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Reproductive Tract Infections Associated with Various MHM Methods: A Systematic
Review

ABSTRACT

Introduction: With approximately 25% of the world's population of reproductive age and facing the issue of menstruation (UN, 2015), ensuring adequate menstrual hygiene management (MHM) is important. Adequate menstrual hygiene management is characterized by the use of clean materials that collect or absorb menstrual blood, and proper disposal for these materials (Biran et al. 2012). Inadequate MHM has numerous consequences, including health, psychosocial, and socio-economic effects (Sommer and Sahin 2013). The issue of a possible link between different materials and infection rates has been raised, particularly, a concern that some materials (e.g. menstrual cups) would be inappropriate in refugee settings where hygienic conditions are poor and therefore infections might be elevated. No systematic study comparing the relative infection rates of the different materials could be found, and there is very little information on MHM in refugee settings in general available. The studies and guidelines which do exist emphasize the importance of providing MHM methods which are 'culturally acceptable', with the choice usually being between reusable cloth and pads (both disposable and reusable) (Annex 2, UNFPA 2011).

This systematic review therefore investigates if it is possible to establish whether different MHM materials have different levels of infection, which could also be useful to inform interventions in settings such as refugee situations.

Methods: A systematic review was conducted to determine if a relationship existed between various MHM products and their RTI incidence rates.

Results: This study identified fourteen studies that were relevant and met the inclusion criteria. The review focused on four categories of analysis: study design, symptoms assessed, age distributions, and RTI rates (including toxic shock syndrome—TSS). There was considerable heterogeneity in the study design, ranging between informal semi-structured interviews regarding RTI symptoms and diagnosis to laboratory confirmed examinations for these results. The papers split between two main age groups: adolescent girls and girls and women of any menstruating age. Between the studies that measured symptoms, there were significant variations in the symptoms recorded. Most of the studies found lower RTI rates with what was sometimes referred to as “hygienic” practices, including sanitary pads and menstrual cups, and higher rates of RTIs with “unhygienic” practices such as reusable cloth. For example, one study found RTI rates of 21.5%, 28.5% and 26.9% respectively in the menstrual cup, sanitary pad and control arms (Philips-Howard et al. 2016).

Discussion and Conclusion: Sanitary pads and menstrual cups demonstrated positive effects on safety, comfort, and usability. In the studies included in this review, these two methods were found to have lower RTI rates than reusable cloth and pads, those products traditionally deemed “culturally appropriate.” These results provide a positive indication that there might be new options for use in humanitarian situations.

INTRODUCTION:

Globally, about 25% of the population is women of reproductive age (15-49) (UN, 2015) facing the issue of menstruation.

Women and communities deal with menstruation in a variety of ways, ranging from isolation of the girl or woman in a hut for duration of the menstrual period, to low tech traditionally available methods such as cloths and falalin cloth (a type of reusable cloth used to absorb menstrual blood), to modern high tech and more expensive methods including: disposable and reusable sanitary pads, tampons, and menstrual cups. We could find no estimate regarding the distribution of use of these various menstrual hygiene management (MHM) methods among women.

The idea of MHM is central to framing how girls and women deal with this issue. Adequate MHM has been defined as “women and adolescent girls using a clean material to absorb or collect menstrual blood, and this material can be changed in privacy as often as necessary for the duration of the menstrual period. MHM includes soap and water for washing the body as required, and access to facilities to dispose of used menstrual management materials.” (Biran et al. 2012)

Previous studies have documented the effects of inadequate MHM, including health (infections, dysmenorrhea, reactions to harmful chemicals in the menstrual material), psychosocial (shame, social exclusion), socio-economic (women and girls not attending school, missing work, engaging in transactional sex in order to pay for materials), and gender based violence (Sommer and Sahin 2013). Several criteria for assessing MHM methods have also been listed, including health issues as mentioned above, effectiveness (e.g. in preventing soiling of garments), ease of use and level of

disgust associated with the methods, cost, environmental issues, and “cultural appropriateness”.

Issues related to MHM are becoming increasingly visible at the global level. In fact, within the last 2-3 years, MHM has become a high visibility issue in many human rights fora, including those dealing with Water and Sanitation, women’s status and to some extent, health. Normative development frameworks such as the Millennium Development Goals (MDGs) which ended in 2015, made no mention of MHM, but the Sustainable Development Goals (SDGs) which run for the period 2016-2030 at least mention it indirectly under the Water and Sanitation goal (UN 2017)

The humanitarian community was earlier in recognizing the importance of MHM. The Sphere Manual for humanitarian action (2004, revised in 2011) makes very explicit mention of the importance of MHM. The ‘protection cluster’ of the Inter-Agency Standing Committee (IASC) for humanitarian action has also included reference to MHM since 2001 with ‘dignity kits,’ which were introduced already in 2001 by UNFPA and are now provided by multiple agencies (Tellier 2017). The amounts and types of MHM products offered differ greatly, with a great deal of attention paid to “cultural acceptability” and providing kits that contain sanitary items “explicitly tailored the local needs of women and girls” (UNFPA Turkey, 2015) but there is no recommendation for one specific MHM method, in fact specific methods often go unmentioned. (see Appendix 2 for further information). The need for MHM in humanitarian situations has been previously emphasized (Sommer 2012), but we could find no studies examining the effect of poor MHM in humanitarian crises in terms of infection rates.

We were therefore interested in assessing some of the factors, which might inform an

approach to MHM in displaced populations, beyond ‘cultural appropriateness’. In particular, Rheinländer and Wachira (2015) have expressed a concern that, in refugee settings, “the preconditions of water and basic hygienic conditions to manage and clean the cup, means that many women in poor and uncertain settings cannot use this method.”

While a systematic review exists confirming the connection between poor MHM and reproductive tract infections (RTIs) (Sumpter and Torondel 2013) there is no systematic examination of how specific MHM methods associated with RTI rates. There is also no study looking at the health effects of different methods in displaced populations.

