

# Natural ventilation to reduce tuberculosis transmission risk in healthcare facilities in Peruvian prisons.

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*Background:* The high prevalence of tuberculosis (TB) in prisons is an important public health problem, compounded by the emergence of drug-resistance. As well as the health risks to the prisoners themselves, TB in prisons is an important danger for prison healthcare workers, visitors, and the household contacts of TB infected prisoners on release.

*Aim:* To evaluate room ventilation in the healthcare facilities of 8 Peruvian prisons before and after the renovation or new construction of healthcare infrastructure guided by the principles of optimising natural ventilation.

*Methods:* A carbon dioxide tracer gas technique was used to measure ventilation in 94 different rooms in healthcare facilities, including consultation rooms, treatment rooms, wards, waiting rooms, laboratories, cells for TB patients, and sputum collection areas. Architectural features and environmental variables were recorded. Measurements were repeated following renovation or construction of new infrastructure (financed by the Global Fund). Theoretical risk of TB transmission to a healthcare worker during an 8 hour shift was estimated for each room using the Wells-Riley airborne infection model, assuming prisoners in each room had untreated pulmonary TB producing 13 infectious quanta per hour.

*Results:* Baseline median room ventilation was 15 air-changes/hour (ACH) (interquartile range (IQR) 9.3-26). Following renovation/new construction, median ventilation increased to 28 ACH (IQR 20-41;  $p < 0.001$ ). Differences in wind speed were not significant. Theoretical risk of TB transmission decreased from 22% to 14% ( $p < 0.001$ ). The natural ventilation modifications (eg skylights, elevated roofing and additional windows) comprised a small fraction of overall budget.

*Discussion:* In countries where climate permits, optimising natural ventilation is an effective and low cost intervention to provide high rates of fresh air exchange and theoretical reduction in TB transmission risk in healthcare facilities in prisons.