STUDY PROTOCOL

REVISED The nexus between improved water supply and water-borne diseases in urban areas in Africa: a scoping review protocol [version 2; peer review: 2 approved]

Previously titled: The nexus between water sufficiency and water-borne diseases in cities in Africa: a scoping review protoco

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Abstract

Introduction: Currently, an estimated two thirds of the world population is water insufficient. As of 2015, one out of every five people in developing countries do not have access to clean sufficient drinking water. In an attempt to share the limited resource, water has been distributed at irregular intervals in cities in developing countries. Residents in these cities seek alternative water sources to supplement the inadequate water supplied. Some of these alternative sources of water are unsafe for human consumption, leading to an increased risk in water-borne diseases. Africa contributes to 53% of the diarrheal cases reported globally, with contaminated drinking water being the main source of transmission. Water-borne diseases like diarrhea, cholera, typhoid, amoebiasis, dysentery, gastroenteritis, cryptosporidium, cyclosporiasis, giardiasis, guinea worm and rotavirus are a major public health concern. The main objective of this scoping review is to map the available evidence to understand the sources of water among residents in cities in Africa and the relationship between clean water sufficiency and water-borne diseases in urban Africa.
Methods and analysis: The search strategy will identify studies published in scientific journals and reports that are directly relevant to African cities that have a population of more than half a million residents as of 2014 AND studies on the ten emerging water-borne

Open Peer Review

Reviewer Status ✓ ✓

	Invited Reviewers	
	1	**2**
version 2 (revision) 08 Dec 2020	✓ report	✓ report
version 1 05 May 2020	? report	? report

1. **Batsirai Majuru**, World Health Organization, Geneva, Switzerland

2. **David Musoke**, Makerere University College of Health Sciences, Kampala, Uganda

Any reports and responses or comments on the article can be found at the end of the article.

diseases, which are diarrhea, cholera, typhoid, amoebiasis, dysentery, gastroenteritis, cryptosporidium, cyclosporiasis, giardiasis, guinea worm and rotavirus.

Ethics and dissemination: This scoping review did not require any formal ethical approval. The findings will be published in a peer-reviewed journal.

Keywords

Water-borne diseases, water insufficiency, scoping review, African cities, water supply

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Author roles: Mutono N: Conceptualization, Data Curation, Formal Analysis, Investigation, Writing – Original Draft Preparation, Writing – Review & Editing; **Wright J**: Methodology, Supervision, Visualization, Writing – Review & Editing; **Mutembei H**: Methodology, Supervision, Writing – Review & Editing; **Muema J**: Data Curation, Investigation, Methodology, Validation; **Thomas M**: Data Curation, Investigation, Validation; **Mutunga M**: Data Curation, Investigation, Methodology, Validation; **Thumbi SM**: Conceptualization, Methodology, Supervision, Validation, Visualization, Writing – Review & Editing

Competing interests: No competing interests were disclosed.

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REVISED **Amendments from Version 1**

The current version includes a more detailed definitions section which standardises the key terms used in this protocol. In addition, the title, abstract and the inclusion and exclusion criteria have been amended to ensure the aim and the scope of the study is clear and precise. Details on the variables to be extracted from the articles for full-text screening have been clearly stated to capture indicators on water sources, sufficiency and safety with occurrence of waterborne diseases in cities in Africa. Finally, the presentation of results has been improved to ensure the study locations of the studies reviewed will be linked to the coordinates from peer reviewed and publicly available water scarcity map from the Water Footprint Network to allow us to make observations on the trend between cities with prevalence of waterborne diseases and water scarcity. The resultant maps will enable researchers to identify areas that have gaps in knowledge and research needs.

Any further responses from the reviewers can be found at the end of the article

Introduction

Urbanization in sub-Saharan Africa (SSA) is growing at 4% annually, with the population living in urban areas projected to double by 2050[1]. This rapid urbanisation outpaces the development of infrastructure in these cities leading to inadequate access to basic amenities, including good housing, adequate social amenities, and continuous supply of safe drinking water to city residents[2]. Poor access to clean water driven by rapid population growth, increased water demand, infrastructural constraints, and consumer response to cope with insufficient supply of safe water through use of alternative water sources is associated with ill-health[3]. This rapid urbanisation is anticipated to accelerate demand for water[2,4], which lies at the nexus of food security, poverty reduction, economic growth, energy production and human health[5,6].