This systematic review will focus on infection, specifically reproductive tract infections (RTIs). This paper, however, is not examining RTIs on their own, but rather their prevalence in association with various MHM methods.

Given the less than ideal situation with respect to water and sanitation in refugee settings, we were interested to know what the infection rates are of the different methods in baseline situations, and therefore whether some would seem more likely candidates for use in refugee or low resource settings.

RESEARCH QUESTION:

Question I: Using reproductive tract infections as an indicator, how do sanitary pads (disposable or reusable), menstrual cups, tampons and reusable cloth compare as MHM methods?

METHODS:

Question I: A systematic review was undertaken in order to determine how sanitary pads, menstrual cups, tampons, and reusable cloth compare as MHM methods using reproductive tract infections as an indicator.

In order to conduct this systematic review, literature was searched that was relevant to menstrual hygiene and our MHM methods. Our searches were conducted in February and March of 2017 using PubMed, EBSCO, and MEDLINE/ProQuest. Our searches were restricted between 2000 and 2017. Key informants added additional sources regarding toxic shock syndrome. See Appendix 1 for further information on search terms and number of papers.

Inclusion Criteria: Papers were included if they reported quantitative rates of infection due to a menstrual hygiene method, papers with qualitative results were included if they also contained a quantitative study. Papers were included regardless of the method of RTI measurement and no exclusion was done based on country income status. The search and paper involving toxic shock syndrome was included on advice from a key informant. Papers were only included if they were a peer reviewed scientific article in English, periodicals and pamphlets were excluded. Only papers written between 2000 and 2017 were included.

Papers were screened initially by their abstract and title to determine if they met the inclusion criteria. If the title and abstract were insufficient, the body of the paper was read to determine if the paper met inclusion criteria.

An independent reviewer examined the article selection.

RESULTS

Fourteen studies were identified as matching the inclusion criteria, including two systematic reviews (see Table 1).

The studies were conducted in three countries: Kenya, Canada, and India.

1. Study Design

There was some range among the papers in regards to the method with which the RTI was measured. Some studies conducted lab based tests using vaginal swabs to ascertain the RTI status of their participant (Philips-Howard et al. 2016, Das et al. 2015, Rathore et al. 2007), although Philips-Howard et al. (2016) and Rathore et al. (2007) also performed interviews and collected qualitative information regarding physical symptoms. In regard to self-reported symptoms, the methods varied slightly. Some studies based RTI diagnosis upon freely given self-reported symptoms (Anand et al. 2015, Kansal et al. 2016, Shah et al. 2013). Other studies relied on responses given to pre-structured questionnaires (Balarugan and Bendigeri 2012 and Juyal et al. 2014). Still others specifically mentioned their use of female attendants who interviewed the participants about their RTI symptoms (Shah et al. 2013). Two studies used the syndromic approach, which are commonly used guidelines for diagnosing sexually transmitted diseases without laboratory confirmation. One study explicitly mentioned their use of WHO guidelines (Bhilwar et al. 2015). The other that used the syndromic approach emphasized that they use trained female public health nurses (Singh et al. 2001).

While many of the papers carefully distinguished between the MHM methods they were measuring, others distinguished only between “hygienic” and “non-hygienic” practices. Most of the papers carefully defined what they meant by this distinction, which often defined hygienic as a disposable sanitary pad and non-hygienic as traditional

reusable cloth (Anand et al. 2015 and Kansal et al. 2016). Rathore et al. (2007) however did not define what they meant by these terms. In other words, the reference to “hygienic” vs. “non-hygienic” generally referred to the method used, rather than how the method was used. If the study did make any mention of how the method was used (e.g. method used for drying), there was no comparison to other ways of using the MHM method.

2. Symptoms Assessed

There was a wide range of symptomatic levels within the studies from 2.6%-6.6% of patients reporting RTIs (Anand et al. 2015) to 52%-70% reporting RTIs (Rathore et al. 2007) and there was also no discernable pattern by diagnostic method. The studies identified a wide range of symptoms to diagnose RTIs. Of the studies that used a syndromic approach, a formally outlined and replicable process created by the WHO in order to assess both STIs and RTIs (WHO 2003), different symptoms were used as the marker for a reproductive tract infection. There were also a number of studies that did not specify which specific symptoms they measured or how symptoms were translated into disease. For example, in the study by Philips-Howard et al. (2016) it was unclear which symptoms were measured, but RTI diagnosis was completed and confirmed through a laboratory test. Das et al. (2015) also completed laboratory confirmations of RTI diagnosis, however they specified the symptoms they were examining in relation the diagnosis: abnormal vaginal discharge, burning or itching in the genitalia, burning or itching when urinating, and/or genital sores. Kansal et al. (2016) used a questionnaire, but gave no further indication for how they measured the presence of an RTI.

Of those studies that did explicitly state the symptoms they measured, there was variance per the specific symptoms. Anand et al. (2015) characterized a positive RTI as responding 'yes' to the following symptoms: itching or irritation over vulva, boils/ulcers/warts around vulva, pain during urination/defecation, swelling in the groin and painful blister like lesions in and around vulva. Shah et al. (2013) identified RTI symptoms as irregular vaginal discharge and itching with irregular discharge but it is unclear how these symptoms were translated into a RTI diagnosis. Similarly, Bhilwar et al. (2015) reported their most commonly recorded symptoms, which were abdominal pain, back pain, and vaginal discharge.

