

# The Microbial Mother Meets the Independent Organ: Cultural Discourses of Reproductive Microbiomes

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**Abstract** The human microbiome is changing the way experts and non-experts think about germs and microorganisms. This essay is a gender analysis of contemporary discourses surrounding the human reproductive microbiome, specifically the vaginal microbiota and the penile microbiota. I first historically situate the human reproductive microbiome within the germ theory of disease. Then, I draw on Heather Paxson’s Foucauldian and Latourian concept of microbiopolitics to argue that microbiopolitics is not only about how humans should live with microorganisms; but it also impacts how humans and microbes live together as gendered beings. I illustrate this gendering through two figures: the *microbial mother* and the *independent organ*.

**Keywords** Germ · Microbiome · Reproduction · Gender · Microbial mother · Independent organ

I wanted my baby to receive the microbial community that Mother Nature had provided me as a mother. In the end, my daughter flipped and I delivered her vaginally. But if she hadn’t, I would have taken things into my own hands, quite literally, and inoculated her myself shortly after birth by putting some of my vaginal fluid into her mouth. (Levy 2013)

In the epigraph above, Karen Levy describes a new kind of human relating to microorganisms, particularly between mother and child. Levy, a mother and microbiologist, raises concerns not about the risks of Cesarean delivery as surgery but more specifically the risk it poses to processes of natural seeding of a healthy microbiome, which would otherwise be provided by vaginal delivery. Her article, “My Baby, My Microbiome,” is a call for recognizing the health benefits of being enveloped by microbes (bacteria, viruses, fungus, and other microscopic organisms), including during birth. Imbalanced or unhealthy microbiomes have been correlated to obesity, asthma, autoimmune diseases, depression, digestive disorders, and

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diabetes (Ley 2010; “Lower Asthma Risk Linked To Microbes In Infants’ Homes” 2015; Yurkovetskiy et al. 2013; Wright 2014). The human microbiome is described by the National Institutes of Health (NIH) as the collective genomes of the microbes (composed of bacteria, bacteriophage, fungi, protozoa, and viruses) that live inside and on the human body (Yang 2012). In a turn away from bacteria as dangerous, contemporary science news describes microorganisms in increasingly positive ways as necessary for “good” health.<sup>1</sup> This marks a move away from a much longer history in which domains like sanitary science, personal hygiene, medicine, and public health campaigns constituted germs as pathogenic (which will be further discussed later). In early reports coming out of the NIH’s Human Microbiome Project (HMP), scientists and science journalists argued that microorganisms both outnumber our own human cells and may be an avenue to solve our contemporary health problems; in other words, microbes are our saviors (“2012 Release: NIH Human Microbiome Project Defines Normal Bacterial Makeup of the Body” 2015; Peterson et al. 2009; “The Microbes of Men - NIH Research Matters - National Institutes of Health (NIH)” 2014). Science writer Micheal Pollan writes, “Researchers now speak of an impoverished ‘Westernized microbiome’ and ask whether the time has come to embark on a project of ‘restoration ecology’ – not in the rain forest or on the prairie but right here at home, in the human gut” (2013).

This essay recognizes both this historical shift in discourses about germs and health, as well as analyzes the ways in which gender functions to shape different relationships with microorganisms based on reproductive morphology. In other words, reproductive microbiome discourses position some bodily spaces as more appropriate for the benefits of microbial colonization (i.e., the vagina) than others (i.e., the penis). It takes a cultural studies and feminist science studies approach to understanding the role of gender in human reproductive microbiomes, further bringing these fields into contact with the medical humanities. Within the field of medical humanities, Bradley Lewis advocates for a cultural studies perspective that “[is] interested in breaking down the barrier between humanities and science, hoping to unleash the force of critical thought on the ever burgeoning power house of biomedical technoscience” (1998, 20). As Susan M. Squier writes in conversation with Anne Hunsaker Hawkins, “Whether we teach in a university or a medical school, whether we write for humanities scholars or physicians, the medical humanities and cultural studies can enable us to make [power] connections: to see how bodies get made (and remade) in the hospital, the farm, the school and the home, and how in each site we have the choice to cultivate better, less compromised, lives” (2004, 253). This essay takes seriously this process of bodies being remade within discourses of the human reproductive microbiome, specifically in regards to gender. First, I will theoretically and historically situate my argument in what Heather Paxson calls microbiopolitics (building on the work of Michel Foucault) and the history of germ theory. Then, I will discuss the ways in which feminist science studies scholars make space for gendered critiques of science and medicine. In the end, I am arguing that the differences in our contemporary relationship with microbes at the sites of the vagina and penis are being gendered in order to maintain our contradictory relationship with germs as pathogens and saviors.

## Microbiopolitics, germs, and gender

The biological existence of human beings and microorganisms are political. As Michel Foucault argued, “. . . modern man is an animal whose politics calls his existence as a living being into question” (1978, 188). The management of life and the well-being of the population has become a primary focus of governments and political authorities (particularly in regards to

infections due to microorganisms), but as Nikolas Rose (2001) argues, the old configuration of biopolitics has shifted to a molecular politics. The vital life processes (such as reproduction and sexuality) are no longer primarily managed at the level of population but through technologies of the self that account for individual risks and the ethics of their individual health choices. As Levy's quote makes clear, she is taking individual responsibility for providing her infant with a healthy microbial start, and she suggests that others should do the same (2013). Rose argues, "Life now appears to be open to shaping and reshaping at the molecular level: by precisely calculated interventions that prevent something happening, alter the way something happens, make something new happen in the cellular processes themselves" (2001, 16). The human microbiome is ripe for inclusion in this molecular biopolitics as projects like uBiome and The American Gut Project make way for individuals (and governments) to manage microbial-human futures (Hill 2012; "American Gut Project" 2015). But microorganisms are not simply a new molecular realm for human health innovation; they have a long history wrapped up in death, decay, waste, and filth (Barnes 2006).