Currently, an estimated 40% of the global population is water insufficient[7]. The World Health Organisation (WHO) international benchmark states a minimum water requirement per person per day of between 50 and 100 litres in order to meet basic domestic needs[8]. However, by 2017, only half of the population residing in urban SSA had access to safely managed drinking water that was free from contamination. Goal 6 of the Sustainable Development Goals (SDGs) aims to attain sustainable management and availability of sufficient clean water and sanitation for all[7]. This aligns with Aspiration 1 of the African Union Agenda 2063 objectives, on sustainable development in Africa[9].

Residents of urban areas in Africa depend on both improved and unimproved water sources including piped water, boreholes, wells, vendors and surface water[8]. However, the Africa Infrastructure Country Diagnostic report by the World Bank categorised piped water as the only major source of improved water in SSA[10]. In 2017, piped water was only accessible to 230 million people (61%) in urban areas in this region[11]. In an attempt to share and ration limited resources, piped water has been distributed in cities in developing countries at irregular intervals, known as intermittent water supplies (IWS)[12]. Residents have responded to these challenges by seeking alternative sources of water, some of which are unsafe for human consumption[13,14]. Half (53%) of the water sources in Africa are faecally contaminated, predisposing the people to the risk of diarrheal diseases[15].

In 2016, more than half a billion deaths in SSA were attributed to diarrheal diseases with contamination of drinking water identified as one of the leading risk factors[16]. Major pathogens, such as *Escherichia coli*, cryptosporidium, *aeromonas* spp, shigella and entamoeba, often found in unsafe water, are associated with moderate-to-severe diarrhea which is especially life threatening to infants[17]. Disease surveillance and response in SSA lists cholera, diarrheal diseases and typhoid fever as some of the priority diseases associated with poor quality water, that should be regularly monitored and reported[18].

Previous reviews have explored the prevalence of intermittent water supplies in low income settings[19], household water availability across Africa[20], the global burden of diarrheal diseases[16,21] and implications of intermittent water supply on gastrointestinal illness[22]. We have found no review focused on urban areas in Africa and the implications of water-borne diseases as a result of intermittent piped water in this region.

This manuscript details the protocol to a review of the link between insufficient piped water supply and waterborne diseases and syndromes in urban Africa. In doing so, it seeks to address the following research question: "what is the proportion of residents with safely managed water in cities in Africa and what is the correlation with water-borne diseases and the symptoms?" This will be achieved by synthesising findings of studies on: a) water sufficiency in cities within Africa; b) consequences of rapid urbanisation on water sufficiency in African cities; and c) the linkages between water sufficiency and water-borne diseases and their symptoms in Africa.

This work should provide information to guide policies that aim to help Africa achieve one of its Agenda 2063 aspirations on provision of adequate basic necessities for urban populations in the region[9].

Definitions

For the purpose of this protocol and the planned review, key terms are defined and classified as follows:

- **Waterborne disease:** includes cholera, typhoid, amoebiasis, cyclosporiasis and giardiasis diseases[16–18]
- **Symptoms of waterborne diseases:** focus on diarrhea, dysentery and gastroenteritis[16,17]
- **Etiological agents of diarrheal diseases:** include cryptosporidium and rotavirus[16,17]
- **Water insufficiency:** is classified as having less than 50 litres per person per day[8]

- **City:** an urban area with a population of more than half a million residents[23]

Methods

The scoping review will use the Joanna Briggs Institute methodology guidance[24] and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines for conducting systematic reviews and meta-analysis (http://www.prisma-statement.org). These methodologies have been used for published scoping reviews[25,26].

Inclusion criteria

The review will include the following criteria:

1) Studies undertaken in African Union member states.

2) Studies describing the water situation in cities, classified as urban areas with greater than half a million residents. Since the classification of a city and urban environments is not standardised[2], we use areas with a population greater than 0.5 million people to be consistent with the UN report that estimates one in every three people will reside in cities with at least half a million inhabitants by 2030[23] (Figure 1). The list of the cities that meet this criterion have been selected from the United Nations World Urbanisation Prospects of 2014[27].

3) Studies focusing on water-borne diseases, symptoms and etiological agents:

a) Diseases include cholera, typhoid, amoebiasis, cyclosporiasis and giardiasis diseases

b) Symptoms include diarrhea, dysentery and gastroenteritis

c) Etiological agents include cryptosporidium and rotavirus

4) Studies published in scientific journals or grey literature from government or non-governmental organisations

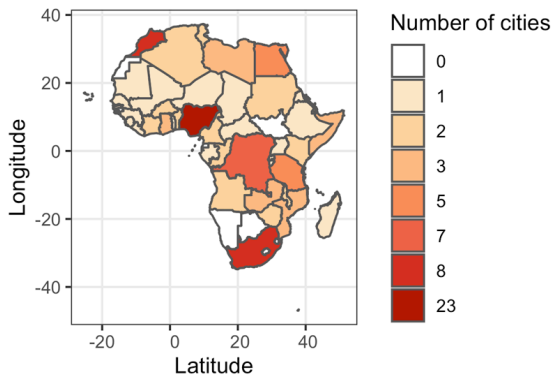

Figure 1. Member countries in the African Union and the number of cities with a population greater than half a million residents. Source of data: United Nations World Urbanisation Prospects, 2014[27].

