Mass General Brigham

Supply Chain Disruption In Healthcare: Planning and Mitigation

James R. Francis, FACHE
Jarrod Goentzel, PhD

January 26, 2024

Center for Disaster Medicine – Region 1 Disaster Health Response System and Regional Emerging Special Pathogens Treatment Center

Disclosure

- The content provided in this webinar is presented by the individual speakers only and does not represent of reflect the official policy or position of any portion of the United States Government.

- The content is not meant to be a substitute for medical professional advice, diagnosis, or treatment. The information herein should be adapted to each specific patient based on the treating medical professional's independent professional judgment and consideration of the patient's needs, the resources available at the location from where the medical professional services are being provided (e.g., healthcare institution, ambulatory clinic, physician's office, etc.), and any other unique circumstances. This information should not be used to replace, substitute for, or overrule a qualified medical professional's judgment.

Moderators & Speakers

Moderator:

Eileen Searle, PhD, RN
Director of Funded Projects
Massachusetts General Hospital

Speakers:

James R. Francis, FACHE
Chair, Supply Chain Management and Assistant Treasurer
Mayo Clinic
Assistant Professor, Health Care Administration
Mayo Clinic College of Medicine and Science

Jarrod Goentzel, PhD
Director, MIT Humanitarian Supply Chain Lab
Principal Research Scientist
Massachusetts Institute of Technology

Learning Objectives

1. Understand supply chain systems and common disruptions resulting in constraints

2. Explore critical lessons learned from recent supply chain disruptions

3. Identify planning and operations efforts that can be undertaken to mitigate the effects of supply chain disruption at the local/facility level

MAYO CLINIC

SUPPLY DISRUPTION IN HEALTHCARE: PLANNING AND MITIGATION

JAMES R. FRANCIS

CHAIR, SUPPLY CHAIN MANAGEMENT

JANUARY 26, 2024

Mayo Clinic and Mayo Clinic Health System

Charitable, not-for-profit, academic medical center

In 2022, Mayo Clinic and Mayo Clinic Health System:

Ranked Best Hospital and #1
in more specialties than any other hospital in the nation*

$16.3B
revenue
(net and other sources)

73,600
Total Personnel consisting of physicians, scientists, allied health staff, research associates, fellows, residents and students

Operated
22 hospitals in
5 states

Provided essential health care services to more than
1.4M patients
50 states
139 countries

MAYO CLINIC

* U.S. News and World Report, Mayo Clinic Rochester

Mayo Clinic Destination Medical Centers (and the Mayo Clinic Care Network)

MAYO CLINIC

Mayo Clinic Supply Chain*

2023 Supplies, Services, Rx, & Capital – $6.8B

- Supplies & Services – $**3.2B**/ Pharmaceuticals - **$2.0B**/ Capital – **$1.6B**

2023 Average FTEs – **806** SCM; MC Stores – **122**; HTM - **368**
2023 Net expense - **$69.7M** vs plan of **$63.7M**

Plan for 2024 – **$67.4M** SCM**; $10.8M** MC Stores**; $63.7M** HTM

Technology

- Oracle, Innovit, GHX, Ecteon, OneTrust, Tecsys, Wavemark, SCLogic, Par Excellence, Onbase, Magento, Alteryx, Tableau, UIPath, Google, etc

Mayo Clinic is a member and service provider – Captis, LLC. – a national aggregation supply network

- 2019 – 2023 Continued in Masters Class
- 2018 – Inducted into inaugural Masters Class (10th year anniversary)
- 2015 – First healthcare provider to be ranked #1
- Recognized since 2009 and placed in the Top 5 each year since 2011

MAYO CLINIC

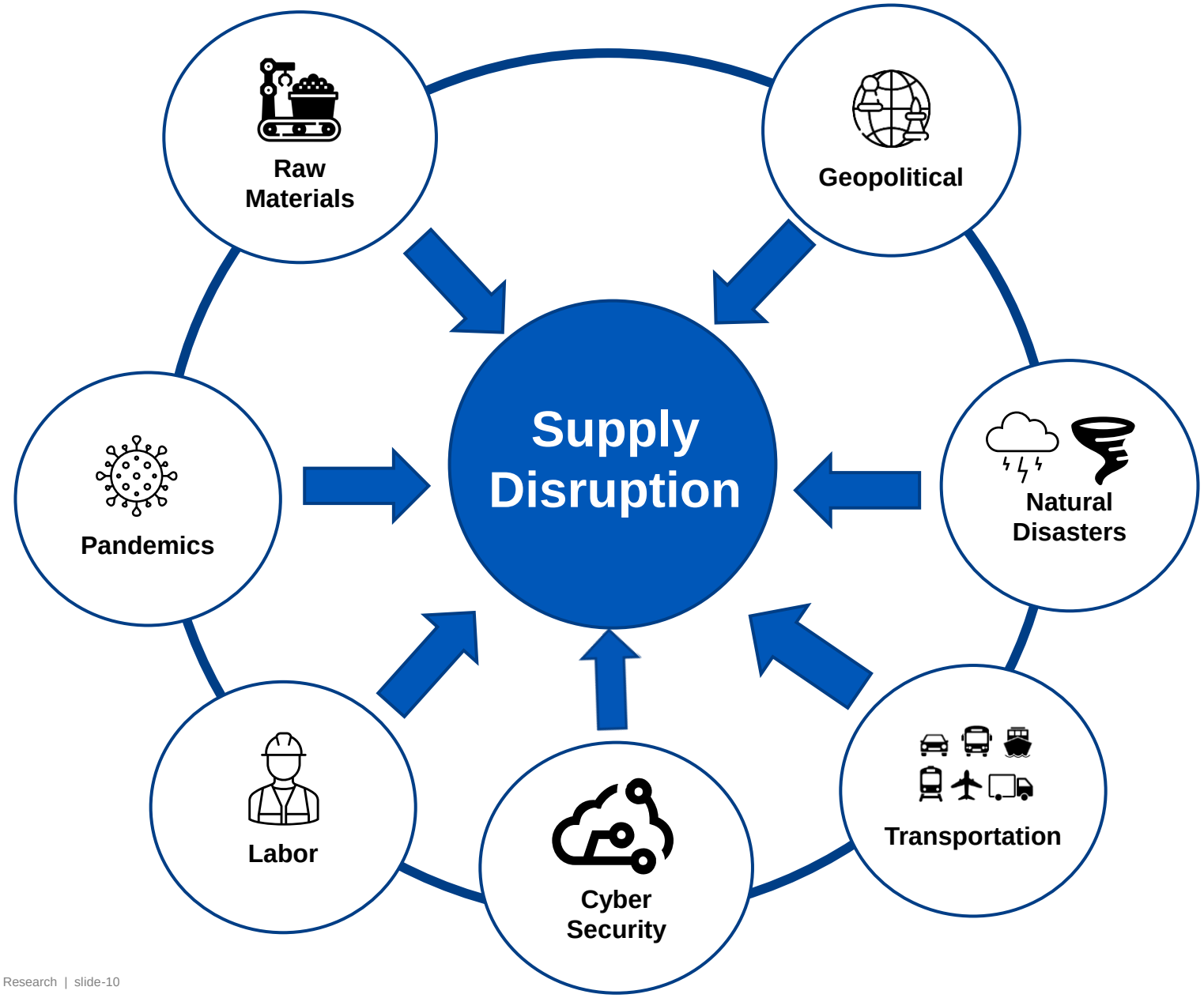
* A Division within the Department of Finance / Mayo Clinic Shared Services Organization

MAYO CLINIC

Supply chain management is an integral component of high value* healthcare. It involves the delivery of products, information, and solutions in direct support of patient care.

***Value – Safety, Quality, Outcome, Cost, Reimbursement, Patient Experience, Length of stay, etc.**

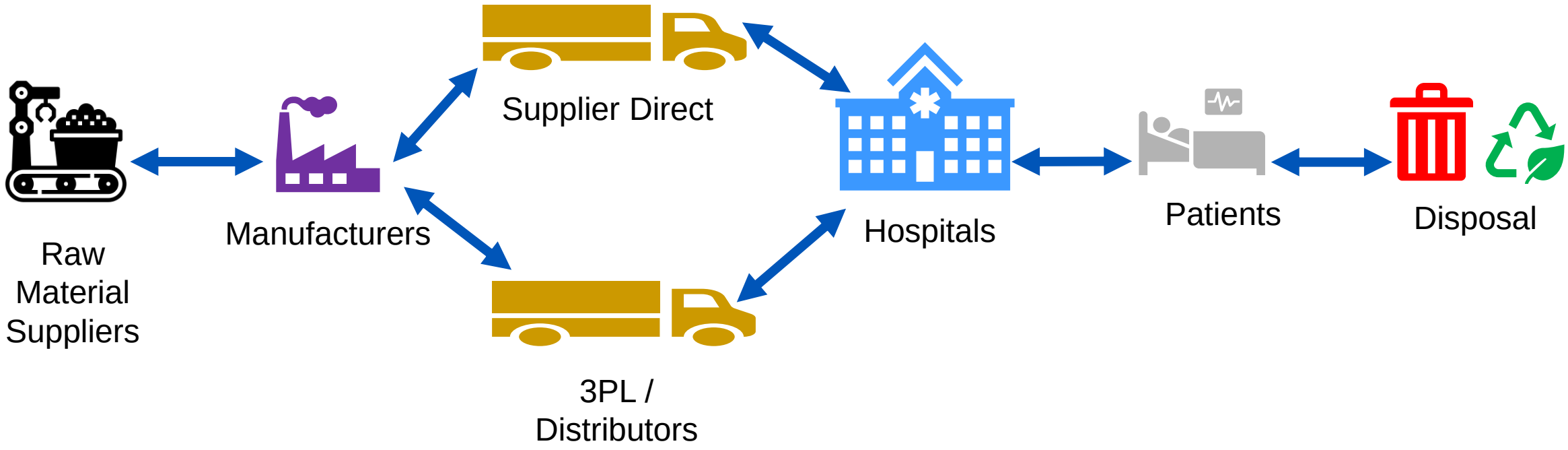
What causes a supply disruption ?



