Curr Obstet Gynecol Rep (2015) 4:43–52
DOI 10.1007/s13669-014-0107-6

FAMILY PLANNING (A BURKE, SECTION EDITOR)

Current Status of Multipurpose Prevention Technology (MPT) Development

Cynthia Woodsong · Jonathon Holt · Brid Devlin · Zeda Rosenberg

Published online: 20 January 2015

Abstract Multipurpose prevention technologies (MPTs) are pharmaceutical products being developed for multiple indications, primarily prevention of HIV, pregnancy, and/or sexually transmitted infections. MPT products could be a combination of multiple drugs co-formulated for separate indications, or a single product with multiple indications. This paper reviews MPT work published since 2013, including technical papers on aspects of product development, papers focused on issues that will be critical to future MPT clinical research and introduction, and selected papers concerning products for prevention of pregnancy or HIV/STIs. Collaborative efforts between researchers and funders aim to provide efficiencies in the product development process, building on experiences from both the contraceptive and vaginal microbicide fields.

Keywords Multipurpose prevention technology · HIV prevention · Contraception · STI prevention · Microbicides

Introduction

Women, particularly those in resource poor countries and settings with a high incidence of HIV, need options for reproductive health products, including protection from multiple types of sexually transmitted infections (STIs). A "multipurpose prevention technology" (MPT) would simultaneously address two or more reproductive health needs such as HIV, pregnancy, STIs, or other reproductive tract infections. MPTs could be a combination of multiple drugs co-formulated for separate indications, or a single product with multiple indications. These products could be more attractive to women because they could achieve the primary benefit of contraception, for example, but have the added benefit of STI protection without the need for a separate product.

Condoms can prevent pregnancy, STIs and HIV, but correct and consistent condom use for multiple indications continues to be challenging for many [1•], prompting development of products that may be more attractive to users. Dosage forms for MPTs currently in development include vaginal rings, vaginal gels, cervical barriers, and injectables. Indications include prevention of pregnancy, HIV, and STIs, notably herpes simplex virus (HSV) [2, 3••].

MPTs for prevention of HIV, pregnancy, and or STIs are a new class of product, and multiple developers, primarily in the not-for-profit sector, are applying significant efforts to their development. MPTs are positioned within the broad field of reproductive health, particularly pregnancy prevention, as well as within infectious diseases, particularly sexually transmitted infections, including HIV. Thus, publications relevant to MPTs are included in a large body of literature. This review focuses on MPT papers published since 2013, as well as selected publications relevant to MPT development. The majority of papers explicitly focused on MPTs over this time period are reviews and papers that were written to raise awareness and support for the MPT concept. For example, in 2014, WHO sponsored a special issue published by BJOG, entitled "Multipurpose Prevention Technologies: Maximising Positive Synergies," which includes editorials, commentary, reviews, and articles that point to the need for MPTs [4••]. Reviews and

This article is part of the Topical Collection on *Family Planning*

C. Woodsong (✉) · J. Holt · B. Devlin · Z. Rosenberg
International Partnership for Microbicides, 8401 Colesville Rd., Ste. 200, Silver Spring, MD 20901, USA
e-mail: cwoodsong@ipmglobal.org

J. Holt
e-mail: jholt@ipmglobal.org

B. Devlin
e-mail: bdevlin@ipmglobal.org

Z. Rosenberg
e-mail: zrosenberg@ipmglobal.org

commentaries highlight a range of practical as well as technical issues that confront MPT development [3••, 5•, 6–9].

Practical issues include funding constraints for research and development [10], the complexity of regulatory pathways for MPT approval [11, 12], policy considerations [5•, 13], expected challenges with providing access to future MPTs [14], and end-user perspectives and preferences for MPTs [15•]. Papers reporting on technical issues for MPT drug development highlight selection of active pharmaceutical ingredients (APIs) [16•], and challenges with developing the dosage form, such as target release rates, drug-drug interactions, and drug delivery mode [6]. Since adherence has been identified as a challenge for development of HIV prevention products, technical papers on adherence measurements also contribute to progress on MPTs [17•, 18, 19].

