# COVID-19 in East Africa: National Projections of Exposed, Contagious, Symptomatic & Severe Cases

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# Overview: COVID-19 in Africa

- African nations have thus far reported lower disease incidence with 58,663 confirmed COVID-19 cases and 1,710 deaths across the continent as of 17 May 2020 (WHO Situation Report #118)
- Infectious disease surveillance and reporting infrastructure remains highly underdeveloped in many African countries, and COVID-19 testing is limited given the shortage of human resources and appropriate laboratory and surveillance facilities across the continent.
- African populations may be at particular risk for high morbidity and mortality from COVID-19 given the high prevalence of immunocompromised individuals including those with HIV, malnutrition, and other communicable and non-communicable comorbidities.
- To contain the spread of COVID-19 and keep infections at a manageable level, many countries have instituted curfews, lockdowns, and other social distancing interventions. However, effective implementation of such measures may be difficult to sustain given sociocultural, economic, and political factors.

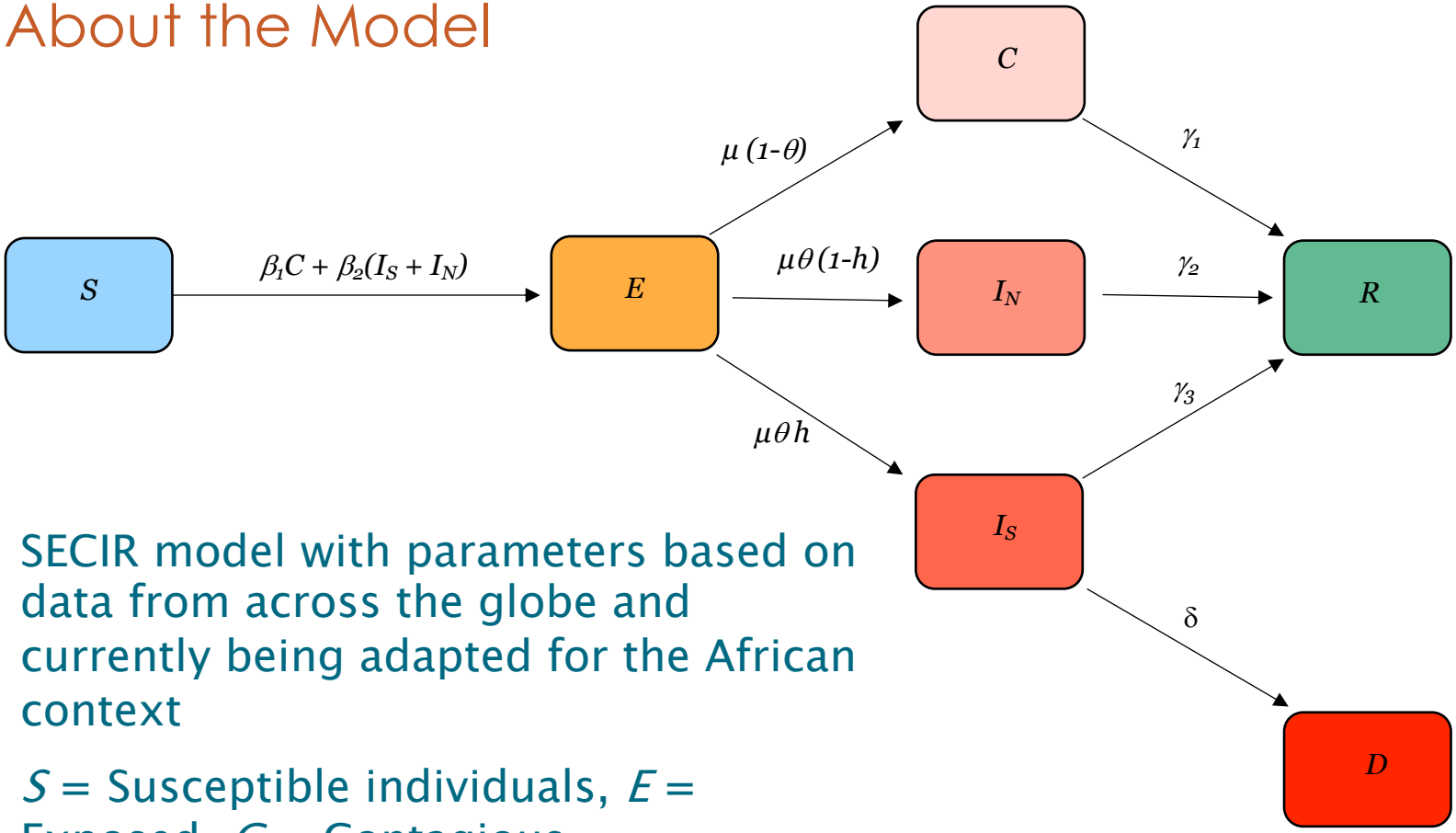
# Modeling Objectives

- The purpose of this model analysis is to estimate potential COVID-19 case burdens in each country and region of Africa considering various social distancing interventions.
- Given current trends in case burden, the model estimates the potential resource needs, particularly hospital beds, that would be needed under different scenarios.
- The model is for planning purposes and is based on current understanding and the most up-to-date assumptions.
- The results here are not forecasts but scenarios that may unfold given the assumptions about social-distancing and population health.

# Disclaimers

- As with all responsive research, this work has not been peer-reviewed.
- At this time, given insufficient testing data, we have not been able to assess the impact of the lockdown (starting in April 2020 in most countries) on transmission. We will be able to offer better guidance on the projected number of cases in coming days/weeks.
- Current estimates are made using case data current as of 13 May 2020 and publicly available here. Our findings will be continuously updated to reflect best available data and insights on the SARS-CoV-2 virus and COVID-19 pandemic
- This research was funded by the Centers for Disease Control and Prevention's Modeling in Infectious Disease (MInD) Network and was produced by a team of researchers at CDDEP and John Hopkins University; this work does not represent the views of these institutions.
- For comments or clarifications, please email Jessica Craig at craig@cddep.org

# About the Model




- SECIR model with parameters based on data from across the globe and currently being adapted for the African context
- $S$ = Susceptible individuals, $E$ = Exposed, $C$ = Contagious, Asymptomatic, $I_N$ = Infected mild symptoms, $I_S$ = Infected with severe symptoms, $R$ = Recovered, $D$ = Dead

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# About the Model: Assumptions & Limitations

- The majority of case projections begin on the day each country reached 20 or more confirmed cases.
- Some countries have not yet reached this threshold, and for these cases the highest number and the date that first occurred (in some cases a few weeks ago) is used:
  - Burundi 15 cases 5/2/20
  - Gambia 22 cases 5/11/20
  - Mauritania 9 cases 5/12/20
  - Namibia 16 cases 4/5/20
  - Seychelles 11 cases 4/6/20
- We assume that confirmed cases represent symptomatic cases in our model. Confirmed cases may increase faster than predicted in the near future as testing capacity increases and contact tracing continues.
- Lockdown start dates were sourced from multiple news sites and lockdown end dates are being continuously updated to reflected rapidly changing policies, however, it is possible that some of these are already out of date. Where countries did not have dates for the lifting of lockdown we have assumed it will last 60 days.
- It is assumed that lockdown reduces disease transmission by 25 percent in a moderate lockdown or 44 percent in a hard lockdown.
- Age effects are not yet included in the model. In every country reporting data on ages of patients, COVID-19 has been more severe in the elderly population. While the average age in most African countries is generally lower than other countries, co-morbidities such as HIV/AIDS status, malnutrition, and TB may increase vulnerability in younger age groups.
- There is to-date only limited evidence that climate or viral mutations may impact transmission, and as such the current scenario planning assumes they will have no appreciable effect on transmission.

# About the Model: Scenarios

**Baseline** Disease continues to spread with no curfew, lockdown, social distancing, or other intervention(s) and with no change in transmission rate. ($R_0$= 2.74)

**Intervention Scenarios**:

1. ***Moderate Lockdown*** Reduce transmission by 25% during lockdown period, then transmission resumes at 90% of pre-lockdown value due to sustained changes in behavior.
2. ***Hard Lockdown*** Reduce transmission by 44% during lockdown period, then transmission resumes 90% of pre-lockdown levels.
3. ***Hard Lockdown and Continued Social Distancing/Isolating Cases*** Transmission is reduced by 44% during the lockdown period then, through social distancing regulations and isolation of symptomatic individuals, resumes at 75% of pre-lockdown levels.

# About the Model: Parameters

- Incubation period of 3 days
- 85 percent of infected population have no/mild symptoms
- Rate of progression to severe disease is 6 percent
- Asymptomatic clearance period of 3 days
- Symptomatic clearance period of 5 days
- $R_0$ (Basic reproductive number) of baseline scenario is approximately 2.74, in line with estimates from other country contexts[4]
- Parameters values are continually re-estimated as data on viral transmission become available


References

1. Explaining the Bomb-Like Dynamics of COVID-19 with Modeling and the Implications for Policy. Gary Lin, Alexandra T Strauss, Maxwell Pinz, Diego A Martinez, Katie K Tseng, Emily Schueller, Oliver Gatalo, Yupeng Yang, Simon A Levin, Eili Y Klein, For the CDC MInD-Healthcare Program. medRxiv 2020.04.05.20054338; doi: https://doi.org/10.1101/2020.04.05.20054338
2. Liu S, Luo H, Wang Y, Wang D, Ju S, Yang Y. Characteristics and Associations with Severity in COVID-19 Patients: A Multicentre Cohort Study from Jiangsu Province, China. SSRN 2020; Available at: https://papers.ssrn.com/abstract=3548753.
3. Bi Q, Wu Y, Mei S, et al. Epidemiology and Transmission of COVID-19 in Shenzhen China: Analysis of 391 cases and 1,286 of their close contacts. Infectious Diseases (except HIV/AIDS), 2020. Available at: http://medrxiv.org/lookup/doi/10.1101/2020.03.03.20028423.
4. Wu JT, Leung K, Leung GM. Nowcasting and forecasting the potential domestic and international spread of the 2019-nCoV outbreak originating in Wuhan, China: a modelling study. The Lancet 2020; 395:689-697.

# Regional Definitions

- We present national case projections by region. Intermediate regional classification of nations, outlined below, followed those set forth by the United Nations Statistics Division. Inclusion/exclusion of a country or region and regional classification is meant for organizational purposes only and do not represent official endorsement or geopolitical position in any way.
- **North Africa:** Algeria, Egypt, Libya, Morocco, Sudan, Tunisia
- **Middle Africa:** Angola, Cameroon, Central African Republic, Chad, Congo-Kinshasa (Democratic Republic of the Congo), Congo-Brazzaville (Republic of the Congo), Equatorial Guinea, Gabon, Sao Tome and Principe
- **West Africa:** Benin, Burkina Faso, Cabo Verde, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Togo
- **East Africa:** Burundi, Djibouti, Ethiopia, Eritrea, Kenya, Madagascar, Malawi, Mauritius, Mozambique, Rwanda, Seychelles, Somalia, South Sudan, Tanzania, Uganda, Zambia, Zimbabwe
- **Southern Africa:** Botswana, Eswatini, Namibia, South Africa
- Comoros, Mayote, Reunion, Lesotho, and St Helena are currently omitted due to lack of case data

# Definitions

- Isolation – Individuals who are COVID-19 positive or who demonstrate symptoms similar to those of COVID-19 and stay at home and have no contact with other people for at least 2 weeks.
- Asymptomatic – Individuals who have COVID-19 but display no or mild symptoms.
- Symptomatic – Individuals who have COVID-19 and display moderate or severe symptoms.

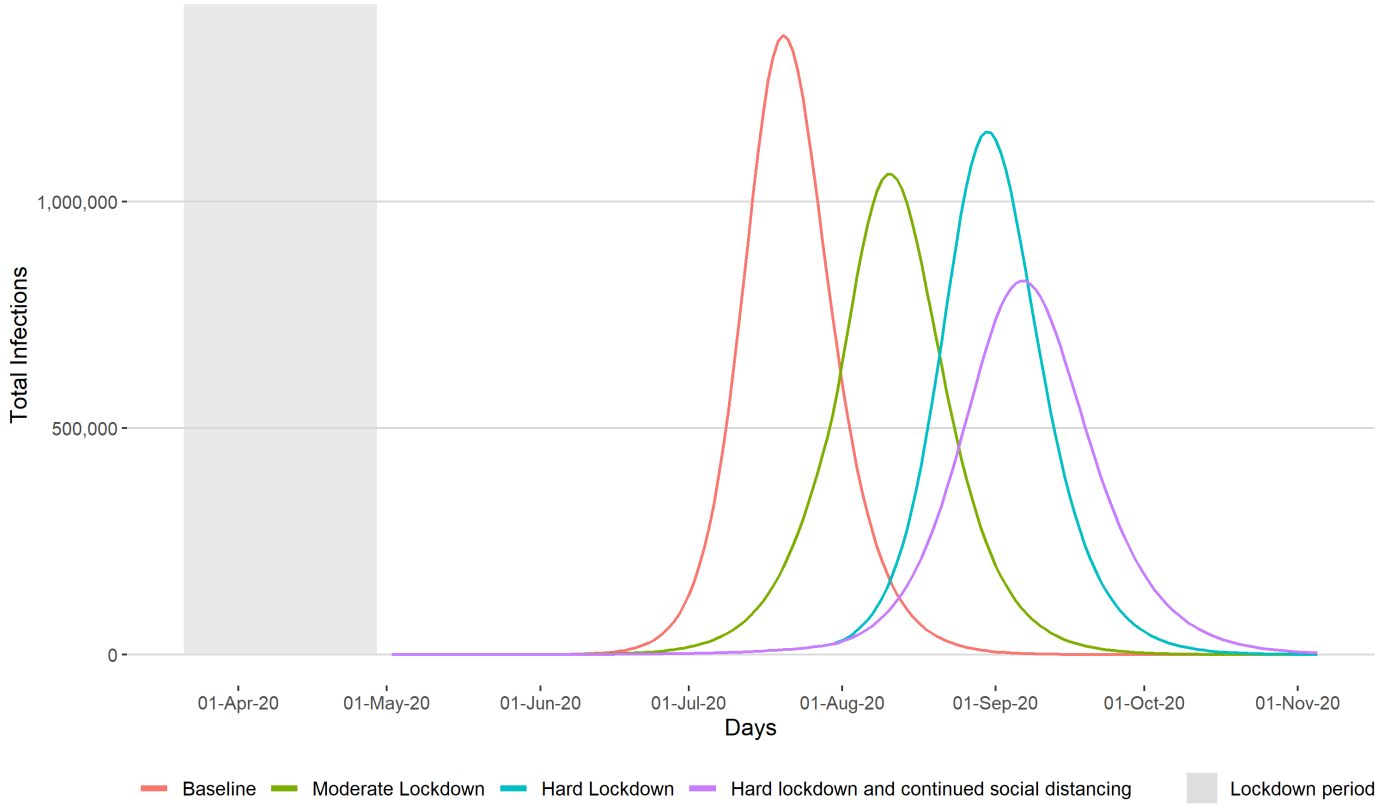
# Short-term Impact of Current Lockdowns

**Caveat**: The implementation and intensity of lockdowns is likely to differ greatly between countries. Here, all are modeled equally, starting the same day and continuing for the same duration. *We aim to make this more realistic in coming days.*

- National 60-day lockdown in countries should be effective in:
  - Buying time to prepare health facilities for surge cases and prepare for social distancing, including educating people, and setting up hand washing stations, etc.
  - Reducing new cases in following weeks if social distancing is strictly enforced and good contact tracing continues during the course of the lockdown.
- What will happen when the lockdown is lifted?
- Different options:
  - Can maintain some general social distance practices among the general population to reduce overall transmission in the longer term.
  - Can have multiple lockdowns with breaks between to control the number of infections and hospitalizations at one time.
  - Can mandatorily isolate individuals with symptoms of respiratory illness until they recover so they do not transmit the virus.
  - Here we model a general reduction in transmission due to social distancing and isolation of symptomatic individuals.