MAYO CLINIC

Basic Healthcare Supply Chain

Prevent the delay or cancellation of a patient encounter while protecting colleagues

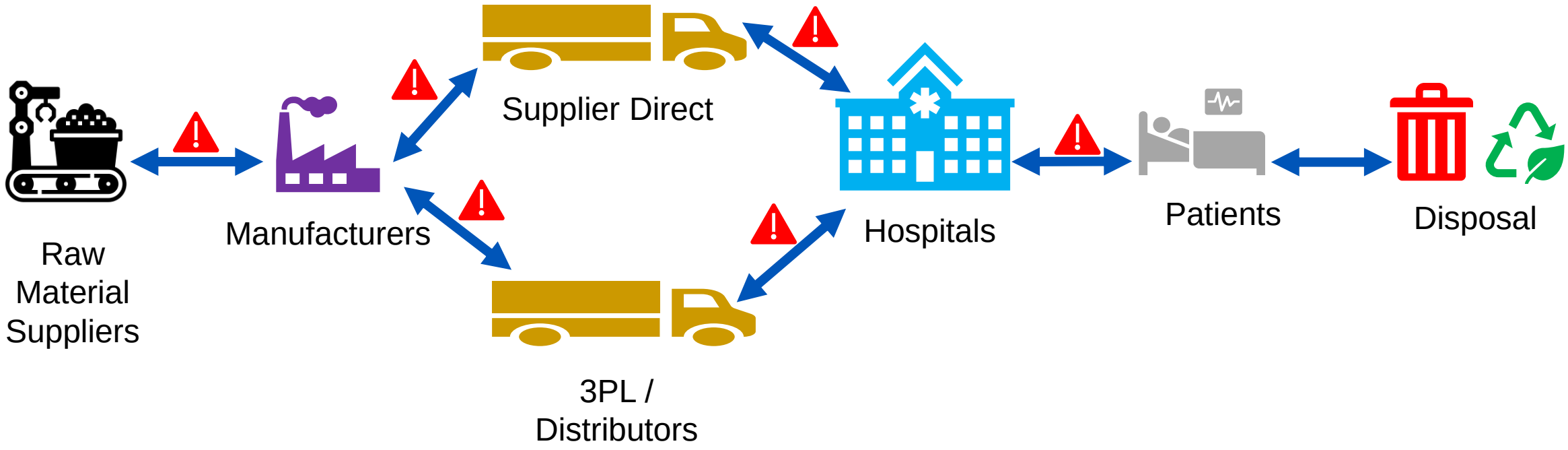


Primary Process Flows: Information, Materials/Supplies, and Money

MAYO CLINIC

Basic Healthcare Supply Chain

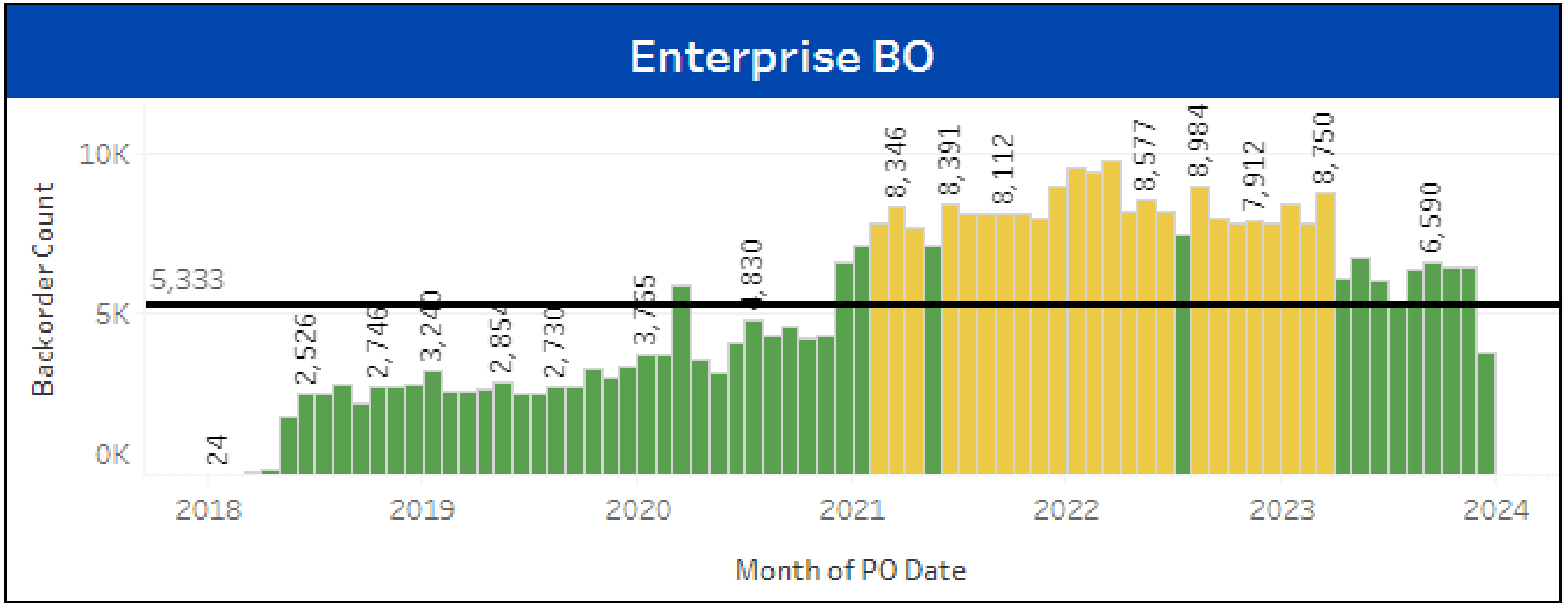
Prevent the delay or cancellation of a patient encounter while protecting colleagues



Primary Process Flows: Information, Materials/Supplies, and Money

MAYO CLINIC

Backorders – All Product Categories



MAYO CLINIC

TAUBER INSTITUTE FOR GLOBAL OPERATIONS
UNIVERSITY OF MICHIGAN

MAYO CLINIC

Cost of Backorders Summary

Total Annual Cost of Backorders

$17.27M

Substitutes	Distribution	Labor
$11.98M	$1.34M	$3.95M

August 2023

Mayo spends on average $165 every time there is a backorder

Planning and Mitigation

- ***Thanks to COVID-19, the entire world awakened to the importance of supply chain management.***

- Lessons learned from other disruptions and counter measures deployed
  - e.g., Ebola, SARS, Hurricane Maria, Winter Storm in Texas
- Continuous surveillance of potential and real disruptions and proactive mitigation steps
  - Mayo Clinic founding member of Healthcare Industry Resiliency Collaborative (HIRC) www.hircstrong.org
- Robust business continuity and disaster plans
- Investments in technology to increase visibility and transparency
- Digitalization of the supply chain, control towers, AI, early alert/warnings, transparency with key supply partners (visibility of demand signals – in/out)
- New sourcing and contracting strategies (e.g., production, 125% allocations, supplier held / dedicated inventory, etc.)

MAYO CLINIC

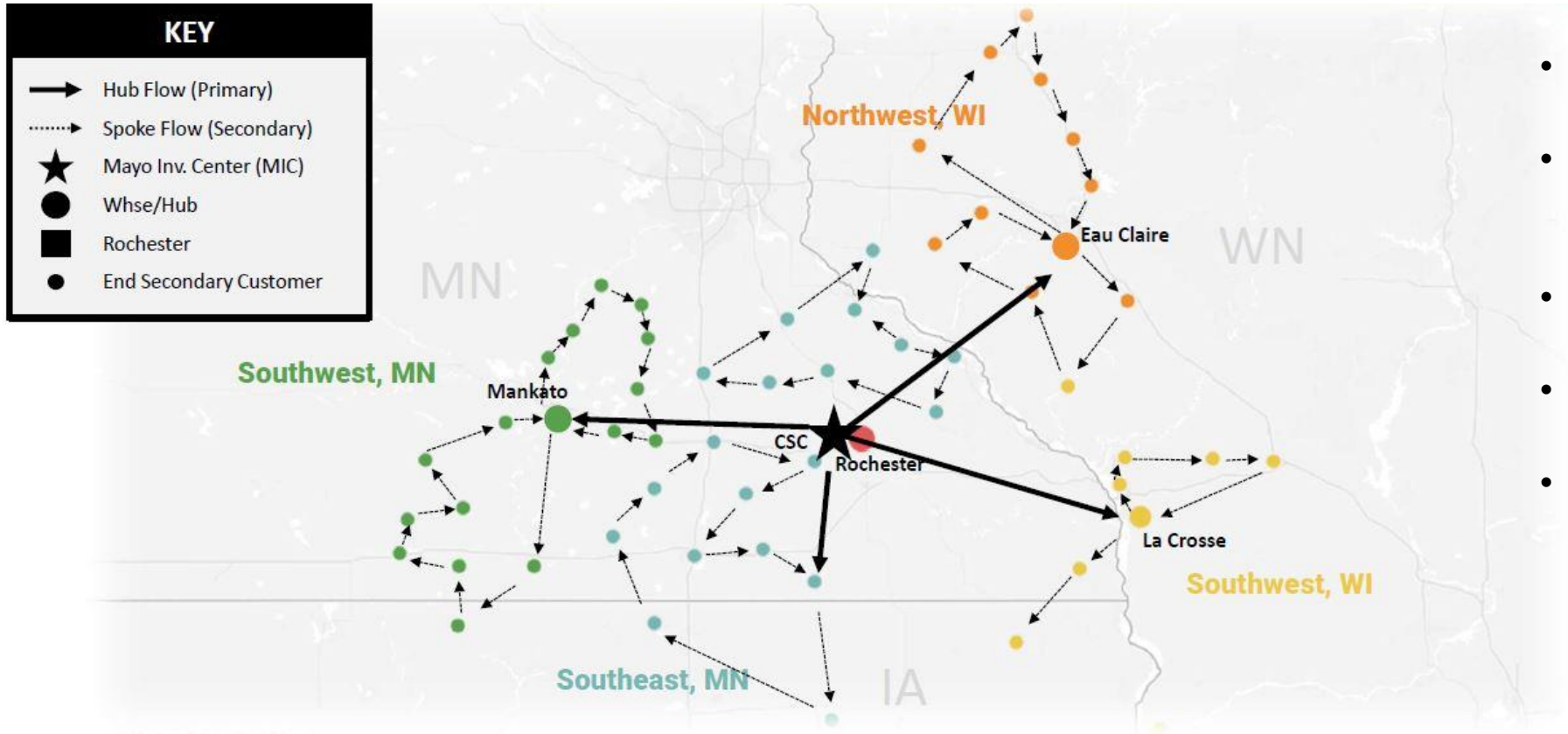
Planning and Mitigation - *continued*

- ***Thanks to COVID-19, the entire world awakened to the importance of supply chain management.***

