
Update on Neonatal Male Circumcision: A Public Health Perspective

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Additional information is available at the end of the chapter

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Abstract

Male circumcision (MC) is an effective preventive health intervention. WHO and UNAIDS jointly recommend that the international community considers MC as a potential long-term HIV prevention measure. Neonatal male circumcision (NMC) is a type of MC performed within 1 month after birth. There are several advantages in favor of NMC over circumcision at a later age; it is simpler, safer, and cheaper. Maximum benefits of MC are achieved through NMC. NMC is also more convenient and risk compensation after the surgery is unnecessary. Concerns over NMC include child rights, pain during the surgery, possibility of reduced sexual pleasure, and a long timeframe before achieving HIV reduction benefits. The local HIV epidemic and medical guidelines, policies and strategies, public education and demand creation, finance, readiness of health system, staff training, monitoring and evaluation (M&E), and quality assurance should be considered before and during the implementation of NMC. This chapter uses Thailand as an example of how a country might benefit from introducing NMC as a public health measure. Parents should be informed about the benefits and risks of NMC where service is available to allow them to decide whether their children should be circumcised.

Keywords: circumcision, neonatal male circumcision, HIV prevention, STI prevention, Thailand

1. Introduction

Whether to promote neonatal male circumcision (NMC) as a preventive health measure has long been a contentious subject among health professionals and the general public. NMC has been performed as a modern health intervention in English-speaking countries for health and hygiene since the mid-nineteenth century [1]. Although NMC lessened in popularity in the United Kingdom before World War II [2] and later in the United States over the last few

decades [3], recent findings in several randomized controlled trials (RCT) confirming that male circumcision reduces heterosexual HIV acquisition [4–6], have renewed interest in NMC and debates continue on whether it should be promoted as a public health measure.

NMC, similar to other clinical procedures, has associated medical benefits and risks. However, current academic debates seem riddled with subjective feelings on the issue rather than a dispassionate analysis of recent scientific findings. Internet searches reveal many scientific articles written from the point of view of certain mind-sets, either concurring with NMC or deprecating NMC. These biases are also true regarding dedicated websites discussing circumcision. These articles and websites fall prey to social acceptability biases, which are not surprising given the sensitive nature of MC due to religious beliefs, cultural or religious rites, and sexuality. This conflicting information creates a lot of confusion among physicians and parents of newborn males. Many parents decide not to circumcise their babies, while many NMCs are routinely performed without support of factual scientific knowledge.

Other factors must be considered besides the theoretical medical benefits and risks for each individual. These include the characteristics of targeted localities, for example, real-life clinical circumstances, readiness of health staff, the local HIV epidemic, finance and costs, and related laws and regulations. The unique situation of each area will determine whether NMC should be promoted as a public health measure. Ethical and legal issues such as child rights are also important to explore.

After circumcision was confirmed as an effective HIV prevention measure, the author led a series of studies to evaluate the possibility of using NMC as a public health measure in Thailand [7–10]. The results and conclusions of those studies have been included in this chapter. The lessons learnt from Thailand might be useful for other countries with similar contexts.

This chapter starts by elaborating on how NMC is different from other forms of circumcision and why it is worth be considered as a public health measure. Traditional circumcisions practiced under religious rituals are beyond the scope of this article. An objective summary of the pros and cons of NMC from up-to-date scientific evidence follows. This chapter touches upon important aspects of NMC as a public health measure. The author also discusses his views toward implementation of NMC impartially. Readers should consider this information with care and adapt it to suit their local context. The article ends with recommendations and conclusions. Finally, the author hopes that this article is valuable for those who hope to gain more insight on this very interesting health intervention.

2. Distinguish NMC from other forms of circumcision

2.1. Types of circumcision

Many varieties of circumcisions are currently performed. They can be classified according to their characteristics and purposes. Acknowledging the whole spectrum of circumcision will help distinguish NMC from other procedures. **Figure 1** shows how different types of the