# Projections: East Africa

# **Burundi:** Projected Total Infections (Asymptomatic, Symptomatic, and Severe) With and Without Lockdown

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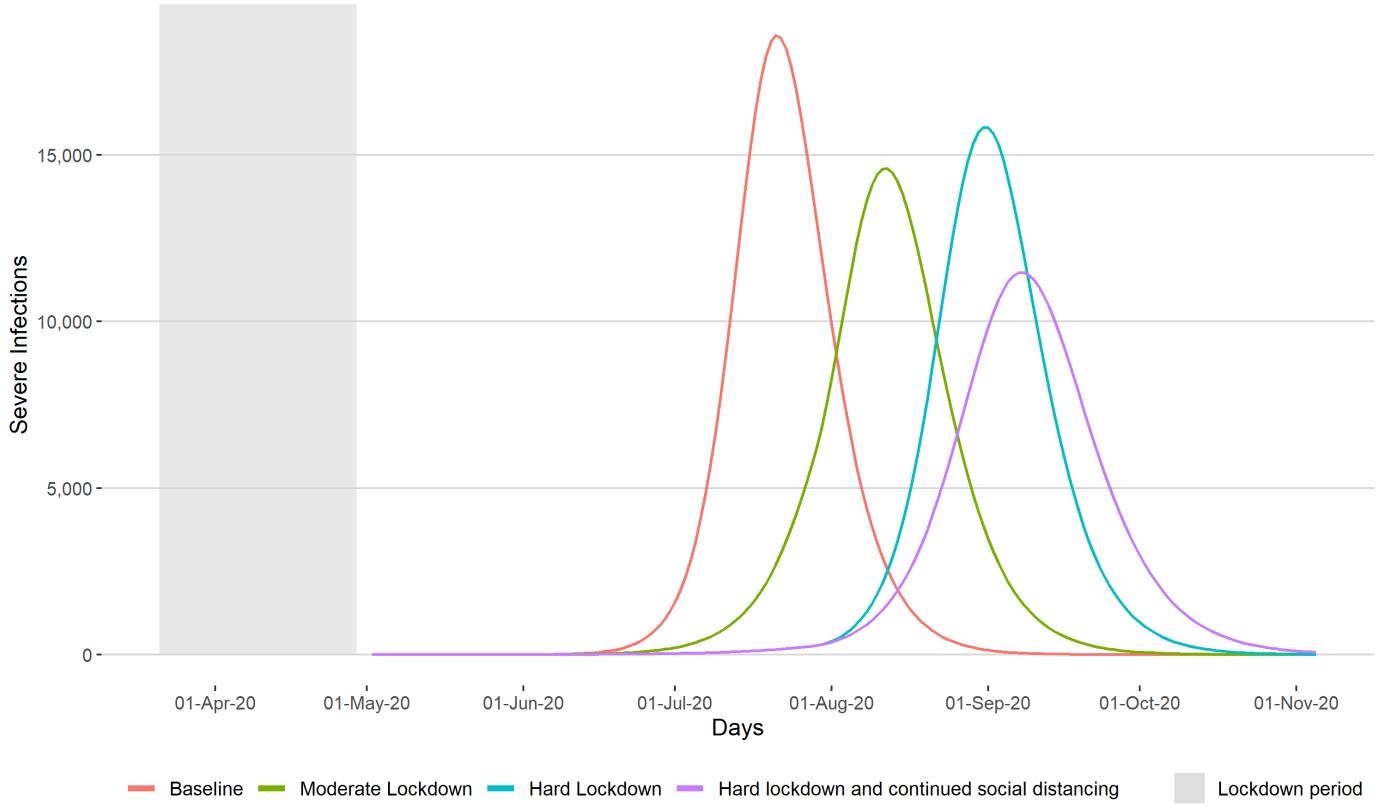
# **Burundi**: Projected Severe Infections With and Without Lockdown

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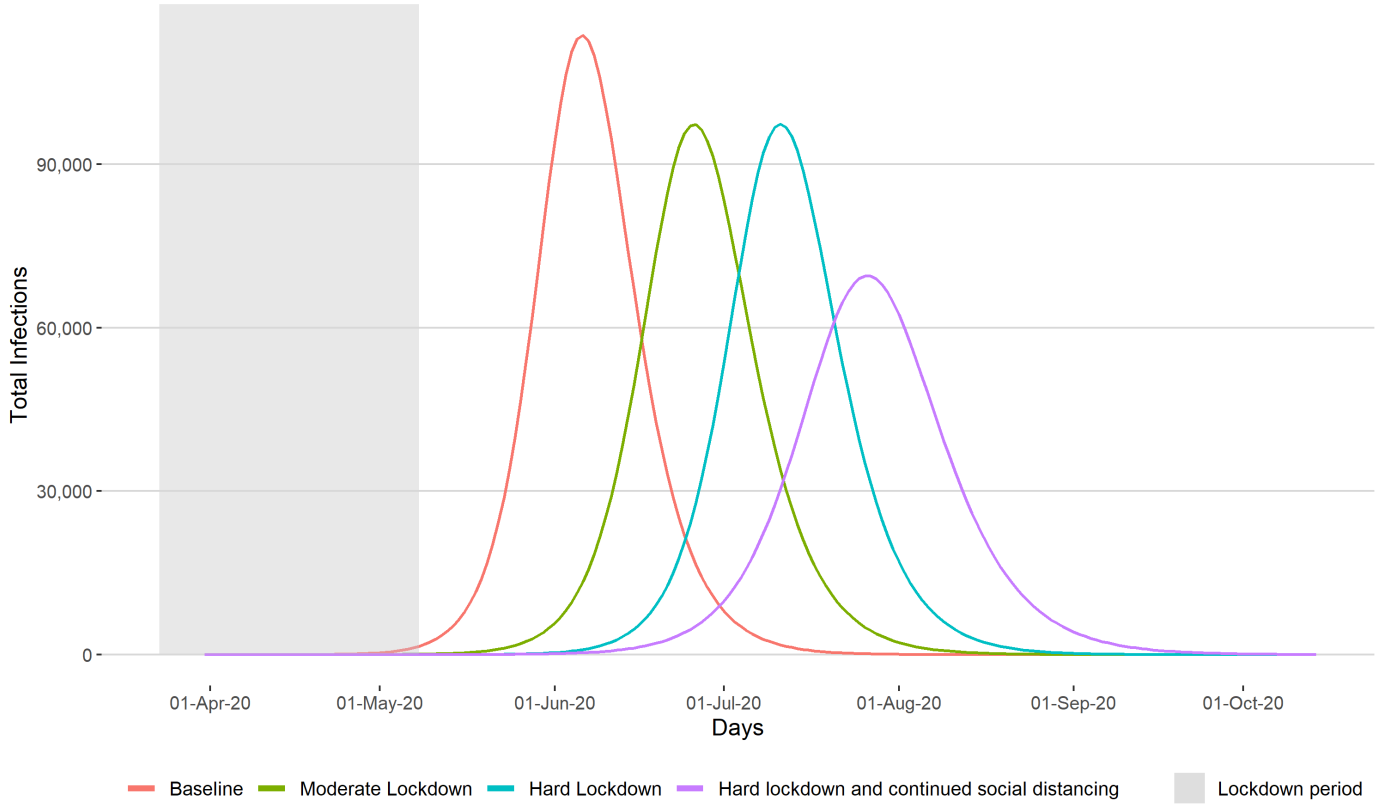
# **Djibouti:** Projected Total Infections (Asymptomatic, Symptomatic, and Severe) With and Without Lockdown

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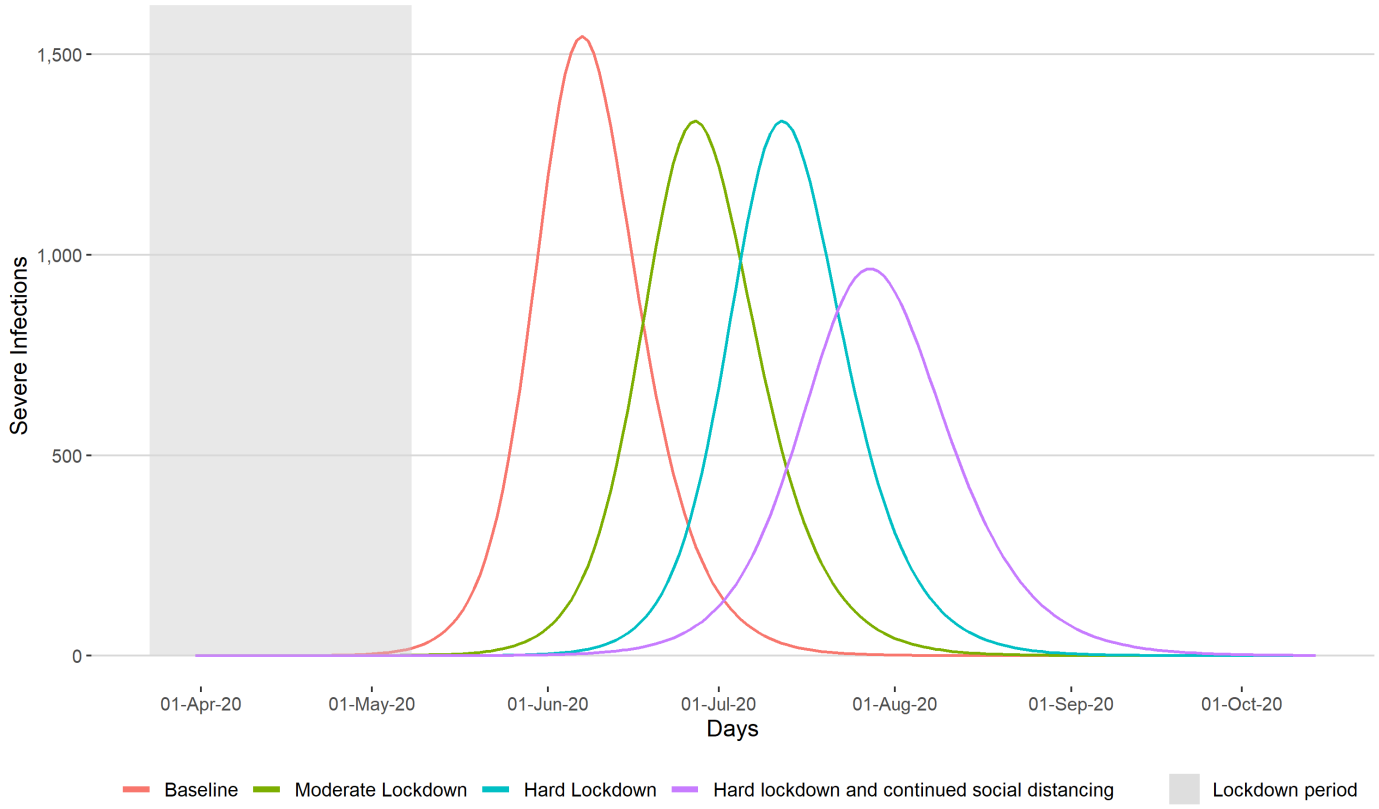


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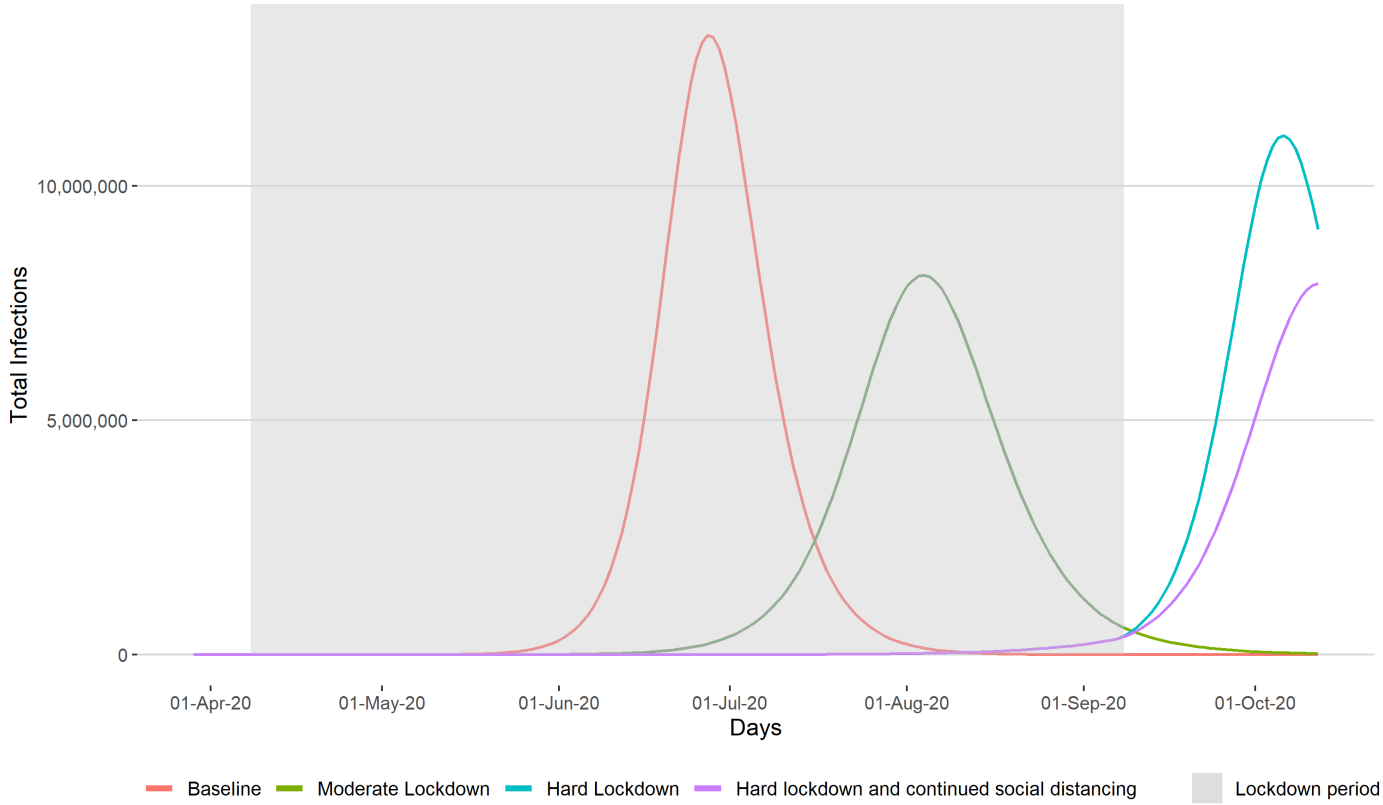
# **Ethiopia:** Projected Total Infections (Asymptomatic, Symptomatic, and Severe) With and Without Lockdown

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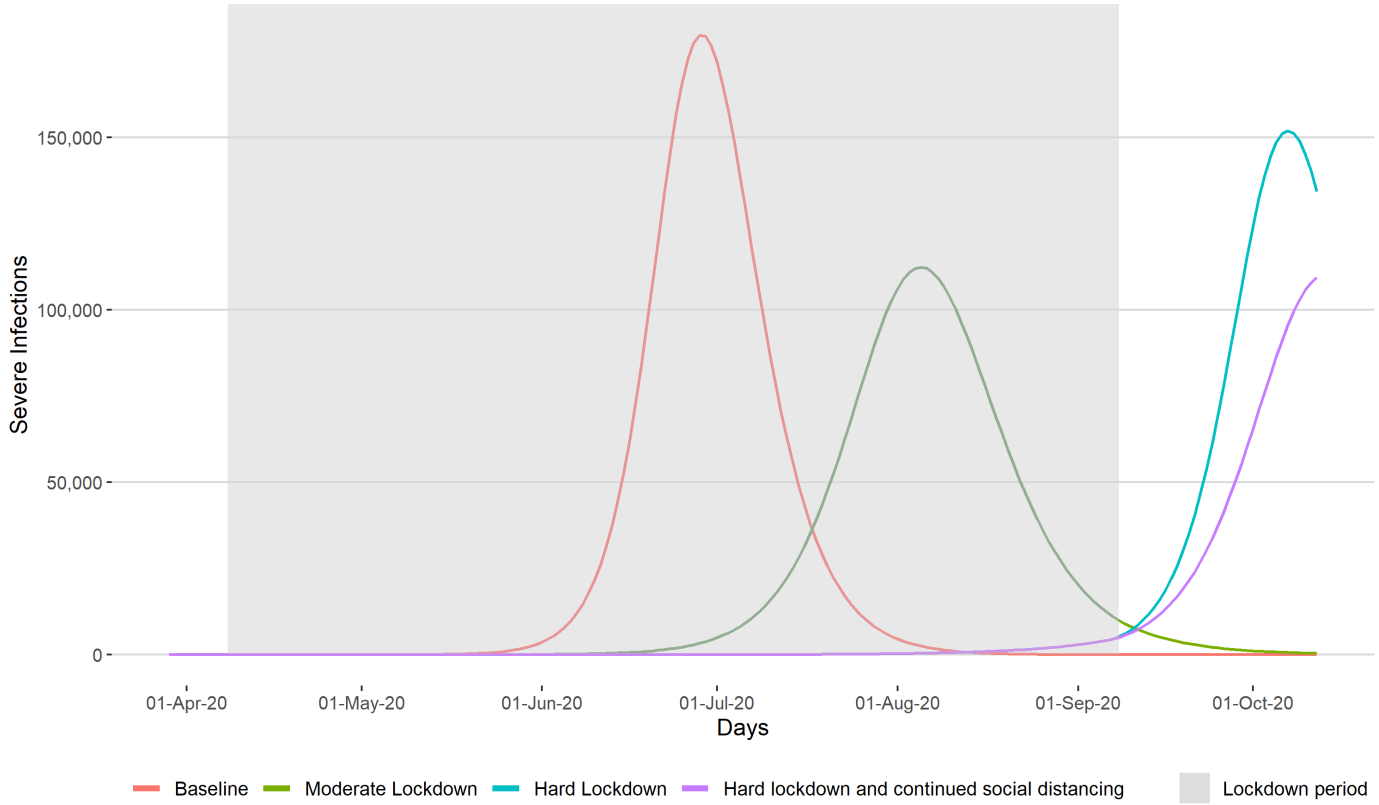