Heather Paxson's anthropological work (2008) on raw-milk cheese farmers introduces the concept of microbiopolitics, a melding of Foucault's biopolitics and Rose's molecular politics. She argues that microbiopolitics calls attention to dissent between how we should live with microorganisms (individually and at the level of populations), which mirrors concerns about how humans should live with one another. Paxson utilizes Bruno Latour's *The Pasteurization of France* to describe the management of peoples through knowledge of microorganisms on human populations. She writes,

Latour argues that with microbes revealed to be controlled, hygienists, government officials, and economists laid the groundwork for what they believed to be "pure" social relations – relations that would not be derailed by microbial interruption, that could be predicted and thus rationally ordered. Biopolitics, then, is joined by microbiopolitics: the creation of categories of microscopic biological agents; the anthropocentric evaluation of such agents; and the elaboration of appropriate human behaviors vis-a-vis microorganisms engaged in infection, inoculation, and digestion. (2008, 17)

Today, microbiopolitics can be seen at the tension between Pasteurian and post-Pasteurian subjectivities. She writes, "whereas Pasteurianism in the realm of food safety has suggested a medicalization of food and eating, post-Pasteurians want to invest in the potentialities of collaborative human and microbial cultural practices" (17). This essay can be situated within Paxson's conceptualization of microbiopolitics, in which Pasteurianism (control of microorganisms toward protecting individuals and populations) comes into tension with post-Pasteurian (microbial and human collaboration) at the site of the human reproductive microbiome. As I will argue, microbiopolitics is not only about how humans should live with microorganisms; these relations with microorganisms impact how humans should live together as gendered beings. Before further explorations of gender and human reproductive microbiomes, I would like to trace out briefly the history of bacteriology to lay a foundation for the current tensions between germs as pathogenic (Pasteurian) vs. germs as saviors (post-Pasteurian).

Many historians of medicine mark the late nineteenth century as revolutionary in the development of modern medicine due to the acceptance of the "germ theory" of disease. Micheal Worboys writes, "In 1881, the germ theory of disease was defined in a medical lexicon as 'the idea that the origin of many diseases lay in the pathogenic actions of certain micro-organisms when introduced into the body'" (2000, 3). However, this heroic tale of scientific advancement has been increasingly described as evolutionary rather than

revolutionary – recognizing the plurality of actors and agents in developing germ theories of disease (Worboys 2000; Latour 1993). Prior to and during the coalescing of a germ theory of disease, microorganisms were not only understood as possible disease agents but also known to be important to healthy digestion (Worboys 2000). However, the very real problems of urban crowding alongside industrialization in the mid-nineteenth century led to increases in intermittent epidemics of “yellow fever, cholera, and smallpox, which caused more fear than mortality, [and] there were the ever-present influenza and pneumonia, typhus, typhoid fever, diphtheria, scarlet fever, measles, whooping cough, dysentery, and – above all – tuberculosis,” which is often described as the greatest killer of the nineteenth century (Leavitt and Numbers 1997, 5). In other words, these very real problems of disease and urban life were the impetus for the founding of city and state health departments, health legislation, the building of modern infrastructure (sewer, water, and hospital facilities), and, as Nancy Tomes argues, advocacy toward the “private side” of domestic hygiene – gendered home based practices of cleanliness based in logics of public health and informed by germ theories (1990). However, today historians like Tomes describe Western peoples’ existence as charmed due to advances like vaccines, antibiotics, antiseptics, pasteurization, and following a “gospel of germs,” which have prolonged the human life span (1998, xiv).

There were many meanings between the 1860s and 1870s about what germs were: chemical poisons, ferments, degraded cells, fungi, bacteria or a class of parasites. As Worboys argues, “There was also great uncertainty over whether germs were cause, consequence, or mere concomitants of disease, not to mention which diseases were associated with germs” (2000, 3). However, if we go back further, the etymology of the term, germ, has been traced to mean origin, sprout, or shoot in Middle French (*germe*) and the action of germination or sprouting. In relation to the human, germ has also been used to describe semen and sperm. This word carries forth meanings concerning original states from which organisms develop (particularly plants), a seedling, the embryo within a seed, emerging growth of a germinated seedling, the part of an animal capable of reproducing it in kind (semen or ovum), a “primal source of life,” and, finally, the causative agent of disease (“Germ, N.” 2017). In the long debate to classify bacteria, it was Ferdinand Cohn (1828-1898) who originally placed bacteria in the plant kingdom (O’Malley 2014, 66), which brings together the botanist meanings to the scientific classification of bacteria and its association with the older term germ during this period.

