Emerging World Diseases: Trachoma

Charlotte Cleveland
Lake Forest College
Lake Forest, Illinois 60045

The CDC (2023) lists 20 different conditions on their list of neglected tropical diseases (NTDs). NTDs are ailments that have been widely ignored and dismissed by global health organizations and agencies. The most apparent reason for the general apathy surrounding NTDs is impoverishment. NTDs disproportionately afflict those living in poverty-stricken areas, where little education, healthcare, and medication are available. Thus, strategies to mitigate these diseases tend to be under researched, underfunded, and inadequate. Interestingly, despite NTDs being considered abandoned by the wider world, most of them are household names. For example, Chagas disease, dengue, leprosy, rabies, African sleeping sickness, leishmaniasis, and schistosomiasis are among the NTDs most people would consider themselves to be familiar with (CDC, 2023). However, a great many NTDs are completely alien to the majority of the Western world. A harrowing example of a largely unknown, yet crippling, NTD is trachoma (CDC, 2023).

Trachoma, or blinding trachoma, is a debilitating infectious disease brought on by the intracellular bacterium *Chlamydia trachomatis*, an infection of which most notably leads to permanent disability (WHO, 2022). Trachoma initially causes scarring of the eyelid. This scarring, if severe enough, will in turn cause the eyelashes to grow incorrectly. The eyelashes will continuously rub against the eyeball, eventually leading to grave corneal scarring and overall visual impairment to varying degrees (WHO, 2022). This progression of trachoma is predictable, and has been given five different grades (WHO, 2022). Grade 1, follicular trachomatous inflammation, is followed by intense trachomatous inflammation (WHO, 2022). Trachomatous scarring is the 3rd grade, where the scarring of the eyelid first begins (WHO, 2022). The natural continuation of the disease without treatment leads into the 4th grade, trachomatous trichiasis, sometimes referred to just as trichiasis (WHO, 2022). At this point, the eyelashes have grown inward, and surgery is necessary. The last grade, corneal opacity, is the permanent blindness or visual impairment of the patient (WHO, 2022). The entire process of infection is wretched, from beginning to end. As of 2020, nearly 1.9 million people were visually impaired due to trachoma (Robinson, 2022).

Chlamydia trachomatis is, without a doubt, a successful pathogen. The primeval bacterium not only is able to take advantage of multiple reservoirs (flies and humans), but also is transmissible either from fly to fly, fly to human, or human to human (WHO, 2022). For comparison, malaria, mankind's greatest foe, can only be proliferated between flies and humans, not between humans (barring rare cases, like blood transfusion). This is part of what makes trachoma so terrifying. Equally of note, trachoma is not the only disease in which Chlamydia trachomatis has been implicated. This same same bacterium, as suggested by the name of the genus it belongs to, is responsible for chlamydia, the world's most common STI (Malhotra, 2013). As previously mentioned, the bacterium is spread through either the bite of an infected Musca sorbens fly, or, through direct, personal contact with various bodily secretions (namely of the eyes and nose) of already infected individuals (Robinson, 2020). The disease, first reported in an ancient Egyptian medical scroll (Yaghoobi, 2018), persists today across many continents, including South America and Africa (WHO, 2022). In fact, an estimated 85% of all trachoma cases occur in Africa, specifically in rural areas affected by poverty (Mayo Clinic, 2020).

As of 2020, experts place the number of individuals considered at risk for trachoma worldwide at around 125 million (Trachoma Atlas, 2020). Considered a neglected tropical disease, people living in crowded conditions and/or without access to proper sanitation are most at risk of developing the condition (Mabey, 2003). Furthermore, young children of these communities are most susceptible to the disease (Mayo Clinic, 2020). The yearly financial burden of trachoma infection worldwide is estimated to be roughly 3-5 billion US dollars (WHO, 2022). The WHO previously aimed to eradicate trachoma by the year 2020, but these efforts were unsuccessful (Renneker, 2022). Overall, trachoma has been able to persist in Africa due to a variety of complex factors. Cultural beliefs and misinformation (Mtuy, 2019;Feyisa, 2022), inadequate sanitation (Garn, 2018;Prüss-Ustün, 2019), and insufficient healthcare infrastructure (Seidlein, 2017;Mtuy, 2020) are among the primary contributors.

