The War on COVID-19: Reducing Rt Deep Dives

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

A Workplace Norms

Develop workplace norms to minimize reoccurrence

B Testing & Tracing

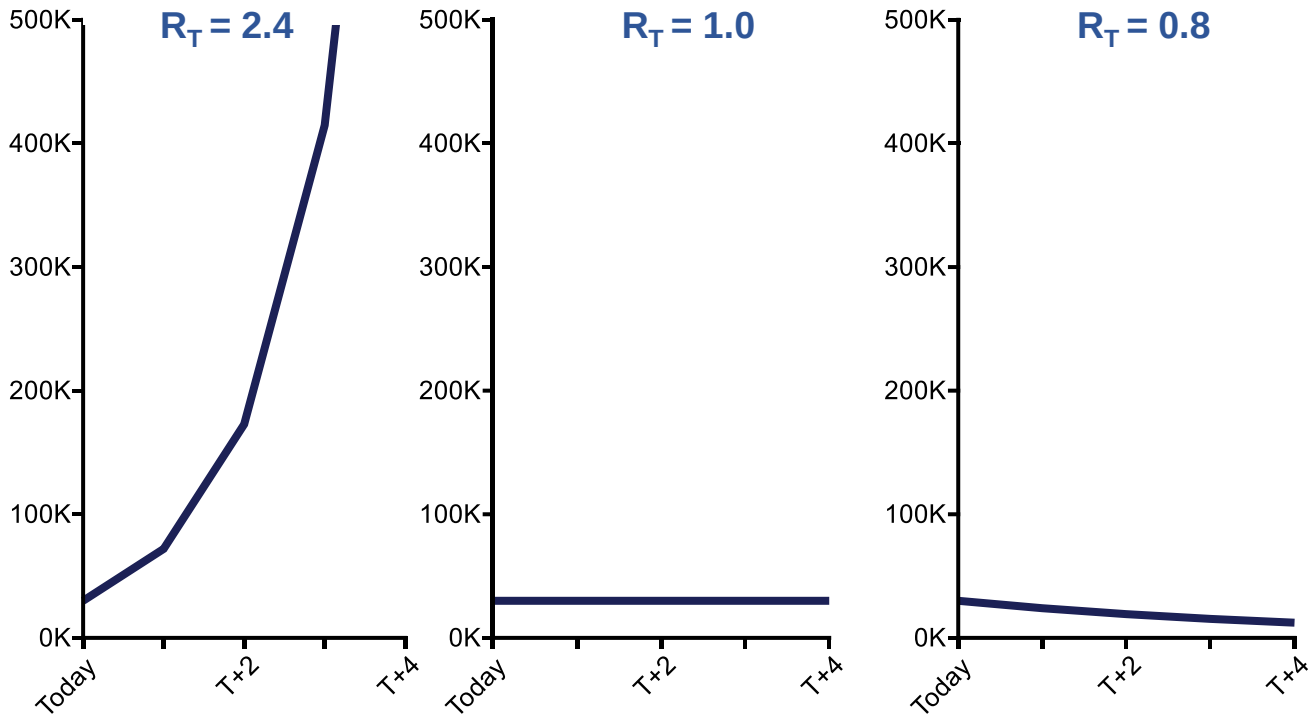
Develop massive testing & tracing plan to be used to identify & contain virus spread

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

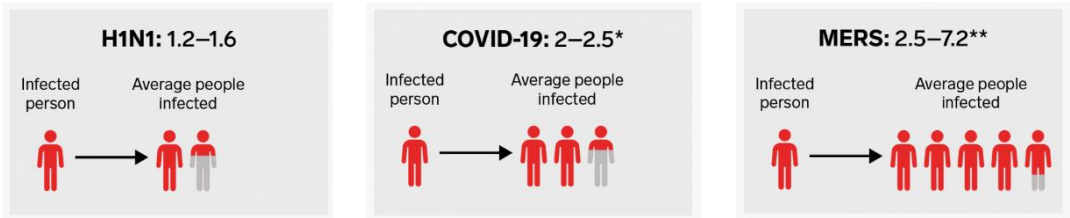
Source: Bain Capital Partners analysis

Reminder: Why Reducing R_T Matters

MA New Cases Under Different R_T



Visualizing R_T



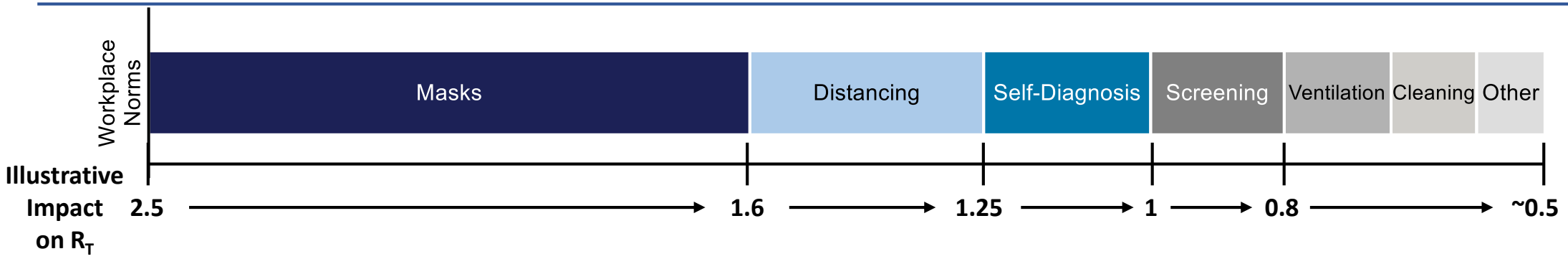
Lower spread can significantly reduce the number of daily new cases, despite greater population exposure

