

POLICY PAPER

Problem Statement

How should the state of Massachusetts improve the resiliency of its supply chain of medical and personal protective equipment (PPE) in preparation for a future public health crisis?

Background

In order to solve any case of public health crisis, usually in the form of epidemics, it is imperative that the impacted communities and their governments should secure a sufficient number of medical resources in response. These resources include intangible components such as medical expertise of practitioners or administrative efficiency of governmental agencies, but most fundamentally, the optimal resolution of health crises lies in the supply and use of medical equipments. As the recent and ongoing Covid-19 pandemic illustrated, the U.S. supply chain of such equipments has many vulnerabilities, which transcend geographical areas and the types of equipments concerned.

Geographically, the supply chain inadequacy is a national phenomenon, and particularly prevalent in rural areas where transportation is less efficient, health literacy is lower and healthcare access sporadic.<sup>1</sup> Comparatively, Massachusetts is a largely urban state with 91.4% of its population living in towns and cities, but with high level of urbanization come higher residential density and greater demand for everyday medical gears, while its larger number of

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<sup>1</sup> “Healthcare Access in Rural Communities,” Rural Health Information Hub

hospitals tend to strain supplies of professional medical devices in times of emergency, as was witnessed in late 2020 when ultra-cold freezers used for storage of vaccines were in shortage.<sup>2</sup> Similar gaps existed, and continue to exist, between the supplies and demands for exam tables, ventilators, and the more day-to-day goods like N95 masks and PPE.<sup>3</sup> Since March 2020, the state of Massachusetts has been championing intra-state business mobilization to supplement a lacking medical supply chain,<sup>4</sup> but this mobilization was *ad hoc* and temporary, and focuses disproportionately on face masks, hand sanitizers and other everyday equipment, but not the more sophisticated devices. For example, in as late as September 2021, the provision of certain exam tables still took up to 5 months as compared to the pre-pandemic 6 weeks,<sup>5</sup> and shortages of ECMO machines persisted in many states during the recent hike in Covid-19 cases.<sup>6</sup> As a result, at this time the enhancements made to Massachusetts' medical supply chain were less than optimal, and this policy brief intends to outline measures to further improve its resiliency in more institutional ways.

### Landscape

Before that, it is imperative to identify the three layers of a medical supply chain's resiliency, to devise policies accordingly. The first layer is called *pre-crisis preparation*, which concerns the

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<sup>2</sup> Tanner Stening, "'There are so many supply chain issues': Some Massachusetts hospitals are borrowing ultra-cold freezers; others say they don't need them," Mass Live (December 22, 2020).

<sup>3</sup> For example, see Timothy Aepfel, "COVID creates shortages of an array of U.S. medical supplies," Reuters, September 21, 2021; Megan L. Ranney et al., "Critical Supply Shortages — The Need for Ventilators and Personal Protective Equipment during the Covid-19 Pandemic," *The New England Journal of Medicine*, vol. 382:e41 (April 30, 2020); "Medical Device Shortages During the COVID-19 Public Health Emergency," FDA Website.

<sup>4</sup> Christina Quinn, "Massachusetts Companies Mobilize To Supplement Medical Supply Chain," GBH News (March 30, 2020).

<sup>5</sup> Aepfel, "COVID creates shortages," September 21, 2021.

<sup>6</sup> Blake Farmer, "Across The COVID-Ravaged South, High-Level Life Support Is Difficult To Find," NPR (September 6, 2021).

creation of a standing emergency response framework and the preparatory establishment of manufacturing and storage capacities. The second layer is called *productive efficiency*, which denotes the responses taken *after* a public health crisis takes place, including the capacity to manufacture additional, relevant gears in time. The third layer is *distribution*, which encompasses not only to bring manufactured medical assets to their consumers, but also the equity of such distribution. These three layers rest upon each other — Without pre-crisis preparation, there would be few manufacturers of medical assets, thus rendering any improvement to productive efficiency meaningless and providing little buffer at the inception of a public health emergency. Without productive efficiency, the state would be compelled to deal with health crises with regular manufacturing and distributional schedules, which are unlikely to meet the greater demands for their goods. Finally, without optimization of the distribution network, two problems could arise — Some urgently required assets might not reach their designated customers in time, creating avoidable shortages, and uneven (inequitable) coverage could disproportionately put minorities, lower-income families, migrants and the elderly at risk. Such unevenness is particularly alarming in pandemics, when breaches in any one social group could eventually spread to its other sectors. Consequently, any public health policy must deal with these three aspects simultaneously in order to have lasting effects on the state's medical supply system.

