

**Model predicts employee illnesses and work absences due to COVID-19 in a produce farm operation for 2020 strains compared to the Delta variant**

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*FInd CoV Control* (**F**ood **I**ndustry **CoVid-19** **C**ontrol) is an agent-based model of COVID-19 transmission developed for applications in the food industry. This model tracks the health state of each individual worker (hence the name “agent-based”) in a food production operation or facility at 8-hour intervals. The agent-based model structure has 3 key components: (1) SARS-CoV-2 disease model, (2) employee characteristics, and (3) the social contact network. The current version of the *FInd CoV Control* model\* was designed specifically for produce farms. When first developed, this model was intended to represent transmission dynamics that are characteristic of the strains of SARS-CoV-2 that were dominant in the United States (US) in 2020.

However, the Delta variant, characterized by increased transmissibility and decreased vaccine effectiveness, has become the dominant strain of COVID-19 in the US today, accounting for over 80% of new infections in the two-week period ending July 10, 2021, and 99% of new infections during the two weeks ending September 11, 2021. Here, we describe the modifications we made to the model in order to better represent the transmission characteristics of this variant compared to the original (2020 strains) model settings (Table 1). We also include some illustrative results to show how our conclusions are affected by the differences between the 2020 strains and the Delta variant.

Current epidemiological evidence suggests that the Delta variant is spreading in the presence of a considerable fraction of the population already immune due to the natural infection or vaccination. Notably, this is different from the situation for the 2020 strains; these were dominant earlier in the pandemic, when the fraction of the population already immune was lower, including at the very start, when the population was fully susceptible. While noting these important differences, here we present results for both the 2020 strains and Delta variant in a hypothetical fully susceptible population to be able to analyze the maximum differences in the capacity for infection spread. Below, we show side-by-side comparisons, on the same axes, of the average number of employees who are infectious and unavailable for their scheduled work shifts (Figure 1) at 8-hour intervals over a period of 90 days, starting when 1 infected worker comes to work on day 0, for a hypothetical fresh produce farm. This hypothetical farm has 103 employees, including 1 health and safety manager, 3 supervisors (each supervising 3 crews), and 9 crews (each with 10 workers and 1 foreman).

To allow for assessment of mitigation strategies, first, the baseline version of the model (i.e., no mitigation strategies implemented) is simulated, which provides the baseline results to use for comparison (Figure 1, black curves). Mitigation strategies are then evaluated by simulating the model, and the effectiveness of each strategy is evaluated with respect to their ability to prevent both total infections (Figures 1A and 1B, colored curves) and worker absences (Figures 1C and 1D, colored curves). We show the predictions for 2020 strains (Figures 1A and 1C) compared to predictions for the Delta variant (Figures 1B and 1D).

**Table 1.** Parameter differences between 2020 strains and for the Delta variant in the “default” setup of the *FInd CoV Control* model.

Parameter	2020	Delta
Intermediate $R_0$ in work environment <sup>1</sup>	3	6
Intermediate $R_0$ in shared housing <sup>1</sup>	1	2
Fully Vaccinated protection against infection <sup>2</sup>	90%	65%
Fully Vaccinated protection against <i>symptomatic</i> infection <sup>2</sup>	94%	88%
Partially Vaccinated protection against infection <sup>2</sup>	80%	21%
Partially Vaccinated protection against <i>symptomatic</i> infection <sup>2</sup>	88%	37%
Severity multiplier <sup>3</sup>	1	2

