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Full Length Research Paper

Maternal child health through water, sanitation and hygiene

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Each year 290,000 women die from complications during pregnancy, birth and the neonatal period and, an estimated 10 to 20 million women suffer from related health complications ((WHO, UNICEF, UNFPA, WB, 2012). Almost 90% of the maternal deaths occur in Sub-Saharan Africa and South Asia. Much of this is preventable through practices that have long been established. Hygiene and cleanliness are basic concepts in health care. They are included in most health promotion and health worker training programs. Evidence available shows their invaluable contribution to quality health service provision. Maternal mortality has decreased by one-third over the past 20 years (WHO, UNICEF, UNFPA, WB, 2012) in part related to increase in safe deliveries by skilled personnel, reduced fertility and antenatal care. However, these substantial improvements have not benefited the rich and the poor alike. The burden of mortality and morbidity falls disproportionately on the poor and remains a great challenge in our world. Provision of clean water, sanitation and hygiene has played a major role in achieving this reduction.

Key words: Maternal child health, Sub-saharan Africa, water sanitation and hygiene, maternal mortality, pregnancy.

INTRODUCTION

Each year 290,000 women die from complications during pregnancy, birth and the neonatal period; and, an estimated 10 to 20 million women suffer from related health complications (WHO, 2012). Almost 90% of the maternal deaths occur in Sub-saharan Africa and South Asia. Much of this is preventable through practices that have long been established. Hygiene and cleanliness are basic concepts in health care. They are included in most health promotion and health worker training programs. Evidence available shows their invaluable contribution to quality health service provision. Maternal mortality has decreased by one-third over the past 20 years (WHO, 2012), in part related to increase in safe deliveries by skilled personnel, reduced fertility and antenatal care. However, these substantial improvements have not benefited the rich and the poor alike.

Maternal mortality has to be reduced by 75% by 2015

to reach Millennium Development Goal 5. We are off track, particularly in the poorest countries and regions. Most of these countries also face the grimmest water, sanitation and hygiene situation.

Through the experience of countries that have drastically reduced their maternal mortality rates, we have learned much about the necessary policies and interventions. As with most complex health and development issues, there is no one magic bullet. Besides increasing knowledge on family planning methods, changing the position of women in their communities and improving access to quality (maternal) health care, it is quite obvious that access to clean water, sanitation and hygiene at home and in the clinic play a key role as well.

Nevertheless, the effect of water, sanitation and hygiene on maternal mortality is greatly under-researched. This paper seeks to address the links through a review of current literature from the water, sanitation and hygiene (WASH) as well as the maternal health angle. A review of a large number of documents reveals both the multitude of relationships between

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Table 1. Maternal mortality ratio—deaths of women per 100,000 live births by region.

Region		Range	Estimated number of Maternal Deaths 2010	Life time risk maternal deaths (2010)
	Deaths per 100,000 live births			One in
Sub-Saharan Africa	500	400-750	162.000	39
South Asia	220	160-320	83,000	150
Europe	20	18-24	2200	2900
Worldwide	210	170-300	287.000	180

Source: WHO, UNICEF, WB, UNFPA, 2010.

maternal health and WASH, and various areas that deserve further research. The findings show that access to water, sanitation and hygiene, from pregnancy to birth and the weeks of recovery afterwards, have in different ways an impact on the health outcomes and survival of the mother.

Finally, the paper provides several policy, programmatic and research recommendations to address the importance of WASH for maternal health. These recommendations particularly Centre on the need for integration of WASH and maternal health interventions within Ministries, institutions and organizations. There are no meta-studies specifically on this topic.

Objectives

The main objective of this review is to outline from literature the underlying challenges in Maternal Child Health in relation to WASH and suggest some remedies.

METHODOLOGY

Published literature was reviewed on evidence-based interventions and “packages” of interventions across: maternal health, mortality or morbidity; reproductive health, antenatal and neonatal care; water or sanitation or hygiene and health services; hand washing practices; quality/cleanliness of health services and clinics; and decision making, power relations and health seeking behaviour. The search for relevant materials included the publications of Elsevier, Medline, Lancet, Google scholar as well as international organizations including WHO, UNICEF, UNFPA, WB. Preference was given to interventions and research related to Sub-Saharan Africa and Asia. Of the 2,000 articles identified, approximately 500 were reviewed in full. The emphasis was on peer-reviewed publications and literature mainly dating past the year 2000 with some exceptions where the paper was particularly relevant or dealt with aspects that are not time-bound (e.g. history of maternal health interventions).