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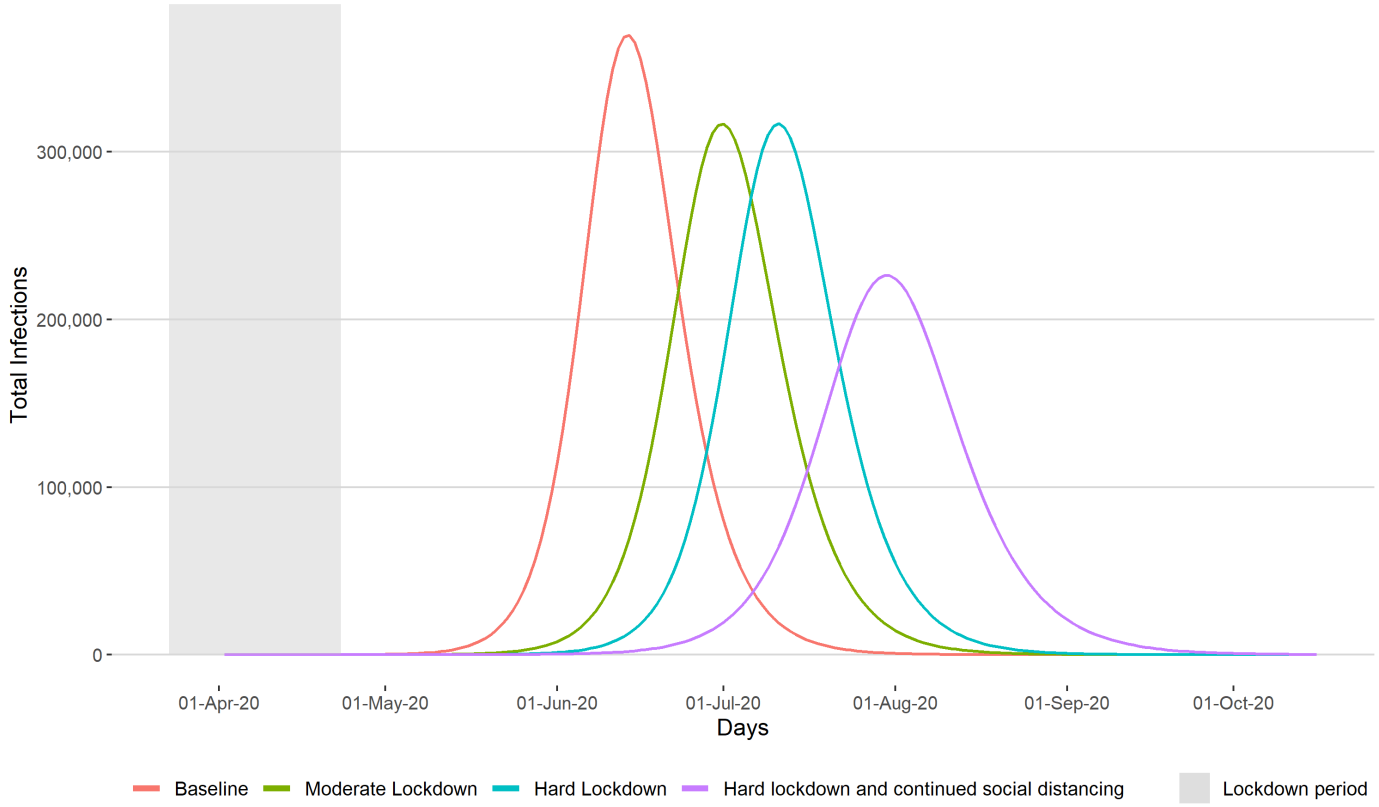
# **Eritrea:** Projected Total Infections (Asymptomatic, Symptomatic, and Severe) With and Without Lockdown

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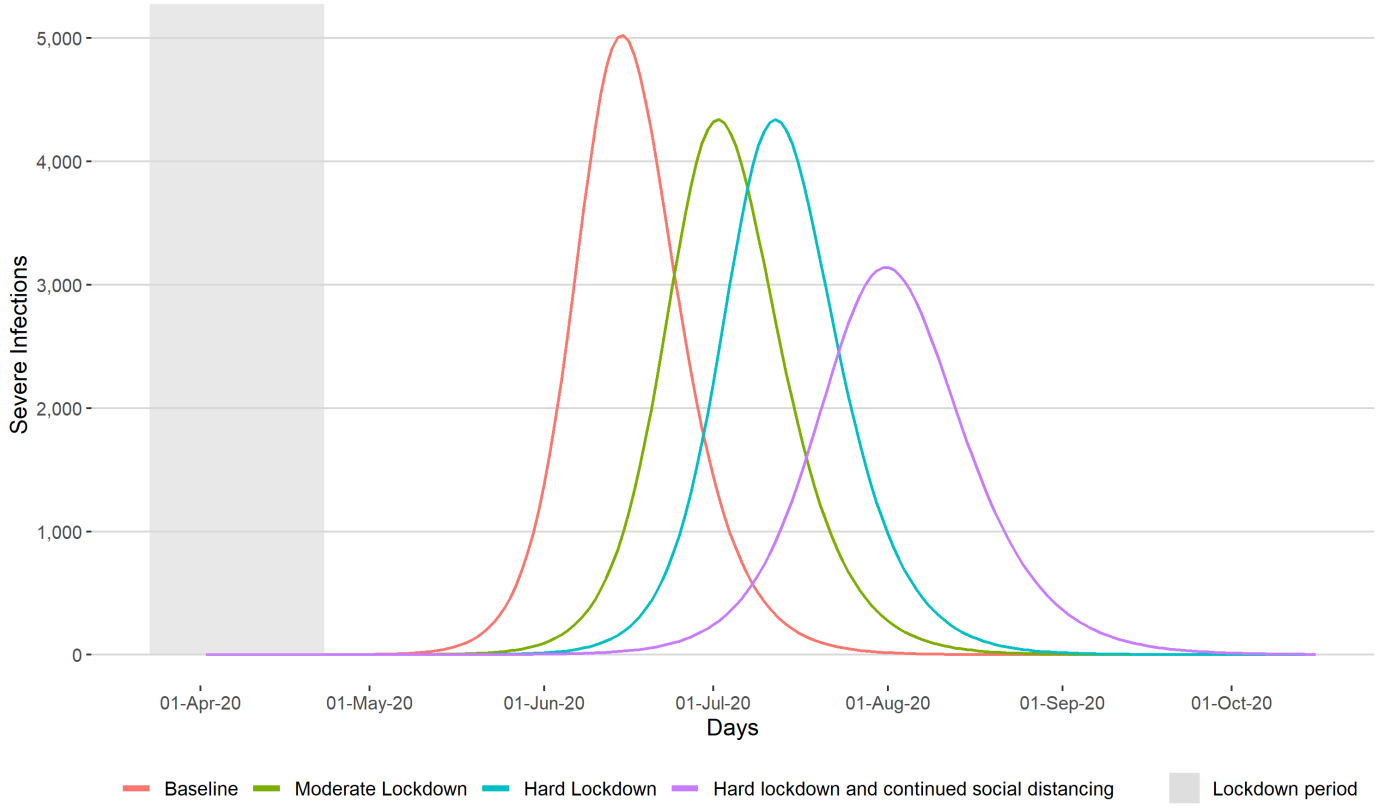


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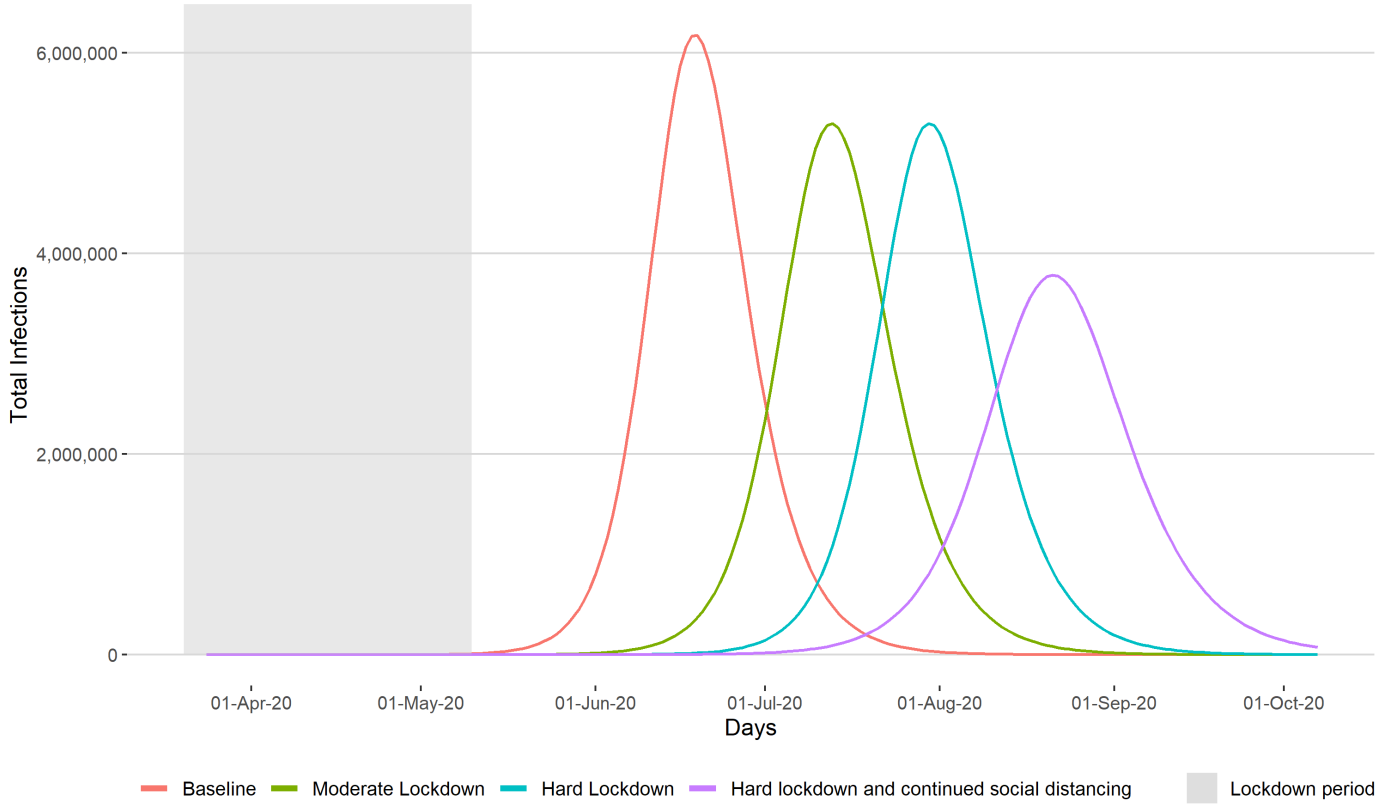
# **Kenya:** Projected Total Infections (Asymptomatic, Symptomatic, and Severe) With and Without Lockdown

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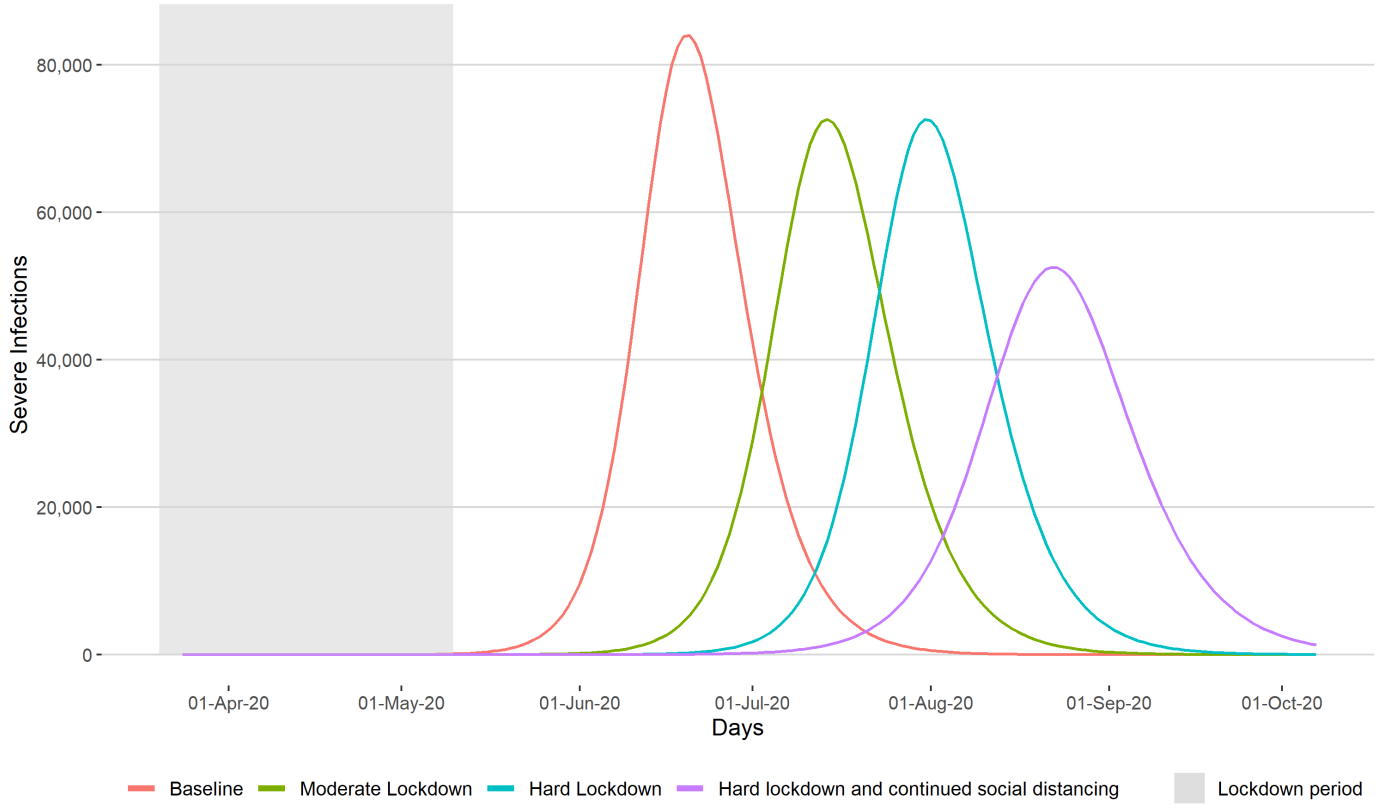


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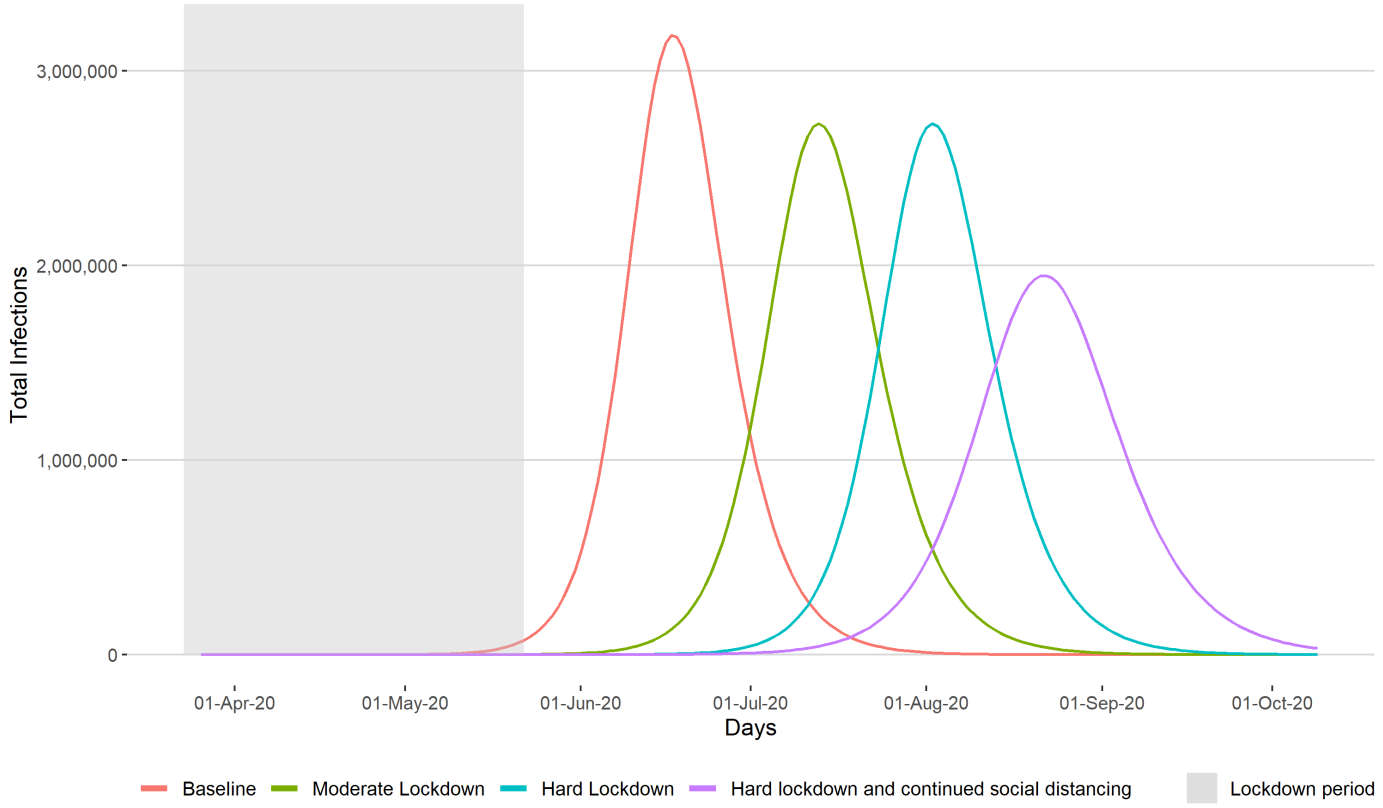
# **Madagascar:** Projected Total Infections (Asymptomatic, Symptomatic, and Severe) With and Without Lockdown

