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Research Article

# Open the Tap for Maternal and Newborn Care

**Abraham Babatuiamu Titigah[1]*, Patrick Atobrah[2], Corey Leclair[3], Rafael Van de Bergh[3], Lauren D'Mello-Guyett[3,4], Peter Maes[3], Claire Braun[3], Julita Gil Cuesta[3], Samuel Sieber[3], Winfred Ofosu[5], Kofi Issah[6], Osman Abdullah Musah[2] and Jerry Akuaku[2]**

*[1]Builsa North District Hospital, Sandema, Ghana; [2]Regional Hospital, Bolgatanga, Ghana; [3]Medical Department, Médecins Sans Frontières, Operational Centre Brussels, Belgium; [4]Department for Disease Control, Faculty of Infectious and Tropical Diseases, London School of Hygiene and Tropical Medicine, UK; [5]Regional Health Directorate, Bolgatanga, Ghana; [6]Regional Health Directorate, Sunyani, Ghana*

## ABSTRACT

**Background:** Reliable provision of safe water at healthcare facility level is essential to achieve quality care and minimize the risk of healthcare associated infections. To this end, various standards stipulate that availability of water should be guaranteed in healthcare facilities. However, the adherence to and consequences of non-adherence to these standards in the healthcare sector are rarely evaluated.

**Objectives:** We set out to assess the association between water rationing and early neonatal infections in the Bolgatanga Regional Hospital, which is faced with water rationing three days per week.

**Setting:** Data from the maternity and neonatal care unit of the Bolgatanga Regional hospital were used.

**Design and participants:** A retrospective cohort study using routine hospital data was conducted. Associations were assessed between the source of water (piped or stored/trucked during rationing) in the hospital in the first 48 hours after delivery and the development of early neonatal infection; risk ratios (RR) and their associated 95% confidence intervals (95% CI) were calculated.

**Results:** It was found that the risk of early neonatal infection during periods of stored/trucked water (6.9/1000 live births) was twice that during tap water (3.4/1000 livebirths); (RR 2.0, 95% CI 1.3-3.2, p=0.002). Furthermore, only 30% of the new-borns had uninterrupted access to tap water in the first two days after birth.

**Conclusion:** During water rationing, the significantly higher risks of early neonatal infections should be considered prospectively and alternatives secured to protect such vulnerable groups. More research is recommended to build a specific association between the alternative sources of water during rationing and the risk of neonatal infections in order to identify the best option during such difficult times.

**Keywords:** WASH, Rationing, Neonatal Infections, Healthcare Associated Infections, SORT IT, Operational Research

## INTRODUCTION

Water is life. The importance of water for the efficient and effective delivery of essential maternal and neonatal services cannot be overemphasized [1-3] The sustained supply of sufficient and quality water, and the continuous application of Infection Prevention and Control (IPC) principles are essential if quality healthcare in general and maternal and neonatal care are to be assured [1,4-6]. For this reason the World Health Organization (WHO) has set minimum thresholds of water supply for healthcare facilities [1]. International standard have been created to ensure compliance to these basic principles. However, in many low and middle income countries (LMICs), adherence to and monitoring of such standards is erratic, with only 68% of the healthcare facilities having access to improved water, 19% having improved sanitation and 35% having soap for handwashing [1]. These gaps in infection prevention are even more critical when certain vulnerable groups are considered, such as immunocompromised patients, mothers and neonates [5,7]. One of the main adverse consequences of poor access to Water, Sanitation and Hygiene (WASH) in maternal and neonatal

***Corresponding author:** Abraham Babatuiamu Titigah, Obstetrician/Gynaecologist and Medical Superintendent, Builsa North District Hospital, Sandema, Ghana, Tel: +233208072154; E-mail: babatuiamu@yahoo.co.uk

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services is the occurrence of Health Care Acquired Infections (HCAIs) [8,9]. Contaminated tap water sinks, and faucets have been previously described as the sources of infections at facility level [10,11]. However, less emphasis has been placed on investigating external water sources (wells, piped water, trucked water and stored water) and their impact on health and HCAIs.

The neonatal care unit (NCU) of the Bolgatanga Regional Hospital (BRH), in the Upper East Region of Ghana, where water rationing has been common place since 2014 offers a unique opportunity to investigate the infectious consequences of piped versus stored water on neonatal health. Clinical surveillance data and microbiological assessments undertaken can prove to be of considerable value for the decision-making process in situations where water rationing is considered for healthcare facilities [11,12]. We therefore investigated the association between piped versus stored water and the rates of reported infections among neonates delivered in the BRH.

