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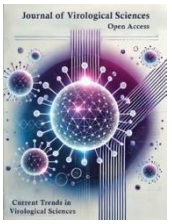

Review Article

Ripple Effects of COVID-19 on Taiwan's Infectious Disease Landscape

Michael Ross[1*], Linda Greene[2], Jason Miller[3], Sarah Bennett[4]

[1]Department Department of Virology, Harvard Medical School, Boston, MA, USA

[2]Center for Viral Research, University of California, San Francisco, CA, USA

[3]Department of Infectious Pathogens, Yale School of Medicine, New Haven, CT, USA

[4]Virology and Bioinformatics Unit, Stanford University, Stanford, CA, USA

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Abstract

The COVID-19 pandemic has significantly reshaped healthcare priorities and public health infrastructures around the globe. While its direct impacts have been widely studied, emerging evidence highlights its indirect effects on the surveillance and incidence of other infectious diseases. This review explores the findings from a comprehensive observational study conducted in Taiwan, which evaluated how COVID-19 and associated mitigation strategies influenced the reporting and occurrence of notifiable infectious diseases. By critically analyzing the data trends, methodology, and broader implications, this article provides an in-depth synthesis of the pandemic's ripple effects across Taiwan's public health system.

Introduction

The COVID-19 pandemic, caused by the novel coronavirus SARS-CoV-2, brought unprecedented challenges to global health systems. Beyond the direct morbidity and mortality caused by the virus, the pandemic profoundly disrupted routine health services, disease surveillance mechanisms, and public behavior. While many studies have focused on COVID-19 itself, the indirect effects on other infectious diseases remain underexplored in some regions.

Taiwan offers a unique perspective in this context. Due to its swift and coordinated public health response, Taiwan managed to contain the initial outbreaks effectively. Measures such as border controls, contact tracing, quarantine, social distancing, and widespread mask usage were implemented early and rigorously. These non-pharmaceutical interventions (NPIs), while targeted at COVID-19, potentially influenced the transmission dynamics of other infectious agents as well.

The study under review—conducted by a Taiwanese research team—investigates how the COVID-19 pandemic affected the incidence and reporting of notifiable infectious diseases in Taiwan. Using nationwide surveillance data from 2018 through 2021, the authors assess changes in disease patterns before and during the pandemic. This review critically evaluates their findings, methodology, and the broader public health implications.

The study employed a retrospective observational design, analyzing national surveillance data from Taiwan's Notifiable Infectious Disease Surveillance System (TNIDSS). The authors categorized notifiable diseases into three primary groups: respiratory, gastrointestinal, and vector-borne illnesses. They then compared the monthly and annual case counts of these diseases between pre-pandemic years (2018–2019) and pandemic years (2020–2021).

Decline in respiratory infections

The most striking reduction occurred in respiratory infections. Diseases such as influenza, measles, and tuberculosis showed substantial declines during the pandemic years. For instance, influenza cases dropped by over 90% compared to pre-pandemic levels. This reduction is likely attributed to stringent NPIs such as mask-wearing, social distancing, school closures, and enhanced hand hygiene, which are particularly effective against airborne pathogens.

Reduced gastrointestinal illnesses

Gastrointestinal infections, including norovirus and salmonellosis, also saw a decline—though less dramatic than respiratory diseases. The decrease could be partially due to improved hygiene practices and behavioral changes, such as reduced dining out and increased use of hand sanitizers.

*Correspondence to: Michael Ross, Department of Virology, Harvard Medical School, Boston, MA, USA, E-mail: evelyn.reed@jhu.edu

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Vector-borne diseases showed mixed trends

Interestingly, the impact on vector-borne diseases such as dengue fever was more variable. While some reduction was observed, the trends were not as consistent or pronounced. The authors hypothesized that vector-borne diseases might be less affected by NPIs, especially those not directly linked to human-to-human transmission. However, decreased travel and mobility may have played a role in reducing case importation.

Concerns about underreporting and surveillance gaps

The study acknowledged the possibility of underreporting during the pandemic. With healthcare systems overwhelmed or redirected toward COVID-19, some cases of other diseases might have gone undiagnosed or unreported. Reduced healthcare-seeking behavior during lockdowns may have further exacerbated this issue.

Literature Review

The study's design boasts several strengths. Firstly, it leverages a robust national surveillance database, ensuring comprehensive and high-quality data. Secondly, the use of a multi-year baseline (2018–2019) allows for meaningful comparisons that account for inter-annual variability. Thirdly, the application of Poisson regression modeling enhances the statistical rigor of the analysis.

Moreover, the authors' decision to categorize diseases based on transmission mode (respiratory, gastrointestinal, vector-borne) enables a nuanced understanding of how different interventions may have affected various pathogens.

Contextualizing the findings

The findings from Taiwan align with trends observed in other regions. For instance, similar declines in influenza and other respiratory illnesses were reported in countries like South Korea, Japan, and New Zealand during the early pandemic phase. These patterns underscore the effectiveness of NPIs beyond COVID-19 and suggest potential applications for future outbreak control.

