Algorithmic Healthcare Prioritization: Designing Fair Vaccine Distribution Systems

A hospital is developing an algorithm to prioritize COVID-19 vaccine distribution among its staff. The proposed system aims to create an automated ranking of eligible recipients based on risk factors and exposure levels. The hospital administration believes an algorithmic approach would provide a more objective and fair distribution method than manual allocation.
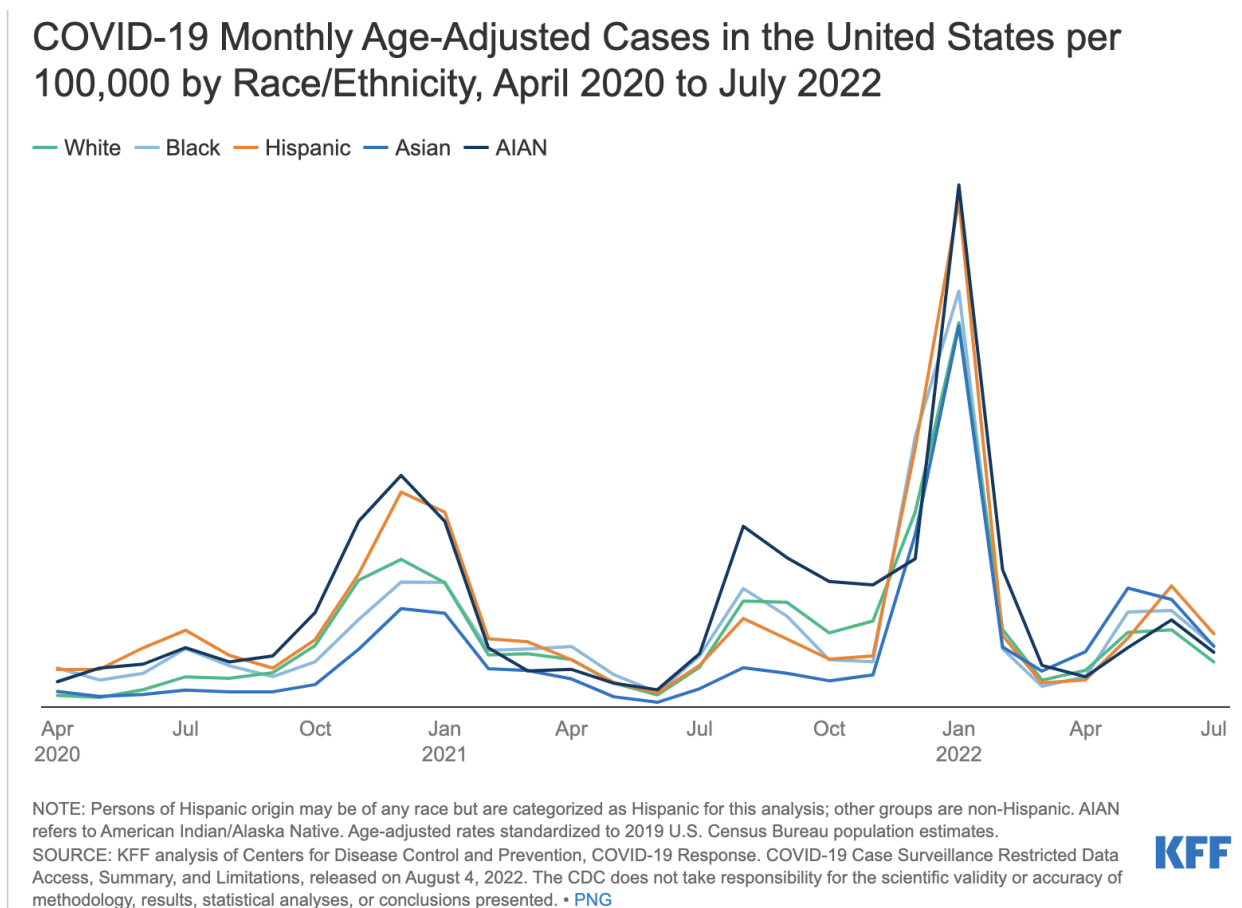
The development team has access to a hospital database containing staff information including age, job roles, and departmental assignments. They must design a system that considers both individual risk factors (such as age and health conditions) and occupational exposure levels. The algorithm needs to account for the complex nature of hospital staffing, including rotating residents, part-time workers, remote staff, and various specialized departments from emergency care to research.