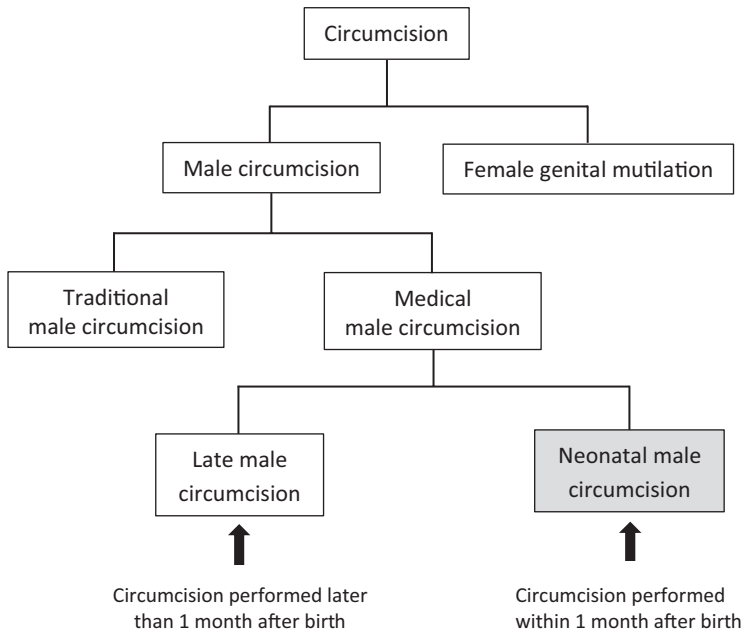


Figure 1. Schematic presentation of types of circumcision.

surgeries are categorized and pinpoints the whereabouts of NMC within the broad range of circumcision types. NMC is highlighted and discussed because of its favorable characteristics over other types of circumcision. It should be noted that other terms are used to refer to NMC such as “early infant male circumcision” and “newborn male circumcision.”

2.1.1. Exclusion of female genital mutilations

First, the word “male” is intentionally added into the term to make sure that we are specifically talking about circumcision in males. All forms of female genital mutilations, described by some as female circumcision, procedures that intentionally alter or cause injury to the female genital organs for non-medical reasons [11] are excluded from this article. These procedures, which occur in some regions of the world, have no medical benefit and harm girls and women in many ways. The complications can be short and long term and include excessive bleeding, infection, urinary problems, keloid, sexual problems, and psychological trauma [12]. Female genital mutilations are a clear example of human rights violation. Collective efforts to prohibit and eliminate this practice are fully warranted.

2.1.2. Traditional MC

The prevalence of global male circumcision is estimated at 39% [13]. MC can be classified as traditional and medical. About half of the circumcisions are performed traditionally and are generally associated with certain religious or cultural beliefs [13]. In Muslim and Jewish

cultures, MC is mandatory and conducted as part of a religious ceremony. Circumcision in Muslim male child varies from birth to puberty. For instance in Thailand, Muslim boys are usually circumcised between the ages of 6 and 15. The circumcision rate among men in the Philippines is very high. Circumcision is performed as a rite of passage to welcome boys to the next phase in life and is believed to be a remnant of pre-colonial Islamic influence. Jews traditionally conduct a circumcision ceremony on the eighth day of a male infant's life. Traditional MC normally takes place outside of established medical settings. Those performing the circumcision mostly are not trained health professionals, so there are concerns about possible complications such as excessive bleeding and infections. Efforts have been made to reduce the risk of adverse events associated with traditional circumcision. Traditional MCs are ruled out from this article since they are inevitable and not considered public health interventions.

2.1.3. *Medical MC*

Medical MC was introduced in English-speaking countries in the mid-nineteenth century. The primary purpose was to reduce masturbation which was considered an unhealthy behavior [14]. It was also performed to improve genital hygiene since the foreskin was believed to serve as a pouch that allows the accumulation of smegma. Medical MC is usually performed in established health facilities by trained medical practitioners. It is generally carried out a few days after birth. The surgery is performed only if the infant is healthy and may be postponed if the infant has a medical condition. Currently, medical MC is relatively prevalent in the United States, Canada, and Republic of Korea. Almost universal MC in the Republic of Korea is the result of the influence of the United States [15].

2.1.4. *Focus on NMC*

MC performed under 1 year of age is called infant MC. NMC is a specific type of infant MC which is administered within 1 month of birth. There are several advantages in favor of NMC over circumcision at a later age. In this chapter, we focus on NMC performed as a preventive medical measure in established health facilities.

2.2. **Why NMC is worth being considered as a public health measure?**

2.2.1. *NMC carries potential health benefits of MC*

Since NMC is performed early in life, it generally includes all the potential health benefits of MC. In this section, proven medical benefits of MC are presented and discussed.

2.2.1.1. *Improved genital hygiene*

Penile cleanliness is easier to maintain for a circumcised penis because there is no pocket underneath the prepuce that needs to be exposed before cleaning, which could be problematic in young boys. While most children eventually learn to retract the foreskin and cleanse the area as routine hygienic practice before puberty, some might find this difficult. There is a great variability in when the foreskin is fully retractable, with about 40% of boys having

a fully retractable foreskin by age 10 [16]. Parents and boys are sometimes unclear whether they should try to force the foreskin open to clean the under area or leave it alone. This is not a dilemma for circumcised boys. The pouch under foreskin's inner surface is where smegma is compiled. Smegma is the accumulation of sebum combined with dead skin cells produced by the foreskin's inner surface. A build-up of smegma due to lack of routine cleaning may produce foul odors which are caused by the colonization of bacteria and chemical transformations.