- Supplier collaboration and accountability – Continuous Planning and Forecasting
- Developing an agile and innovative workforce
- Communication needs and strategies
- Strengthening governmental and regulatory relationships
- New distribution models and logistical enhancements (e.g., moving from JIT to internal distribution and inventory management)

MAYO CLINIC

Mayo Clinic: New distribution strategy



- Moved from JIT distribution to internal distribution centers
- Agreements with all 3 distributors
- Increased accountability for distributors on self-manufactured products
- Manage inventory and distribution network
- Robust disaster / continuity plans
- DIOH:
  - 5 days at POU
  - 30+ days in inventory
  - Critical SKUs at distributor (5000+)
  - Pre-selected auto substitutes

MAYO CLINIC

A Look Ahead

- Global supply chain pressures and disruptions have declined. Performance is improving; however, the healthcare supply chain has not ever been resilient or proficient.
- The disruptions faced over the past three (3) years have served to accelerate transformational needs in the supply chain with a focus on planning for and mitigating supply interruptions.
- The focus of supply chain executives has shifted back to the basics of spend management and generation of savings in view of the financial challenges being faced by providers and on-going financial headwinds.
- Other areas of focus include managing inflation, labor costs and other workforce issues.
- Advancements and investments in the area of digital capabilities and analytics to increase demand planning and forecasting in order to mitigate supply disruptions and improve supply assurance.
- Seeing many midsized HCOs investing in new warehousing infrastructure, when a far more modest investment in technology may achieve similar outcomes.

MAYO CLINIC

Supply Chain Disruption in Healthcare: Planning and Mitigation

January 26, 2024

Jarrod Goentzel, MIT

MIT Humanitarian Supply Chain Lab

https://humanitarian.mit.edu

MIT Center for Transportation & Logistics

https://ctl.mit.edu

MIT Humanitarian Supply Chain Lab introduction

- Lab created in 2011 within the MIT Center for Transportation & Logistics
  - Combines MIT expertise in engineering, management, information technology, social science, economics, urban planning, and other disciplines
- Mission
  - To understand supply chain systems and improve their ability to meet human needs via government services, NGO actions, and private markets
- Methods
  - Empirical research to develop theory on decision-making during crises and understanding of complex supply chain systems
  - Scientific development of evidence and tools to improve supply chain performance
  - Practical application by shaping policies through research and upgrading skills via education and training in various organizations and jurisdictions

MIT Humanitarian Supply Chain Lab Highlights

2010

Haiti Earthquake

Worked with MIT Lincoln Laboratory to develop a multi-sectoral humanitarian needs assessment

2012

Superstorm Sandy

Supported NYC Donations Coordination Team with in-kind donations and NYC Emergency Management with resource mobilization

2013

WFP: Darfur C&V

Study examined cost drivers and reliability within the supply chain for food commodities, across multiple markets to inform cash and voucher suitability.

2014

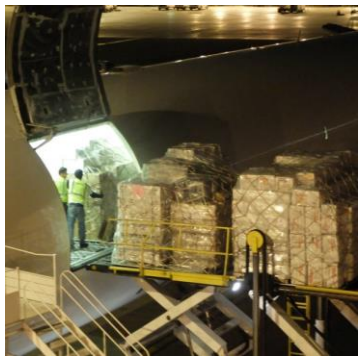
Ebola Epidemic

Joined ACCEL to respond to the Ebola epidemic in West Africa and strengthen systems aimed at preventing future outbreaks and epidemics.

2015

Post-harvest Storage Uganda

Research in Uganda with USAID and WFP, focused on scalable business models for improved post-harvest storage technologies.



MIT Humanitarian Supply Chain Lab Highlights

2016

Uganda Market System Monitoring

Began 5+ year project to monitor and evaluate USAID agricultural market interventions

2017

Harvey, Irma, Maria

Supported FEMA directly during the costliest hurricane season to date

2018

Public-Private Roundtable

Convened leaders for rapid assessment of supply chain resilience during the 2017 hurricane season

2019

National Academies

Directly supported a FEMA sponsored Federal Advisory Committee Act consensus study titled "Post-hurricane Supply Chain Adaptability Study."

2020

COVID-19 Monitoring

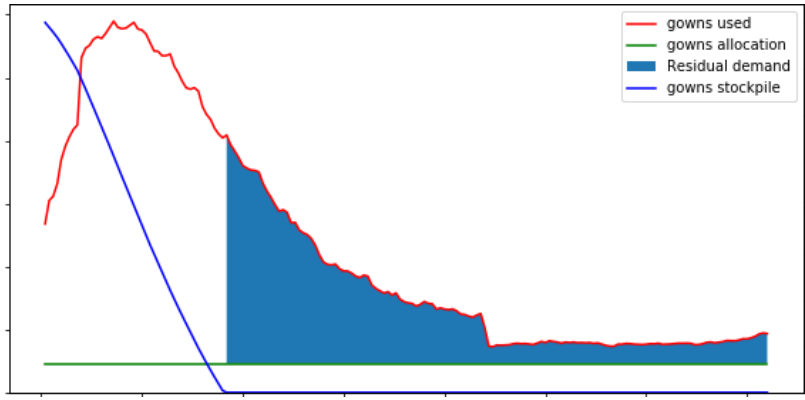
Rapid assessments for FEMA by monitoring dynamic changes to commodity flows and capacities of the private sector supply chains.

MIT Humanitarian Supply Chain Lab

Jarrod Goentzel (ctl.mit.edu/goentzel)

Nurses don PPE before entering a COVID-19-positive, non-critical patient's room (Naval Medical Center San Diego, August 2020)

MIT HSCL collaborated with MGH Center for Disaster Medicine to study PPE supply chains



In September 2014, Liberia's capital city of Monrovia with a population of 1.5 million people had NO open hospital

MIT HSCL joined an academic consortium led by Massachusetts hospitals to train and equip healthcare workers in Liberia
(pictures from February 2015)

MIT Humanitarian Supply Chain Lab

Planning Demand

Personal Protective Equipment (PPE) in Massachusetts During the COVID-19 Pandemic (2019-21)

Jarrod Goentzel (ctl.mit.edu/goentzel)

Enhancing PPE Preparedness for Healthcare Facilities

- Collaboration between MGH Center for Disaster Medicine and MIT Humanitarian Supply Chain Lab
- From July 2020 – July 2021 our team conducted research sponsored by the Assistant Secretary for Preparedness & Response (ASPR) determining the appropriate PPE stockpile for a state level public health agency.
- Over the course of this research, we conducted:
  - 30 subject matter expert interviews
  - Released a survey with 332 responses
  - 14 meetings with MDPH representatives

MASSACHUSETTS GENERAL HOSPITAL
CENTER FOR DISASTER MEDICINE

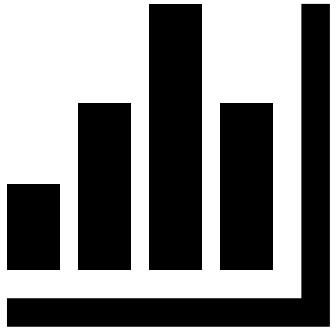
ASPR Office of the Assistant Secretary for Preparedness & Response

Disclosure: The work represented in this presentation was supported by funding from the Assistant Secretary for Preparedness and Response (ASPR). The presentation and its contents are solely the responsibility of the authors and do not necessarily represent the official views of the ASPR.

Preparedness Planning Framework

Epidemiological and other models

How much will our population need?



Demand Plan

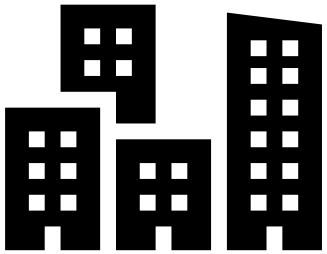
Item Demand

How resilient and robust is our internal resupply capacity?

Supply Plan

Residual Demand

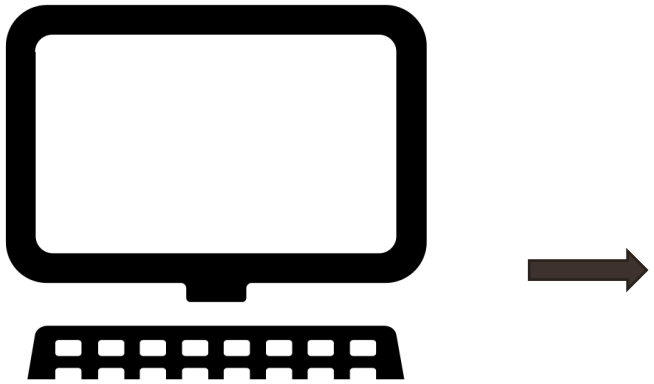
How much "insurance" is our organization willing and able to provide to fill supply gaps?

