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Principal Component Analysis for Identifying Key Indoor Air Quality Factors in a Healthcare Facility

[Analisis Komponen Utama untuk Mengenal Pasti Faktor Kualiti Udara Dalamannya Utama di Fasilitas Penjagaan Kesihatan]

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Abstract

Effective management of indoor air quality (IAQ) is essential in healthcare settings, serving as a key element in supporting sustainability through patient comfort and staff well-being. This study aims to establish a baseline IAQ dataset as part of sustainability programs (SP) in Malaysian government healthcare facilities and determine primary contributors for IAQ variability by Principal Component Analysis (PCA). IAQ assessment was conducted in four departments at Hospital Kuala Lumpur, Endoscopy Clinic (EC), Psychiatric Clinic (PC), Cytotoxic Drug Reconstitution (CDR), and Information Technology (IT) based on the Industry Code of Practice on Indoor Air Quality (ICOP on IAQ 2010). Eleven parameters were measured, and PCA was performed using XLSTAT 2019 software to identify dominant influencing IAQ parameters. Results showed most IAQ parameters complied with acceptable ranges; however, deviations were observed in air temperature (21.43 ± 0.61 °C), air movement (0.13 ± 0.01 m/s), relative humidity ($68.85 \pm 5.38\%$), and carbon dioxide (CO₂) concentration (760.5 ± 413.63 ppm), particularly at P6-PC where CO₂ peaked at 1380 ppm. One-way ANOVA and Tukey post hoc tests showed statistically significant differences ($p < 0.001$) in CO₂ and RH across departments. PCA results identified CO₂, total bacterial count (TBC), and total fungal count (TFC) as dominant contributors, with loadings exceeding 0.75.

Variations in occupancy and ventilation performance were the main contributors to IAQ differences between departments. This study underscores the importance of targeted IAQ interventions tailored to departmental functions and reinforces the role of PCA supported IAQ assessment in advancing sustainable healthcare facility management. © 2026, Penerbit Universiti Kebangsaan Malaysia. All rights reserved.

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Healthcare facilities; indoor air quality; sustainability management

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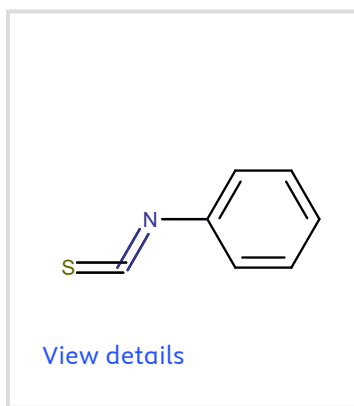
GEOBASE Subject Index

air quality; carbon dioxide; health care; indoor air; principal component analysis; sustainability; ventilation

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