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Editorial

POST-COVID-19 RESEARCH PRIORITIES: FROM LONG-TERM EFFECTS TO SOCIOECONOMIC RECOVERY

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INTRODUCTION

The COVID-19 pandemic, caused by the SARS-CoV-2 virus, rapidly spread worldwide, becoming a global health crisis with unprecedented consequences.[1] As of November 2020, more than 54 million cases and 1 million deaths have been reported globally.[2] The pandemic posed significant challenges to healthcare systems, particularly intensive care units (ICUs), which face overwhelming surges in critically ill patients requiring care.[3] Research on post-COVID-19 effects is crucial because of the persistent health impacts on recovered patients. Long-COVID, or post-acute COVID-19 syndrome presents a significant public health challenge.[4] It manifests with symptoms such as fatigue, dyspnea, cognitive impairment, and cardiovascular issues (Bayry et al., 2021; Garg et al., 2021). Notably, neurological sequelae are the most common symptoms, affecting 91.6% of patients in one study,[5] highlighting the need for further investigation. The pandemic has also altered daily behaviors, such as time use, travel, and purchasing habits, which have not fully returned to pre-pandemic levels despite vaccination.[6] Research into the post-COVID-19 effects is essential for developing effective interventions, rehabilitation strategies, and healthcare policies.[7] Sex-informed approaches are necessary, as studies show a higher prevalence of long-term COVID-19 among women with potential reproductive health implications.[8] Ongoing research is vital for understanding the long-term consequences, improving patient outcomes, and preparing for future public health crises. Some key areas of COVID-19 research should be continued, ultimately for the next 5 years, such as vaccine development and efficacy, long COVID-19, mental health impact, telemedicine and remote healthcare, epidemiological modeling and surveillance, socioeconomic impacts, and recovery strategies.

VACCINE DEVELOPMENT AND EFFICACY

COVID-19 vaccine development and efficacy research has significantly progressed, with various platforms, including vector, RNA, subunit, inactivated, and DNA vaccines approved for human use (Kudlay & Svistunov, 2022; Mohammed et al., 2022). Clinical trials and real-world studies have indicated that these vaccines effectively reduce infection rates, disease severity, hospitalization, and mortality (Mohammed et al., 2022; Wang et al., 2023). Although rapid development has raised efficacy concerns, studies have shown that most vaccines remain effective against emerging variants (Kudlay & Svistunov, 2022; Mohammed et al., 2022). However, constant mutation of the virus requires ongoing research and potential vaccine redesign.[9] Further investigations are needed to optimize vaccination regimens, evaluate booster doses, determine correlates of protection, and assess long-term safety and effectiveness (Kim et al., 2021; Wang et al., 2023). Enhancing vaccine stability, immunogenicity, and production scalability is essential for global vaccination needs.[10] Lessons from COVID-19 vaccine development are expected to expedite vaccine availability for other diseases and improve future pandemic preparedness.[11]

LONG COVID-19

Long COVID-19, or post-acute sequelae of COVID-19 (PASC), involves symptoms persisting beyond 12 weeks of SARS-CoV-2 infection (Garg et al., 2021; Walia et al., 2021). Affecting 10-35% of survivors and manifests as fatigue, dyspnea, chest pain, cough, depression, anxiety, PTSD, memory loss, and concentration issues.[12] It affects the respiratory, cardiovascular, and nervous systems, imposing significant burdens on individuals, healthcare systems, and the economy (Parotto et al., 2023; Sideratou & Papaneophytou, 2023). The pathophysiology of long-term COVID-19 remains poorly understood, with ongoing symptoms often not aligning with objective cardiopulmonary health measures.[13] Four main pathophysiological categories have been identified: virus-specific variations, oxidative stress, immunological abnormalities, and inflammatory damage.[14] Evidence suggests an increased risk of suicidal ideation and behavior, emphasizing the need to manage psychiatric, neurological, and medical conditions in these patients.[15] Addressing long-term COVID-19 requires more research into its epidemiology, pathophysiology, and long-term effects. Establishing post-COVID care clinics, multidisciplinary approaches, and rehabilitation centers is essential for effective management.[4] Additionally, exercise programs and physical activity may help improve symptoms and reduce long-term effects.[16]

MENTAL HEALTH IMPACT

The COVID-19 pandemic has significantly affected mental health, increasing psychological distress, anxiety, depression, PTSD, and burnout among the general public, healthcare workers, and vulnerable groups (Lange et al., 2021; Radfar et al., 2021; Ramírez-Ortiz et al., 2020). For example, up to 42% of general practitioners experienced psychological disturbances during lockdowns.[17] These mental health effects sometimes persisted even after public health restrictions were lifted. One study found that people with dementia and their caregivers faced longer-term psychological effects due to the loss of social support services.[18] Adolescents also showed increased depression symptoms and decreased mental well-being even after the schools reopened.[19] The substantial and potentially long-lasting mental health consequences of COVID-19 across demographics underscores the need for targeted interventions and support systems. Future research should focus on longitudinal studies to understand long-term mental health trajectories and develop effective strategies for promoting psychological resilience post-pandemic (Radfar et al. 2021; Soklaridis et al. 2020).