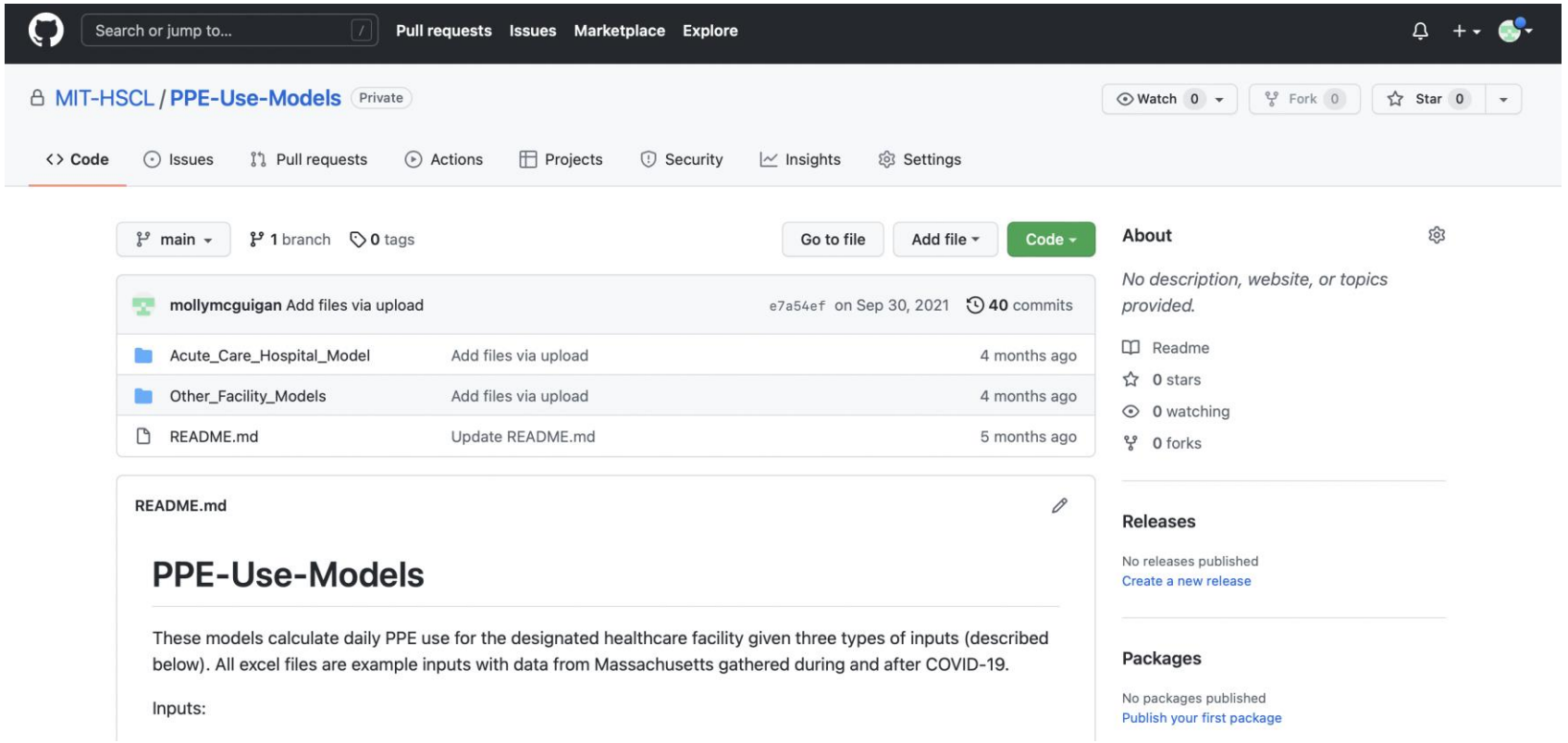


Stockpile Plan

PPE Demand Planning via Simulation

Surprisingly, extensive literature review revealed no model to predict PPE consumption based on epidemiological case projections. So we developed one with facility consultation.



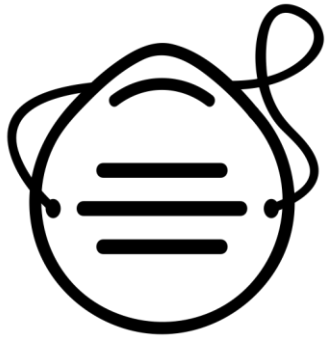


Facility Demand Levers

Patient visits

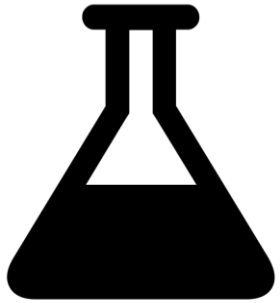
Decreasing patient visits by 50% decreases gown and glove use by 50%

PPE reuse



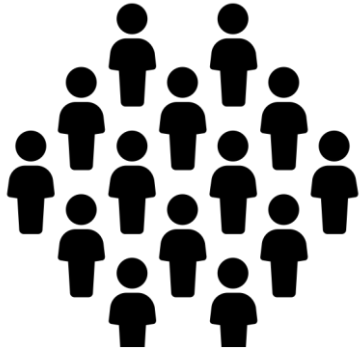
Increasing N95 and eye protection reuse policies from 1 use to 5 uses can decrease N95 use by 80% in all facilities

Diagnostic test turnaround time



Decreasing COVID test turnaround time from 2 day to 1 day decreases N95 use in skilled nursing by 22%

Cohorting



Cohorting can decrease N95 use:

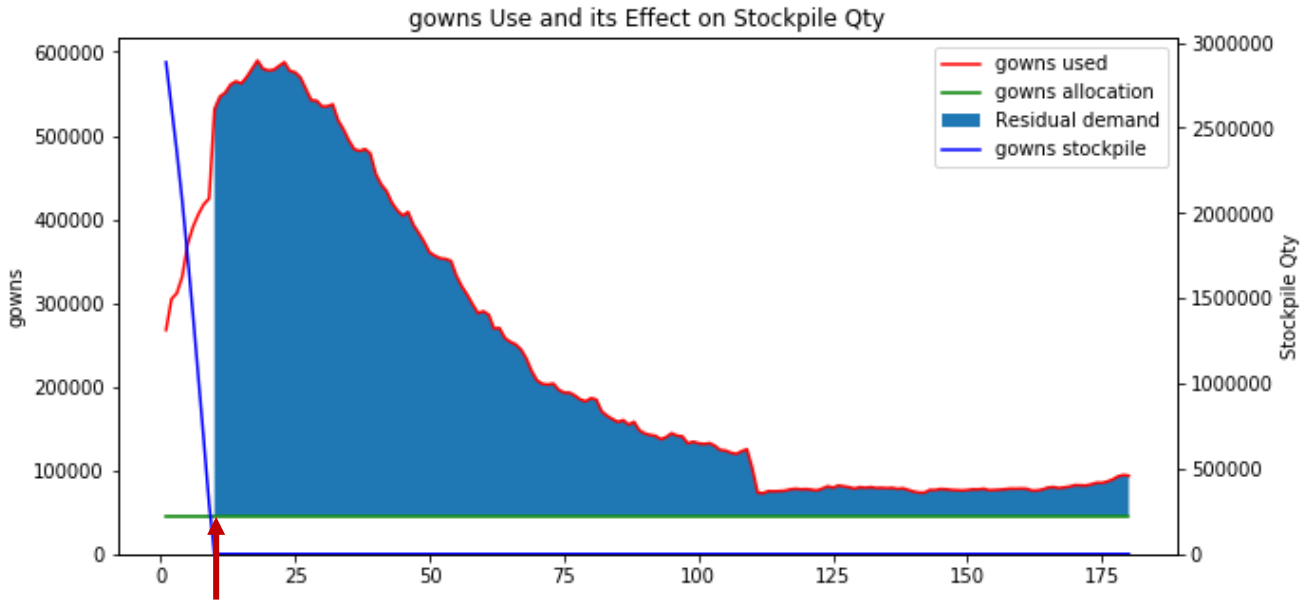
- 47% in acute care hospitals
- 92% in assisted living
- 95% in skilled nursing

Massachusetts Facility Supply Plans – April 2021

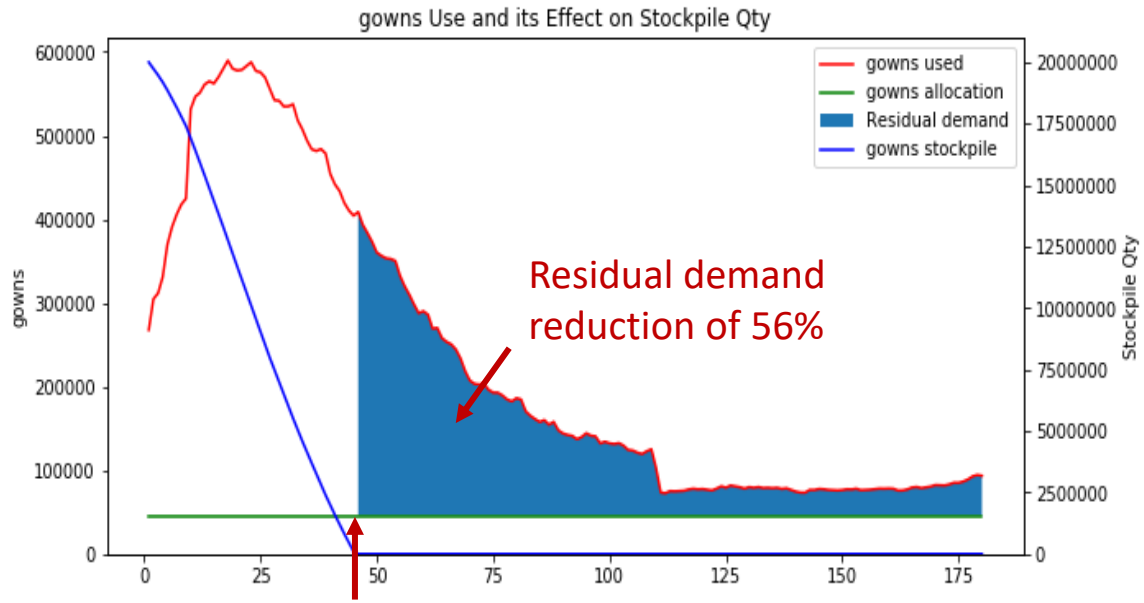
Facility type	Days of supply on hand in Apr 2021	Days of supply on hand prior to COVID	Days of supply definition
Acute care hospital	90	14	Average daily use during COVID
Outpatient	90	14	
Skilled nursing	60	4	
Assisted living	60	4	
EMS	90	30	
Dental	90	7	
Behavioral health	90	7	