## METHODS

### Study design

A retrospective cohort study assessing in-hospital neonatal infection rates as a function of the hospital source of water in the immediate postnatal period.

### Study setting-general

Ghana, a low-income West African country, has set a target of providing all its health facilities with adequate access to WASH. Currently, the Ghanaian national policy for WASH in health facilities is only partially developed, and only 68% of the facilities have provision of basic WASH [1,13]. The BRH is a Government referral facility serving a catchment area of 1 million [14], and has a 206 bed capacity [15]. The neonatal care unit (NCU), established in 2014, has a bed capacity of 10 and sees approximately 300 admissions/year.

The hospital is connected to a piped water network, but the water system is not regularly functional: in 2014, water rationing was introduced by the Ghana Water Company Limited in response to increasing demands placed upon the antiquated water treatment systems [16]. The Bolgatanga Regional Hospital (BRH) in the Upper East Region of Ghana is one of many health facilities in LMIC where water supply is compromised [17]. BRH was not exempt from rationing, and only received piped water on Sunday, Monday, Thursday, and Fridays [16], and the hospital is thus forced to rely on local water storage and water trucking.

### Study population and study definitions

The study population consisted of neonates born in the labor ward of the BRH between December 2015 and June 2017. Two cohorts were compared: Neonates born on a day followed by two days of stored/trucked water usage, and neonates born on a day followed by two days of piped water usage. These time periods were selected as they corresponded to the mean length of stay for neonates in the hospital, thus reflecting the period during which neonates were exposed to different water sources. Between these two cohorts, the risks of early neonatal infections, defined as the number of early neonatal infections per total live births in the respective cohort, were compared.

### Data sources and variables

Aggregate data on all neonates born in BRH were obtained from the delivery registers according to the weekday of birth. Specific characteristics of neonates born in BRH and later admitted to the NCU with a neonatal infectious morbidity were extracted from the admission and discharge registers. The schedule of water provision for BRH was obtained from the Ghana Water Company Limited regional office, Bolgatanga.

Neonatal infection was diagnosed clinically when a newborn had fever, hypothermia, lethargy or poor feeding necessitating admission within the first 28 days of life. Neonatal infections were considered early when onset was within 7 days after birth, and late if it started after 7 days [18]. Early neonatal infection is related to maternal genital colonization and the infection prevention control (IPC) strategies within the perinatal period, while late neonatal infections may be acquired in the caregiving or community environment [18]. For these reasons, the definition of early neonatal infection was used to assess the risk of health facility acquired infection (HCAIs).

### Data collection, analysis and statistics

Data were extracted from the delivery, admission and discharge registers into a Microsoft Excel-based study database. Neonates were assigned to the two cohorts based on the water source (rationed and piped) during the two days following their birth; neonates with an admission period spanning different sources of water were excluded from the analysis. All analyses were conducted using Excel. The difference in the neonatal infection rates between the two cohorts was characterized using relative risk (RR) and the associated 95% confidence interval (95% CI).

## RESULTS

Between December 2015 and June 2017, 3572 live births were registered at the Bolgatanga Regional Hospital (BRH). A total of 1077 live births (30%) occurred during a period of two consecutive days when tap water was available, and 505 live births (14%) occurred during a period of two consecutive days of water rationing. Among these two cohorts, 72 live births (5%) were subsequently admitted to the NCU with an early neonatal infection. Characteristics of the newborns admitted to the NCU are provided in **Table 1**.

When comparing neonatal infection rates between these two cohorts, babies born in a period of water rationing were at significantly higher risk (RR 2.0, 95% CI 1.3-3.2, p=0.002) of subsequent admission for early neonatal infection (**Figure 1**).

**Table 1:** Characteristics of babies delivered in Bolgatanga Regional Hospital (BRH) in periods of piped tap water access and periods of water rationing, and subsequently admitted to the Neonatal Care Unit (NCU) on account of neonatal infections, Ghana, December 2015-June 2017.

| Content | PIPED TAP WATER | RATIONED WATER |
|---|---|---|
| Total | 37 | 35 |
| Female (N; %) | 16 (43%) | 17 (49%) |
| Birth weight in kg (mean; SD) | 2.98 (± 0.47) | 2.87 (± 0.46) |
| Maternal age (median; IQR) | 27 (25-29) | 25 (22-27) |
| Neonatal age at admission in days (median; IQR) | 2.0 (1.0-3.0) | 1.0 (0.5-3.5) |
| Duration of stay in neonatal unit in days (mean; SD) | 3.5 (3.0-5.0) | 4.0 (3.0-6.3) |