Even those studies that collected their data through surveys without laboratory confirmation varied in their methods of collection and this study heterogeneity is important to consider. Considering the studies that used self reported symptoms (Anand et al. 2015, Kansal et al. 2016, and Shah et al. 2013), the first reported a detailed description of what symptoms were used in order to determine RTI diagnosis while the second made no mention to what RTI symptoms or metric was used to make the diagnosis. Shah et al. (2013) had no standardized metric for converting symptoms into diagnosis and only had a record of the most widely reported symptoms. Across the papers that included which RTI symptoms they measured, whether by laboratory test or self reported there was considerable heterogeneity in these symptoms. Some of the symptoms measured were common e.g. unusual vaginal discharge (Shah et al. 2013, Anand et al. 2015, Das et al. 2015, Balamurugan and Bendigeri 2012, Juyal et al. 2014, Mani 2014) and itching or pain in the genitalia (Anand et al. 2015, Shah et al. 2013, Das et al. 2015, Juyal et al. 2014 and Mani 2014). Others were specific to the studies that had

laboratory confirmation e.g. unusual vaginal pH and amine testing (Rathore et al. 2007 and Balamurugan and Bendigeri 2012).

3. Age Distributions

Studies generally fell into two categories in terms of the age of participants. The first category referred to women aged 15 to 45-50 (Anand et al. 2015, Das et al. 2015, Singh et al. 2001, Bhilwar et al. 2015, Balamurugan and Bendigeri 2012, Rathore et al. 2007, and Mani 2014) and the other category involved adolescent girls ranging 12-22 in age (Philips-Howard et al. 2016, Shah et al. 2013, Kansal et al. 2016, Juyal et al. 2014).

Another common division was between unmarried versus married participants, with the latter including ever married women (meaning they have been married at least once although may not be currently married) (Anand et al. 2015, Singh et al. 2001, Bhilwar et al. 2015, Rathore et al. 2007, and Mani 2014), unmarried participants (Juyal et al. 2014) or marriage status unclear (Philips-Howard et al. 2016, Shah et al. 2013, Das et al. 2015, Sumpter and Torondel 2013, Kansal et al. 2016, Balamurugan and Bendigeri. 2012, Farage et al. 2007).

No clear pattern emerges between age and RTI rates. Mani (2014) found that the RTI was the highest among the 18-20 age group, although second highest in the age group of 36-40 year olds. However, we also see that for some studies that included participants from the wider age range (15-45), higher RTI rates were seen in the older age group (Bhilwar et al. 2015). Balamurugan and Bendigeri 2012 found over 80% of women in the 25-34 age group while compared to less than 70% of the 18-24 age group.

3. RTI Rates and TSS

Seven out of the thirteen papers showed increased likelihoods of having an RTI with the use of what was termed “non-hygienic” or “traditional” products (that is, reusable cloth) when in comparison to disposable sanitary pads. When comparing only reusable cloth to disposable sanitary pads, there were varying degrees of difference between the rates of RTIs. Several papers found that users of “hygienic” MHM methods were less likely to get an RTI (Anand et al. 2015, Singh et al. 2001, Kansal et al. 2016). However, not all papers reported a statistically significant difference between the reusable methods such as old cloth and falalin cloth (Shah et al. 2013). There was also some discussion on the drying methods of reusable cloths. It was found that drying cloths in the shade led to statistically significantly higher RTI rates (Juyal et al. 2014 and Mani 2014). However Das et al. (2015) found no statistically significant difference in terms of RTI rates between those who dried their cloths or pads inside vs. outside the house.

Six out of eleven papers (not including systematic reviews) examined cloth and each found that cloth had higher rates of RTI than their comparison. Six of eleven papers examined reusable pads, whose users were more likely to have an RTI than those who used disposable pad, but no direct comparison to cloth. Nine of eleven papers examined disposable pads, which tended to have lower rates than cloth and reusable pads with one exception (see Table 2). Menstrual cups were discussed in one paper, but were reported to have a lower RTI rate when compared to sanitary pads and a control arm (21.5%, 28.5% and 26.9% respectively), bacterial vaginosis was also significantly less prevalent in the menstrual cup arm than with pads (14.6% and 19.8% respectively), the study also

identified no adverse events associated with menstrual cup use (Phillips-Howard et al. 2016).

There is one confirmed case of TSS associated with menstrual cup use (Mitchell et al. 2015). Phillips-Howard (2016) checked for TSS but found no cases associated with menstrual cup use, in fact the prevalence of the bacteria *S. aureus*, which produces the toxins that cause TSS were highest among the sanitary pad experimental arm and lowest among the menstrual cup arm of the study. Despite the high prevalence of these bacteria in sanitary pads, Farage et al. (2007) found in their systematic review that sanitary pads did not promote reproductive tract infections.

In their systematic review, Sumpter and Torondel (2013) concluded that while 7/14 papers indicated an association between RTI rates and MHM methods, the papers were of insufficient quality and of various methodologies of the papers they examined were to reach appropriate conclusions. After separating the papers by sufficient quality, the remaining papers showed an insignificant relationship between bacterial vaginosis and MHM (OR=1.07) (Sumpter and Torondel 2013).

DISCUSSION:

Unhygienic vs. Hygienic

The papers that compare “hygienic” forms of MHM to “non-hygienic” forms were careful when using these terms and to provide appropriate definitions. There is however one notable exception to this (Rathore et al. 2007), the paper reports a significantly higher rate of RTIs in unhygienic vs. hygienic pads, but the lack of definition between the two terms applies the cultural assumptions of the reader for how hygienic vs. non-hygienic should be interpreted. This makes it difficult to draw further

conclusions when more specific definitions were not given. However, the manner in which the papers that did define these differences clump together multiple MHM methods (Anand et al. 2015 and Kansal et al. 2016) makes a carefully delineated comparison of MHM methods equally difficult.

Age Distributions

It is difficult to compare whether or not there were different prevalence proportions of RTIs by age group between papers because they all use different metrics for measuring the infection (e.g. odds ratio vs. percentage) with not enough background data to do recalculations. RTIs often increased with age, but one study found the highest RTI percentage in the 18-20 age group (Mani 2014). This is quite interesting but leads to the conclusion that this could be due to the younger participants having more sexual partners or not treating their infection as effectively as the older women, these different numbers could also reflect changing sexual patterns for different cohorts. The trend of older women having more RTIs was consistent in other papers (Bhilwar et al. 2015 and Balamurugan and Bendigeri 2012).

