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BRIEF COMMUNICATION

Bacterial contamination of water samples in Gabon, 2013

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Abstract Contamination of water is a major burden in the public health setting of developing countries. We therefore assessed the quality of water samples in Gabon in 2013. The main findings were a contamination rate with coliforms of 13.5% and the detection of a possible environmental reservoir for extended spectrum beta-lactamase-producing bacteria.

Introduction

In 2001, more than 600,000 deaths in sub-Saharan Africa were attributed to unsafe water, sanitation, and hygiene.[1] A recent meta-analysis showed that the burden of diarrheal diseases due to contaminated drinking water may be greatly underestimated and highlights the need for continual monitoring of water quality.[2] *Escherichia coli* is especially recommended as an indicator organism for fecal pollution, and total coliforms as indicator organisms for the cleanliness and integrity of distribution systems.[3]

Water, particularly drinking water, can also be a vector and reservoir for antimicrobial-resistant bacteria. For instance, 4% of drinking water bags and 40% of samples from sewer and river sites in Kinshasa, Democratic Republic

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of the Congo were contaminated with extended spectrum beta-lactamase (ESBL)-producing Enterobacteriaceae.[4] Therefore, contaminated water bodies could give rise to colonization and infections with ESBL-producing Enterobacteriaceae in humans. The objective of this study was to assess microbial contamination with coliforms in Gabon and to test the antibiotic susceptibility.

Methods

During a cross-sectional study, 200 water samples were collected from different water sources in the provinces of Estuaire, Moyen-Ogooué, Ogooué-Ivindo, and Ngounié in Gabon in 2013 (Figure 1). The selection of samples was based on availability and accessibility, and therefore is not representative.

From each sampling site, 500 mL of water was collected in sterile bottles. Water taps and standpipes were allowed to run for 1 minute and were sanitized with an open flame before the water was aseptically collected. Samples were placed in a cool box before transport to the laboratory for analysis within a maximum of 4 hours after sampling. For each sample, the following items were recorded: date/time, type of water source (e.g., tap water, standpipe, open water body), temperature (e.g., water or environment), color (i.e., "colorless", "yellow", or "brown"), turbidity (i.e., "clear", "slight", "moderate", and "intensive"; a nephelometer was unavailable) and odor (i.e., "chlorous", "earthy", "sanious", or "inodorous") (Table 1).[5] Water sources were classified as "improved" (e.g., harvested rainwater, protected springs, boreholes, piped water sources) or "unimproved" (e.g., river, unprotected wells, and springs), based on the World Health Organization criteria.[2]

A pilot study of 10 samples (i.e., 8 improved and 2 unimproved water sources) using a standardized method (i.e., membrane filtration technique of 100 mL water) and culture on Columbia blood and MacConkey agar (Oxoid, Wesel, Germany; 24 hours, 37°C, ambient air) revealed high contamination by nonfastidious pathogens and did not allow for the quantification and subculture of single colonies.[5] We therefore decided to streak 500 μL of the water sample directly onto Columbia blood and MacConkey agar plates, which yielded a detection level of ≥200 colony-forming units (CFU)/100 mL. Samples containing >100 indicator organisms/100 mL were categorized as "high to very high" risk of fecal contamination, based on the World Health Organization criteria.[2,3]

All colonies growing on both agars (24 hours, 37°C, ambient air) were quantified and one colony of each

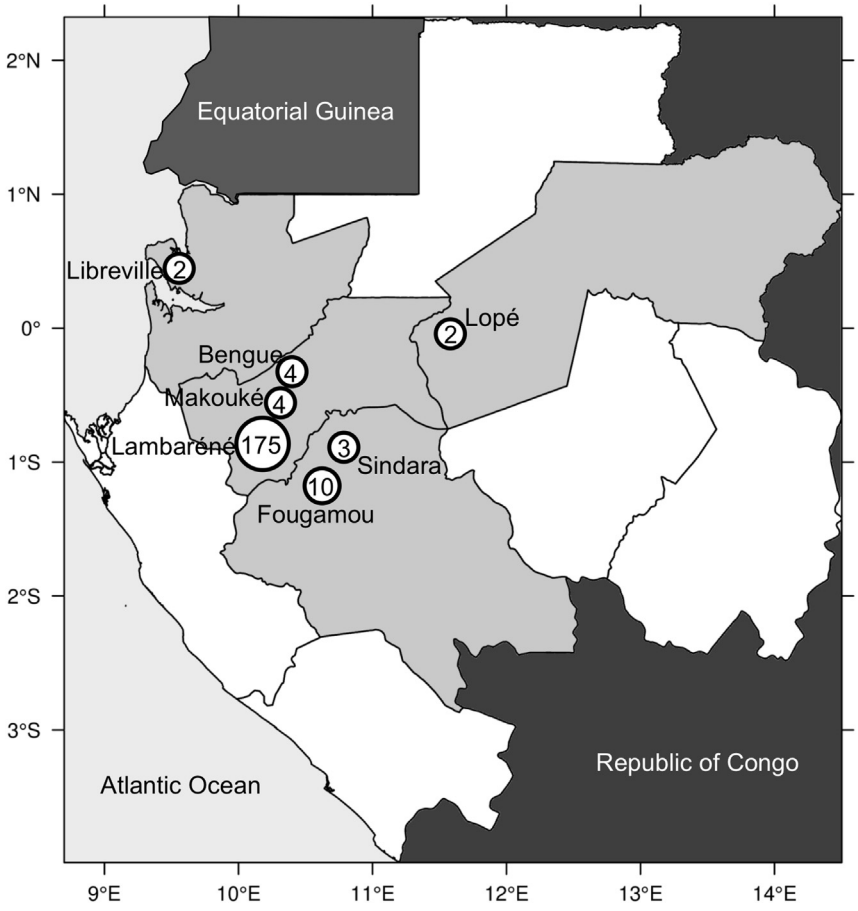

Figure 1. Map of Gabon. The provinces from where water samples were obtained are shaded in gray. The sites from where samples were obtained are indicated by circles and the number within indicates the number of samples taken. Vertical and horizontal scales indicate the degrees of longitude and latitude, respectively.