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Letter to Editor

Implementing Sustainable Solutions in Medical/Biomedical Laboratories to Cope With Global Warming Challenges

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Dear editor,

In recent years, the urgency of adopting sustainable practices in biomedical research has become more apparent (1). My eight-year tenure as a senior researcher and manager in Iran and the UK highlighted the critical need for innovative solutions to counteract environmental challenges such as water scarcity and frequent power cuts. These issues, exacerbated by global warming and mismanagement of resources, threatened the continuity of our research activities and the preservation of vital data. These initiatives not only improved operational efficiency but also resulted in significant cost savings and reduced environmental impact. Effective leadership and comprehensive training were key to the successful implementation and sustainability of these solutions. The research center now serves as a model for sustainability in biomedical research, with plans to expand renewable energy use and optimize resource efficiency further.

Challenges Faced

Iran's arid climate, coupled with inefficient water resource management, posed significant obstacles to our research operations (2). Frequent power outages disrupted our work most of the year, especially in the summertime, particularly affecting data preservation in temperature-sensitive environments. Moreover, the scarcity of reliable water supply further complicated our scientific endeavors. Biomedical research activities, requiring strict temperature controls and continuous power, faced significant operational risks due to these environmental challenges.

Innovative Solutions Implemented

To address these challenges, a strategic initiative was devised, concentrating on harnessing renewable energy and optimizing water resources. Our approach involved the following key steps:

1. **Solar energy adoption**: Capitalizing on Iran's abundant sunshine, the installation of a photovoltaic solar energy system has been proposed, the implementation of which involves detailed analysis and selection of high-efficiency solar panels capable of providing a stable and continuous power supply (3). This system includes battery storage units to store excess energy, ensuring power availability during cloudy days and at night. The solar energy system can also be integrated with the existing power infrastructure, significantly reducing dependency on the unreliable national grid.
2. **Microscale water harvesting**: A microscale water harvesting system has been proposed, which is designed to capture and store seasonal snowfall and occasional rain. This system utilizes a network of gutters and storage tanks equipped with filtration units to ensure the purity of the harvested water (4). The stored water shall be used for various laboratory needs, including cooling systems for sensitive equipment and maintaining controlled environments for biological samples. The efficient use of harvested water reduced our reliance on municipal water supplies, which were often inconsistent and highly contaminated with heavy metals and toxic chemicals.

Scientific and Operational Outcomes

The adoption of these sustainable solutions will significantly improve the laboratory's resilience and operational efficiency. The solar panels will provide a reliable power source, safeguarding our critical research data stored in -20 °C freezers. With uninterrupted power,

we could maintain the integrity of our biological samples and ensure the continuity of long-term experiments (5). The water harvesting system ensured a consistent water supply, enabling uninterrupted research activities. Additionally, the quality and purity of harvested water were rigorously tested, meeting the stringent standards required for biomedical research applications.

Financially, these initiatives resulted in substantial cost savings. By reducing electricity costs through solar energy, it was possible to allocate more funds toward advanced research activities. Furthermore, the reduction in water costs allowed us to invest in state-of-the-art laboratory equipment and resources, enhancing the overall research capability of our center. Environmentally, these efforts minimized our carbon footprint and set a precedent for sustainable practices in the biomedical research community.

Leadership and Change Management

Effective leadership is crucial in driving these changes. Employing a combination of transformational and democratic leadership styles, our team is engaged and motivated, fostering a collaborative and innovative work environment. Regular communication, active listening, and conflict resolution are key strategies that facilitate the smooth implementation of these initiatives. The collaborative approach not only encourages team members to contribute innovative ideas but also ensures their commitment to sustainable practices (6).

To manage the transition, it is proposed that comprehensive training sessions be held on the operation and maintenance of the new systems. These sessions can equip the team with the necessary skills to handle any technical challenges that arise, ensuring the sustainability of our initiatives. Regular feedback loops were established to address concerns and continuously improve our practices.

Evaluation and Future Prospects

The success of our initiatives can be evaluated through comprehensive data collection on energy consumption, water usage, and environmental impact. Aligning our efforts with sustainable development goals, tools such as the Sustainability Scorecard and Environmental Impact Assessments were used to measure progress and identify areas for improvement. The collected data indicated a significant reduction in energy consumption from non-renewable sources and a marked decrease in water wastage.

Moving forward, our research center aims to serve as a model for sustainability in biomedical research. The future step toward a more sustainable medical research center is the implementation of use of organic and natural resources such as bacteria (7), wild and rare medicinal plants (8), as well as antibiotics, antivirals, or potential chemotherapeutic agents (9), which have already been initiated by my team during the coronavirus disease 19 outbreak (10-12) and toward cancer treatment. By continuing to innovate and refine our practices, it is hoped that other institutions facing similar challenges be inspired to adopt sustainable solutions. Our plans include expanding the solar energy system to cover more aspects of our energy needs and further optimizing our water harvesting techniques to increase efficiency and output.

Conclusion

The journey of implementing sustainable solutions in a biomedical research center has been transformative. By addressing the dual challenges of power cuts and water scarcity, we have not only planned to enhance our operational efficiency but also contributed to a greener and more resilient future. Other research centers facing similar environmental challenges must consider adopting renewable energy and water resource optimization strategies to ensure the sustainability of their scientific endeavors.

Competing Interests

None.

Ethical Approval

Not applicable.

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