Exclusion criteria

1) Studies not written in the English or French language

2) Systematic reviews

3) Studies conducted in non-member states of the African Union

Search strategy

Comprehensive literature searches will be undertaken in Embase, MEDLINE, Web of Science and Google Scholar databases. These four databases have been identified as the optimal combination of databases that will guarantee adequate coverage of studies for this scoping review[28].

The search strategy will take a three-step process. The first step will involve carrying out a limited search in MEDLINE, Google Scholar (first 500 results), Embase and Web of Science databases. The text and index terms that are used to describe the articles will be assessed. The second step will include searches using the keywords and index terms. In the final step, we will go through the references to identify key articles that might have been missed in the first two steps. The search terms used in the study are seen in Table 1.

Study selection

Once the searches have been undertaken in the databases, the title and abstracts will be extracted from the articles. Duplicates will be removed, and the review team will screen the studies using two levels: initial screening and full-text screening. During the initial screening process, three reviewers will read the abstracts of the studies captured by the search terms and assess their relevance in light of the inclusion criteria. To ensure consistency, 10% of all the studies will be randomly selected and independently reviewed by one other reviewer. Any inconsistencies between the primary and secondary reviewers will be discussed and a consensus reached.

Full text articles will be obtained for the studies that pass the initial screening stage. Microsoft Excel (version 16.36) will be used to store the extracted data. Table 2 shows the characteristics that will be extracted from each study. Of the data extracted, 10% will be randomly selected and independently reviewed by one other reviewer. Any inconsistencies amongst the reviewers will be discussed and an agreement will be reached.

All irrelevant studies will be removed and the reason for their exclusion will be recorded. In this stage, another 10% of the studies will be sampled and shared with the secondary reviewer who will exclude or include the studies based on their relevance to the study objective. Consensus will be reached for any discrepancies in the studies among the reviewers.

Presentation of results

If a sufficient number of studies report on the effect of water insufficiency on health outcomes, we will calculate heterogeneity

Table 1. Search terms that will be used to identify studies.

Parameter	Search terms
Population	Huambo OR Luanda OR Cotonou OR "Abomey-Calavi" OR "Abomey Calavi" OR Ouagadougou OR Bobo-Dioulasso OR "Bobo Dioulasso" OR Bunjumbura OR Younde OR Yaounde OR Douala OR Bangui OR Ndjamena OR Brazaville OR Pointe-Noire OR "PointeNoire" OR Abidjan OR Bouake OR Kinsasha OR Cairo OR "Al Qahirah" OR Al-Qahirah OR Alexandria OR "Al-Iskandariyah" OR "Al Iskandariyah" OR "Port Said" OR "Bur Said" OR "Addis Ababa" OR Libreville OR Banjul OR Accra OR Kumasi OR Conakry OR Nairobi OR Mombasa OR Monrovia OR Antananarivo OR Lilongwe OR "Blantyre-Limbe" OR "Blantyre Limbe" OR Bamako OR Nouakchott OR Casablanca OR "Dar-el-Beida" OR "Dar el Beida" OR Rabat OR Nampula OR Tetouan OR Fes OR Marrakech OR Tangier OR Tanger OR Maknes OR Meknes OR Agadir OR Maputo OR Matola OR Niamey OR Lagos OR Kaduna OR Akure OR Kano OR Abuja OR Aba OR Kigali OR Dakar OR Freetown OR CapeTown OR Durban OR Pretoria OR "Port Elizabeth" OR Bloemfontein OR "Dar es Salaam" OR Arusha OR Mbeya OR Lome OR Kampala OR Kitwe OR Lusaka OR Harare OR Bulawayo OR "Benin City" OR Enugu OR Ibadan OR Ikorodu OR Ilorin OR Jos OR Maiduguri OR Nnewi OR Onitsha OR Oshogbo OR Owerri OR "Port Harcourt" OR Sokoto OR Umuahia OR Oyo OR Warri OR Zaria OR Hargeysa OR Merca OR Mogadishu OR Muqdisho OR Johannesburg OR Soshanguve OR Vereeniging OR Khartoum OR "Al-Khartum" OR "Al Khartum" OR Nyala OR Safaqis OR Tunis OR Mwanza OR Zanzibar OR Ndola OR Algiers OR "El Djazair" OR Wahran OR Oran OR Bukavu OR Kananga OR Kisangani OR Lubumbashi OR "Mbuji-Mayi" OR "Mbuji Mayi" OR Tshikapa OR Djibouti OR "Al-Mansurah" OR "Al Mansurah" OR "As-Suways" OR "As Suways" OR Asmara OR "Sekondi Takoradi" OR Banghazi OR Misratah OR Tarabulus OR Tripoli
	AND
Exposure	water AND (scarc* OR intermittent OR break* OR ratio* OR deficit OR deficien* OR unavailab* OR continu* OR interrupt* OR stress OR supply OR sufficien* OR insufficien*)
	AND
Outcome	"water borne" OR "water-borne" OR cholera OR typhoid OR diarrhea* OR diarrhoea OR amoebiasis OR dysentery OR gastroenteritis OR cryptosporidi* OR cyclosporiasis OR giardiasis OR rotavirus

