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## Review

# Contextual factors and motivations affecting rural community sanitation in low- and middle-income countries: A systematic review

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## ABSTRACT

**Background:** Unsafe management of human faecal waste represents a major risk for public health, particularly in low- and middle-income countries. Efforts to improve sanitation conditions are considerably sensitive to contextual specifics of natural and social environments. This review operationalises, analyses, and synthesises evidence of how contextual factors and motivations affect different sanitation outcomes with a specific focus on community approaches to rural sanitation.

**Methods and findings:** We operationalised contextual factors and motivations as determinants that influence sanitation conditions independently of the examined intervention. We conducted a systematic search of both peer-reviewed and grey literature with no restriction on the methods. After screening the titles and abstracts of 19,198 records obtained through initial searches, we scrutinised the full content of 621 studies for relevance. While 102 of these studies qualified to be assessed for risk of bias and information content, ultimately, just 40 studies met our eligibility criteria. Of these 40 studies from 16 countries, 26 analysed specific interventions and 14 were non-interventional. None of the experimental studies reported the effects of contextual factors or motivations as operationalised in this study and only observational evidence was thus used in our review. We found that sanitation interventions are typically seen as the principal vehicles of change, the main instruments to fix 'deviant' behaviour or ensure access to infrastructure. The programmatic focus of this study on sanitation determinants that act independently of specific interventions questions this narrow understanding of sanitation dynamics. We identified 613 unique observations of quantitatively or qualitatively established relationships between certain contextual factors or motivations and 12 different types of sanitation outcomes. The sanitation determinants were classified into 77 typologically similar groups clustered into 12 broader types and descriptively characterised. We developed a graphical synthesis of evidence in the form of a network model referred to as the sanitation nexus. The sanitation nexus depicts how different groups of determinants interlink different sanitation outcomes. It provides an empirically derived conceptual model of sanitation with an aggregate structure indicating similarities and dissimilarities between sanitation outcomes with respect to how their sets of underlying determinants overlap.

**Conclusion:** This study challenged the understanding of context as merely something that should be controlled for. Factors that affect targeted outcomes independently of the analysed interventions should be scrutinised and reported. This particularly applies to interventions involving complex human-environment interactions where generalisability is necessarily indirect. We presented a novel approach to comprehending the contextual factors and motivations which influence sanitation outcomes. Our approach can be analogously applied when mapping and organising underlying drivers in other areas of public and environmental health. The sanitation nexus derived in this study is designed to inform practitioners and researchers about sanitation determinants and the outcomes they influence.

## 1. Introduction

Unsafe management of human faecal waste represents a major risk for public health, particularly in low- and middle-income countries. In 2015, global access to improved sanitation facilities was estimated to be

82% in urban areas and just 51% in rural areas. People living in rural areas make up an overwhelming majority of the estimated 946 million who defecate in the open (UNICEF/WHO, 2015). A sanitation target was included but not achieved in the Millennium Development Goals, and the subsequent Sustainable Development Goals include an

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ambitious target to eliminate open defecation (OD) worldwide and ensure the entire world population has access to adequate and equitable sanitation by 2030. In recent years, sanitation programs and research have gained momentum and numerous sanitation research papers have recently emerged. There is thus an increasing need to organise and synthesise the gradually accumulating evidence.

To date, most systematic reviews have investigated links between sanitation conditions and various diseases (Esrey et al., 1991; Jasper et al., 2012; Ziegelbauer et al., 2012; Benova et al., 2014; Heijnen et al., 2014; Grimes et al., 2014; Stocks et al., 2014; Strunz et al., 2014; Speich et al., 2016; Jung et al., 2017; Freeman et al., 2017) while fewer reviews have analysed evidence surrounding the health impacts of sanitation interventions (Fewtrell et al., 2005; Clasen et al., 2010; Wolf et al., 2014; Freeman et al., 2017). Although diverse, all these systematic reviews concluded that better sanitation reduces risks to human health. At the same time, they almost unequivocally complain about the heterogeneity of literature that makes any synthesis difficult.

Although it is known that successful sanitation also has important non-health benefits (e.g. Sclar et al., 2017), potential health gains are undoubtedly a primary motivation behind efforts to improve sanitation. Despite this, it is unclear whether a predominant focus on health impacts alone can be successful. Sanitation interventions revolve around complex human-environment interactions. Health effects tend to be delayed in time, confounded, and conditional on various environmental and social parameters such as water access, handwashing practices, or female literacy (Schmidt, 2014; Hammer and Spears, 2016; Carter, 2017). Moreover, successful sanitation most likely has a property of emergence: only if a sufficient threshold of latrine coverage and use is attained by an entire community does a transition phase emerge enabling the potential effects on the health of individuals to materialise (Fuller et al., 2016; Garn et al., 2017; Harris et al., 2017).

