Original Article

Visually clean is not necessarily microbiologically safe: Learnings from WASH assessment of maternity units of Gujarat, India

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Abstract

Background and Aims: Water Sanitation and Hygiene (WASH) within the context of Sustainable Development Goal (SDG) is well debated; however, WASH in health care sector is still in nascent phase, especially for maternity units. Although there are studies on WASH in maternity units, least are focused towards the microbiological safety. The objective of present study is to compare the visual assessment with microbiological assessment of selected maternity units of Gujarat (India) and to document microbiological contamination and drug resistance. **Methods:** A cross-sectional study was carried out in 10 selected maternity units of Sabarkantha and Gandhinagar district of Gujarat, India, during Feb-March 2018. Two steps of Tool Box Plus were used for documentation: visual and microbiological assessment. Antimicrobial Resistance (AMR) patterns amongst positive microorganisms were also documented. **Results:** Although the majority of the studied maternity units were visually clean, the microbiological findings contraindicated the same. The overall visual score across all facilities was close to 50% indicating good visual cleanliness. Out of 195 samples collected, 18% (35) samples were positive for pathogenic organisms and the majority were identified from mops and labour table. 1/3rd of organisms were resistant to >5 antibiotics. Pathogenic organism identified includes Acitenobacter, Klebsilla, MR CONS, E coli, Psudomonas Aeruginosa and Pseudomonas species. **Conclusions:** Visual assessment alone which is currently used for assessment of hygiene is not a proxy for safety. It should be validated by the microbiological method. Microbiology surveillance should be explored to get valuable insights on the effectiveness of cleaning practices of the maternity units.

Keywords: Antimicrobial resistance, microbiological assessment, visual assessment, Water sanitation and hygiene

Introduction

Globally there is a 38% reduction in maternal deaths from 2000 to 2017. However, India is still continuing as a major contributor for the highest-burden of maternal deaths (12%) after Nigeria.[1] Further, worldwide 8% and in developing countries an estimated 10-15% of maternal deaths are due to infections that can be directly linked to unhygienic conditions during labor and birth, at home or in facilities, and to poor hygiene practices in the six weeks after birth.[2] Adequate Water Sanitation and Hygiene (WASH) and improved maternal health are important targets of Sustainable Development Goals (SDGs). According to the Global Conference on Primary care held at Astana in 2018, primary healthcare is a cornerstone of a sustainable health system for effective universal health coverage

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and health-related SDGs.[3] Moreover, The latest World Health Assembly (WHA) 70.7 and 72.7 also stressed WASH in Health Care Facilities (HCFs) especially on primary healthcare.[4] More than two-thirds (66%) of India's population is residing in a rural area and use rural healthcare services. In addition, more than 50% of total maternal deaths are attributed to poor states consists of mainly rural population.[5] Therefore, to reduce maternal death, the quality of primary health care needs to be focused more. The provision of WASH in health care facilities helps to avert infections and spread of disease, protect staff and patients, and uphold the dignity of vulnerable populations including pregnant women and the disabled.[6]

Inadequate WASH standards in HCFs in many low- and middle-income countries are a major cause for concern.[6] Recent data shows that in low and middle-income countries (LMIC), 50% of HCFs lack piped water, 33% lack improved sanitation, 39% lack adequate infectious waste disposal and 73% lack sterilization equipment. Nationally representative data from six countries shows that only 2% of HCFs provides all Water Sanitation Hygiene and waste management services. As a result, an estimated 16% of patients acquire health care-associated infections. Moreover, sepsis and other infections account for a growing proportion of maternal (11%) and neonatal deaths (22%).[7] As per the global baseline report of 2019, one in four HCFs lack basic water services and one in five has no sanitation services – impacting 2.0 billion and 1.5 billion people, respectively.[8] Reflecting implications for the dignity of patients and other users who seek health care services, particularly women in labor and their newborn babies.