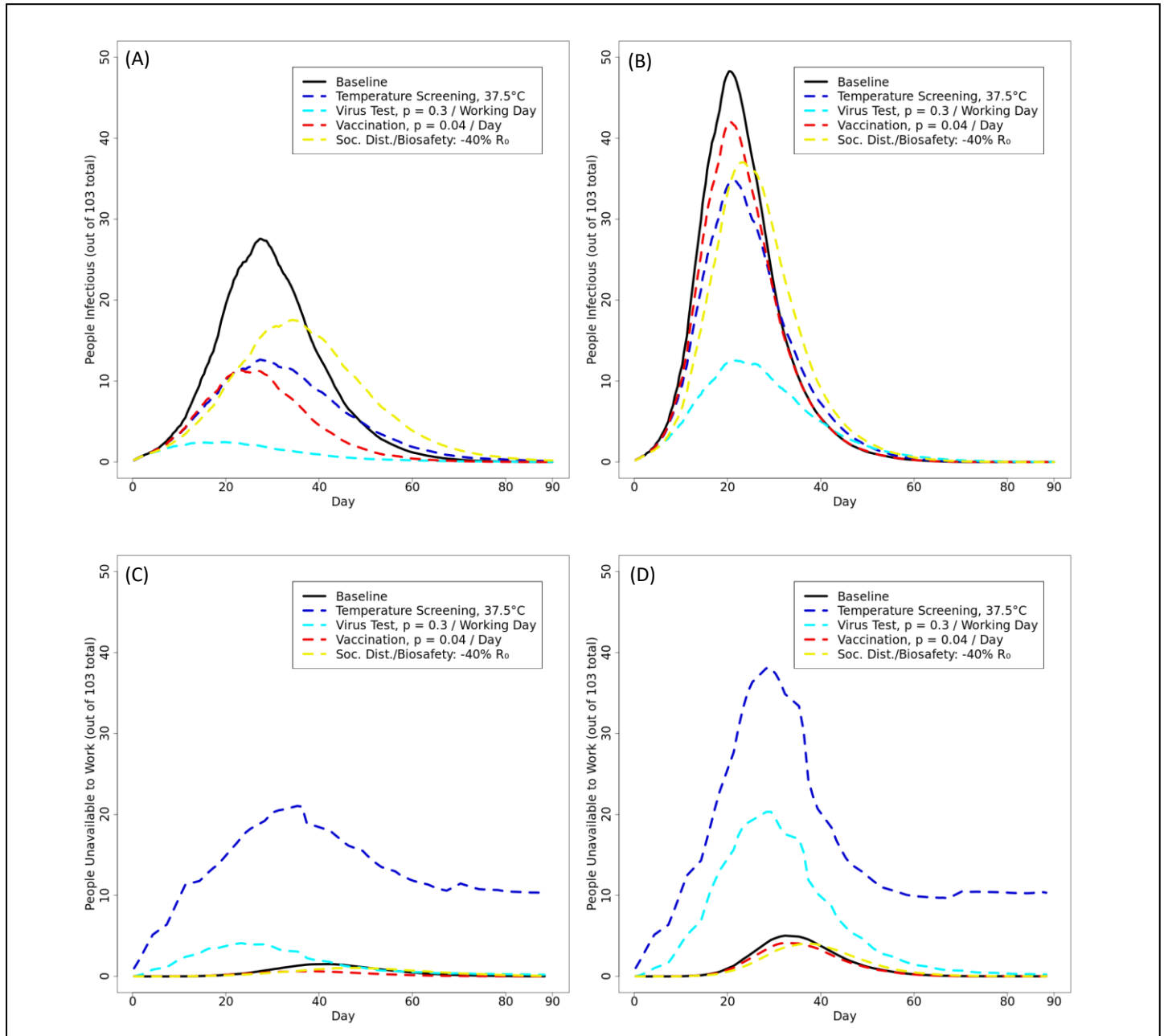
<sup>1</sup>“Intermediate  $R_0$ ” refers to the value of the basic reproduction number used (by assumption) when the user selects the “Intermediate” answer to the corresponding question about the (baseline) extent of social distancing.

<sup>2</sup>Parameter values are based on currently available epidemiologic data.

<sup>3</sup>The “severity multiplier” indicates the multiplier used (by assumption) for the (age-specific) risks of hospitalization given symptomatic infection (i.e., the probabilities, for members of each age group, of transition from Mild symptomatic infection to Severe symptomatic infection rather to Recovered). These probabilities (before multiplication) were originally based on hospitalization rates observed in 2020, and this multiplier is therefore 1, by definition, for 2020 strains. The results shown in Figure 1 were relatively insensitive to the exact value of this multiplier.

Overall, subject to model limitations and assumptions, the preliminary results indicate that surveillance through viral testing approximately every 3 working days, prevents more infections and results in fewer employees unavailable to work compared to temperature screening (at 37.5°C) of all employees daily. Social distancing/biosafety measures and vaccination both result in fewer worker absences compared to surveillance measures. While these qualitative phenomena observed for 2020 strains and the Delta variant are broadly similar, there are two major differences:

1. Vaccination interventions are appreciably less effective against the Delta variant than against the 2020 strains (although they can still make a meaningful difference).
2. The situation is worse with the Delta variant than with 2020 strains in essentially all respects.



**Figure 1.** Mean number of infectious workers (A and B) and workers who are unavailable to work (C and D) over time, for baseline (in black, solid line) and various mitigation strategies (temperature screening, at a threshold of 37.5°C; virus testing, at a rate of 30% of employees per working day; vaccination, at a rate of an average of 4% of unvaccinated employees vaccinated per day; and social distancing and/or biosafety interventions, resulting in a 40% reduction in the basic reproduction number), with type of intervention indicated by color. Results are shown for 2020 strains (A and C), and for the Delta variant (B and D). **All depicted predictions are under the assumption of 1 infected employee in an otherwise fully susceptible population on day 0.**

\*The *FlnD CoV Control* model is freely available <https://www.foodcovidcontrol.com/FOODCTL/> as an interactive web-based decision support tool.