch FG, Welch MW, Meyer M, et al. (2024) Evaluation of ATP bioluminescence for rapid determination of cleanliness of livestock trailers after a commercial wash. Translational Animal Science 8: 52. [Crossref] [Google Scholar]

13. Reyes SN, Rodriguez R, Murias A, et al. (2025) Tandem bioluminescent tests for rapid detection of urinary tract infections and antimicrobial resistance using a portable luminometer. Analytical Chemistry 97: 16628-16638. [Crossref] [Google Scholar] [Indexed]

14. Matsui A, Niimi H, Uchiho Y, et al. (2019) A rapid ATP bioluminescence-based test for detecting levofloxacin resistance starting from positive blood culture bottles. Scientific reports 9: 13565. [Crossref] [Google Scholar] [Indexed]

15. Calabretta MM, Alvarez-Diduk R, Michelini E, et al. (2022) ATP sensing paper with smartphone bioluminescence-based detection. Methods in Molecular Biology 2525: 297-307. [Crossref] [Google Scholar] [Indexed]

16. Li G, Yu T, Wu Q, et al. (2017) Development of an ATP luminescence-based method for assimilable organic carbon determination in reclaimed water. Water Research 123: 345-352. [Crossref] [Google Scholar] [Indexed]

17. Cheng JB, Li MD, Liu J, et al. (2017) Study on the correlation of different methods for detecting the total bacterial count on egg surfaces. Acta Laser Biology Sinica 26: 260-265.

18. Chen M, Qi JC, Li LJ, et al. (2020) Study on the application of ATP bioluminescence method in the monitoring and evaluation of airborne microorganisms. Military Medical Sciences 44: 523-529.

19. van Arkel A, Willemsen I, Kluytmans J (2021) The correlation between ATP measurement and microbial contamination of inanimate surfaces. Antimicrobial Resistance and Infection Control 10: 116. [Crossref] [Google Scholar] [Indexed]

20. Kotsiou OS, Gouta E, Natsaridis N, et al. (2026) The role of ATP bioluminescence in monitoring surface hygiene in hospital settings: A comprehensive review. Antimicrobial Resistance and Infection Control 15: 44. [Crossref] [Google Scholar] [Indexed]

21. Bernardes LDO, Dos Santos FR, Angeloni NLN, et al. (2023) Monitoring of surface cleaning and disinfection in a Brazilian pediatric unit. Therapeutic Advances in Infectious Disease 10: 2008382823. [Crossref] [Google Scholar] [Indexed]

22. Moazzami M, Gröndal H, Hansson I, et al. (2025) Challenges in cleaning and disinfection and environmental monitoring in Swedish slaughterhouses. Acta Veterinaria Scandinavica 67: 47. [Crossref] [Google Scholar] [Indexed]

23. Chan ASF, Chan HLY, Yan BKL, et al. (2023) Effectiveness of adenosine triphosphate to monitor manual cleaning and disinfection efficacy of flexible endoscopes in Hong Kong. JGH Open: An Open Access Journal of Gastroenterology and Hepatology 7: 141-147. [Crossref] [Google Scholar] [Indexed]

24. Moazzami M, Bergenkvist E, Boqvist S, et al. (2023) Assessment of ATP-bioluminescence and dip slide sampling to determine the efficacy of slaughterhouse cleaning and disinfection compared with total aerobic and Enterobacterales counts. Journal of Food Protection 86: 100155. [Crossref] [Google Scholar] [Indexed]

25. Johnson DC, Leal LA, Perez JG, et al. (2024) Evaluation of ATP bioluminescence for rapid determination of farrowing room cleanliness after pressure washing at a commercial sow farm. Translational Animal Science 8: 138. [Crossref] [Google Scholar] [Indexed]

26. Li F, Guo L, Song XJ, et al. (2016) Evaluation and analysis of disinfection effect using ATP bioluminescence detection and microbial bacterial culture counting methods. Chinese Community Doctors 32: 119-120.

27. Tao C, Yan S, Qin J, et al. (2026) Real-time feedback of ATP bioluminescence in evaluating the handwashing efficiency of healthcare personnel. Journal of Biology and Health Science 3. [Crossref] [Google Scholar]

28. Yu RM, Wang M, Tong L, et al. (2016) Application of ATP bioluminescence method to evaluate the hygiene status of tableware and kitchen utensils in military canteens. Journal of Preventive Medicine of Chinese People's Liberation Army 34: 812-814.

