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Facilitators and barriers to effective water and sanitation interventions for characterizing shigellosis incidence in Jiangsu, China

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Abstract

Effective water and sanitation interventions can help to reduce the prevalence of waterborne diseases such as shigellosis, which is a diarrheal disease prevalent in rural areas of China. Water and sanitation interventions can be strengthened or undermined by facilitators and barriers, which are factors that assist or hinder access to safe water and adequate sanitation. Facilitators and barriers can be assessed using a conceptual framework of socioeconomic and water and sanitation determinants to understand the prevalence of shigellosis. Insight into facilitators and barriers can help various stakeholders to strategize with communities to implement a sensible solution to the rural water crisis in China.

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1. Introduction

In 2000, the United Nations established eight measurable goals - the Millennium Development Goals (MDGs) - that focused on reducing poverty through improving health and development. The target for water and sanitation is MDG Target 7c, which aimed to reduce “the proportion of the population without sustainable access to safe

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drinking water and basic sanitation” by half by 2015¹. The water goal was reached; the sanitation goal was not. Despite reaching the water goal, close to 1 billion people in the world continue to lack access to safe water. The MDGs successors – the Sustainable Development Goals (SDGs), include Goal 6: to “ensure availability and sustainable management of water and sanitation for all”.

Currently, 20% of the world’s population resides in China, which has 7% of the world’s freshwater supply². Lakes and major rivers in China are severely polluted and water from reservoirs is unsuitable for drinking even after wastewater treatment³. Due to clean water scarcity, weak water infrastructure, and large urban-rural disparities, 96.6 million people in China still lack access to safe drinking water while 455.5 million people still lack access to adequate sanitation⁴.

Poor water quality can be a major threat to human health. Exposure to water contaminated with human fecal matter as a result of open defecation or the lack of a toilet facility can cause severe diarrheal diseases. It is estimated that diarrhea caused by waterborne diseases accounts for 3.6% of the global disease burden, killing 1.5 million people every year⁵. Over 90% of diarrheal diseases are associated with children under the age of five⁶.

China has implemented a five-year plan worth 410 billion RMB (66 billion USD) to provide safe drinking water through the expansion of its public water system to 54% of the population living in cities and towns by 2015⁷. Access to water still varies greatly due to regional disparities; the rural population is more vulnerable to water-related diseases than the urban population. Accounting for 60% of the total population⁸, 70% of the rural population still lacks access to safe drinking water.

2. Burden of diarrhea due to unsafe water and poor sanitation: A case study of shigellosis in Jiangsu, China

It is estimated that 700, 000 deaths each year are caused by a single type of bacteria called *Shigella*, which causes bacillary dysentery, or shigellosis⁹. Symptoms include watery diarrhea (that may contain mucus and blood), painful bowel movements, abdominal pain, nausea and vomiting, rapid dehydration, and weight loss. In rural areas, the lack of vaccines and access to antibiotics to cure shigellosis can be overcome by improving water sanitation, and hygiene (WASH) interventions. This infectious diarrheal disease accounts for 5% of all diarrheal episodes in China¹⁰. In China, shigellosis infections require legal notification from all clinical and hospital doctors to the local Center for Disease Control and Prevention (CDC).

Shigellosis is a growing diarrheal disease among children in the eastern province of Jiangsu, China¹¹. Jiangsu is the most densely populated province in China, with most of the population concentrated in its capital, Nanjing. Shigellosis is driven by geographical elements such as temperature and relative humidity. The majority of shigellosis incidents occur during the summer and autumn months (July - October)^{10,11}. Tang et al.¹¹ analyzed the spatial and temporal trends of *Shigella* incidence trends from 2001 to 2011 in Jiangsu and found that shigellosis incidence rates followed a decreasing trend over time, but peaked in 2004, 2006, and 2011. Maps illustrating incidence rates were created, and indicated that the southeastern region of Suzhou and Wuxi were identified as the two most prominent hotspots for *Shigella* transmissions.

The disease burden associated with shigellosis can be effectively prevented by well-implemented WASH interventions, which can reduce diarrhea prevalence by one third¹². Currently, no studies have evaluated the effectiveness of current water and sanitation interventions in shigellosis hotspots and rural towns in Jiangsu. By exploring the relationship between water and sanitation interventions and the prevalence of shigellosis in recent years, one can better understand the WASH conditions leading up to the end of the MDGs, and the conditions that follow into the time frame of the SDGs.

3. A Conceptual Framework using Facilitators and Barriers

A conceptual framework is a system of concepts that supports, verifies, and outlines the process of the study. As shown in Figure 1, a conceptual framework can be built on the relationships between facilitators and barriers, and the state of water and sanitation interventions.

The facilitators and barriers to effective water and sanitation interventions will be used as factors for understanding access to safe water and adequate sanitation, and how they can be used to gauge the prevalence of shigellosis. Facilitators and barriers can be further categorized into the following themes: socioeconomic determinants and water and sanitation interventions, as shown in Table 1.

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