Various MHM Types

There were limited studies on the infection rate of the menstrual cup, but the available data pointed toward the trend of low RTI rates with the cup, and rates lower than that of the sanitary pad (Philips-Howard et al. 2016). The TSS case is important however the patient concerned reported causing a abrasion with the initial insertion (Mitchell et al. 2015) and skin abrasions are a known risk factor for TSS (Mayo Clinic 2014) however this is just one case therefore additional investigations would be useful.

While Philips-Howard et al. (2016) found sanitary pads to have a higher RTI rate than its other experimental arm (menstrual cups), most of the papers demonstrated that the sanitary pads resulted in a smaller proportion of RTIs especially when compared to “non-hygienic” methods such as reusable cloth (Anand et al. 2015, Shah et al. 2013, Kansal et al. 2016, Balamurugan and Bendigeri 2012, Rathore et al. 2007). While all results were not comparable, it was found that the menstrual cup had the lowest rates of RTI followed by sanitary pads, reusable pads and reusable cloth. The RTI rates for the reusable cloth were also dependent on the drying method with improper drying leading to higher RTI rates. While it was found to be safer to dry the cloths outside, significant taboo and stigma regarding having others view the MHM products often inhibited women from doing so (Shah et al. 2013 and Sumpter and Torondel 2013).

The definition of MHM by Biran et al. 2012, which has also been adopted by the Joint Monitoring Program makes no mention of drying conditions but based on the potential association with an increased infection risk, it is something that requires further consideration. Additionally, these studies were performed primarily with women at their stable home locations, and it seems likely that drying conditions could pose further difficulties in a refugee or crises encampment setting.

Limitations and Heterogeneity:

Methodology:

While the symptoms include considerable heterogeneity, it was also present in the study designs themselves. The biggest differences in the study design was whether or not the participants had their RTI diagnosis confirmed by laboratory tests or were completed using a syndromic approach. Few studies followed a syndromic approach and confirmed

results by laboratory testing (Das et al. 2015 and Philips-Howard et al. 2016), but most who used the syndromic approach only used that method to confirm diagnosis (Singh et al. 2001 and Bhilwar et al. 2015). Using the syndromic approach varies from simply recording common symptoms of an RTI, and involves a systematic formal approach. However the inconsistency between the reports that used some form of syndromic approach is considerable, and conclusions must be drawn in light of that.

Limitations:

The primary limitation of this study was the time limit, which resulted in a limited scope of the paper in order to be able to conduct a more thorough analysis. For example, the inclusion criteria were tightened to only include reproductive tract infections, because the net cast by the term infections was too wide. This paper in no way claims to be exhaustive it attempts to collect the available information on this limited topic. While the papers each produce a compelling argument on the RTI rate, each present their data in a slightly different manner, which makes comparison difficult. This paper also does not include a general search regarding RTI rates and focuses on comparisons between certain MHM methods. In addition there was one paper that could not be found in its entirety (Singh et al. 2001).

Conclusion:

Currently humanitarian crises rely primarily on distributing sanitary pads to fill the needs of menstruating women (see Appendix two), which have been proven to be effective and safe. However, there still exists concern over their safety as well as their usability in restricting women's movement. Pads however require little education as to their use and are seen as a useful tool for early crisis intervention.

However, while the field of MHM is relatively young and still emerging there are other methods that require more thorough consideration. Cultural considerations are heavily drawn upon when discussing appropriate MHM, but culture is a fluid construction and with the availability of cheaper and equally viable MHM products, there deserves to be a more critical look at their use in humanitarian crises, not least those which are long-term.

There are not that many studies comparing RTIs or infection rates in MHM methods and in these studies relatively limited data. Those that exist have heavily heterogeneous data, often of limited quality. There is an obvious need for universal metrics and more studies. Based on the available studies, the menstrual cup provided no basis for concern in low resource situations in regard to infection, in fact they were found to have the lowest rates and are equally viable as an option for use in refugee settings. The lack of literature does point toward a need for additional research on the cup, especially in comparison to other methods.

Table 1:

Author	Year of Publication	Population (age etc)	MHM Method	Measures	Rates	Comments
Philips-Howard, PA et al.	2016	Primary school girls in rural Western Kenya 14-16 yo, experienced 3 menses, self tested with vaginal swabs, symptoms documented by nurses, no symptoms	Menstrual cup vs disposable sanitary pads vs “usual practice”	STIs and RTIs	“RTI prevalence was 21.5%, 28.5% and 26.9% among cup, pad and control arms”	All participants received education and hand soap RTIs measured in a lab, talk about TSS
Anand E, Singh J, Unisa S	2015	Ever married women 15-49 in India, self reported incidents of RTI symptoms. RTI given if yes	“non-hygienic” vs “hygienic” (sanitary pads or	RTI symptom rate, vaginal discharge	Unhygienic method users were 1.04 times more likely to have any symptom	SP A RTI MHP A RTI (PM, ML) MH A RTI (PM, ML)

		replied to any of the following symptoms: itching or irritation over vulva, boils/ulcers/warts around vulva, pain during urination/defecation, swelling in the groin and painful blister like lesions in and around vulva	locally prepared napkins)		of RTI (OR = 1.046, p < 0.001)	
Shah SP, Nair R, Shah PP, Modi DK, Desai SA, Desai L	2013	164 adolescent girls (12-22) from 8 village in Gujarat, India, individual interviews with female interviewers about symptoms of RTIs, which generally included irregular vaginal discharge and itching with irregular discharge	Old cloths, new cloth (falalin) and sanitary pads	Questionnaire: quality of life, experience and satisfaction, symptoms of RTI, self reported	34% of old cloth users, 16% falalin cloth users, and 13% of sanitary pad users reported vaginal discharge, not a statistically significant difference	Reports some very interesting qualitative data SP A RTI (PM, E, PM) MHP A RTI (E, ML) MH A RTI (PM, E, ML)
Das, P et al.	2015	486 women in Odisha, India, vaginal swabs collected and tested, confidential tests, average age in early thirties for both groups, used laboratory confirmed results, but also examined symptoms of RTIs: abnormal vaginal discharge,	Reusable absorbent pads vs disposable pads	Bacterial Vaginosis (BV) (RTI) and urinary tract infection (UTI)	Reusable pad users were have symptoms of urogenital infections or to be diagnosed with at least one urogenital infection (BV or UTI) than those using disposable pads	MHM A RTI (E, ML) MHP A RTI (E) MH A RTI (PM, E, ML)

