The War on COVID-19 Roadmap

Hospital Balance & Safe Return to Economic Activity
- Need to keep hospital demand in balance with supply of beds & workers
- Need to bring economy back to normal
- Need to maximize safety
- Need to avoid a second lockdown

Segmentation
Implement segmentation model, sequencing segments returning to work

Treatment
Identify and rapidly deploy effective therapeutic treatments and longer-term a vaccine

Reduce $R_I$
Implement policies & procedures to reduce the rate of spread

Co-living
Develop guidelines for high risk segments living with segments returning to work

Enablers
Develop guidelines for back-to-school (including childcare) and transportation

Therapeutics
While waiting for vaccine, implement effective treatments to curb hosp. rate

Vaccine
Accelerate vaccine development & prepare for deployment at-scale

Testing & Tracing
Develop massive testing & tracing plan to be used to identify & contain virus spread

Focus of follow up on Reducing Rt through (i) workplace norms and (ii) testing & tracing

Source: Bain Capital Partners analysis
Reminder: Why Reducing $R_T$ Matters

**MA New Cases Under Different $R_T$**

<table>
<thead>
<tr>
<th>$R_T$</th>
<th>MA New Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.4</td>
<td>500K</td>
</tr>
<tr>
<td>1.0</td>
<td>100K</td>
</tr>
<tr>
<td>0.8</td>
<td>0K</td>
</tr>
</tbody>
</table>

**Visualizing $R_T$**

- **H1N1:** 1.2–1.6
  - Infected person
  - Average people infected

- **COVID-19:** 2–2.5*
  - Infected person
  - Average people infected

- **MERS:** 2.5–7.2**
  - Infected person
  - Average people infected

Lower spread can significantly reduce the number of daily new cases, despite greater population exposure.

Source: Prof. Uri Alon, Prof. Ron Milo, Prof. Nadav Davidovich, Prof. Amos Zahavi, Dr. Hagit Ulanovsky; Intermittent Work: A feasible strategy for a return to economic activity that can prevent a second wave of COVID-19; Weizman Institute of Science; Business Insider; WSJ.com
Reducing $R_T$ Summary Thought Model

**Impact of Workplace Norms**

- **Masks**: Illustrative Impact on $R_T$ is 2.5
- **Distancing**: Impact is 1.6
- **Self-Diagnosis**: Impact is 1.25
- **Screening**: Impact is 1
- **Ventilation**: Impact is 0.8
- **Cleaning**: Impact is <0.5
- **Other**: Impact is ~0.5

**Impact of Testing & Tracing**

- **Testing & Tracing**: Illustrative Impact on $R_T$ is 2.5
- **Other**: Impact is ~0.5

**Workplace norms and a robust testing & tracing strategy can each independently significantly reduce $R_T$**

Source: Bain Capital Partners analysis
Reminder: Massachusetts COVID-19 Cases

# of new cases showing signs of flattening; growth rate has slowed since people movement slowed

MA growth rate has dramatically slowed since stay-at-home mitigation efforts, and new cases / day may be in early stages of declining

Note: There is day-to-day variability in cases reported by testing laboratories and no single day change in indicative of overall cases trends
Source: Mass.gov; as of 5/21/20

90,084 total cases
2,396 in hospital
647 in ICU
6,148 total deaths
Massachusetts re-opening plan data-based, hinges on driving down COVID impact and planning for healthcare system readiness and testing capability.

Source: Governor’s Office Re-Opening Pan (Released May 18th)
Agenda

Reduce $R_T$

A  Workplace Norms
Develop workplace norms to minimize reoccurrence

B  Testing & Tracing
Develop testing & tracing plan to be used to identify & contain virus spread

Source: Bain Capital Partners analysis
Workplace Norms Roadmap

Workplace Norms
- Lower cost / complexity than testing & tracing, but highly effective

Masks & PPE
- Mandating mask usage can reduce $R_T$ by 60%+. Surgical masks the ideal long-term solution for workplaces

Self Diagnosis
- Meticulous and accurate daily symptom self-reporting can reduce $R_T$ by up to 40%

Employer Screening
- Additional at-work temperature checks can reduce $R_T$ by up to 20%

Distancing & Workplace Configuration
- Distancing at work can limit the number of “super spreader events”

Ventilation
- Proper ventilation important to reduce spread caused by airborne particles

Disinfecting & Cleaning
- Appropriate sanitization protocols can keep workplaces safe

Effective implementation of workplace norms can have a significant impact on $R_T$
# The MA Plan: Working Norm Guidance

<table>
<thead>
<tr>
<th><strong>Masks &amp; PPE</strong></th>
<th><strong>MA Social Guidance</strong></th>
<th><strong>MA Employer Guidance</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Masks required</strong> when unable to maintain six feet social distance in public</td>
<td>Masks mandatory for all employees</td>
</tr>
<tr>
<td></td>
<td>Advised to <strong>monitor for symptoms</strong> and stay home if feel sick</td>
<td>Employees w/ symptoms stay home. Self-screening, including temp/symptom checks, recommended</td>
</tr>
<tr>
<td><strong>Self Diagnosis</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Employer Screening</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Distancing</strong></td>
<td>Advised to limit trips outside the home &amp; maintain social distance</td>
<td>Employees, customers, vendors must remain at least six feet apart to the greatest extent possible</td>
</tr>
<tr>
<td><strong>Ventilation</strong></td>
<td></td>
<td>Improved ventilation for enclosed spaces a recommended best practice</td>
</tr>
<tr>
<td><strong>Sanitization</strong></td>
<td>Advised to <strong>wash hands frequently</strong> for at least 20 seconds with soapy water</td>
<td>Cleaning &amp; disinfecting protocols mandatory. Daily sanitation of all high-touch areas recommended</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td><strong>High risk populations</strong> should only leave the home for essential errands</td>
<td><strong>Recommended</strong> Signage; training; occupancy limits; physical partitions; staggered schedules; vulnerable workers encouraged to stay home</td>
</tr>
</tbody>
</table>

Source: MA.gov
Workplace Norms Agenda

- Masks & PPE
- Self-Diagnosis
- Employer Screening
- Distancing & Workplace Configuration
- Ventilation
- Sanitization
Masks are a Critical Component to Reduce Spread

1 Studies Show They Significantly Reduce Spread
   • Worn properly, if 80%+ of the population wore masks, we could reduce $R_T$ below 1
   • Even cloth masks help contain highly infectious coughs or sneezes that otherwise travel up to 25ft away and effectively trap large droplets expelled during breathing or speaking that can aerosolize
   • Surgical masks can effectively trap small droplets, and are 2-3x more effective than cloth

2 They Enforce “Don’t Touch Your Face”
   • Masks provide a barrier to a large portion of your face, limiting spread from touching contaminated surfaces

3 They Send a Powerful Signal
   • Masks give a sense of communal effort to combat the virus and inspire others to wear masks
## Why We Need Masks: How the Virus Spreads

### Droplets Released by Activity

<table>
<thead>
<tr>
<th>Activity</th>
<th>Droplets Released</th>
<th>Size of Particles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breathing</td>
<td>~ 500 – 3,000 / 10 min</td>
<td>○</td>
</tr>
<tr>
<td>Speaking</td>
<td>~ 3,000 – 30,000 / 10 min</td>
<td>○ ↔ ○</td>
</tr>
<tr>
<td>Coughing</td>
<td>~ 3,000 / event</td>
<td>○ ↔ ○</td>
</tr>
<tr>
<td>Sneezing</td>
<td>~ 30,000 / event</td>
<td>○ ↔ ○</td>
</tr>
</tbody>
</table>

One cough or sneeze releases a large number of droplets, many of which stay airborne.

### How Masks Reduce $R_T$

- Risk of exposure to the virus a function of (1) viral load in droplets exposed to and (2) time exposed to droplets.
- Large particles carry more of the virus but fall to the ground much faster than small particles.
- Masks reduce exposure to viral load via:
  - Containment of the cough or sneeze of a sick person (prevents large particle dispersion).
  - Filtration of both small and large particles during frequent conversational interactions.
  - Filtration during extended exposure to the breath of an infected person.