2.2.1.2. Elimination of the chance to have phimosis and paraphimosis

Phimosis is defined as the inability to retract the foreskin over the glans penis in uncircumcised males. Male infants are born with congenital physiologic phimosis resulting from adhesions between the epithelial layers of the inner prepuce and glans. As mentioned earlier, this condition will go away in most boys with age after intermittent foreskin retraction and erections. Un-retractable foreskin that occurs after previously retractable or after puberty is considered a health problem and called pathologic phimosis when nonretractability is associated with local or urinary complaints caused by the phimotic prepuce [17]. Most pathologic phimosis in adults is the result of distal scarring of the foreskin due to poor hygiene, balanitis, balanoposthitis, and forceful retraction of the foreskin. It can also occur because of infections or inflammations. For the elderly, increased risk of phimosis is caused by the loss of skin elasticity and infrequent erections. Symptoms of phimosis are difficulty or pain during urination, collection of urine in prepuce, painful erection, and paraphimosis.

Paraphimosis is the condition where the foreskin is trapped behind the glans penis for a long time and can no longer be pulled forward over the tip of the penis. Paraphimosis is common among children who have forgotten to retract their foreskin after voiding or bathing [18]. Other causes of paraphimosis are infection, physical trauma, trying to retract the foreskin back too forcefully, and leaving the foreskin in a pulled back position for an extended period of time. Persons who have phimosis are at risk for developing paraphimosis. When paraphimosis occurs, the prepuce and the distal part of glans may be swollen and painful. Paraphimosis is considered a medical emergency as blood supply to the tip of the penis is diminished [18]. The condition requires immediate medical attention. If left unattended, paraphimosis may lead to serious complications such as severe infection and loss of the penis due to gangrene.

2.2.1.3. Reduction of balanitis and exclusion of balanoposthitis

Balanitis refers to inflammation of the glans penis and can occur at any age. Data from meta-analyses showed that circumcised males have a 68% lower prevalence of balanitis than uncircumcised males [19]. Symptoms may include tight and shiny skin on the glans, redness on the glans, itchiness, unpleasant smelling discharge, painful urination, and localized pain. There are many possible causes of balanitis including poor hygiene, irritation, physical trauma, skin conditions, phimosis, and various infections. Pathologic phimosis is a possible complication of balanitis. It can occur especially when balanitis is frequent since the preputial orifice may be scarred and reduced elasticity. Meatal stenosis is another possible complication of balanitis but is uncommon.

If the foreskin is also affected together with the glans penis, the condition is called balanoposthitis [20]. Therefore, balanoposthitis affects uncircumcised males only. Balanitis usually leads to balanoposthitis except in circumcised males. Signs and symptoms of balanoposthitis are similar to those of balanitis only if they also involve the foreskin, not just the glans. Diabetes is an important underlying cause of both balanitis and balanoposthitis especially in the patients with poorly controlled blood sugar [21]. Prophylaxis circumcision reduces the risk of balanitis and eliminates the chance of developing balanoposthitis. Circumcision is also an effective treatment for both conditions.

2.2.1.4. HIV reduction

Reduction of the risk of HIV acquisition during heterosexual sexual intercourse is perhaps the most significant and most discussed benefit of MC. Researchers have speculated about this benefit early on in the HIV epidemic as it was observed that the rates of circumcision inversely correlated with the rates of HIV infections [22, 23]. In Asia, for example, the prevalence of HIV was high where the rate of circumcision was low (e.g., Thailand and Cambodia) and the prevalence of HIV was low where the rate of circumcision was high (e.g., the Philippines and Korea).

Three randomized controlled trials conducted in South Africa [4], Kenya [5], and Uganda [6] later confirmed that MC reduces the risk of female-to-male HIV transmission by 51–60%. All three studies were stopped early by their respective data and safety monitoring boards due to the obvious differences in HIV incidence between the intervention and the control arms. The protective effect seemed to be sustainable as the effect was maintained at 58% for 72 months of follow-up compared to 60% at 24 months of follow-up among Kenyan trial participants [24]. MC is seen as surgical vaccination as it can be done once and does not rely on consistent health behaviors.