Although linkages between poor hygiene and environment at the time of birth and maternal child infection have been identified,[9] the published literature related to WASH assessment of maternity units is scant especially from LMIC countries such as India. Findings from various Service Availability and Readiness Assessment (SARA) surveys reveal the poor state of WASH in many health facilities, particularly in maternity wards, and also inadequacies in broader issues of infection control.[10] There are many standard tools available for assessment of WASH in HCFs but unfortunately mechanism for evaluating the quality of the hospital cleaning regimen is limited. The majority of tools based on subjective measurement of WASH should have validated with microbiology surveillance and photo documentation. A recent review of WASH assessment tools (India & Global) shows that except Tool Box and Kayakalp guidelines developed by the Government of India (GoI), none of the standards validate the visual assessment with microbiological findings.[11]

Further, cleaning has never been regarded as an evidence-based science and consequently receives little attention from the scientific community. Since there are no scientific standards to assess environment cleanliness, finding the evidence for benefit in the control of infection is further hampered.[12] Dancer *et al.* stated that currently cleanliness is monitored by visual audit hence whatever is visually clean is considered as safe for the patient and providers. However, the visual assessment will inevitably be subject to bias under these circumstances. This means that visual assessment is insufficient for defining cleanliness, nor will it accurately predict the infection risk for patients.[12] More so, monitoring programs do exist for operation theatre surface colonization and others for the specific pathogen in clinical areas of risk. Recently, attention has focused on areas outside the theatre environment. No one set of standards exists for general hospital wards, however, and there is considerable variation in sampling methodologies and quantitative reporting.[13]

With the rise in institutional delivery in India, the protocol to monitor cleanliness is the need of the hour. Lack of microbiological surveillance leads to a missed opportunity to analyze the effectiveness of quality of care provided and the level of cleanliness. Inadequate WASH and environment reservoir play an important role in many parts of the life cycle and antimicrobial production, use and disposal contributing to the emergence and spread of AMR.[8] The practice of giving antibiotics to all pregnant mothers after delivery to avoid infection is still highly prevailing in India which may further increase the risk of Antimicrobial Resistance (AMR). Hence it is important to understand the AMR pattern in maternity units which can help to reduce not only infections but also AMR amongst patients and healthcare providers. There is also a lack of published literature on WASH assessment of HCFs using visual audit including microbiological components and AMR, especially for maternity units in India. The objective of the present study is to compare the visual assessment with the microbiological screening of maternity units of Gujarat using a set of tools (TOOLBOX Plus) and to identify the organism and document AMR pattern in selected maternity units of Gujarat.

Methods

Present study is a cross-sectional study of 10 maternity units (5 nos./district) of Sabarkantha and Gandhinagar District of Gujarat conducted during Feb- March 2018. Facilities includes 6 Primary Health Centers (PHCs) and 4 Community Health Centers (CHCs). The selection of a health care facility is based on the following criteria:

a) In PHC at least 15 deliveries/month,
b) In CHC at least 30 deliveries/month
c) Availability of adequate health staff (More than 75% filled up staff).

The present paper focuses on WASH assessment of HCFs using visual assessment which was further verified by microbiological surveillance of maternity units. Two steps of Tool Box Plus were utilized for documentation.

Step 1: Visual assessment (Walkthrough)

Walkthrough captures the subjective measurement of visual cleanliness while passing through the maternity units. During

the walkthrough assessment microbiological samples and photographs from the same sites were also collected by trained researchers to verify the result of walkthrough and microbiological assessment. Walkthrough assessment was done in predefined areas like maternity wards, Labour rooms and cleaners' store area. To avoid any bias in the microbiological results, walkthrough was done prior to other tools of Tool BOX plus.

Analysis plan

As per the different components of the walkthrough, area-wise and total visual assessment scores were calculated. Checklist questions related to the state of hygiene, such as 'Are water points for hand washing in the delivery room visibly clean? Are they free from debris?' Responses "yes/no/not applicable" are made to a series of questions on the visual observations of the state of hygiene. Area wise scores were also calculated e.g. Hand washing facility, storage facility, etc., which can be used as a basis for quality improvement.