Even today, discourses about microbiomes seem to be calling forth this deeper meaning of germ as researchers debate what metaphor should be used to describe the human microbiome, specifically those arguing for thinking of the human microbiome as an ecosystem (over organ or superorganism) (Juengst 2009). It was in the 1880s that a consensus began to emerge around thinking of bacteria as germs, and during this period medical professionals began to shift to using the terms bacteria and microorganisms over the term germ. Yet, colloquially the term, germ, is still used today but often to denote its more negative meaning as disease agent. With the recognition of germs as disease agents, modern medicine shifts from understanding diseases by symptoms to understanding diseases by processes and causes. For example, in 1882 after Robert Koch identified the tubercle bacillus as cause of disease, consumption (a word to describe a disease symptom – wasting away) changes to tuberculosis which describes a process of a specific bacteria entering the body (Worboys 2000, 4; Rothman 1995). In this way, bodily orifices become central to concepts of disease and contagion, especially reproductive organs. The vagina and the penis are made to be risky zones of contact even beyond social concerns of unplanned pregnancy. Allen M. Brandt writes, we continue “to define the sexually transmitted diseases as uniquely sinful” (1987, 202). In other words, the infectious diseases transmitted through the sharing of microorganisms

during penile, vaginal, or anal contact function microbiopolitically. Sexually transmitted infections (STI) are a means of shaming peoples into more conservative (less “risky”) sexual encounters and protect the spread of infections through the population. Simultaneously, the infected vagina runs the risk of passing these pathogens onto potential progeny during pregnancy and birth, which brings forth older meanings of germ – as progenator of the species. Overall, the dominant historical narrative facing contemporary microbiome discourse is described by Nancy Tomes as a “gospel of germs,” or the belief that microbes cause disease and can be avoided by certain protective behaviors. She writes,

Beliefs concerning the existence of germs are among the most widely shared scientific precepts governing everyday life in modern Western societies. Although some may still disagree about the link between specific microbes and a particular ailment, the general principle that pathogenic microorganisms can cause sickness is rarely disputed. Like the law of gravity or the solar-centered planetary system, the so-called germ theory of disease has the aura of timeless and universal truth. (1998, 2)

This history of germ theory and its microbiopolitics are foundational in constructing the contemporary contradiction between microorganisms as pathogenic and saviors, as well as, creating gendered human-microbial subjects.

The discourses of science and medicine are powerful, and their influence on what it means to be a woman or a man or something more are seemingly inescapable. Our bodies are closely observed from conception to death via normalizing and disciplinary biomedical<sup>2</sup> practices. The trouble in dealing with biomedical discourse is the longstanding assumption that science and medicine exist outside of culture or that the methods of scientific investigation are genuinely objective. Feminist science studies scholars have spent a lot of ink arguing the contrary, primarily because they recognize gender ideology in many seemingly objective “scientific” conclusions (Martin 1992; Oudshoorn 1994; Bivins 2000; Moore 2002; Richardson 2012). Emily Martin opens her canonical essay “The Egg and the Sperm” stating,

I am intrigued by the possibility that culture shapes how biological scientists describe what they discover about the natural world. If this were so, we would be learning about more than the natural world in high school biology class; we would be learning about cultural beliefs and practices as if they were part of nature. (1991, 485)

Her essay goes on to make precisely this point about the ways in which culture (especially gender) shapes biological knowledge. While her essay was published twenty-six years ago, it triggered more studies of the role of gender in the production of scientific knowledge, and it is a reminder that gender is a concept that keeps getting put to work in the sciences and medicine for normative ends. For this reason, feminist science studies scholars and cultural studies scholars must do the work of thinking through the relationship between materiality and discourse. Evelyn Fox Keller argues that science is a construction project, and as such it is a collection of representations of the “natural” world, or a project to describe a “prelinguistic or pretheoretical” domain (1992, 3). For Keller “nature” is only accessible through representations, and representations are necessarily structured by language (and therefore culture), so “no representation can ever ‘correspond’ to reality. At the same time, however, some representations are clearly better (more effective) than others” (5). Paula Treichler writes, “Language is not a substitute for reality; it is one of the most significant ways we know reality, experience it, and articulate it; indeed, language plays a powerful role in producing experience and in certifying that experience as ‘authentic’” (1999, 4).

The language used in scientific representations shift as audiences change from expert to lay. Jeanne Fahnestock (1998) argued that moves to lay audiences worked by connecting scientific information to already held values and future benefits (moving the rhetoric from forensic and deliberative to epideictic). Gender becomes a very useful value system to incite lay interest in scientific findings, which is why we see popular science titles such as, “Men’s Microbes are from Mars, Women’s from Venus” and “Gross! Apparently Bacteria is What Makes or Breaks a Relationship” (Fram 2015; Z. Barnes 2014). Yet, as scientific journal articles like “Mighty Male Microbes” and “Welcome to the Microgenderome” tell us, the value of catchy gender oriented titles are not only attractive to lay audiences (Mueller 2013; Flak, et al. 2013).

In her essay “Sex Cells: Gender and the Language of Bacterial Genetics,” Roberta Bivins argues that bacteria were sexualized and given gender in order to be included in the already sexualized field of genetics. She argues that sexualizing bacteria was not simply a “rhetorical device” or purely a linguistic construction. Bivins writes, “The design of the experiments were themselves shaped by assumptions of sex and gender; unsurprisingly, these experiments then produced results which inevitably validated those assumptions” (2000, 114). Additionally, prior knowledge of genetics constrained thinking of bacterial reproduction without sex because sex at this time was the only known mechanism for the transfer of genetic material. In this way, the sexualization of bacteria is contingent on what is intelligible at the time of its discovery, but, as Bivins suggests, even when other models provide a better heuristic for bacterial genetic transfer, sex still persists despite being warped in the process. Following her work, this close reading of the language and representations of human reproductive microbiomes in popular science reporting can tell us how gender persists in the re-making of human-microbial relations. The history of germ theory (germ as pathogen), sexualization of bacterial genetic transfer (persistent role of gender in science), and microbiopolitics (categorization of microbes and their ecologies) constitute significant pieces of the cultural milieu in which the human reproductive microbiome is currently being made.