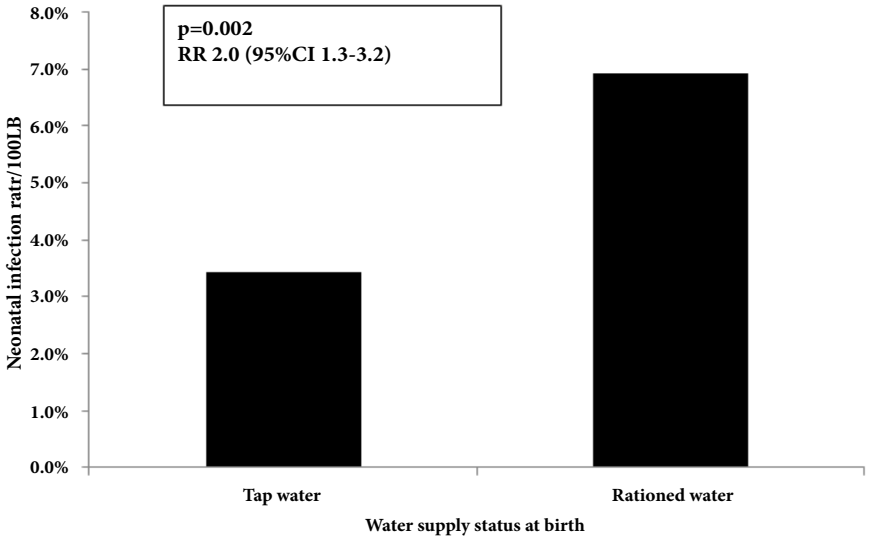


**Figure 1:** Early neonatal infection rates among babies delivered in Bolgatanga Regional Hospital in periods of tap water access and periods of water rationing, Ghana, December 2015- June 2017.

## DISCUSSION

This rapid assessment indicated that a baby born during the period of water rationing had twice the risk of early neonatal infection as one who was born during periods of tap water access in the Bolgatanga Regional Hospital of Ghana. This finding highlights the infectious consequence of neglecting the established standards of continuous supply of quality water in the context of IPC within health facilities [1,19].

In 2005, the needs assessment for accelerating gains in maternal and neonatal health in this hospital found a commendably efficient water system [20]; an observation in stark contrast with our finding that less than one baby in three is born in a period offering has access to tap water for at least two consecutive days. This is likely to be attributable to the water rationing introduced in 2014 [16]. Our study suggests that IPC may be one of the first victims of such a water rationing: Both the possibly poor quality of alternative sources (tapped buckets, large storage tanks, water trucking) and the inadequate quantities during rationing are likely to affect IPC measures [1]. Furthermore, effects may not remain limited to the period of rationing only, as the healthcare provider who must work with the available water may consciously or subconsciously use less water for handwashing, thus compromising adherence to IPC recommendations. This behaviour may continue during periods of tap water access, leading to an elevated risk of health care acquired infections (HCAIs) [7]. The situation is likely not unique to our setting: Data from Uganda, Rwanda, and Tanzania shows a worryingly low proportion of deliveries under safe water and sanitation conditions [21,22].

Our study had some limitations. First, data on maternal and newborn clinical risk factors for neonatal infections, such as membrane status, gestational age, maternal antibiotics, maternal Group B Streptococcal genital colonization and others were not captured for analysis. While these factors could affect the rates of neonatal infection, they are unlikely to vary extensively by weekday of birth and introduce a bias. Second, the diagnosis of neonatal infection was not standardized and no cultures were obtained from neonates, contact surfaces, or water sources, precluding any assessment of the source of infection. Finally, and possibly most importantly, the availability of free residual chlorine (FRC) in the tap and stored water was not monitored, nor was the chemical water quality from different sources compared.

## CONCLUSION

In conclusion, our study indicates the considerable risk for newborns associated with a lack of access to tap water in the immediate postnatal period. In situations where water rationing is being considered, health facilities should be exempted from water rationing, in order to avert adverse infectious morbidities among babies during their most vulnerable period. Health care facilities should also endeavour to have their independent water supply systems whenever possible.

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## AUTHORS' CONTRIBUTION

All authors met the ICMJE authorship requirements and contributed significantly towards the final article.

## ETHICS AND CONSENT

Permission for the study was obtained from the Navrongo Health Research Centre Institutional Review Board *via* the approval ID: NHRCIRB297. As the study was conducted on retrospective routine clinical data, the issue of consent did not apply.

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