But any policy would affect the many stakeholders differently. These stakeholders can be grouped into three categories, each with generally homogeneous interests and preferences despite slight internal disagreements. The first category is the *consumers*, including general residents, medical workers and (medical, business, or social) organizations. Each of them is a buyer of

medical assets and cannot operate fully without them during public health emergencies. As a result, their interests lie in sufficient and timely access of medical gears and lower prices of the said equipments. There also are *producers*, including both manufacturers, retailers or importers of medical supplies, whose primary goals are, at least theoretically, maximization of their profits (a.k.a. incomes minus costs). Therefore they are most likely to support measures that expand their consumer base, increase demands for medical goods, or lower the costs of production and transportation. A third group is the *intermediaries*, such as governmental agencies, trade groups and labor unions. Most of them represent certain sub-groups within the consumer or producer classes, with whom their interests align, but there is one major exceptions: insurance companies. For now they remain largely outside the medical supply landscape, but their participation would likely improve affordability, and thus coverage, of medical product access. A comprehensive policy that concerns the medical supply chain must take into consideration all these groups and seeks to broker a compromise, if not balance, amongst them.

### Options

Any option that is to be considered must conform to two overarching constraints: legality and costs. On a federal level the Defense Production Act, but the authorities it grants to the executive branch do not extend to state governments.<sup>7</sup> A supplementary Pandemic Emergency Manufacturing Act was introduced by Sen. Elizabeth Warren (D-MA) in February 2021 to allow for broad reforms to the national medical supply chain, but little autonomy is given to each state,

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<sup>7</sup> Brief overview of the Act can be found at Anshu Siripurapu, “What is the Defense Production Act?” Council on Foreign Relations (Updated January 26, 2021).

and the proposed bill lacks specificity.<sup>8</sup> As for now, the chief legal foundation for the state government of Massachusetts remains the Commerce Clause, which permits state participation in, and influence upon intra-state business activities as long as the state acts as a “market participant” instead of a “regulator”, through setting up state-owned enterprises.<sup>9</sup> This interpretation, as well as the natural state authority in regulating in-state commerce, forms the basis of Massachusetts intervention in its medical supply chain.

As for economic feasibility, although data is lacking as to how much medical supply chain insufficiencies cost the state each year, it is possible to come up with a crude estimate. Such costs come from two sources: the inefficiencies within the current supply system, and the gap between the current supply chain and the ideal. It is estimated that U.S. hospitals “could save up to... \$11 million a year per hospital by reworking [their] supply chains.”<sup>10</sup> Given its 102 hospitals, it is estimated that Massachusetts would save up to \$1.12B per year by solving existing inefficiencies. Another study found that by doubling the capacity of Department of Health and Human Services, including their supply of medical goods, in March 2020, would have reduced national Covid-19 fatalities by 90%.<sup>11</sup> Other than the immense emotional and psychological damages, these fatalities also led to great monetary losses. Assuming that these fatalities are evenly distributed among the different groups of American society, such avoidable losses amounted to \$14.4T by October 2020 since the pandemic started, thus convertible into roughly \$7T per year.<sup>12</sup> Given that the state Massachusetts roughly possesses 2.11% of the national

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<sup>8</sup> S. 187 - Pandemic Emergency Manufacturing Act of 2021, 117th Congress (2021-2022), U.S. Congress.

<sup>9</sup> “Commerce Clause Limitations on State Regulation,” Exploring Constitutional Conflicts, University of Missouri, Kansas City; “The Commerce Clause,” Interactive Constitution, National Constitution Center.

<sup>10</sup> Tina Reed, “U.S. hospitals wasting about \$25.4B on supply chain every year,” Fierce Healthcare (Oct 22, 2018).

<sup>11</sup> Xingyu Li et al., “Mathematical model of the feedback between global supply chain disruption and COVID-19 dynamics,” *Scientific Reports*, vol. 11, article no. 15450 (July 29, 2021).

<sup>12</sup> Using the data that the total Covid-19-related economic loss was at \$16T, see David M. Cutler, “The COVID-19 Pandemic and the \$16 Trillion Virus,” *The Journal of the American Medical Association*, vol. 324, no. 15 (2020).

population and 2.78% of its economy, the avoidable monetary loss, should a more comprehensive medical supply chain be in place during a public health crisis, is expected to be \$175B per year.<sup>13</sup> There is much controversy regarding the theoretical frequency of pandemics occurring, but recent findings suggest a 2% possibility of them taking place any year.<sup>14</sup> As a result it is calculated that reworking the state's medical supply chain would save approximately  $(2\% \times 175B) + 1.12B = 4.62B/year$ . Even when a more conservative estimate is used, the annual savings still amount to more than \$2B. In other words, any combination of policy options that costs less than \$2 billion each year and could effectively mitigate existing deficiencies within the state medical supply system should be deemed economically sound and worthwhile.