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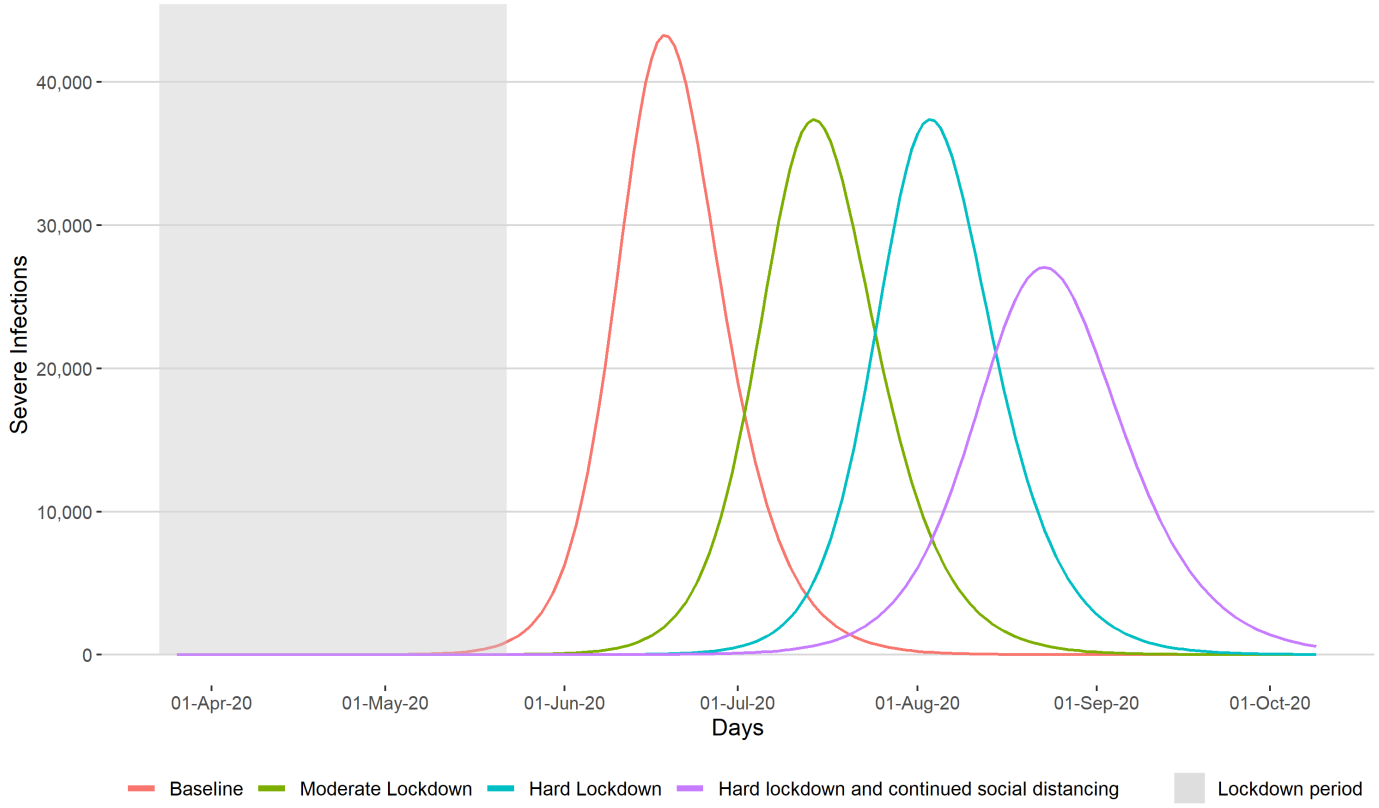


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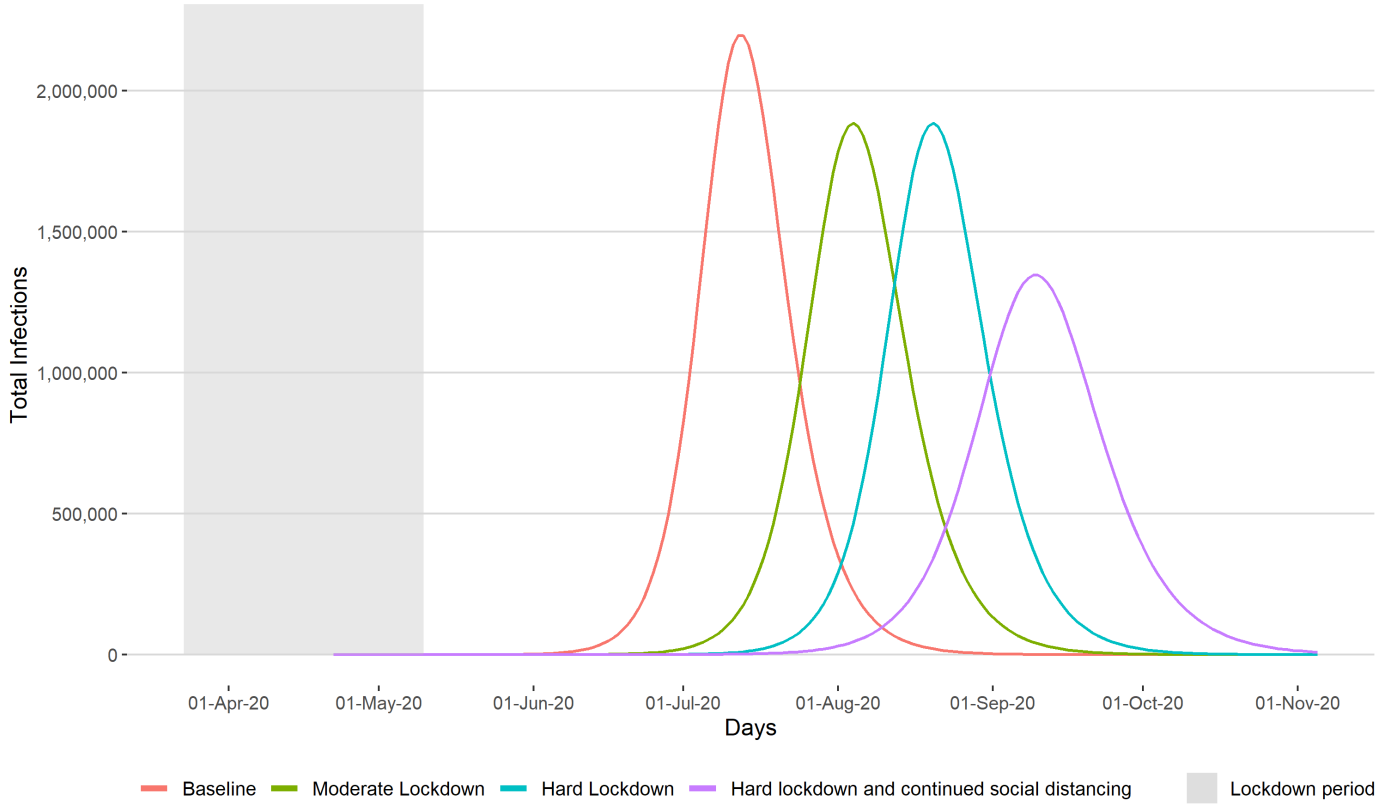
# **Malawi:** Projected Total Infections (Asymptomatic, Symptomatic, and Severe) With and Without Lockdown

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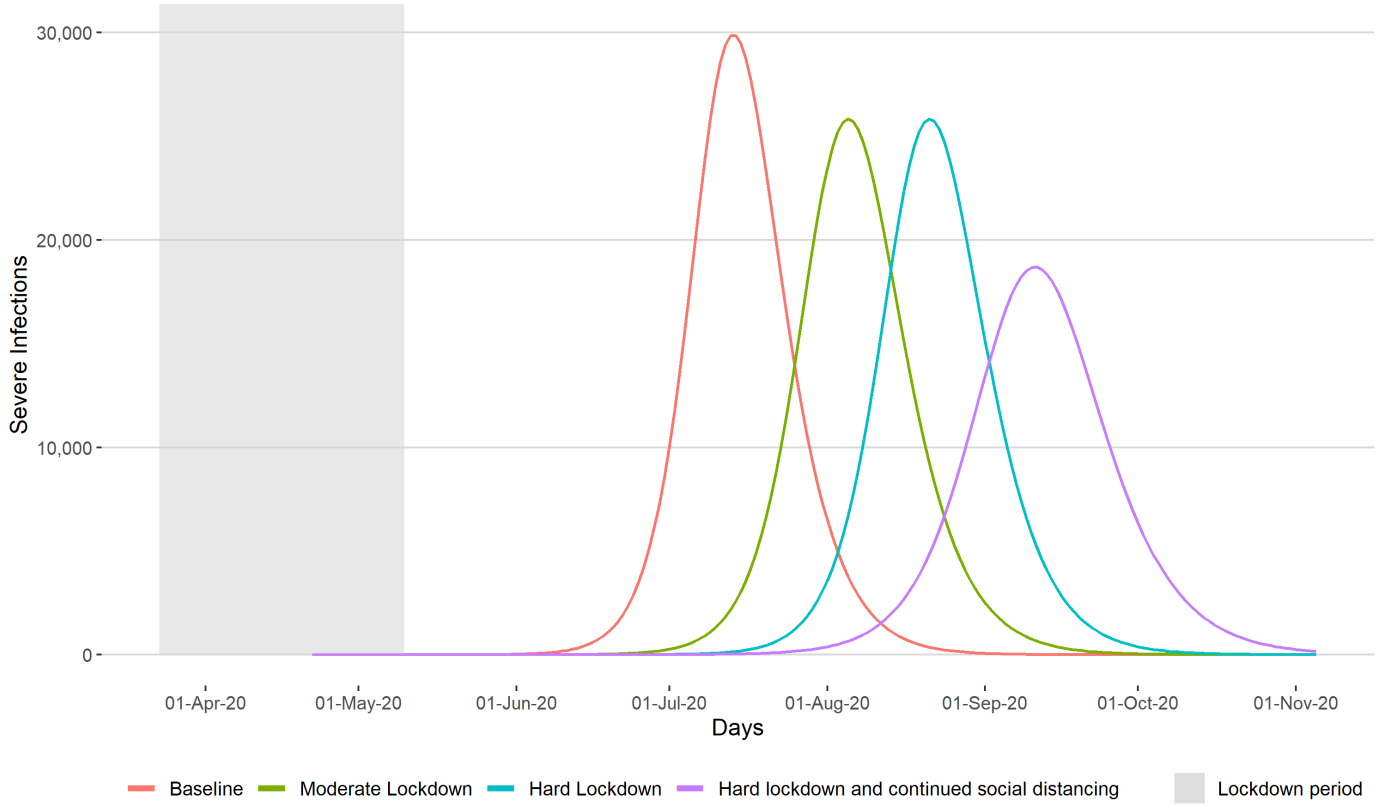


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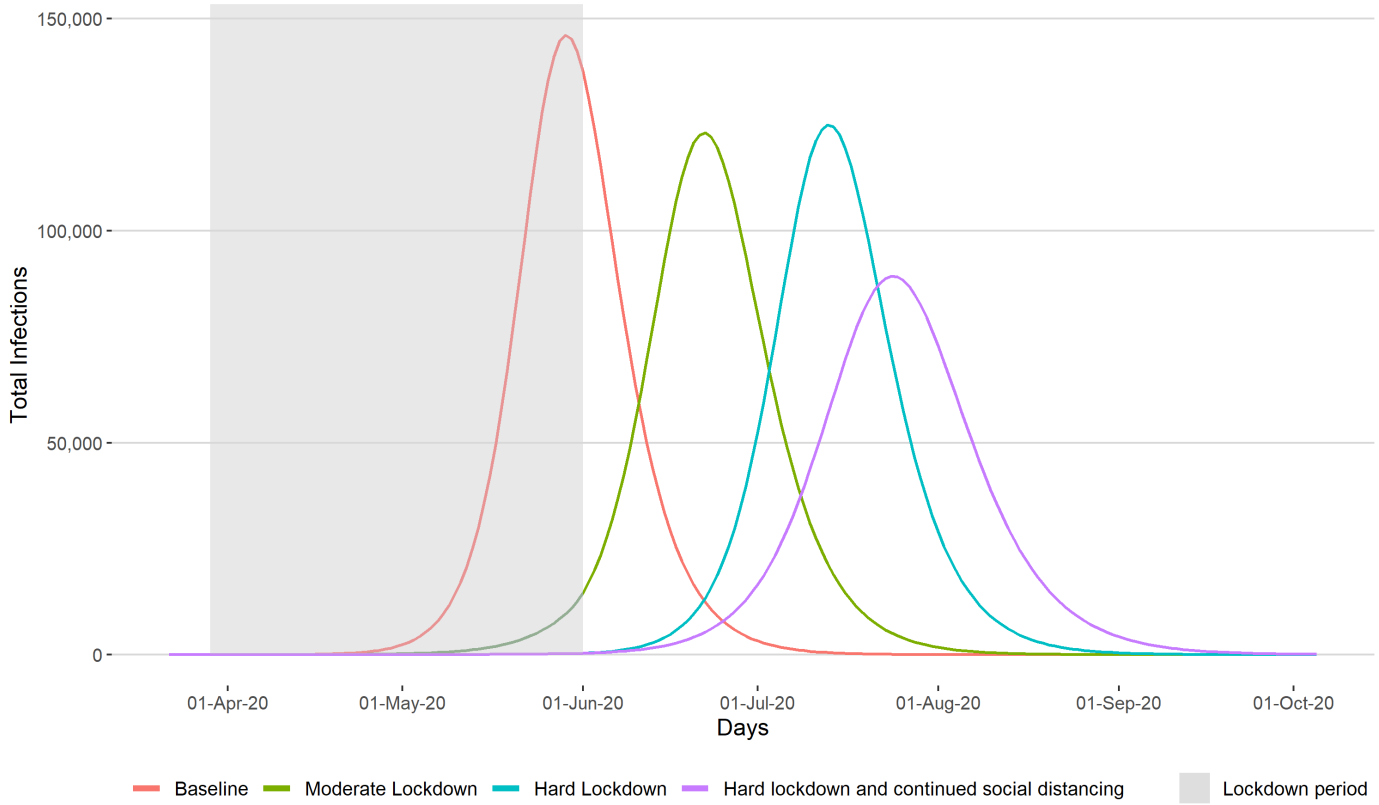
# **Mauritius:** Projected Total Infections (Asymptomatic, Symptomatic, and Severe) With and Without Lockdown