Practical considerations for MPTs

Demographic and Epidemiological Motivations for MPT Development

Globally, new HIV infections occur most often amongst women of reproductive age, and incidence is high among populations that also report high unmet need for contraceptives [20–22]. Regardless of a technical or practical focus, publications on MPTs frequently begin with compelling statistics on women and HIV/STI infection, unmet need for contraception, and consequences of unintended pregnancies. Harrison et al. [3••] have a brief introductory review of these overlapping needs that is particularly robust yet succinct. Calvert and Ronsmans [23] proposed "an alternative method to estimate the proportion of pregnancy-related deaths due to HIV" and extracted data from 23 studies to conclude: "HIV-infected women had eight times the risk of a pregnancy-related death compared with HIV-uninfected women." The ESHRE Capri Workgroup Group reviewed epidemiological data from the European region that demonstrated a strong need for MPTs for prevention of unintended pregnancy and STIs [24•]. These included national data on unintended pregnancy and induced abortions, STI rates, contraceptive use, and sexual behavior. The workgroup noted that although such data are "frustratingly scarce and unreliable" (p. 9), they nevertheless point to actions that could be taken to improve sexual and reproductive health. Interestingly, the workgroup observed that such data are more widely available for resource-limited countries than for European countries.

There is continued agreement that women need more contraceptive options, as well as reliable and affordable access to the available methods [22, 25, 26]. Ross and Stover's [27] analysis of nationally representative data from 113 countries showed a consistently positive relationship between use of highly effective contraceptive methods and the number of contraceptive options available to women. They concluded that "entirely new methods of family planning can increase modern contraceptive use in countries that make them widely available, giving more options to meet the needs of individuals" (p. 211). They observed that the contraceptive method mix varies widely between countries, reflecting differences in user preferences, government policy, and the cost and/or access to products. This finding is reiterated in recent work with adolescents [28] and women living with HIV [29], which reports that women's needs and preferences for method choices, and how to access them, change over their reproductive life cycle.

Coordination of MPT Development Efforts

MPTs have benefitted from efforts to coordinate product development, and these coordination efforts are summarized in three recent publications [3••, 5•, 30]. CAMI-Health serves as the secretariat for the Initiative for MPTs (IMPT) and is charged with advancing the scientific agenda, facilitating collaboration, raising awareness, and developing strategies to support the commercial success and public health impact of MPTs [5•]. An MPT product pipeline is maintained on the CAMI-Health website, as well as reports and references to relevant publications in the MPT field (www.cami-health.org). Part of this coordination effort involves the drawing together of funding bodies and donors with interests in supporting MPT development programs so that there is a concerted and focused effort across all development partners in the field. This effort is further supported by the development of a broad spectrum Target Product Profile [3••, 5•, 30] , described further below, to help guide funding bodies and developers in the definition of the specific Target Product Profile for their individual products and keep their various programs in alignment with the common goals.

Contraceptives and HIV

The reported potential for hormonal contraceptives, particularly injectable depot medroxyprogesterone acetate (DMPA), to increase risk of infection with HIV and other STIs, as well as progression of HIV disease, is of particular concern for MPT development, although evidence continues to be inconclusive [31•]. WHO guidance supports use of hormonal contraception for women at risk of HIV infection [32], yet there is some disagreement with this position, and there is continued discussion about the need for a clinical trial to investigate the risk [13, 33]. Butler et al. modeled the effects of reducing the use of injectable contraceptives and concluded that a net public health benefit would likely only accrue to countries with the highest incidence of HIV [34].

Secondary analysis of data from the MDP 301 microbicide efficacy trial of Pro 2000 vaginal gel indicates a "modest increased risk" for HIV infections amongst trial participants who used DMPA as their contraceptive, compared to injectable norethisterone enanthate (Net-En), oral contraceptive pills, and no contraceptive use [35]. Phillips et al. [29] reviewed data on contraceptive use by HIV+ women, to assess drug interactions between antiretrovirals (ARV and the range of contraceptive options, and concluded that "[s]ubstantial uncertainty remains regarding drug interactions between some contraceptive methods and ARVs "(p. 887).