## Gender and the human reproductive microbiome

This analysis of gender in human reproductive microbiome research and reporting is part of a larger research program focusing on discourses associated with the human microbiome broadly. Over the course of four years, I have been collecting digital materials about microbes through Google alerts (key word: microbes). In the process of collecting primary sources broadly, I was struck by the recurring imagery and language of reproductive microbiomes. This broad survey of materials led to my asking: how is the human microbiome gendered? And what is gender doing for our understanding of the human microbiome? For this project, I pulled from my broader archive research and reports that focused on the vaginal microbiota and the penile microbiota.<sup>3</sup> The materials that this essay focuses on were chosen because they traversed multiple kinds of media. For example, the work of Martin J. Blaser (discussed later) started in his research lab, became a popular book (*Missing Microbes*), was reported in *The New York Times*, led to an interview on *The Daily Show with Jon Stewart*, and later became the subject of a documentary film titled *Microbirth*. In other words, I chose the artifacts I did because they are part of a story that is impossible to ignore, especially when looking at the vaginal microbiota. In contrast, the penile microbiota did not have such an extended reach, but it became a necessary organ to know in comparison because it was part of this emerging human reproductive microbiome. When it comes to microbiomes, differences are not surprising considering the incredible specificity researchers are finding as they explore a variety

of human microbiota. But what is of particular interest is the ways in which gender difference inscribes very different relations with microbes, not just differing human microbiomes.

I would like to begin this analysis by describing two images from the cover of *Nature*. *Nature* is a scientific journal first published in 1869, and it is one of the only academic journals that publishes scientific research across a variety of fields of study (with an impact factor of about 38.1). The human microbiome was featured as a cover story in the March 2010 issue and again in a June 2012 issue.<sup>4</sup> The cover art for these two issues are useful representations of the kinds of imagery used to depict the human microbiome and subsequently the gendering of this relationship to microbes. The first image was of a masculine body form that is transparent through to a brightly highlighted gut and modeled after a full body scan. The second image<sup>5</sup> is of a feminine face looking directly at her microbial silhouette. This microbial reflection is constituted by various microbes held together by a thin translucent form in the shape of the woman's face. These images suggest different relations with microbes; in the masculine form the human microbiome is focused on the gut, and in the feminine image the woman is wholly microbial.

The feminine body is thoroughly constituted, even within the mind, with microbes, and these microbes are “Fellow Travelers” as the magazine headline conveys. The masculine body is seen through to the guts, which mark a bounded and controlled space for masculine microbe relations, and these microbial mates are described as “Our Other Genome” on this magazine cover. The focus on the gut for the masculine image has more significance than just being a specific space of microbes within the male (and female) body. When describing the gut, the American Gut Project<sup>6</sup> states, “[y]our gut is a hole that runs through your body. Your gut is actually, developmentally speaking, the outside of your body, but it has evolved many intricacies that make it seem like the inside” (“American Gut Overview” 2015). It is as if the masculine gut microbes are considered an outside within the male body, whereas the feminine body is a wholly microbial body. The purpose of this analysis is to describe the gendered terrain of human and microbe relations, and to do this I will focus on vaginal and penile microbiota (as part of the human reproductive microbiome).<sup>7</sup>

## A. The microbial mother

The relationship between the female body and microbes carries greater weight than merely the two pounds that is supposed to represent this microbial organ.<sup>8</sup> Actually, the female microbe relationship is described aptly in a *Slate* article titled, “What’s in Your Vagina?: A Healthy Microbiome Hopefully” (Velasquez-Manoff and Waldman 2013). If you are curious about what is in your vagina, you can turn to Blaser’s popular science book *Missing Microbes*, which devotes an entire chapter to the significance of microbes in birth processes.<sup>9</sup> Blaser is the director of the human microbiome program at New York University and argues in his book that our overuse of antibiotics, c-sections, and antiseptics are causing changes to the human microbiome and therefore harming human health (2014a). Central to his argument is highlighting the significance of microbes in mammalian reproductive processes. His book along with other texts that discuss female bodies, microbes, and the vagina are the focus of the following analysis.

The vagina is the locus of pre-pregnancy discussions of female microbe relations, and this relationship is not static; it changes as microbiomists shift to a focus on pregnancy, birth, and breastfeeding. In other words, it is as if the female body transforms from a semi-individual prior to pregnancy into a microbially-dependent-body or from a space for the germ as pathogen to a space for microbes for human survival. Her capacity to become pregnant alters her and her relationship

with microbes. Within female microbiome discourses, we find an emphasis on strict reproductive function, such as understanding the vagina solely for its purpose in reproducing the human species. Due to thinking in this limited way about vaginas, these discourses often assume heterosexuality when constituting human and microbe relations, especially in conversation with the penile microbiota. Also, the goal of function disproportionately privileges white women's vaginal hygiene practices, over those of African American and Hispanic women (Nelson et al. 2007).<sup>10</sup> The relationship of the vagina with microbes functions too narrowly, maintaining reproductive function while ignoring the multiple ways women are living with microbes. Before elaborating on what was just stated, I would like to offer a grounding for recent constructions of the vagina from human microbiome research on the vaginal microbiota.