There is scientific evidence that explains why circumcised males would have lower risk of acquiring HIV infection through heterosexual intercourse. Unlike the glans penis, the inner surface of the prepuce is lined with mucosal epithelium with no protective keratin layer. Histologically, the lining of inner foreskin is similar to the lining of nasal mucosa and vagina which are the common entry points of infectious organisms. Thin mucosal epithelium and lack of a protective keratin layer also make the foreskin more susceptible to minor trauma during sexual intercourse [25]. Therefore, the existence of foreskin serves as an entry point for HIV. Langerhans dendritic cells are antigen-presenting immune cells. They are abundant close to the mucosal lining surface of the inner foreskin [26]. In general, their primary function is to take up and process microbial antigens to become fully functional antigen-presenting cells. Langerhans cells in the foreskin and other HIV target cells are the major targets for the HIV, since they have surface CD4 receptors and cofactors that HIV bind to when infecting cells. It is possible that HIV may stay alive longer in the preputial cavity between the non-retracted foreskin and the glans penis since the micro-environment is suitable for its survival [25]. Lower rates of other sexually transmitted infections (STIs) among circumcised men may indirectly reduce the risk of HIV infection [27]. Results from an RCT found a reduction of symptomatic genital ulcer disease and herpes simplex virus type 2 (HSV-2) infections due to circumcision accounted for an 11.2% and 8.6% reduction in the contraction of HIV infection, respectively [28].

2.2.1.5. Reduction of other STIs

Reduction of the risk of acquiring other STIs in circumcised men is less pronounced compared to HIV. Early observational studies revealed conflicting results. Respectable information came from a meta-analysis that concluded that circumcised men are at lower risk for chancroid and syphilis [29]. RCTs conducted in Uganda and South Africa found a 35% and 34% lower prevalence of high-risk HPV genotypes in circumcised men [30, 31]. The study in Uganda also found a 28% lower incidence of herpes simplex virus type-2 (HSV-2) [31]. The South African trial also found protection for *Trichomonas vaginalis* [32]. There is no concrete evidence supporting the preventive effect of MC on the risk of contracting gonorrhea or Chlamydia.

The female partners of circumcised men receive indirect health benefits from MC. Female partners had a lower prevalence of genital ulcers, *T. vaginalis* infection, and bacterial vaginosis compared to female partners of uncircumcised men [33].

2.2.1.6. Cancer reduction

Penile cancer is quite rare in developed countries but is more prevalent in developing countries [34]. Being uncircumcised is a strong risk factor for penile cancer. A systematic review found a 67% reduced risk of invasive penile cancer in circumcised men compared to uncircumcised men [35]. This preventive effect probably occurs through the elimination of phimosis, a strong risk factor for penile cancer [36]. Another explanation is that circumcised men are less likely to acquire HPV as mentioned earlier. High-risk HPV is suspected to be involved in the causation of penile cancer as it is found in a large proportion penile cancer cases [37]. The odds of detecting HPV are lower in circumcised men compared to uncircumcised men [38]. Chronic relapsing balanitis and balanoposthitis due to poor hygiene and circumcision may also increase the risk of invasive penile cancer.

It is well established that most cervical cancer cases are caused by high-risk HPV. Given that circumcised males are less likely to contract HPV, their female partners also are less likely to be infected with HPV. There is evidence showing that these associations help reduce the risk of cervical cancer. A meta-analysis of case-controlled studies found that monogamous women whose male partners had six or more sexual partners and were circumcised had a lower risk of cervical cancer than women whose partners were uncircumcised [38].

2.2.2. Advantages of NMC over circumcision at later age

There is unanimous consensus from the scientific community that MC, if implemented as a non-therapeutic preventive health measure, should be done as early as possible. The procedure is preferably performed within a few days after birth for healthy boys. Following are the list of advantages supporting the rationale to perform MC early in life rather than waiting.

2.2.2.1. Maximum benefits of circumcision are achieved

Late circumcision reduces the risk of urinary tract infections (UTIs) which occur mostly during the first year of life by almost 10 times [39]. Thus, there is a loss of this preventive health

benefits when circumcision happens late in life, from adolescent onward. Protection against UTIs and kidney damage in infancy is lost if it is not performed during the first year of life.

Avoiding childhood phimosis and balanoposthitis is also lost if circumcision is not performed early. Some benefits associated with STI prevention would be lost if circumcision is done after sexual debut. As penile cancer is associated with phimosis and HPV infection, late circumcision means increased risk of cancer.

From a public health perspective, a disease prevention measure has to be implemented on a scale large enough to have an impact at the population level. Circumcision could resemble a vaccination program against HIV. The indirect benefits of MC in women would not occur unless a sufficient number of men are circumcised to allow the effect of herd immunity [40]. Higher MC coverage can be achieved easier through NMC. All pregnant women and their husbands could be educated about NMC during antenatal care sessions and decide about the procedure prior to delivery. Circumcisions can be conducted within a few days of birth for healthy infants while the mother recovers from labor and delivery. This would allow mothers and infants to be discharged together.