### All masks are effective at stopping some of the particles emitted from breathing, speaking, coughing & sneezing

Source: Bain & Co, Morawska L. Droplet fate in indoor environments, or can we prevent the spread of infection?; Erin Bromage, The Risks - Know Them - Avoid Them
Mask Usage is About Egress

Protecting the Wearer (Ingress)
- Cloth masks ineffective at protecting wearer from inhaling infected particles
- Protecting the wearer requires medical grade mask (surgical mask, N95)

Protecting Contacts (Egress)
- Cloth masks are highly effective at protecting contacts – can reduce large particle egress from infected by up to 99% (helps keep sneezes, coughs, and other large droplets from spreading)

Protecting the Wearer & Contacts
- The best scenario: everyone wears a mask
- Egress dramatically reduced, and some impact on ingress as well

Universal mask usage could have a significant impact on reducing egress from infected individuals, including asymptomatic individuals

Theoretical Effectiveness of Masks

**Theoretical Mask Use Impact on $R_T$**

<table>
<thead>
<tr>
<th>Adherence: Proportion of the public that wears masks</th>
<th>More people wear masks</th>
<th>Fewer people wear masks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Adherence</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- High adherence and average efficacy leads to disease containment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- High efficiency leads to disease containment</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Blue area is what is needed to stop the spread of COVID-19

**Commentary**

- **Higher adherence**, even with less effective masks, can greatly reduce $R_T$
- But adherence hard without mandates: in an '06-'07 experiment, **less than 50% of participants** kept up the recommended mask wearing routine
- Companies and governments should consider **mandatory use** policies

**Mean % Filtration Efficiency of Various Masks**

<table>
<thead>
<tr>
<th>Material</th>
<th>Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scarf</td>
<td>49%</td>
</tr>
<tr>
<td>100% Cotton Masks</td>
<td>51%</td>
</tr>
<tr>
<td>Tea Towel</td>
<td>72%</td>
</tr>
<tr>
<td>Surgical Masks</td>
<td>89%</td>
</tr>
<tr>
<td>N95 Mask</td>
<td>95%+</td>
</tr>
</tbody>
</table>

Note: Data based on Bacteriophage MS2 (23 nm in diameter) - COVID-19 virus particles are ~125 nm in diameter

Widespread use of masks, even lower quality cloth masks, can have a significant impact on $R_T$

**Country Case Studies: Mask Usage vs. Case Growth**

**Broad Regional Sampling**

Countries with universal masks see lower daily growth and greater reduction in cases. 

**Source:** "Universal Masking To Restart Society and Save Lives" Kai, Goldstein, Morgunov, Nangalia, Rotkirch. April 24, 2020 

**Note:** Only some US states went into lockdown
## Different Types of Masks

<table>
<thead>
<tr>
<th>Mask Type</th>
<th>Use Case</th>
<th>Small Particle Filtration¹</th>
<th>Large Particle Filtration</th>
<th>Reusable?</th>
<th>Comfort</th>
<th>Cost</th>
<th>Supply Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>N95</td>
<td>High risk medical situations</td>
<td>95%+</td>
<td>✓</td>
<td>✓</td>
<td>Low/Med</td>
<td>~$1 / mask (normally)</td>
<td>Significant constraints</td>
</tr>
<tr>
<td>3-ply, non-woven disposable</td>
<td>Surgical (medical use)</td>
<td>70-90%</td>
<td>✓</td>
<td>✓</td>
<td>High</td>
<td>~$0.10 / mask (normally)</td>
<td>Some constraints</td>
</tr>
<tr>
<td>(Surgical / Procedural)</td>
<td>Procedural (medical and non medical use)</td>
<td>Up to 50-70%</td>
<td>✓</td>
<td>✓</td>
<td>Max usage 8hrs</td>
<td>~$5 / mask</td>
<td>Minimal constraints on general use 3-ply</td>
</tr>
<tr>
<td></td>
<td>General use ear loop mask</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cloth</td>
<td>Short-term solution when surgical masks unavailable</td>
<td>~50%</td>
<td>✓</td>
<td>✓</td>
<td>Varies</td>
<td>~$5 / mask</td>
<td>No constraints</td>
</tr>
</tbody>
</table>

Cloth masks an effective near-term solution; longer-term, 3-ply masks present best solution for workplace

¹ Filtration of particles 0.02 - 1µm

Sources: Bain & Co.; McKinsey citing CDC regulations, Cardinal Health, 3M; BCP Analysis
## Types of Non-Woven Masks

<table>
<thead>
<tr>
<th>Not recommended</th>
<th>Provides incremental filtration relative to cloth masks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat Mask</td>
<td></td>
</tr>
<tr>
<td>Flat masks</td>
<td>3-ply masks</td>
</tr>
<tr>
<td>(no filter layer disclosed)</td>
<td>3-ply only (With a filter, but no disclosure on what the filter is)</td>
</tr>
<tr>
<td></td>
<td>Melt-blown filter media (But no ASTM specification)</td>
</tr>
</tbody>
</table>

### “General Use” Masks

- 50-70% Small Particle Filtration
- Masks are made with three layers: an outer layer of usually non-woven fabric, a middle filtration layer, and a skin-gentle inner layer
- Melt-blown filter media (one-type of filter media) is made using very small (<10 micron) polymer filaments that offer incrementally better filtration of airborne particles

### “Procedural” or “Isolation” Masks

- ASTM Level (none, 1, 2)
- Historical use in lower risk healthcare settings (e.g. bedside procedures) and by dentists
- The particle filtration difference in an ASTM L1, L2, and L3 mask is minimal

### “Surgical” Masks

- ASTM Level 3
- Often has tie-on straps to provide closer fit and better filtration
- Intended to higher risk of fluid exposure (twice the fluid protection offered from an L1 mask)

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There is a spectrum of non-woven face masks; 3-ply & melt-blown will likely provide sufficient filtration for offices

Source: Bain & Co citing ASTM International Standardization News
Masks Needs to be Used Properly to Be Effective

### How to Put a Mask On
- Should **cover nose and mouth**
- Should fit **snuggly, but comfortably**
- Wash **hands** before and after wearing

### How to Take a Mask Off
1. **Wash hands**
2. Don’t touch the front of the mask or your face
3. Carefully remove the mask by **grasping the ear loops** or untying the ties (untie bottom first, then top)
4. If your mask has a filter, remove and immediately throw away in a **closed container**
5. Wash hands again

### How to Reuse a Mask
**Cloth Masks**
- Clean **after every wearing**
- Wash in regular laundry using **hot water and soap**
- Dry with **high heat**

**Surgical Masks**
- Cannot be laundered
- If visibly soiled or damaged, **throw away in a closed container**
- Otherwise, put in a breathable, **closed container** (i.e. paper bag) for **72+ hours**

### The Need for Education
- Need education materials, funding & advertising on proper mask use
- Efforts should be similar to CDC efforts on hand washing
### Mask Supply Chain Overview

<table>
<thead>
<tr>
<th>Manufacturers</th>
<th>Distributors</th>
<th>Consumers</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Three major types of manufacturers:</td>
<td>• Distributors buy ~80% masks from overseas manufacturers and sells to domestic consumers</td>
<td>• Healthcare providers are the largest consumers of surgical &amp; procedural masks (e.g. hospitals, dentists, nursing homes)</td>
</tr>
<tr>
<td>• Large Asian based (~80% of supply)</td>
<td>• Distributors are usually focused on specific end markets (e.g. healthcare provider focused, manufacturing focused, etc.) and sell masks as part of larger PPE/supplies offering</td>
<td>• Industrial / construction companies largely use non-FDA approved masks (e.g. dust masks, industrial N95 masks)</td>
</tr>
<tr>
<td>• Medical Integrated Distributor / Manufacturers (e.g. Medline)</td>
<td></td>
<td>• While healthcare demand has slowed, there is potential for resurgence as the US and other countries begin to reopen:</td>
</tr>
<tr>
<td>• High End Technical (e.g. 3M)</td>
<td></td>
<td>• Chance of a second wave of infection</td>
</tr>
<tr>
<td>• Responsible for getting masks tested (either through a 3rd party or self testing) in order to clear certain FDA certifications</td>
<td></td>
<td>• Reintroduction of elective procedures</td>
</tr>
<tr>
<td>• Many larger manufacturers create both surgical and procedural masks</td>
<td></td>
<td>• Mass adoption of mask wearing by the general public and the broader workforce</td>
</tr>
</tbody>
</table>

**“Before the pandemic, half the world’s masks were manufactured in China; now, with production there shifting into overdrive, that figure may be as high as 85%”**

Wall Street Journal

**“Demand from healthcare is up 300-1000%. Manufacturing and sourcing has been impacted as we ramp up supply...you’d see a delivery delay of around one month.”**

Medline

**“Due to COVID-19 and the needs of our medical customers, [we are] not accepting any new customers at this time.”**

Owens & Minor

**“We have procedural masks from a long standing, approved supplier. I don’t think they are FDA certified, but that’s because we historically haven’t sold to healthcare.”**

Grainger

**“We’ve opened up the door for all elective surgeries so we’re really ramping up preparation now.”**

Mid-Valley Hospital, Washington state

**“Most people expect a second wave, and expect that second wave to be worse.”**

Mt. Sinai Hospital, New York

Source: Bain & Co
3-Ply Mask Supply

China is now producing more than ~1 Billion masks per week

“Before the pandemic, half the world’s masks were manufactured in China; now, with production there shifting into overdrive, that figure may be as high as 85%”

Wall Street Journal

Many of these Chinese producers are new, and product quality varies

- Sampling of Chinese mask manufacturers on Alibaba showed that over 50% had been selling on the platform for less than 1 year
- While ~50% claimed to have CE level certification, less than 20% made claims about FDA approval and the consistent ASTM testing level

As a result, supply constraints have eased for general-use masks

“I don’t expect a shortage of supply of these general melt-blown masks from Asia, as long as there isn’t a second wave of infection because then China may shutter its borders.”

