

Characteristics of particles concentration in a paediatric intensive care unit (PICU)

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The PICU provides intensive care services to critically ill neonates, infants, and children. However, unlike other indoor environments, the understanding of indoor air quality within the PICU is very limited.

We aimed to investigate indoor particle sources, the spatial distribution and variation of particle concentrations within an Australian hospital PICU (Royal Children’s Hospital, Brisbane) which had two isolation beds and 6 beds in an open plan arrangement.

Methods:

- Measurement: Indoor/outdoor total particle number (PN) concentration by TSI CPC 3787s, PM₁₀ concentration by TSI DustTraks, PN concentration in various locations by TSI P-Trak and CPC 3007.
- Two week measurements were conducted in August 2014.

Results:

- Both 24-hour average indoor PM₁₀ (0.6 – 2.2 μg m⁻³, median: 1.1 μg m⁻³) and PN (0.1 – 2.8 × 10³ p cm⁻³, median: 0.67 × 10³ p cm⁻³) concentrations are significantly lower (p < 0.01) than the outdoor concentrations (6.7 – 10.2 μg m⁻³, median: 8.0 μg m⁻³ for PM₁₀ and 12.1 – 22.2 × 10³ p cm⁻³, median: 16.4 × 10³ p cm⁻³ for PN).
- Based on daily 24-hour average indoor and outdoor PM₁₀ and PN concentrations, the relationships between indoor and outdoor concentrations for both PM₁₀ and PN were very weak (R² = 0.08). This implies that indoor concentrations were mainly affected by indoor sources, and not by outdoor air.
- The overall average PN concentration of the supply air ranged from 1.9 p cm⁻³ to 329 p cm⁻³, with a median value of 20.6 p cm⁻³.
- The overall filtration efficiency of the two stage filters (primary filter: fabric bag; secondary filter: high efficiency particulate air filter) was 99.99%, which is very close to the designed standard value of 100%.
- There were very strong indoor particle sources in the PICU, which could increase indoor PN and PM₁₀ concentrations from about 0.1 × 10³ (p cm⁻³) to above 100 × 10³ (p cm⁻³), and from about 2 μg m⁻³ to 70 μg m⁻³, respectively (see Figure 1).

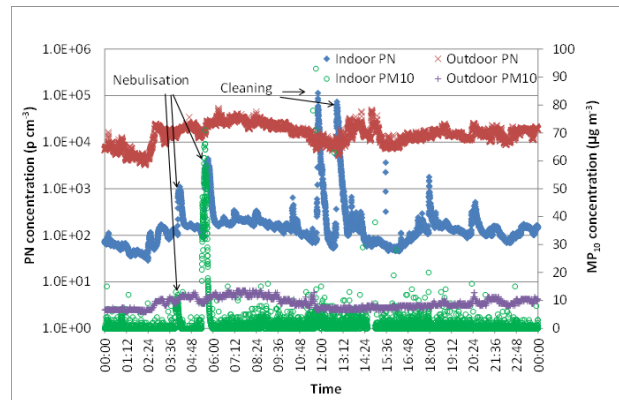


Figure 1. An example of time series of indoor PN and PM₁₀ concentrations in the PICU.

- The main indoor sources for particle generation identified in the PICU were nebulisation therapy, tracheal suction and cleaning activities.
- Based on multipoint measurement data, the spatial variation of particle concentration in the PICU was weak because particles generated at each location could quickly be transported to other locations (< 5 minutes) (see Figure 2).

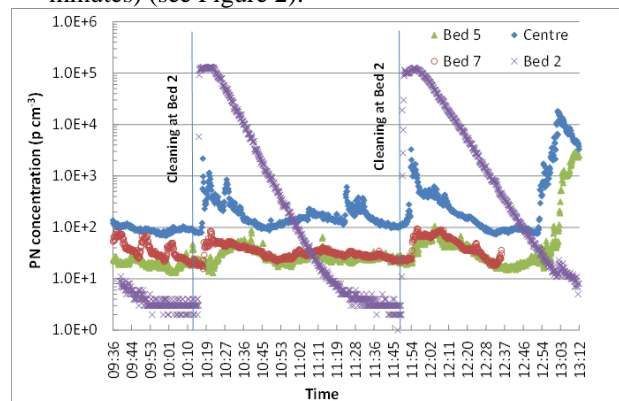


Figure 2. Time series of indoor PN concentrations at 4 locations (Centre, Bed 2, Bed 5, Bed 7), with particle source information (at Bed 2).

This study provided PN and PM₁₀ concentration and particle sources in a PICU for the first time and demonstrates that the major source of particles came from internal sources. Further investigation is required to assess the clinical implications.