2.2.2.2. Simpler, safer, and cheaper

Circumcision is much easier to perform during the neonatal period than at a later age. General anesthesia is not required which diminishes the possible adverse events associated with it. The procedure also takes less time, usually just a few minutes to complete. The tissues and blood vessels involved are so tiny that there is no need for stitches.

Bleeding and infection are the two main serious side effects of MC. When performed by trained health personnel at well-equipped health care facilities, NMC is safe and has a low rate of complications [41].

It is cost saving to conduct MC during the neonatal period than at an older age. A study in the US found that NMC was about 10 times cheaper than circumcision performed later [42]. This advantage is especially important in developing countries.

2.2.2.3. More convenient

Circumcising infants during their first few days of life is a lot more convenient than to circumcise older boys or adolescents. Neonates are ready for surgery and would not require the counseling required for older boys. There is no need to do HIV counseling and testing for newborns, since they are considered HIV negative, except for those born to HIV-infected mothers. Older boys need to be informed of the benefits and risks of the procedure and must give their informed consent. Confounding factors include fear of the surgery and psychological difficulties. If the procedure is done during school age, students will have to take time off school. Healing is also faster at around 1 week for NMC compared to at least 2–3 weeks for circumcision in adults [43]. Sexually active persons must abstain from sexual intercourse for 6 weeks to ensure proper healing. Having sex during this period would make patients prone to infections including HIV thus negating the main benefit to be gained from procedure.

Other benefits of NMC over circumcision at later age include no long-term memory of the surgery and a better cosmetic outcome.

2.2.2.4. No risk compensation

Risk compensation is a phenomenon by which people adjust their health behavior in response to the perceived level of risk. People become more careful where they sense greater risk and less careful if they feel more protected. Sexually active males who were circumcised as an adult may engage in greater sexual risks due to a perception they have less HIV risk following MC. This could occur among female partners of circumcised men as well if they perceive lower risk. There is little chance of risk compensation for NMC. Boys who are circumcised very early in life would not sense any change in risk as they have been circumcised their whole lives.

2.2.3. Concerns over MC

Besides the low probability of medical risks associated with the surgery such as bleeding, infection, and unsatisfactory cosmetic result, several concerns have been raised. Some of the issues raised are considered controversial, while others have no evidence to support them. In following section, each topic is discussed citing the ongoing conversation and debate as well as up-to-date scientific information.

2.2.3.1. Ethical issues

Since the surgery is performed on an infant who cannot provide consent, NMC has repeatedly raised ethical-related concerns [44]. The decision to circumcise children is usually taken by the parents who act in their child's best interests. People argue that the authority to perform interventions on a child should be limited to ones proven to be medically necessary. Scholars who do not view NMC as a necessary medical intervention suggest that it should be delayed until boys are mature enough to decide for themselves. Thus, this ethical issue boils down to whether people perceive NMC as a medical necessity based on the available scientific evidence. The guidelines and recommendations issued by relevant authorized bodies and medical committees might help determine its necessity.

There are a lot of discussions and debates in the literature whether NMC is a violation of child rights to bodily integrity [45–49]. The principle of bodily integrity refers to the right of each human being to autonomy and self-determination over their own body. Scholars and activists who favor an intact penis and oppose circumcision promote a concept of "Genital Integrity" which refers to the condition of having complete and unaltered genital organs. In their view, NMC is an unconsented physical intrusion and a human rights violation.

2.2.3.2. Pain during NMC

There is concern that NMC introduces unnecessary pain to the newborn. Children who have undergone NMC do experience pain as evidenced by increased heart rate, decreased oxygen

saturation, and facial expressions indicative of pain during the procedure [50]. Pain experienced during the procedure has long-lasting effects on the circumcised child. Circumcised infants have been observed to have a stronger pain response to subsequent routine vaccination than uncircumcised infants [51]. Various interventions, in single and in combinations, have been used to minimize pain during NMC, e.g., sucrose syrup, oral acetaminophen, topical analgesic cream, and local nerve block. Sucrose alone has not been proven effective in reducing pain from circumcision [52], while topical analgesia may have some effect [53].

2.2.3.3. *Reduced sexual pleasure*

There are abundance of neurones which are sensitive to the touch in the foreskin. This leads many to believe that circumcised men might have less sexual pleasure than uncircumcised men [54]. This issue is not limited to NMC but is relevant to circumcision at any age. However, most studies testing this hypothesis have not found this to be true. Recent reviews concluded that loss of the foreskin by circumcision had no adverse effect on sexual pleasure during sexual acts [55, 56].