Former VP R&D, US manufacturer

However, supplies of medical-grade masks are still significantly constrained

“We’ll now have universal demand for masks. We’re running into the problem that there are thousands of makers of masks but there are only so many melt-blown facilities that create filter fabric good enough for hospital use. Prices of FDA-level masks are going up for the next wave of demand”

Supply Chain Director, Mt. Sinai Hospital

Production has ramped significantly in China, easing supply constraints for general-use masks

Source: Bain & Co citing Chinese National Development and Reform Commission, South China Morning Post, NPR, WSJ, Alibaba (first page of results, N=45), market participant interviews
### MA Distributor Survey

#### What types of masks do you typically sell?
- **26** Medical Only
- **26** General use & Medical
- **26** General use Only

#### What is the backlog time on getting masks?
- **9** Not taking pre-orders
- **17** Yes
  - **13** More than 3 months
  - **4** 1-3 months
  - **0** Less than 1 month

#### Do you have stock today for any type of mask?
- **26** Yes
  - **26** General use

#### What types of masks do you have in stock?
- **17** Procedural (Level 1)
  - **10** Procedural (Level 2)
  - **7** General use

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**Other Considerations**

- The majority of distributors (~90%) indicated that at least 75% of their mask supply comes from China
  - Nearly half of the distributors surveyed sourced 100% of their masks from China
- ~20% of distributors have only started working with their manufacturer in the past few months

"We have been looking to expand manufacturers from other countries. But decisions to change manufacturers, and considerations on how long we’ve worked together is at corporate level."

Fastenal

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**Note:** "Surgical" was defined as ASTM Class 3, FDA/CE approved, “Procedural” as ASTM Class 1-2, FDA/CE approved, and “General use” as not ASTM certified (may or may have FDA/CE approval, or melt-blown non-woven filtration).

**Source:** Distributor interviews (N=17), Interviewed “Surgical Mask” suppliers within 500 miles of Boston

---
<table>
<thead>
<tr>
<th>Distributor</th>
<th>Phone #</th>
<th>Masks in Stock?*</th>
</tr>
</thead>
<tbody>
<tr>
<td>A&amp;BJ International</td>
<td>347-399-9843</td>
<td>Yes</td>
</tr>
<tr>
<td>Abbott Ball Company</td>
<td>860-236-5901</td>
<td>Yes</td>
</tr>
<tr>
<td>Associated Bag</td>
<td>800-926-6100</td>
<td>Yes</td>
</tr>
<tr>
<td>Central Equipment LLC</td>
<td>508-758-3758</td>
<td>Yes</td>
</tr>
<tr>
<td>Conlon Products</td>
<td>978-682-8842</td>
<td>Yes</td>
</tr>
<tr>
<td>Darby Dental Supply</td>
<td>800-645-2310</td>
<td>Yes</td>
</tr>
<tr>
<td>DocPPE</td>
<td>888-493-5554</td>
<td>Yes</td>
</tr>
<tr>
<td>Fastenal</td>
<td>864-569-7070</td>
<td>Yes</td>
</tr>
<tr>
<td>Fisher Scientific</td>
<td>800-766-7000</td>
<td>Yes</td>
</tr>
<tr>
<td>Get a mask.store</td>
<td>848-206-6398</td>
<td>Yes</td>
</tr>
<tr>
<td>Go Green Solutions</td>
<td>978-852-7977</td>
<td>Yes</td>
</tr>
<tr>
<td>Harrison Shrader</td>
<td>207-312-4991</td>
<td>Yes</td>
</tr>
<tr>
<td>Lane Printing &amp; Advertising</td>
<td>781-767-4450</td>
<td>Yes</td>
</tr>
<tr>
<td>Northern Safety</td>
<td>800-571-4646</td>
<td>Yes</td>
</tr>
<tr>
<td>Safety Today</td>
<td>800-837-5900</td>
<td>Yes</td>
</tr>
<tr>
<td>Unination</td>
<td>646-661-1500</td>
<td>Yes</td>
</tr>
<tr>
<td>Ace Surgical Supply</td>
<td>800-441-3100</td>
<td>No</td>
</tr>
<tr>
<td>Airgas</td>
<td>855-625-5285 X4805</td>
<td>No</td>
</tr>
<tr>
<td>Atlantic Paper and Supply</td>
<td>(401) 725-0950</td>
<td>No</td>
</tr>
<tr>
<td>Bound Tree Medical</td>
<td>800-533-0523</td>
<td>No</td>
</tr>
<tr>
<td>CAM Office Services</td>
<td>791-932-9868</td>
<td>No</td>
</tr>
<tr>
<td>Contollo</td>
<td>(508) 841-5822</td>
<td>No</td>
</tr>
<tr>
<td>DetraPel</td>
<td>617.514.7777</td>
<td>No</td>
</tr>
<tr>
<td>Henry Schein</td>
<td>800-772-4346</td>
<td>No</td>
</tr>
<tr>
<td>Noble Supply &amp; Logistics</td>
<td>508-944-5722</td>
<td>No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Distributor</th>
<th>Phone #</th>
<th>Masks in Stock?*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spectrum Chemical</td>
<td>800.772.8786</td>
<td>No</td>
</tr>
<tr>
<td>Uline</td>
<td>800-295-5510</td>
<td>No</td>
</tr>
<tr>
<td>Cintas Corp</td>
<td>978.244.6787</td>
<td>Called - no answer</td>
</tr>
<tr>
<td>Creative Touch Designs</td>
<td>19784994444</td>
<td>Called - no answer</td>
</tr>
<tr>
<td>DOT Fleet Parts</td>
<td>978-455-9082</td>
<td>Called - no answer</td>
</tr>
<tr>
<td>EPIC Business Essentials</td>
<td>828-395-7458</td>
<td>Called - no answer</td>
</tr>
<tr>
<td>Flagship Press</td>
<td>617-719-5215</td>
<td>Called - no answer</td>
</tr>
<tr>
<td>Galls LLC</td>
<td>8594337142</td>
<td>Called - no answer</td>
</tr>
<tr>
<td>Industrial Protection Services</td>
<td>603-685-8023</td>
<td>Called - no answer</td>
</tr>
<tr>
<td>Matouk</td>
<td>646-489-0229</td>
<td>Called - no answer</td>
</tr>
<tr>
<td>MG Products</td>
<td>9783525042</td>
<td>Called - no answer</td>
</tr>
<tr>
<td>MSC Industrial Supply</td>
<td>781-272-4884</td>
<td>Called - no answer</td>
</tr>
<tr>
<td>Body Armor Outlet, LLC</td>
<td>603-479-1919</td>
<td>Called - no answer</td>
</tr>
<tr>
<td>Brooks Brothers</td>
<td>917 225 8996</td>
<td>Called - no answer</td>
</tr>
<tr>
<td>D.O.T. Fleet Parts Inc.</td>
<td>781-956-8723</td>
<td>Called - no answer</td>
</tr>
<tr>
<td>New Balance</td>
<td>617-925-1410</td>
<td>Called - no answer</td>
</tr>
<tr>
<td>Proforma Eagle Print &amp; Promotion</td>
<td>617-429-3400</td>
<td>Called - no answer</td>
</tr>
<tr>
<td>Razz-m-tazz Promotions, LLC</td>
<td>19788740502</td>
<td>Called - no answer</td>
</tr>
<tr>
<td>Richmond Hardware</td>
<td>7818430066</td>
<td>Called - no answer</td>
</tr>
<tr>
<td>Safety Inc.</td>
<td>978-532-7330 x103</td>
<td>Called - no answer</td>
</tr>
<tr>
<td>Stericycle</td>
<td>847-943-6796</td>
<td>Called - no answer</td>
</tr>
<tr>
<td>Trans Med USA Inc</td>
<td>978-649-1970</td>
<td>Called - no answer</td>
</tr>
<tr>
<td>veritiv</td>
<td>8625918461</td>
<td>Called - no answer</td>
</tr>
<tr>
<td>WB Mason</td>
<td>508-846-1490</td>
<td>Called - no answer</td>
</tr>
</tbody>
</table>

