

Pollution, Biomarkers, and Health

A Systematic Scoping Review for Indoor-Building-Human Research

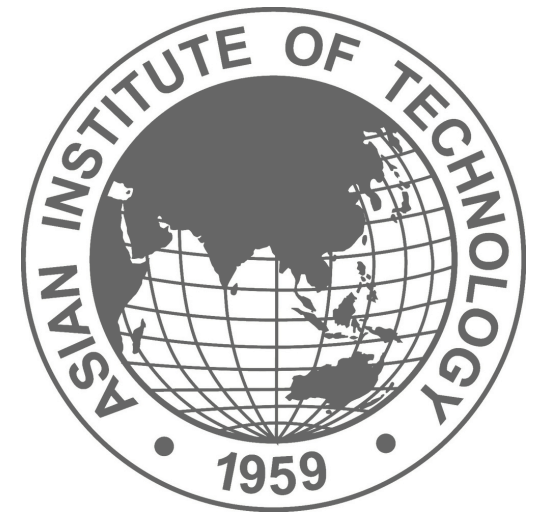
Matilda Subek Simon¹, Prachi Dave^{1,4}, Mohammed Medawj^{1,4}, Mahmoud Salih^{1,4}, Worravit Nakpan², Lai Nguyen Huy³, Patthrarawalai Sirinara², Zahra Hadipour¹, Indira Pandey¹, Sana Rauf¹, Kim Oanh Nguyen³, Kiat Ruxrungtham², Bumi Herman², Piyanuch Prongfa², Suttipong Wacharasindhu², Somporn Kamolsiripichaiporn², Tobias Bader^{1,4}, Sabine Dittrich¹

¹Deggendorf Institute of Technology (DIT), ECRI, Pfarrkirchen, Germany

²Chulalongkorn University (Thailand)

³Asian Institute of Technology (Thailand)

⁴Deggendorf Institute of Technology (DIT), TC Mainburg, Mainburg, Germany



Introduction

Air pollution is a major global health risk, affecting multiple biological systems and contributing to a wide range of health outcomes. Because people spend most of their time indoors, buildings act as key exposure mediators between outdoor environmental conditions and indoor air quality, shaping human health responses.

Biomarkers, symptoms, and health outcomes are used to assess these effects, yet gaps remain in identifying sensitive indicators and indicators specific to vulnerable populations. Consolidating this evidence is essential to inform future research linking outdoor conditions, buildings, indoor air quality, and human health.