Expected output

To prepare a firm ground for a concept note aimed at advising the governments’ Ministry of Health (MOH). Armed with such information, the Ministries of Health (MOH) will be better placed to devise the best policies to enact in order to facilitate the tackling of the challenges.

Funding

There was no external funding for this review

Limitations of the study

The literature survey and the groups consulted noted that there is relatively little research on the links between water, sanitation and hygiene on the one hand and maternal health on the other. There are no meta-studies specifically on this topic. Much of the research to which reference is made are relatively small studies, are location-specific or not of high quality, thus pre-empting the ability to provide evidence-based generalizations over large populations. In the future, greater emphasis on research and interventions related to the links between water, sanitation, hygiene and maternal health in developing countries is needed.

Issues such as the impact of malaria and environmental hygiene on maternal health are not covered by this literature review.

RESULTS

Section a) – maternal mortality causes of death

Maternal mortality—the death of women during pregnancy, childbirth, or in the neonatal period up to four weeks after delivery remains a major challenge to health systems worldwide. Of the estimated 287,000 maternal deaths in 2010, 99% of these occurred in developing countries with sub-Saharan African and Southern Asia accounting for 85% of the global burden (WHO, 2012).

As shown in Table 1, there are large differences between various regions of the world. This extraordinary

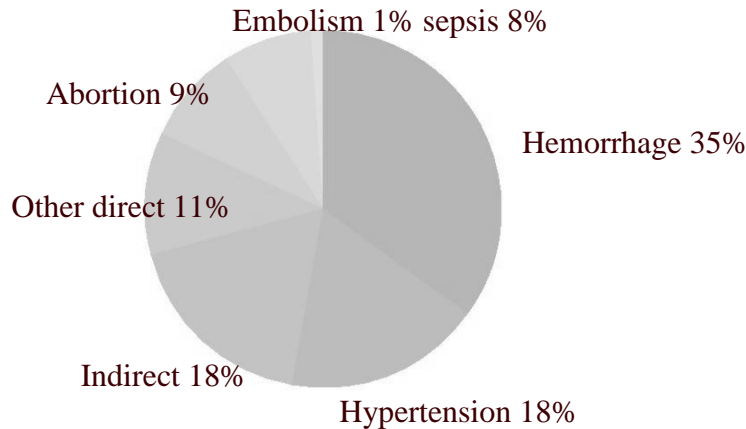


Figure 2. Causes of maternal deaths. (Source: Countdown to 2015).

inequity between the burden of women dying in developing and industrialized countries has been called the largest discrepancy of all public-health statistics (Carine and Wendy, 2006). Tragically, many of these deaths could be prevented by practices and interventions that have been proven to be effective.

The health of many women who survive beyond childbirth is also compromised. Of the 140 million women who give birth each year, an estimated 10 to 20 million suffer from complications related to pregnancy and poor birth management. This includes continuing illnesses and conditions such as anaemia, urinary tract infections, damage to pelvic structure, fistula, incontinence, infertility (Veronique et al., 2006; Alvarez, 2009; WHO, 2010).

Reduction in maternal deaths

After a long period of very slow improvement, between 1990 and 2010 the estimated worldwide annual maternal mortality has dropped by almost 50%, from about 546,000 deaths down to about 287,000 (Margaret et al., 2010) with varying progress found in different regions. South Asia has experienced a far more rapid improvement than Sub-Saharan Africa—about 42% (WHO and UNICEF, 2010). Without the HIV/AIDS epidemic, maternal deaths would have been reduced by perhaps another 18%, with the greatest reduction in Sub-Saharan Africa (Margaret et al., 2010).