Note: *In Stock when the company was contacted (May 19-20, 2020)
Source: Company websites; company calls.
Other PPE

High-risk industries

- In high-risk industries, such as healthcare, PPE is required
- PPE should be acquired by industries with high exposure to customers (e.g., restaurants, retail, personal services); needs will vary by workplace
  - Disposable gloves should be used when touching food; face shields when coming into close contact with others (e.g., salons)

Cleaning

- CDC recommends that employers provide disposable gloves and gowns to cleaning staff
- Additional PPE (e.g., face shield) may be required based on the cleaning / disinfectant product and whether there is a risk of splash

Screening

- CDC recommends the use of disposable gloves
- Eye protection (goggles or disposable face shield) is needed if physical partitions are not used
- A gown is only needed if extensive contact with an employee is anticipated

Nitrile gloves are recommended, although latex or vinyl gloves can also be used

Other PPE is only recommended in high-risk industries and for cleaning and screening staff

Note: Gloves to be changed after each "task"; hands must be washed between glove changes
Sources: Bain & Co, McKinsey, BCP Analysis
Workplace Norms Agenda

- Masks & PPE
  - Self-Diagnosis
    - Employer Screening
    - Distancing & Workplace Configuration
    - Ventilation
    - Sanitization
# Self-Diagnosis

**Where Infections Come From**

<table>
<thead>
<tr>
<th>Symptom</th>
<th>% of Cases</th>
<th>Conceptual “Difficulty” to Report</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fever</td>
<td>64%</td>
<td>Low</td>
</tr>
<tr>
<td>Sinus Pain</td>
<td>50%</td>
<td>Low</td>
</tr>
<tr>
<td>Cough</td>
<td>46%</td>
<td>Low</td>
</tr>
<tr>
<td>Expectoration</td>
<td>32%</td>
<td>Low</td>
</tr>
<tr>
<td>Chills</td>
<td>18%</td>
<td>Low</td>
</tr>
<tr>
<td>Difficulty breathing</td>
<td>11%</td>
<td>Low</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>6%</td>
<td>Low</td>
</tr>
<tr>
<td>Vomiting</td>
<td>3%</td>
<td>Low</td>
</tr>
<tr>
<td>Altered sense of smell</td>
<td>44%</td>
<td>Medium</td>
</tr>
<tr>
<td>Stuffy nose</td>
<td>25%</td>
<td>Medium</td>
</tr>
<tr>
<td>Sore throat</td>
<td>13%</td>
<td>Medium</td>
</tr>
<tr>
<td>Headache</td>
<td>13%</td>
<td>Medium</td>
</tr>
<tr>
<td>Joint or muscle pain</td>
<td>10%</td>
<td>Medium</td>
</tr>
<tr>
<td>Fatigue</td>
<td>18%</td>
<td>High</td>
</tr>
</tbody>
</table>

Meticulous and accurate daily symptom surveying and self-reporting can reduce $R_T$ by up to 40%. Some symptoms easier to track than others – consider implementing a tiered symptom structure.

Source: Quantifying SARS-CoV-2 transmission suggests epidemic control with digital contact tracing” by Luca Feretti, Chris Wymant, Michelle Kendall, Lele Zhao, Anel Nurtay, Lucie Abeler-Domer, Michael Parker, David Bonsall, Christophe Fraser, Oxford University, Scientists to Stop COVID-19
Self-Diagnosis: How to Administer

<table>
<thead>
<tr>
<th>Description</th>
<th>Lower Cost</th>
<th>Higher Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper Survey</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Printed checklist employee submits on arrival if able to work</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apple / CDC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public health-app that provides recommended action based on symptoms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Free Apps</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apps from startups &amp; larger corps (e.g. MSFT, Buoy Health, Bright.MD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Code Solution</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low code workforce mgmt &amp; crisis response app that includes symptom reporting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Custom Solution</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In-house app that can track symptoms, issue guidance and communicate w/ employees</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ability to Verify</th>
<th>Manual</th>
<th>Requires screenshots</th>
<th>Varies</th>
<th>Yes</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>Free / Low</td>
<td>Free</td>
<td>Free</td>
<td>Low</td>
<td>Low to medium</td>
</tr>
<tr>
<td>Customizability</td>
<td>Medium</td>
<td>Limited</td>
<td>Varies</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>

Employers should consider leveraging solutions that make it possible to verify employee completion and access the results

Source: Bain & Co
Workplace Norms Agenda

- Masks & PPE
- Self-Diagnosis
- **Employer Screening**
  - Distancing & Workplace Configuration
  - Ventilation
  - Sanitization
Employer Screening Effectiveness

Where Infections Come From

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Infection Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>Asymptomatic</td>
</tr>
<tr>
<td>80%</td>
<td>Pre-Symptomatic</td>
</tr>
<tr>
<td>60%</td>
<td>Symptomatic w/o Fever</td>
</tr>
<tr>
<td>40%</td>
<td>Symptomatic w/ Fever</td>
</tr>
<tr>
<td>20%</td>
<td>Environmental</td>
</tr>
<tr>
<td>0%</td>
<td>Estimated ~20% of infections come from a symptomatic individual with fever</td>
</tr>
</tbody>
</table>

Pros
- If checks caught every fever, possible to reduce $R_T$ by up to 20%
- Likely to encourage self-screener compliance
- Highly visible check that may help put workers more at ease
- Devices relatively inexpensive

Cons
- Thermometers can be inaccurate, especially thermal infrared cameras used for larger populations
- Easy to bypass check by taking ibuprofen/acetaminophen before
- Can be difficult to implement and may cause bottlenecks
- Smaller devices require PPE and a trained screener to operate

On-site temperature checks can reduce RT by up to 20%

Source: “Quantifying SARS-CoV-2 transmission suggests epidemic control with digital contact tracing” by Luca Feretti, Chris Wymant, Michelle Kendall, Lele Zhao, Anel Nurtay, Lucie Abeler-Domer, Michael Parker, David Bonsall, Christophe Fraser, Oxford University, Scientists to Stop COVID-19
## Employer Screening Tools & Case Studies

<table>
<thead>
<tr>
<th>Description</th>
<th>Thermal Infrared Cameras</th>
<th>No Contact Thermometers</th>
<th>Standard Thermometers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Infrared sensors measure temperature from a distance</td>
<td>Infrared sensors measure temperature without touching skin</td>
<td>Forehead, mouth &amp; ear thermometers measure temperature through contact</td>
</tr>
<tr>
<td><strong>Accuracy</strong></td>
<td>+/- 2 °C</td>
<td>+/- 0.3 °C</td>
<td>+/- 0.3 °C</td>
</tr>
<tr>
<td><strong>Throughput</strong></td>
<td>20 individuals / minute</td>
<td>6 individuals / minute</td>
<td>1-2 individuals / minute</td>
</tr>
<tr>
<td><strong>Cost</strong></td>
<td>$6,500+</td>
<td>$100+</td>
<td>$10-50</td>
</tr>
<tr>
<td><strong>Commentary</strong></td>
<td>• Week-long backorders currently</td>
<td>• Difficult to obtain currently</td>
<td>• May cause bottlenecks at workplaces – more ideal for SMBs</td>
</tr>
<tr>
<td></td>
<td>• Optimally, would screen individuals one at a time, 6ft apart</td>
<td>• Must be used in draft-free spaces out of the sun, 6in from forehead</td>
<td>• Requires the most PPE to operate</td>
</tr>
<tr>
<td></td>
<td>• Best for the largest workplaces</td>
<td>• Requires some PPE to operate</td>
<td></td>
</tr>
<tr>
<td><strong>Examples</strong></td>
<td>Using to screen facility workers</td>
<td>Walmart® Screening all associates</td>
<td>THE HOME DEPOT Sent to employees to use at home</td>
</tr>
</tbody>
</table>

Source: Bain & Co, company websites, press releases, literature review
Workplace Norms Agenda

- Masks & PPE
- Self-Diagnosis
- Employer Screening

• Distancing & Workplace Configuration
  - Ventilation
  - Sanitization
Social Distancing – Why 6 Feet?