TELEMEDICINE AND REMOTE HEALTHCARE

Telemedicine and remote healthcare services have grown significantly and transformed post-COVID-19, with the pandemic accelerating telehealth technology adoption, making them essential for healthcare provision.[20] This shift has increased research on patient satisfaction with remote services both before and during the pandemic.[20] Synchronous telemedicine, such as video conferencing and telephone consultations, has been effective in ensuring continuity of care, convenience, improved access, and earlier disease management.[21] However, patient perspectives vary despite the widespread adoption by healthcare professionals. In Latin America, 84% of patients found telemedicine suitable during the pandemic, but only 54% saw it as viable for post-pandemic rheumatic care,[22] indicating a need for further research on long-term acceptance and challenges in sustaining telemedicine. Telemedicine has become vital in post-COVID-19 healthcare, offering benefits such as better access, cost-effectiveness, and reduced waiting time (Graf et al., 2023; Pinnock et al., 2022). Nonetheless, challenges such as patient privacy, technology literacy, and necessary legislation remain.[21] As healthcare systems evolve, the balance between remote and face-to-face consultations will be refined, with telemedicine becoming a core component of the "new norm" in healthcare delivery.[23]

EPIDEMIOLOGICAL MODELING AND SURVEILLANCE

Epidemiological modeling and surveillance are vital in public health decision-making and policy development, enhancing traditional data to improve situational awareness, assessing epidemiological characteristics, and informing preventive strategies.[24] Various traditional and innovative methods are used for infectious disease surveillance, with data dissemination being essential for public health actions.[25] Emerging data sources, such as spatial big data, including medical claims and mobile phone records, have enhanced disease mitigation and public health coordination.[26] Crowdsourced data from the Internet and mobile tools can address gaps in models, although data quality and bias remain challenging.[27] Wastewater-based epidemiology is gaining importance, especially in underserved communities.[28] The field is rapidly evolving and incorporating diverse data sources and advanced techniques. Systems such as AEGIS provide real-time health monitoring[29] and genomic sequencing combined with epidemiological data can guide interventions to reduce disease incidence and prevalence.[30] There is a need to standardize electronic health record-based surveillance, potentially by repurposing tools such as computable phenotypes and large data platforms.[31] The goal is to enhance the prediction and response to infectious disease threats, as shown by comparative studies of forecasting methods for epidemics.[32]

SOCIOECONOMIC IMPACTS AND RECOVERY STRATEGIES

Disasters have complex socioeconomic impacts, disproportionately affecting vulnerable populations and exacerbating existing inequalities.[33] Hurricane Katrina, for instance, highlighted disparities in recovery rates across different socio-demographic groups in the New Orleans, with less flooded and less vulnerable areas recovering faster.[34] Immigrant communities often encounter unique recovery challenges due to language barriers, cultural differences, and bureaucratic navigation difficulties.[35] Conventional recovery indicators such as governmental data have significant time lags, but correlations between social media sentiment and socioeconomic recovery activities suggest the potential for real-time recovery monitoring.[36] Research emphasizes the need to assess disaster impacts at a micro level, as recovery varies significantly between regions within a country.[37] A comprehensive disaster recovery approach is essential, which entails culturally competent management strategies,[35] targeted economic recovery plans,[38] and advanced technologies such as AI for better situational awareness.[36] Recovery theories should consider pre-disaster vulnerabilities, immediate post-impact responses, and broader societal conditions.[39] Integrating environmental, economic, and social factors in risk assessments enables policymakers to design equitable and effective interventions to address differential disaster impacts on vulnerable populations.[40]

CONCLUSION

The COVID-19 pandemic has reshaped global health priorities, highlighting the importance of sustained research across multiple domains. Key areas for investigation over the next five years include vaccine efficacy, long COVID, mental health, telemedicine, epidemiological surveillance, and socioeconomic recovery. By addressing these priorities, the global

community can improve patient outcomes, strengthen healthcare systems, and enhance preparedness for future public health crises.

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