

Understanding the Challenges of Providing PPE in the U.S. during COVID-19

Shaghayegh R. Arangdad, PhD

A. Blanton Godfrey, PhD

North Carolina State University, USA

OUTLINE

- **Introduction**
- **Challenges**
- **Impact Of COVID-19 In Healthcare Supply Chain**
- **U.S. Response To COVID-19 & PPE Shortages**
- **Covid-19 Data Management In The U.S.**
- **Prediction Models Based On PPE Needs**
- **Discussion & Conclusion**

INTRODUCTION

Since the first case of the new coronavirus was reported on November 2019 in China, approximately 147 million people have been diagnosed resulting in over 3.11million deaths . About 22% of these deaths were in the US .

32,092,128

Confirmed cases in U.S.

572,287

Deaths in U.S.

INTRODUCTION

THE COVID-19 pandemic caused massive shortages in the Personal Protective Equipment (PPE) supplies needed to treat the virus as the disease spread rapidly throughout the world during 2020. Global supply chains suddenly became a new problem in public attention.

OVER SIX THOUSAND HOSPITALS as well as all fifty states competed with each other for Personal Protective Equipment in the U.S.

SHORTAGES OF PPE for doctors and nurses were major news stories nightly on news broadcasts with pictures of doctors and nurses wearing trash bags as substitute gowns and homemade masks that offered little protection



SITUATION

Even though we had seen the devastation of COVID-19 in China and other countries, the United States was totally unprepared when the virus started spreading rapidly here.

**Hospitals had less than
2 days of PPE on hand**

**Many ran out of PPE in
the first few days**

CHALLENGES

A major challenge was the disruption to the PPE supply chains in the U.S. and large PPE shortages across the country.

A second challenge was the lack of an accurate database of the production capabilities of U.S. suppliers of PPE.

SUPPLY CHAIN CHALLENGES IN HEALTHCARE



Costs



Lack Of Quality



Lack Of Supply Chain Health
Information Technologies

IMPACT OF COVID-19 PANDEMIC IN THE HEALTHCARE SUPPLY CHAIN



JUST-IN-TIME DELIVERY

- The practice of many healthcare organizations was purchasing using just-in-time delivery from Group Purchasing Organizations.
- Suppliers who normally produced based on a predictable and regular demand struggled to change their production processes to meet the rapid changes in demand.

THE GLOBAL NATURE OF THE MEDICAL SUPPLY CHAIN



- Around 50% of masks used in the world are made in one country, China. As the virus hit China first, the lockdowns there diverted supplies and paused production causing significant shortages of masks throughout the world.

U.S. RESPONSE TO COVID-19



Travel Restriction



Screening at the port of entry and mandatory home quarantine was implemented for travelers.



Stay Home

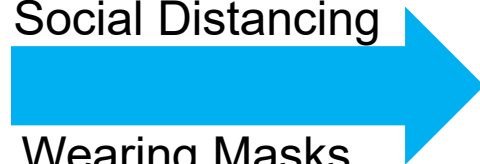


The U.S. second action was stay home orders instructing citizens to restrict their commuting outside their homes if not required.



Social Distancing

Wearing Masks



Social distancing and wearing masks in public areas was also recommended by the U.S. government and the CDC.

US RESPONSE TO PPE SHORTAGES

UNIVERSITIES

Many universities in the U.S. reacted quickly to PPE shortages.

Some made masks by hand, others revamped research facilities into manufacturing production operations.

TEXTILES & APPAREL COMPANIES

- Many apparel companies quickly turned their production lines to masks and gowns.
- Nonwovens companies retooled production facilities to produce the three-layer fabrics needed for N95 masks.
- Many companies that did not previously produce PPE, such as **Ralph Lauren** and **Canada Goose** adjusted their operations to produce critically needed products.

TEXTILES & NON-TEXTILES MANUFACTURES

Many non-textile manufacturers, e.g., Ford and Honeywell, also responded to contribute to the manufacture of PPE.

- Increasing manufacture of **finished** PPE and healthcare products.
- Increasing manufacture of **components** needed to make PPE:
 - Yarns and thread
 - Fabrics
 - Antibacterial and durable water repellent finishes

COVID-19 DATA MANAGEMENT IN THE U.S.