Sanitation interventions thus reveal features typical to what Shiell et al. (2008) referred to as the interventions implemented in complex systems. It is argued that the outcomes of such interventions are sensitive to initial conditions and to various specifics of natural and social environment. Consideration of contextual factors thus becomes essential for designing and implementing interventions in complex systems and for assessing the external validity of research findings on these interventions. Additionally, causality between the inputs and impacts of interventions implemented in complex systems is generally difficult to attribute. Conventional approaches to quantitative impact evaluations and associated evidence-based decision making may not be appropriate when dealing with phenomena in complex systems (Shiell et al., 2008; Hawe et al., 2004).

The research question examined in this review addresses which

contextual factors and motivations influence which sanitation outcomes and how. To clarify this research focus, a logical model of sanitation (Fig. 1) was developed. In this model, the red sections indicate the focus of this review. Fig. 1 portrays the health and non-health benefits of sanitation as a function of dynamic interplay between various factors and components. The sanitation conditions and preferences in Fig. 1 represent sanitation outcomes examined in the studies covered by this review. Sanitation conditions contain variables describing sanitation situations such as latrine availability and use. Sanitation preferences such as willingness to adopt or pay for a latrine refer to sanitation choices that immediately precede sanitation conditions. The intersecting sets of implementation factors, contextual factors, manipulated factors, and motivations in Fig. 1 contain different types of predictors which determine sanitation outcomes. For the purpose of this review, motivations and contextual factors are operationalised as predictors which influence sanitation outcomes *independently* of the sanitation intervention examined in a given study, whereas implementation and manipulated factors operate *due to* this intervention implementation. The conceptual distinction between motivations and contextual factors is that the former represents psychosocial constructs while the latter represents the various observable parameters of a broadly defined external environment (its various natural, social, cultural, political, or economic characteristics). Implementation factors are influences that shape the design and quality of an intervention implementation (if any). Manipulated factors are conditional to participation in an intervention. Firstly, there is the participation in an intervention itself. They may also encompass initial levels of targeted outcomes (e.g. baseline latrine coverage) and the parameters that are directly manipulated by the intervention as in its theory of change.

In addition to the reviews on the health impacts of sanitation conditions or interventions referred to above, attempts to synthesise literature on intermediate links and components within the logical model of sanitation outlined in Fig. 1 have been scarce. A recent systematic review by Sclar et al. (2016) examined the relationships between sanitation conditions and faecal exposure along main transmission pathways finding little or no effects of sanitation on the indicators of transmission. Another recent review and meta-analysis by Garn et al. (2017) attempted to quantitatively characterise how different sanitation interventions affect sanitation conditions. This review detected only a modest impact of interventions on latrine coverage and use. Once again, however, the aggregate quantitative findings are not easy to generalise due to the high heterogeneity across studies. This heterogeneity is attributed to various context-specific influences which shape the results of individual case studies (Garn et al., 2017p. 338). For example, the Community-Led Total Sanitation (CLTS) was

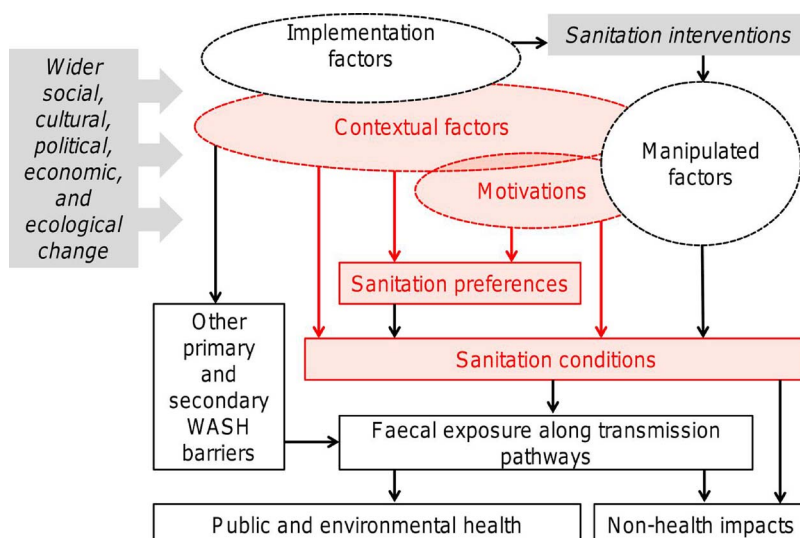


Fig. 1. Logical model of sanitation (red sections indicate the focus of this review). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

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