Effectiveness of Distancing

- Studies demonstrate distancing most effective at distances greater than three feet
- CDC recommends “6 feet apart” as a general rule of thumb

Factors that Impact Effectiveness

- Ventilation and air flow
- Indoor vs outside space
- Positioning and posture of individuals
- Duration of exposure
- Activities performed by individuals (e.g., talking, sneezing, exercising)

“6 Feet Apart” is a great rule of thumb for most low risk situations

"Super Spreader Events"

Large Gatherings Responsible for Majority of Spread

- “R_t” is an average – in practice, “super spreader events” responsible for majority of infections
- Studies on Ebola show that 3% of cases were responsible for 61% of infections
- Other disease studies show that 20% of population responsible for 80% of transmission potential

Potential Past COVID-19 “SSE”s

- Large religious gatherings or services
  - Large religious gatherings in Qom, Iran led to massive outbreaks in February
  - France’s weeklong Christian Open Door prayer meeting in Feb (linked to 2500 cases)

- Parties and Festivals
  - Large birthday party in Westport, CT on 3/5
  - Engagement party in Rio de Janeiro on 3/7

- Funerals

- Face-to-face Business Networking
  - Boston’s Biogen leadership meeting in Feb

Broad policies against large gatherings are critical to avoid additional “super spreader events” that rapidly spread the virus

Workplace Reconfiguration

Reconfiguration needs will vary by workplace

- Industry
- Workplace type
- Workplace risk
- Federal, state, and local guidelines

Three principles to guide reconfiguration

1. Ensure social distance between employees, customers, and vendors
2. Minimize usage of shared equipment and touch points
3. Clearly and effectively communicate with employees and customers about new protocols

Employers will need to reconfigure workspaces and staffing policies to abide by distancing guidelines and promote worker safety
Workplace Norms Agenda

- Masks & PPE
- Self-Diagnosis
- Employer Screening
- Distancing & Workplace Configuration
  - Ventilation
- Sanitization
Ventilation: Why is it Important?

Evidence from Studies

- Recent studies found evidence the virus is transmitted from contaminated air
  - One study found high levels of airborne viral RNA in a patient’s toilet area
  - Another found viral contamination in air samples from rooms where patients were isolating
  - In China, nine customers in a restaurant were infected because of the HVAC system
- Proper ventilation can prevent spread by diluting & displacing particles
  - Ventilation adds clean, disinfected air that dilutes contaminated air
  - Directional airflow moves infectious air to filters

Risk Factor | Description
---|---
Ventilation | • Ventilation dilutes particles with clean air
Circulation | • Circulation prevents particles staying in place (enabling better ventilation and filtration)
Filtration | • Filters trap and remove particles from the air
Humidity | • Too humid and particles settle on surfaces
  • Not humid enough and respiratory system dry out

Employers can take precautions to reduce airborne exposure to coronavirus through adjustments to their ventilation systems

Source: Bain & Co citing Scientific American; The American Society of Heating, Refrigerating, and Air-Conditioning Engineers; How Healthy Buildings Can Help Us Fight Coronavirus
Workplace Norms Agenda

- Masks & PPE
- Self-Diagnosis
- Employer Screening
- Distancing & Workplace Configuration
- Ventilation
- Sanitization
Sanitization Recommendations

<table>
<thead>
<tr>
<th>Mandatory Protocols in MA Plan</th>
<th>Key Sanitization Recommendations</th>
<th>How Frequently to Clean</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Provide <strong>hand washing capabilities</strong> throughout the workplace</td>
<td>• Continuously sanitize <strong>common &amp; high-touch areas</strong></td>
<td>High-Touch</td>
</tr>
<tr>
<td>• Ensure <strong>frequent hand washing</strong> by employees and <strong>adequate supplies</strong> to do so</td>
<td>• Ask employees to <strong>wipe down workstations at end of each day</strong></td>
<td>Every 2-3 hrs</td>
</tr>
<tr>
<td>• Provide <strong>regular sanitization of high touch areas</strong>, such as workstations, equipment, screens, doorknobs, restrooms throughout work site</td>
<td>• Use <strong>appropriate EPA-approved disinfectant</strong></td>
<td>Med-Touch</td>
</tr>
<tr>
<td></td>
<td>• Install <strong>hand sanitizers</strong> in common areas and next to entries</td>
<td>3-4x / day</td>
</tr>
<tr>
<td></td>
<td>• Use <strong>signage to clearly mark</strong> the last time an area was cleaned</td>
<td>Low-Touch</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Once / day</td>
</tr>
</tbody>
</table>

How Frequently to Clean

- **High-Touch**
  - Handles, Elevator Buttons
  - Every 2-3 hrs

- **Med-Touch**
  - Lobby Furniture
  - 3-4x / day

- **Low-Touch**
  - Windows, Cabinets
  - Once / day

**Standard sanitization protocols can ensure workplace health and safety**

Note: Cleaning removes germs, disinfecting kills germs; [*] Contact time represents the recommended amount of time that a consumer should wait before wiping the surface and resuming activity on it.
Source: MA.gov, Bain & Co citing CDC; EPA; Miami-Dade Guidelines for Businesses; CBRE; Press Releases
# High-Traffic Areas

## Kitchens / Cafeterias

- **Adopt clear standards**, such as:
  - 50% max capacity
  - Designated entrances & exits
  - No shared food
  - Single-use cups & utensils
- **Stagger lunch/break times**
- **Use self-dispensing soap**
- **Enable “grab-and-go” options**

## Elevators

- **Promote social distancing**
  - Capacity limited to 4 ppl
  - Visible **markers** to stand on
  - **Waiting areas**
  - **Hand sanitizers** at elevator entrances
  - **Plastic coverings over buttons**
  - **Increased ventilation & filtration**
  - **High-risk pop. options** (e.g., solo rides)

## Bathrooms

- **Touchless devices** (soap & water, towel dispensers, anti-viral cleaning supplies)
- **Track** sanitization and inform tenants of **last cleaning** via signage
- **Consider touchless door pulls & partition hardware**
- **Required mask usage**
- **Clean 3-4 times per day**

### Case Studies

- **Sanitizing kitchen and break areas after usage; providing hand sanitizers and disinfectant wipes in high-traffic areas**
- **Maintaining social distancing standards**
- **Four-occupant maximum**
- **Providing all guests with complimentary PPE kits**
- **Increased cleaning of high-touch surfaces**
- **Placing signs explaining protocol in all lobbies**
- **Increasing cleaning to 3-4 times per day**
- **Reminding employees to practice good hygiene**

### Employers should establish and communicate protocols for high-traffic areas

---

Note: For meetings, retain name of attendees for at least one month in the case that public health authorities need to trace attendees

Source: Bain & CO, citing CDC; Miami-Dade Guidelines for Businesses; CBRE; Press releases
Reducing $R_T$ Roadmap

**Workplace Norms**

- Lower cost / complexity than testing & tracing, but highly effective

- **Masks & PPE**
  Mandating mask usage can reduce $R_T$ by 60%+. Surgical masks the ideal long-term solution for workplaces

- **Self Diagnosis**
  Meticulous and accurate daily symptom self-reporting can reduce $R_T$ by up to 40%

- **Employer Screening**
  Additional at-work temperature checks can reduce $R_T$ by up to 20%

- **Distancing & Workplace Configuration**
  Distancing at work can limit the number of “super spreader events”

- **Ventilation**
  Proper ventilation important to reduce spread caused by airborne particles

- **Disinfecting & Cleaning**
  Appropriate sanitization protocols can keep workplaces safe

Effective implementation of workplace norms can have a significant impact on $R_T$

Source: Bain Capital Partners analysis
Agenda

Reduce $R_T$

A. Workplace Norms
   Develop workplace norms to minimize reoccurrence

B. Testing & Tracing
   Develop testing & tracing plan to be used to identify & contain virus spread

Source: Bain Capital Partners analysis
Group B: Testing & Tracing

- Testing Targets & Approach
- Tracing Approach
Reminder: Current Testing Capacity

MA Testing continues ahead of the US average in tests on a per capita basis, though US average has continued to increase while MA has plateaued.

Source: https://covidtracking.com/data/us-daily, Mass.gov as of 5/21
Reminder: Why Testing is Critical

Effective at Reducing Rt

- Self-Isolation
- Household Quarantine
- App Tracing
- Known Contact Tracing
- All Contact Tracing

Success in Other Countries

Cumulative positive test rate

Most success stories in containing COVID are in countries that have over-tested with low positive rates, though mainly in early spread of disease.