		burning or itching in the genitalia, burning or itching when urinating, and/or genital sores				
Sumpter C and Torondel B	2013	Systematic Review	many	RTIs	Meta-analysis of a subset of studies found no association between bacterial vaginosis and menstrual hygiene management, found MHM associated with an RTI in 7 papers but were generally of low quality and the methodologies varied greatly.	MHM A RTI (PM, E, ML) MH A RTI (PM, E, ML)
Singh MM, Devi R, Garg S, Mehra M	2001	130 ever-married women 15-45, used “syndromatic approach” to detect RTI by trained public health nurse	unclear	RTIs	72.7% of participants with an RTI had “poor menstrual hygiene”	Could not find full paper, but I think I would need to read it to determine if this paper fits inclusion criteria MHM A RTI (PM, ML)

						MH A RTI (PM, ML)
Kansal S, Singh S, Kumar A	2016	650 adolescent girls Varanasi (15-19), interviews, RTI self-reported	Hygienic (sanitary napkin) vs non hygienic (cloth used as absorbant)	RTI	Non hygienic (6.6%) hygienic (2.6%)	SP A RTI (PM, E, ML) MH A RTI (PM, E, ML)
Bhilwar M et al.	2015	Married women (15-49) in urban slum in Delhi, India, diagnosis per WHO syndromatic approach: most reported symptoms: back pain, abdominal pain, vaginal discharge	cloth	RTI	Using cloth were 2.6 more likely to present with an RTI	MH A RTI (PM, E, ML)
Balamurugan SS and Bendigeri N	2012	656 women 15-45, pretested structure "pro forma" used to collect RTI data: three out of the following four conditions had to be met for positive diagnosis: 1) Watery vaginal discharge. 2) Vaginal pH more than 4.5 using pH indicator paper. 3) Amine odour test positive (odour described as fishy after addition of 10% KOH). 4) Clue cells in Gram's stained	Cloth and sanitary pads	RTI	38% of women who used cloth had an RTI vs 15% with sanitary pad users (unclear if difference statistically significant)	Cloth facilitated endogenous infections leading to increased risk of RTI MH A RTI (PM, E, ML)

		vaginal smear under microscopy.				
*Rathore M, Vyas L, And Bhardwaj AK	2007	Ever married women in rural locations 15-45 Interviewed by MPW and interns and offered medical examinations: these examination looked at microbiological tests, vaginal pH testing, amine test, wet mounting, gram-staining and amsel criteria to determine RTI status	unclear	RTI	70% who used unhygienic pad had RTI while 52% of those using hygienic pad had an RTI	Full paper not available MH A RTI (ML, PM)
Farage, M et al.	2007	Systematic review	Sanitary pads	RTI (vulvovaginal candidiasis)	Conclude that pads do not promote these infections, could not find paper so no exact numbers found	SP A RTI (E) MHP A RTI (E, ML) MH A RTI (E, ML)
Juyal R, Kandpal, S. D., Semwal, J	2014	Unmarried adolescent girls (15-18), interview with pretested, prestructured questionnaire: common self reported symptoms of RTI were white colored discharge and pain in the lower abdomen	unclear	RTI	“strong association found between RTI and poor menstrual hygiene”	MHP A RTI (E) MH A RTI (E) Hygiene determined either or nor they used sanitary napkins, new cloth every time, and if washing dried the

						cloth in direct sunlight, and taking a daily bath during menstruation and washing genitalia at least twice daily
Mani, G	2014	520 Married women 18-45, symptoms included: abnormal vaginal discharge (discharge accompanied by itching or irritation, bad odor, abdominal pain, fever and other problems), ulcers or boils in and around the genital region, pain in lower abdomen which was not related to menstruation, pain or burning sensation during urination, swelling in the groin and painful blister like lesions in and around vagina. Among currently married women, pain during sexual intercourse and spotting after	RTIs was higher among women who used cloth or homemade pads, followed by those who used both cloth/ homemade pads and commercial sanitary napkins ($p < 0.05$). Drying Practices: those who used direct sunlight have a significantly lower prevalence of RTI symptoms compared to those who	RTI	Symptoms of RTIs were highly associated with menstrual hygiene factors, The prevalence of RTI/STI symptoms was highest in the age group 18-20 years (57.1%) followed by 36-40 years (48.1%)	Three stage sampling method, recorded symptoms from previous 12 months using standardized, semi-structured questionnaire

		sexual intercourse was also taken to be indicative of RTI	dried the napkins in the shade			
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Table 2

Authors	Methods	RTI Rates
Philips-Howard et al. 2016	Cup vs disposable pad vs control	21.5% vs 28.5% vs 26.9%
Anand et al. 2015	Disposable vs reusable pad	Reusable pad 1.04 as likely to have symptom
Shah et al. 2013	Old cloth vs new cloth vs disposable pad	34% vs 16% vs 13%

Das et al. 2015	Reusable vs disposable pad	2.3 times as likely with reusable pad
Singh et al. 2001	“poor menstrual hygiene”	Full paper not found
Kansal et al. 2016	Disposable pad vs cloth	2.6% vs 6.6%
Bhilwar et al. 2015	Disposable pad vs cloth	2.6 times as likely with cloth
Balamaurugan and Bendigeri 2012	Disposable pad vs cloth	38% with cloth, 15% with disposable pad
Rathore et al. 2007	unclear	70% “unhygienic” vs 52% hygienic
Juyal et al. 2014	Disposable pad vs cloths/rags	16.1% disposable pad vs 88.2% cloths/rags
Mani 2014	Cloths or reusable pads vs disposable pads	43.4% cloth or reusable pads vs 29.4% disposable pads

Appendix 1

How searches were concluded: Searches were concluded after all available results had been analyzed against inclusion criteria.

