



PROVIDING BETTER HEALTHCARE THROUGH SYSTEMS ENGINEERING:

Improving Vaccine Access: Optimizing Storage and Hub Location in a Developing Country

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Many developing countries still face the prevalence of preventable childhood diseases because their vaccine supply chain systems are inadequate by design or weak by structure to meet the needs of their populations. Using Nigeria as a case study, this talk evaluates different regional supply chain scenarios to identify the cost-minimizing hub locations and storage capacities for doses of different vaccines to achieve a 100% II rate. First, we employ a shortest-path optimization routine to determine hub locations. Second, we develop a total cost-minimizing routine based on stochastic optimization to determine the optimal capacities at the hubs. This model uses vaccine supply data between 2011 and 2014 provided by Nigeria's National Primary Health Care Development Agency (NPHCDA) on Tuberculosis, Polio, Yellow Fever, Tetanus Toxoid, and Hepatitis B. Our emphasis is on meeting requirements given observed volatility in supplies to determine storage levels that will enable availability of vaccines during immunization campaigns. Our regionally integrated but vaccine disaggregated simulation projected three key policy implications: First, improving system performance, i.e., having the right quantities on hand and on time requires looking at each vaccine independently and understanding the regional variability. Second, reducing the hierarchical complexity of the vaccine supply chain will improve its performance. This simplification is even more important if the cost of capacity expansion is in fact positively correlated with the scale of expansion. Thus, in resource or budget-constrained environments like Nigeria's, capacity increases to improve system performance may be possible even with reduced budgets. Third, the recent successes recorded by Nigeria for having negligible newly reported polio cases demonstrate that the continued strengthening of the supply chain must be sustained.

Ekundayo Shittu conducts basic and applied research that take a systems engineering approach to aid decision making under uncertainty on investments into energy technology portfolios and the economics of climate change response policies. Pivotal to his research is the examination of how key stakeholders deal with climate change risk and uncertainty. He examines ways of integrating formal decision tools and microeconomics to develop climate policies that aid the adoption of renewable energy technologies. Current projects include understanding the effects of uncertainty in technological learning on energy capacity additions, investigating how energy firms' investments are shaped by competitive and regulatory pressures, studying how to adequately value renewable energy given the evolution of storage technologies to mitigate intermittency, investigating the role of incumbent inertia in the strategic decision on the adoption of renewable energy, studying the impacts of modularity on firms' outsourcing and investment decisions, and studying the platforms for an effective and efficient disaster response system. He also applies his research tools to supply chain issues in healthcare logistics.

This seminar series is presented by the U-M Center for Healthcare Engineering and Patient Safety (CHEPS): Our mission is to improve the safety and quality of healthcare delivery through a multi-disciplinary, systems-engineering approach. For the Zoom link and password and to be added to the weekly e-mail for the series, [please RSVP](#). For additional questions, contact CHEPSseminar@umich.edu. Photographs and video taken at this event may be used to promote CHEPS, College of Engineering, and the University.