Responses to the questions were pooled and used to create summary percentage scores. The visual state of hygiene score (SOH-V score) was then grouped according to quartiles, with a score of 75% or more labeled 'very good', 50_74% 'good', 25_49% 'moderate', and 0_24% 'poor'.[14]

Step 2: Microbiological surveillance

During the walkthrough process Sterile damp swabs samples were taken at up to 15 designated sites per facility within the maternity ward, delivery room, and cleaners storeroom to gain an objective measure of infection risk. Samples were collected by trained Researchers and all standard precautions were taken to avoid contamination of samples.

Analysis technique

Samples were analyzed in an accredited laboratory. One swab was taken per site using a single swab method. Samples were transported in the cold chain to the lab for the analysis process. The swab samples were streaked directly on agar plates. Nutrient, Chocolate, MacConkey, and blood agar was selected for the isolation process. The plates were incubated for 24 hours at 37°C under aerobic conditions. After the incubation period, the growth on the plates was further characterized by Gram staining and standard biochemical tests. Further, the disc method as per CLSI guideline was used for each pathogen to assess the AMR pattern.[15]

Ethical approval for the study was received from the Institute Ethics committee of the Indian Institute of Public health Gandhinagar. Approval from the Government of Gujarat and the manager of selected HCFs was were also taken prior to assessment.

Results

Characteristics of participating facilities

Basic facilities like running water, electricity with back up were available in all the facilities. Half the facilities had a lack of handwashing facilities in maternity wards. Majority of facilities lack flushable toilets for the patients. In all facilities, waste was separated into 4 categories in appropriate waste containers. The majority of facilities had a dedicated area for safe storage of waste. However, 3 PHCs did not have separate space for waste storage hence, store waste in open area. Lack of color-coding system for mops was found in the majority of facilities.

Walkthrough observation (visual assessment)

The overall score across all facilities type was close to 50% (as per the categories explained in methodology) except one indicating good visual cleanliness. Out of total of 10 facilities selected, 7 facilities had a very good state of hygiene, whereas 2 facilities had a good state of hygiene and one facility (facility 1) had the lowest score and fell under a moderate state of hygiene. Out of all PHCs, facility 2 had the highest scores and facility 1 had the lowest scores, whereas the remaining 3 fell under good state of hygiene and one in a moderate score of hygiene. Out of four CHCs, three had >50% scores. However, facility 7 had the lowest state of hygiene.

Further, the state of hygiene of maternity units and labor room varies from facility to facility, it ranges from 100% to 41%. However, except facility 1, all had a good state of hygiene. All facilities had 100% scores for storage and disposables. Although overall scores of the facilities were good, the state of hygiene of maternity toilets was poor amongst all except facility 2. It was also observed that there were no separate toilets for the maternity ward. The cleanliness of the handwashing station was also poor in most of the facilities. Amongst all 4 CHCs, facility 7 had the lowest score but scores related to maternity ward cleanliness and labour room was more than 80% however, cleaning material and linen area score was less than 50%.

Microbiological surveillance

A total of 195 samples were collected from 10 selected facilities from designated sites. Out of the total 195 samples, 18% (35) samples were positive for pathogenic organisms. Out of 35 positive samples, 37 organisms were identified it includes: *Acinetobacter, Klebsiella,* MRCoNS*, E Coli, Pseudomonas Aeruginosa* and *Pseudomonas species*. Out of total identified organisms, the majority were critical organisms *Pseudomonas Aeruginosa* (27%), MRCoNS and Acinetobacter (10.8%) and Klebsila and ecoli (5.4%) Pseudomonas Species (40%) respectively.

