What will continue to drive future trends?

Frequency and magnitude of subsequent waves will depend on multiple factors:

- Population level immunity from natural infection and/or vaccination, including:
  - Extent of infection
  - Extent of vaccination
    - Vaccine characteristics and efficacy
    - Strategy and priority groups (e.g., at risk groups, by age group)
    - Extent of vaccination coverage/resistance
  - Duration of protection against severe disease/death and infection (vaccine, natural immunity)

- **Severity of disease, access to early clinical care and availability of therapeutics**

- **VOCs** circulating and emerging, and transmissibility of VOCs

- **Use of Public Health and Social Measures**, including:
  - Type of measures – identify most effective measures at lowest cost (pandemic fatigue, political/economical cost)
  - Timeliness of implementation
  - Adherence to measures
Unity studies is a global seroepidemiology standardization initiative to increase quality evidence-based knowledge in country and regions for action, through:

1. Availability of standardized sero-epi investigations protocols & antibody assays,
2. Direct support to countries to develop country specific protocols with special attention to LMIC,
3. Aggregation, comparison and analysis of aligned studies,
4. Strong coordination between WHO and field partners

EarlyInvestigations-2019-nCoV@who.int,
Inclusion of seroepidemiology data from hundreds of studies

Number of general population studies aligned with the WHO Unity protocol:

<table>
<thead>
<tr>
<th>Region</th>
<th>Gen Pop Studies: Not Unity-Aligned</th>
<th>Gen Pop Studies: Unity-Aligned</th>
<th>Gen Pop: Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>5</td>
<td>34</td>
<td>39</td>
</tr>
<tr>
<td>South-East Asia</td>
<td>24</td>
<td>24</td>
<td>48</td>
</tr>
<tr>
<td>Europe: LMIC</td>
<td>12</td>
<td>7</td>
<td>19</td>
</tr>
<tr>
<td>Europe: HIC</td>
<td>65</td>
<td>204</td>
<td>269</td>
</tr>
<tr>
<td>Americas: LMIC</td>
<td>16</td>
<td>28</td>
<td>44</td>
</tr>
<tr>
<td>Americas: HIC</td>
<td>340</td>
<td>81</td>
<td>421</td>
</tr>
<tr>
<td>Eastern Mediterranean</td>
<td>5</td>
<td>17</td>
<td>22</td>
</tr>
<tr>
<td>Western Pacific</td>
<td>16</td>
<td>16</td>
<td>32</td>
</tr>
<tr>
<td>Global</td>
<td>483</td>
<td>411</td>
<td>894</td>
</tr>
</tbody>
</table>

(Bergeri et al, submitted)
## Methods *(Bergeri et al, submitted)*

<table>
<thead>
<tr>
<th>Identify eligible serosurvey data</th>
<th>Identify antibody target</th>
<th>Pool by country, time</th>
<th>Aggregate by WHO region and globally</th>
<th>Smooth estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify <strong>national</strong> or <strong>subnational</strong> (state/provincial) serosurveys that provide estimates of seroprevalence in the <strong>general population</strong> <em>(n=894 as of 24 Sep).</em></td>
<td>Stratify 2021 surveys detecting <strong>anti-N</strong> Abs vs. <strong>anti-S</strong> Abs to compare Ab kinetics and isolate seroprevalence from infection in countries using S-based vaccines.</td>
<td>Calculate weekly seroprevalence in each <strong>country</strong> by pooling serosurveys in that country in a 3-month moving window with <strong>random-effects meta-analysis</strong>.</td>
<td>Estimate seroprevalence for each WHO region (and globally) as the <strong>population-weighted average</strong> of country (and WHO region) MA estimates.</td>
<td>Fit a <strong>generalized additive model</strong> (GAM) to produce smooth model estimates of average seroprev. from Jan 2020 to Apr 2021. Results are updated weekly.</td>
</tr>
</tbody>
</table>

### Notes:

1. Includes household and community samples, residual sera, blood donors, pregnant or parturient women, and multiple general population sampling frames.
2. In countries using vaccines that only target the S-protein (mRNA, viral vector, etc.), serosurveys detecting anti-N Abs typically indicate seroprevalence from infection.
3. This step is repeated 3 times: using all serosurveys and stratifying 2021 serosurvey data by those detecting anti-N targets and those detecting anti-S targets.
Population-level immunity *(Bergeri et al, submitted)*

Modelled estimates of seroprevalence by WHO region, Jan 20 - Apr 21, show considerable region-to-region variation

Mar/Apr 2021 modelled seroprevalence ranged from 1.2% in WPR to 48.5% in AFR
(Bergeri et al, submitted)
Protective immunity against common cold coronaviruses is short-lasting and reinfection is rather common.

Antibodies to more closely related MERS-CoV and SARS-CoV-1 can be detected for years. Risk of reinfection reduced by 80-90% for at least 5-7 months after primary infection, and potentially at least a year. Protection from natural infection against reinfection is strong up to 6-12 months following primary infection, but does not reach 100%, just like protection from vaccination.

Beta and Delta does not seem to cause a higher number of reinfections compared to non-VOC.

Delta grows to higher viral loads, which can favour breakthroughs.

Reinfection/breakthroughs can be favoured in settings with high force of infection (high community transmission).

Vaccine-derived protection

Vaccine efficacy against severe disease versus vaccine efficacy against any infection

Protection against severe disease appears to be maintained, even when there appears to be declines over time in vaccine efficacy against infection and symptomatic disease

Tartof SY et al. Lancet 2021

Krause PR et al. Lancet 2021