Facility Stock Readiness

1X COVID with pre-COVID facility stockpiles



1X COVID with post-COVID facility stockpiles



Results for stock readiness

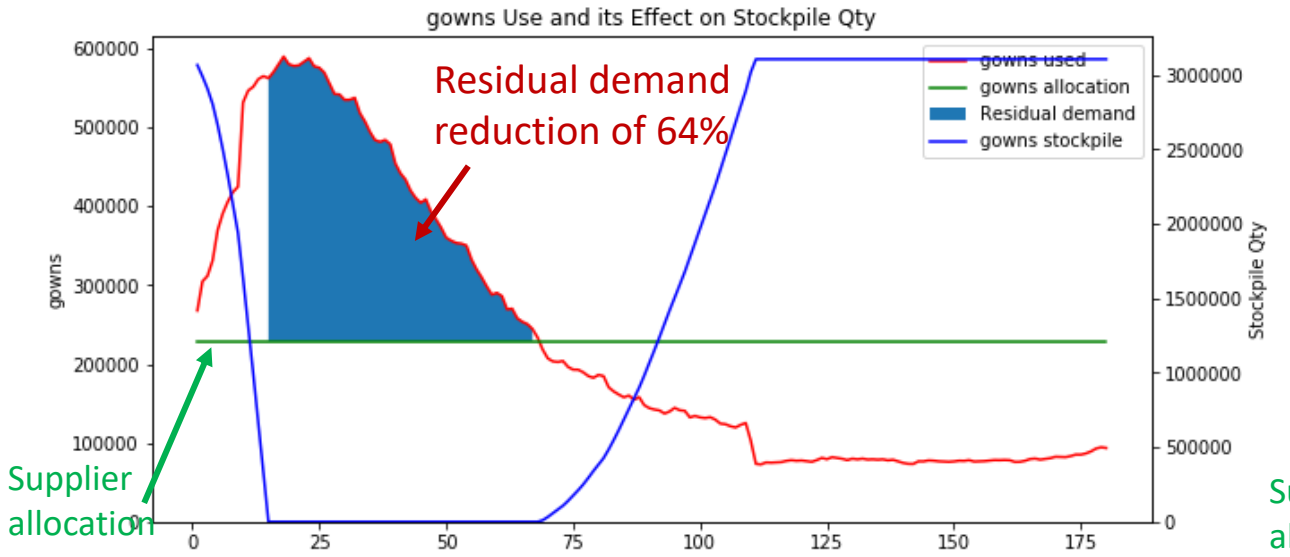
- Increase ability to meet initial PPE demand from 5-6 days to 45-75 days, depending on the item
- Reduce reliance on government stockpiles by 49-59%, depending on the item

Insights

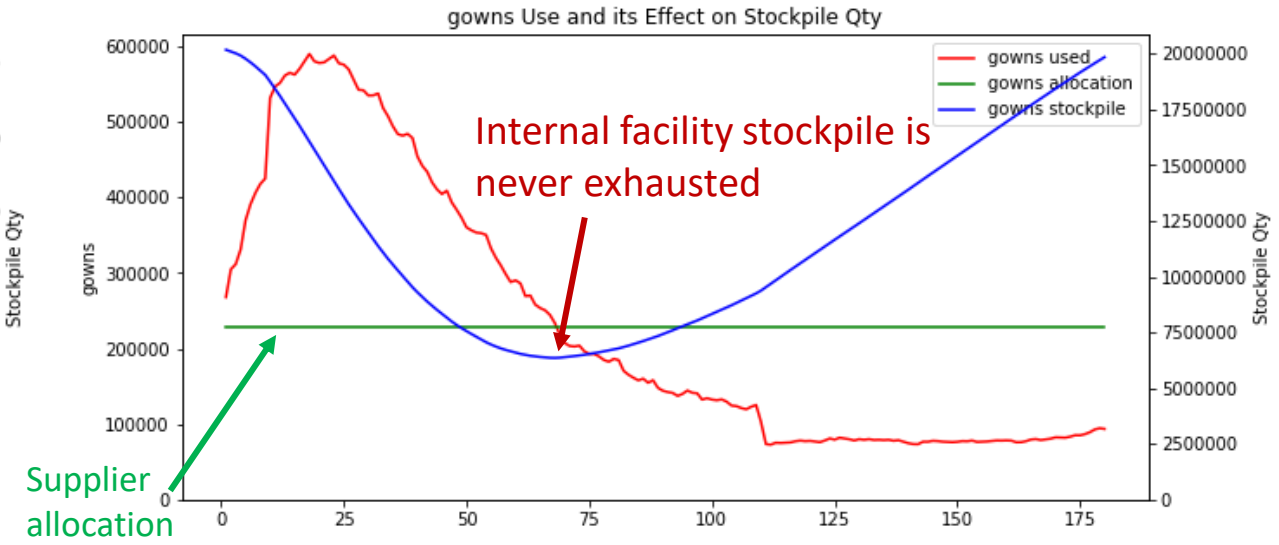
- Maintaining facility safety stock equivalent to post-COVID levels is a key preparedness lever
- Stockpiles delay the initial stockout, allowing time for creative sourcing

Supplier Relationship Readiness

1X COVID with pre-COVID facility stockpiles, supplier daily shipment = average daily PPE use



1X COVID with post-COVID facility stockpiles, supplier daily shipment = average daily PPE use



Results for relationship readiness

- Increase ability to meet initial PPE demand from 5-6 days to 15-35 days, depending on the item
- Reduce reliance on government stockpiles by 64-96%, depending on the item

Insights

- Combining stock readiness & supplier relationship readiness could fully prevent stockouts in a pandemic similar to COVID for all PPE items studied
- Facilities with low PPE demand normally, such as long-term care, may need relationships facilitated by the government

Key Lessons

Create emergency preparedness plans that allow you to quickly pull policy levers to adjust PPE demand (key lesson 1)

- Evaluate current guidance for cohorting patients in healthcare facilities
- Evaluate current emergency PPE reuse guidance
- Encourage facilities to create alternate care pathways to decrease in-person patient visits where appropriate
- Look for opportunities to decrease diagnostic testing turn-around times in emergencies, including a plan to support the demand surge for ancillary testing supplies

Invest in facilitating and understanding facility supply plans (key lesson 2)

- Create avenues for facilities to share information on PPE supply chains with each other and with government planners
- Encourage or mandate minimum facility PPE stockpiles
- Facilitate the creation of contingency supplier contracts for facilities with low non-pandemic demand or limited resources

Invest in a dynamic emergency stockpile (key lesson 3)

- Invest in human capital to monitor the emergency stockpile, place orders with suppliers, and reassess stockpile levels
- Create contingency agreements with suppliers

Maintain and improve situational awareness for preparedness planning

- Simulate demand for different pandemic scenarios and incorporate the results into the PPE preparedness planning process
- Plan for regular readiness reviews that revisit and update old assumptions
- Coordinate with other agencies to prevent redundancies in PPE preparedness

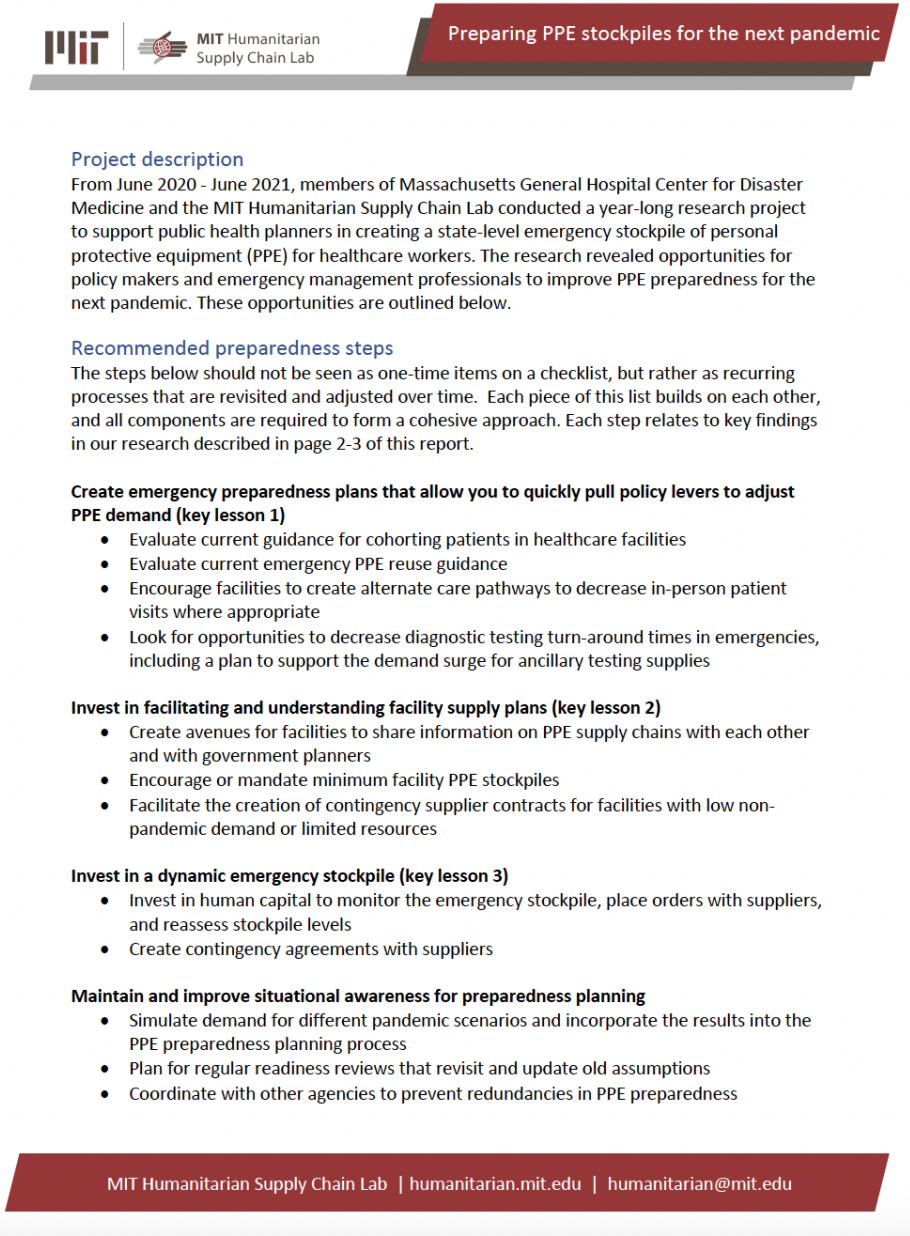
References

Four-page summary
https://dspace.mit.edu/handle/1721.1/138837

Master's thesis
https://dspace.mit.edu/handle/1721.1/144720

Code for PPE demand planning
https://github.com/MIT-HSCL/PPE-Use-Models

Full report
upon request



MIT Humanitarian Supply Chain Lab

Preparing PPE stockpiles for the next pandemic

Project description

From June 2020 - June 2021, members of Massachusetts General Hospital Center for Disaster Medicine and the MIT Humanitarian Supply Chain Lab conducted a year-long research project to support public health planners in creating a state-level emergency stockpile of personal protective equipment (PPE) for healthcare workers. The research revealed opportunities for policy makers and emergency management professionals to improve PPE preparedness for the next pandemic. These opportunities are outlined below.

Recommended preparedness steps

The steps below should not be seen as one-time items on a checklist, but rather as recurring processes that are revisited and adjusted over time. Each piece of this list builds on each other, and all components are required to form a cohesive approach. Each step relates to key findings in our research described in page 2-3 of this report.