Such policy options must be addressed in three stages, each corresponding to an aforementioned aspect of the concept "resiliency". In stage 1, an administrative framework is to be established, under which standing storage of medical assets should be amassed and regular manufacturers secured. Several policies are to be considered:

- 1) A specific office is to be created under the state Commissioner of Public Health, in which the authority to coordinate medical supply chain issues is to be vested; its annual budget should not be expected to exceed \$2.5M, which is similar to all sub-departmental state agencies and commissions.<sup>15</sup>
- 2) A state-wide census is to be conducted every 5 years, in which all in-state manufacturers, importers and retailers of medical assets should be registered and inspected. The census should record their capacity, distribution networks, numbers of employees, raw materials and

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<sup>13</sup> The actual damages likely exceed that amount, since Massachusetts also is a regional and national traffic hub, and its economy disproportionately impacted by cross-border movements of people and goods, which tend to be hit particularly hard during pandemics.

<sup>14</sup> Marco Marani et al., "Intensity and frequency of extreme novel epidemics," *PNAS*, vol. 118, no. 35 (Aug 2021).

<sup>15</sup> For example, the FY2019 budget for Executive Office of Housing and Economic Development was \$2.67M.

capability of increasing productive output in times of emergency. It also must keep a registry of in-state medical asset stockpiles, and update it regularly should the storage amount change. A typical state census in Massachusetts costs \$6M in preparation and outreach,<sup>16</sup> and this considerably less expansive census should be expected to cost much less, and an annual budget of \$1M would suffice.<sup>17</sup>

- 3) Given that the state's medical supply chain is less than adequate, Massachusetts should encourage establishment of new producers or relocation of existing ones. The former is simpler to execute as it is a strictly in-state matter — Once the census identifies weak spots within the supply chain (e.g. the supply of a particular type of hand sanitizers cannot meet popular demands), a state grant could be set up to encourage entrepreneurs entering this market. Such a grant could be given to cover initial production costs, or in the form of low- or no-interest loans. Tax or employment preferences are also advised, but they have greater impact on major producers instead of medium- to small-sized businesses. The relocation is more legally nuanced, because state encouragement of inter-state movement of business entities can be construed as a constitutional violation of the Commerce Clause. Therefore, it is advised that Massachusetts organize a state-run company (like MBTA) that acts as a market and not a government entity, and use it to negotiate with out-of-state suppliers. This entity should incentivize business relocation through market-based mergers, acquisitions or, more feasibly, contractual obligations. Such contracts could demand that Massachusetts should enjoy prioritized access to their products in times of crisis, and in exchange the entity (on behalf of the state government) would pay higher prices in times of peace. The grant

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<sup>16</sup> Christina M. Wade, "States spend big bucks on census preparation," *The Daily News* (Newport), Jan. 21, 2020.

<sup>17</sup> i.e. \$5M accumulated for every such census.

could be derived from the existing Massachusetts Growth Capital Corporation, which so far has awarded \$687.2M in economic relief to in-state businesses.<sup>18</sup>

When this framework is established, supply chain improvement can move on to stage 2, in which productive efficiency of medical good manufacturers in Massachusetts should be enhanced. In that case, once a public health emergency is declared, these manufacturers can ramp up their productive capacity to meet such increased demands in a short period of time. Two options are feasible and possible:

- 1) A state law can be enacted to mandate some minimum productive efficiency for each type of medical gear, based on the size of the plant, energy use and other factors. This policy is costless to the budget, but might produce legal controversies — whether intra-state manufacturing of medical goods would be construed as “a part of the interstate stream of commerce” still largely depends on court opinions, and any lawsuit filed by impacted enterprises would indefinitely delay passage of this regulation.<sup>19</sup>
- 2) There also are less direct methods of promoting greater productive efficiency. For example, the state can impose slightly higher taxes on the production or sale of medical gears that fail to meet certain standards of manufacturing, and can fine producers that fail to meet certain thresholds of efficiency. The more positive alternative is state subsidies to those that voluntarily improve manufacturing efficiency. Moreover, the state-owned entity that is to act as a buyer of out-of-state medical resources can opt to cooperate with only those businesses that would conform to certain requirements. Such measures are essentially market-based decisions and are more politically feasible.

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<sup>18</sup> “COVID-19 Resources and Guidance for Businesses,” The Commonwealth of Massachusetts.