The potential effect of HIV prevention prophylaxis on contraceptive efficacy has also been questioned. In the Partners PrEP study, Murnane and colleagues found no increase in pregnancy incidence among women using daily oral emtricitabine/tenofovir disoproxil fumarate (FTC/TDF) as pre-exposure prophylaxis (PrEP), and hormonal contraceptives [36]. This randomized placebo control study reported high adherence and included women not using hormonal contraceptives, who served as an important comparison group for investigation of contraceptive efficacy.

Papers have also reported gaps in understanding how contraceptive products might affect the vaginal environment so as to increase risk of HIV and STIs [37–39]. Van de Wijgert et al., conducted a review of data on the effect of hormonal contraceptives on the vaginal microbiome, to assess if DMPA use increased HIV acquisition by increasing bacterial vaginosis or vaginal candidiasis risk, but did not find evidence to support an association [38]. MPT development efforts will continue to investigate how, if, and to what extent contraceptive products interact with those intended for HIV prevention. The potential for HIV risk to increase with use of hormonal contraceptives further supports the need for new methods to prevent pregnancy and HIV, particularly in regions with high HIV incidence.

Regulatory Challenges

The regulatory pathway for MPTs is expected to be challenging. Brady and Manning highlight some of the complexities of the regulatory pathway for multiple indications and provide a typology for the possible pathways, which will vary according to indication and whether or not the APIs are approved [7]. Critically, any approval for a multiple-API, multiple-target therapeutic presents a complicated set of questions around safety and efficacy of the independent components, the potential for interactions between the active ingredients, and the complexity and scale of clinical trials necessary to support approval for an MPT product. Relevant information on regulatory pathways is also included in recent papers on regulatory issues for HIV-prevention microbicide development. Nardi et al. [11] provided an overview of the regulatory environment and dossier content that could be expected from the European Medicines Agency (EMA) and the US Food and Drug Administration (FDA), in accordance with the International Conference on Harmonization (ICH).

Given the current scale of Phase III microbicide trials required to provide statistically meaningful proof of efficacy, combining additional primary endpoints for a second indication, such as contraception, remains a daunting proposition. A series of consultations convened by WHO to provide guidance on regulatory issues for microbicides was summarized in Stone et al. [12]. These documents all point to the need for additional studies, data, and information that will be required for licensure of MPTs, and, thus, further raise awareness of the need for funding support and efficient timelines [5•, 10].

Perhaps the most important message MPT developers are currently receiving from the relevant regulatory bodies is that all involved understand the vital need for these products, as well as the potential for elaborate clinical development programs to become cost-prohibitive for a developing world indication. There is a clear sense of collaboration in determining the most cost-effective yet safe and responsible pathway to approval of an MPT product.

User Preferences and MPT Acceptability

The importance of user preferences and product acceptability is recognized in the literature on both contraceptives and microbicides, and many of these issues will be relevant to MPTs. Tolley et al. [17•] described approaches to assess user acceptability of MPT features so as to inform product development. These included studies of user sensory perceptions and determination of preferred product characteristics, acceptability studies (preferably based on product use) that asked participants to place values on various product attributes, and studies using conjoint analysis or discrete choice models that asked participants to state preferences in the context of choice. Brady and Tolley described a number of social and behavioral issues expected to influence user perspectives and preferences for specific types of MPT products [40•]. For example, users may prefer that long-acting injectables be delivered in a single dose, but they may be willing to receive two injections if this provides a higher level of efficacy. Similarly, while quick return to fertility following product removal/discontinuation is important to many potential users, some may consider a more lengthy period of drug clearance as a "bonus."

Although a number of the MPT review articles call for information on user acceptability and preferences for MPTs, as well as social and cultural norms that will likely influence use [3••, 5•, 7] very little primary research in this area has been conducted. Woodsong et al. [15•] reported that the majority of women, men, health professionals, and community stakeholders in two microbicide gel studies in Malawi and Zimbabwe were generally supportive of MPTs. Some

participants further noted that disclosure of MPT use may be similar to that of contraceptives, with some women electing not to disclose the reason for product use. However, participants also expressed a number of misperceptions (e.g., an assumption that HIV-prevention microbicides will also prevent pregnancy), and concerns (e.g., long-term effects of an MPT on future fertility), which should be addressed in future product development and the introduction process.

