Dispersion modelled endotoxin concentrations for residents near livestock farms: spatial distribution and characteristics.

Wouters I[1], *de Rooij M*[1], *Erbrink H*[2], *Winkel A*[3], *Ogink N*[3], *Hoek G*[1], *Heederik D*[1]

[1]*IRAS Utrecht University,* [2]*Erbrink Stacks Consult,* [3]*Wageningen Livestock Research*

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Background: Microbial air pollution from livestock farms have been implied to affect public health. Emissions of endotoxin, a pro-inflamma-tory agent of microbial origin, may be of importance, yet quantification of resident's exposure was thus far lacking. Objectives were to apply and evaluate dispersion modelling of livestock farm endotoxin immisions and to assess attribution differences between farm-types.

Methods: Dispersion of endotoxin from livestock barns was modelled by a Gaussian plume model. First endotoxin emission values were derived through measurements for major farm-types. Annual average and 99.5 percentile airborne endotoxin concentrations were modelled for a grid of 313.000 points with 125m distance representing a livestock dense area of 70km2 in the Netherlands, and for home addresses of ~14.000 non-farming residents.

Endotoxin concentrations measured at 61 residential sites were compared to dispersion modelled concentrations. Spatial patterns of endotoxin levels were explored by contour plots. Contributions to ambient endotoxin concentrations of farm-types were determined by descriptive analyses.

Results: Modelled and measured annual average endotoxin concentrations correlated substantially (Pearson r=0.51) and absolute levels matched. Contour plots of dispersion modelled endotoxin concentra-tions showed highly variable endotoxin concentrations over the 70km2 area, clearly identifying areas with elevated levels. 99.5-percentile endo-toxin concentrations exceeded the Dutch health council recommenda-tion of 30 EU/m3 in approximately 2% of the surface area. Main major contributors to annual average ambient endotoxin concentrations were poultry houses (mean contribution 37%) and pig houses (53%), although other farm-types sometimes contributed substantially as well. At more than 80% of the residential addresses ambient endotoxin con-centrations are the resultant of attribution from multiple farm types.

Conclusions: Realistic dispersion modelling of livestock farm endotoxin is feasible which enables studying dose-response relationships with health endpoints. Furthermore, valuable insights regarding expo-sure characteristics were discovered: spatial variation in average and peak values and farm-types contributions was considerable, with multi-ple farm-types contributing.