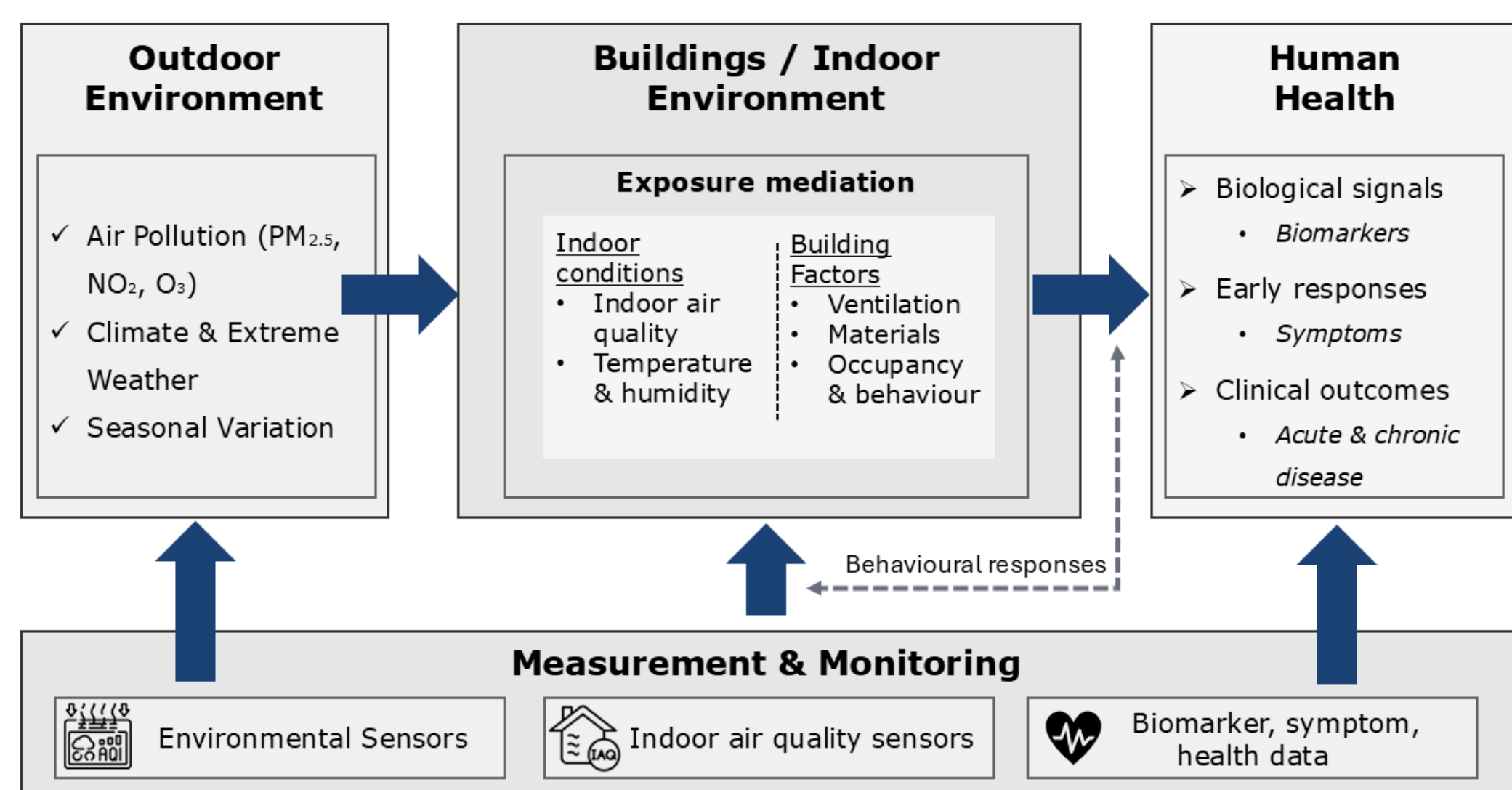


Figure 1. Conceptual framework linking outdoor environment, buildings, and human health.

Methods

Systematic synthesis of existing evidence is the basis of evidence-based public health and medicine. Systematic reviews provide a transparent and reproducible foundation for identifying relevant biomarkers, symptoms, and health outcomes to inform future research and policy.

A PRISMA-guided scoping review of PubMed, Ovid MEDLINE, and the Cochrane Library (2019–2025) was conducted using a predefined protocol, comprehensive literature searches, and standardized screening and data extraction.

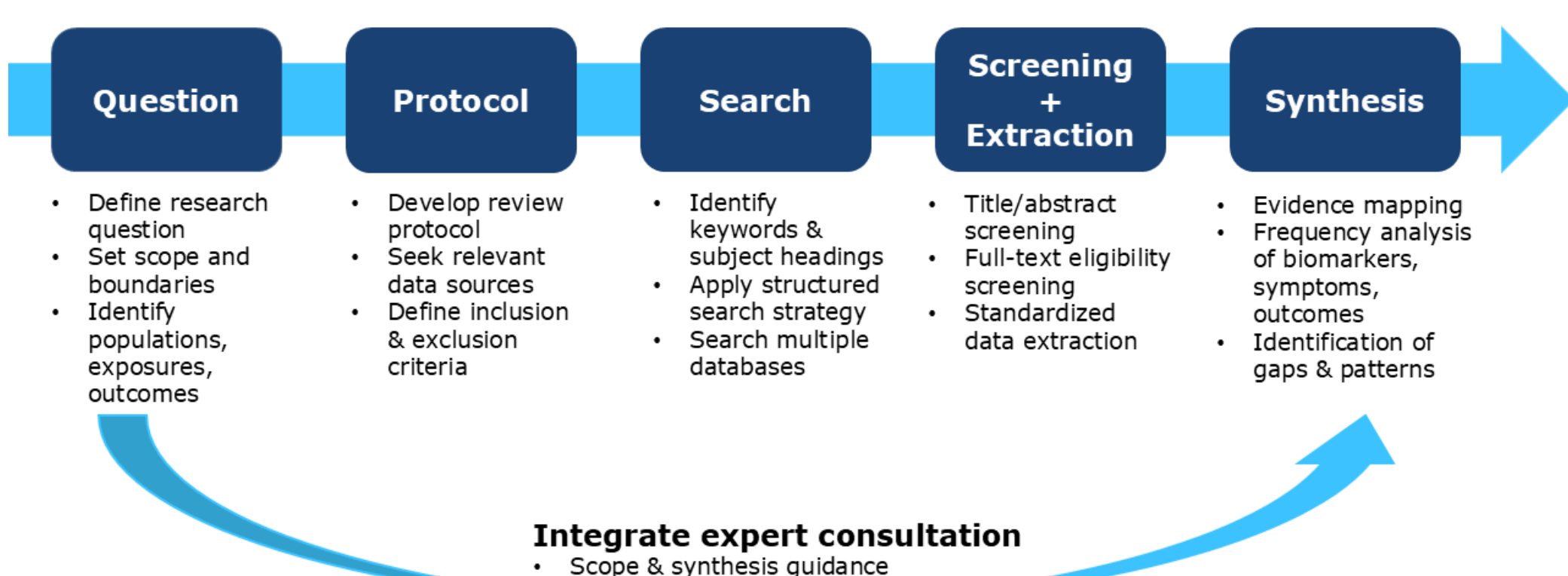


Figure 2. Systematic review workflow.