Current research being conducted in Kenya (CDC/KEMRI) and Rwanda (Rinda Ubuzima) to investigate vaginal ring contraceptive acceptability is assessing user interest in MPT rings, as well as preferences for a range of product attributes (*personal communication*). Market research is another methodology that has recently been applied to assessment of MPT acceptability, and a study conducted in three African countries found women and men to be eager for such a product. Regional differences were noted with regard to preferences for an MPT injectable, an implant, a vaginal film or a vaginal ring. Although this report has not been published in the peer-reviewed literature, a summary is available on the CAMI-Health website (http://resource.cami-health.org/resources/ipsos.php).

An important work by Merkatz and colleagues presented data on acceptability and successful use of a new contraceptive ring that recently completed a Phase III efficacy trial [41•]. The ring, containing Nestorone®/ethinyl estradiol, was intended to be used on a 21-day-in/7-day-out cycle for 13 cycles. Although this ring was not being developed as an MPT, the research team expanded the knowledge base around vaginal ring acceptability through development of a model that demonstrated a positive relationship between acceptability and product use. This model was an important advance in linking acceptability with adherence, and should be applicable to future MPT development, particularly vaginal rings.

Technical Considerations

Target Product Profile and Priority Settings

A consensus "Target Product Profile" (TPP) has been proposed to guide product development [3••, 5•, 30]. As indicated in Table 1 , the current MPT priority product is for prevention of HIV and pregnancy, preferably formulated for sustained delivery in a vaginal ring with contraceptive efficacy equivalent to currently available methods, quickly reversible, and providing HIV efficacy of at least 40 % (when compared to no product use). TPP criteria for storage, shelf-life, cost, and disposal have further implications for product design decisions. Individual product-specific TPPs are currently being drafted by product developers, with a focus on the specific accommodations necessary for the selected active ingredients [5•]. The consultative TPP development process has also highlighted regional differences in priorities, with sub-Saharan African countries most concerned with an MPT for pregnancy and HIV indications, while Asian and developed countries have expressed greater need for pregnancy and non-HIV STI prevention [3••]. Thus, a "suite of MPT product configurations" will be needed to meet the diverse global public health needs and preferences for MPTs [3••].

It is important to note that aside from condoms, the only MPT that has demonstrated efficacy is tenofovir gel, which provided moderate protection from HIV and HSV when used peri-coitally by women in the CAPRISA 004 study conducted in South Africa [42]. A confirmatory trial was recently completed and results are expected soon [43•]. Thus, although the TPP highlights continuous release vaginal rings as the route of administration, Tenofovir gel for coitally-associated use may be the first new MPT to become available.

Pipeline

MPT product development is primarily occurring outside of the commercial pharmaceutical sector, by not-for-profit research groups that are engaged in the IMPT. Currently, only one large pharmaceutical company (Merck) is actively engaged in MPT development. At the time of this writing, the IMPT lists 28 products as "under development" on the CAMI-Health website, including 11 vaginal rings, 11 vaginal gels, two vaginal films, two vaginal tablet/pill/capsules, one diaphragm and one female condom. (http://mpts101.org/mpt-database).

Table 2 presents the seven products that reflect the TPP priorities for route of administration (vaginal ring) and indication (HIV plus contraception). Products being developed by the International Partnership for Microbicides (IPM) and CONRAD combine an anti-retroviral with levonorgestrel [44•, 6]. IPM's ring combines dapivirine with levonorgestrel, and CONRAD's ring combines levonorgestrel with tenofovir. IPM is targeting a dose of levonorgestrel intended to suppress ovarian function sufficiently to prevent menstrual cycles, and CONRAD is targeting a low dose of levonorgestrel with the intention of providing contraception through cervical mucus changes and not impacting ovarian function or the menstrual cycle. Both rings are intended to prevent HIV-1 and pregnancy, with 90-days of continuous use and with no removal. The Population Council has two MPT rings in development; both include MIV 150 (a non-nucleoside reverse transcriptase inhibitor), zinc acetate, and levonorgestrel for prevention of HIV, HSV, and pregnancy [41•, 45, 46•]