Reductions in maternal mortality

As each situation differs, it is difficult to identify all the causes of these improvements in the maternal deaths or to pinpoint the relative importance of each. However, factors often sighted are the increase in safe deliveries by skilled personnel, reduced fertility, antenatal care as well as international advocacy and availability of additional

resources to improve maternal health (WHO, UNICEF, WB, UNFPA, 2010; WHO, 2012; Margaret et al., 2010).

The early downward trend in maternal mortality in northern Europe (Netherlands, Denmark, Norway and Sweden) starting around 1850 and more recent evidence from Sri Lanka and Malaysia (1945-1955) corroborate the importance of skilled personnel attending childbirth, clean deliveries and good management (Wim van L, Vincent de, 2001; Irvine, 2000; Woods et al., 2006; Indra et al., 2003).

Inequity in health provision

The substantial improvements in maternal health have not benefited rich and poor alike. The reduction in maternal mortality has been uneven between and within countries, favouring those families with more resources. For example, on average in Africa, the richest 20% of African women are three times more likely to have skilled attendants at birth compared to the poorest quintile. These wealthier families are able to afford the direct and indirect costs associated with birth (data 1994-2005) (Joseph et al., 2007).

Direct causes of death

Between 11% and 17% of maternal deaths happen during childbirth itself; and between 50% and 71% occur in the immediate post-partum period. Mortality is extremely high on the first and second days after birth (Carine and Wendy, 2006). Four main killers that are the immediate or direct causes of about 70% of maternal deaths worldwide are haemorrhage, Hypertension, Abortion and Embolism (Figure 1) (WHO, 2010).

Severe bleeding/hemorrhage

Each year almost 14 million women are noted to suffer severe blood loss during childbirth or the post-partum

period of whom around 140,000 die while another 1 to 2 million suffer long-lasting consequences of complications (Carine and Wendy, 2006; Khalid, 2006; Angela and Charles, 2001; Afisah et al., 2009). Anaemia reduces resistance to blood loss and is related to haemorrhaging during and after birth. In anaemic women, the risk of dying during pregnancy or childbirth is about 3.5 times higher than in non-anaemic women (Bernard et al., 2009; Cavill, 2012; Sandy, 2010; Sujeevani, 2001). With 35% of the maternal deaths caused by haemorrhage, it is the leading direct cause of maternal mortality.

Hypertensive disorders and (Pre-) Eclampsia

Pre-eclampsia, leading to eclampsia consists of central nervous system seizures, which often leave the patient unconscious and, if untreated, lead to one out of about 5 maternal deaths each year (Khalid, 2006; Angela and Charles, 2001).

Puerperal sepsis

A general term used to describe infections of the genital tract and is particularly common with unhygienic births and induced abortions. One path for infections is through the birth canal of the woman, where microorganisms can cause puerperal sepsis. An early symptom of puerperal sepsis is fever (Carla, 2003; Khalid, 2006; Angela and Charles, 2001). It is significantly related to morbidity as women who survive the initial infection may go on to develop pelvic inflammatory disease, chronic pelvic pain, damage to reproductive organs, and infertility (Cavill, 2012).

Unsafe abortion

As may be expected, the precise proportion of deaths attributable to complications from unsafe abortion is not known. Estimates range from 8% to 30% of the total maternal mortality, much of which could be averted with family planning services (Khalid, 2006; Angela and Charles, 2001; WHO & UNICEF, 2010). Safe abortion reduces maternal mortality (WHO, 2010). An example is the decrease in maternal mortality in Romania from 159 deaths per 100,000 live births in 1989 to 83 deaths over a two-year period, after the country's restrictive abortion law was revoked (Carine and Wendy, 2006). In addition, abortion-related morbidity can pose a serious threat to women throughout their reproductive years (Carla, 2003).

RESULTS

Section b) - Significance of water, sanitation and hygiene for health in maternal Health

There is considerable evidence about the importance of

water, sanitation and hygiene for health in general. It has been estimated that globally about 2 million deaths could be prevented annually if everyone practiced appropriate hygiene and had access to safe, reliable drinking water and sanitation. In this estimate are many children under five years in developing countries who suffer from diarrhoea and subsequent malnutrition and diarrhoea-related diseases. Small children are at greater risk from diarrhoea and life-threatening dehydration (WHO, UNICEF, UNFPA, WB, 2012).