The microbiological contamination ranges from 5% to 42% in selected HCFs. Facility-wise comparison of microbiological screening shows that out of all facilities, facility 7 had the highest (42.1%) microbiological contamination. In comparison to other CHCs also, Facility 7 had two times higher contamination,

whereas other CHCs had less than 20% contamination. Out of all PHCs of two districts, Facility 5 had higher contamination (25%) whereas facility 2 and facility 1 had 21% and 16.7% contamination, respectively. The contamination in the remaining three facilities (Facility 5, 6 and 10) was ≤10%.

Site wise microbiological contamination

Site wise microbiological contamination shows that majority (37.1%) of organisms were identified from mops of maternity and labor room. While 25.7% of total samples were positive from labor table and 17.1% from buckets of labor room and maternity wards. Out of total samples collected >5% of positive samples were from the sink of maternity, and 3% from labor room sink. Remaining 8% positive samples were from toilet sink and 3% were from maternity beds.

Antimicrobial resistance

All positive samples were further tested for antimicrobial resistance. Out of the total 37 organisms identified, one-third of organisms were resistant to >5 antibiotics whereas 35% were resistant to <5 antibiotics and 30% were not resistant to any antibiotics respectively. Site wise AMR pattern shows that out of total positive samples from mop and buckets, almost 50% were resistant to ≥5 antibiotics. Similarly, out of total positive samples from labor table, 22% were resistant to ≥5 antibiotics.

Visual assessment vs. microbiological assessment

The comparison between visual assessment scores and microbiological assessment is shown in Figure 1. Interestingly facilities that had poor and highest scores on visual assessment, on verification by microbiological surveillance, no major difference was found between the two.

Facility 1 that had the lowest hygiene score as per the visual assessment, the microbiological contamination was 16.7%. However, facility 2 which had the highest scores (very good hygiene score) had higher (21.1%) contamination. Moreover, the facility 7 that scored more than 50% on visual assessment (good state of hygiene) had the highest (42.1%) contamination. Similarly, facilities (facilities 5, 8, 10 and 9) that had a very good state of hygiene had ≥15% of samples positive for any microorganisms. On the contrary, facilities like 6, 4 and 3 had a good or very good state of hygiene and low contamination, compared to other facilities. Hence, out of total 10 facilities assessed, all facilities were found with good or very good state of hygiene, however, when state of hygiene was verified by microbiological assessment, it shows higher contamination and poor state of hygiene except facility 3 (VA score 74.1 and 5% contamination) and facility 6 and 4 (VA score >79% and contamination 10%).

Figure 2 shows the photograph of the labor table captured during the walkthrough assessment of facility 5. Although visually it looks clean, it was contaminated with Acenetobacter microorganism.