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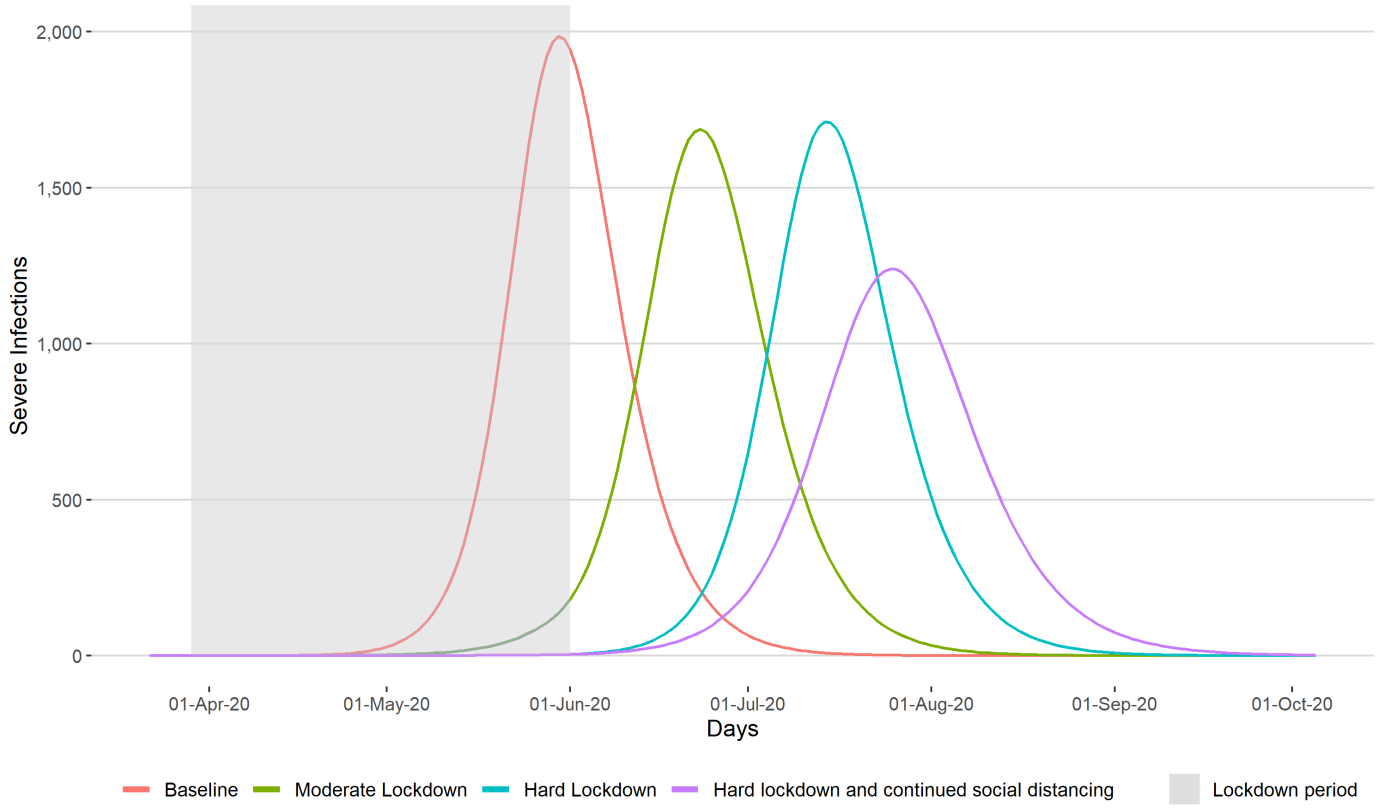
# **Mauritius:** Projected Severe Infections With and Without 60-Day Lockdown

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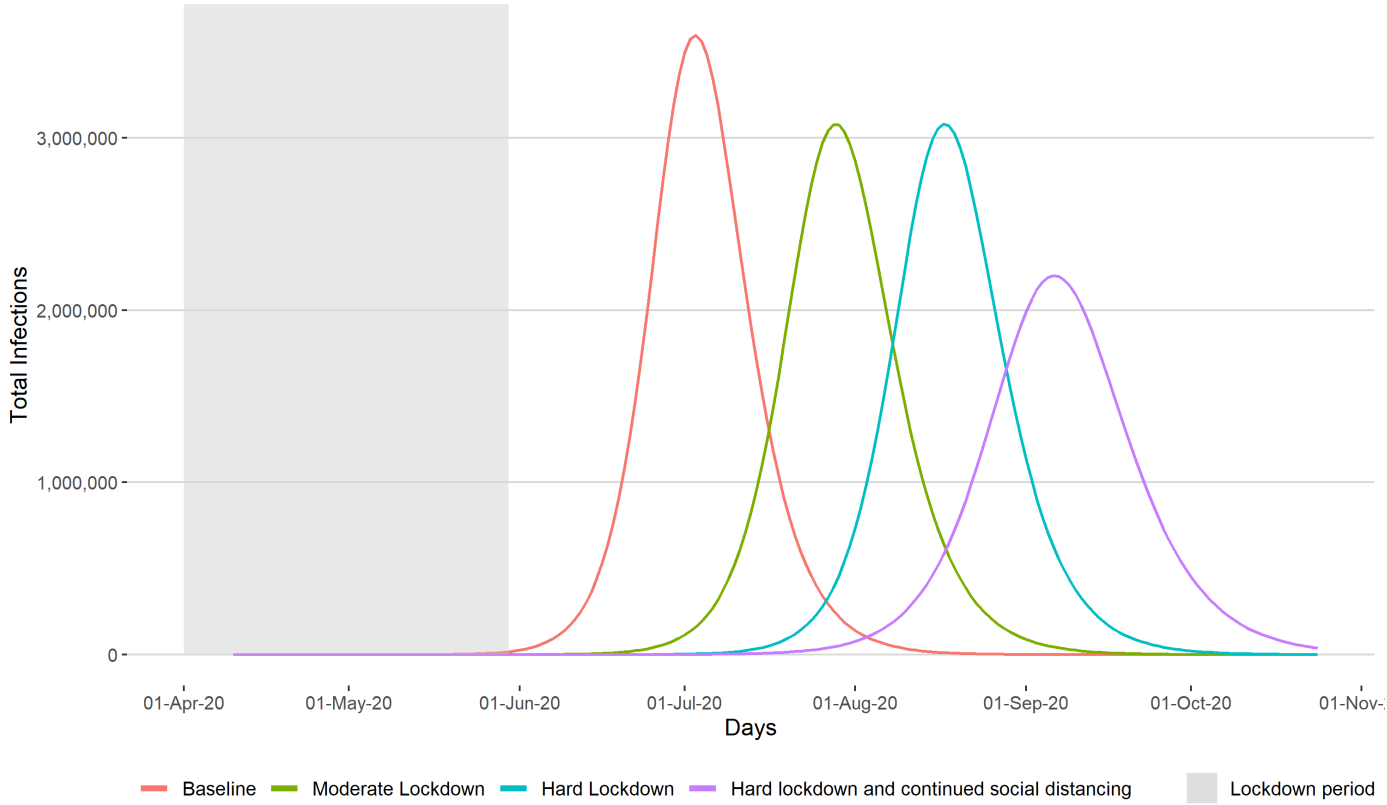
# **Mozambique:** Projected Total Infections (Asymptomatic, Symptomatic, and Severe) With and Without Lockdown

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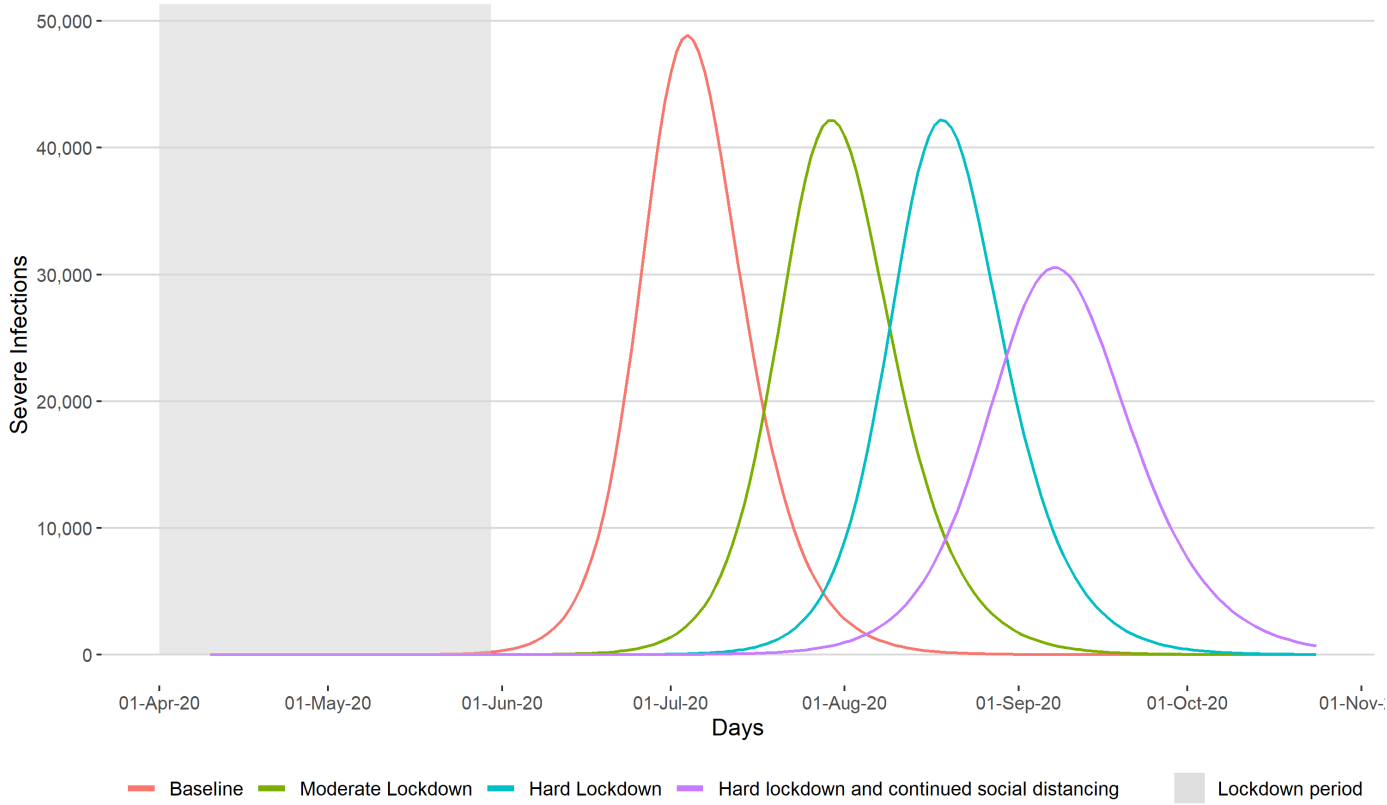


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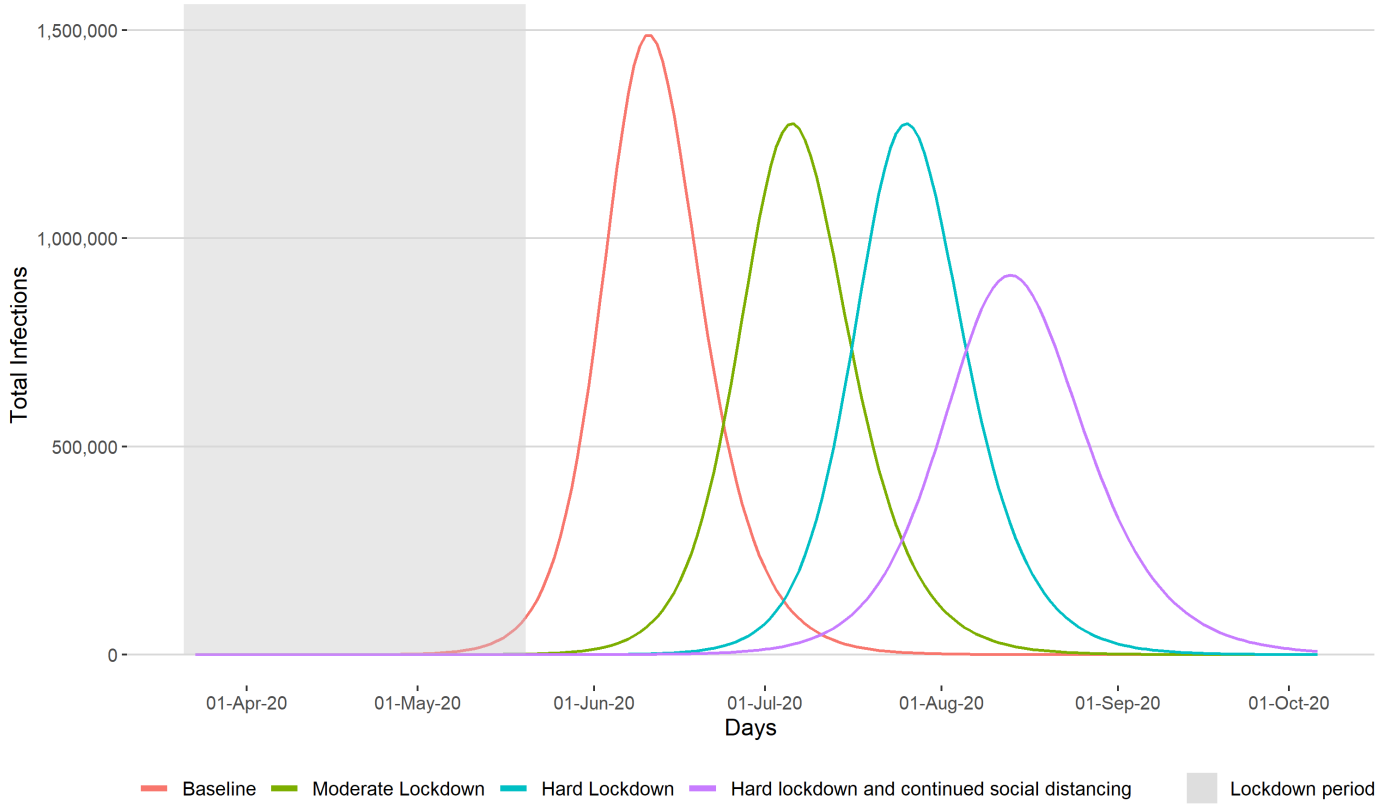
# **Rwanda:** Projected Total Infections (Asymptomatic, Symptomatic, and Severe) With and Without Lockdown

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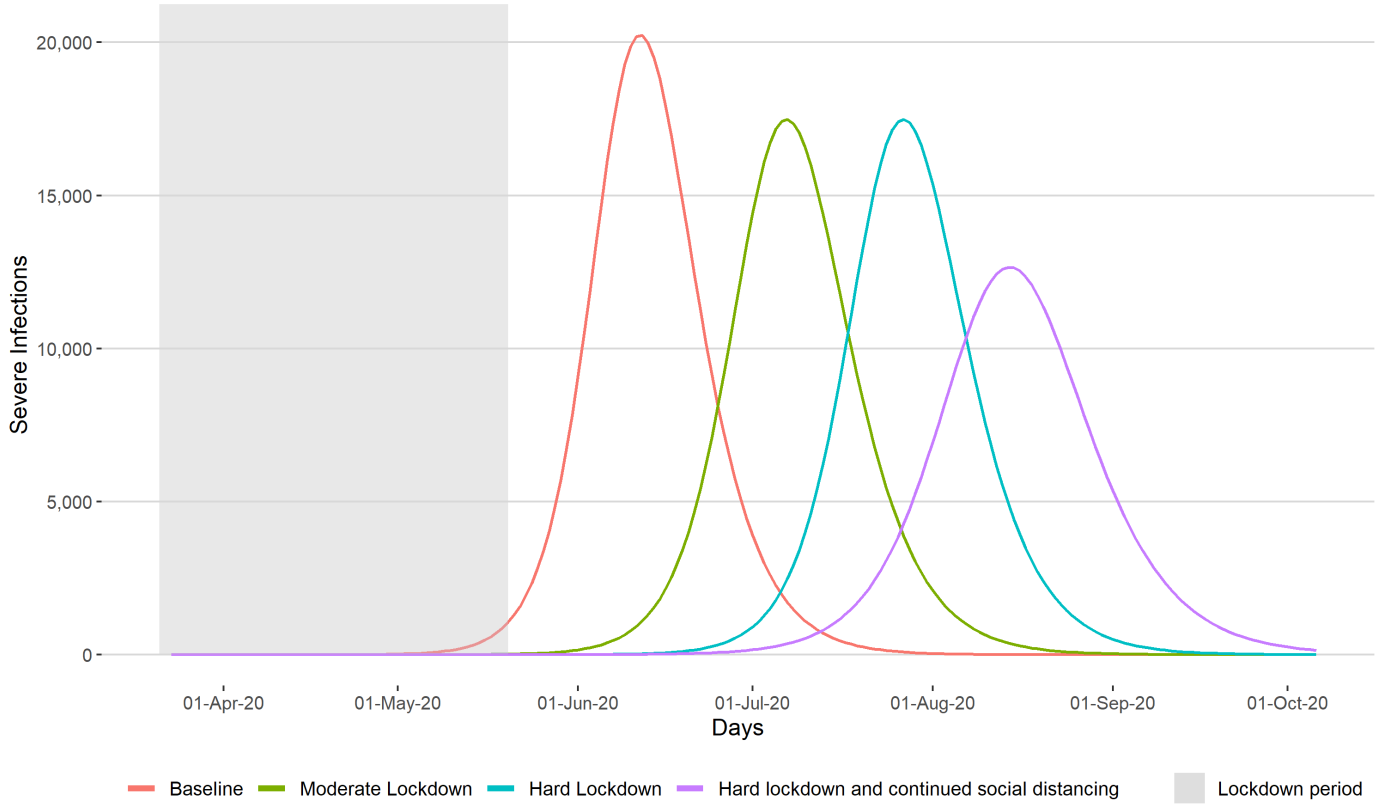
# **Rwanda:** Projected Severe Infections With and Without Lockdown Lockdown