There are also several early-stage concepts in the pipeline, many of which are identified in Table 1 and in the product prioritization considerations of the IMPT. While the majority

Table 1 Target Product Profile (TPP) parameters for prioritizing MPT development

Parameter	Preferred criteria	Minimally acceptable criteria
Indications	HIV + contraception (high emphasis for sub-Saharan African markets) (high emphasis for sub-Saharan African markets)	HIV + HSV (high emphasis for non-LDC markets) contraception + STI (high emphasis for Indian and Chinese markets) BV, HPV, and TV (moderate emphasis) GC + syphilis (minimal emphasis)
Route of administration	Vaginal rings	Oral pills, injectables
Dosage form and schedule	Sustained release (1–12 months) Pericoital Fast-acting Topical (vaginal)	Daily Oral
Efficacy: (i) HIV (ii) Contraception (iii) STI	80% >Current levels per contraceptive of >90% >80%	40%–70% Current levels with recommended use 40%
Storage conditions	40°C/75% RH	15–30° C/65% RH for topical/pills Refrigeration at 4° C for injectables
Shelf life	>36 months	24 months
Yearly product cost/user	<US$ 50	<US$ 100
Disposal/waste	Concealable, biodegradable user disposal	Controlled disposal (to include all associated materials (implant, injectables))
Adherence	>80% of users follow prescribed regimen	>60% of users follow prescribed regimen
Time to licensure	5 years	8–12 years (by 2020)
Reversibility	0–24 hours for oral, topical, sustained-release methods 14 days for implants, injectables	14–30 days for oral, topical, sustained-release methods 90 days for implants, injectables

Source: Reprinted from Harrison et al. 2013 [3••]

involves small molecule approaches, many with established therapeutics, Whaley and Zeitlin [16•] provided a detailed review of the in vivo potential for monoclonal antibodies to be utilized as drugs delivered in combinations to achieve MPT goals.

Delivery Mode

Important technical work in product delivery modes is also contributing to MPT development. Innovations in vaginal ring designs, as shown in Fig. 1 and reviewed by Malcolm et al.

Table 2 Vaginal ring products for prevention of HIV and pregnancy

Indication			Active Pharmaceutical Ingredient (and product name, when applicable)	Stage of Development			Developer
HIV	Pregnancy	HSV[1]		Early Pre-clinical	Advanced Pre-clinical	Clinical	
♦	♦		Ascorbic Acid, Boc-Lysinated Betulonic Acid, Ferrous Gluconate, Polyamino-Polycarboxlic Acid, Tenofovir (Biorings ™)	♦			BioRings LLC
♦	♦		Levonorgestrel, Dapivirine		♦		International Partnership for Microbicides
♦	♦	♦	Levonorgestrel, MIV 150, Zinc Acetate, Carragenan	♦			Population Council
♦	♦	♦	Levonorgestrel, MIV 150, Zinc Acetate	♦			Population Council
♦	♦	♦	Levonorgestrel, Tenofovir (TFV)			♦	CONRAD
♦	♦	♦	Levonorgestrel,Tenofovir Disoproxil Fumarate (TDF)		♦		Albert Einstein College of Medicine
♦	♦		Progestin ,MK 2048 (Vicriviroc)	♦			Merck

(Note: A full listing of MPT products in development can be found at www.cami-health.org)

