



**HYGIENIC ASSESSMENT OF DRINKING-WATER
QUALITY AND ITS POTENTIAL HEALTH
IMPLICATIONS IN THE KHOREZM REGION,
UZBEKISTAN: A STUDY PROTOCOL**

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ABSTRACT

Background: Safe drinking water is fundamental to public health. In arid settings, groundwater mineralization, agricultural activity, ageing distribution networks and limited sanitation protection of decentralized supplies may affect water quality. The Khorezm region of Uzbekistan has environmental and hydrogeological conditions that warrant systematic assessment of drinking-water safety. Objective: This protocol describes a cross-sectional environmental health study designed to characterize physicochemical, microbiological and organoleptic quality of drinking water in the Khanka and Urgench districts and to explore associations with routinely recorded childhood morbidity. Methods: The study will collect 120 water samples from centralized supplies, shallow groundwater wells and artesian wells during four seasons. Planned analyses include pH, total dissolved solids, hardness, calcium, magnesium, nitrate, nitrite, ammonium, chloride, sulfate, fluoride, iron, selected metals, turbidity, colour, odour, taste, heterotrophic plate count, total coliforms, thermotolerant coliforms, Escherichia coli and enterococci. Results will be compared with applicable national requirements and WHO guideline values. Aggregate morbidity data among children aged 0–14 years will be analyzed using descriptive statistics and correlation analyses. Discussion: The study will provide locally relevant evidence for water-safety planning, sanitary protection of water sources and priority monitoring. No empirical results are reported in this protocol; results will be disseminated only after laboratory quality assurance and statistical analysis are completed.



INTRODUCTION

Access to safe drinking water is a core public-health requirement. Drinking water may transmit infectious agents when faecal contamination occurs, while chemical constituents can cause acute or chronic health concerns depending on concentration, exposure duration and individual susceptibility. The World Health Organization (WHO) promotes a preventive, risk-based approach to water safety that extends from catchment protection through treatment, distribution and household use [1].

Microbial contamination remains the most widespread drinking-water risk. The detection of *Escherichia coli* in water intended for drinking indicates recent faecal contamination and warrants immediate investigation. WHO guidance specifies that *E. coli* or thermotolerant coliform bacteria should not be detectable in any 100 mL sample of water directly intended for drinking [1]. Chemical hazards also require locally appropriate surveillance because their occurrence varies with geology, land use, water source and distribution conditions.

The Khorezm region is located in the lower Amu Darya basin and has a sharply continental, arid climate. Groundwater quality can be influenced by evaporative concentration of dissolved salts, soil salinity, irrigation practices and agricultural inputs. In addition, differences between centralized supplies and decentralized wells may lead to different exposure profiles. These factors make a source-to-consumer assessment of water quality scientifically and practically relevant.

The present work is framed as an observational environmental-health study protocol. It is deliberately presented without invented laboratory or health results. Transparent reporting of methods, participant or data-source selection, potential bias and planned statistical analyses is consistent with the STROBE recommendations for observational research [2].

OBJECTIVES

Primary objective

To assess physicochemical, microbiological and organoleptic indicators of drinking water from selected centralized and decentralized sources in the Khanka and Urgench districts of the Khorezm region.

Secondary objectives

- To compare water-quality indicators across source types, districts and seasons.
- To identify samples that require follow-up against applicable national standards and WHO guideline values.
- To describe temporal patterns in routinely reported morbidity among children aged 0–14 years in the study districts.
- To explore ecological associations between selected water-quality indicators and aggregate childhood morbidity indicators, while avoiding causal interpretation.
- To formulate evidence-informed recommendations for source protection, monitoring and water-safety management.



METHODS

Study design and setting

This is a cross-sectional, repeated seasonal environmental monitoring study with an ecological analysis of routinely available childhood morbidity data. Sampling will be undertaken in Khanka and Urgench districts, Khorezm region, Uzbekistan. The study considers centralized piped water, shallow groundwater wells and artesian wells because these sources may differ in hydrochemical composition, sanitary protection and vulnerability to contamination.

Sampling framework

A total of 120 water samples are planned: 48 from centralized water-supply systems, 40 from shallow groundwater wells and 32 from artesian wells. Sampling locations will be selected to represent both districts and relevant source categories. Sampling will be distributed across spring, summer, autumn and winter to capture seasonal variability. The final report will document the date, location, source type, sampling conditions, field observations and chain-of-custody information for every sample.

For microbiological testing, samples will be collected in sterile containers, transported at 2–4 °C and analyzed as soon as practicable. For water sampled from a piped system, water will be allowed to run before collection in accordance with the applied sampling procedure. Field staff will record visible sanitary risks, including poor well protection, nearby waste disposal, livestock activity, evidence of flooding and potential wastewater intrusion.

Laboratory measurements

The planned physicochemical panel comprises pH, electrical conductivity, total dissolved solids, total hardness, calcium, magnesium, nitrate, nitrite, ammonium, chloride, sulfate, fluoride, total iron, turbidity, colour and selected metals, including lead, cadmium, arsenic, nickel, chromium and zinc where analytical capacity permits. pH will be determined potentiometrically; conductivity and total dissolved solids by conductometry; hardness by ethylenediaminetetraacetic acid titration; selected ions by titrimetric, photometric or ion-selective electrode methods; and trace metals by atomic absorption spectrometry or an equivalent validated method.

