Exploring Model Assumptions of Rubella Vaccine Introduction in the Democratic Republic of Congo
Fan Liu, Helen Gu, Xiaoying Shi, Kurt Frey
Contact: fliu6@stanford.edu

Background
- No rubella vaccine in immunization schedule in the Democratic Republic of Congo (DRC)
- Vaccination depends on age:
  - Youth → mild infection
  - Pregnant Women → infection leads to Congenital Rubella Syndrome (CRS) with severe birth defects
- Low vaccine coverage may increase age of infection, escalating rubella incidence among pregnant women → increase in CRS cases
- WHO recommends 80% measles vaccination coverage before introducing rubella vaccine

Prior Research
- Cheng et al. 2021 investigates whether introducing rubella vaccine into the DRC is likely to increase the disease burden of congenital rubella syndrome

Problem Statement
- Explore assumptions and understand how they impact model predictions
  - Changing demographics (according to UN estimates of an aging population), changes in rubella infectivity (basic reproductive number R₀), changes in routine immunization rates (RI), varying exogenous case importation rate

Results
1. Varying Population Pyramid: Dynamic Median
   - Overtime, CRS burden decreased at 60% routine immunization due to fewer susceptible people

2. Varying R₀
   - R₀ = 4
   - R₀ = 8
   - At higher R₀, the CRS burden has a rebound
   - CRS burden at 60% routine immunization is worse than at 0% routine immunization

3. Varying the Importation Rate (RI)
   - Prolonged negative shocks → sharp increase in CRS
   - 10x importation rate → more outbreaks, less variance

Conclusions
- Dynamic population pyramid: aging population results in lower CRS burden in the long run at 60% RI
- R₀ is important; as R₀ increases, the benefits of incomplete vaccination are less compelling
- Negative RI shocks can lead to sharp increase in CRS burden
- RI doesn’t seem to impact the overall trajectory of CRS burden but results in less volatility/uncertainty in estimates

Acknowledgements
Thank you to Kurt Frey at the Bill & Melinda Gates Foundation for his mentorship and to the CME 217 team for their assistance.