Based on systematic reviews, Sandy (2010) found risk reductions in diarrhoea of 48% from hand washing with soap, 17% associated with improved water quality and 36% from safe excreta disposal (Gary et al., 2005). Some common health problems related to poor water and sanitation include: bacterial and viral infections (diarrhoea, cholera, dysentery, typhoid, poliomyelitis and hepatitis), parasitic infections (amoeba and *Giardia*, roundworms, whipworms, hookworms and schistosomiasis), and other infections such as upper respiratory infections, trachoma and scabies (Koblinsky et al., 2006). Much of the impact of safe water supply and improved sanitation on health is mediated through hygiene practices. For example, hand washing with soap reduces the risk of diarrhoea, and of upper respiratory and skin infections. Face washing prevents trachoma and other eye infections (Sandy, 2010).

Quantity of water

The distance to water source also has implications for maintaining personal and household hygiene. Research indicates that very low amounts of water (often less than 5 l per capita per day) are collected when the round trip to collect water takes 30 min. or more (Jamie and Sandy, 2010). The potential health advantage of having a water point in the family compound or in the household is substantial because more water is available for hygiene. A further advantage of having a functioning water supply near or in the home is that less water needs to be stored. Household water storage increases risk of contamination from vector-borne diseases and from oral-faecal routes (Jamie and Sandy, 2010). Curtis (1995) found that provision of a yard tap nearly doubled the odds of a mother washing her hands after cleaning her child's anus and more than doubled the odds that she would wash any faecal soiled linen immediately (Guy and Jamie, 2003).

Two studies in 1999 and 2004 of household water use in rural areas of sub-Saharan Africa concluded that a rough average for use of water in rural areas was around 10 l per person per day with huge variations between countries and households. This average is, however, far below the basic level of 20 l considered as the minimum needed to maintain personal and domestic hygiene needed for good health (Sandy and Vivian, 2006; Friede and Mieke, 2009).

WASH in relation to maternal health

We examined literature with linkages between WASH and maternal health. However, beyond a few subjects such as hygiene during the birthing process, we found remarkably little research showing a link between water, sanitation and hygiene as independent variables associated with maternal mortality and morbidity.

During pregnancy

During the months before delivery, the health status of the woman can be affected by variables such as: distance to the water source and quantity of water used, quality of water, having and using a clean toilet.

One study, using global databases from World Bank, WHO and UNICEF, found that increased access to improved water sources and improved sanitation is significantly associated with decreased maternal mortality ratios (odds ratio 0.58, $P=0.008$ and 0.52, $P = 0.009$ respectively). The authors Cheng (2012) suggest that better water quality and sanitation reduce the risk of morbidity related to illnesses such as anaemia, nutritional deficiency, hepatitis as well as reducing the workload of women. They note that both clean water and skilled birth attendants are necessary for lower maternal mortality (Sydney and Jeffrey, 1999).

A recent study by Muldoon and colleagues examined the link between the strength of the health system and important public health outcomes across nations. Access to sustainable water and sanitation was associated with a lower maternal mortality ratio (aRR 0.88; 95% CI 0.82-0.94). Water and sanitation was also associated with a lower infant mortality and child mortality (aRR 0.85; 95% CI 0.78-0.93 and aRR 0.82; 95% CI 0.75-0.91 respectively).

Distance to water source

Women should gain about one kilogram per month in the second and third trimesters of pregnancy. However, carrying water is one of the heaviest tasks and is known to affect weight gain during pregnancy and infant birth weight. For example, Rosen and Vincent found three studies from Sub-Saharan Africa estimating that carrying water accounted for an average of 10% of the carrier's daily calorie intake, with considerable variation (Sandy and Vivian, 2005; Friede and Mieke, 2009). Thus easy access to safe water may improve maternal health, simply because pregnant and nursing women no longer have to carry heavy loads of water several times a day (Cavill, 2012). The reader may think about being pregnant and carrying a full suitcase (20 kilograms) one kilometre each day. This is roughly equivalent to the very modest provision of 15 litres of water per person for a family of

four people when the water point is located 160 meters away.

