IEOM Orlando 2025 Paper Revisions

**Results**

**Reviewer Comment:** Graphical Analysis and Explanation Figures 2a and 2b are referenced to describe unmet demand, but there is no explicit mention of the time frame in which these values were observed. Providing a timeline or specific peak periods for unmet demand could improve the reader’s understanding of when healthcare strain is most critical.

**Reza’s Comment:** Figures 2a and 2b describe unmet demand but do not mention the time frame. We need to explicitly state that these figures show total unmet demand over the entire planning horizon. To address the second part, you can analyze the Excel data to find the period with the highest unmet demand. Summing unmet demand for each period will allow you to determine the peak.

**New Paragraph in Paper**: Figure~\ref{fig:udHeatmap} compares the aggregate unmet demand that each Florida county attains during the entire planning time horizon (155 days). In both the vaccinated and unvaccinated scenarios, aggregate unmet hospital demand steadily rises until its peak on day 100, where it begins decreasing as patients are distributed across Florida.

**Discussion of Policy Implications**

**Reviewer Comment:** The results suggest that vaccination reduces infection peaks and hospital strain, particularly in metropolitan areas. It would be valuable to briefly discuss how these insights could inform public health policies, such as targeted vaccination campaigns or resource allocation strategies.

**Reza’s Comment:** Since our results indicate that vaccination reduces infection peaks and hospital strain, particularly in metropolitan areas, we should add a dedicated discussion section explaining how our findings can be used by decision-makers. This section should translate the results into practical, non-technical insights for policymakers, focusing on how vaccination strategies and resource allocation could be optimized based on our model.

**New Section in Paper:**

\section{Discussion of Policy Implications}

The case study demonstrates the clear benefit of vaccination in reducing peak infections and mitigating hospital strain under a pandemic scenario, especially in densely populated metropolitan areas. For practical purposes, we translate these findings into insights for policymakers seeking designed targeted vaccination strategies and resource allocation policies.

\subsection{Targeted Vaccination Campaigns}

From a policy standpoint, the data in Section 3.2 suggests that regional heterogeneity in transmission patterns shape vaccination strategies. In other words, “hotspot” areas with higher infection rates and denser populations, e.g. the metropolitan areas Miami-Dade and Broward Counties, should receive proportionally greater vaccine resources early in an outbreak. Targeted vaccination campaigns in such high-risk counties could mitigate the surge capacity required by healthcare facilities, reducing the need for extensive patient transfers, such as the “chaining” effect observed in our model, and in turn, unmet hospital demand.

Policymakers should thus launch vaccination campaigns in urban centers where contact rates are highest, and hospital capacity is more likely to be exceeded. As infection hotspots are likely to change over time, policymaker should also continuously monitor case counts and hospital occupancy to dynamically redirect vaccine supplies and respond to shifting hospital demand. The importance of dynamic vaccination campaigns is highlighted by the waning of vaccine efficacy as observed in our study. These late-stage resurgences call for booster programs and ongoing vaccination efforts to preserve the protection afforded by vaccines. Proactive planning can mitigate late spikes in infection rates, and therefore reduce the need for abrupt reallocation of patients and resources.

\subsection{Optimizing Healthcare Resource Allocation}

The unmet demand projections in Figure 2 reveal a contrast between metropolitan counties which are regularly close to capacity, and rural counties which tend to have fewer hospital beds but proportionally lower infection surges. To reiterate patient transfer results discussed in Section 3.3, larger counties like Orange, Hillsborough, and Duval often become receivers whereas many northern rural counties repeatedly send away patients away due to comparatively limited hospital capacity.

These results underscore the importance of coordinated allocation of hospital resources like beds, staffing, PPE, etc., especially during peak demand. Policymakers and healthcare administrators should consider spatial load balancing that can rapidly redistribute patients among facilities to ensure that no single county is overrun while neighboring counties have spare capacity. One can also implement tiered resource provisioning in vulnerable counties, such as the metropolitan counties that receive a high volume of incoming patients, during forecasted surges. In general, policymakers should anticipate the areas of most risk and implement preemptive measures to prevent the overburdening of healthcare facilities.