The technical team must now determine different factors, how they would be weighted, and handle edge cases. While the hospital aims to create an equitable distribution system, early testing of similar algorithms at other institutions has shown unexpected biases - such as inadvertently deprioritizing frontline residents. The team must also consider how the algorithm will handle changing information about vaccine availability and risk factors.

1. Identify Direct and Indirect Stakeholders.
2. What are the social, cultural, economic and environmental contexts where the design will be used?
   a. Consider the following:
      i. Identify List of Factors that would be used for algorithm
      ii. Discuss Prioritization of Factors
         1. Discuss statistics given*
      iii. As a designer what additional information would be needed to implement an algorithm. What questions do you have and who would you ask?
3. What are key values at stake and value conflicts?

*Some statistics to consider:

Figure 1 [1]:

COVID-19 Monthly Age-Adjusted Cases in the United States per 100,000 by Race/Ethnicity, April 2020 to July 2022

— White — Black — Hispanic — Asian — AIAN

NOTE: Persons of Hispanic origin may be of any race but are categorized as Hispanic for this analysis; other groups are non-Hispanic. AIAN refers to American Indian/Alaska Native. Age-adjusted rates standardized to 2019 U.S. Census Bureau population estimates.
SOURCE: KFF analysis of Centers for Disease Control and Prevention, COVID-19 Response. COVID-19 Case Surveillance Restricted Data Access, Summary, and Limitations, released on August 4, 2022. The CDC does not take responsibility for the scientific validity or accuracy of methodology, results, statistical analyses, or conclusions presented. • PNG

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- "Indeed, in an initial cross-sectional study of vaccine distribution disparities, the CDC COVID-19 response team reported that only 5.4 % of the first 12 million doses went to individuals identifying as Black, with 11.5 % going to people identifying as Hispanic [2].

- When examining transmission rates, "We estimate that as of October 2020, individuals aged 20-49 are the only age groups sustaining resurgent SARS-CoV-2 transmission with reproduction numbers well above one, and that at least 65 of 100 COVID-19 infections originate from individuals aged 20-49 in the US"[3].

Case Study from:
https://ethicsinsociety.stanford.edu/tech-ethics/education-programs/case-studies

References:

[1] Hill L., & Artiga S. (2022). Covid-19 cases and deaths by Race/ethnicity: Current data and changes over time. Retrieved from https://www.kff.org/racial-equity-and-health-policy/issue-brief/covid-19-cases-and-deaths-by-race-ethnicity-current-data-and-changes-over-time/

[2].Painter EM, Ussery EN, Patel A, Hughes MM, Zell ER, Moulia DL, et al. Demographic characteristics of persons vaccinated during the first month of the COVID-19 vaccination program - United States, December 14, 2020-January 14, 2021. MMWR Morb Mortal Wkly Rep 2021;70:174–7. [DOI] [PMC free article] [PubMed] [Google Scholar]

[3] Monod, M., Blenkinsop, A., Xi, X., Hebert, D., Bershan, S., Tietze, S., Baguelin, M., Bradley, V. C., Chen, Y., Coupland, H., Filippi, S., Ish-Horowicz, J., McManus, M., Mellan, T., Gandy, A., Hutchinson, M., Unwin, H. J. T., van Elsland, S. L., Vollmer, M. A. C., Weber, S., … Imperial College COVID-19 Response Team (2021). Age groups that sustain resurging COVID-19 epidemics in the United States. *Science (New York, N.Y.)*, *371*(6536), eabe8372. https://doi.org/10.1126/science.abe8372