One of the primary nodes of female microbiome discourse is the Vaginal Microbiome Consortium (VMC) at Virginia Commonwealth University. They argue that previously researchers assumed that the vagina was predominantly composed of *Lactobacilli* (bacteria), which are known to utilize carbohydrates to produce lactic acid. This process was believed to be responsible for protecting the vaginal environment from infection<sup>11</sup> (Akst 2014). However, recent research is finding more variation in the vaginal microbiota and complicating this understanding of the dynamics of microbial communities. In other words, to be medically labeled as “healthy,” a female no longer needs to house predominantly *Lactobacilli* in her vagina. Larry Forney, a microbial ecologist, states,

In the past we've made some generalizations about what kinds of bacteria are found in the vagina, what kinds of bacteria are good or healthy or protective. What the research is showing is there are tremendous differences between women in terms of the kinds of bacteria that are present and the changes in the communities that occur over time.” (qtd. in Akst 2014)

Forney and his colleagues published a study in 2011 that surveyed the vaginal microbiota of 396 women and found that the majority had microbial communities dominated by one of four strains of *Lactobacillus*, but a quarter of the women surveyed had vaginas dominated by other anaerobic bacteria (with microbes of genera known to produce lactic acid) (Ravel et al. 2011). In addition, the women without primarily *Lactobacilli* appeared to researchers as suffering from bacterial vaginosis (BV)<sup>12</sup>, but without any clinical symptoms (Iannacchione 2004). In other words, BV is an infection where it is agreed that microorganisms are the cause, but pinpointing a specific species has been difficult. This is significant because research has linked BV with preterm labor (which was understood to be due to low levels of *Lactobacilli*), and African American women are seen as at greater risk for preterm labor due to what appears to be BV in their vaginal environment. Finally, Jacques Ravel stated, “[microbe] communities can change rather dramatically in women in a relatively short period of time,” and each woman is different in terms of the stability of her vaginal microbiota<sup>13</sup> throughout her lifespan (qtd. in Akst 2014). In other words, the relationship between the female body, the vagina, and microbes is not thoroughly understood. Jennifer Fettweis Director of the VMC states, “In many samples, only a fraction of [the genetic sequences] align to anything we have in our database. So, I think there's still a lot of work to be done in terms of actually understanding: What are these organisms?” (qtd. in Akst 2014).

Overall, the vagina of today is seemingly more complex than previous incarnations, but this new found multiplicity is very hard to maintain through processes of accommodating scientific language that prescribes particular behaviors and medical practices geared toward an assumed shared value of “protecting humanity” (Fahnestock 1998). As Treichler argues, “ambiguity



and uncertainty are hallmarks of scientific inquiry that require social and linguistic management” (1987, 36). This often means that for “meanings to be made” or signified this ambiguity needs to be “made sense of.” The question might be: why should women care about their vaginal microbiome? The resounding answer that popular scientific reporting suggests is that “[i]f the vaginal microbiome were suddenly to shift across the entire human population, it’s not unreasonable to predict that humanity would go extinct” (Velasquez-Manoff 2013). This is a pretty lofty burden for each vagina to bear. The vagina moves from a conception of uncertainty, complexity, and fluidity to a single biological function: procreation of the species.

In his 2013 article in *Slate*, Moises Velasquez-Manoff recounts a lecture by Gregor Reid<sup>14</sup> at an American Society of Microbiology conference titled, “The Vaginal Microbiome’s Role in Humanity.” Reid’s lecture was a call to microbiologists to recognize the significance of the vagina in passing from generation to generation the microbes necessary for human survival. In this lecture he equates this vaginal passing through birth processes with the transmission of “human culture.” In this way, vaginas come to bear the burden of continuing the species and human culture (probably in the form of maintaining gender ideology). Reid is quoted saying, “To not place a huge focus on the vaginal microbiome is like putting human survival at risk” (qtd. in Velasquez-Manoff 2013). This same concern resonates in the work of Blaser as he argues, “for millennia, mammalian babies have acquired founding populations of microbes by passing through their mother’s vagina. This microbial handoff is also a critical aspect of infant health in humans. Today it is in peril” (2014b). Additionally, Karen Levy raises concerns in her birth story about her vaginal microbiome by stating, “But as a microbiologist, [recovering from a c-section was] not my primary concern. Instead, my first thought was of my vaginal microbiome. I wanted my baby to have access to it” (2013). The vagina is being constructed as the primary passage of human survival. This call for the significance of the vagina in seeding a healthy microbiome through vaginal birth led to investigation (and some cases of experimentation) with “vaginal seeding” for babies delivered via Cesarean section (Dominguez-Bello et al. 2010; Stein 2016; Sanders 2016). Gauze put into the mother’s vagina prior to C-section was after surgery wiped on the infant to avoid missing this microbial transfer. The question for researchers has been when does the microbiome begin, and for many (including Blaser) the birth process has been the focal point. However, a study reported in *Science News* found that the microbiomes of vaginally and C-section delivered infants had comparable microbiomes at four to six weeks post-delivery (Sanders 2017; Chu et al. 2017).

However, the vaginal microbiota has been increasingly attributed to successful human reproduction, and any imbalance (e.g., bacterial vaginosis) puts this process at risk. The female body is not alone or the privileged progenitor of human life in reproductive microbiome discourse but host to microbes that make possible each stage of pregnancy. To be a mother is a delicate microbial process. Blaser describes this microbe-constituted mother in great detail in his chapter titled, “Mother and Child.” He explains the vagina of the mother in a submissive role to her commensal microorganisms:

During pregnancy, these tiger-mother *Lactobacilli* flourish and predominate, crowding out other resident species and potential invaders. They are gearing up for the main event – birth – which occurs around the thirty-eighth or thirty-ninth week for most pregnancies. We don’t know what initiates the process, why one woman is two weeks “early” while another is one week “late.” My suspicion is that microbes are involved in this too. (2014a, 93)

