Keeping People Alive

It wasn't very long ago that being diagnosed with HIV (human immunodeficiency virus) was a virtual death sentence. Math—specifically, calculus and probability—helped change that once-bleak prognosis. Two teams of researchers working independently combined experiments with calculus to model the virus's growth and show that in the phase when the virus appears dormant, billions of virus particles are being produced daily. So instead of dormancy, the body's immune system and the virus are actually in a hard-fought stalemate. That phase was the time to target the virus to give the immune system some much-needed help. The researchers then used probability to determine that a combination of three drugs was extremely likely to control the virus despite its rapid mutation. They were right on all counts: the combination administered early is not a cure and is not cheap, but it does suppress the virus and halt its spread.

Math is also helping in the worldwide battle against malaria, a disease that kills over 400,000 people annually. The scope of mathematical models ranges from the cellular level, where math is used to understand how characteristics of red blood cells change after being infected by malaria-causing parasites, to the regional level, where math describes both the spread of infection and the relative effectiveness of vaccines and mosquito nets against malaria. Since infected humans can transmit the parasites to mosquitoes, who can then infect humans, modeling the spread involves representing two-way interactions between networks of mosquitoes and humans, each comprised of individuals who move randomly. These models also apply to other mosquito-borne illnesses, such as dengue fever or the Zika virus.

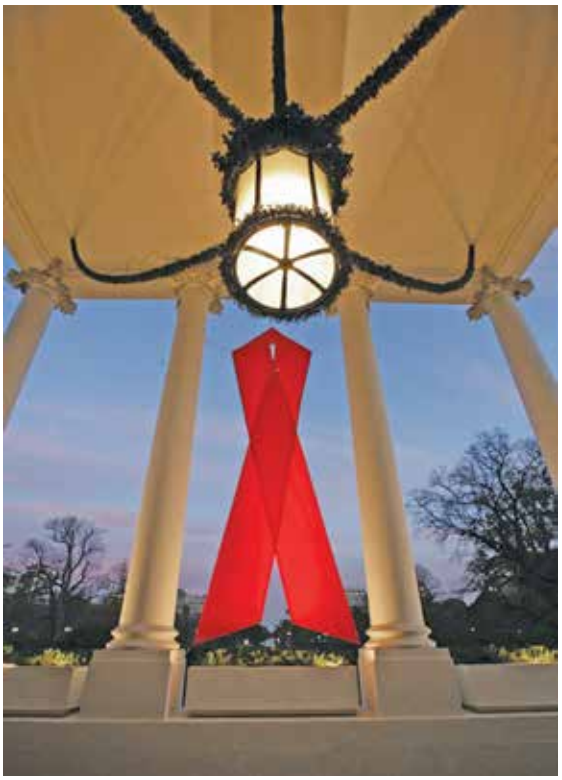

Photo of HIV/AIDS awareness ribbon by Eric Draper.

For More Information: *Infinite Powers: How Calculus Reveals the Secrets of the Universe*, Steven Strogatz, 2019.

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MM/144

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