Microbiological analyses will include heterotrophic plate count, total coliforms, thermotolerant coliforms, *E. coli* and enterococci. Membrane filtration and culture-based confirmation procedures will be used in accordance with validated laboratory procedures. Organoleptic assessment will include odour, taste, colour and turbidity. Any water sample positive for *E. coli* will be flagged for immediate sanitary follow-up because this finding indicates a potential faecal-contamination event [1].

Quality assurance and quality control

All measuring instruments will be calibrated according to manufacturers' specifications. Reagents will be checked for expiry and stored according to laboratory requirements. Field blanks, duplicate samples and laboratory control samples will be used where feasible. Standard



operating procedures will govern sample labeling, transport, storage, analytical methods, recording and data verification. Any result outside an instrument's validated measurement range will be repeated or reported with an appropriate qualification.

Health data

Aggregate morbidity data for children aged 0–14 years will be requested from district health-information systems and pediatric outpatient facilities for the defined study period. The analysis will focus on broad diagnostic categories plausibly relevant to water quality, including acute intestinal infections and selected digestive or genitourinary conditions. No personal identifiers will be collected or analyzed. Morbidity rates, where denominators are available, will be expressed per 100,000 children.

Statistical analysis

Continuous water-quality indicators will be summarized using means and standard deviations or medians and interquartile ranges, depending on distribution. Categorical compliance outcomes will be summarized as counts and percentages. Source-type, district and seasonal comparisons will use appropriate parametric or non-parametric tests after examination of distributional assumptions. Correlation between aggregate water-quality indicators and aggregate morbidity indicators will be explored using Pearson or Spearman coefficients, as appropriate. Statistical significance will be set at two-sided $p < 0.05$, with confidence intervals reported where applicable.

The analysis will not infer individual-level causality from ecological associations. Potential confounding by sanitation, hygiene, healthcare access, nutrition, socioeconomic conditions, seasonality and diagnostic practices will be recognized in interpretation. Missing or unavailable laboratory and morbidity data will be reported transparently; no unsupported imputation will be performed in the primary analysis.

Ethics and data protection

The protocol will be submitted to the relevant institutional ethics body before data collection begins. Water sampling does not involve human biological specimens. The health component will use aggregate, de-identified data. Permissions from responsible water, sanitary-epidemiological and health authorities will be obtained as required. All data will be stored on password-protected systems accessible only to the research team.

EXPECTED CONTRIBUTION AND DISCUSSION

The study is expected to generate an integrated description of water quality across different supply types and seasons. Its principal contribution will be local evidence for prioritizing water-quality surveillance and sanitation measures in a region where environmental conditions may increase vulnerability to salinization and source contamination. WHO guidance emphasizes that effective drinking-water management requires a multiple-barrier approach: source protection, appropriate treatment, secure distribution, operational monitoring and independent surveillance [1].



Comparing centralized, shallow groundwater and artesian sources may help identify where monitoring should be intensified. For example, decentralized sources may require sanitary inspection in addition to laboratory testing because a single test does not fully capture intermittent contamination risk. Repeated seasonal sampling is important because local conditions, operational disruptions and seasonal changes can affect both microbial and chemical water quality [1].

The protocol has limitations. The proposed association analysis uses aggregate data and cannot establish individual exposure or causality. A limited number of samples may not represent every settlement or household. Water quality at the source may also differ from quality after storage or within household plumbing. These limitations will be stated clearly in the final manuscript, and conclusions will be confined to the evidence produced by the study.

CONCLUSION

This protocol provides a transparent framework for assessing drinking-water quality and its potential public-health relevance in the Khorezm region. The study combines physicochemical, microbiological and organoleptic assessment with contextual sanitary observations and aggregate childhood morbidity analysis. It is designed to support evidence-based water-safety planning rather than to pre-judge results. Final conclusions and any claims regarding associations will be made only after the planned laboratory testing, quality control and statistical analysis are complete.

DECLARATIONS

Ethics approval and consent to participate

Ethical approval will be obtained from the relevant institutional ethics committee before study initiation. The study uses environmental samples and aggregate, de-identified health data; individual informed consent is not anticipated. This statement must be updated with the approval committee name and reference number before submission.

Consent for publication

Not applicable.

Availability of data and materials

De-identified data will be available from the corresponding author upon reasonable request, subject to institutional and legal requirements.

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Competing interests

The authors declare no competing interests.

Author contributions

SBSS conceived the study, drafted the protocol and will coordinate data collection and analysis. DBA supervised the study design, methodology and manuscript development. Both



authors will review and approve the final manuscript. Update author initials and roles if additional authors are included.

REFERENCES

1. World Health Organization. Guidelines for drinking-water quality: fourth edition incorporating the first, second and third addenda. Geneva: World Health Organization; 2026.
2. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP, for the STROBE Initiative. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. BMJ. 2007;335:806. doi:10.1136/bmj.39335.541782.AD.
3. World Health Organization. Guidelines for drinking-water quality: fourth edition incorporating the first and second addenda. Geneva: World Health Organization; 2022.
4. World Health Organization. Guidelines for drinking-water quality: small water supplies. Geneva: World Health Organization; 2024.
5. World Health Organization. Water safety plan manual: step-by-step risk management for drinking-water suppliers. 2nd ed. Geneva: World Health Organization; 2023.
6. O'zbekiston Respublikasi. O'zDSt 950:2011. Drinking water: hygienic requirements and quality control. Tashkent; 2011