In addition, to describing *Lactobacilli* as “tiger-mother,” Blaser suggests that the very trigger of labor is probably microbes as well. This equation of microbes to being active in birth

processes and the mother as vessel is repeated throughout this birth story. For example, the vagina itself is explained to be a glove, a carrier of necessary for survival microbial life. Blaser writes, “Very flexible, rather like a glove, the vagina covers the newborn’s every surface, hugging its soft skin as it passes through” (2014a, 93). This organ is a transmitter of something much more important than herself, microbes and human survival. Also, the use of microbes as germs bringing forth life pulls on the older meanings of germ as origin, sprout, and progenitor. But, the glove (or vagina) is agentic; it hugs and covers the newborn. In microbiopolitical fashion, the mother (or medical professional) might even intervene in this process by way of “vaginal seeding” to be sure this hand-off from vaginal microbiota to infant is completed. The technologies of microbiopolitics are not merely to repress violently the bodies of women but function to produce new objects and subjects of knowledge that create new bodily norms (through observation, practices, and capacities). Jana Sawicki states, “Disciplinary technologies control the body through techniques that simultaneously render it more useful, more powerful and more docile” (1999, 193). The relationship being constituted through microbial motherhood functions microbiopolitically as one of the newest reproductive technologies to enhance and utilize women’s bodies.

The management of women’s bodies occurs through discourses of maintaining balance and avoiding behaviors that shift this vaginal equilibrium. One threat to vaginal health is bacterial vaginosis. Even before a woman becomes pregnant (the assumption being that all women should at some point become pregnant), she needs to maintain a “healthy” vagina by avoiding susceptibility to BV. Velasquez-Manoff states,

Vaginosis increases the risk of contracting secondary infections, from Herpes to HIV. But even on its own, the microbial shift may prompt low-grade inflammation that can derail reproduction. It can prevent fertilization in would-be-mothers, prompt spontaneous abortion in pregnant women, and increase the risk of preterm birth later in pregnancy. (2013)

The focus of this concern about BV is on its connection to reproduction, as the sentences build upon the risks that BV poses beyond “secondary infections” alone. The centrality of pregnancy in women’s microbial relationships assumes a reproductive body, and this limits the possibilities of relating to microbes in other sexual ways.

Additionally, the women in this discourse who need to alter their behaviors the most to maintain a “healthy” vagina are African American and Hispanic women, which suggests that their reproductive bodies are a risk and in need of greater medical surveillance. Bacterial vaginosis is estimated to affect about thirty percent of US women annually, but the prevalence in African American women is about fifty percent and among Hispanic women thirty percent (Koumans et al. 2007). The assumed cause of this BV discrepancy is often attributed to douching, which researchers have found to be more abundant in minority ethnic groups (McKee et al. 2009). Barbara Cottrell, a researcher at Florida State University, suggests that “[i]t would be nice if the CDC had a campaign: Start talking about ecosystems – that the vagina has an ecosystem – in grade school,” to help women understand that there is no need to douche. She adds, “let your vagina clean itself” (qtd. in Velasquez-Manoff 2013).

The trouble with these assumptions about BV and racialized behaviors is that the “healthy” vagina is now a white reproductive vagina predominantly colonized by *Lactobacillus*. The very infection being called BV is defined by low-levels of *Lactobacillus*, and “90 percent of white women harbor vaginal microbiomes that [are] dominated by *Lactobacillus*. ... There is a racial difference in the vaginal environment [putting] the microbial [community] in parallel” (Akst 2014).

As mentioned earlier in this essay, the Vaginal Microbiome Consortium would suggest that our old paradigm of *Lactobacillus* dominance as equated with “healthy” is being challenged. But, the transition to discourses of pregnancy moves from uncertainty to prescribing behaviors.

What emerges from the discourse is a new microbiopolitical subject: the *microbial mother*. Her relationship to microbes shifts from the germ as pathogen prior to birth (e.g., BV) to microbes as savior in pregnancy. She is increasingly dependent on her microbes in ways that create a new form of microbiopolitical agency; she needs microorganisms for a healthy birth. She has a reproductive body with a single function: the procreation of humanity. She is closely supervised; physicians will now need to sample and test her vaginal microbiome throughout her reproductive life. She is white, harboring the helpful *Lactobacillus* over “other” microbial configurations. She is constituted through and through with microorganisms both pathogenic and saviors. The microbial mother represents a subjectivity too narrowly focused on reproduction and language of the microbial as savior.

## B. The independent organ

We find a different situation with the penile microbiota. Current studies concerning microbes and the male reproductive tract often begin by stating, “the penis is understudied” (Wein 2015; Vence 2014). The assumption of researchers has been that male and female reproductive parts are quite different, especially in terms of microbial diversity and the sheer quantity of microbes gendered organs sustain. It has been known for some time that the vagina has a robust microbial community, but the penis was thought to be desolate in comparison. The NIH situates current human reproductive microbiome research by saying, “There’s strong evidence that the microbial communities in the female reproductive tract affect reproductive health and resistance to infectious disease. The microbes of the male reproductive tract, in contrast, aren’t well understood” (Wein 2015). In this way, many of the stories suggest surprise in findings that counter these initial assumptions about the male reproductive tract. The penis and its accompanying parts are more microbial than initially thought. This includes the male urinary tract and the coronal sulcus,<sup>15</sup> the former thought to be sterile in pre-sexually active males, and the latter thought to be a much simpler microbial community than current research is suggesting. Additionally, circumcision has become the locus of much of the discourse concerning microbes and the male body.