Table 2. Variables to be extracted from the articles for full-text screening.

	Variable	Details
1	Authors	Authors of the article
2	Publication type	Thesis, article
3	Title of the article	Full title
4	Year of publication	Year the article was published or written
5	Geographical scope of the study	City/cities the study was conducted
6	Study type	
7	Duration of the study (if applicable)	
8	Rate of urbanisation	Metric, population of the city
9	Water demand/supply	Main water source, main water distributor, water demand
10	Indicators of water supply	Frequency of water supply, water rationing, cost, coverage, quality
11	Water-borne diseases/symptoms/etiological agents	Diarrhoea, cholera, typhoid, amoebiasis, dysentery, gastroenteritis, cryptosporidium, cyclosporiasis, giardiasis, rotavirus
12	Cases of water-borne disease/symptoms/etiological agents	Lab-confirmed/self-reported/clinically diagnosed
13	Water insufficiency	Metric, proportion of urban population with sufficient water supply, proportion of urban population with insufficient water supply
14	Use of the WHO water insufficiency classification of less that 50 litres per person per day	Yes/No
15	Proportion of population with water borne diseases	Metric
16	Area proposed for future research	

(I^2) for this subset. The index of heterogeneity (I^2 statistic) will be calculated from the sum of the squared deviations of the estimate of each study, from the overall estimate, and weighted by the influence of the study on the calculation of the overall estimate. We will examine the risk bias in the study level and characterize whether the metrics of water insufficiency and health are representative of the whole urban population or only a sub-group. We will use the R statistical software (version 3.6.1) to conduct this analysis[29].

Cluster analysis will be performed to collate similar studies using Ward's agglomerative hierarchical clustering method, which is used in other scoping reviews[30]. The optimal number of clusters will be chosen to ensure the inner homogeneousness and external heterogeneousness of a cluster is balanced. For studies that focus on diarrheal disease, we will differentiate the self-reported studies from those with etiological characterisation of pathogens and input these studies into the planned cluster analysis.

The study locations will be geo-coded and the data will be presented using digital maps that will depict the water sufficiency in these different cities. The results will be linked to the coordinates from the peer reviewed and publicly available water scarcity map layer from the Water Footprint Network[31] which has been used in previous systematic reviews[32]. This will allow us to make observations on the trend between cities with prevalence of waterborne diseases and water scarcity. The resultant maps will enable researchers to identify areas that have gaps in knowledge and research needs.

Ethics and dissemination

The study does not involve any interviews or interactions with humans or animals and does not require ethical approval. The findings will be published in a scientific peer-reviewed journal.

Study status

Currently, we are undertaking the literature searches in the MEDLINE, Embase, Web of Science and Google Scholar databases and extracting the titles and abstracts from the articles which will be used in the initial screening process.

Data availability

No data are associated with this article.

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Publisher Full Text

Open Peer Review

Current Peer Review Status: ✔ ✔

Version 2

Reviewer Report 12 February 2021

https://doi.org/10.21956/aasopenres.14295.r28241

✔ **Batsirai Majuru**
World Health Organization, Geneva, Switzerland

This is a much improved protocol.

- On the definition of water insufficiency, the authors may wish to note that the WHO document cited by Gleick (reference #8 in the manuscript) has recently been updated, and the main recommendations are 5.3 L/person/day for drinking, 20 L/person/day for basic access and a national policy for intermediate access at least 50 L/person/day.

- The drinking-water target ensures hydration for lactating women engaged in moderate activity at moderately high temperatures – the population group with the highest physiological needs.

- Basic access is needed to ensure sufficient qualities of water are available for drinking, cooking, food hygiene and handwashing and face washing under most circumstances.