However, the Taiwan study also emphasizes the delicate balance between focused pandemic response and maintaining routine health services. The risk of surveillance fatigue, underreporting, and diagnostic overshadowing (where clinicians focus heavily on COVID-19 at the expense of other conditions) is real and must be addressed in preparedness planning.

Public health implications

The decline in various notifiable infectious diseases during the COVID-19 pandemic presents both opportunities and challenges for public health systems. On one hand, the effectiveness of non-pharmaceutical interventions (NPIs) demonstrates the potential of behavioral and policy-driven strategies in curbing disease transmission. On the other hand, these same interventions have disrupted routine health service delivery, disease surveillance, and data completeness.

Reinforcing the value of NPIs

One key takeaway from the Taiwanese study is the value of NPIs beyond their application in COVID-19 control. Mask mandates, hand hygiene campaigns, and physical distancing substantially reduced the burden of respiratory illnesses. These interventions, which were once considered excessive for seasonal diseases, now emerge as viable strategies for managing outbreaks—especially during peak seasons or when dealing with high-risk populations.

This prompts a reconsideration of public health norms: should mask-wearing become standard during influenza season? Could targeted NPIs reduce disease transmission without widespread lockdowns in future epidemics? Taiwan's experience provides compelling evidence in favor of integrating flexible, data-driven NPIs into routine public health practice.

Surveillance system adaptability

The study also highlights the importance of resilient and adaptable disease surveillance systems. While Taiwan's centralized surveillance infrastructure enabled the detection of declining trends, the potential for underreporting during a crisis cannot be ignored. When healthcare personnel and resources are diverted toward managing a pandemic, diseases that are less urgent or more familiar may receive less attention. Moreover, patient reluctance to seek care during outbreaks can further hinder data accuracy.

Therefore, strengthening surveillance infrastructure is critical—not only in terms of data collection but also in ensuring continuity and reliability during public health emergencies. Diversifying surveillance methods (e.g., incorporating syndromic surveillance, digital tools, wastewater monitoring) may help mitigate disruptions in future crises.

Immunity gaps and post-pandemic risks

An important issue raised implicitly in the study is the potential for immunity gaps. When transmission of common pathogens drops sharply due to NPIs, population-level immunity may wane over time. This can set the stage for larger or more severe outbreaks once restrictions are lifted. The dramatic reduction in influenza, for instance, may lead to lower herd immunity, increasing susceptibility in future seasons.

This concept of "immunity debt" necessitates proactive planning for post-pandemic disease resurgence. Public health officials should monitor immunity levels through serosurveys and be prepared for potential surges in certain infections—especially those that rely on natural exposure for long-term immunity reinforcement.

Comparison with global trends

The findings from Taiwan echo broader global patterns observed during the COVID-19 pandemic. A number of studies from diverse regions—including Europe, North America, and East Asia—have documented similar declines in notifiable diseases, especially those spread via respiratory and fecal-oral routes.

Respiratory infections: A global decline

Countries like Japan and South Korea reported steep reductions in influenza, respiratory syncytial virus (RSV), and even pertussis during the early years of the pandemic. A study from the U.S. Centers for Disease Control and Prevention (CDC) found that the 2020–2021 flu season was virtually absent in terms of hospitalizations. This global trend underscores the high transmissibility of respiratory viruses under normal conditions—and how significantly NPIs can alter that trajectory.

Taiwan's near-eradication of influenza during the pandemic years is therefore part of a wider epidemiological shift. Importantly, it demonstrates how coordinated national policy can yield measurable public health benefits beyond the initial target.

Gastrointestinal and vector-borne diseases

Gastrointestinal infections such as rotavirus, shigellosis, and norovirus also declined globally during the pandemic, often tied to increased handwashing and food safety awareness. The findings in Taiwan mirror this trend, reinforcing the notion that health behavior modification can suppress fecal-oral transmission.

Vector-borne disease trends, however, were more variable worldwide. In tropical regions, changes in mosquito populations, climate, and human mobility all influenced dengue transmission differently. In Taiwan's case, localized dengue outbreaks appeared to decline, but not as dramatically as other infections. This highlights the unique epidemiological characteristics of vector-borne diseases and their partial immunity to behavioral interventions.

Discussion

Underreporting and behavioural shifts

The potential for underreporting remains a critical concern. Many individuals may have avoided hospitals or clinics for fear of COVID-19 exposure. Others may have encountered delayed diagnostics due to overwhelmed facilities. These behavioral changes could skew the apparent decline in other diseases. It's difficult to disentangle whether the reductions reflect a true decrease in transmission or a drop in detection.

Taiwan's strict border control measures and travel restrictions likely played a major role in reducing imported cases of various infectious diseases. The sharp drop in international movement effectively reduced exposure to many exogenous pathogens, particularly those endemic in other parts of Asia. Thus, the trends observed may be partially attributed to reduced disease importation, not solely internal interventions.