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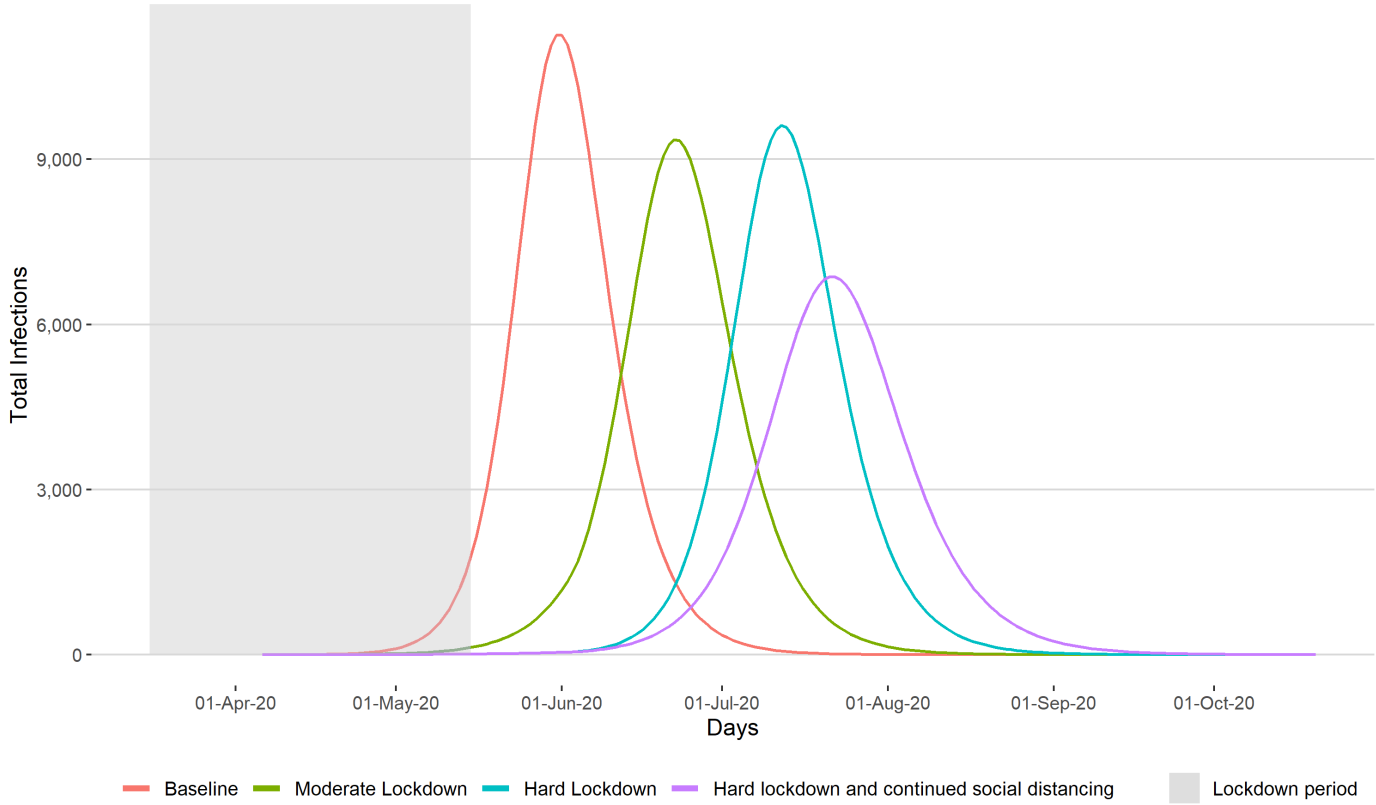
# **Seychelles:** Projected Total Infections (Asymptomatic, Symptomatic, and Severe) With and Without Lockdown

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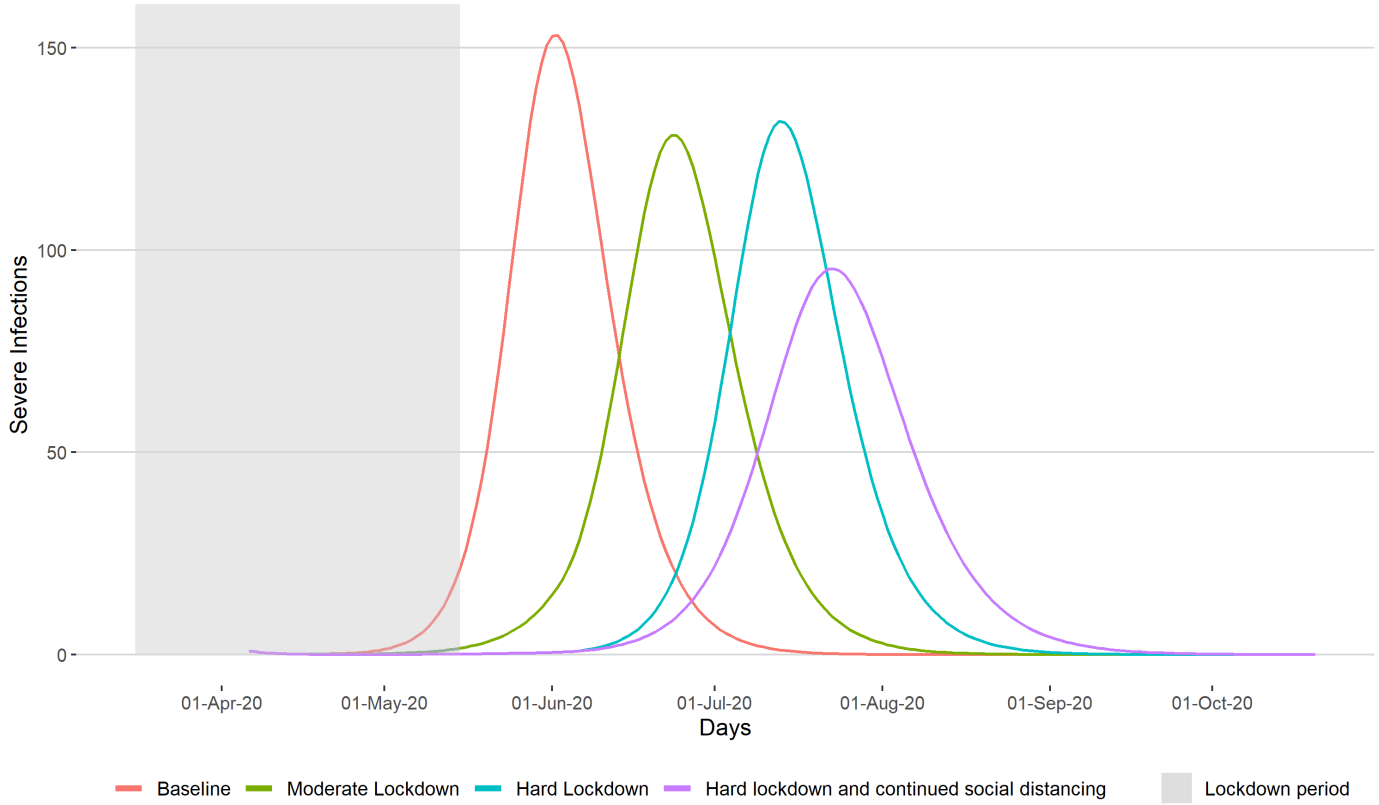


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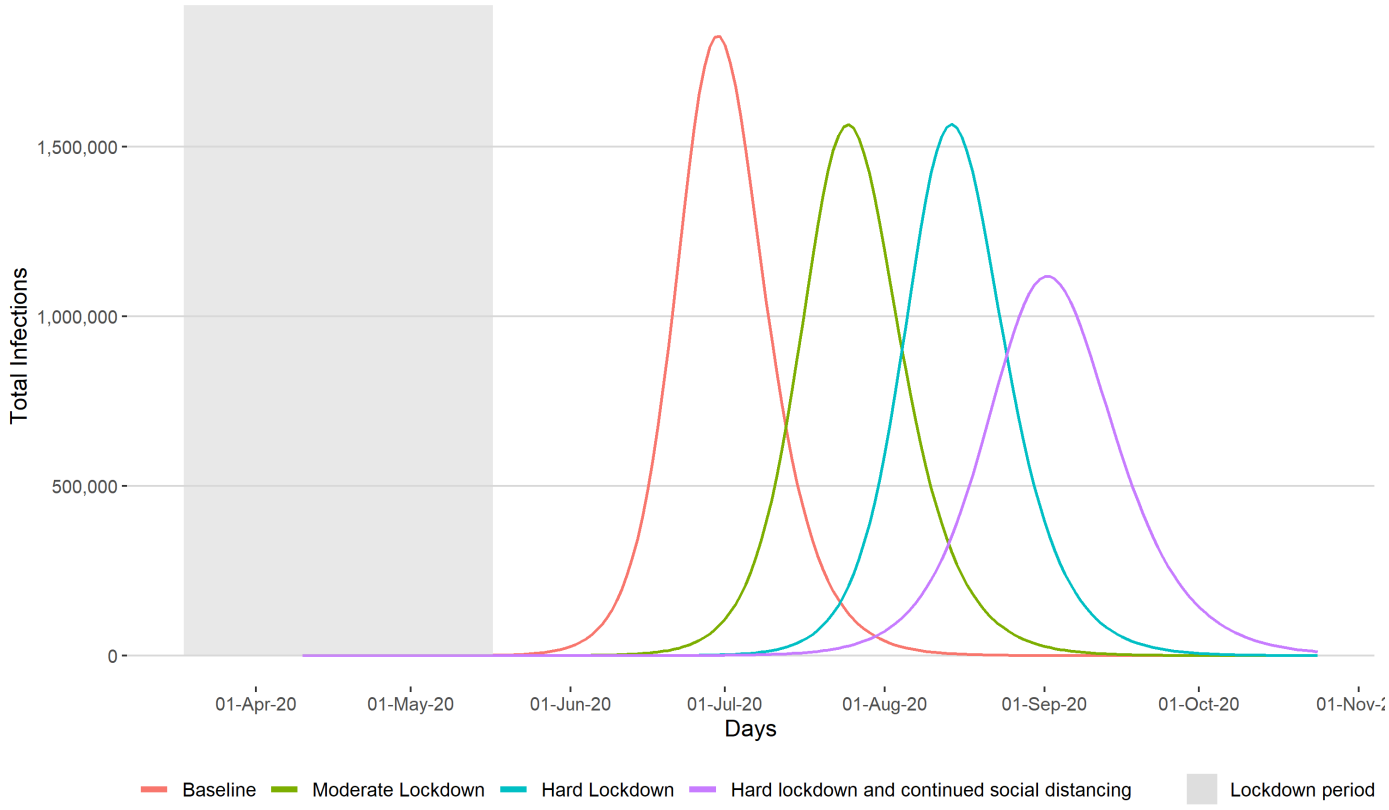
# **Somalia:** Projected Total Infections (Asymptomatic, Symptomatic, and Severe) With and Without Lockdown

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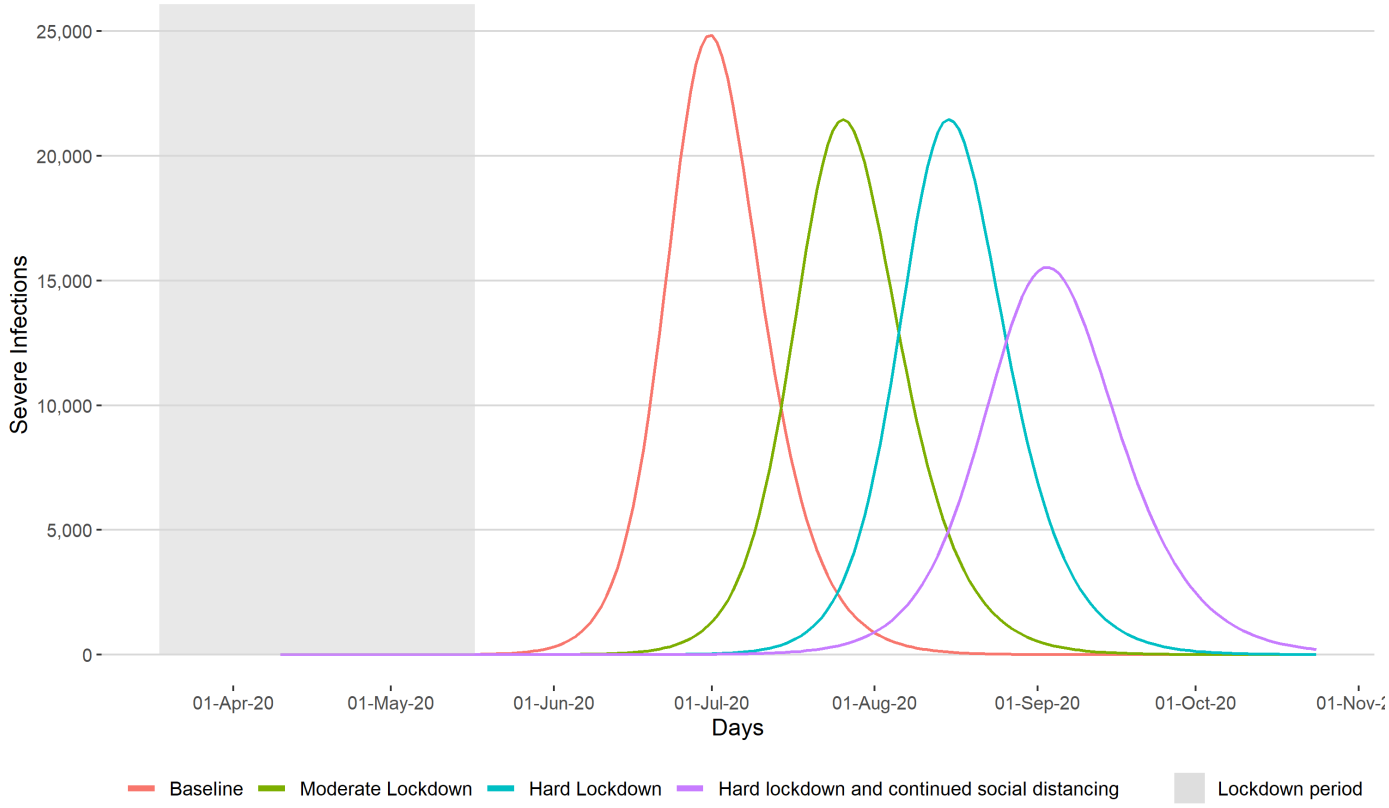


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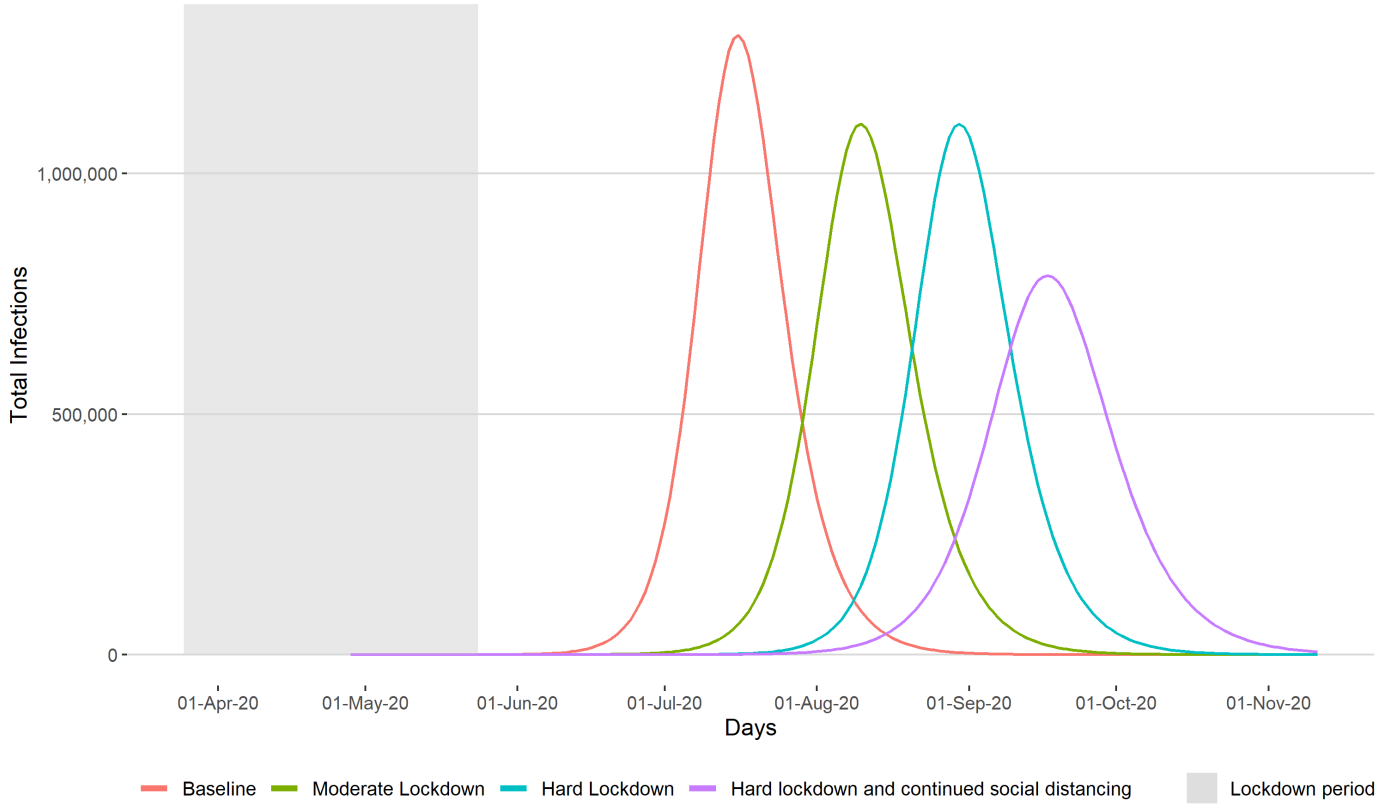
# **South Sudan:** Projected Total Infections (Asymptomatic, Symptomatic, and Severe) With and Without Lockdown