A study, in which water was tested as an independent variable, was undertaken by Alvarez et al (2009), comparing variables between many countries in Sub-Saharan Africa using data from studies undertaken between 1997 and 2006. It showed a significant correlation ($r = -0.399$; $P = 0.008$) between decreasing maternal mortality and the increasing access to improved water sources such as piped water, public tap, borehole or pump, protected well (Alvarez et al., 2009).

Water quality affects maternal health

In addition to the quantity used, the quality of water can have an impact on the pregnant woman. Water quality refers to both its microbiological and chemical (salinity, arsenic, fluoride) quality.

A study of the impact on pregnant women of biological contamination of water through faecal-oral routes was undertaken by the IDCCR-B (International Centre for Diarrhoeal Disease Research, Bangladesh) after an urban outbreak of Hepatitis E (HEV). The report noted that the transmission of HEV is an example of an illness which has a differential impact on pregnant women and is transmitted usually through faecal contamination of drinking water, with periodic outbreaks in Asia and Africa. For pregnant women, this HEV infection is a more severe illness than for the general population with poor outcomes for themselves and their babies (June et al., 2012).

Chemical contamination of water can also have negative impacts on pregnant women. The following examples relate to salinization of water and arsenic contamination. One recent study (2011) examined the impact of increasing saline intrusion during the dry season in shallow groundwater aquifers and ponds in coastal areas of Bangladesh with a population of more than 35 million. It appeared that people, particularly the poor, in these coastal areas were consuming 2½ to 8 times the WHO/FAO daily recommended intake of sodium/salt (2 grams a day) in the dry season when water from the sea and from brackish ponds washes into the drinking sources. In the study of 1,000 pregnant women with hypertension, a sharp rise of 2.4 times more cases of hypertension/pre-eclampsia were diagnosed in the pregnant women during the dry season (ICDDR. 2009).

Arsenic contamination of drinking water supplies is a global problem. Estimates are that 136 to 178 million people worldwide drink water contaminated with arsenic above the WHO/FAO guideline of 10 parts per billion for drinking water.

Hygiene affects maternal health

More than 2 out of 5 maternal deaths occur within 24 h of

birth from causes related to haemorrhage and puerperal sepsis, and many surviving mothers probably suffer longer-term effects. Sepsis (bacterial infection in the bloodstream or body tissues) is mainly caused by unhygienic practices and poor infection control in labour and delivery (Simon et al., 2004).

Clean hands

Clean hands are essential to promote safe and healthy deliveries. Hand washing reduces exposure of the mother and new-born to pathogens and thus helps reduce mortality (Cavill, 2012). The importance given to hand washing is highlighted in the WHO (World Health Organization) short course called Essential New-born Care Course, which is given at the local level to clinic staff.

Clean perineum and bathing

One small study found in Tanzania showed that women who bathed before delivery were almost three times less likely to develop puerperal sepsis than women who did not bathe (Rhee et al., 2008).

Fistula

Access to water and sanitation is essential to living with the consequences of fistula (as well as the healing of perineum ruptures and episiotomy). It is estimated that more than 2 million young women in Asia and sub-Saharan Africa live with untreated obstetric fistula, a hole that develops between the bladder or rectum and the vagina as a result of obstructed and difficult childbirth. Fistula results in incontinence, as women cannot control urine or faeces, often meaning they lose status and dignity, becoming shunned by their community and families. Women with fistula tend to be young, impoverished and have little or no access to medical care. Incontinent of urine and/or stool, these women become ostracized and shunned by their community. Basic personal hygiene, including frequent cleansing of the genital area, is very essential to help manage obstetric fistula and to prevent infections (Maggie and Kristina, 2005).

Menstrual hygiene

From a longer-term perspective, safe reproductive health should begin early and include menstrual hygiene to avoid subsequent health problems. Menstrual hygiene refers to having water and clean, private toilets, using menstrual pads only once or reusing cloths that have

been adequately cleaned and dried, having a place to wash regularly and change clothes. A survey by Water Aid in Bangladesh reported health problems resulting from poor menstrual hygiene such as vaginal scabies, abnormal discharge, and urinary tract infection (Cavill, 2012).