[1] HSV: Herpes simplex virus

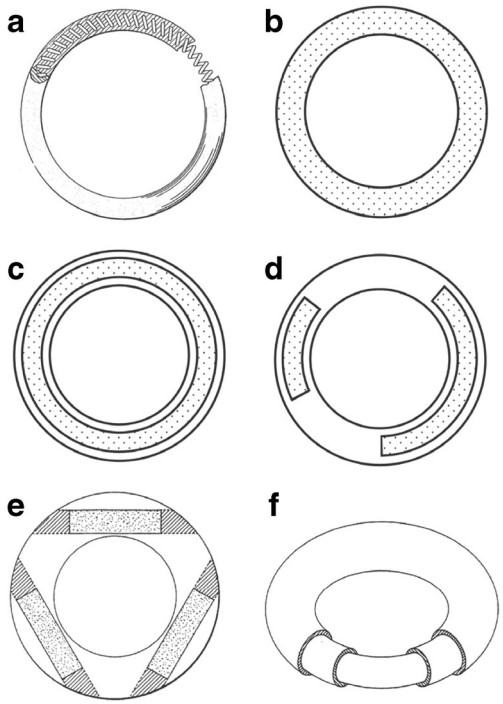

Fig. 1 Representative vaginal ring designs **(a)** Over-molded metal spring design first described in a 1970 patent. (**b**) Matrix-type ring with solid micronized drug dispersed throughout the entire polymer. (**c**) Full length reservoir/core ring design, where the drug-loaded core is encapsulated by a non-medicated, rate-controlling polymer membrane. (**d**) Multiple partial core ring design, where each core contains a different drug substance. (**e**) Insertable core ring design, where drug-loaded cores are inserted into a prefabricated ring body before sealing the ends. (**f**) Sandwich or shell ring design, where a drug-loaded layer is sandwiched between a non-medicated polymeric central core and a non-medicated outer rate-controlling polymer membrane. Source: Reprinted from Malcolm et al., 2012 [47].

[47], include matrix designs, reservoir configurations, ring segments, and drug-loaded pods [6, 47, 48•, 49, 50•]. These have been further developed to deliver multiple APIs for multipurpose prevention [6, 48•, 49, 50•, 51•] for durations of use ranging from one to twelve months. Barrier methods under development for MPT products include the FC Female Condom and the SILCS diaphragm [6, 52]. The FC Female Condom contains no drug product, but SILCS is being investigated for use with microbicide gels [53] such as tenofovir, or with dapivirine loaded into the outer rim of the product [54•]. Other routes of MPT administration at earlier stages of development include films [55], nanofiber technology [56•], injectables, and implants [30].

Cost of the final product remains a key consideration alongside the technical aspects of the various delivery modes being developed. A myriad of factors feed into the per-year cost of an MPT, ranging from the duration of use of a single product to the required conditions (e.g., temperature) for delivery and storage. MPTs such as a contraceptive/HIV prevention product may be better received in some markets, such as the US or the EU, than a product offering HIV-prevention only. Indeed, it is considered that a revenue stream from US/EU MPT users might support the costs inherent in providing the product to lower-resource settings. Significant work is needed to further determine the right MPT delivery modality for the target setting as well as the user preferences that might support production of an MPT product that achieves high initial uptake and continued use [7].

Additional Challenges for MPT Development

Although literature explicitly focused on MPTs and published since 2013 is limited, a number of practical and technical considerations for MPTs can be found in the literature on contraceptives as well as HIV prevention. A full review of all work in these fields is outside the scope of this review, but a few particularly salient topics should be mentioned because a number of the practical and technical considerations overlap. For example, Hillard's work on menstrual suppression caused by use of hormonal methods [57] is important for MPT development, since menstrual disruption could positively and/or negatively affect user acceptability and continued use of an MPT that affects menses. As noted above, two of the advanced MPT vaginal rings containing levonorgestrel are expected to have different effects on menses, and the Population Council's contraceptive three-month progestin-only ring is designed to extend the period of lactational amenorrhea [45, 58]. Thus, the decisions about formulation of APIs have implications for product performance as well as for user acceptability.

Work to extend the period of use for contraceptive rings will provide important insights into practical and technical considerations for extended use MPTs. An extended use product could be less costly for providers and users, and reducing the frequency of resupply could improve adherence by avoiding the loss of protection due to missed appointments for collection of new rings. As discussed above, the Population Council is developing a contraceptive ring to be worn for 12 months, on a 21-day-in/7-day-out basis [58]. However, HIV prevention rings are intended to be worn continuously. While the acceptability model of Merkatz et al. [41•] highlighted key aspects to guide acceptability and introduction of their specific contraceptive ring, it is not known if women will wear vaginal rings for extended periods of time without the periodic removal for cleaning/rinsing and menses that the Population Council ring provides. Cleaning and menses have been key reasons reported for non-adherent ring removals in microbicide trials conducted in Africa [59].