29. Liu S, Ge YY, Hong HJ, et al. (2025) Validation study of ATP bioluminescence amplification 24h detection method for qualitative microbiological testing of cosmetics. Journal of Daily Chemical Science 48: 12-17. [Crossref] [Google Scholar]

30. Tong H, Zhu R, Ding J, et al. (2025) Comparison of cleaning effects of vacuum-assisted boiling washer-disinfectors on rigid endoscopic instruments: Impact of cleaning cycle parameters. The Journal of Hospital Infection 163: 98-104. [Crossref] [Google Scholar] [Indexed]

31. Mo JJ, Huang F, Shen HM, et al. (2020) Application of ATP bioluminescence method in detecting the cleaning effect of da Vinci robotic arms. Nursing and Rehabilitation 19: 71-73.

32. Tršan M, Vehovc M, Seme K, et al. (2020) Evaluation of ATP bioluminescence for monitoring surface hygiene in a hospital pharmacy cleanroom. Journal of Microbiological Methods 168: 105785. [Crossref] [Google Scholar] [Indexed]

33. Deshpande A, Dunn AN, Fox J, et al. (2020) Monitoring the effectiveness of daily cleaning practices in an Intensive Care Unit (ICU) setting using an Adenosine Triphosphate (ATP) bioluminescence assay. American Journal of Infection Control 48: 757-760. [Crossref] [Google Scholar] [Indexed]

34. Wang Y, Chen W, Lin K, et al. (2025) Utilizing an adenosine

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triphosphate bioluminescence assay as an indicator of instrument and environmental cleanliness in the radiology department: A pilot study. Infection Prevention in Practice 7: 100449. [Crossref] [Google Scholar] [Indexed]

35. van Arkel A, Willemsen I, Schuermans A, et al. (2026) Assessing environmental contamination in Dutch and Belgian nursing homes: A cross-border ATP-based study. The Journal of Hospital Infection 169: 29-34. [Crossref] [Google Scholar] [Indexed]

36. van Arkel A, Willemsen I, Kilsdonk-Bode L, et al. (2020) ATP measurement as an objective method to measure environmental contamination in 9 hospitals in the Dutch/Belgian border area. Antimicrobial Resistance and Infection Control 9: 77. [Crossref] [Google Scholar] [Indexed]

37. McCafferty CE, Abi-Hanna D, Aghajani MJ, et al. (2018) The validity of adenosine triphosphate measurement in detecting endoscope contamination. The Journal of Hospital Infection 100: 142-145. [Crossref] [Google Scholar]

38. Li CX, Qin MT, Li HL, et al. (2018) Consistency test between the paper strip method and ATP bioluminescence detection method in tableware disinfection. Journal of Preventive Medicine of Chinese People's Liberation Army 36: 804-805. [Crossref] [Google Scholar] [Indexed]

39. Yu HJ, Tang W, Ji CP (2015) A brief discussion on the application of ATP rapid detection in railway food safety supervision and management. Journal of Disease Monitoring and Control: 354-356.

40. Newell BJ, Pittman JC, Pagano HP, et al. (2016) Responding to the 2014 Ebola outbreak: The value of effective interprofessional communication during emergency response. Disaster Medicine and Public Health Preparedness 10: 639-640. [Crossref] [Google Scholar] [Indexed]

41. Alharbi NK, Alariqi L, Mantero J, et al. (2025) Methods and tools for rapid risk assessments for acute public health emergencies. Journal of Infection and Public Health 18: 102965. [Crossref] [Google Scholar] [Indexed]

42. Chadwick S, Townes DA, Perrone LA (2021) Utility of point of care and rapid diagnostics in humanitarian emergencies. The Journal of Applied Laboratory Medicine 6: 236-246. [Crossref] [Google Scholar] [Indexed]

43. Li Y, Ren X, Jia M, et al. (2019) Application of UPT-POCT in public health emergencies. Springer: 187-190. [Crossref] [Google Scholar]

44. Lee CY, Degani I, Cheong J, et al. (2021) Development of integrated systems for on-site infection detection. Accounts of Chemical Research 54: 3991-4000. [Crossref] [Google Scholar] [Indexed]

45. Omidbakhsh N, Ahmadpour F, Kenny N (2014) How reliable are ATP bioluminescence meters in assessing decontamination of environmental surfaces in healthcare settings? PloS one 9: 99951. [Crossref] [Google Scholar] [Indexed]

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