Water quality

In addition to the research on water quality and maternal health mentioned earlier, there are a small number of studies on water quality and neonatal survival. Because fertilizers are applied early in the growing season and residues may subsequently seep into water through soil run-off, the concentrations of agrichemicals in water vary seasonally. A study in India found an association between the presence of fertilizer chemicals in water in the month of conception and infant mortality, particularly neonatal mortality. Similar studies in South Africa and Colombia suggest that 10% increase in water toxins from fertilizers is significantly associated with about a 15% increase in infant mortality within the first month (Zulfiqar and Zohra, 2010).

Hand washing and clean deliveries

Edmond (2010) writing in the *Journal of Paediatric Medicine* notes that there is strong evidence that hand washing can reduce neonatal sepsis and infection rates. Hand washing by birth attendants and mothers were reported in one study to increase new-born survival rates by up to 44% (Oestergaard et al., 2011), and in another study in Bangladesh to decrease neonatal tetanus rates by 36% (Stekelenburg, 2004; Mikey, 2006) and in Pakistan by 56% (Black et al., 2010). Hand washing by birth attendants before delivery in another study in Tanzania reduced neonatal mortality rates by 19% (Rhee et al., 2008). Research in southern Nepal, showed that among new-borns where both the birth attendant and mothers washed hands with soap, the risk of neonatal death was 41% lower. The benefits of hand washing in the study seemed to be greater among new-borns who are at greater risk, for example, babies having low birth weight (Oestergaard et al., 2011). Another piece of research found that the use of soap to wash hands before delivery reduced the risk of cord infection by 49%. This study noted: "Many infants (92%) are born at home, and almost all are exposed to substantial infectious challenge during the first days of life. In the absence of topical cord antiseptics, hand washing with soap and water before assisting at delivery may reduce the risk of cord infection; in general, continued emphasis should be placed on promoting this important and simple intervention in community health programs" (Anna van et al., 2006; Cavill, 2012).

However, Blencowe et al. (2011) commented on the quality of the evidence, in a systematic review of multiple databases, on the relation of clean birth and postnatal care practices to neonatal deaths from sepsis and tetanus. They found: "The overall quality of evidence for impact of clean birth and postnatal new-born care practices reviewed on cause-specific mortality is very low. However as there is strong biological plausibility and this is an accepted standard of care, and randomized controlled trials would be considered unethical". The authors then had 30 experts examine the evidence. The conclusion of this panel was that about 30% of the neonatal mortality from tetanus was reduced by clean practices at home, by 38% in a health facility and by 40% through clean postnatal care (Umesh et al., 1998).

Clean cord cutting and tying

Infected cords cause neonatal deaths. In rural Nepal, failure to wash hands before cutting the cord or use of dirty clothes on the umbilical cord were associated with 60% and 70% increased risk of cord infection, respectively. Moreover, failure to use a boiled or sterilized blade led to a 2.3-fold increase in risk of cord infections [39]. Tradition and culture play a role in birthing procedures, particularly during deliveries at home. For example, related to care of the umbilical cord, studies in various countries note that many things are applied to cut the umbilical cord: clarified butter, ashes, oil, herbs and/or cow dung (Kenya, Tanzania, parts of India, Pakistan) (John. 1997; Luke and Gary, 2006; Hannah et al., 2011; Black et al., 2010; Asp and Sandberg, 2011). Trying to change these customs to dry cord care, where nothing is applied to the cord (or only an antiseptic), can meet with considerable resistance.

Antenatal care

In many countries, women have heavy workloads and are involved with these up to the delivery time (Koblinsky et al., 2006; Michael, 2001). One of the roles of antenatal education is to help women prepare better for delivery, to help them learn about risk factors and danger signs, to plan for having trained attendants at the delivery and rapid emergency help if needed. Antenatal education also provides the opportunity to learn more, including more about safe hygiene, water and sanitation during and after pregnancy. Thus, the antenatal visit can, at least theoretically, activate the link between improved WASH and maternal health (WHO, 2010).