2.2.3.4. *Effectiveness in preventing HIV in men who have sex with men (MSM)*

MC reduces the risk of heterosexual HIV transmission in men, but its effect on male-to-male sexual transmission is uncertain. As the current HIV epidemic is concentrated in men who have sex with men (MSM) in many parts of the world, the lack of evidence to support that MC could reduce the risk of HIV acquisition among this population raises concerns over the implementation of this measure as a public health intervention. Observational studies on the protective effect of MC against HIV infection among MSM revealed conflicting results, with some studies showing positive results [57, 58] and others negative results [59–61]. A systematic review concluded that MC might offer HIV protection only among MSM who practice primarily insertive anal sex, but not for those who practice primarily receptive anal sex [62]. An RCT is needed to confirm this finding.

2.2.3.5. *Long timeframe to see the HIV reduction benefits*

Another concern on the implementation of NMC is a long waiting period to see the HIV prevention effect. Since NMC is conducted among newborns, it may take at least 15 years before they are sexually active and for the NMC to yield HIV prevention benefits. However, if this public health intervention is to be done, sooner is better than later. The only intervention that could have yield similar effect on the HIV epidemic is a preventive vaccine. According to the current status regarding HIV vaccine development, it is probable that NMC will yield an effect before an HIV vaccine is available.

3. NMC as a public health measure

A lot of factors come into play in deciding whether to promote NMC as a public health measure in a country or at a specific locality. Following are the issues that need to be considered before implementation of this health intervention.

3.1. Local HIV epidemic

Promoting NMC as a public health measure depends largely on the characteristics of the local HIV epidemic. Generally, the main reason to step up NMC service in health care facilities is to reduce the risk of HIV infection in the population. It may be not worth promoting NMC, if HIV is not a major public health problem in the country or of the target locality. As MC is proven to reduce only the risk of HIV acquisition through heterosexual transmission, it will not be appropriate to promote NMC where new HIV infections occur mainly through other routes of transmission, namely through same sex intercourse in males or intravenous drug use. An economic study using information on the local HIV epidemic as part of the analysis would help determine if NMC is justifiable for the country in the event that the country has to bear the majority of the costs of the intervention.

3.2. Medical guidelines on NMC

Soon after MC was proven to reduce the risk of HIV contraction among heterosexual males, global health authorities such as the World Health Organization and the Joint United Nations Programme on HIV/AIDS recommended that MC, including NMC, be adopted as part of comprehensive national HIV prevention strategies in countries with high prevalence of heterosexually transmitted HIV infection and low rates of male circumcision. The American Academy of Pediatrics determined that the preventive benefits of neonatal circumcision outweigh the risks of the procedure and should be offered to the families who have boy infants [63]. This statement has also been endorsed by the American College of Obstetricians and Gynecologists [64] and the American Urologic Association [65].

While these international recommendations influence some local practitioners, most health care personnel need national guidelines on NMC before they can start providing the service. Hence, local medical professional organizations should be included as important stakeholders while planning for the intervention. Their statements in favor of NMC would assist program implementation in a big way.

3.3. Policies and strategies

Clear policies and strategies will guide the respective details regarding NMC service. The magnitude and characteristics of the program will depend on the policies from a high-level authorized body, usually the Ministry of Health. The NMC implementation strategy can range from promotion of routine NMC to offering NMC only on a case-by-case basis or per request. The overall strategic plan should translate into action plans for each time interval including target numbers of NMC. The policies will also clearly specify the financial aspect of the program mainly on the payment scheme for the service.

3.4. Public education and demand creation

The general public needs to be educated about NMC before the service is promoted. Public education can be rolled out in a variety of ways. Educational materials should be straightforward, comprehensive, and attractive. The main contents of the media should include benefits

and risks of NMC as well as other supporting information such as availability and cost. The design of the education campaign should follow dedicated steps starting with a formative research targeting different audiences such as the general population and pregnant mothers. The formative research and subsequent baseline survey will define the content of the message and explore its suitability along with other relevant issues such as the dissemination channels.

Clear and scientifically accurate information about NMC can prevent misconceptions and rumors about the procedure in the community. Perceived benefits of NMC at the societal level together with high level of satisfaction among early adopters will help increase the demand for the services.

3.5. Finance

NMC represents an added expenditure for the health care system even though the unit cost of NMC is lower than for circumcision at a later age. How the expenses are covered will depend on the nature of the program. However, the parents of the newborns should not have to pay for the total cost if NMC is promoted as a public health intervention. In developing countries, where resources are limited and a high number of recruitments are targeted in a short period of time, local governments usually do not have to pay, as the programs are supported by international agencies. In some other circumstances, the health insurance system may pay for the service. Partial payment by the parents is another possible option.