Public Health Strategy

Testing data is the underlying driver for public health officials, businesses and individuals to inform policy.

Necessary but not sufficient in the absence of behavioral change / workplace norms.

Source: Mass.gov; as of 5/18/20; Centre for Mathematical Modelling of Infectious Diseases COVID-19 working group; based on data from worldometers aggregate data.
Testing Context: Massachusetts's Announced Testing Plan

**Testing Ramp**

- **Utilization Today:** 10-15
- **Stated Capacity Today:** 30
- **July Target:** 45
- **December Target:** 75

**Testing Use Cases**

- **Target Testing Populations & Objectives**
  - All Symptomatic Individuals (July)
  - Limited high-risk / front line (July)
  - Contact tracing testing (July)
  - Incremental employer testing (July+)
  - Wide surge / surveillance (Dec)

- **Test Types**
  - Largely PCR testing (July)
  - Innovation / Antigen / Other (Dec)

**Commentary**

- **Aspiration of 75K tests / day would lead other states & many countries in terms of announced targets**

- **Plan is in the range of the number of tests bottom up MA needs in the near-term, large-scale testing beyond symptomatic and front-line workers (driven by employers) may require more capacity**

- **Public / Press Reactions Generally Supportive:**
  - Public Health experts urge reopen based on test data
  - Workers advocates raising right to regular testing

Source: Massachusetts Re-Opening Plan (May 18th Release)
## Testing Context: Capacity Targets

### Announced Target Testing Capacity

<table>
<thead>
<tr>
<th></th>
<th>International</th>
<th>US States</th>
<th>Massachusetts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tests / Day / 100K Population</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Germany</td>
<td>775</td>
<td>206</td>
<td>MA (Gov Plan)</td>
</tr>
<tr>
<td>Singapore</td>
<td>709</td>
<td>227</td>
<td>MA (Estimated Range)</td>
</tr>
<tr>
<td>UK</td>
<td>300</td>
<td>177</td>
<td>1,814</td>
</tr>
<tr>
<td>Minnesota</td>
<td>355</td>
<td>168</td>
<td>Jul</td>
</tr>
<tr>
<td>New Jersey</td>
<td>227</td>
<td>168</td>
<td>Dec</td>
</tr>
<tr>
<td>New York State</td>
<td>206</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>California State</td>
<td>177</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Connecticut</td>
<td>168</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>Iowa</td>
<td>117</td>
<td>50-125</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Test Target (K/Day)</th>
<th>643</th>
<th>40</th>
<th>200</th>
<th>20</th>
<th>20</th>
<th>40</th>
<th>70</th>
<th>6</th>
<th>10</th>
<th>75</th>
<th>50-125</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population (M)</td>
<td>83.0</td>
<td>5.6</td>
<td>66.7</td>
<td>5.6</td>
<td>8.8</td>
<td>19.5</td>
<td>39.5</td>
<td>3.6</td>
<td>8.5</td>
<td>6.9</td>
<td>6.9</td>
</tr>
</tbody>
</table>

Source: Bain & Co, State Benchmarking
Testing: Strategic Framework & Approach

**Strategy**

**A** Strategic Objective
- Symptomatic
- Contact Tracing
- Front-Line Workers
- High-Risk Populations
- Other Sub-Populations
- Universal Testing

**B** Type & Innovation
- PCR / Viral
- Antigen
- Pooling
- Combined Tests
- Future Innovation

**Feasibility**

**C** Cost
- Per Test Cost
- Total Cost to System
- Payors
- Employers
- Individuals

**D** Ability to Ramp
- Lab Capacity
- Supply Chain / Inputs
- Distribution / POC
- Communication

**Holistic approach to testing must consider the objective, tools available, feasibility & cost to implement**

Note: Serology Testing Incremental & another source of surveillance
Testing Strategy: Critical Populations

Critical Populations for Testing Focus

| Highest Risk | - make available proactive testing |
| High Risk | - capacity permitted proactive testing |

Massachusetts Labor Force Breakdown (Total 3.6M)

- Hospitals (Cat 2)
- Accommodations
- Service counter
- Warehousing and distribution
- Utilities
- Mining and Agriculture
- Professional services
- Sales
- Trades - indoors
- Trades - outdoors
- Couriers/messengers
- Sales
- K-12
- Manufacturing
- Construction
- Senior Housing, US Census Data, Bain & Co analysis, Bain Capital Partners Analysis
- Public Safety
- Health care services
- Eating & drinking
- Transportation services
- Retail
- Daycare/pre-schools/day camp
- Education
- Industrial workplaces
- Ag & Utilities
- Office workplaces
- Field Forces
- Large scale gathering places

High Risk Populations

- Nursing / Assisted Living: 54K
- Elderly Public Housing: 71K
- Prisons / Homeless: 28K
- Students: ~1.5M

Capacity

- Critical Labor Force (230K-1.5M)
  (Front-line hospital workers, Nursing home workers, first responders in first wave; expand to Med risk with capacity)

- High Risk Populations (150K)
  (Institutional housing, non-domicilled)

- Flu Season Surge
  (Typical flu season, if all symptomatics get tested → 50-60k new ILI cases per week during peak)

- Back to School Surge
  (likely to require one-time testing around back to school / university season → 20k/day if spread over 2 months)

Testing Strategy: Summary Range of Options

Strategic Approach & Required Testing Capacity

Considerations for Strategy

1. Symptomatic Testing
2. Contact Tracing Testing
3. High Risk Populations (including but not limited to nursing homes, prisons / homeless shelters, elderly public housing)
4. Front Line Workers (critical front line workers e.g., nurses, healthcare workers, police/fire & secondary front line workers e.g., other healthcare, retail, transportation)
5. Seasonal Surge Capacity (surge testing for seasonal events: symptomatic Flu (~8k/day), back to school (~10-20k/day)
6. Additional Capacity (allows for proactive testing beyond the above population groups)

Source: Bain Capital Partners & Bain & Company analysis; Expert Interviews
Note: 10-15K / day surge capacity for Flu season or back to school included in “Limited Front Line / High Risk Testing” & “Expanded”; Employer-Led model includes 90K in other capacity for monthly testing of the general population
## Testing Strategy: Communication of Testing Approach

### State Benchmarking

<table>
<thead>
<tr>
<th>Population</th>
<th>Massachusetts</th>
<th>California</th>
<th>New York</th>
<th>District of Columbia</th>
<th>Maryland</th>
<th>Texas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Testing (per week/100K):</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• May 19: 1,283 tests</td>
<td>775</td>
<td>1,251</td>
<td>1,185</td>
<td>647</td>
<td>713</td>
<td></td>
</tr>
<tr>
<td>• May 5: 1,144 tests</td>
<td>512</td>
<td>948</td>
<td>775</td>
<td>534</td>
<td>437</td>
<td></td>
</tr>
<tr>
<td>Symptomatic</td>
<td>✓ (emphasis)</td>
<td>✓ (emphasis)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓ (emphasis)</td>
</tr>
<tr>
<td>Asymptomatic with exposure</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>High risked population (Ages 65 and above, etc.)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Healthcare workers and first responders</td>
<td>✓ (emphasis)</td>
<td>✓ (emphasis)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Essential workers (Child care / workers, delivery etc.)</td>
<td>✗</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

### Target groups for testing, communicated in state testing strategy

- **Symptomatic**
- **Asymptomatic with exposure**
- **High risked population (Ages 65 and above, etc.)**
- **Healthcare workers and first responders**
- **Essential workers (Child care / workers, delivery etc.)**

### Doctors note required (based on interviews with local clinic/pharmacies)

- **With symptoms**
- **Without symptoms**

Massachusetts guidance, May 13: “Asymptomatic individuals can be recommended for diagnostic testing at the discretion of their healthcare provider, a state agency, or an employer.”

