

**GLOBAL ASSESSMENT OF EXPOSURE TO TRIHALOMETHANES IN DRINKING WATER AND BURDEN OF DISEASE**

**Global exposure and comparative assessment of disease burden related to disinfection by-products vs. diarrheal diseases from unsafe drinking water**

STUDY PROTOCOL – September 2017

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## INTRODUCTION

Lack of access to improved drinking water sources is still a main problem in many parts of the world, leading to high incidence rates of waterborne infections or sanitation-related diseases. Chlorination of drinking water is a major public health intervention to provide safe drinking water to the population and control for water-borne infectious diseases. On the other hand, disinfection process with chlorine generates undesired chemical by-products such as trihalomethanes (THMs). In some countries, this environmental exposure can be of concern since the whole population is exposed through ingestion, inhalation and dermal contact, and long-term exposure to THMs has been linked to adverse health problems, including bladder cancer. THM levels in drinking water are rarely reported in the majority of countries and current levels at a global scale are unknown.

## AIM

To develop country-wide estimates on the concentrations of total THMs in drinking water as a marker of disinfection by-products exposure, and to conduct a comparative risk assessment of bladder cancer attributable to THM levels and water-borne infectious diseases attributed to lack of improved drinking water sources on a global scale.

Specific aims are:

- a. To develop a global map of current THM levels in drinking water
- b. To estimate bladder cancer burden attributable to THM levels at a global scale
- c. To conduct a comparative risk assessment between bladder cancer attributable to THM levels and water-borne infectious diseases attributed to lack of improved drinking water sources

## METHODS

### Study population

We will conduct a global evaluation including the most populated countries within each of 18 UN regions by descending population-size order until they make up 75% of each UN regions' population. Micronesia and Polynesia are not included since the population is very low (<1 million inhabitants). For operational reasons, we will use population size by UN regions (*UN report 2015*) as a criterion to prioritize countries. A European-based THM assessment has already been conducted and the present evaluation will expand to countries outside the European Union.

### Global THM map

We will collect concentrations in drinking water ( $\mu\text{g/L}$ ) of total and specific THMs (chloroform, bromoform, dibromochloromethane, bromodichloromethane) from the latest year available, representative at national or regional level. When possible, we will calculate population-weighted average THM levels in each country, taking into account the population size. Two approaches will be followed to conduct the data collection.

- a. Questionnaire to key contacts. The main approach to ascertain data is through a questionnaire addressed to national reference experts in National agencies, Universities, etc. in the different countries. The questionnaire includes country and institute/person providing the information, year of information provided, reporting geographic region, country-level annual measurement values of total and individual THMs and population served. Other information regarding percentage of population receiving disinfected water, source of drinking water (ground/surface), type of main disinfectant used or maximum contaminant level for THM will also be collected. When available, raw data of THM measurements will be gathered as well.
- b. THM data published in scientific papers or reports. For countries where key contacts cannot be identified or where recent THM data cannot be collected, scientific papers or reports with representative THM concentrations in drinking water will be used.

**Burden of disease and comparative risk assessment**

a. Burden of bladder cancer. We will estimate the annual number of bladder cancer cases and disability-adjusted life years (DALYs) in men attributable to THM exposure by country. The dose-response function from the largest international meta-analysis available (*Costet et al. 2011*) will be used. The population in each country will be obtained from the UN report in 2015. The age standardized bladder cancer incidence rate in 100,000 men will be obtained from the Globocan 2012. We will explore ways to incorporate the age pyramid in the estimation of projected bladder cancer cases.

b. Comparative risk assessment. A comparative risk assessment will be conducted comparing the health impacts of exposure to THM and microbial agents in drinking water. The cases of diarrheal diseases and DALYs attributable to unsafe water sources in the whole population will be collected using the Global Burden of Disease project estimates (*GBD 2015 DALYs and HALE Collaborators*). Different exposure scenarios will be included: i. Current exposure to untreated water and THM levels, ii. Universal access to treated water with current THM levels, iii. Universal access to treated water with THM levels below a threshold.

**Data quality and Sensitivity analysis**

Estimates of THM levels, attributable burden of disease and comparative risk assessment will be conducted at national, regional (WHO regions) and global level. If data is available, sub-national estimates will be calculated for the largest countries in the world.

An indicator of data quality for the collected THM levels in each country will be calculated, considering the percentage of population covered, the number of water samples used to estimate levels, population-weighted mean or the source of information used (surveillance, reports, research papers, etc). Sensitivity analysis to better estimate the burden of disease in a given area will be conducted excluding those countries with lower data quality.

**PLANNING 2017**

	Jan-Feb	Mar-Apr	May-Jun	Jul-Sep	Oct-Dec	Jan-Feb	Mar-Apr
Protocol	x	x					
Identifying key contacts		x	x	x	x		
Data collection			x	x	x		
Data analysis					x	x	
Manuscripts writing						x	x

**REFERENCES**

Costet N et al. Water disinfection by-products and bladder cancer: is there a European specificity? A pooled and meta-analysis of European case-control studies. *Occup Environ Med.* 2011 May;68(5):379-85.

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