Results (Ongoing)

Most frequently reported biomarkers, symptoms and health outcomes include:

- Cardiovascular markers: Systolic Blood Pressure (SBP), Diastolic BP, general Blood Pressure
- Lung function markers: FVC, FEV₁, Peak Expiratory Flow
- Respiratory diseases: Asthma, COPD
- Inflammatory markers: CRP, IL-6, IL-8, TNF- α

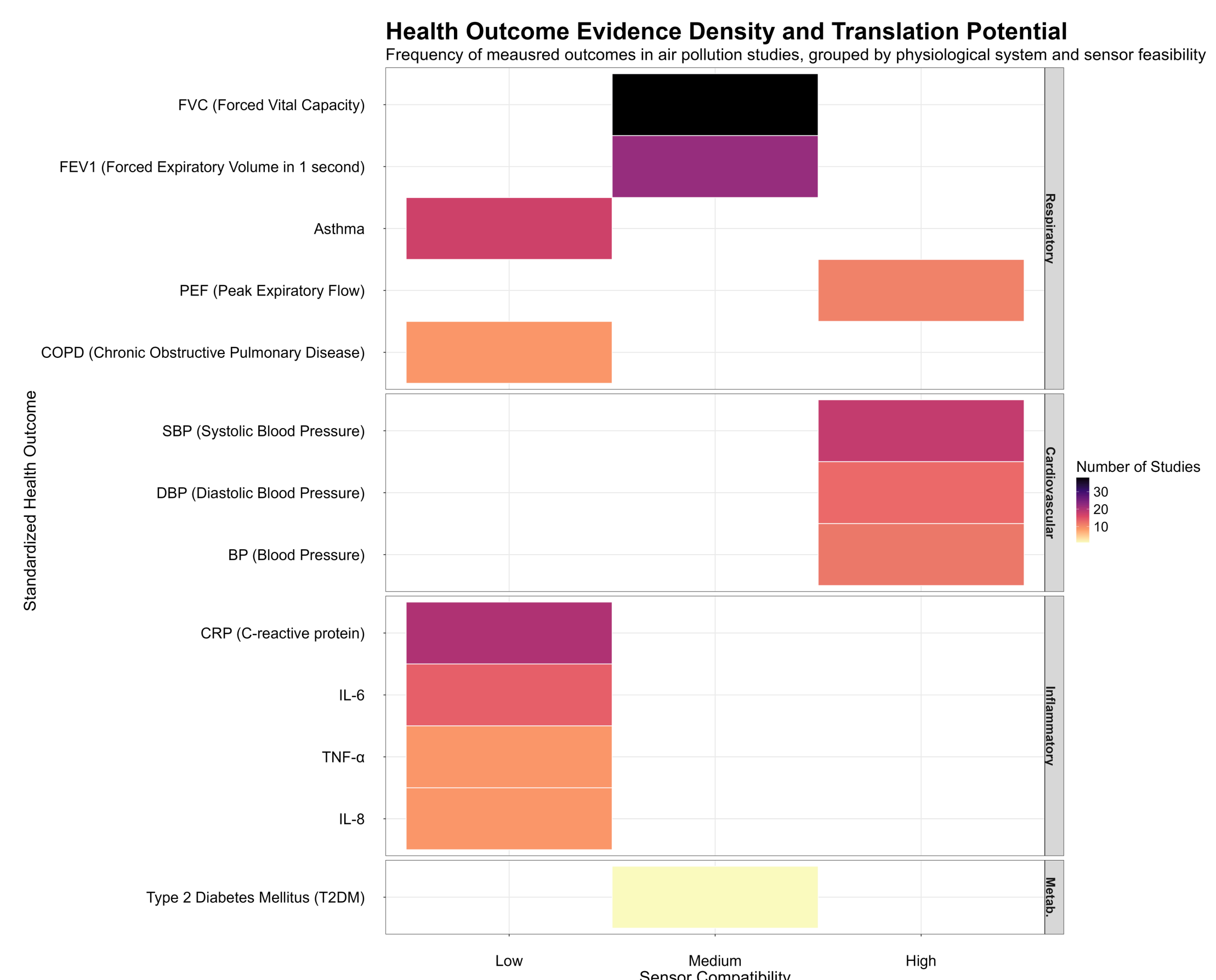


Figure 2. Heatmap of marker frequency distribution, physiologic system and sensor compatibility.

Sensor compatibility indicates how easily biomarkers can be monitored in real-world settings, guiding which measures are practical for routine surveillance or intervention (Table 1).

Table 1. Conceptual / translational classification based on current monitoring technologies.

High	Routinely measurable with non-invasive or wearable sensors
Medium	Requires clinical-grade devices but feasible for periodic monitoring
Low	Requires lab-based assays or diagnosis

Foundation for Future Work

This ongoing scoping review identifies key pollution-related biomarkers, symptoms, and health outcomes, with a focus on inflammatory, respiratory, and cardiovascular indicators. The findings can inform the translation of biological signals into sensor-based monitoring and their integration into indoor environments, while also helping to conceptualize future clinical monitoring studies. Continued analysis will further highlight research gaps, harmonize outcome selection, and guide interventions to reduce pollution-related health risks.

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References