PubMed Search, February 24, 2017: sanitary pad AND reproductive tract infection

("menstrual hygiene products"[MeSH Terms] OR ("menstrual"[All Fields] AND

"hygiene"[All Fields] AND "products"[All Fields]) OR "menstrual hygiene products"[All

Fields] OR ("sanitary"[All Fields] AND "pad"[All Fields]) OR "sanitary pad"[All Fields]) AND ("reproductive tract infections"[MeSH Terms] OR ("reproductive"[All Fields] AND "tract"[All Fields] AND "infections"[All Fields]) OR "reproductive tract infections"[All Fields] OR ("reproductive"[All Fields] AND "tract"[All Fields] AND "infection"[All Fields]) OR "reproductive tract infection"[All Fields]) AND ("2000/01/01"[PDAT] : "2017/12/31"[PDAT])

This search returned 7 hits, 3 of which met the criteria for the research question.

- Phillips-Howard, Penelope, et al. "Menstrual Cups and Sanitary Pads to Reduce School Attrition, and Sexually Transmitted and Reproductive Tract Infections: A Cluster Randomised Controlled Feasibility Study in Rural Western Kenya." *BMJ open*, vol. 6, no. 11, 2016, pp. 1
- Anand, Enu, Jayakant Singh, and Sayeed Unisa. "Menstrual Hygiene Practices and its Association with Reproductive Tract Infections and Abnormal Vaginal Discharge among Women in India." *Sexual & reproductive healthcare : official journal of the Swedish Association of Midwives* 6.4 (2015): 249-54. *PubMed*.
- Shah, Shobha P, et al. "Improving Quality of Life with New Menstrual Hygiene Practices among Adolescent Tribal Girls in Rural Gujarat, India." *Reproductive Health Matters*, vol. 21, no. 41, June 2013, pp. 205-213. *PubMed*.

PubMed Search, February 24, 2017: tampon AND reproductive tract infection

Tampon[All Fields] AND ("reproductive tract infections"[MeSH Terms] OR ("reproductive"[All Fields] AND "tract"[All Fields] AND "infections"[All Fields]) OR "reproductive tract infections"[All Fields] OR ("reproductive"[All Fields] AND

"tract"[All Fields] AND "infection"[All Fields]) OR "reproductive tract infection"[All Fields]) AND ("2000/01/01"[PDAT] : "2017/12/31"[PDAT])

This search returned 2 hits, none of which met the inclusion criteria for the research question.

PubMed Search, February 24, 2017: menstrual cup AND reproductive tract infection

((("menstruation"[MeSH Terms] OR "menstruation"[All Fields] OR "menstrual"[All Fields]) AND Cup[All Fields]) AND ("reproductive tract infections"[MeSH Terms] OR ("reproductive"[All Fields] AND "tract"[All Fields] AND "infections"[All Fields]) OR "reproductive tract infections"[All Fields] OR ("reproductive"[All Fields] AND "tract"[All Fields] AND "infection"[All Fields]) OR "reproductive tract infection"[All Fields]) AND ("2000/01/01"[PDAT] : "2017/12/31"[PDAT]))

This search returned 2 hits, one of which met the inclusion criteria for the research question, but also had been found in a previous search (Philips-Howard et al. 2016).

PubMed Search, February 24, 2017: menstrual hygiene management AND reproductive tract infection

((("menstruation"[MeSH Terms] OR "menstruation"[All Fields] OR "menstrual"[All Fields]) AND ("hygiene"[MeSH Terms] OR "hygiene"[All Fields]) AND ("organization and administration"[MeSH Terms] OR ("organization"[All Fields] AND "administration"[All Fields]) OR "organization and administration"[All Fields] OR "management"[All Fields] OR "disease management"[MeSH Terms] OR ("disease"[All Fields] AND "management"[All Fields]) OR "disease management"[All Fields])) AND

("reproductive tract infections"[MeSH Terms] OR ("reproductive"[All Fields] AND "tract"[All Fields] AND "infections"[All Fields]))

This search returned 6 hits, 4 of which met the inclusion criteria for the research question, one of which had been found in a previous search (Philips-Howard et al. 2016)

- Das, Padma, et al. "Menstrual Hygiene Practices, WASH Access and the Risk of Urogenital Infection in Women from Odisha, India." *Plos ONE*, vol. 10, no. 6, June 2015, pp. 1-16. *PubMed*
- Sumpter, Colin and Belen Torondel. "A Systematic Review of the Health and Social Effects of Menstrual Hygiene Management." *Plos ONE*, vol. 8, no. 4, Apr. 2013, pp. 1-15. *PubMed*.
- Singh, M. M., et al. "Effectiveness of Syndromic Approach in Management of Reproductive Tract Infections in Women." *Indian journal of medical sciences* 55.4 (2001): 209-14. *PubMed*.

PubMed Search, February 24, 2017: menstrual hygiene products AND reproductive tract infection

("menstrual hygiene products"[MeSH Terms] OR ("menstrual"[All Fields] AND "hygiene"[All Fields] AND "products"[All Fields]) OR "menstrual hygiene products"[All Fields]) AND ("reproductive tract infections"[MeSH Terms] OR ("reproductive"[All Fields] AND "tract"[All Fields] AND "infections"[All Fields]) OR "reproductive tract infections"[All Fields] OR ("reproductive"[All Fields] AND "tract"[All Fields] AND

"infection"[All Fields]) OR "reproductive tract infection"[All Fields]) AND
 ("2000/01/01"[PDAT] : "2017/12/31"[PDAT])

This search returned 5 hits, 2 of which met the inclusion criteria for the research question, but both of which had been identified in previous searches (Anand et al. 2015 and Shah et al 2013)