Absence of qualitative data

The study, being primarily quantitative, does not explore qualitative aspects such as public perceptions, healthcare worker experiences, or compliance rates with NPIs. Including such dimensions could have enriched the analysis and provided a more comprehensive picture of how societal behavior affected disease trends.

Taiwan's experience during the COVID-19 pandemic serves as a case study in effective epidemic management and its wider consequences. The country's ability to limit community transmission, enforce coordinated public health measures, and maintain surveillance integrity offers a model for future outbreak preparedness. At the same time, the indirect effects—reduced disease surveillance, potential immunity gaps, and underreporting—highlight the complexity of managing a health system during a global crisis.

As we move into a post-pandemic world, the need to adopt an integrated, holistic approach to infectious disease control becomes ever more apparent. Combining behavioral science, epidemiological data, and health systems planning will be crucial to both preventing future pandemics and mitigating their ripple effects.

Summary of key insights

This comprehensive review of the Taiwanese observational study on notifiable infectious diseases during the COVID-19 pandemic yields several essential insights:

- Widespread Decline in Infectious Diseases: The pandemic and the accompanying NPIs led to a pronounced reduction in many infectious diseases, particularly those transmitted via respiratory and fecal-oral routes. The data strongly suggest that these interventions were effective beyond their original intent.
- Disease-Specific Variability: Not all diseases declined uniformly. Vector-borne diseases such as dengue showed less consistent reductions, pointing to the limitations of NPIs for pathogens with complex transmission pathways. This suggests that while broad measures are effective, disease-specific strategies remain necessary.
- Surveillance Vulnerabilities: Despite Taiwan's robust public health system, the potential for underreporting and missed diagnoses during the pandemic cannot be overlooked. Resource diversion, fear of healthcare settings, and disruptions in routine services may have masked the true burden of non-COVID diseases.
- Behavioral and Structural Shifts: The pandemic altered public health behavior and healthcare infrastructure in ways that may have long-term consequences. Heightened hygiene awareness, reduced global mobility, and telemedicine adoption all played roles in changing disease dynamics.
- Future Risks and Immunity Gaps: The temporary suppression of disease transmission may lead to future susceptibility, especially for diseases where immunity depends on periodic exposure or vaccination. As NPIs are lifted, a resurgence in certain infections is possible, necessitating proactive planning.

Long-term integration of NPIs

One of the most pragmatic implications is the consideration of NPIs as regular tools in the infectious disease control arsenal. For instance, strategic mask mandates during flu season or in healthcare settings may become a routine part of preventive medicine. Similarly, public hand hygiene campaigns could be institutionalized through educational programs, signage, and infrastructure (e.g., sanitizer dispensers in public spaces). Public acceptance of these measures, however, remains a key determinant. Policymakers must balance epidemiological benefit with cultural norms and social fatigue, particularly after a prolonged global crisis.

Enhancing resilience in health systems

The study underscores the importance of resilient health systems that can maintain core services and surveillance functions even during emergencies. This includes developing surge capacity, training healthcare workers in multi-disease awareness, and reinforcing the importance of continuous reporting even in times of crisis. Moreover, public health systems should avoid an over-reliance on centralized strategies and consider decentralized or community-based surveillance methods, especially when hospital-based detection falters.

Future surveillance innovations

Emerging technologies—such as digital contact tracing, syndromic surveillance using mobile apps, and even artificial intelligence—could provide more responsive and adaptive tools for real-time disease tracking.

Taiwan's experience provides a baseline against which future surveillance innovations can be evaluated. In addition, integrating laboratory networks with epidemiological data systems can help detect early warning signs of emerging infections or disease rebounds post-pandemic.

Global comparisons and collaboration

While Taiwan's findings are context-specific, they hold significant relevance for other countries seeking to learn from successful pandemic responses. Global collaboration—through platforms like the World Health Organization (WHO), the Global Outbreak Alert and Response Network (GOARN), and academic exchanges—can facilitate cross-country comparisons and best practice dissemination.

For example, lessons from Taiwan could inform responses in densely populated regions or places with comparable healthcare infrastructure. Similarly, nations with less robust surveillance systems can draw insights from Taiwan's experience in maintaining data quality under pressure.

Conclusion

The COVID-19 pandemic has been a stress test for global health systems. While much of the world struggled with containment, Taiwan emerged as an exemplar of effective early response. The study reviewed here highlights a less-explored aspect of that response—the indirect impact on other notifiable infectious diseases.

The substantial decline in diseases like influenza and norovirus illustrates the power of NPIs, while the resilience of vector-borne diseases underscores the need for disease-specific strategies. The broader message is clear: public health actions have ripple effects that extend far beyond their immediate targets.

By studying these ripples, we can better prepare for future health challenges. The pandemic has offered hard-earned lessons in preparedness, flexibility, and integration. Taiwan's experience, rigorously documented and analyzed in the original study, provides a valuable reference point for building more adaptive and holistic public health systems worldwide.

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