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Lessons from the Pandemic for Healthcare Operations

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Preface

In the aftermath of the COVID-19 pandemic, the world faced numerous challenges that prompted a reevaluation and transformation of health-care systems. The world reacted to these challenges by innovating new technologies, adapting existing technologies to suit the challenges, and adopting these technologies for new usage. Consequently, new technologies and policies were developed and implemented, while existing processes were scrutinized for their effectiveness and efficiency, leading to ongoing improvements. The pandemic served as a natural experiment for exploring new ways of working, and its hysteresis effect has extended into the post-pandemic era. Communities have come to recognize the crucial role of new technologies in enhancing efficiency and access across various domains, including healthcare, education, public health and safety, and global supply chains.

This book brings together eleven works that delve into the lessons learned from the COVID-19 pandemic, which can be applied to the post-pandemic world to enhance efficiency, equity, and fairness. It also emphasizes the importance of preparedness in combating future pandemics or public health disasters, regardless of when or where they may occur. In this book, each study offers a unique perspective through which to view the evolving outlines of healthcare delivery, policy, and research. This is illustrated using several real-world experiences, empirical studies, and forward-looking insights. The contributions fall under three broad themes: The management of policies and funding in healthcare,

x

The role of data and data-driven research, and Accessible healthcare services during and after pandemic: Factors and policies affecting the management and control of such services.

The Management of Policies and Funding in Healthcare

Part One discusses the importance of public health and the lack of sufficient funding in this domain. The authors Arti Barnes and Sameer Vohra explain that public health investments are crucial not only for health but also for economic success, and it is essential to recognize their value and impact. Some barriers to funding include economic effectiveness standards, long-term prevention costs, and the influence of healthcare interest groups. The post-pandemic funding cuts, on top of an already underfunded infrastructure, may make the nation ill-prepared for future pandemics.

Part Two investigates budget allocation decisions in public health within the Global Fund's financing for HIV, tuberculosis, and malaria programs. Iva Rashkova presents models for both donors and grant recipients to optimize budget allocations between public and private distribution channels and among various disease-specific health products. This contribution proposes a modified greedy heuristic for donors and an index heuristic for recipients. The algorithm obtains promising results for improving system outcomes compared to benchmark policies. The results indicate that effective budget allocation decisions can significantly enhance treatment outcomes in resource-limited settings.

The Role of Data and Data-Driven Research

In Part Three, Joshua J. Barrett, Vinayak Deshpande, Martyn Knowles, Sandeep Rath, David Rowe, and Benjamin C. Wood propose a data-driven optimization model for surgical tray design using point-of-use surgical instrument data in collaboration with OpFlow. This model streamlines trays, improves instrument utilization, and delivers substantial cost savings. Validation through testing and expert review has demonstrated its superiority over current practices. The solution was

implemented at UNC Rex Hospital and the authors report projected annual savings of \$1.39 million for a representative set of trays.

Part Four by Selvaprabu Nadarajah and Sylvia Dziemian provides an adopt-and-enhance approach, focusing on the role of the decision-centered use of data and technology in decarbonization goals in health-care. This primarily includes adopting successful decarbonization strategies from other energy-intensive sectors and enhancing its patient-focused activities with decarbonization potential. The authors discuss decision intelligence for managing risks in adopting renewables on-site in a hospital. Thereafter, they propose a decision intelligence research framework to study the challenges in inequity access in decarbonizing tuberculosis care delivery. The findings show that addressing access inequity to care is a unique opportunity to simultaneously address health, costs, and emissions objectives. In this journey, strengthening data, predictive capabilities, and decision algorithms can help significantly.

Part Five by Roopa Foulger reviews the challenges, technologies, and impacts of data on healthcare operations, emphasizing the crucial role of data-driven insights in shaping the sector's future. The findings show that the explosion of healthcare data indicates a future of personalized, efficient, and data-driven patient care. Technological advancements and initiatives like the Meaningful Use Act have initiated transformative changes, including remote patient monitoring and innovative documentation platforms. Despite these advancements, challenges such as cybersecurity threats, data quality issues, and regulatory complexities must be addressed. Healthcare organizations and policymakers must ensure robust data protection, privacy, and ethical use.

