



Characterizing distribution of airborne microbial pollutants due to human activities in hospital environments

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Project Context, Research Gap & Experiment(Planning and Setup)



Study Motivation:

- Airborne particles generated by surgical staff are a major contributor to SSI risk
- Impact of staff activity intensity is often mentioned but not systematically defined

Objective:

- To experimentally characterize the generation and short-range distribution of airborne particles caused by human activities in an operating room environment, under different ventilation conditions.
 - Standardized movement scenarios with different intensity levels
 - Human volunteers instead of breathing manikin
 - Enables controlled comparison across different operational conditions and ventilation layouts

Study Sites

- **Simulated full-scale Operating Room Laboratory/OR Lab (NTNU):**
 - Controlled environment for protocol development, training, preliminary testing and some achievable experiments within the controlled environment and body box chamber study .
- **Hospital Operating Room (St. Olav's Hospital):**
 - Realistic/Real-world application, in-situ validation of findings and protocols.

Experimental Part

- Optical Particle Counters (OPCs)/Alphasense OPC-N3 for particle concentration and size distribution at multiple locations within the OR lab.
- Simultaneous CFU along PM measurements as the next step at St.Olav Hospital

Numerical Simulation

- CFD Software

Investigated/Variable parameters

Controlled parameters:	Control measure:
Movements and activity level	A predefined movement and action plan for each member of the staff

Controlled parameters

Controlled parameters:	Control measure:
Number of persons	4 staff members and 1 patient (manikin)
Staff members and patient	Same person for each role for all mock surgeries
Door openings	0
Talking	-
Electrocautery	No use of electrocautery
Operation length	variable
Clothing	Same for each role for all mock surgeries

Test Facility

- Full-scale operating room laboratory(Dimensions: **7.0 × 8.7 × 3.1 m**)
- Airflow rate range: **3800–14530 m³/h**
- Ventilation Systems: **Mixing ventilation (MIX) and Laminar airflow (LAF)**



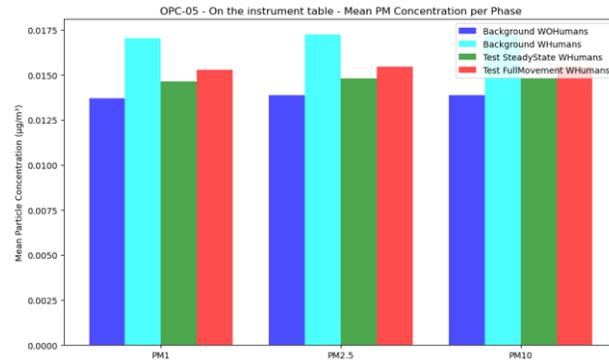
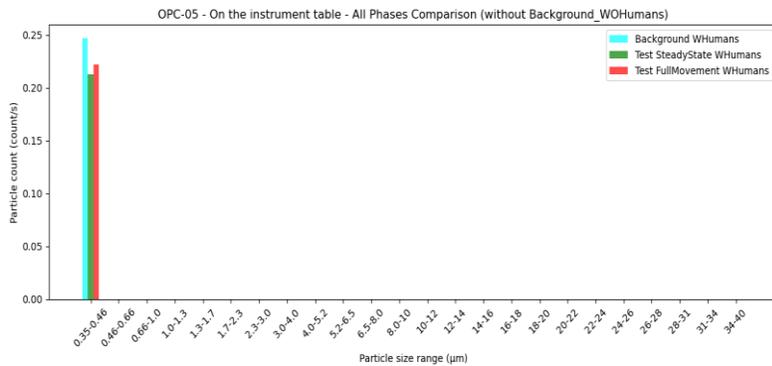
Training Sessions & Preliminary Results



- **Human Volunteers**
 - Volunteers acting as surgical staff
 - Thermal manikin representing the patient
- **Training Session (Key Methodological Step)**
 - Volunteers trained to perform repeatable, well-defined and standardized movements
 - Follow predefined activity protocols gained by observing real surgery at St.Olav hospital (Hip arthroplasty surgery)

From Surgical Task to Experimental Movement
 Observed task → Abstract movement → Defined duration & frequency

Preliminary Results:



Expected Result	Current Contribution
Experimental protocol	Human-volunteer-based, controlled OR protocol
Source characterization	Activity-intensity-based particle generation
Short-range distribution	OPC measurements at critical microenvironment locations
Modeling input	Intensity-based source terms
Risk assessment	Future phases



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