Create emergency preparedness plans that allow you to quickly pull policy levers to adjust PPE demand (key lesson 1)

- Evaluate current guidance for cohorting patients in healthcare facilities
- Evaluate current emergency PPE reuse guidance
- Encourage facilities to create alternate care pathways to decrease in-person patient visits where appropriate
- Look for opportunities to decrease diagnostic testing turn-around times in emergencies, including a plan to support the demand surge for ancillary testing supplies

Invest in facilitating and understanding facility supply plans (key lesson 2)

- Create avenues for facilities to share information on PPE supply chains with each other and with government planners
- Encourage or mandate minimum facility PPE stockpiles
- Facilitate the creation of contingency supplier contracts for facilities with low non-pandemic demand or limited resources

Invest in a dynamic emergency stockpile (key lesson 3)

- Invest in human capital to monitor the emergency stockpile, place orders with suppliers, and reassess stockpile levels
- Create contingency agreements with suppliers

Maintain and improve situational awareness for preparedness planning

- Simulate demand for different pandemic scenarios and incorporate the results into the PPE preparedness planning process
- Plan for regular readiness reviews that revisit and update old assumptions
- Coordinate with other agencies to prevent redundancies in PPE preparedness

MIT Humanitarian Supply Chain Lab | humanitarian.mit.edu | humanitarian@mit.edu

MIT Humanitarian Supply Chain Lab

Sourcing Supply

Personal Protective Equipment (PPE) in Liberia during the Ebola Epidemic (2014-16)

Jarrod Goentzel (ctl.mit.edu/goentzel)

Motivation

Liberia during the 2014-15 Ebola epidemic

- 192 Healthcare worker deaths
- Before Ebola hospitals were undersupplied and understaffed with limited infection control practices in place
- Hospitals were one of the most dangerous places during the initial phase of the Ebola outbreak
- The capital city of Monrovia with a population of 1.5 million people had NO open hospital for the month of September

Mobilization

- Funded by the Paul G. Allen Family Foundation - #TackleEbola
- No financial interests/COI
- All photos with the verbal consent of individuals
- Credit goes to the team



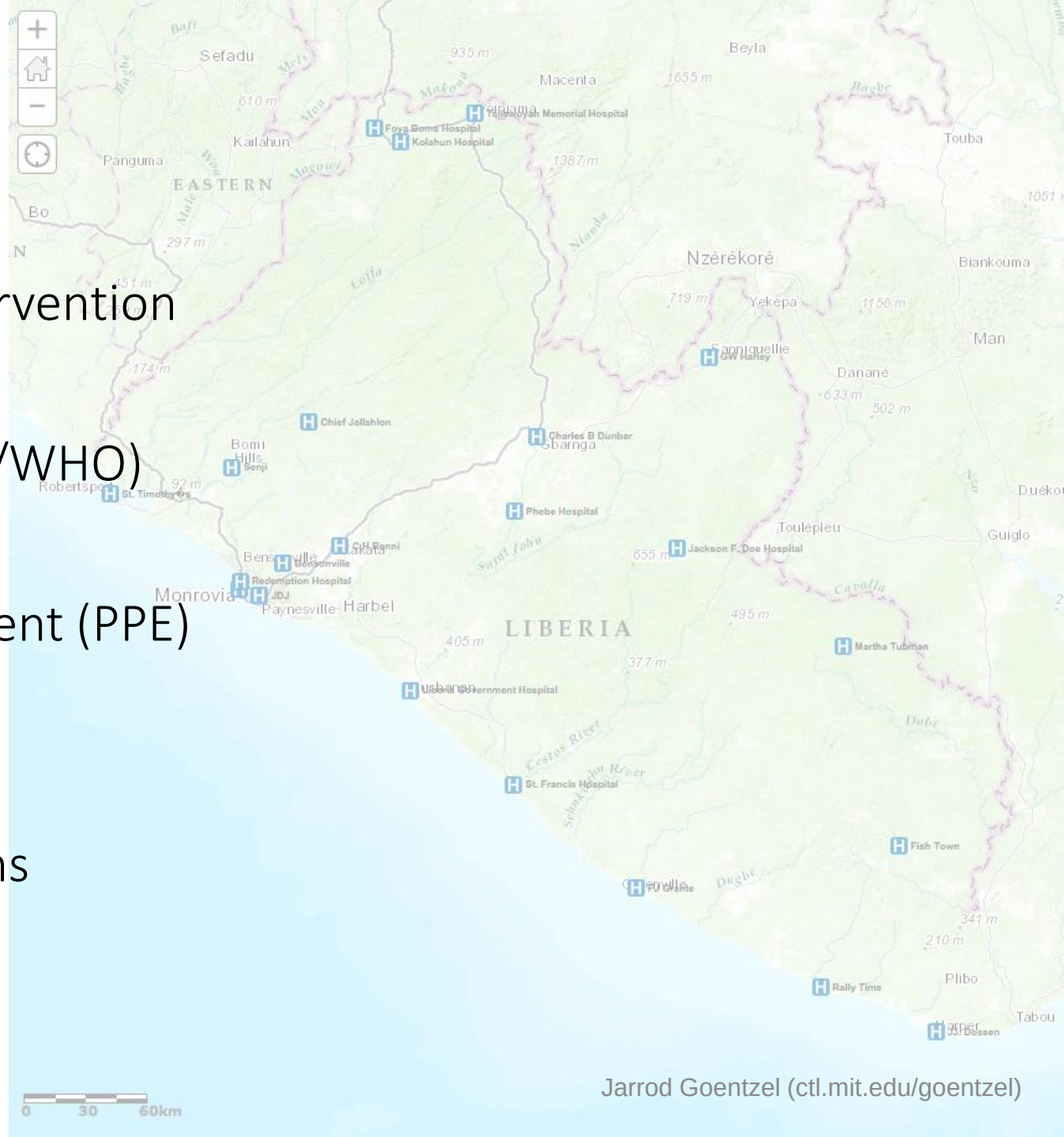


Massachusetts Institute of Technology

Credit for several slides goes to Michelle Niescierenko

Intervention

- Infection Prevention & Control (IPC) intervention
- All 22 Liberian Government Hospitals
- “Keep Safe, Keep Serving” Training (CDC/WHO)
- One week of training & mentorship
- 3 months of Personal Protective Equipment (PPE)
- Water & Sanitation (WASH) supplies
- Quality Improvement
- Training for the Hospital IPC Focal Persons



Jarrod Goentzel (ctl.mit.edu/goentzel)

MIT Humanitarian Supply Chain Lab

Demand and Supply Planning

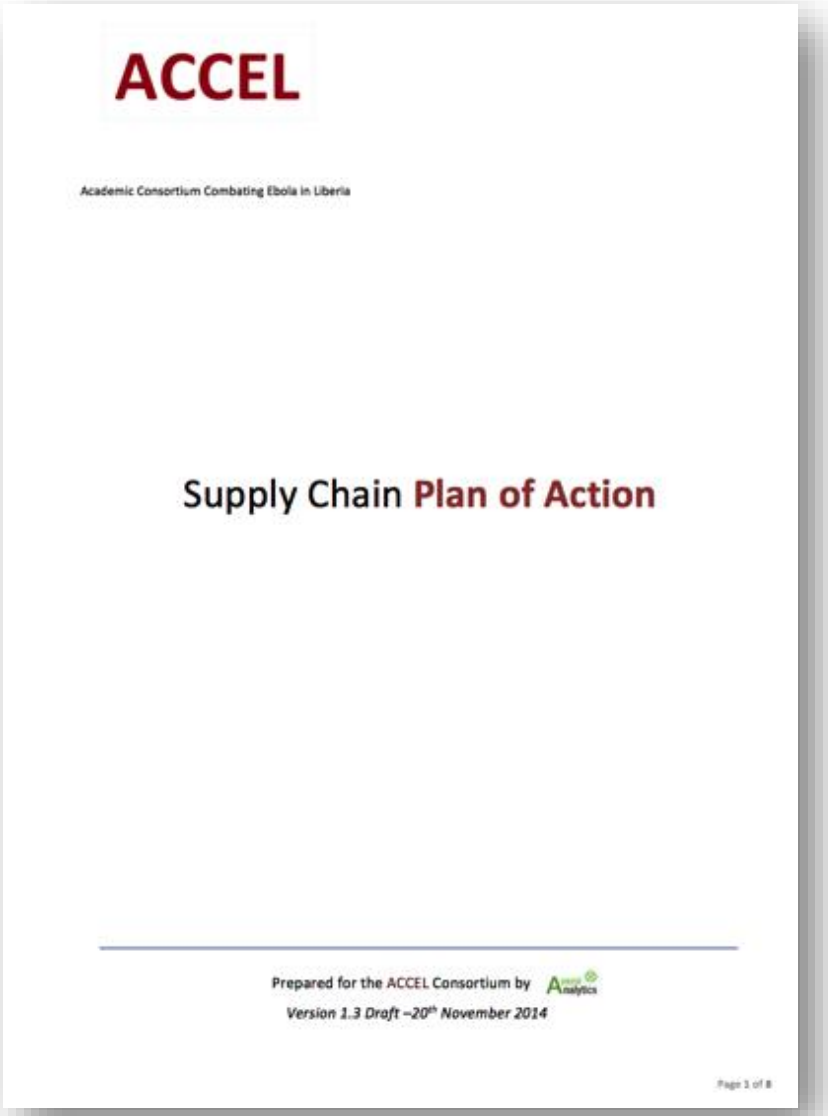
- Award from Allen Foundation November 15
- Version 1.0 plan November 18
- Version 1.3 plan November 20

News and Press Release • **Source:** UNICEF • **Posted:** 7 Nov 2014 • **Originally published:** 7 Nov 2014

GENEVA/COPENHAGEN/NEW YORK, 7 November 2014 – UNICEF has sent almost 3,000 metric tonnes of life-saving supplies including protective equipment and essential medicine in the past three months to fight the spread of Ebola in Guinea, Liberia and Sierra Leone. The children's agency is among the largest source of supplies in the Ebola response.