- A national policy objective of at least intermediate access of 50 L/person/day is recommended to ensure adequate quantities of water are available for drinking, cooking, food hygiene and all personal hygiene (handwashing, face washing, bathing and laundry), under most circumstances

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Reference Source

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Public health, water quality, water policy and regulation

I confirm that I have read this submission and believe that I have an appropriate level of

expertise to confirm that it is of an acceptable scientific standard.

Reviewer Report 08 January 2021

https://doi.org/10.21956/aasopenres.14295.r28242

David Musoke
Department of Disease Control and Environmental Health, School of Public Health, Makerere University College of Health Sciences, Kampala, Uganda

The authors have addressed most of the comments raised earlier. However, the introduction of the abstract can further be made more succinct, and statistics omitted as suggested earlier. In addition, the earlier concern regarding the exclusion criteria has not been satisfactorily addressed.

Competing Interests: No competing interests were disclosed.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Version 1

Reviewer Report 24 August 2020

https://doi.org/10.21956/aasopenres.14158.r27733

David Musoke
Department of Disease Control and Environmental Health, School of Public Health, Makerere University College of Health Sciences, Kampala, Uganda

Generally, this is a well written protocol for the scoping review which is likely to generate key information concerning water and related diseases in cities in Africa. However, my main concern as detailed below is the need to explore other water indicators beyond sufficiency as they also contribute to water borne diseases.

Abstract:

- The background in the abstract is very wordy and therefore can be made more succinct.

- Use of statistics in the background of an abstract is discouraged due to the inability to cite accordingly.

Background:

- Whereas the background has focused on water sufficiency (quantity), it is important for the authors to consider describing other key water indicators such as coverage, quality, cost and continuity that also contribute to the occurrence of water borne diseases.

- The background may be strengthened by providing information on the various sources of water used in urban settings in Africa, both improved and unimproved.

- Water statistics for 2015 are used yet more recent literature is available.

- Whereas the study aim is on water sufficiency, other parameters as noted above have a direct contribution to water borne diseases. It is therefore not clear how these parameters are to be considered in the scoping review.

Protocol:

- In the inclusion criteria, other water indicators noted above should be considered.

- The exclusion criteria in principle should not be the opposite of the inclusion criteria but rather any predefined conditions that will be used omit any studies that would have met the inclusion criteria.

- The exposure search terms as well as variables (Table 2) may also include the various water indicators beyond quantity.

- The use of the term ‘emerging diseases’ may need to be justified.

- The choice of selection of the 10 ‘diseases’ also needs to be justified.

- The outcome and independent variables to be considered in the review need to be described explicitly in the protocol.

Is the rationale for, and objectives of, the study clearly described?

Yes

Is the study design appropriate for the research question?

Yes

Are sufficient details of the methods provided to allow replication by others?

Partly

Are the datasets clearly presented in a useable and accessible format?

Not applicable

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Environmental and Public Health including water, sanitation and hygiene.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 03 Dec 2020

Mutono Nyamai, University of Nairobi, Nairobi, Kenya

The background in the abstract is very wordy and needs to be more succint

- We have substantially shortened the 'background' section of the abstract in order to make it more succinct.

Use statistics in the background of an abstract is discouraged

- We have removed statistics from the background section of the abstract.

It is important for the authors to consider describing other key water indicators such as coverage, quality, cost and continuity that also contribute to the occurrence of water borne diseases.

- In order to limit the scope of this review we have specifically focused on insufficiency, as well as large African cities with population of more than 0.5 million AND selected waterborne diseases/symptoms/etiological agents AND water situation. In order to address other water indicators like cost, coverage, etc. and how they may be possible confounders, we will extract this information from the articles during the full text screening process as highlighted in Table 2, point 10.

The background may be strengthened by providing information on the various sources of water used in urban settings in Africa, both improved and unimproved.

- We agree with the reviewer and have therefore edited line 60 so that it now includes the main sources of water used in urban areas in the African content.

Water statistics for 2015 are used yet more recent literature is available.

- Paragraph 2 and 3 have been updated to include the recent statistics from the UNICEF/WHO Joint Monitoring Program report.

Whereas the study aim is on water sufficiency, other parameters as noted above have a direct contribution to water borne diseases. It is therefore not clear how these parameters are to be considered in the scoping review.

- These parameters have been included in Table 2 which highlights the variables that will be extracted from the articles during the full-text characterisation process. We will report how they contribute to waterborne diseases.

In the inclusion criteria, other water indicators noted above should be considered.

- Point 10, Table 2 lists the other indicators which will be extracted from the articles during the full-text screening process.

