

## **Pathways for exposure to waterborne pathogens and state transitions among exposed hosts: a conceptual framework for waterborne disease surveillance**

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Surveillance for waterborne disease is a critical tool for defining the health risks associated with waterborne pathogens. Unfortunately most surveillance systems only detect cases of extremely severe disease or extremely large outbreaks of less severe disease. The data from these systems is of limited use for estimating incidence rates of waterborne infectious disease.

Conventional risk factor epidemiology focuses on the individual as the unit of exposure. Because of the critical importance of secondary spread and the role of herd immunity in defining the impact of a specific exposure, the spread of infectious disease must be studied at the level of the community. In this paper, we describe a conceptual framework for describing the incidence of waterborne infectious disease based on the pathways for exposure to pathogens and the state transitions among exposed hosts. With this structure, we demonstrate that understanding patterns of secondary spread is essential to defining rates of waterborne infectious disease.

Epidemiological studies that focus exclusively on the individual may be both costly to conduct and will yield inaccurate estimates of the risk of infectious disease attributable to drinking water. We outline how this model can be used as the basis for estimating rates of waterborne infectious disease using relatively simple and inexpensive surveillance tools.

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## **Drinking water consumption habits of the population of Santiago, Chile**

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A survey of 1200 people in the Santiago Metropolitan Area was conducted in order to determine the drinking water habits of the population and estimate their exposure to copper in the drinking water. The presence of copper in drinking water is partly caused by slow dissolution of copper plumbing pipes. The maximum concentration of copper in drinking water occurs after water has stagnated in the copper pipe, a process that usually occurs at night.

The study was done during the winter of 1997 on a statistical sample of the population of Santiago. This paper presents the distribution of water consumption by age (<1 year; 1–10 years; 11–19 years; 20–64 years; >64 years), socio-economic groups (A–B–C1, C2–C3, D, E), and sex. The relative errors in the measurements and the consumption times during the day also are included. This information is relevant for the exposure to copper contained in drinking water and the consumption of water from other beverages. Water contained in foods, except soups, is not included in the calculation of drinking-water consumption.

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## **Conceptual framework for evaluating basin-scale multiple pathway exposure to pesticides**

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There is a need to create a better conceptual framework for analysing and interpreting the environmental release of pesticides and how they impact human populations. Current drainage basin-scale models do not consider multiple pathways of human exposure for estimates of risk. Furthermore, exposure models typically have oversimplified transport components. In this study, a basin-scale model was combined with a multiple pathway exposure model by translating temporal and spatial media concentrations into values of total exposure from different pathways. This new conceptual framework gave more refined estimates of total risk to human populations living in a drainage basin.

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## **Exposure of the population of Santiago, Chile, to copper contained in drinking water**

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Copper present in drinking water originates from natural and anthropogenic (mainly copper plumbing pipes) sources. In spite of the long life of copper plumbing pipes, estimated to be 60 years or more, copper is liberated to drinking water as a result of electrochemical and thermodynamic processes. A model has been created in order to estimate the population exposure to copper contained in drinking water. This exposure depends on several variables such as the physicochemical characteristics of the water, the length and diameter of the pipe involved, the stagnation period of the water during the day and night, and the age of the pipes. Measurement of these variables was carried out in 250 homes in the Santiago Metropolitan Area. The 250 homes are a sub-sample of a larger sample surveyed in Santiago to determine water consumption habits. The