3.6. Readiness of health system and staff training

A baseline assessment of the readiness and capability of the health system should be conducted. For health facilities, the issues to be assessed should include the antenatal and child delivery service and availability of necessary medical equipment and supplies. Knowledge and attitudes toward NMC should be explored among health care personnel. The information gained from the surveys will help identify the basic elements needed for the service that are still lacking and the aspects that should be emphasized while training health care personnel.

Safety is the first priority when implementing NMC as a public health measure. The surgery should be performed by trained health staff. The health staff who performs the surgery should be educated comprehensively on all aspects related to delivery of NMC, and not just the operation. A training package on NMC developed by the WHO and its partners is available online [66].

3.7. Monitoring and evaluation (M&E) and quality assurance

A system to routinely monitor the performance of the NMC program should be established. The indicators should cover both medical and public health aspects of the intervention. Newly trained staff should conduct first NMC cases under the supervision of more experienced persons. The results of the monitoring system will indicate whether the program is being implemented as intended and should be used to adjust the program to meet the goals in a timely manner. On an interval basis, the outcomes of the program should be comprehensively

evaluated. The evaluators could be from internal and/or external entities as appropriate. The information from the M&E system should be analyzed and used to improve the service and guarantee the quality of the service.

4. Thailand and NMC

Soon after it was confirmed that MC was effective in reducing the heterosexual transmission of HIV among men, the author formed a research team at Chiang Mai University, in Northern Thailand, to investigate the possibility of adopting NMC as a public health intervention in Thailand. A critical review compiling related information and the author's thoughts was the first publication [7]. A series of surveys have been conducted to gain insight on related issues in the country including knowledge and opinions of health staff on the intervention [10], the experiences of health staff on the procedure and capability of the Thai health care system to implement NMC [8], and acceptability as well as concerns of NMC among postpartum mothers [9].

Following are the findings of the abovementioned studies. This case study can serve as an example for other countries that share a similar context to Thailand and are considering adopting NMC as a public health measure.

4.1. Background on Thailand

Thailand is an upper middle income country [67] and located in Southeast Asia. The country was categorized as a "high" human development country according to the most recent Human Development Index (HDI) report [68]. Thailand has a well-established health care system. The infant mortality rate is considered low at 11:1000 live births [69]. The coverage of antenatal care among pregnant women and rate of delivery at the health facilities are high. The country has three major health insurance systems that cover almost all of its citizens namely the Universal Health Coverage Scheme, the Civil Servant Medical Benefit Scheme, and Social Security Scheme. People who can afford or have private health insurance could go to private hospitals for convenience.

Thailand was one of the Asian countries hardest-hit by the HIV epidemic during the early 1990s. The AIDS Epidemic Model (AEM) estimates that more than 1 million Thais were infected by the HIV virus. High quality and good coverage of antiretroviral treatment has saved a lot of lives. It is estimated that there are currently more than 400,000 people living with HIV in the country [70]. Thailand's MC rate in general is quite low [13]. It is prevalent only in Muslim communities especially in the southern most provinces.

4.2. Why should Thailand consider promoting NMC?

Thailand is a good candidate country for promoting NMC as a public health measure for many reasons. Most HIV infections in Thailand occur through heterosexual transmission, of which the risk is substantially reduced by MC. Theoretically, the effect of MC on HIV risk

reduction should be of significant magnitude in countries where the baseline MC rate is low and achievement of high coverage of MC is possible. Thailand has a relatively strong health care infrastructure as evidenced by the relatively low infant mortality rate [69]. An NMC program could possibly be built on this existing capability. The country has high coverage of maternal and child healthcare services including family planning, antenatal care, and deliveries that almost universally occur in the hospitals [71]. Thailand was the first developing country to eliminate mother-to-child HIV infection [72]. Health care personnel can educate pregnant mothers and their families about the benefits of having their children circumcised. Offering NMC could occur during the antenatal period if the fetus is identified as a boy in utero. Mothers can also be advised on how to care for their child after NMC and can be discharged from the hospital with the infant. Lastly, most Thais are Buddhists. Buddhism does not have any prohibition or negative beliefs toward circumcision. Further details on this issue were published in a critical review [7].