PubMed Search, February 24, 2017: menstrual hygiene AND reproductive tract infection

((("menstruation"[MeSH Terms] OR "menstruation"[All Fields] OR "menstrual"[All Fields]) AND ("hygiene"[MeSH Terms] OR "hygiene"[All Fields])) AND ("reproductive tract infections"[MeSH Terms] OR ("reproductive"[All Fields] AND "tract"[All Fields] AND "infections"[All Fields]) OR "reproductive tract infections"[All Fields] OR ("reproductive"[All Fields] AND "tract"[All Fields] AND "infection"[All Fields]) OR "reproductive tract infection"[All Fields]) AND ("2000/01/01"[PDAT] : "2017/12/31"[PDAT])

This search returned 27 hits, 9 of which met the inclusion criteria for the research question, 5 of which had been identified in previous searches (Philips-Howard et al. 2016, Anand et al. 2015, Das et al. 2015, Shah et al. 2013, Sumpter and Torondel 2013

- Kansal, Sangeeta, et al. "Menstrual Hygiene Practices in Context Schooling: A Community Study among Rural Adolescent Girls in Varanasi." *Indian Journal of Community Medicine*, vol. 41, no. 1, Jan-Mar2016, pp. 39-44. *PubMed*.
- Bhilwar, Meenakshi, et al. "Prevalence of Reproductive Tract Infections and Their Determinants in Married Women Residing in an Urban Slum of North-East

Delhi, India." *Journal of Natural Science, Biology & Medicine*, 2015 Supplement, pp. S29-S34, *PubMed*.

- Balamurugan S. and ND Bendigeri. "Community-Based Study of Reproductive Tract Infections among Women of the Reproductive Age Group in the Urban Health Training Centre Area in Hubli, Karnataka." *Indian Journal of Community Medicine*, vol. 37, no. 1, Jan. 2012, pp. 34-38. *PubMed*.
- Rathore, Monika, Leela Vyas, and A. K. Bhardwaj. "Prevalence of Reproductive Tract Infections Amongst Ever Married Women and Sociocultural Factors Associated with it." *Journal of the Indian Medical Association* 105.2 (2007): 71,2, 74, 78. *PubMed*.

EBSCO/Academic Search Premier, March 7, 2017: sanitary pad AND reproductive tract infection

Restricted by date range (2000-2017), periodicals excluded from search results.

This search returned 7 hits, 3 of which were relevant to the research question, two of which had been identified in previous searches (Kansal et al. 2016 and Shah et al. 2013)

- Farage, Miranda, et al. "Do Panty Liners Promote Vulvovaginal Candidiasis or Urinary Tract Infections?: A Review of the Scientific Evidence." *European Journal of Obstetrics & Gynecology & Reproductive Biology*, vol. 132, no. 1, May 2007, pp. 8-19. *EBSCOhost*

EBSCO/Academic Search Premier, March 7, 2017: tampon AND reproductive tract infection

Restricted by date range (2000-2017).

This search yielded 2 hits, neither of which were relevant and matched inclusion criteria.

EBSCO/Academic Search Premier, March 7, 2017: menstrual cup AND reproductive tract infection

Restricted by date range (2000-2017).

This search yielded 2 hits, none of which were relevant and matched inclusion criteria.

EBSCO/Academic Search Premier, March 7, 2017: menstrual hygiene management AND reproductive tract infection

Restricted by date range (2000-2017).

This search yielded 4 hits, 2 of which were relevant and matched inclusion criteria, both of which had been identified in previous searches (Das et al. 2015 and Sumpter and Torondel 2013)

EBSCO/Academic Search Premier, March 7, 2017: menstrual hygiene products AND reproductive tract infection

Restricted by date range (2000-2017).

This search yielded 10 results, 4 of which were relevant to the inclusion criteria, three of which had been identified in previous searches (Das et al. 2013, Shah et al. 2013, and Farage et al. 2007)

- Juyal, R., et al. "Menstrual Hygiene and Reproductive Morbidity in Adolescent Girls in Dehradun, India." *Bangladesh Journal of Medical Science*, vol. 13, no. 2, Apr. 2014, pp. 170-174. EBSCOhost

EBSCO/Academic Search Premier, March 7, 2017: menstrual hygiene AND reproductive tract infection

Restricted by date range (2000-2017).

This search yielded 33 hits, 9 of which were relevant to the inclusion criteria, eight of which had been identified by previous searches (Das et al. 2015, Bhilwar et al. 2015, Juyal et al. 2014, Sumpter and Torondel 2013, Kansal et al. 2016, Shah et al. 2013, Balamurugan and Bendigeri 2012, Farage et al. 2007)

- Mani, Geetha. "Prevalence of Reproductive Tract Infections among Rural Married Women in Tamil Nadu, India: A Community Based Study." *Journal of Pioneering Medical Sciences*, vol. 4, no. 1, Jan-Mar2014, pp. 18-24.

PROQUEST/MEDLINE, March 7, 2017: sanitary pad AND reproductive tract infection

Restricted by date range (2000-2017).

The search yielded 6 results, 3 of which were relevant to the inclusion criteria, all which had been previously identified in past searches (Philips-Howard et al. 2016, Shah et al. 2013, and Kansal et al. 2016)

PROQUEST/MEDLINE, March 7, 2017: tampon AND reproductive tract infection

Restricted by date range (2000-2017).

This search yielded two results, none of which met the inclusion criteria.

PROQUEST/MEDLINE, March 7, 2017: menstrual cup AND reproductive tract infection

Restricted by date range (2000-2017).

This search yielded two results, one of which met the inclusion criteria, but had been previously identified in a search (Philips-Howard et al. 2016)

PROQUEST/MEDLINE, March 7, 2017: menstrual hygiene management AND reproductive tract infection

Restricted by date range (2000-2017).