Disease, both infectious or otherwise, often proliferates in the absence of proper education. For example, a study done in Ethiopia suggests that the basic lack of awareness surrounding trachoma is a pressing issue. To begin, Feyisa (2022) reported that of those surveyed, 88.60 percent of participants were aware that treatment for trachoma did exist, meaning over 10 percent of the sample were entirely unaware of there being any treatment at all. The ramifications of this finding are disturbing. Similarly, only 75 percent of participants were aware of any existing prevention methods, indicating that 25 percent of individuals surveyed had no knowledge of how trachoma may be prevented (Feyisa, 2022). These gaps in knowledge are further compounded by local beliefs surrounding AMT (Azithromycin mass treatment). AMT campaigns have sought the worldwide elimination of trachoma yet have been viciously hampered by regional beliefs and misunderstandings. When surveying those who declined to participate in the AMT campaign, 23 percent attributed their refusal to take part to the unpleasant side effects they had during a previous campaign (Feyisa, 2022). While this is understandable, what is particularly worrying is that another 7.10 percent declined not because of side effects they themselves had experienced, but rather the fear of side effects that had been instilled in them through rumor and word of mouth (Feyisa, 2022).

Among the Maasai in Tanzania, traditional remedies for trachoma remain. As studied by Mtuy (2019), medicinal plants are frequently used to treat the *Chlamydia trachomatis i*nfection, to questionable degrees of success. Commonly, trachoma in these communities is treated either by grinding the leaves of the plants into a paste to dilute for use in eye drops, or, by directly applying the leaf-derived liquid to the eye (Mtuy, 2019). In addition, a popular practice in the local treatment of trachoma by the Maasai is using the coarse underside of a specific medicinal plant's leaf (*Grewia bicolor*) to scar the eyelid, creating open, bleeding wounds. This practice may also be done with a razor blade (Mtuy, 2019). Dubious treatments outside of those regarding medicinal plants also exist, ranging anywhere from applying a water-tobacco mixture to the eye, to drinking blood and animal fat as a curative measure (Mtuy, 2019). Little research has been done on these practices, and so it is unclear how exactly these measures may affect the trachoma infection itself, as well as the morbidity and mortality rates. However, despite the prevalence of these dubious practices, the Maasai people do not inherently distrust or dismiss Western medicine (Mtuy, 2019). In fact, many Maasai believe Western medicine to be just as, if not more, effective in eliminating trachoma. This reality may leave one puzzled as to why these cultural remedies have been able to persist for so long. In essence, the likely reason for the staying power of these remedies is simply the lack of access to readily available Western medicine. In the communities studied, researchers reported that in some areas, Maasai individuals would have to walk nearly 10 miles to receive care from Western health facilities (Mtuy, 2019). Not only that, but many Maasai reported being mistreated by medical staff, citing the language barrier as a source of frustration (Mtuy, 2019). With all this information being presented, it's of little surprise that these local treatments are so prevalent in rural communities. The unfortunate truth is that these people have no other choice but to risk their health in the pursuit of trying to stave off an infection that is treatable.

In regard to trachoma, there exists a wealth of social factors that contribute to the perpetuation of the disease. The issue of proper sanitation and water access is often at the forefront of trachoma-centered discussions. A 2018 study spearheaded by Garn et al. demonstrated that trachoma infections were shown to be significantly rarer among households that possessed latrines, as opposed to those who did not. This implies that contamination from fecal bacteria and a lack of waste-related hygiene heightened the spread of trachoma, presumably due to the increased attraction of *Musca sorbens* flies. Indeed, although these flies are attracted to (human) feces, they will not breed in latrines (Emerson, 1999). Likewise, in communities that had access to household water, far fewer trachoma cases were noted than in areas without household water. This in turn suggests that both proper waste sanitation measures and readily

available water sources decrease the prevalence of trachoma. Though, interestingly, it has been demonstrated that water access is a far more important determinant in trachoma case rates than sanitation (Garn, 2018).

However, sanitation access still remains a major factor in the spread of trachoma. Prüss-Ustün (2019), surveying Sub Saharan African households, found that only around 30 percent had access to basic sanitation measures, and a scant 8.4 percent washed with soap after coming into contact with fecal material. Statistics such as this hint at the reasoning behind the popularized "WASH" strategy – water, sanitation, and hygiene (Aragie, 2022). *Musca sorbens*, sometimes called "eye-seeking" flies, feed on discharge from the eyes and noses of humans, so washing one's face is paramount in dissuading flies (Robinson, 2020).