To make this link, however, the quality of education and service in the antenatal clinic must be adequate. For example, research in Zambia showed that only 15% of women who visited the antenatal clinic had adequate knowledge about the risk factors and/or danger signs of

pregnancy (Jody and Joyceen, 2011) and two studies in Tanzania and Kenya showed that only about half those attending the antenatal clinic received health education (Saffrom et al., 2011; Mikey, 2006). Conversely, the Zambian study showed that 2½ times more women who know the risk factors well made use of the clinic delivery services compared to the group of women who did not (Jody and Joyceen, 2011).

Factors influencing maternal health related to WASH

Antenatal care and maternal health interventions usually focus on the woman as the prime controller of reproductive health. However, the woman's control over her own health can vary considerably. She may share decision-making power with others or, indeed, have little say over basic expenditures and important health decisions such as having birth, provision of water and sanitation facilities or seeking emergency help. For example, research by Stekelenburg et al. (2004) in Zambia found that in 47% of cases women themselves decide where to deliver, in 14% the parents, in 11% the husband, in 9% relatives in general and in 3% the traditional birth attendant (Jody and Joyceen, 2011; Stekelenburg, 2004).

In many societies older women or grandmothers traditionally have considerable influence on maternal and child health decisions at the household level such as when to attend the antenatal clinic and where birth takes place (David et al., 2002). Jensen (1990) describes research in Ghana showing that older female relatives have a special role in relation to childbirth and after delivery take care for the child for 7 days or so, also showing the new mother how to wash, feed and care for the baby. Additionally, this gives the mother time for recovering from the delivery (Anna van et al., 2006). The influence of men on reproductive health is complex. Men are often important gatekeepers of reproductive health care even though they may lack knowledge about it. Men are excluded from the actual process of childbirth due to cultural norms, yet being decision makers in many families they have the power to decide if a woman is brought to the hospital for care or not (Michael et al., 2001).

Thus, power over maternal care may not be held not by the individual woman but rather by male family members, older women, elders, or by the wider community. However, traditional arrangements are also shifting, although at different speeds and in different ways, tending to empower women over their own health and that of their children (Darmstadt et al., 2006).

These decision-making and resource-allocation powers related to maternal health have their parallel in household water, sanitation and hygiene. As Krukkert shows with reference to Nepal, men are not usually the target of hygiene promotion efforts even though they have a major

voice in purchases and decisions about investments in and design of latrines, when to invest in and where to locate water points. This gap between the focus of promotion efforts and control of decisions appears in one form or another in many countries, with the result that interventions promoting hygiene and sanitation for men are attracting more attention (Aubel, 2001). With respect to sanitation and hygiene investments, WASH projects in Nepal (SNV) and Bangladesh (BRAC) are now developing hygiene promotion targeted specifically on men as they often are primary decision-makers about construction of toilets, new water points and even soap purchases (Aubel, 2001; Darmstadt et al., 2006).

Water, sanitation and hygiene in medical facilities

Health centres and hospitals should have consistent or at least predictable running water, clean toilets, safe refuse disposal, clean beds and areas for birthing (Kyomuhendo, 2003). Running water is preferred, of course, over storage in barrels and tanks; water-seal toilets (which separate human faecal matter from contact with flies and humans) are preferred to pit latrines. Unfortunately this is not always the reality. For example, in one of the only comprehensive studies that could be found, the Ministry of Health in Uganda stated that poor and inadequate sanitation and lack of water in health units was a major cause of dissatisfaction, especially in rural government health facilities. Toilets were very dirty and unhygienic, something that is complicated by the fact that the public have not developed a culture for using toilets: people defecate in the open even when pit latrines are available. In most of the Kampala City Council health centres there was little running water in toilets, inadequate garbage disposal and few cleaners (Clarissa and Jamie, 2010). This situation is not unique to Uganda, although it seems that such sanitary monitoring may be rare or may not be made public.

A challenge in government health care systems is the disjunction between construction of water and sanitation facilities, which is often organized centrally or by other departments, and their repair/maintenance, which is often a local responsibility to which few resources or attention may be given (Clarissa and Jamie, 2010). Interestingly, in Malaysia and Sri Lanka, a World Bank study found that the provision and maintenance of functional basic services for hygiene and WASH in health centres - and the convenient location of clinics - were among the elements that helped these nations achieve early and rapid improvement in maternal health (Indra et al., 2003). Karlsen (2014) has argued that reliable water supply and toilets is an indicator of basic services for health facilities (Romano, 2011).