The exclusion criteria in principle should not be the opposite of the inclusion criteria but rather any predefined conditions that will be used omit any studies that would have met the inclusion criteria.

- We agree with the reviewer and have therefore modified the exclusion criteria and only listed conditions that will omit studies that meet the inclusion criteria.

The exposure search terms as well as variables (Table 2) may also include the various water

indicators beyond quantity.
- Point 10 of Table 2 has been updated to include other indicators of water supply (frequency of water supply, water rationing, cost, coverage, quality).

The use of the term 'emerging diseases' may need to be justified.
- Based on the advice from the first reviewer, this term has been omitted from the protocol.

The choice of selection of the 10 'diseases' also needs to be justified
- We have modified this to exclude '10 diseases'. The 'Definitions' section now classifies waterborne diseases, symptoms and etiological agents of diarrheal diseases, and includes justifications where appropriate.

The outcome and independent variables to be considered in the review need to be described explicitly in the protocol.
- As this is a scoping review rather than a systematic review, we will focus on the methods of the included studies, as opposed to their findings or examination of effect sizes derived for outcomes variables. This will form the inputs to the cluster analysis, so we do not have an outcome and an independent variable given the nature of the type of review we will be conducting.

Competing Interests: No competing interests were disclosed.

Reviewer Report 29 May 2020

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Batsirai Majuru
World Health Organization, Geneva, Switzerland

The paper outlines a protocol for a scoping review of the links between sufficiency of water supply and water-borne diseases in cities in the African region. In the protocol, the authors propose to conduct a search of both peer reviewed and grey literature on water sufficiency in African cities of >500,000 residents and 'ten emerging water-borne diseases'.

The authors attempt to address pertinent questions regarding water supply in the African region. However, the protocol in its current state reads like a decent initial draft, that now requires refinement and sharpening. There are several areas that are unclear. I have tried to offer what I hope is useful criticism.

The rationale for, and objectives of the study are somewhat unclear.
Per the protocol, the question to be answered is: 'what is the water sufficiency in cities in Africa and what is the correlation with water-borne diseases?' There are several concerns with the scope,

definition of terms, and assessment criteria that make the rationale and objectives of the review somewhat unclear. These are outlined below.

The study design is not entirely appropriate for the research question.

The protocol requires further development and elaboration, primarily in the outcome variables of interest i.e. the waterborne diseases. The central idea in the protocol seems to be linking water insufficiency to the 'ten emerging waterborne diseases'. There are several concerns here.

1. The terminology needs to be clarified and standardized:
   -Diarrhoea is a symptom of several diarrhoeal diseases, including cholera and typhoid. Classifying it as a disease in itself is inaccurate.
   -Gastroenteritis is a set of symptoms (including diarrhoea, vomiting, nausea) arising from intestinal infection, so again, classifying it as a disease in itself is inaccurate.
   -*Cryptosporidium* and rotavirus are microorganisms / aetiological agents that cause diarrhoeal diseases, but are not diseases in themselves.
   -Guinea worm is a parasite, not a disease in itself. Diarrhoea is not a typical symptom of dracunculiasis (guinea worm disease).

2. What criteria were used to classify the 'emerging' diseases? This should be clearly described.
   - The question whether the diseases / symptoms / infectious agents listed in the protocol are 'emerging' is highly debatable. The paper cited on some of the said emerging diseases is from 16 years ago - it is fair to say that the landscape has changed a lot since then.
   - The GEMS 2013 study on aetiology of moderate-severe diarrhoea in low-income countries highlighted rotavirus, ETEC, *Cryptosporidium* and *Shigella* as the main pathogens of concern. There are likely more recent studies on this, which the authors are advised to look up.
   - Guinea worm disease / dracunculiasis has been eradicated in most countries, with about 30 cases per year (sometimes less) now reported from 3 or 4 countries in Africa, so it is unclear how it could be termed an emerging disease.

3. If the hypothesis is that water insufficiency leads to waterborne disease, how is the insufficiency determined? E.g. if City X has a published water rationing schedule in which water is supplied 12 hours per day for 7 days a week, vs City Y that intermittently supplies water 2 days a week - are the households in both cities water insufficient? I have no bright ideas on this, but it may be food for thought.

4. Most diarrhoeal cases in literature are self-reported, thus aetiological info will likely be limited.
   - Is there some weighting that would be assigned to studies based on the depth of information on the waterborne disease(s) provided? Studies reporting on the aetiology of the diarrhoeal disease may arguably carry more weight than those only reporting diarrhoea / gastroenteritis, which may not necessarily be waterborne.

Some definition of terms and scope is required for the review to be replicated by others.