To date, the majority of advanced vaginal microbicide trials have been conducted among women in sub-Saharan Africa , which is the population bearing the brunt of the global burden of new HIV infections [20]. When MPT products, particularly

those targeting HIV prevention, enter advanced clinical testing, these studies will also likely be conducted in African countries. Another important recent publication by Cohen et al. [60•] described a range of ethical issues that must be considered in such research. They observed that microbicide trials require use of effective contraceptives, and advanced trials are conducted in settings with high HIV incidence, while contraceptive trials require use of experimental contraceptives and are conducted in low risk settings. Ethical requirements for minimizing risks to participants and providing appropriate standards of care and prevention services to participants must be addressed during development of MPT clinical trial protocols.

Conclusion

Since the creation of the IMPT under the guidance of CAMI-Health in 2009, the research community has made great strides in defining key product attributes and an over-arching TPP to assist the field in prioritizing MPT products. Over the years following the IMPT formation, many product development groups, research networks, and innovators have turned their attention to developing MPT products, aided by funding opportunities from donors and governmental agencies. Over the 2013-2014 period, the MPT field has focused primarily on positioning the need for these products, and taking stock of microbicide clinical trial findings as well as the continued discussions about relationships between hormonal contraceptives and HIV. As noted above, there have been few primary publications on new MPT research or development.

However, it is clear that the development of MPT products is progressing within various product development groups, including not-for-profit and academic organizations that have published the articles cited in this review. These groups are focusing on innovative delivery systems, formulations, and novel active ingredients to bring MPT concepts forward through the formalized drug/device development requirements necessary to progress into human studies. Indeed, CONRAD is currently implementing a Phase I study of their contraceptive/HIV prevention vaginal ring (http://www.conrad.org/prevention-trials.html), and IPM is slated to initiate an MPT Phase I study in 2015 [61]. While advances are being made in the development of a wide array of product modalities with diverse prevention targets and intended mechanisms of action, much of this work will not be published prior to initiation of clinical studies.

It remains clear from the literature and the current development stage of MPT products, that there is a significant need and interest in these products across funders/donors, healthcare providers, community leaders, advocacy groups, and end users. However, there remains uncertainty about regulatory expectations for pivotal clinical studies required for product approval. There is also a need for further data to guide considerations of factors impacting user acceptability and the scope of the programs needed to support both product introduction and access. Despite these challenges, the network of experts and advocates that are supporting and driving the MPT effort remains strong and focused, and it seems reasonable to anticipate an increasing volume of publications on successful formulation development, preclinical and clinical testing of new products, and expansion in our understanding of women's needs and preferences for MPT product characteristics.

Compliance with Ethics Guidelines

Conflict of Interest Cynthia Woodsong, Brid Devlin, and Zeda Rosenberg report grants from the Bill and Melinda Gates Foundation, grants from the United States Agency for International Development, grants from United Kingdom AID, grants from the Netherlands Ministry of Foreign Affairs , grants from the Danish Ministry of Foreign Affairs, grants from Irish AID, and grants from the Norwegian Ministry of Foreign Affairs. In addition, they report that they have US Patent 8,580,294B2 issued to International Partnership for Microbicides, and US Patent 61/904,073 pending.

Jonathon Holt reports grants from the Bill and Melinda Gates Foundation, grants from the United States Agency for International Development, grants from United Kingdom AID, grants from the Netherlands Ministry of Foreign Affairs, grants from the Danish Ministry of Foreign Affairs, grants from Irish AID, and grants from the Norwegian Ministry of Foreign Affairs. In addition, Dr. Holt has US Patent 61/904,073 pending.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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- • Of importance
- •• Of major importance

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3.•• Harrison PF, Hemmerling A, Romano J, Whaley KJ, Holt BY. Developing multipurpose reproductive health technologies: an integrated strategy. AIDS Res Treat. 2013;2013:790154. doi:10.1155/2013/790154. *Harrison et al. provided a succinct summary of MPT development efforts. This paper is an essential "go-to" for anyone interested in MPTs. The paper includes a number of tables with important details about MPT development, including a table summarizing the regional needs and priorities for MPTs.*

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