Approval for testing screening performed by public entities

---

Note: NY Government (19.4M); California Government (39.5M total population); DC Government (702.5K)
## Testing Strategy: How to Get Tested Today

### Over 200+ testing locations across Massachusetts

<table>
<thead>
<tr>
<th>Hospitals</th>
<th>• Majority of hospitals are testing for COVID-19</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other medical facilities</td>
<td>• Certain urgent care centres, walk-in clinics, family medical facilities, etc. are testing for COVID</td>
</tr>
<tr>
<td>Mobile testing sites</td>
<td>• Mobile testing sites have been set up to provide greater access to testing for certain populations (i.e. nursing homes)</td>
</tr>
<tr>
<td>Drive-thru</td>
<td>• Several drive-thru facilities have been set up specifically to test for COVID (e.g. pharmacies, schools, retail etc.)</td>
</tr>
</tbody>
</table>

### What you need to do to get tested

<table>
<thead>
<tr>
<th>Symptomatic individuals¹ or closed contacts of COVID cases</th>
<th>• Contact a testing site</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Doctor’s note not required (confirmed with call benchmarking at testing locations)</td>
</tr>
</tbody>
</table>

### Asymptomatic individuals

Massachusetts guidance: “Asymptomatic Individuals: Asymptomatic individuals can be recommended for diagnostic testing at the discretion of their healthcare provider, a state agency, or an employer. Individuals are encouraged to confirm with their insurance whether the test will be covered.”

---

¹Symptomatic individuals include elderly, chronically ill or debilitated individuals such as resident of long-term care facility, symptoms of COVID-19 may be subtle such as alterations in mental status or in blood glucose control

Sources: Department of Health Massachusetts, Massachusetts government; Market participant interviews

Note: List of all testing sites in Massachusetts can be found here: [https://www.mass.gov/doc/ma-covid-19-testing-sites/download](https://www.mass.gov/doc/ma-covid-19-testing-sites/download)
## Testing Strategy: Test Types & Innovations

<table>
<thead>
<tr>
<th>PCR</th>
<th>Antigen</th>
<th>PCR Pooling</th>
<th>Antibody (Serology)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Viral DNA/RNA test from nasal/throat or saliva</td>
<td>• Nasal swab test to detect viral surface proteins (antigens)</td>
<td>• Pooling of PCR samples to run same process reducing cost for low-risk testing</td>
<td>• Detection of the antibody response to the virus</td>
</tr>
<tr>
<td>• Samples typically processed in scale clinical labs or large hospitals with complex testing equipment</td>
<td>• Samples typically processed in at-home, at doctor’s offices or clinics with $500 readers</td>
<td>• Useful for large populations like colleges</td>
<td>• Backwards looking surveillance tool</td>
</tr>
<tr>
<td><strong>Timing</strong></td>
<td><strong>Early</strong> (can detect ~2-3 days before symptoms present)</td>
<td><strong>Later than PCR</strong> (often detection commences in line with onset of symptoms)</td>
<td><strong>Early</strong> (in line with PCR testing)</td>
</tr>
<tr>
<td><strong>Accuracy</strong></td>
<td><strong>High</strong> (95% sensitivity) reported but lower (80%) in practice</td>
<td><strong>Medium</strong> (80% PCR sensitivity) lower in practice (limited data)</td>
<td><strong>High</strong> same as PCR, but requires additional follow up testing</td>
</tr>
<tr>
<td><strong>Commercial Cost</strong></td>
<td><strong>Medium</strong> (~$100+ fully-loaded cost, ~$30-50 ‘at cost’)</td>
<td><strong>Low</strong> (~$20-30 fully-loaded cost)</td>
<td><strong>Low</strong> (~$15-20 pooled / test)</td>
</tr>
</tbody>
</table>

Sources: FDA, CDC, Bain & Company Analysis, Ginko Bioworks: “How to deploy millions of COVID-19 tests per day”, expert interviews
PCR tests generally believed to have higher sensitivity rate relative to antigen tests

- Experts indicate that PCR tests are typically more sensitive in the earlier periods of the infection
  - **PCR**: Uses the amplification of the genetic material to enable detection at even low amounts of viral RNA
  - **Antigen**: Detects the specific viral protein in the collected sample

- Clinical trials suggest PCR test are also more sensitive
  - PCR EUA filings: ~95-100% sensitivity rates (*real world sensitivity rates cites ~66-85%*)
  - Antigen EUA Filings¹: ~80-85% sensitivity rates (*real world rates to be determined*)

PCR amplifies the DNA (viral RNA converted) by a large magnitude

---

**Note:** ¹Only Quidel has received EUA for antigen tests

**Source:** Industry participant interviews; Quidel EUA; Native Antigen
Testing Strategy: Antigen Test

**Antigen Test Description**

- Identifies the virus using **viral surface proteins** as a marker for infection by **binding proteins from the coronavirus** surface spikes
- Tests are **inexpensive** to manufacture and **current infrastructure supports massive production**
- Tests are typically carried out at clinical hospitals or at point-of-care locations
- FDA has granted approval to one manufacturer, Quidel Corporation via the emergency use authorization
- Few false positives but lower sensitivity - **80% sensitivity relative to PCR tests**

**Sample Collection**
- Collect nasal / throat sample of human DNA using a swab
- Can be done at **point of use** / at home, much like pregnancy tests

**Test Administration**
- **Trained clinician** transfers collected swab to vile, transfers to paper which contains antibodies designed for binding
- Can perform **4-5 per hour**

**Results**
- Communicate results to tested individual (if at point of care location the individual remains at hospital / medical center while sample is tested) in **15-30 minutes**

**Quidel** has received EUA and is producing tests that are compatible with their widespread machines.

**OraSure** and **E25Bio** are developing at-home antigen tests in addition.

**Antigen test costs ~$20-$25 per test**

Source: Technology Review Fierce Biotech; FDA, Health Advances, Ginko Bioworks
Cost: Testing Cost by Type

Estimated Range of Cost / Test

Preliminary Expert Estimates – Cost Build to System

**PCR / Molecular**
- Commercial estimates for COVID PCR tests at scale ~ comparable to cost structure of molecular flu tests
- ~$95-$100
- "At Cost"

**Antigen**
- Immunoassay / antigen based tests are up to 3-5x cheaper than molecular tests for existing use cases like the flu
- $20-$30

**PCR Pooling**
- Pooling of 5-7 PCR samples
- $15-$20

Potential Levers to Reduce Costs

- **PCR Cost Efficiencies** as non-profits and other players enter, distribution & collection costs are eliminated
- **Potential to substitute antigen / pooling in asymptomatic testing** but lower sensitivity
- **At home and point of care tests** can lower distribution costs considerably across tests

Source: Health Advances, Discussions with Industry Experts, Bain Capital Partners Analysis, Health Advances interviews and analysis, CMS Clinical Laboratory Fee Schedule
1 Based on 2020 payment rates for molecular and immunoassay test for Influenza A+B, RSV, and Strep. Source: Health Advances, Bain & Company, Expert Estimates, Bain Capital
# Feasibility: Supply Chain & Inputs

<table>
<thead>
<tr>
<th>Supply Chain Input</th>
<th>Description</th>
<th>Technical</th>
<th>Regulatory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swab, Medium</td>
<td>• Sterile swabs and medium used to collect and transport samples</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 3 manufacturers ramping production (1.5M/day)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reagents</td>
<td>• Used in the PCR to isolate RNA and multiply specimen to test</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Requires dNTPs as raw materials; high-purity chemicals with</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>consolidated manufacturing, limited shelf life</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lab Technicians</td>
<td>• High throughput machines operated by well-trained lab technicians</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Shortage in technicians can be made up for with technician availability</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>as other lab test frequency has decreased during COVID</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Testing Equipment</td>
<td>• CDC has approved many test kits; most are low throughput</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Likely will scale faster than inputs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Market Efficiency</td>
<td>• Current co-ordination of demand and supply is inefficient, with certain</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>labs/hospitals overloaded while others have excess capacity; scale of</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>operation influences ability to source</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Expert Interviews, Bain & Company, Bain Capital Partners
### Feasibility: Point of Collection Strategies (excluding home)

<table>
<thead>
<tr>
<th>Testing at pharmacies &amp; retail</th>
<th>Government-run drive-thru testing</th>
<th>Testing at temporary facility</th>
<th>3rd party testing</th>
<th>Employer testing</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
<td><img src="image3.png" alt="Image" /></td>
<td><img src="image4.png" alt="Image" /></td>
<td><img src="image5.png" alt="Image" /></td>
</tr>
</tbody>
</table>

- **Testing at pharmacies & retail**
  - Select states have authorized pharmacies (e.g., CVS) and retail (e.g., Walmart) to collect specimens onsite as long as the test is carried out by qualified personnel.

- **Government-run drive-thru testing**
  - Governments have set up drive-thru testing in parking lots, allowing people to drive up and get tested without leaving their car.
  - Heavily utilized across US due to efficiency of testing and limited exposure required.

- **Testing at temporary facility**
  - In a number of cities, mass testing is being temporarily conducted in large facilities such as a gymnasiums, community centers and convention centers.

