

# Evaluation of Autonomous Cleaning Robots in Reducing Hospital Acquired Infections: A Comparative Study

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## Abstract

Hospital Acquired Infections (HAIs) pose significant challenges to healthcare systems worldwide, leading to increased morbidity, mortality, and healthcare costs. The advent of autonomous cleaning robots presents a novel approach to enhancing environmental cleanliness and reducing the incidence of HAIs. This paper presents a comprehensive comparative study on the effectiveness of autonomous cleaning robots versus traditional manual cleaning methods in reducing HAIs in healthcare settings. We systematically analyze data from various healthcare facilities that have implemented robotic cleaning technologies, comparing infection rates, cost-effectiveness, and overall efficiency. Our findings suggest that autonomous cleaning robots significantly reduce the incidence of HAIs, demonstrating not only superior cleaning efficiency but also the potential to save lives and reduce healthcare expenditures. The study also explores the technological advancements in autonomous cleaning robots, including UV-C disinfection, HEPA filtration, and smart navigation systems, which contribute to their effectiveness. This paper contributes to the ongoing discussion on integrating innovative technologies in healthcare to improve patient safety and operational efficiency.

## Background

Hospital Acquired Infections (HAIs) are infections that patients acquire during their stay in hospitals or other healthcare facilities, which were not present or incubating at the time of admission. These infections can be caused by a wide range of pathogens, including bacteria, viruses, and fungi, and are a significant source of morbidity and mortality globally. Traditional cleaning methods, while effective to a degree, have limitations in consistency, coverage, and the ability to eliminate all pathogens, especially those resistant to standard cleaning agents. In contrast, autonomous cleaning robots offer a promising solution by providing thorough and consistent cleaning, leveraging advanced technologies such as UV-C light for disinfection and HEPA filters to capture airborne pathogens.

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### Main Findings

1. **Infection Rate Comparison:** Autonomous cleaning robots have been shown to significantly reduce the rate of HAIs in healthcare facilities. Studies indicate a marked decrease in infection rates in areas serviced by these robots compared to those relying on manual cleaning methods.
2. **Technological Advancements:** The success of autonomous cleaning robots in reducing HAIs can be attributed to their use of advanced technologies. UV-C disinfection technology, for instance, has proven effective in killing a wide range of pathogens, including multi-resistant organisms, by damaging their DNA or RNA. Similarly, HEPA filtration systems capture and remove from the air particles as small as 0.3 microns, including pathogens, thus reducing the risk of airborne transmission.
3. **Cost-Effectiveness:** While the initial investment in autonomous cleaning robots may be higher than traditional cleaning methods, the long-term savings are significant. Reduced incidence of HAIs translates into lower healthcare costs associated with treating these infections, shorter hospital stays, and decreased need for antibiotics, which also helps in combating antibiotic resistance.
4. **Efficiency and Consistency:** Robots provide consistent cleaning quality, covering areas that may be overlooked or inaccessible to human cleaners. Their ability to work around the clock without fatigue further enhances their efficiency and effectiveness in maintaining a clean and safe hospital environment.

5. **Challenges and Limitations:** Despite their benefits, the integration of autonomous cleaning robots into healthcare facilities faces challenges, including the high initial cost, the need for technical support and maintenance, and potential resistance from cleaning staff. Additionally, robots cannot completely replace human judgment and may require human intervention for complex cleaning tasks.

### **Conclusion**

The evaluation of autonomous cleaning robots in reducing Hospital Acquired Infections (HAIs) demonstrates their potential as a valuable complement to traditional cleaning methods in healthcare settings. By leveraging advanced technologies, these robots offer a more efficient, consistent, and effective means of reducing the incidence of HAIs, ultimately contributing to safer healthcare environments. However, for their full potential to be realized, healthcare facilities must address the challenges associated with their integration, including cost, technical support, and staff training. Future research should focus on long-term outcomes, integration strategies, and patient safety impacts to further validate the role of autonomous cleaning robots in healthcare.

### References

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