\subsection{General Guidance}

Government agencies could enhance pandemic response by integrating dynamic, real-time decision-making support systems that builds off our SIRV framework and patient transfer insights to continuously reallocate vital hospital resources and vaccines where they are most needed. Efforts like these could help mitigate potential second-waves of infections in conjunction with targeted vaccination campaigns designed to counteract the loss of vaccine immunity. Cost-benefit analyses should weight the financial, logistical, and infection risks of large-scale patient transfers against investment in permanently expanded local health care infrastructure. Moderate infection surges may justify temporary, coordinated patient transfers, while areas with consistent high infection rates, like the metropolitan counties in our study, could benefit from hospital capacity upgrades to meet hospital demand.

**Patient Transfer Dynamics**

**Reviewer Comment:** The concept of “chaining” in patient transfers is an important observation, but further discussion is needed to clarify its impact on healthcare infrastructure. Were there any counties that acted as major hubs for transfers? Additionally, could any policy recommendations be made to mitigate the cascading effect of overburdened hospitals?

**Reza’s Comment:** The concept of "chaining" in patient transfers is a key observation, but we need to discuss its impact more explicitly. We can acknowledge this as a study limitation, as we prioritized the optimal solution and did not introduce additional constraints to prevent cascading effects. Using network metrics such as in-degree, out-degree, or PageRank for Zi,j​, we can identify which counties act as major hubs for patient transfers. I can help you create them.

**New Information in Paper:** This information is to be placed in the conclusion, where we already list the chaining of patients as a limitation of the study.

Although we acknowledge the chaining of patient transfers as a limitation of this study, we prioritized the optimal solution of the model, that is, the minimization of unmet hospital demand, and did not introduce additional constraints to prevent the cascading effects.

**Comparison to Real World Data**

**Reviewer Comment:** The model produces insightful results, but a brief comparison with historical data from Florida (if available) could strengthen the study’s credibility. Does the observed unmet hospital demand align with actual healthcare challenges faced during past outbreaks?

**Reza’s Comment:** While historical data from Florida would help validate the model, obtaining and cleaning such data could be time-consuming. Instead, you can conduct a simple literature review or online search to compare our findings with previous healthcare challenges in Florida. If similar trends are observed in past outbreaks, we can mention that for credibility.

**New Information in Paper:** This information will be placed after our unmet demand results in its own paragraph.

Similar patterns emerge in historical COVID-19 hospitalization data from Florida, reinforcing our model’s findings about high unmet hospital demand in metropolitan centers. The Florida Hospital Association reported that ICU occupancy across Florida rose above 90% capacity during peak infection waves, with South Florida counties, like Broward and Miami-Dade, activating emergency response measures to handle overflowing admissions \parencite{ FloridaHospitalAssociation2021}. These local surges align with our observation that densely populated regions bear the brunt of unmet hospital demand. Statewide data from the Florida Department of Health demonstrated that even moderate increases in COVID-19 cases quickly strained available hospital beds, placing rural counties at risk for partial capacity shortages as patients were transferred to larger health systems \parencite{FloridaDepartmentHealth2021}. We therefore see that the upward trend in unmet hospital demand during Florida’s COVID-19 surges corroborate the trends in our model and the necessity of coordinated patient and resource allocation across counties.

Bibtex Entries for citation purposes.

@misc{FloridaHospitalAssociation2021,

title = {Florida COVID-19 Hospitalization Update},

author = {{Florida Hospital Association}},

howpublished = {Online Resource},

note = {Accessed: 2021-08-10},

year = {2021},

url = {https://www.fha.org/Coronavirus}

}

@misc{FloridaDepartmentHealth2021,

title = {Florida Department of Health COVID-19 Response},

author = {{Florida Department of Health}},

howpublished = {Online Dashboard},

note = {Accessed: 2021-08-10},

year = {2021},

url = {https://www.floridahealth.gov/programs-and-services/emergency-preparedness-and-response/covid-19/index.html}

}