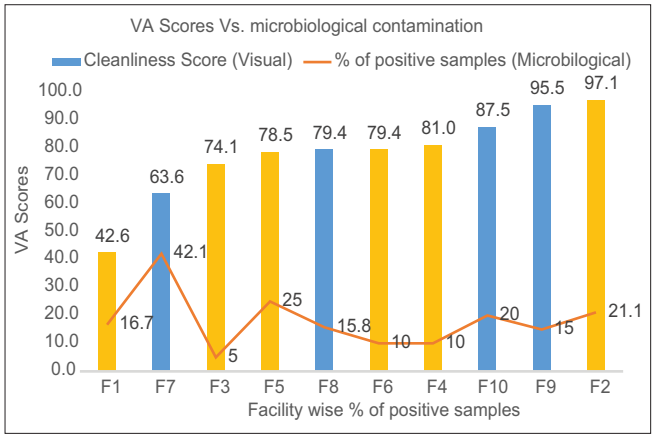

Figure 1: Comparison between visual assessment and microbiological surveillance

Discussion

The present study reflects that, on visual assessment, the majority of selected facilities had good visual cleanliness except facility 1. However, when the state of hygiene was verified by a microbiological assessment; it shows the opposite picture. Although, Facility 1 had the lowest VA score which shows poor visual cleanliness; had low contamination compared to other facilities that had a good or very good state of hygiene. Similarly, those facilities scored very good or good state of hygiene, had higher contamination (Facility 2: VA score 97.1, 21% positive samples; Facility 7: VA score 63.6% and 42% positive samples). Similarly, earlier multicounty WASH and Clean Study conducted in Gujarat and Bangladesh reported similar findings.[9] Another study compared visual assessment against the biochemical and microbiological screening of the hospital. The result shows that whereas most surfaces looked clean, less than a quarter were free from organic soil (ATP) and less than half were microbiologically clean.[13]

Microbiological surveillance identified pathogenic organisms like MRCONS, Acinetobacter, Psudomonas aeriginosa from sites of labour table, maternity wards, toilets and cleaning material like mops were identified. The percentage of positive swabs from the total samples collected was 18%. Out of all positive samples, the highest contamination was found in labour room or maternity

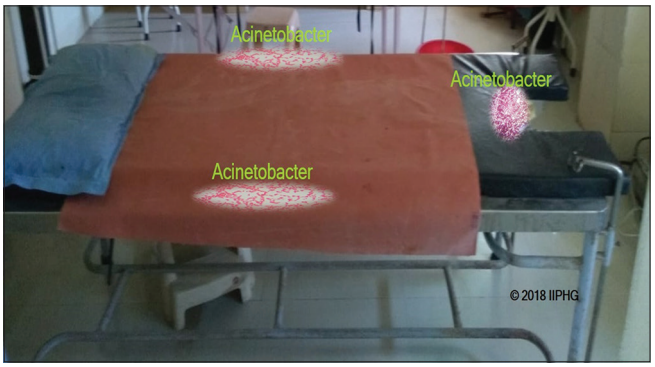

Figure 2: Photo validation of visual assesment and microbiological assesment (Facility 5 Labour table)

mops which is crucial findings and needs an urgent action for implementation of standard protocol for the cleanliness of mops which is usually overlooked or get limited importance.

The second highest positive samples were from labor tables which is again a critical finding as recently there has been an increase in institutional delivery rate hence the quality of cleaning should get more attention as unhygienic practices or unclean surfaces may put mother and baby both on the risk of getting an infection. Moreover, out of the 37 organisms identified, one-third of organisms were resistant to >5 antibiotics. This in turn highlights the critical issue of AMR and the need for strengthening the antibiotic policy of HCFs, as currently all mothers are given antibiotics irrespective of type of delivery.

The strength of the present study is the use of a standardized and validated tool for assessing the visual cleanliness across two districts of the state. In addition, the use of microbiological surveillance and correlating with the visual cleanliness made this study unique of its kind. One of the limitations of the study is that it failed to capture the secondary data on infection rates of patients admitted to the hospital, which might have been a potential resource to correlate with these WASH findings. Further, there is also an absence of a mechanism for the screening of healthcare staff for nosocomial infection which can be linked to hospital cleanliness and microbiological results. Another limitation was the Hawthorn Effect, although the walkthrough along with micro assessment was done prior to other tool administration, there may be a bias.

The present study highlights an important finding that visual assessment or audit of any HCFs which is currently in practice is not sufficient for safe and clean hospital environment but the microbiological assessment is needed for monitoring the effectiveness of cleaning practices. Because whatever is visually clean may not be microbiologically sterile. The present study also found the highest positive samples from the mop of the maternity unit, hence cleaning material like mops can itself spread the infection in the hospital and it should be cleaned as per the standard protocols. Although various guidelines like Kayakalp have been initiated for improvement of WASH in HCFs but still there is a need for identification of gaps in infection control practices of facilities. Moreover, AMR and microbiological contamination in an important area like labor room and cleaning materials is also a big challenge and requires further research on how to clean labor room and cleaning materials used for cleaning for a safe environment.

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Conflicts of interest

There are no conflicts of interest.

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