There are two primary studies that have circulated in popular science journalism concerning the microbes of men. First, in January 2010, researchers at the Translational Genomics Research Institute (TGen) and Johns Hopkins University conducted a study of the penile microbiome of twelve Ugandan men before and after circumcision. They found that circumcision reduces the presence of anaerobic (non-oxygen) bacteria and increases the amount of aerobic (oxygen required) bacteria (Price et al. 2010). The second study of interest was conducted by David E. Nelson, J. Dennis Fortenberry and their team at Indiana University, which studied the microbial communities of the urinary tract and penis of eighteen US adolescent males. Their research found that pre-sexual males had bacteria in their urinary tracts, that the bacteria in the urinary tract was not the same as that found on the coronal sulcus, and that the bacterial populations of the coronal sulcus were significantly effected by circumcision (Nelson et al. 2012). Both of these studies pivot on discussions of circumcision and frame the conversation in terms of control and risk. Men’s bodies are distinct from their microbes (there exists no microbial father), and the maintenance of their individual autonomy is maintained through discourses of the germ as pathogen. But, this discourse shifts when considering uncircumcised males, which are seen as more microbial than their

foreskinless peers, and therefore “riskier.” The penis becomes the focal point of a different relationship with microbes than the broader discourses of the human microbiome that tend toward the philosophical. For example, in the work of science writer Michael Pollan the human microbiome triggers questions about the possibility of being a superorganism<sup>16</sup> made up of microbes and human cells (2013).

Whereas the vagina is under threat of having too few microbes due to douching, running the risk of not being able to pass on its microbial flora, the penis is presented as being overrun and in need of cleansing. Circumcision becomes the suggested route to reducing or altering the penile microbiota (or at least shifting from anaerobic to aerobic microbes) to improve male reproductive health. In our efforts to reduce the prevalence of HIV and other sexually transmitted diseases, researchers have been trying to find ways to improve penile hygiene. One such method is the use of penile wipes that contain a topical microbicide and “could decrease the frequency of penile colonization with microorganisms” (Hankins 2007, 63). However, wipes (or improved hygiene) are not as prevalent in this discussion as circumcision (Hird 2013; Pappas 2014; Vence 2014; Withnall 2014). In both these suggestions, circumcision or the use of wipes, the goal is to reduce the microbes present on the penis. Lance B. Price stated in a press release about his research on the penile microbiota and circumcision that:

From a public health perspective the findings are really interesting because some of these organisms that are decreasing could cause inflammation. We’re used to thinking about how disrupting the gut microbiome can make someone more susceptible to an infection. Now we think maybe this disturbance [in the penile microbiome] could be a good thing – could have a positive effect. (qtd. in Perkel 2013)

In other words, the penis represents a microbiota that should be managed differently than other parts of the human body. The male body may have microbes on the penis, but they can be controlled through circumcision making sure the only “germ” passed on in reproduction is semen. Moore describes masculine agency in reproduction writing,

Agency is assigned to men to impregnate. Gender relations are represented as heterosexual, the man having the power to control reproduction . . . Agency shifts and is then assigned to sperm. Gender relations continue to be represented as heterosexual and patriarchal. (2002, 114)

By keeping control of this double meaning of germ as both semen and disease agent, circumcision works to maintain masculine agency in reproduction. It is also important to highlight that in Price's discussion of male reproductive parts he chooses the gut as the microbiota of comparison. The dominant space of microbes on the male body reside within the gut (as the masculine *Nature* cover depicted). The microbial terrain of the male body is constituted as limited and disconnected, which is a microbial relationship based on thinking of microbes (germs) as pathogens. Circumcision functions to reclaim a masculinized body that is not excessive or as vulnerable to microbes for its health, a quick snip to microbiopolitical independence: it makes the *independent organ*.

However, those men who choose to keep their foreskin are ushered into a feminized domain of vulnerability to microbial infestation. Cindy Liu stated, “Men who are uncircumcised have significantly more bacteria on their penis, and the type of bacteria are also very different” (qtd. in Vence 2014). This description is more akin to those of the vaginal microbiota than the penile microbiota described by Price above. She continues by saying, “Some of the anaerobes commonly found on the uncircumcised penis and on occasion inside the male urogenital tract

are the same species associated with bacterial vaginosis (BV) in women” (Vence 2014). Here we have a direct link between the microbial mother and the uncircumcised male by way of BV, but this male, as carrier of BV, is a threat to the microbial mother in his refusal to remove that which feminizes his body, his foreskin, his microbes, his excess. Additionally, it is suggested that male and female reproductive bodies share microbial communities, but this sharing can be altered through circumcision. By removing the foreskin men remove the moist environment that is comparable to the female vagina, and in its place they gain an alternative relationship with microbes – one in which the meaning of germ is primarily semen. The penile microbiota is fragmented from other embodied microbiota (e.g., the gut) through the alteration of this site via circumcision, allowing the focus to be on the independent organ and its germinating semen. Whereas the majority of discourses about the human microbiome are about our dependence on microbes for “good health,” the penis is an organ that carries forward an older relationship with the germ as pathogen, something to be freed from.

### The microbial mother meets the independent organ

In the *Encyclopedia of the Practice of Medicine Based on Bacteriology*,<sup>17</sup> physician J. Buchanan wrote, “Successive epidemics of preventable and unpreventable disease have taught us that if we wish to maintain the highest possible standard of health as a nation. ... if we are to prevent disease and degradation of elementary living matter, there must be *no* overwork, *no* exhaustion, *no* mental strain, and all insanitary states, together with animal and vegetable waste, must be got rid of as speedily and effectively as possible” (1890). In contrast, today science journalist Laura Sanders writes, “Babies are born germy, and that’s a good thing. Our microbiomes – the microbes that live on and in us – are gaining cred as tiny but powerful keepers of our health” (2017). These two discourses on microbes function to illustrate the drastic shift occurring today away from the germ as pathogenic to being “powerful keepers of our health” (saviors). There is a lot of promise as we move away from a rather reductionist popular view of microbes (germs) as dirty, filthy, disease agents. It is becoming apparent that we need to pay closer attention to microbes, and think through how humans and microbes have been companion species (Haraway 2003). In fact, what this research makes clear is that it would be beneficial to cultural studies and the medical humanities to trace out the history of microbes as commensal (or to better understand what makes specific microbes “good” or “bad”). This kind of work could “lead to a better understanding of how human health, disease resistance, development and evolution have depended and continue to depend on interactions with microbes” (O’Malley and Dupré 2007, 158).