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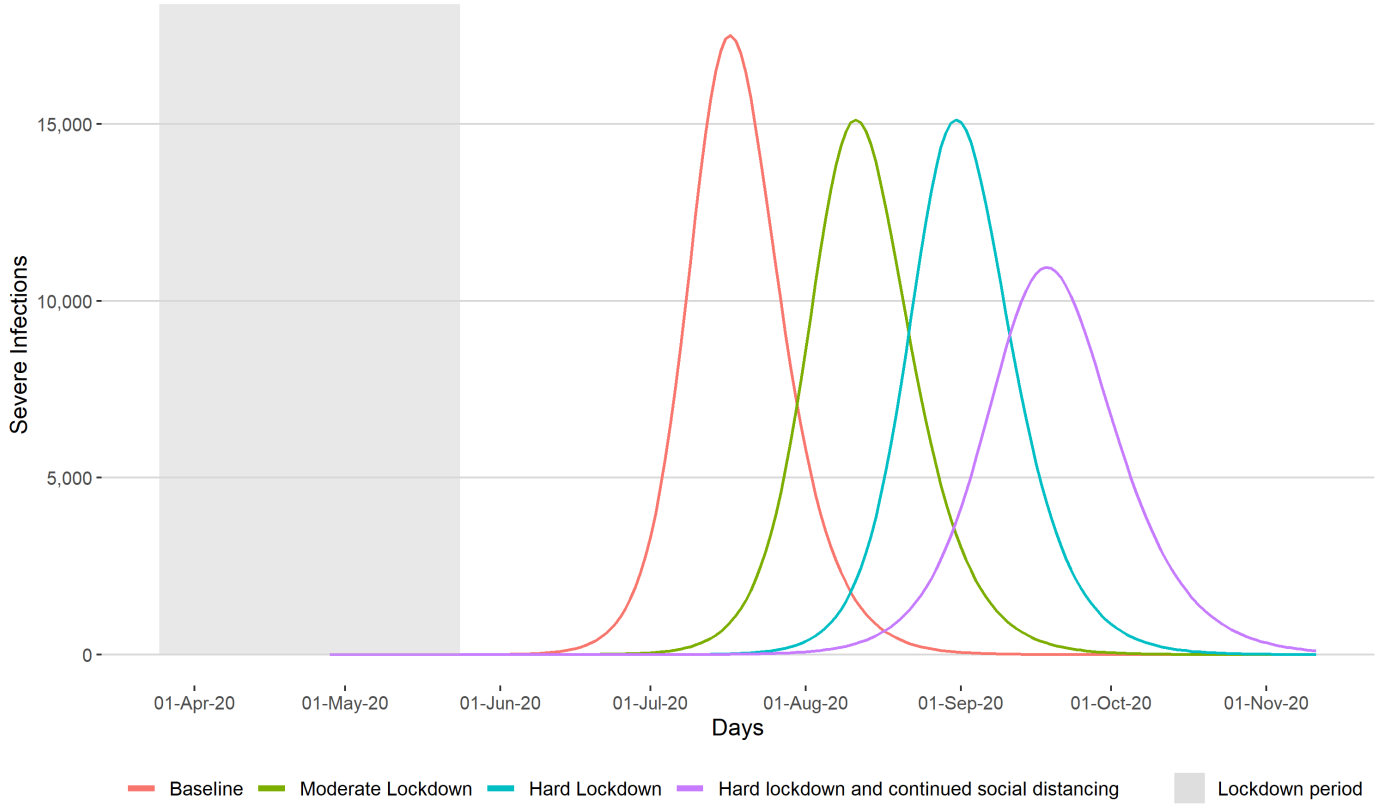


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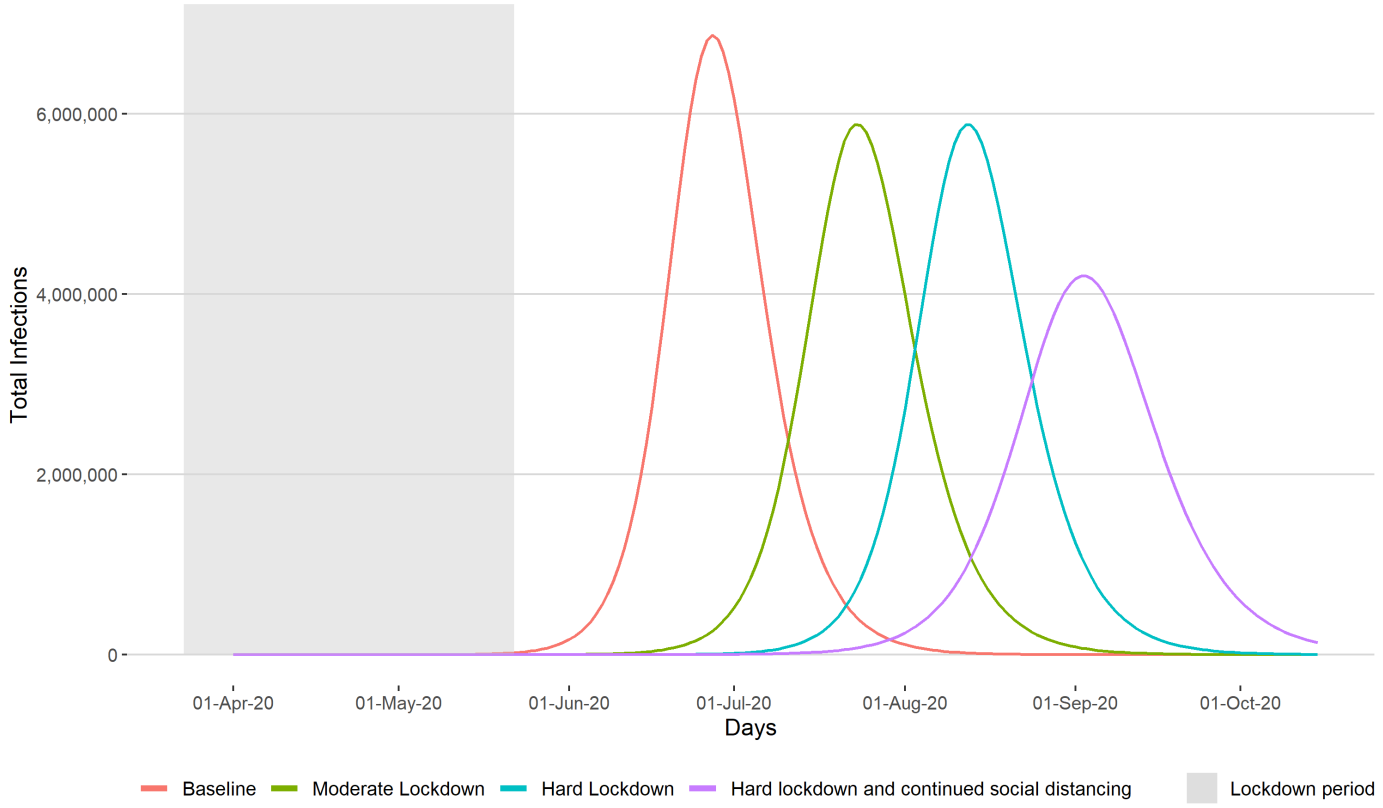
# **Tanzania:** Projected Total Infections (Asymptomatic, Symptomatic, and Severe) With and Without Lockdown

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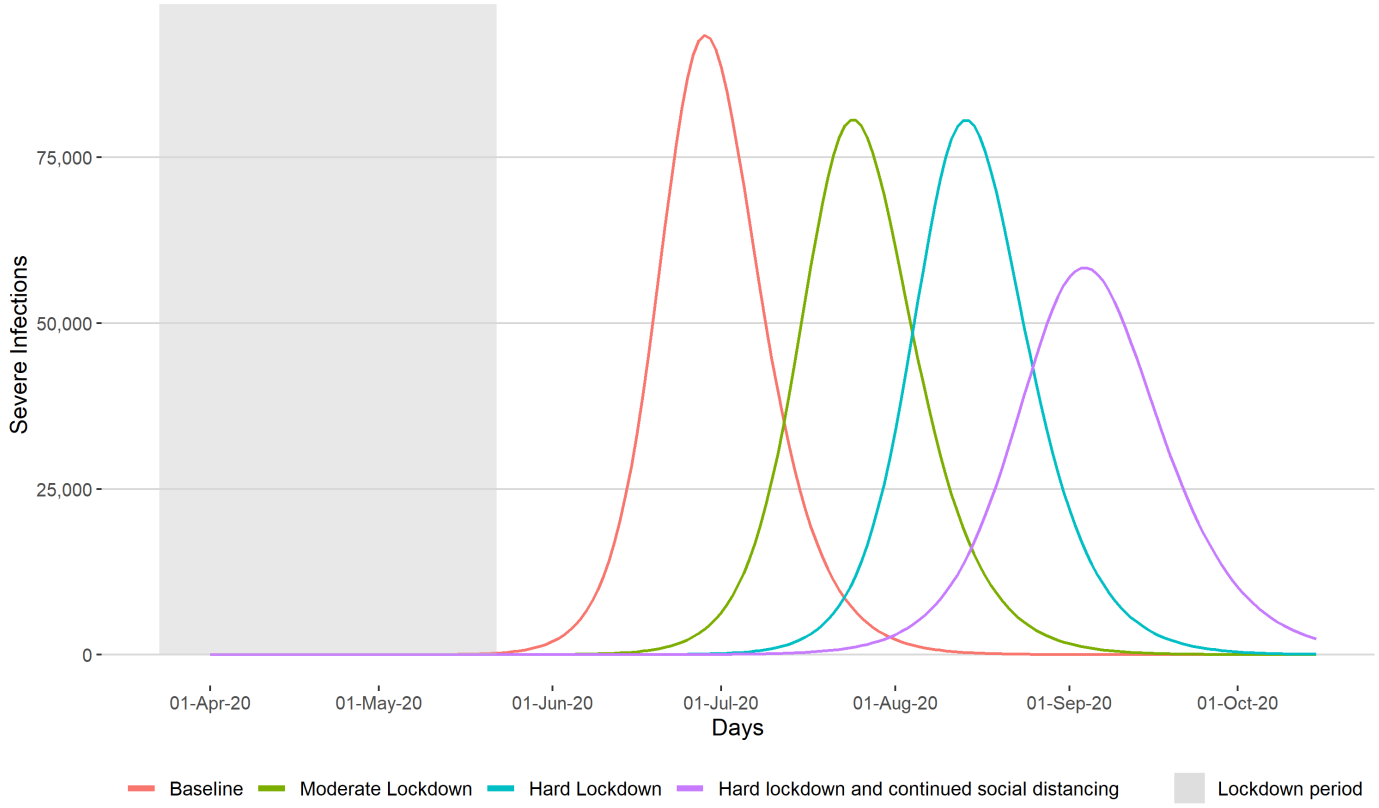


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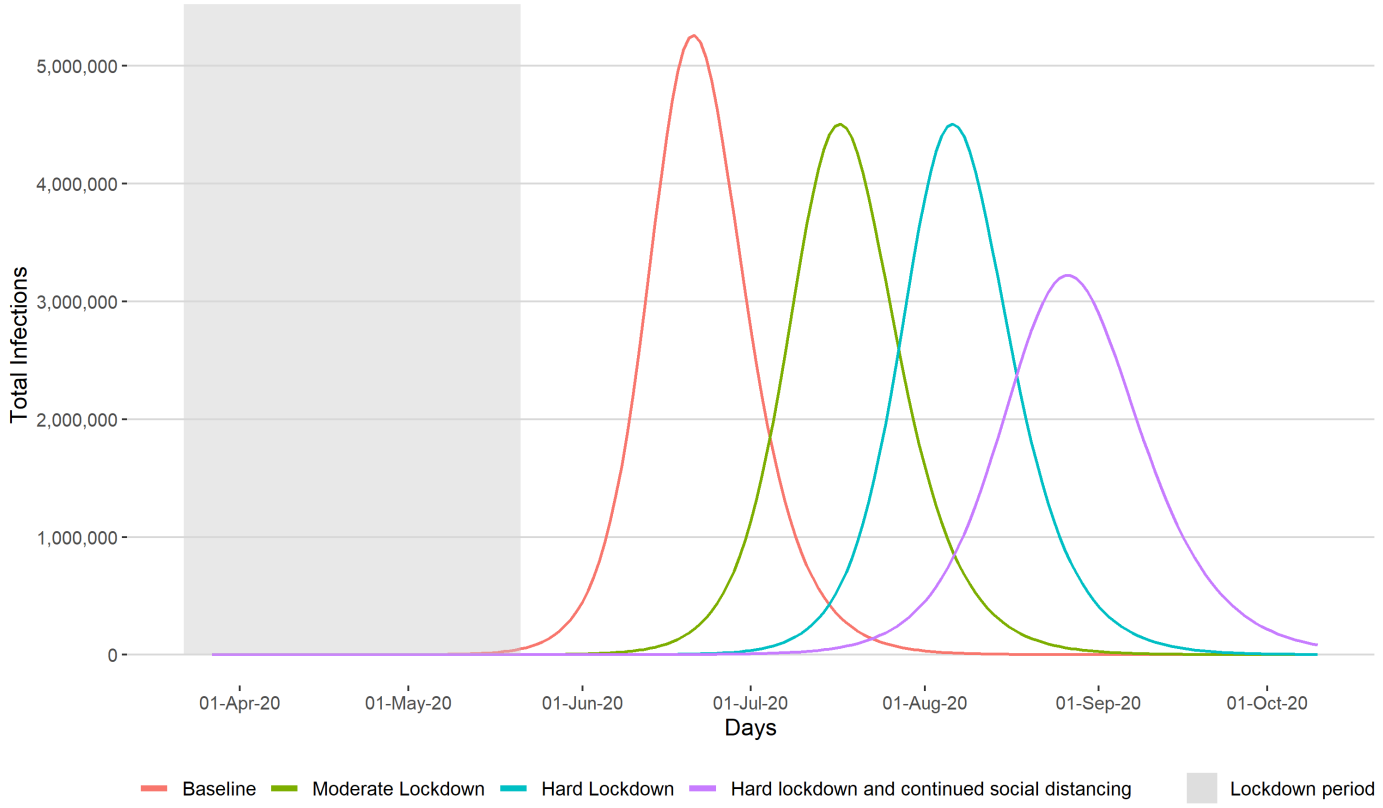
# **Uganda:** Projected Total Infections (Asymptomatic, Symptomatic, and Severe) With and Without Lockdown

