



OPINION

The Power of Data Science for Human Health

BY JOHN DOYLE

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The year 2020 was a difficult one for the whole world. But amid the pandemic-induced tragedies, the speed at which the world's brightest minds came together to produce highly effective vaccines and cutting-edge treatments brought a sense of encouragement to many. The overwhelming response to this scourge was crucial in highlighting what we need in an efficient health care system: agility, equity and better patient experience.

The creation and success of such a multilevel, interdependent, public health system can be fueled by data science.

Building Agility

The pandemic necessitated new and creative ways to collect and leverage real-world data to accelerate massive vaccine trials without sacrificing quality.

Near real-time epidemiologic data describing incidence, prevalence, virulence, morbidity and mortality was analyzed rapidly to inform inclusion/exclusion criteria and other trial design features, as well as targeting communities for need-based trial recruitment. This helped improve the efficiency, effectiveness, and equity of the trials conducted by Pfizer, Moderna and Johnson & Johnson. While these trials represent moonshot accomplishments in biopharma, they only reflect the green shoots applications of DS in improving human health.

Beyond vaccine trials, biopharma also utilizes DS for drug discovery. Advanced analytics, such as AI and machine learning, are now routinely used to simulate the effects of molecules on the body, and deep learning methods are accelerating DNA sequencing and efficient screening of biological omics data for target optimization. These techniques help scan for drug effectiveness in trials so as to repurpose previous drug development for new indications, such as COVID-19.

DS also influences supply-chain resource management, partnerships between biopharma and organizations across sectors, manufacturing operations; Industrial internet of things and training the next generation of workers.

Overall, DS plays a crucial role in ensuring that our evolving public health system is agile, effective in addressing challenges and well-equipped to deliver many more future breakthroughs in medicine.



education, health care, nutrition, transportation and support network.

Expanding access to data sets on these factors is enhancing our understanding of the distribution and impact of SDOH. Through DS, we can gauge the social risk of disease, how population groups interact with health care, whether patients can afford certain treatment options, how local health care providers handle the storage and administration of medications (like the specific refrigeration requirements of some COVID vaccines) and other community-level human health factors. The integration of these factors with individual patient-level risk factors is the future of DS in clinical development.

DS can solve for clinical research inequities by raising awareness of patient needs — especially in rural and economically disadvantaged areas with limited access to broadband data information systems. Through DS, researchers are better equipped to study the role of chance, bias and confounding needs when examining real-world data, especially when inferring causal relationships. DS also helps triage patients for clinical research as a care option, thereby improving equitable access to the latest innovations across diverse populations. Additionally, DS can be used to evaluate massive heterogeneous populations quickly and efficiently, which ultimately leads to advancing more breakthroughs in medicine — such as a possible COVID booster in the horizon.

Ultimately, an integrated approach combining traditional hypothesis-driven experimentation with DS analytics will provide the most comprehensive evidence base to answer the most pressing public health questions.

Bettering Patient Experience

The power of DS to influence every step of the patient journey is crucial when thinking about the measurement and optimization of the patient experience.

DS tools can be used to scan large populations in real-time and identify what segments are at a higher risk for various diseases — either due to socio-economic conditions or genetic predispositions — allowing for more effective prevention tactics and diagnoses.

DS-enabled targeted treatments for specific genotypes, phenotype, omics, etc., are also becoming more commonplace, thus improving patient experience with health care systems by making it more personalized. Follow-up to treatments is also made easier by leveraging the power of DS which handles generational and individual lifetime tracking of inherited health issues. By employing DS to measure the patient's behavioral and social experience after receiving a vaccine or taking a drug, we can better understand a patient's personalized risks as well as preferences for health states. Additionally, systematic surveillance of patients throughout their lifetimes helps determine the level of care patients continue to need.

From prevention to surveillance, sharing of appropriately blinded, privacy protected and curated medical data that is matched to best represent personal interests, characteristics and circumstances can be paramount when it comes to one's health care journey. This provides a deeper understanding of the



how a patient's needs are being addressed. Many of today's digital health products (wearables, sensors, etc.) are focused on measuring the basic human physiological needs such as food, warmth and rest. Psychological needs are also increasingly being addressed using integrated health education and gaming technology tools. The next step will be to optimize self-fulfillment with the aid of digital interventions that incorporate social welfare.

DS is the formative material for building every component of this patient experience pyramid, from the foundation to the capstone. COVID-19 has triggered a push to creatively apply DS to combat a foundational threat to humanity. Now it's up to us to embrace DS and push to optimize self- and community-actualization within the patient experience.

Conclusion

DS benefits human health on the individual, community and societal levels. Clinical, humanistic, economic and social data is being increasingly integrated to derive real-world insights to understand the comparative and cost-effectiveness of new medications, advance next generation vaccine and drug development, and influence policies and programs such as Medicare and Medicaid with evidence. As such, DS will play a vital role in improving population health by making our health care system more agile, equitable and centered on human experience.

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