- **3rd party testing**
  - 3rd party sites (e.g., doctor’s clinics) have begun offering testing at their locations as labs (e.g., Quest) continue to ramp up production of test kits.

- **Employer testing**
  - Some employers are expected to establish testing sites outside of their workplace to enable employee screening before returning to work.
  - Amazon has announced plan to build testing lab strictly for employees.

Source: Expert Interviews, Bain & Company, Bain Capital Partners
Feasibility: Timeline of Solutions

Short-Term
- Utilize existing 30k (state current capacity) with expanded testing
- Continue centralized testing through a handful of large diagnostic companies
- Existing HC infrastructure used whenever possible

Medium-Term
- Production ramped to 50-100k tests/day (45k state target by July)
- Public/private/non-profit partnerships
- Phase in antigen testing on asymptomatic / employer testing
- Prepare for surge / flu season testing

Long-Term
- Universal at-home testing kits including point of care tests
- Saliva-based
- Drive down costs per test

Source: Bain Capital Partners Analysis
Testing: Employer Examples

<table>
<thead>
<tr>
<th>Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Goal to test all employees</strong>, including asymptomatic individuals; <strong>building their own labs</strong></td>
</tr>
<tr>
<td><strong>Free testing of all employees</strong> that are <strong>symptomatic</strong> or have <strong>medical conditions</strong> for COVID19 through self-administered test kit or an appointment at drive-thru locations run by Kroger Health</td>
</tr>
<tr>
<td><strong>Released a detailed back-to-work plan</strong> with a focus on PPE, social distancing, workplace sanitation and employee screening (no explicit discussion of testing)</td>
</tr>
<tr>
<td><strong>No discussion on testing of employees</strong> but announced they can all choose to <strong>work from home in perpetuity</strong>, and all offices will be closed until at least September</td>
</tr>
<tr>
<td><strong>No public discussion of testing of employees</strong>; workforce deemed not critical to work on site can continue to operate remotely until end of year (~85-90% of workforce)</td>
</tr>
</tbody>
</table>

Source: Bain & Company, Press
Testing: Employer Considerations & Key Questions

Considerations for Employers

- **Testing is one part** of a comprehensive return to work strategy; setting workplace norms critical in the near-term
- **Context matters** in terms of location, timing, and the sub-segments of your workforce
- **Testing accuracy is varied** given current capabilities
- **Asymptotic & pre-symptomatic spread is an issue**
- **Testing supply will be increasing** however they may be supply constraints in the near-term
- **As volume grows and alternate providers enter, PCR costs will come down**
- **HR policy needs to be created** around information sharing and sensitivities around testing results

Questions to Consider

- **What is the role of testing** in an overall return to work strategy for your organisation?
- **Should you attempt to secure our own source of testing** to enable a return to work?
- **How prevalent/severe is COVID** in each of the local areas you operate in?
- **How ‘at risk’ are different groups** of employees & how critical is it that they return to work?

Next steps for Setting Up

- **Define testing strategy** (who, how often, goals, etc.)
- **Contact a laboratory if testing is warranted**, to:
  - Secure testing capacity / sample kits
  - Understand specific requirements (i.e., doctors note)
  - Arrange logistics /
  - Discuss options for sample collection provider
- **Develop supporting HR policies**
Group B: Testing & Tracing

• Testing Targets & Approach

• Tracing Approach
Combining Testing with a thorough Tracing program will amplify the impact on reducing $R_T$

- Only 40% of infections come from symptomatic carriers
- 45% of infections come from pre-symptomatic carriers
- True asymptomatic cases between 5% (SK CDC study\textsuperscript{1}) and 25% (CDC director high-end estimate\textsuperscript{2})

\textbf{Estimated COVID-19 Transmission Sources}

\begin{itemize}
  \item If only test and isolate people with symptoms, can reduce $R_T$ by 40% at most – not be effective enough alone
  \item Tracing and testing contacts allows for identification of pre-symptomatics, reducing $R_T$ by up to 85%
\end{itemize}

Source: “Quantifying SARS-CoV-2 transmission suggests epidemic control with digital contact tracing” by Luca Feretti, Chris Wymant, Michelle Kendall, Lele Zhao, Anel Nurtay, Lucie Abeler-Domer, Michael Parker, David Bonsall, Christophe Fraser, Oxford University, Tomas Pueyo
\textsuperscript{1}Coronavirus Disease Outbreak in Call Center, South Korea\textsuperscript{2} by Park et. al
\textsuperscript{2}CDC, Dr. Robert Redfield, NPR
Tracing Scale: Targets by State

Contact Tracer Scaling Plans by State

Planned Number of Tracers / 100k Population

NY: 16,000 (28.6x current)
CA: 17,000 (5.7x current)
MI: 3,400 (26.2x current)
DC: 148 (2.3x current)
MA: 1,700 (1.7x current)
CT: 500 (1.7x current)
DE: 200 (13.3x current)
WA: 800 (1.1x current)
MN: 900 (9.0x current)
OH: 1,065 (1.6x current)
VA: 1,000 (4.0x current)
AR: 50 (0.3x current)
IO: 200 (5.6x current)

Sources:
1: Johns Hopkins Bloomberg School of Public Health, "A National Plan to Enable Comprehensive COVID-19 Case Finding and Contact Tracing in the US", Association of State and Territorial Health Officials, NACCHO, NPR, Press outlets
2: Comparing new contact tracer hire quota to current in-state tracer employee number

1: Johns Hopkins Bloomberg School of Public Health, "A National Plan to Enable Comprehensive COVID-19 Case Finding and Contact Tracing in the US", Association of State and Territorial Health Officials, NACCHO, NPR, Press outlets
2: Comparing new contact tracer hire quota to current in-state tracer employee number

Sources: CDC, AEI, NPR, State gov announcements (As of week of May 14th)
Tracing: Technology Solutions

### Digital Tracing App Types

<table>
<thead>
<tr>
<th>Description</th>
<th>Centralized</th>
<th>Decentralized</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Proximity tracking with storage and processing done centrally on server</td>
<td>Proximity tracking with storage and processing done locally on phone</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alipay Health Code</td>
</tr>
<tr>
<td>AC19</td>
</tr>
<tr>
<td>Corona100m</td>
</tr>
<tr>
<td>Trace-Together</td>
</tr>
</tbody>
</table>

### Example Private Tracing Solutions

<table>
<thead>
<tr>
<th>Devices Used</th>
<th>pwc</th>
<th>Microshare</th>
<th>LOCIX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smartphone app</td>
<td>Badges, key rings, and wristbands</td>
<td>Smartphones, IoT sensors, asset trackers, appliances</td>
<td></td>
</tr>
</tbody>
</table>

**Logix App**

Each dot represents a spot where two workers passed each other within 6ft

Privacy considerations will be key but several countries and US-based companies have successfully developed apps to help in tracing contacts

Sources: McKinsey, Financial Times, company websites
Tracing: Employer Considerations & Key Questions

Considerations for Employers

- Contact tracing has a role to play in workplaces as a part of a back to work strategy
- Different countries have different top-down approaches
- Technology can be a point of leverage and companies are already beginning to develop tech solutions
- Considerations around privacy and data collection will be critical to consider moving forward

Questions for Employers to Consider

- What is the role of contact tracing for your organisation?
- What is the purpose of collecting data? (e.g., track all movements/infected areas vs. just tracing contacts)
- How will you collect information (e.g., manual vs. digital, employee submitted vs. automated)?
- What data protection do you need? (e.g., information storage security, length of information storage, employee access)
The War on COVID-19 Roadmap

Hospital Balance & Safe Return to Economic Activity
- Need to keep hospital demand in balance with supply of beds & workers
- Need to bring economy back to normal
- Need to maximize safety
- Need to avoid a second lockdown

Segmentation
Implement segmentation model, sequencing segments returning to work

Co-living
Develop guidelines for high risk segments living with segments returning to work

Enablers
Develop guidelines for back-to-school (including childcare) and transportation

Treatment
Identify and rapidly deploy effective therapeutic treatments and longer-term a vaccine

Therapeutics
While waiting for vaccine, implement effective treatments to curb hosp. rate

Vaccine
Accelerate vaccine development & prepare for deployment at-scale

Reduce R_T
Implement policies & procedures to reduce the rate of spread

Workplace Norms
Develop workplace norms to minimize reoccurrence

Testing & Tracing
Develop massive testing & tracing plan to be used to identify & contain virus spread

Source: Bain Capital Partners analysis