In pastoralist cultures, like the Maasai of Kenya and Tanzania, seasonal migrations are necessary. This migration is facilitated by a need for new resources, commonly brought about by drought or inadequate grazing land. The Maasai must migrate during the year to guarantee the survival of their livestock, and thus, themselves. Mtuy (2020) aimed to study why MDA (mass drug administration) efforts had been thus far unsuccessful in the Maasai population of Northern Tanzania, a community that is hyperendemic to trachoma infection. It was found that elimination campaigns were woefully unequipped to deal with the epidemic in culturally specific ways. For example, community drug distributors were often incompetent when dealing with migratory populations, electing to simply ignore them (Mtuy, 2020). One individual interviewed explained that he did not take the medication (Zithromax) simply because he was never given any (Mtuy, 2020). Additionally, community drug distributors were found to provide little information regarding medication and treatment, exacerbating the common misconception that individuals need not take the medication as long as they are feeling well (Mtuy, 2020).

Another big player in the incidence of trachoma is economics. Seidlein (2017) conducted a study wherein different types of housing were tested regarding how well each environment possibly fostered the spread of malaria. Prototype houses were built in the rural neighborhoods of Tanzania, single or double storied, each with either a bamboo, shade net, or timber facade. The most inexpensive option, the single storied house with a bamboo facade, happened to be the least effective in reducing the indoor mosquito population (Seidlein 2017). Conversely, the more expensive options of timber and shade netting saw a greater decrease in the number of mosquitoes present in the house (Seidlein 2017). Of course, this study did not examine trachoma specifically, but it should not be discounted. Essentially, both trachoma and malaria are vector-borne diseases. What's more, both malaria and trachoma are spread by tropical dipteran vectors. Each respective vector (*Anopheles gambiae* in this particular study, and *Musca sorbens*) spread antigenic pathogens to humans. These pathogens, Plasmodium falciparum and *Chlamydia trachomatis*, invade the human body via the bite of an already infected fly. Both vectors, being from the same order of insects, share similar morphologies, habitats, and life cycles. So, it stands to reason that one could extrapolate these malaria findings and apply them to trachoma prevention efforts. It stands to reason that these same shade net facades that are shown to be successful in decreasing indoor mosquito populations are likely to have the same effect on *Musca sorbens* populations.

Overall, it is important to acknowledge that we have seen some success in efforts to reduce trachoma numbers throughout the world. A major accomplishment has been the decrease in trachoma numbers by over 90 percent since 2002 (WHO, 2022). However, we are nowhere as close to eradicating the disease as was initially predicted. The WASH and SAFE strategies have catalyzed a great amount of disease prevention and treatment, but more must be done if morbidity and mortality rates are to be stifled. Currently, the WHO continues to use its "SAFE" strategy– Surgery, Antibiotics, Facial Cleanliness, and Environmental Improvement– to help reduce the frequency of trachoma infection across Africa (WHO, 2022). But the WHO needs to adopt a wider-reaching strategy, which includes pastoralist and migratory groups of people like the Maasai. Further, the single greatest weapon we have against trachoma, besides the treatment itself, seems to be education. The WHO needs to put forth concerted efforts not only towards increasing education and awareness among afflicted populations, but also educating drug administrators and local health officials on what they can do to stop the spread. Moreover, facilitating cultural awareness and sensitivity among health organizations is a must. These officials must be knowledgeable in local cultures, languages, seasonal patterns, and fears towards trachoma treatment. Fear of side effects and other existing stigmas need to be dispelled through open dialogues between healthcare workers and patients. Likewise, greater efforts need to be focused on providing for the basic hygiene needs of poverty-stricken communities. The WHO needs to organize access to household latrines, water, and shade nets for those living in rural areas of trachoma endemic countries. Billboards, signage, and posters should be put up in the local languages urging the residents to use soap after coming into contact with feces and advising the benefits of regularly washing one's face.

References

Aragie, S., Lietman, T. M., & Keenan, J. D. (2022). Trachoma control using water, sanitation, and hygiene - Authors' reply. The Lancet. Global health, 10(4), e480.

Birkett, M. A., Caulfield, J. C., Sarah, V., Pickett, J. A., Dewhirst, S., Chen-Hussey, V., Woodcock, C. M., D'Alessandro, U., Last, A., Burton, M. J., Lindsay, S. W., & Logan, J. G. (2020). Responses of the putative trachoma vector, Musca sorbens, to volatile semiochemicals from human faeces. *PLoS neglected tropical diseases*, 14(3), e0007719.

CDC. (2019, November 15). CDC - Neglected Tropical Diseases - Diseases.

Diagnosis. (n.d.). Www.who.int.

Emerson, P. M., & Bailey, R. L. (1999). Trachoma and fly control. *Community eye health*, 12(32), 57.