Telemedicine has reshaped the healthcare landscape in various ways. Part Six by Susan Feng Lu and Shujing Sun explores the benefits of telemedicine adoption, in addition to the challenges and opportunities that paved the way for telemedicine's meteoric rise. The authors discuss various challenges, such as internet limitations, clinical considerations, security and privacy, physician licensing issues, and federal regulations. The authors also analyze the benefits and limitations of this service through different dimensions, such as access, quality, and cost.

In Part Seven, Mehmet Eren Ahsen, Ashish Khandelwal, Ramanath Subramanyam, Anton Ivanov, Ujjal Kumar Mukherjee, Dmitrii Sumkin,

and Sridhar Seshadri detail the organization and findings learned from a data science competition, titled “Mining COVID-19 Testing Data: Understanding Behavior and Providing Actionable Insights” as a part of the Third Midwest Healthcare Workshop. The competition aimed to use crowdsourcing to develop machine learning (ML) models that forecast future COVID-19 positivity rates based on previous infection and social media data. Key insights include the importance of widespread and accessible testing, as higher test rates correlate with lower positivity rates and the influence of social media sentiment on public behavior during health crises. This highlights the need for active engagement by health authorities on digital platforms to support public health measures. The competition also demonstrates the value of crowdsourcing through data competition in public health responses.

In Part Eight, Rodney P. Parker explains that the increased usage of digital technologies in healthcare delivery, such as telehealth is likely to be enduring. In addition, this work describes key lessons derived from the author’s experience of conducting research during the COVID-19 pandemic. The author describes the importance of gathering a research team consisting of complementary but overlapping skills.

Accessible Healthcare Services During and After Pandemic: Factors and Policies Affecting the Management and Control of Such Services

Individuals in rural areas face significant inequities in accessing mental health care due to factors, such as affordability, access, awareness, and stigma. Part Nine by Carina Hebl and Kingshuk K. Sinha investigates the impact of these factors on the likelihood of delaying or postponing mental health care. The authors focus on self-reported assessments from individuals in the Northeast Arrowhead Region of Minnesota and Douglas County, Wisconsin. The findings indicate that awareness is the primary barrier to seeking care, while access is the least common obstacle. The study also shows that demographic differences. For example, non-white individuals are more likely to delay care than white individuals. Also, Duluth residents are more likely to delay than those in neighboring

areas, and young and middle-aged adults face higher stigma-related delays compared to senior citizens.

Part Ten discusses the role of testing and other mitigation measures in managing emerging epidemics. Ujjal Kumar Mukherjee, Sebastian Souyris, and Anton Ivanov present several models incorporating testing, quarantine, lockdowns, and vaccination as control mechanisms, in addition to a specific model for predicting and allocating test kits to connected locations. The results highlight the essential need for managing pandemics, especially for diseases with asymptomatic transmission like COVID-19. Although early implementation is crucial for mitigation, once the disease is widespread, random asymptomatic testing becomes more effective. Overall, effective pandemic control requires a combination of testing, lockdowns, mask mandates, and other measures, rather than relying on testing alone. Vaccination must be combined with testing and other preventative measures until the majority of the population is fully vaccinated, as vaccination alone is insufficient without widespread coverage.

In Part Eleven, Mohammad Moshref-Javadi examines the impact of COVID-19 on consumer shopping behavior, primarily focusing on shifts in shopping channel preferences and patterns. The study analyzes changes in online and in-store shopping and variations in item categories purchased through five different channels. Key findings indicate that consumers diversified their use of shopping channels from 1.52 pre-pandemic to 1.72 during the pandemic, and to 1.76 post-pandemic, indicating a 15.8% increase from pre-pandemic levels. In-store shopping remained 20% lower than pre-pandemic levels. The Buy Online, Deliver to Home channel saw an increase from 26% pre-pandemic to 32% during the pandemic, stabilizing at 18% higher than pre-pandemic levels post-pandemic.