<sup>19</sup> See, for example, “Commerce Clause Overview,” Cornell Law School.



- 3) A more important aspect is the conversion of other manufacturing plants into medical suppliers. This might not be necessary if all other policy changes are in place, but just as a precautionary measure, preferential tax or regulatory treatments can be extended to these *ad hoc* producers and incentives.

Still, an abundance of medical goods does not necessarily translate into their availability to customers, which is dictated by transportation, affordability and equitability. The following policy options are present to facilitate greater development in these aspects:

- 1) Regarding transportation, it might be possible for state transportation authorities to work with the aforementioned medical supply office in monitoring the regional availability of medical goods. Once an area (a town, a municipality, etc) reports shortages, the transportation authorities should be advised to assist in the emergency provision of such equipment. For example, given the reduced number of rail passengers during public health crises, spare trains can be temporarily converted into freights. Special, temporary license plates or certificates can also be issued to vehicles carrying medical supplies to shortage areas.
- 2) To improve affordability of medical goods, there are two avenues. The first is simple conformity to market forces — As long as improvements are made to the other previous stages, supply of medical goods would increase, thus bringing down the price at large. A second policy alternative is more pro-active, which is state-issued price control on all or selective medical assets. This authority, best exemplified in *Nebbia v. New York* (1934), provides legal grounds for state governments to explicitly regulate prices “during a temporary emergency”.<sup>20</sup> A more stringent test requires that such controls only be in

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<sup>20</sup> John N. Drobak, “Constitutional Limits On Price and Rent Control: The Lessons of Utility Regulation,” *Washington University Law Review*, vol. 64, issue 1 (1986), 107-150.

industries “affected with a public interest”. Either way price regulations on medical goods are legally permissible. Nevertheless, such intervention might be contrary to market trends, and given increased costs of raw materials and labor during public health crises, price control might have adverse influences on manufacturers’ production agenda.

3) A more institutional way of solving the coverage and affordability problems is to integrate the purchases of medical goods into existing healthcare insurance programs. An additional bundle can be created: For a premium of  $X$  per year, the insured could enjoy coverage for  $Y$  amount of medical goods they purchase, and the medical good providers would be reimbursed accordingly. If so, consumers will be incentivized to buy more such equipment (e.g. masks, hand sanitizers) even without looming crises. These purchases could be stored for individual use in the future, mitigating sudden surge in their demands during an emergency, and their everyday use can be expected to reduce the impacts of flu and other, more common infectious diseases. This increased demand would also benefit the producers, but might meet mixed feedback from physician groups. On the one hand, as individuals they are among the beneficiaries, as greater access to medical supplies safeguarded their security at workplaces. On the other hand, however, higher coverage of medical goods would likely reduce the number of visits of Massachusetts residents, causing a drop in doctors’, and thus hospitals’, annual incomes. The new insurance program should take into consideration these sentiments, and a framework of its structure is proposed as follows:

1. This insurance bundle should by default be attached to Medicare and Medicaid in Massachusetts, like a mandatory counterpart of the existing Medicare Part D (prescription drugs). It should also be made available as an addition to other (private) insurance

programs to boost its coverage. By late 2020, 1.35M residents of Massachusetts were enrolled in Medicare, with another 1.78M under Medicaid/CHIP.<sup>21</sup> Assuming that half of those insured by private companies should choose to accept the new bundle, this medical good insurance should expect to cover no more than 5M people.

2. The expected individual annual expenditures on personal medical goods are difficult to calculate, but an estimate is possible. Assuming that the average person changes her mask twice every week, throughout the year she would need approximately 105 of them. The average pre-pandemic price for an N95-grade face mask is roughly \$1.82,<sup>22</sup> which would translate into \$191.1 yearly spendings per year per person. When added to hand sanitizer (\$4 per ounce) and other PPE, an average American would ideally spend about \$300 annually on personal medical goods. This increased demand is likely to endure, as several polls indicated, thus rendering this estimate valid for the years to come.<sup>23</sup>
3. And within this \$300 dollars there is space for insurance companies to intervene. Studies show that the optimal price of a face mask for a typical American is at precisely \$1, so in order to reach this optimal scenario, it is advised that the said insurance bundle cover  $(1.82 - 1.00) \times 105 + X$  each year, where  $X$  denotes the covered amounts of PPE other than masks. If it is to cover 50% of these extra equipment costs, the total coverage per year per person would be around \$136.1. In that case, the annual individual premium could be set at  $300 - 136.1 = 163.9$ . Of course, given that the previous policy initiatives would have led to already lowered prices (either through greater competition, reduced

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<sup>21</sup> Louise Norris, "Medicare in Massachusetts," Health Insurance ([healthinsurance.org](http://healthinsurance.org)), November 18, 2020; Norris, "Massachusetts and the ACA's Medicaid expansion," Health Insurance, November 17, 2021.