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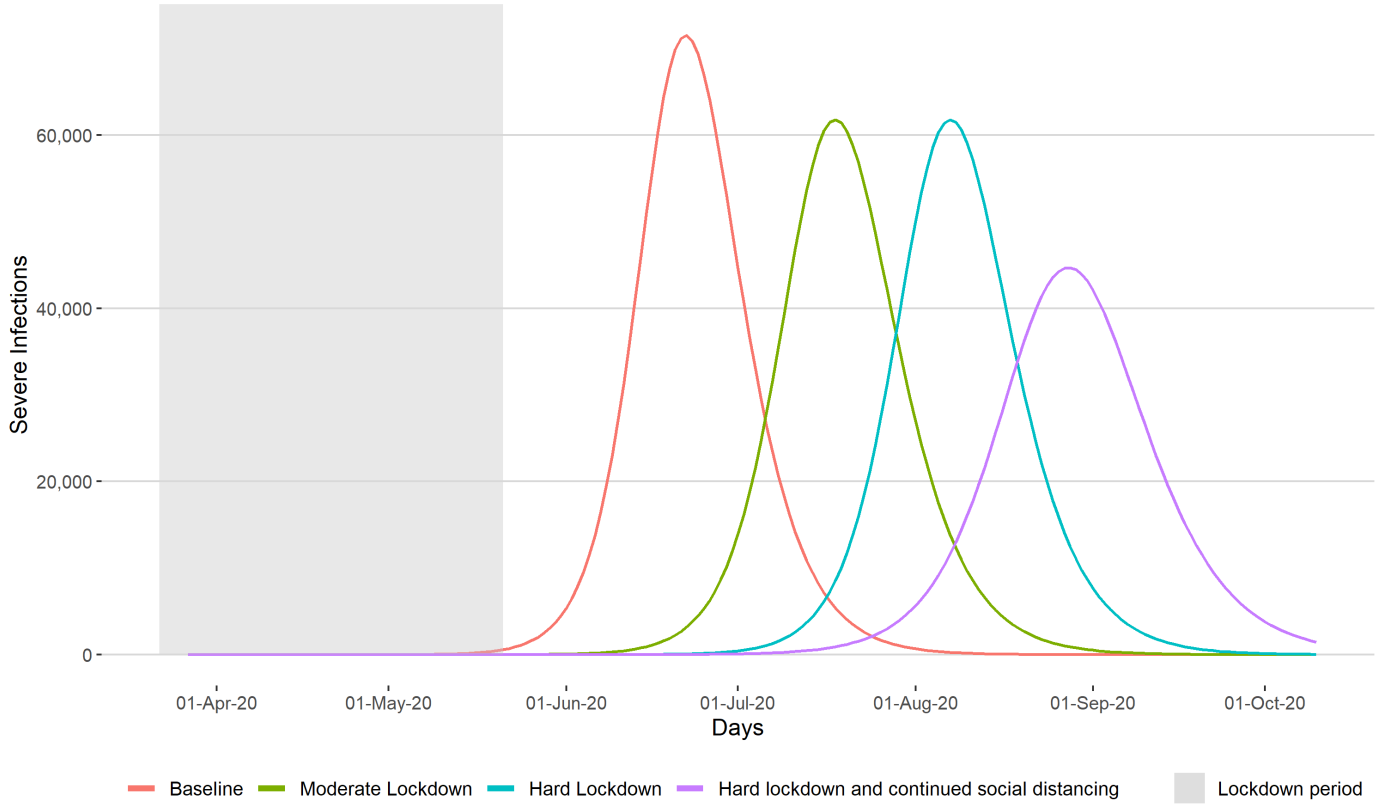


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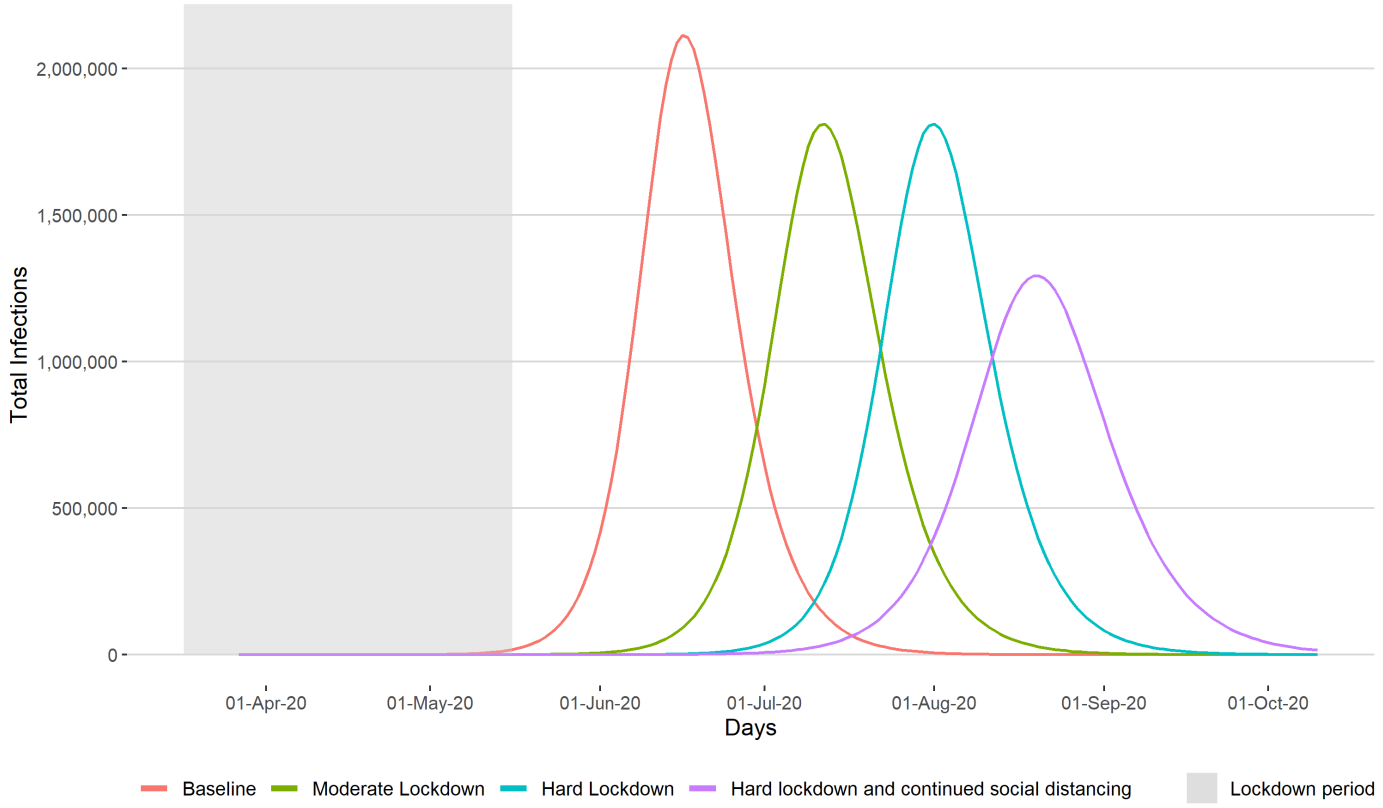
# **Zambia:** Projected Total Infections (Asymptomatic, Symptomatic, and Severe) With and Without 60-Day Lockdown

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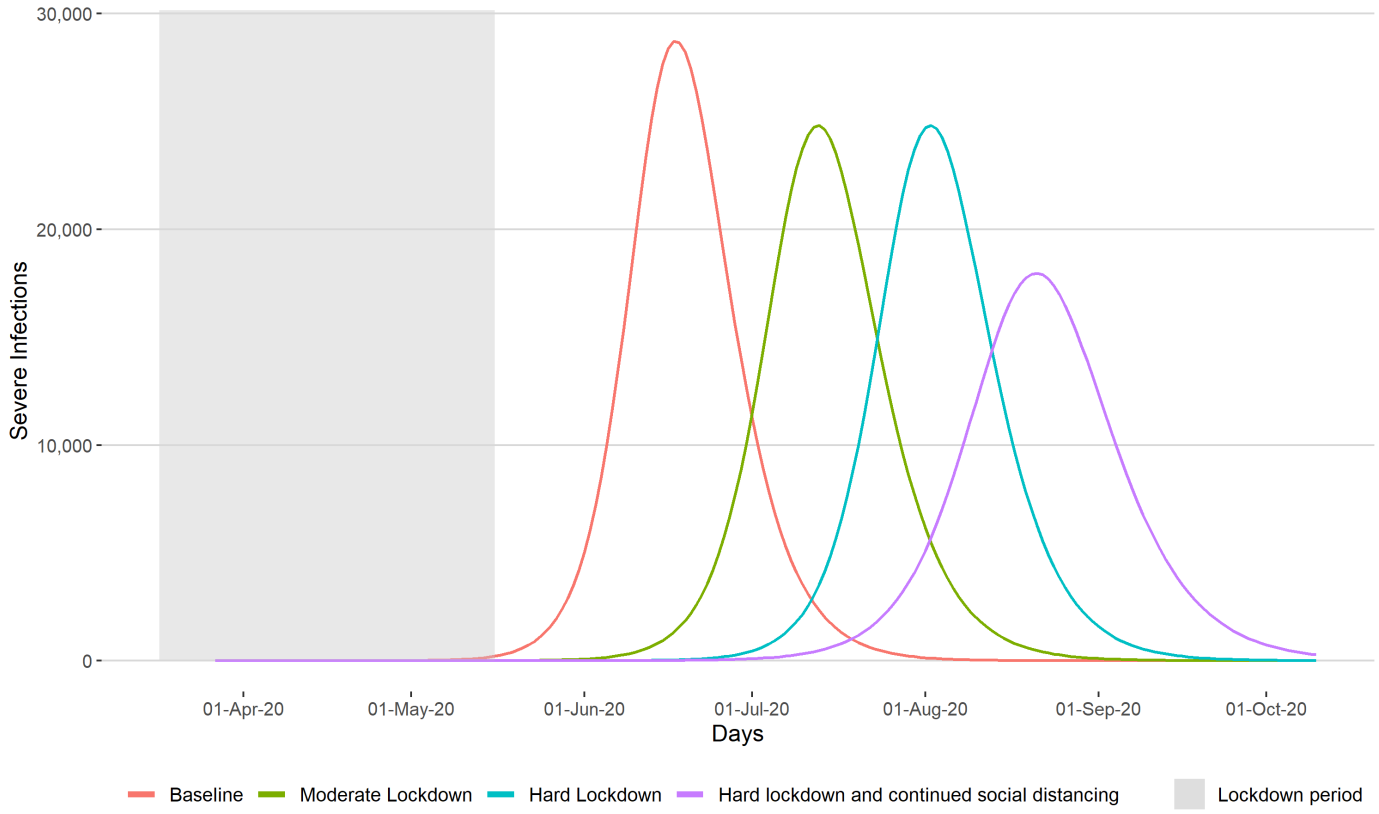


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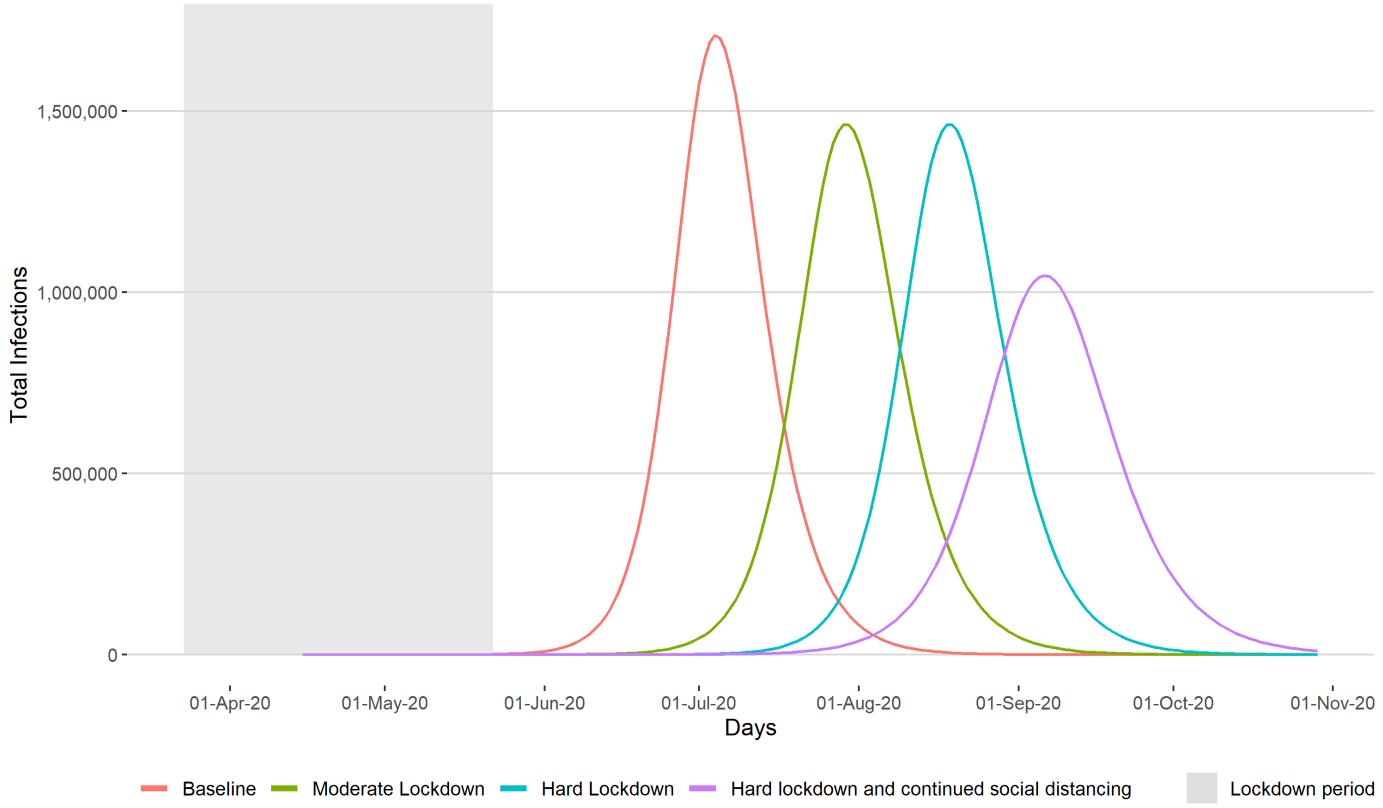
# **Zimbabwe:** Projected Total Infections (Asymptomatic, Symptomatic, and Severe) With and Without Lockdown

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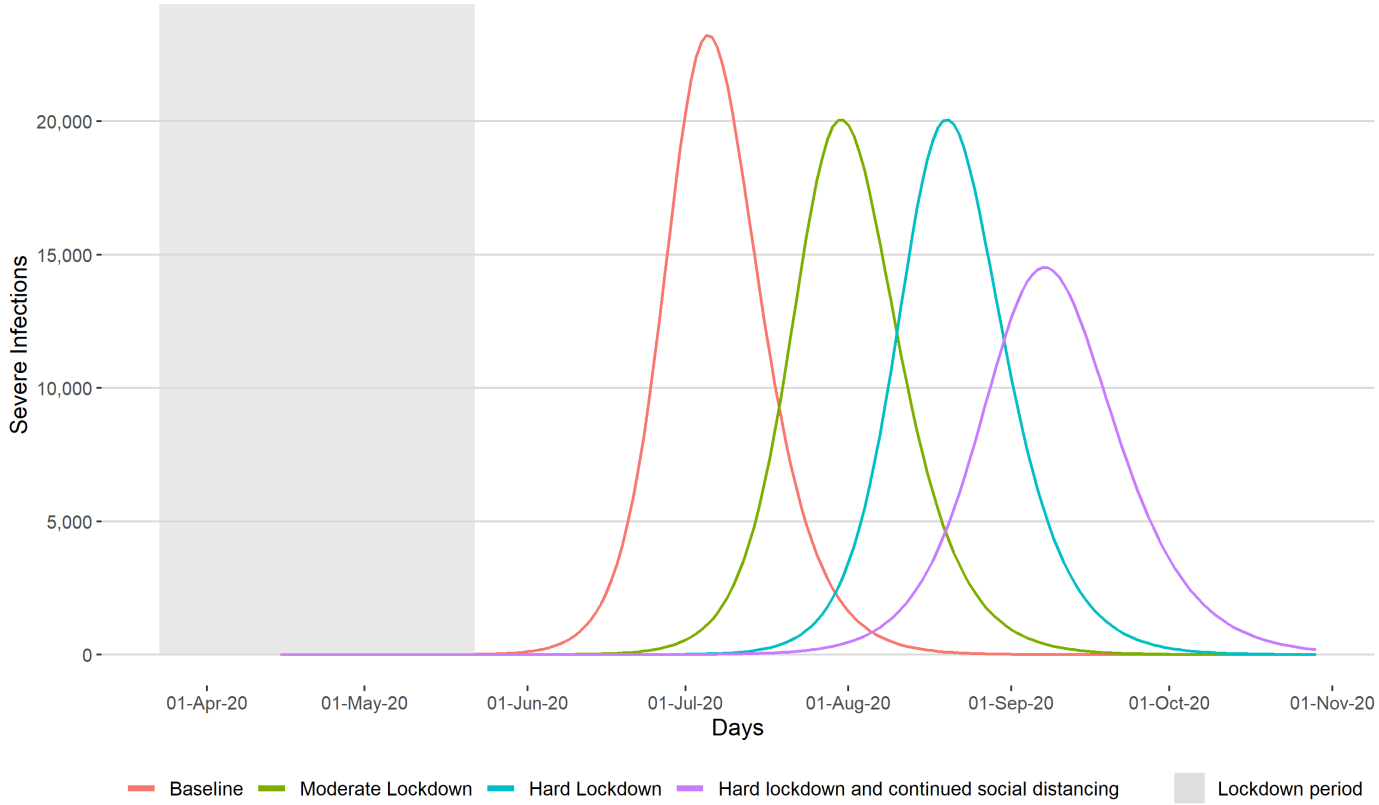
# **Zimbabwe:** Projected Severe Infections With and Without Lockdown

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Thank you!

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