Next week, UNICEF is convening a global consultation with the PPE industry to provide global forecasts and advocate for sufficient global supply. Over 15 manufacturers representing the vast majority of global production capacity will be present, as well as key partners including the World Health Organization (WHO), Medecins sans frontieres (MSF), representatives of the UK and US governments, and others.

https://reliefweb.int/report/liberia/massive-unicef-shipments-supplies-fight-ebola-reach-3000mt-mark



Emergency PPE Specifications

- Various products
- Various standards: US, European, International Standards

Draft WHO list of Personal Protective Equipment for Infection and Prevention Control with Focus on Ebola - CLEANING, WASTE MANAGEMENT AND, SAFE AND DIGNIFIED BURIALS

Version 07 November 2014

Main reference

Personal protective equipment in the context of filovirus disease outbreak response: rapid advice guideline: summary of the recommendations, WHO, October 2014	http://apps.who.int/iris/handle/10665/137410#sthash.84IQyL7.dpuf
Personal protective equipment (PPE) in the context of filovirus disease outbreak response: Technical specifications for PPE equipment to be used by health workers providing clinical care for patients, WHO, October 2014	http://apps.who.int/iris/bitstream/10665/137411/1/WHO_EVD_Guidance_SpecsPPE_14.1_eng.pdf?ua=1
Field situation: How to conduct safe and dignified burial of a patient who has died from suspected or confirmed Ebola virus disease, WHO, October 2014	http://apps.who.int/iris/bitstream/10665/137397/1/WHO_EVD_GUIDANCE_Burials_14.2_eng.pdf?ua=1
Interim Infection Prevention and Control Guidance for Care of Patients with Suspected or Confirmed Filovirus Haemorrhagic Fever in Health-Care Settings, with Focus on Ebola, WHO, August 2014	http://www.who.int/csr/resources/publications/who-ipc-guidance-ebola-final-08082014.pdf
Clinical management of patients with viral haemorrhagic fever: A pocket guide for the front-line health worker, WHO, March 2014	http://www.who.int/csr/resources/publications/clinical-management-patients/en/
Interagency Emergency Health Kit, WHO, 2011	http://www.who.int/medicines/publications/emergencyhealthkit2011/en/
WHO catalogue (WHO internal site)	http://intranet.who.int/tools/wcat/QuickSearch.aspx

*** Recommended
** Alternative
* Optional

Item	Generic item name	Generic item image		WHO Detailed description	Sizes	Certification or minimum testing (or equivalent)
Eyes protection (Goggles or Face shield)	Goggles		***	Good seal with the skin of the face, Flexible PVC frame to easily fit with all face contours without too much pressure, Enclose eyes and the surrounding areas, Accomodate wearers with prescription glasses, Clear plastic lens with fog and scratch resistant, Adjustable band to secure firmly so as not to become loose during clinical activity, Indirect venting to avoid fogging, May be re-usable (provided appropriate arrangements for decontamination are in place) or disposable.	One Size	- EU standard directive 86/686/EEC; EN 166:2002, - ANSI/ISEA Z87.1-2010, or equivalent
	OR					
	Face shield (full shield)		***	Made of clear plastic and provides good visibility to both the wearer and the patient, Adjustable band to attach firmly around the head and fit snuggly against the forehead, Fog resistant (preferable), Completely cover the sides and length of the face, May be re-usable (made of robust material which can be cleaned and disinfected) or disposable.	One Size	- EU standard directive 86/686/EEC; EN 166:2002, - ANSI/ISEA Z87.1-2010, or equivalent
Nose and mouth protection	Mask, medical/ surgical, fluid resistant, structured design	 	***	High fluid resistance, Good breathability, Internal and external faces should be clearly identified, Structured design that does not collapse against the mouth (e.g. duckbill, cup-shape)	S, M, L	EN 14683 Type IIR performance ASTM F2100 level 2 or level 3 or equivalent; - Fluid resistance at minimum 120 mmHg pressure based on ASTM F1862-07, ISO 22609, or equivalent - Breathability: MIL-M-36945C; EN 14683 annex C; or equivalent - Filtration efficiency: ASTM F2101, EN14683 annex B; or equivalent
	OR					
	Respirator	  	*** (used for aerosols with full face shield)*	Shape that will not collapse easily (e.g. duckbill, half-sphere), High filtration efficiency, Good breathability To be used only during procedures that generate aerosols of body fluids Only to be used together with a full face shield.	range of sizes with fit test kit	NIOSH N95, EN149 FFP2, or equivalent: - Filtration efficiency: US42 CFR Part 84 for N95, EN149 clause 7.9.2, or equivalent - Breathability: US42 CFR Part 84 for N95, EN149 clause 7.16, or equivalent
	OR					
	Surgical N95 respirator	  	** (used for aerosols)	Fluid resistant, Shape that will not collapse easily (e.g. half-sphere), High filtration efficiency, Good breathability To be used only during procedures that generate aerosols of body fluids	range of sizes with fit test kit	"Surgical N95 respirator" cleared by the USFDA, or equivalent - Fluid resistant surgical N95 respirator with minimum 80 mm Hg pressure based on ASTM F1862, ISO 22609 , or equivalent
	Alcohol-based hand rub		***	Preferably made locally (refer to main reference), Fulfills recognized standards for microbiological efficacy (ASTM or EN standards), contains 60-85% 'alcohol' depending on ingredients (ethanol or isopropanol), can be liquid, gel or foam (and HCW tolerability & acceptability has already been tested), can be in 100 ml (personal) bottles (should be able to be opened with one hand, e.g. flip top bottle), 500 ml bottles (preferably with wall/ bed/ trolley mounted bracket) or 1lt bottles	100 mL 500 mL 1 L	- ASTM E2315 - ASTM E2755 - 10 or equivalent

MIT Humanitarian Supply Chain Lab

Jarrod Goentzel (ctl.mit.edu/goentzel)

Manufacturer Specifications

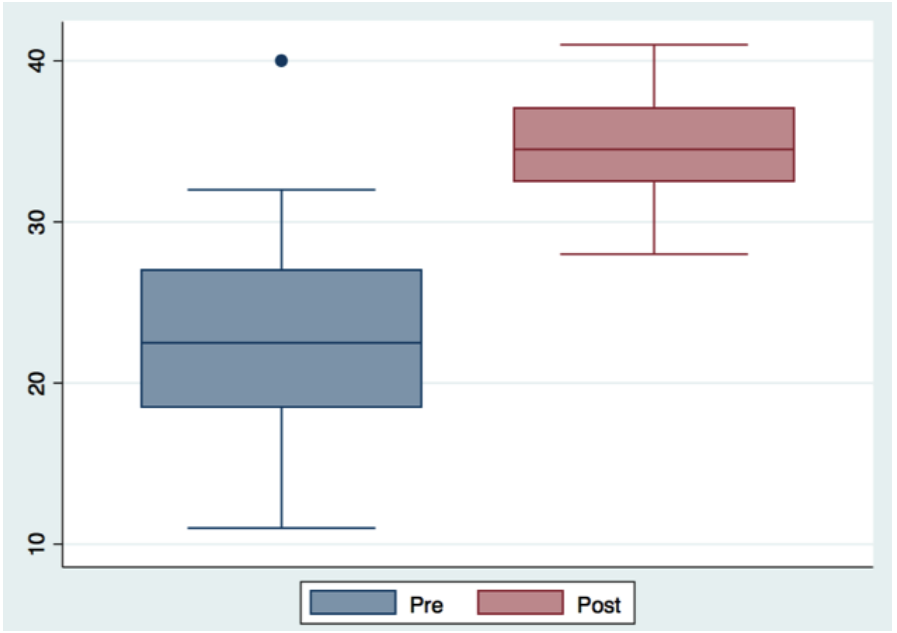
Fig 1. Standard Médecins Sans Frontière ensemble. Adapted from: http://www.bbc.com/news/health-29518703.

Source: Garibaldi, B., et. al. (2018) "A novel personal protective equipment coverall was rated higher than standard Ebola virus personal protective equipment in terms of comfort, mobility and perception of safety when tested by health care workers in Liberia and in a United States biocontainment unit," *American Journal of Infection Control*, (in press) DOI 10.1016/j.ajic.2018.08.014

Results

- Over 70 Tons of supplies delivered to 22 hospitals
- Over 35,000 miles travelled
- Over 2,200 Health Care Workers trained
- Minimum standards of hospitals increased

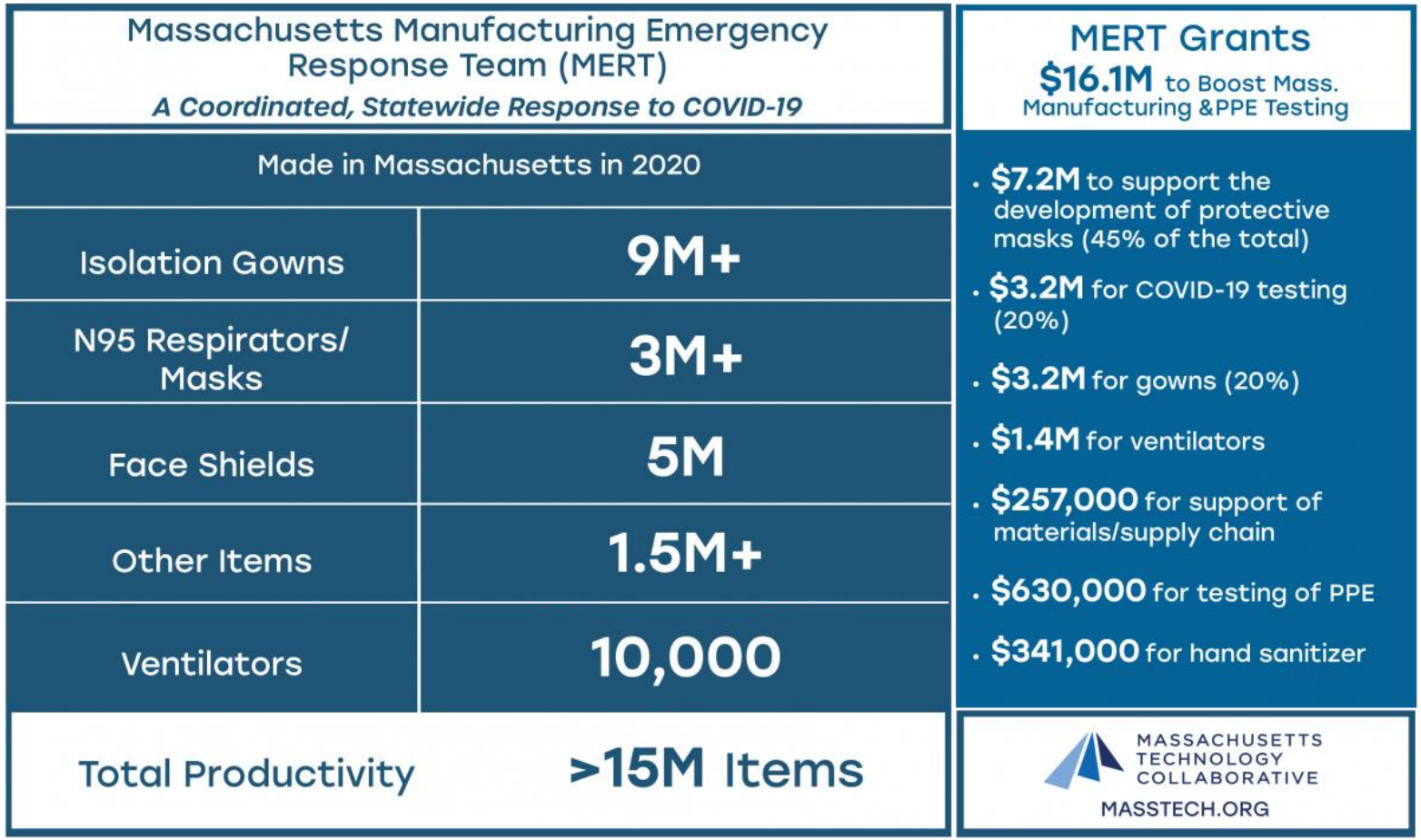
	Mean	SD	P-value (95% CI)
Pre-IPC Intervention	23	6.66	
Post-IPC Intervention	34.5	3.68	0.0001