Microbiopolitics contributes to understanding the biosociality (or role of the biological in the social) of the human reproductive microbiome, especially in regards to gender relations. The language of microbes as pathogenic or savior (while slightly hyperbolic) function to constitute different microbiopolitical relations and subjectivities among gendered humans and microbes. Through analysis of the vaginal microbiota and the penile microbiota, I have shown that the penis is an organ constituted in primarily pathogenic relations with microbes (or germs) via penile alteration (i.e., circumcision). The focus is on the organ and its need to be independent of pathogens. In contrast, the vaginal microbiota constitutes the figure of the microbial mother – a microbial host for both pathogenic and savior organisms with varied biotechnological interventions for the future of humanity. As Bivins argues, “The existence of difference alone was insufficient to call forth the language of gender; inequality was required”

(2000, 129). In the case of human reproductive microbiomes, the uncertainty tied to discourses of being more microbial than human situates the excessive female body as already compromised and excessive (by way of menstruation, pregnancy, a vagina full of bacteria, and often responsible for domestic hygiene (Tomes 1998)). In other words, it might be easier to imagine a woman in the vulnerable position as more microbial than human, whereas the male bears his germs on the "outside" (in the gut) or simply cuts the germs away. But, the vary classification of human is masculine (e.g., mankind), and the penis becomes the primary organ for entrance into manhood (Kessler 1990). In order to maintain this patriarchal order, the penis is constituted through circumcision as less microbial, less vulnerable, and more independent in contrast to the rest of the human (male or female) body.

## Endnotes

<sup>1</sup> The argument of this essay is informed after coding 478 digital media sources (i.e., online news, niche news, online magazines, personal blogs, affiliated blogs, government/professional agency online articles, and university and academic research online news) for a separate and as-yet unpublished content analysis research project. The archive this research draws from was collected from May through October of 2014 by way of Google alerts for the term microbe. However, this essay takes on a cultural studies orientation, instead of content analysis, for understanding the role of gender in human reproductive microbiomes.

<sup>2</sup> Following the work of Ellen Annandale, biomedicine here refers to a medical model in which the "normal" human is defined as healthy when absent of disease, pain, or defect. This model focuses primarily on biological factors and often does not consider the environmental, psychological, or social influences of disease (1998).

<sup>3</sup> Microbiota is a term that is used to refer to a specific site that is part of the larger microbiome. The human reproductive microbiome refers to the collection of microbiota that are associated with human reproduction.

<sup>4</sup> Each issue cover can be accessed at the following web addresses: <https://www.nature.com/nature/journal/v464/n7285/index.html>; <https://www.nature.com/nature/journal/v486/n7402/index.html>

<sup>5</sup> This feminine image from the June 2012 issue has been highly circulated, appearing in a variety of microbiome related news reports, blogs, and research websites.

<sup>6</sup> The American Gut Project is an open source microbiome data gathering endeavor affiliated with the Biofrontiers Institute at the University of Colorado – Boulder.

<sup>7</sup> Gender is a concept that refers to the biological, cultural, and social construction of differences often assumed to be naturally occurring (and tied to reproductive genitalia). In this essay, I am following the work of Suzanne Kessler (and other feminist science studies scholars) recognizing that biological sex is more like gender in that both are social-material constructs (1990). There is no clear locus for sex in the human body, instead genital morphology, chromosomes, and hormones coalesce into something recognizable as male or female (and in some cases as neither).

<sup>8</sup> The human microbiome is often described as similar to other organs in the human body with a similar weight, approximately one kilogram or more than two pounds ("The Hman Microbiome: Me, Myself, Us" 2012).

<sup>9</sup> Excerpts from Blaser's book have been revised to appear in popular sources such as *Wired*, and you can also find his argument reported through *PBS*, *NPR*, *The New York Times*, *The New Yorker*, and *The Daily Show*.

<sup>10</sup> Asian women are described in the discourse as more akin to white women in terms of their vaginal hygiene due to a higher abundance of *Lactobacilli*.

<sup>11</sup> The low pH is argued to create a toxic environment for many pathogenic microbes, but, when *Lactobacilli* are less prevalent, the pH becomes more neutral and susceptible to infection.

<sup>12</sup> Bacterial vaginosis is an infection characterized by an "imbalance" in the vaginal flora that can cause increased discharge, differing odors, and sometimes itching. It is important to note that there is no single microbe strain at cause in this infection; it is diagnosed via symptoms and a perceived low level of *Lactobacillus*.

<sup>13</sup>Their research showed changes in vaginal microbiota within a period of 24 h (Ravel et al. 2011).

<sup>14</sup>Gregor Reid is a microbiologist and the endowed chair of the Canadian Research and Development Centre for Probiotics at Lawson Health Research Institute (which is affiliated with Western University).

<sup>15</sup>The coronal sulcus is the space at the base of the glans of the penis, which creates a boundary between the glans and the neck of the penis.

<sup>16</sup>The use of the metaphor of the human as a superorganism needs to be further explored from a cultural studies perspective. At first glance, it strikes this author as a rather masculine metaphor.

<sup>17</sup>This encyclopedia was intended for a non-expert audience (as well as physicians) to explain the role of bacteria in disease.

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