It is unclear how 'water sufficiency' is defined within the scope of the review. E.g. for households living in slums, water insufficiency may arise from the slum not being connected to the network.

Are they within the scope of the review?
Water deficiency, water scarcity and water insufficiency are used throughout the protocol. Do these terms all have the same meaning within the context of the review?

Other comments:

1. What is the reference for the 53% of diarrhoeal cases being from Africa? The paper by Bain *et al.* cited as ref #13 actually reports 53% of water sources in Africa being faecally contaminated, but does not refer to this 53% as the diarrhoeal disease burden from the African region.

2. Table 2, variable 14 lists 'consumer' under 'Main source of water scarcity metric'. What does this mean? How are consumers sources of water scarcity?

3. Water scarcity is not the only reason for intermittent supply. See for example review by Galaitsi *et al.* (2016[1]).

4. In the abstract, sentence 2: The 2015 statistic is not static, so somewhat inaccurate to quote as: 'As of 2015, xx people do not have access to safe drinking water'. Actually, the most recent estimate is that 1 in 3 do not have access to safe drinking-water.

References

1. Galaitsi S, Russell R, Bishara A, Durant J, et al.: Intermittent Domestic Water Supply: A Critical Review and Analysis of Causal-Consequential Pathways. *Water*. 2016; **8** (7). Publisher Full Text

Is the rationale for, and objectives of, the study clearly described?
Partly

Is the study design appropriate for the research question?
Partly

Are sufficient details of the methods provided to allow replication by others?
Partly

Are the datasets clearly presented in a useable and accessible format?
Not applicable

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Public health, water quality, water policy and regulation

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 03 Dec 2020

Mutono Nyamai, University of Nairobi, Nairobi, Kenya

The terminology needs to be clarified and standardised:
-Diarrhoea is a symptom of several diarrhoeal diseases, including cholera and typhoid. Classifying it as a disease in itself is inaccurate.
-Gastroenteritis is a set of symptoms (including diarrhoea, vomiting, nausea) arising from intestinal infection, so again, classifying it as a disease in itself is inaccurate.
-Cryptosporidium and rotavirus are microorganisms / etiological agents that cause diarrhoeal diseases but are not diseases in themselves.

-Guinea worm is a parasite, not a disease in itself. Diarrhoea is not a typical symptom of dracunculiasis (guinea worm disease).

- In lines 94 – 103, we have clarified the terminology and improved the classification of waterborne diseases, symptoms and etiological agents as follows:
  - **Waterborne disease:** includes cholera, typhoid, amoebiasis, cyclosporiasis and giardiasis diseases.
  - **Symptoms of waterborne diseases:** focus on diarrhea, dysentery and gastroenteritis.
  - **Etiological agents of diarrheal diseases:** include cryptosporidium and rotavirus.
- We added a key definitions section after the introduction which aims to clarify any ambiguity and standardise the terminology.
- We also removed guinea worm from our search strategy in Table 1 (line 140).

What criteria were used to classify the 'emerging' diseases? This should be clearly described.
- The question whether the diseases / symptoms / infectious agents listed in the protocol are 'emerging' is highly debatable. The paper cited on some of the said emerging diseases is from 16 years ago - it is fair to say that the landscape has changed a lot since then.
- The GEMS 2013 study on etiology of moderate-severe diarrhoea in low-income countries highlighted rotavirus, ETEC, Cryptosporidium and Shigella as the main pathogens of concern. There are likely more recent studies on this, which the authors are advised to look up.

- Guinea worm disease / dracunculiasis has been eradicated in most countries, with about 30 cases per year (sometimes less) now reported from 3 or 4 countries in Africa, so it is unclear how it could be termed an emerging disease.

- We have removed the terminology “emerging diseases” as the reference was outdated and its use as a term was ambiguous, as highlighted by the reviewer. In turn, we have changed the emphasis of the paper to mainly focus on the diseases/symptoms/ etiological agents. As mentioned, we specifically define these in the ‘Definitions’ section in lines 89-99.
- We looked at the GEMS 2013 and GEMS 2019 study which highlighted cryptosporidium, enteropathogenic *Escherichia,* shigella and rotavirus as the main pathogens of concern. We decided to focus on rotavirus and cryptosporidium in our scoping review. Globally, rotavirus was the leading etiology for diarrhea mortality among all ages[1] while cryptosporidium had the highest number of deaths with the pathogen present in children between 12-23 months[2].
- We agree with the reviewer that dracunculiasis is not an emerging disease as it has

been eradicated in most countries hence it has been removed from our inclusion criteria.

