COVID-19: Supply Chain Challenges and Research Opportunities

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Medical Supplies, Testing Materials, Vaccines: Issues and Solutions

- **Issue:** Medically-related supplies sourced from foreign suppliers (e.g., China) are vulnerable to disruption, especially in pandemics
  - *Pharmaceutical products,* mainly active pharmaceutical ingredients (API)
  - *Medical supplies,* such as vaccines, PPEs, disinfectants, syringes, etc.
  - *Medical equipment and devices,* such as ventilators, X-Ray machines, etc.

- **Broad solution:** Declare selected medically-related supplies as strategic
  - Mandate that a set percentage be manufactured in the USA
  - US manufacturing to have rapid ramping-up production capabilities
  - Diversify the supplier base of each strategic product
  - Stockpile federal and state strategic reserves of each strategic product
  - Sign option contracts to supply each strategic product in case of emergencies
  - Develop contingency distribution plans for emergencies
Medical Supplies, Testing Materials, Vaccines: Research Topics

Problems: Need solutions for the following

– Develop product acquisition plan (*inventories sizing, shelf life control, stockpile geolocations, supply option instruments*)

– Develop distribution algorithms to allocate product (*private/public logistics, prioritization of shipments*)

– Compile logistics costs (*acquisition/restocking, storage, inspection, transportation, etc.*)
Contingency Plan Coordination

• **Issue:** Coordination of contingency plans
  – Companies have private contingency plans largely unknown to government

• **Broad solution:** Setting up of a *Public-Private Contingency Planning and Coordination Council*
  – Government to mandate sharing of the contingency plans with the Council and a schedule for periodic revalidation and update of the contingency plans
  – Council to coordinate with CDC, FDA, FEMA, DoD
    ○ other agencies?
Vaccines have additional issues requiring special considerations

- Multiple vaccines have different efficacies
- Some have different requirements (e.g., refrigeration)
- Adaptive distribution strategy needed to respond to development and production of new vaccines
- Uncertainties in pathogen mutations and outbreaks call for specialized distribution algorithms (*who gets what and in what order*)
Pharmaceutical Supplies

Pharmaceuticals have additional issues

- API have longer shelf life than the drugs they constitute
- Once a drug is dosed, the expiration clock starts ticking toward the expiration date
- How much to store as API and how much as finished products?
  - Replenishment lead-time will be a factor
  - Stockpiling of API provides added risk pooling flexibility as API can be converted into different dosage forms (e.g., tablets, capsules, injectibles, etc.) and different strengths
- Where to preposition?
- Need to model costs of storage, inspection of supplies, restocking, etc.
- Need models to specify the terms of supply options
Role of IT/AI

- Technology is a cross-functional driver that can increase **efficiency** and **responsiveness** simultaneously, thereby reframing tradeoffs as win-win propositions
- AI/Machine learning allows more accurate prediction of demand
  - Enables lower inventories (efficiency) and just-in-time deliveries (responsiveness)
    - But lean inventories are vulnerable to black swan events
  - Need models to articulate the tradeoff between efficiency and resilience and identify win-win technology-driven solutions
  - Can tools such as blockchain help with supply chain visibility and early warnings of impending shortages?
- IT/AI for lowering Lead times
  - Since shorter lead times (*faster replenishment*) reduce the dependency on accurate forecasting, develop concepts/tools/models for lowering lead times
  - How to fund expedited (*and costlier*) deliveries in case of emergencies?
Role of IT/AI (Continued)

• Logistical resources
  – To optimize logistic operations, we need to understand them and their requisite resources (*manpower, machinery, IT support, etc.*)
  – Are machinery and workers interchangeable for different tasks?
  – Can automation/robots replace people?
    o More so in chemical manufacturing, but less so in pharmaceuticals
Proposed Research Initiatives

- Development of **rigorous models** that can help reposition supply chains of pandemic-related pharmaceuticals and medical equipment as strategic national assets constituting a balanced portfolio of public and private assets and capabilities.

- Formation of an information-sharing and collaborative platform that facilitates **coordinated contingency planning** of supply chains for strategic national assets.

- Establishment of a public, open source **knowledge repository** that provides models, best practices, data, and white papers that focus on providing scientific and sustainable solutions for pharmaceutical and medical equipment supply chains.

- Creation of **intelligent technological/analytics solutions** that uncover win-win supply chain strategies, where efficiency and resilience / responsiveness can be improved simultaneously.
Questions?

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