The current PPE **NEEDS** and **DEMANDS** were identified using the data on patients in hospitals, in states, and in regions of the country.

Many different data management tools were used to identify PPE needs and Demands:

- Data Tracking
- Contact Tracing
- The Strategic National Stockpile

The right data help to evaluate existing situations, predict upcoming crises and make critical decisions

PREDICTION MODELS BASED ON PPE NEEDS

HIGH DEMAND of critical products and **SHORTAGES IN SUPPLY** had a major impact on healthcare supply chains.

Many of the operational problems during the COVID-19 pandemic stem from the current supply chain management systems that have been primarily designed for **COST EFFICIENCIES**.

The challenges managing supply chains during a pandemic require **FLEXIBLE SYSTEMS** designed to quickly adapt to a rapidly changing landscape.

THREE SHORTAGE EXAMPLES

PROTECTIVE GOWNS

High percentage of hospital gowns made by one U.S. company

Fabric suppliers in Central America had been closed and existing fabric supplies were soon exhausted

Several companies responded to the crisis providing millions of yards of high-quality fabric for production of gowns

Low-cost supplies were soon available again from other countries

The U.S. manufacturers were left holding millions of yards of fabric in unsold inventories

FACE SHIELDS

Many organizations, especially research labs in universities, have numerous 3D printers. Designs for the face shields were rapidly shared and soon tens of thousands of face shields were being produced.

The shield makers, almost all not connected to the apparel and textile manufacturing complex, found themselves competing with the manufacturers of surgical face masks and N95 respirators for short-supply narrow-width, elastic fabrics used as head bands for the shields.

N95 RESPIRATORS

The shortages of these critical PPE items were so serious that many healthcare workers were asked to wear theirs for several days or even weeks or resorted to wearing the less efficient surgical masks or even homemade cloth masks

Although the United States is still the number one producer of nonwovens in the world, almost all plants were already running at close to full capacity prior to the pandemic with many making other critical healthcare supplies.

THREE SHORTAGE EXAMPLES

Almost all the critical PPE could be manufactured in the United States and distributed quickly to the healthcare providers and others with critical needs.

No producer of the end items controlled the supply chains end-to-end needed to produce these items.

Most producers were concerned that critical elements of the supply chain would revert to the lowest cost producers outside the U.S. as soon as possible and were reluctant to invest.

Most potential producers of PPE were concerned that they would not be able to recoup their investments in new equipment or facilities as purchasers would revert to sourcing the lowest cost products as soon as they could.

OTHER COUNTRIES

Other countries countered the above concerns in several ways.

- **Taiwan** created an adequate supply of face masks quickly by providing loans for new equipment that would be forgiven after a specified number of masks were provided to the government. This strategy worked amazingly well. Not only were the supplies created for use in Taiwan quickly, but these companies also soon became exporters of the masks to other countries still facing shortages.
- **The U.K.** also faced severe shortages but used a different approach. The government guaranteed purchase of many critical PPE items if manufacturers quickly ramped up production to provide what was needed. [This is almost the identical approach the US used for accelerating the creation and production of the vaccines by Pfizer.](#)
- Some countries just made direct grants for needed equipment to encourage companies to become capable of producing needed PPE.

LACK OF QUALITY



Compounding these problems was the lack of reliable test facilities for assuring that the products created or rapidly sourced from new suppliers and distributors met the **QUALITY** standards created by the FDA, CDC and NIOSH.

➔ Some healthcare providers enlisted labs at local universities to provide basic testing on shipments of suspect quality. Other organizations created in-house facilities to do at least fundamental testing.

SUMMARY & CONCLUSION

Future healthcare materials acquisition programs should be based on much deeper understandings of the entire supply chain.

Clear specifications not just for end products but also for intermediate materials must be developed.

Quality measurement plans and adequate testing facilities must be created for each critical element of the supply chains.

SUMMARY & CONCLUSION

This work has implications for anyone in the healthcare supply chain space (DoD task forces, DLA, DHA, FEMA, DHHS, DHS, State, Local and healthcare systems).

THANK YOU

Shaghayegh R. Arangdad, PhD

srezaei@ncsu.edu

North Carolina State University, USA

A. Blanton Godfrey, PhD

blanton_godfrey@ncsu.edu

North Carolina State University, USA