Feyisa, T., Bekele, D., Tura, B., Adem, A., & Nugusu, F. (2022). To eliminate trachoma: Azithromycin mass drug administration coverage and associated factors among adults in Goro district, Southeast Ethiopia. *PLoS neglected tropical diseases*, 16(6), e0010169.

Garn, J. V., Boisson, S., Willis, R., Bakhtiari, A., Al-Khatib, T., Amer, K., Batcho, W., Courtright, P., Dejene, M., Goepogui, A., Kalua, K., Kebede, B., Macleod, C. K., Madeleine, K. I. M., Mbofana, M. S. A., Mpyet, C., Ndjemba, J., Olobio, N., Pavluck, A. L., Sokana, O., … Freeman, M. C. (2018). Sanitation and water supply coverage thresholds associated with active trachoma: Modeling cross-sectional data from 13 countries. *PLoS neglected tropical diseases,* 12(1), e0006110.

Home | Trachoma Atlas. (n.d.). Www.trachomaatlas.org.

Mabey, D. C., Solomon, A. W., & Foster, A. (2003). Trachoma. Lancet (London, England), 362(9379), 223–229.

Malhotra, M., Sood, S., Mukherjee, A., Muralidhar, S., & Bala, M. (2013). Genital Chlamydia trachomatis: an update. *The Indian journal of medical research*, 138(3), 303–316.

Mayo Clinic. (2018). Trachoma - Symptoms and causes. Mayo Clinic.

Robinson, A., Bristow, J., Holl, M. V., Makalo, P., Alemayehu, W., Bailey, R. L., Macleod, D., Mtuy, T. B., Bardosh, K., Ngondi, J., Mwingira, U., Seeley, J., Burton, M., & Lees, S. (2021). Understanding hard-to-reach communities: local perspectives and experiences of trachoma control among the pastoralist Maasai in northern Tanzania. *Journal of biosocial science,* 53(6), 819–838.

Mtuy, Tara B., et al. "Knowledge, Perceptions and Experiences of Trachoma Among Maasai in Tanzania: Implications for Prevention and Control." *PLoS Neglected Tropical Diseases*, vol. 13, no. 6, 2019, pp. e0007508–e0007508.

Prüss-Ustün, A., Wolf, J., Bartram, J., Clasen, T., Cumming, O., Freeman, M. C., Gordon, B., Hunter, P. R., Medlicott, K., & Johnston, R. (2019). Burden of disease from inadequate water, sanitation and hygiene for selected adverse health outcomes: An updated analysis with a focus on low- and middle-income countries. *International journal of hygiene and environmental health*, 222(5), 765–777.

Renneker, K. K., Abdala, M., Addy, J., Al-Khatib, T., Amer, K., Badiane, M. D., Batcho, W., Bella, L., Bougouma, C., Bucumi, V., Chisenga, T., Dat, T. M., Dézoumbé, D., Elshafie, B., Garae, M., Goepogui, A., Hammou, J., Kabona, G., Kadri, B., ... Ngondi, J. M. (2022). Global progress toward the elimination of active trachoma: An analysis of 38 countries. *The Lancet Global Health,* 10(4), e491-e500.

Robinson, A., Bristow, J., Holl, M. V., Makalo, P., Alemayehu, W., Bailey, R. L., Macleod, D., Birkett, M. A., Caulfield, J. C., Sarah, V., Pickett, J. A.,

Dewhirst, S., Chen-Hussey, V., Woodcock, C. M., D'Alessandro, U., Last, A., Burton, M. J., Lindsay, S. W., & Logan, J. G. (2020). Responses of the putative trachoma vector, Musca sorbens, to volatile semiochemicals from human faeces. *PLoS neglected tropical diseases*, 14(3), e0007719.
Thompson, K., Hutchins, H., Baio, A., Cassama, E., Nabicassa, M., Bailey, R., & Last, A. R. (2015). Health Beliefs and Perceptions of Trachoma in Communities on the Bijagos Archipelago of Guinea Bissau. *Ophthalmic epidemiology*, 22(3), 190–199.
Trachoma. (n.d.). Www.who.int.
von Seidlein, L., Ikonomidis, K., Mshamu, S., Nkya, T. E., Mukaka, M., Pell, C., Lindsay, S. W., Deen, J. L., Kisinza, W. N., & Knudsen, J. B. (2017). Affordable house designs to improve health in rural Africa: a field study from northeastern Tanzania. The Lancet. *Planetary health,* 1(5), e188–e199.
Yaghoobi, G., & Anani Sarab, G. (2018). The History of Trachoma and Current Prevalence (Spotlight on Iran): A Review Article. *Iranian journal of public health*, 47(10), 1458–1465.