This search yielded 5 results, 4 of which met the inclusion criteria, all of which had been previously identified in other searches (Philips-Howard et al. 2016, Singh et al. 2001, Sumpter and Torondel 2013, and Das et al. 2015)

PROQUEST/MEDLINE, March 7, 2017: menstrual hygiene products AND reproductive tract infection

Restricted by date range (2000-2017).

This search yielded 6 results, 3 of which were relevant to the inclusion criteria and all of which had been previously identified (Anand et al. 2015, Shah et al. 2013, and Farage et al. 2007)

PROQUEST/MEDLINE, March 7, 2017: menstrual hygiene AND reproductive tract infection

Restricted by date range (2000-2017).

This search yielded 23 results, 10 of which met the inclusion criteria (Philips-Howard et al. 2016, Singh et al. 2001, Anand et al. 2015, Shah et al. 2013, Sumpter and Torondel 2013, and Das et al. 2015, Balamurugan and Bendigeri 2012, Farage et al. 2007, Kansal et al. 2016, Rathore et al. 2007, and Bhilwar et al. 2015)

PubMed Search, March 28, 2017: Menstrual cup AND toxic shock syndrome

("shock, septic"[MeSH Terms] OR ("shock"[All Fields] AND "septic"[All Fields]) OR "septic shock"[All Fields] OR ("toxic"[All Fields] AND "shock"[All Fields] AND "syndrome"[All Fields]) OR "toxic shock syndrome"[All Fields]) AND (("menstruation"[MeSH Terms] OR "menstruation"[All Fields] OR "menstrual"[All Fields]) AND cup[All Fields])

This search returned 4 hits, 2 of which met the inclusion criteria (including the time range), one of which had been previously identified (Philips-Howard et al. 2016)

- Mitchell, M. A et al. “A Confirmed Case of Toxic Shock Syndrome Associated with the Use of a Menstrual Cup.” *The Canadian Journal of Infectious Diseases & Medical Microbiology* 26.4 (2015): 218–220. *PubMed*.

Appendix Two:

Organization	Search Terms	Number of Results
IASC	Dignity kits	502
UNFPA	Dignity kits	No exact number, but many hits. Kits contain sanitary pads, but was unclear how many or if that number changes depending on situation.
IOM	Dignity kits	28. Dignity kits contain sanitary items, female hygiene kits. Sometimes use UNFPA donated kits.
IFRC	Dignity kits	~15000. Most work done in conjunction with UNFPA. Focus on finding

		“culturally appropriate” kits, say they adjust for number of women, addressing safe disposal, however no exact method given for either of these points. Sanitary materials provided to individuals not households.
UNICEF	Dignity kits	568. Under emergency response, MHM under conducting gender assessments. Reusable cloth or disposable sanitary pads.
UNHCR	Dignity kits	604. “Culturally appropriate kits dignity kits by UNFPA.” Sanitary pads classified under non-food items (NFI). Mostly under 2-3 months in emergency response plans (eg. Syria)
WHO	Dignity kits	238. Hygiene and dignity kits include sanitary pads.

- IASC chosen as organization at the top of global hierarchy in terms of humanitarian response.
- The clusters represent the next level of organization, and results were non-existent for the search “dignity kits” for either the WaSH, Protection, or Health clusters, results were found in individual organization websites
- Other organizations are full and standing invitees (who enjoy the same privileges) of the IASC, this list includes those organizations that had useful or any results when “dignity kits” were searched on organization website.
- OXFAM yielded no results despite suggestion from key informant

Stakeholder: Specific searches of IASC Cluster Organizations

- Will focus on 6 organizations that were honed from the overall list of IASC members/standing invitees that had clear connection with providing dignity kits: UNFPA, IOM, IFRC, UNICEF, UNHCR
- Focusing on responses from the past 5 years

UNFPA:

Emergency	Date of Response	What is included	How Much Included	Notes
Nepal Earthquake	May 2015	Reusable sanitary pad	Not included	
Cyclone Pam	March 2015	Not specified, said to be		Making it easier for

		culturally appropriate, kits designed to be adapted to fit cultural needs		women to move about freely
Iraq 2014-2015		Distribute 95,000 kits, include pads, unclear if disposable or reusable		
Survivors of Boko Haram abduction	May 2015	Distributing kits to women “of childbearing age,” include sanitary napkins		
Syrian Refugees in Turkey	January 2013	Sanitary napkins		Another 20000 kits

IOM

29 results-20 from 2012 on

Emergency	Date of Response	What is included	How much included	Notes
IOM-Syrian Refugees in Jordan	July 2012	Not mentioned		4000 hygiene kits to new arrivals
Typhoon Haiyan - Phillipines	November 2013	“female dignity kits”		
IOM helping Haitians IDPs	Jan 2013	Distributing hygiene kits		
IDPs in Yemen	December 2014	Dignity kits including “sanitary items” to women and girls		
Migrant in Egypt	March 2016	Distributing dignity kits		In Cairo, women receive these kits and also the opportunity for cervical and breast cancer screenings

- An estimated 140 dignity kits donated by UNFPA to Syrian refugee camp, but with over 500, 000 new individuals after June, 25% are menstruating, hardly seems like enough (August 2014)
- Most of the dignity kits they delivered were sponsored or donated by UNFPA
- “1,500 dignity kits for women [...] to reach another 11,220 IDPs” in IOM response in Syrian refugee camp in 2015
- kits including “female sanitary products”

IFRC

Emergency	Date of Response	What is included	How much included	Notes

- distributing hygiene kits, contents unclear, too many results to do systematic search

UNICEF

Emergency	Date of Response	What is included	How much included	Notes
Syrian Refugees	Summer 2013	Sanitary items		Provided by UNICEF Protection programme, this one report discussed 5000 kits distributed
Yemen	2012	“basic necessities for displaced women and girls to maintain feminine hygiene”		

- Multiple reports (bi-weekly) on status in Syria
- Many individual reports given for specific incidences, but don’t seem to give much detail or have much differences between them
- 462 results

UNHCR

- over 600 results, specific reports said nothing more than they distributed dignity kits, which were often donated from other sources

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