MIT Humanitarian Supply Chain Lab

Observations of COVID PPE supply chain adaptation

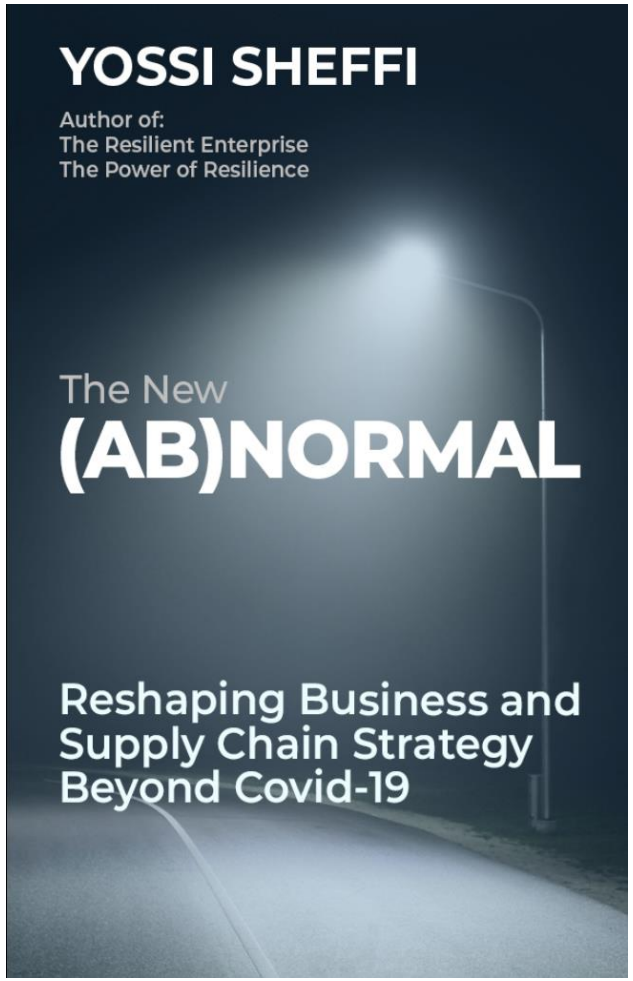
The Manufacturing Emergency Response Team (MERT) supported Massachusetts manufacturers in pivoting their operations to produce needed materials in response to the COVID-19 pandemic



Source: https://masstech.org/MERT

Observations of COVID PPE supply chain adaptation

mask makers ramped up production—China alone increased its total production tenfold to 40 billion per year.[31] One of the many companies using its assets to make masks was Boston-based athletic apparel company New Balance (*see* Chapter 25). At Walmart, CEO Doug McMillon said, "We've also asked some of our apparel suppliers to convert production to PPE for healthcare workers."[32] Many other retailers and manufacturers—including Eddie Bauer, Hanesbrands, Gap, Ralph Lauren, Canada Goose, L.L. Bean, and others—started making and distributing protective masks and gowns.

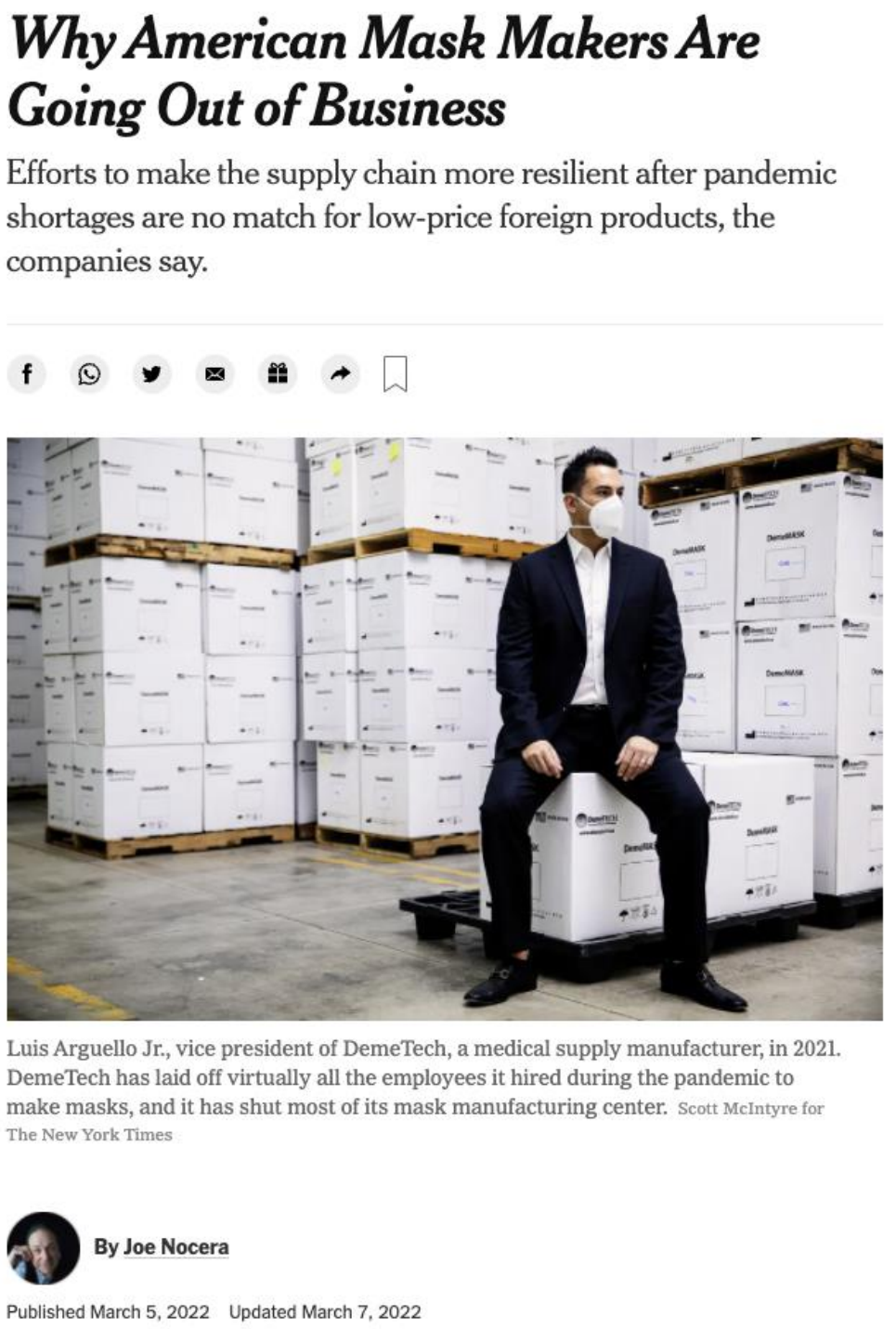


Source: https://sheffi.mit.edu/new-abnormal

Surge Capacity is not Sustainable

- It is hard to know precisely how many companies were born during the pandemic; 36 new members of the American Mask Manufacturer's Association
- Customers disappeared as soon as the wave crested and Chinese companies, determined to regain their market share, began exporting masks below cost
- The federal government spent $682 billion buying goods and services from contractors in 2020…but that is only about 3 percent of America's $21.5 trillion economy

Source: https://www.nytimes.com/2022/03/05/business/dealbook/american-mask-makers.html (March 5, 2022)



Why American Mask Makers Are Going Out of Business

Efforts to make the supply chain more resilient after pandemic shortages are no match for low-price foreign products, the companies say.

Luis Arguello Jr., vice president of DemeTech, a medical supply manufacturer, in 2021. DemeTech has laid off virtually all the employees it hired during the pandemic to make masks, and it has shut most of its mask manufacturing center. Scott McIntyre for The New York Times

By Joe Nocera

Published March 5, 2022 Updated March 7, 2022

MIT Humanitarian Supply Chain Lab

Supply Chain Adaptation Lessons From COVID-19

- Production capacity
  - New suppliers and near-sourcing initiatives emerged but may not be sustainable
  - Must prepare to tap adjacent production capacity to meet exponential growth in demand
- Item stock
  - Facilities needed time to move from Just In Time (daily restocking from distributor) to Just In Case inventory; and investment in emergent stockpiles may not be sustainable
  - States relied on the strategic national stockpile, which requires item rotation and maintenance; and the SNS was slow to commit as a ”buyer of last resort” to ramp up production
  - JIT is only one part of the Toyota Production System that also requires deep suppler relationships
- Demand management
  - Despite proliferation of epidemiological models to predict cases there were no models to predict medical item consumption; demand planning models are needed to assess intervention impact
  - Crisis Standards of Care were quickly applied, though options not actively pursued could have more impact on demand

Emergent Pathogen Preparedness

COVID transmission

+

Ebola virulence

=

Questions

Thank you!

REGION 1
Regional Disaster Health Response System

RESPTC
REGION 1 EMERGING SPECIAL PATHOGENS TREATMENT CENTER

Region1RDHRS@mgh.harvard.edu
www.rdhrs.org
@Region1RDHRS

MGHBRT@partners.org
www.massgeneral.org/disaster-medicine
@MGHDisasterMed