<sup>22</sup> Kelly Tyko, "Coronavirus price gouging: Face mask prices increased 166% on Amazon, report finds," USA Today (March 11, 2020).

<sup>23</sup> "Survey: In the US, people say their use of masks may endure," McKinsey & Company (July 1, 2020).

transportation costs or higher productive efficiency), the actual annual premium and insurers' reimbursement to providers would both be lower than our estimate.

4. In that case, those insured would be able to purchase the same optimal amount of medical supplies, mostly PPE, with roughly 50% of current costs, while the producers are reimbursed exactly at pre-insurance rates, thus their interests remain undamaged. Profits to the insurers lie in the fact that not all of these that are insured would actually buy this many goods, perhaps out of negligence or a lack of necessity. Statistics show that, even with a pandemic going on, only half of all Americans are wearing masks,<sup>24</sup> and obviously a still lower percentage would continue to do so when this emergency is past. If 40% of the insured are to make optimal purchases, each year the insurance program would garner at most  $5M \times 163.9 = 819.5M$  in premiums, and pay  $(50\% \times 5M) \times 300 = 750M$  in reimbursements, allowing it to stay afloat financially.
- 4) Equitability is ensured, not only by the mandatory addition of this program to Medicare and Medicaid, which tend to cover the more vulnerable, but it is also possible to implement waivers for the most disadvantaged or those without any insurance at all. The federal American Rescue Plan Act (ARPA) granted to Massachusetts \$8.7B in Coronavirus State and Local Recovery Funds (CSLRF),<sup>25</sup> which might be used in part to boost coverage or pay for the waived fees.

### Recommendation

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<sup>24</sup> Benjamin Fearnow, "83 Percent of Americans Support Wearing Masks, But Only Half Wear Them," Newsweek (January 23, 2021).

<sup>25</sup> See "About COVID-19 Federal Funds," The Commonwealth of Massachusetts.

Policy Recommended	Costs/Yr (M)	Funded by	Benefits/Yr (M)
Statewide Medical Supply Census	1.2	State Census Fund	The benefits denote the annual economic loss that resulted from a pandemic which, given that these policies are implemented, could have been avoided or mitigated. Here a conservative 50% effect is anticipated
State Medical Supply Coordination Agency	2.5	Regular annual budget + CSLRF	
State-Backed Medical Goods Firm	~500	Acts as a market entity; could expect to garner revenues from the reselling of out-of-state medical supplies in state or from the daughter companies it acquires or merges. Therefore, all its costs (from a state perspective) is initial investment, which, assuming the annual operating expenses of a medium-sized medical supply firm, could be expected at \$1-2B. When distributed throughout several years, the annual costs can be limited.	
State Grant to New Medical Supply Market Entrants	~100	Massachusetts Growth Capital Corporation	
Higher Taxes on Producers That Fail to Meet Productive Efficiency	Balanced / Minimal	These measures are compensated by the resulting increase in productivity, and higher taxes on some companies can be used to pay subsidies to some others	
Subsidies / Lower Taxes on Producers That Meet Standards			
Medical Supply Purchase Insurance	~750	Premiums; ~820M/year	
Insurance Coverage Drive & Waiver		CSLRF	
<b>TOTAL</b>	~480	/	~1000

These above policies are recommended because among the options presented, they are the most practical, straightforward and politically feasible. Moreover, this combination has relatively low costs that, despite a more conservative and pessimistic estimate on its effects, would still manage to be financially sustainable. Further costs are to be expected, but given the damages an unchecked public health emergency could do, they are still economically desirable.

These policies are advised to be executed in three phases. In phase one, immediate action is to be taken regarding the census — Funds should be withdrawn and a group assembled. This *ad hoc* group can later be re-organized into the special state agency and the state-backed firm. Their actual establishment, including that of the new insurance program, would require legislative

participation and political negotiations, and together should be done in phase two, after the necessary information and talents are amassed during the previous stage. The third phase should be simultaneous to the second, but focuses on the business instead of the political, just in case the legislative works should fail. This phase consists of grant-making, negotiating with out-of-state medical suppliers, and preferential taxation / subsidy programs. Compared to the creation of multi-million dollar state firms or entirely new administrative offices, these are less politically charged and require greater executive input, and thus more susceptible to advice, expertise and efforts of the Public Health authorities in Massachusetts.