DISCUSSION

From the point of view of linking WASH interventions to

maternal health, responsibility is held across Ministries potentially creating hurdles to linking the two sectors. However, the apparent invisibility of the issue is a barrier in itself. While medical staff at the local level often participate in hygiene promotion and sanitation programs, above this level there seems to be little joint policy or programming strategy. Within the large WASH sector, maternal health services and hygiene promotion for maternal health are seldom if ever to be found (Sandy, 2010).

Most countries have various policies and strategies and road maps relating to maternal and new-born health. These issues can also be found in policies related to other issues such as human resources for health and education; however, there is often a lack of alignment between policies. Although most countries have separate policies and guidelines on WASH may be found, there is lack of a multi-sectorial approach (involving health, WASH and possibly education).

The Partnership for Maternal, New-born & Child Health (2011) undertook a global review of 142 interventions meant to improve maternal, new-born and child health. The review identified only one essential intervention related to WASH, specifically, hygienic cord and skin care for new-borns. This reflects the lack of alignment or evidence-based linkages between maternal health and WASH, as stated earlier.

On the other hand, Countdown to 2015 considers water and sanitation an important factor in maternal and new-born health. It reports the data for improved drinking water coverage and improved sanitation coverage for the 72 low and middle income 'countdown' countries, that need to make progress on maternal and new-born health. The attention to water and sanitation through this Countdown initiative that concentrates primarily on reporting progress for MDGs 4 and 5 will hopefully stimulate a more multi-sectorial approach to maternal, new-born and child health.

Further Research

It has been noted that there is a lack of robust research, assessment and program evaluation related to the intersection of the WASH and maternal health sectors. Some suggestions for further research include:

- i.) Studies on the impact of water, sanitation and hygiene on maternal mortality and morbidity at household and/or community level.
- ii.) Studies on the influence of socio-cultural perspectives, identifying the barriers for behaviour change and potential change agents within communities, in relation to maternal health and WASH. Assessments and pilots would be useful of the most appropriate, cost-effective, and sustainable clean delivery strategies in community and rural settings. This could include TBA practices and their links to the formal medical setting.

iii.) Rapid assessments of current water and sanitary conditions in health facilities. The dissemination of evidence about current conditions could help catalyse efforts to improve facilities and their maintenance. Additionally, research should be undertaken on the impact of improved water and sanitation in health facilities on maternal health outcomes. This should also include a focus on safe disposal of medical waste at health facilities.

Conclusion

This review has shown the synergy of WASH and maternal health as well as highlighting how little these themes are addressed collectively in research, interventions and programs.

Hygiene and cleanliness are basic concepts in health care. They are included in most health promotion and health worker training programs. However, there appears to be a gap between education, knowledge and practice. Health information and behaviour/practice change are essential to ensuring cleaner environments for better health. Effective WASH programs could work to help communities better understand the advantages of clean water and environment for maternal and child health. Effective behavioural change communication is significant to supporting individuals to improve their practices, especially pregnant women and their families. Health professionals should consistently provide hygienic services and need the support of health systems to achieve this. The global crisis in human resources for health has resulted in lower level cadres and health volunteers taking on more responsibilities relating to maternal and new-born health. These groups receive short training and need to be mentored and supported in the field to ensure that they provide clean practices.

Health systems and WASH sector institutions must work together to advocate for clean water and sanitary facilities at home, school and in the clinic to enable communities and maternal health providers to live and practice according to the principles of WASH. Governments and NGOs play a large role in this and should ensure that WASH elements are incorporated into maternal and new-born health programs.

In summary, there is some information available and evidence about the benefits of water and sanitation to improve health in general and about specific interventions that could improve maternal health. These two areas have not been sufficiently addressed as complimentary themes in global development programming. More collaboration between the two sectors could improve the lives of childbearing women and their children in the future.

Competing Interest

The author declare that they have no competing interest.

Authors' Contribution

SJ conducted the extensive literature review. MM participated in the sequence alignment. MM participated in the design of the study. RC conceived of the study, and participated in its design and coordination and helped to draft the manuscript. All authors read and approved the final manuscript

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