4.3. Readiness of the Thai health care system to implement NMC

A nation-wide survey was conducted in 2011 to gather baseline information on the capability of hospitals in Thailand to provide NMC [8]. Two questionnaires were sent to all hospitals in Thailand providing obstetric services and considered potentially able to perform NMC. The first questionnaire requested information about the facility's characteristics and its provision of NMC in 2010. The second questionnaire, directed to doctors or nurses who are familiar with delivery and postpartum care, contained opinion questions about NMC, and whether the procedure should be offered in the respondents' hospital. Of the hospitals that had deliveries in 2010, only 8.2% provided at least one NMC. Thirty-eight percent of private hospitals and 2.3% of government hospitals provided the service during 2010. The primary reason for performing NMC was parental request. Only a minority of the respondents thought that NMC was easy to perform (31.3%), was safe (39.1%), and should be offered in their health care facilities (29%). Ninety-two percent stated that physicians should perform the procedure instead of nurses. When asked about who should decide whether or not to conduct NMC, 55% indicated the choice should be left to parents. Forty-three percent believed that the service should be free of charge, while the same proportion felt that the parents should pay for some or all of the cost.

In another study conducted during 2011–2012, Thai health care providers' knowledge and attitudes toward NMC were assessed using face-to-face interviews [10]. The participants were physician administrators, practicing physicians, and nurses whose jobs involved NMC clinical procedures or oversight. The subjects were drawn to represent various hospital sizes and regions of the country using a multi-stage sampling technique. The participants were initially asked whether they agreed that MC had an effect on HIV prevention. Subsequently, printed educational materials on the benefits of NMC were presented to the participants for review. The participants were then asked whether NMC should be implemented at their facilities. Of the 133 health staffs who participated in the study, only 38% initially agreed that NMC reduced the risk of sexual HIV transmission. After reviewing the written information about the benefits of NMC, 59% of the participants thought that NMC should be offered in their

hospitals. HIV aside, 96% recognized the benefits of MC on hygiene, 74% knew about the effect of MC on cancer prevention, and 65% recognized that NMC could prevent STIs. Major concerns about NMC raised were safety and child rights. Physicians and nurses who had previous experience in performing circumcision on patients of all ages were more reluctant to have NMC performed in their hospitals.

4.4. Thai postpartum mothers' acceptability of NMC

In 2011–2012, a survey was conducted among 593 postpartum Thai mothers to determine their perceptions, concerns, and acceptability of NMC [9]. The study found that 70% of postpartum mothers knew or had heard of MC. Their biggest concerns were safety and pain of the procedure. After receiving information about the benefits and risks of NMC, one-third of the participants would choose to have their infants circumcised, one-third would not allow their sons to undergo NMC, and the last third were undecided. Mothers were the most influential person in deciding about NMC followed by fathers. Having a higher level of formal education, a circumcised husband, and knowing of at least one circumcised child were independent predictors of acceptability of NMC among postpartum mothers.

4.5. NMC in Thailand, the way forward

The study showed that NMC was rarely performed in government hospitals where the intervention meant to take place. The health care staffs were unaware of the health benefits of NMC. Most health staffs were concerned about the difficulty and safety of the procedure. However, the fact that a large proportion of health staff agreed that NMC should be offered in their health facility after being educated about the benefits of NMC revealed an opportunity for the program to be adopted by the health staff. The majority of postpartum mothers did not know about the benefits of NMC and were concerned about safety issues. The results suggest that NMC may be culturally neutral with evidence that even modest educational efforts can impact mothers' decisions in favor of NMC.

An education campaign on NMC for health professionals and general public is needed before NMC is promoted as a public health practice in Thailand. An economic study demonstrating the cost-effectiveness of NMC in Thailand is also needed in order to effectively advocate for policies to introduce NMC as an established, offered in health facilities.

Though Thailand might gain considerable benefits from the implementation of NMC as a public health measure, its actual occurrence seems to be impassable according to our research findings. Knowledge and technologies on HIV prevention have evolved rapidly and there are a lot of other options to choose from. For Thailand, other interventions are regarded as more attractive strategies, e.g., routine HIV testing among key populations at higher risk of HIV infection, treatment as prevention, and pre-exposure prophylaxis. Another reason why NMC is overshadowed by other interventions is the lack of proof of an HIV prevention effect on MSM who are the current target population. Unless all necessary things have been done, NMC will not be administered as a public health intervention in Thailand and will only be performed by request and on a case-by-case basis.

5. Conclusion

NMC is as an effective preventive health measure. The medical benefits of NMC outweigh the risks, especially after the effect on HIV prevention has been added. Nevertheless, NMC has not been used to its full potential due to controversies and concerns over the subject. Many issues need to be addressed, if NMC is to be implemented as a public health measure. Implementation of NMC shall vary according to the local context. Parents should be informed about the benefits and risks of NMC where the service is available so that they can decide whether their children should be circumcised. NMC is and will be a health intervention under debate in the years to come.

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