If the hypothesis is that water insufficiency leads to waterborne disease, how is the insufficiency determined? E.g. if City X has a published water rationing schedule in which water is supplied 12 hours per day for 7 days a week, vs City Y that intermittently supplies water 2 days a week - are the households in both cities water insufficient? I have no bright ideas on this, but it may be food for thought.

- In this scoping review, the term 'water insufficiency' relates to water quantity, where we used the World Health Organisation's (WHO) international benchmark of less than 50 litres of piped water per person per day[3], as highlighted in lines 49-51. We also included the definition of water insufficiency as used in this paper on line 102.
- In order to address instances such as that which the reviewer gives as an example, we will record how water insufficiency was assessed in the papers and if there are enough articles that use methods for characterising water insufficiency, a categorical variable depicting the methods used will form an input within the cluster analysis . We highlight this in point 13 of Table 2.

Most diarrhoeal cases in literature are self-reported, thus etiological info will likely be limited.
- Is there some weighting that would be assigned to studies based on the depth of information on the waterborne disease(s) provided? Studies reporting on the etiology of the diarrhoeal disease may arguably carry more weight than those only reporting diarrhoea / gastroenteritis, which may not necessarily be waterborne.

- In order to address the concern raised by the reviewer on majority of the studies on diarrheal cases being self reported, we will differentiate studies with self-reports from those with etiological characterisation of pathogens. The differences will then be inputted into the planned cluster analysis of study methods (see lines 173-178).

It is unclear how 'water sufficiency' is defined within the scope of the review. E.g. for households living in slums, water insufficiency may arise from the slum not being connected to the network. Are they within the scope of the review?
Water deficiency, water scarcity and water insufficiency are used throughout the protocol. Do these terms all have the same meaning within the context of the review?

- We have now specifically outlined how we define water insufficiency in the new 'Definitions' section (line 93). We will use the WHO definition of less than 50 litres per person per day as water insufficiency (line 102). One of the variables extracted from the included studies is the use of the WHO water insufficiency definition, as highlighted in Table 2 point 14.
- Informal settlements are within the scope of this review. Water is often distributed in informal settlements through water kiosks or public taps[4]. Study setting (informal versus formal) would be included as a study characteristic within cluster analysis, to help examine if different methods and study designs are adopted in such settings.
- We agree with the reviewer that water scarcity, water deficiency and water insufficiency were used throughout the protocol and to remove any ambiguity, we will focus on water insufficiency but include water scarcity and water deficiency in our search terms to ensure we do not miss out any articles on water insufficiency.

What is the reference for the 53% of diarrhoeal cases being from Africa? The paper by Bain et al. cited as ref #13 actually reports 53% of water sources in Africa being faecally contaminated, but does not refer to this 53% as the diarrhoeal disease burden from the African region.

- We have removed this reference and restructured the sentence (see lines 68-69).

Table 2, variable 14 lists 'consumer' under 'Main source of water scarcity metric'. What does this mean? How are consumers sources of water scarcity?

- The term “consumer” was removed from point 14 in Table 2.

Water scarcity is not the only reason for intermittent supply. See for example review by Galaitsi et al. (2016).

- We agree with the reviewer that water scarcity is not the only reason for intermittent supply. We have addressed this issue in lines 46-49, which captures the main drivers of insufficient water supply as reported by Galaitsi et al[5].

In the abstract, sentence 2: The 2015 statistic is not static, so somewhat inaccurate to quote as: 'As of 2015, xx people do not have access to safe drinking water'. Actually, the most recent estimate is that 1 in 3 do not have access to safe drinking-water.

- Based on the second reviewer’s comment about removing statistics from the abstract, this statement has been removed.

[1] Estimates of the global, regional and national morbidity, mortality and aetiologies of diarrhoea in 195 countries: a systematic analysis for the Global Burden of Disease Study 2016 https://www.thelancet.com/journals/laninf/article/PIIS1473-3099(18)30362-1/fulltext

[2] Diarrhoeal disease and subsequent risk of death in infants and children residing in low-income and middle-income countries: analysis of the GEMS case-control study and 12-month GEMS-1A follow-on study
https://www.thelancet.com/journals/langlo/article/PIIS2214-109X(19)30541-8/fulltext

[3] Basic Water Requirements for Human Activities: Meeting Basic Needs
https://www.tandfonline.com/doi/abs/10.1080/02508069608686494?journalCode=rwin20

[4] Informal water vendors and the urban poor https://pubs.iied.org/pdfs/10529IIED.pdf

[5] Intermittent domestic water supply: A critical review and analysis of causal-consequential pathways https://www.mdpi.com/2073-4441/8/7/274

Competing Interests: No competing interests were disclosed.