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

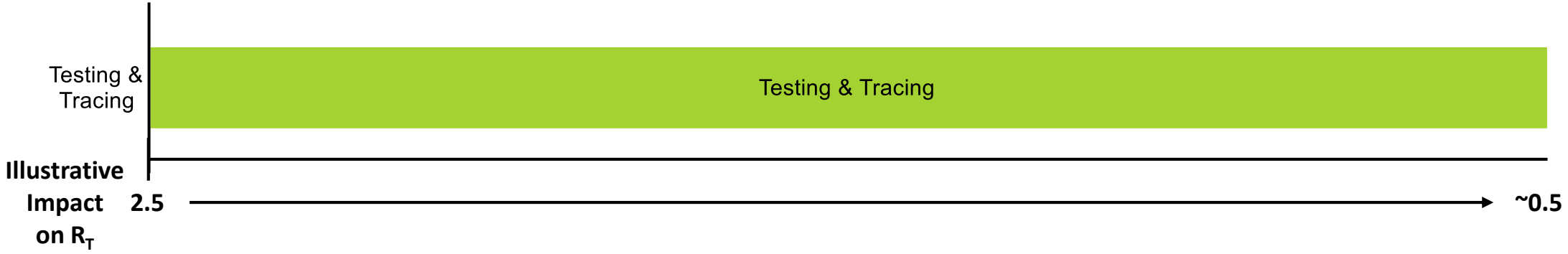
Reducing R_T Summary Thought Model

CONCEPTUAL

Impact of Workplace Norms



Impact of Testing & Tracing

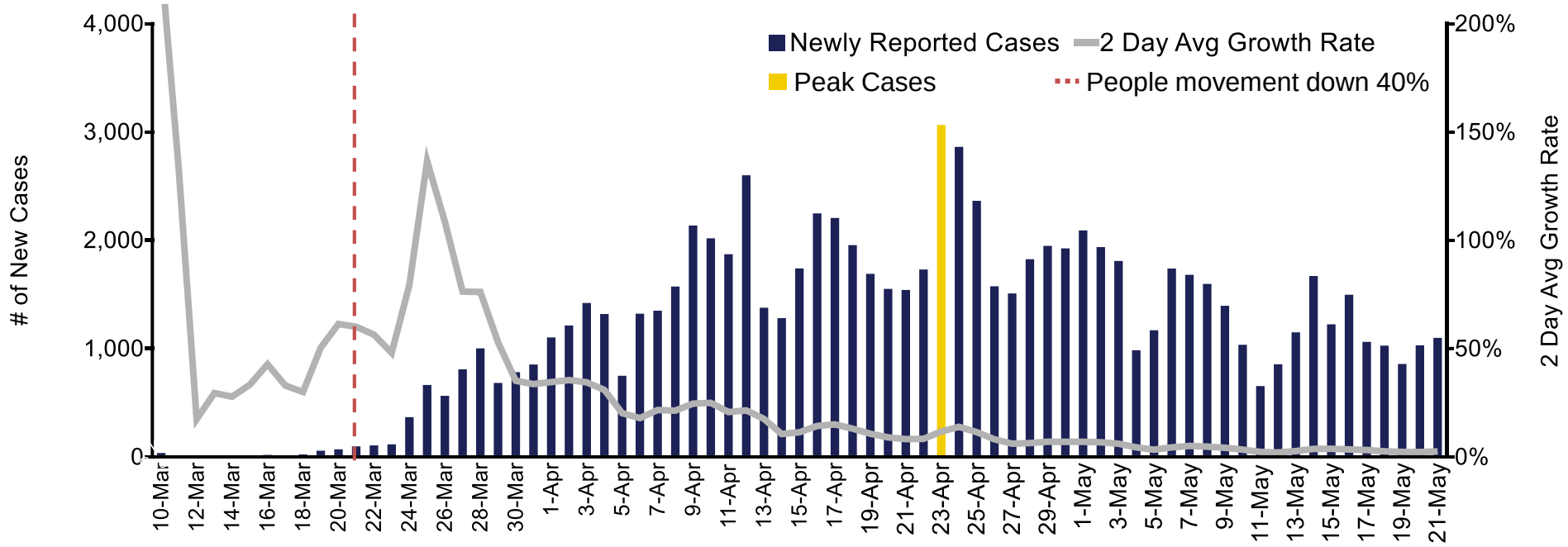


Workplace norms and a robust testing & tracing strategy can each independently significantly reduce R_T

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



90,084 total cases

2,396 in hospital

647 in ICU

6,148 total deaths

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

Context: Massachusetts Re-Opening Dashboard

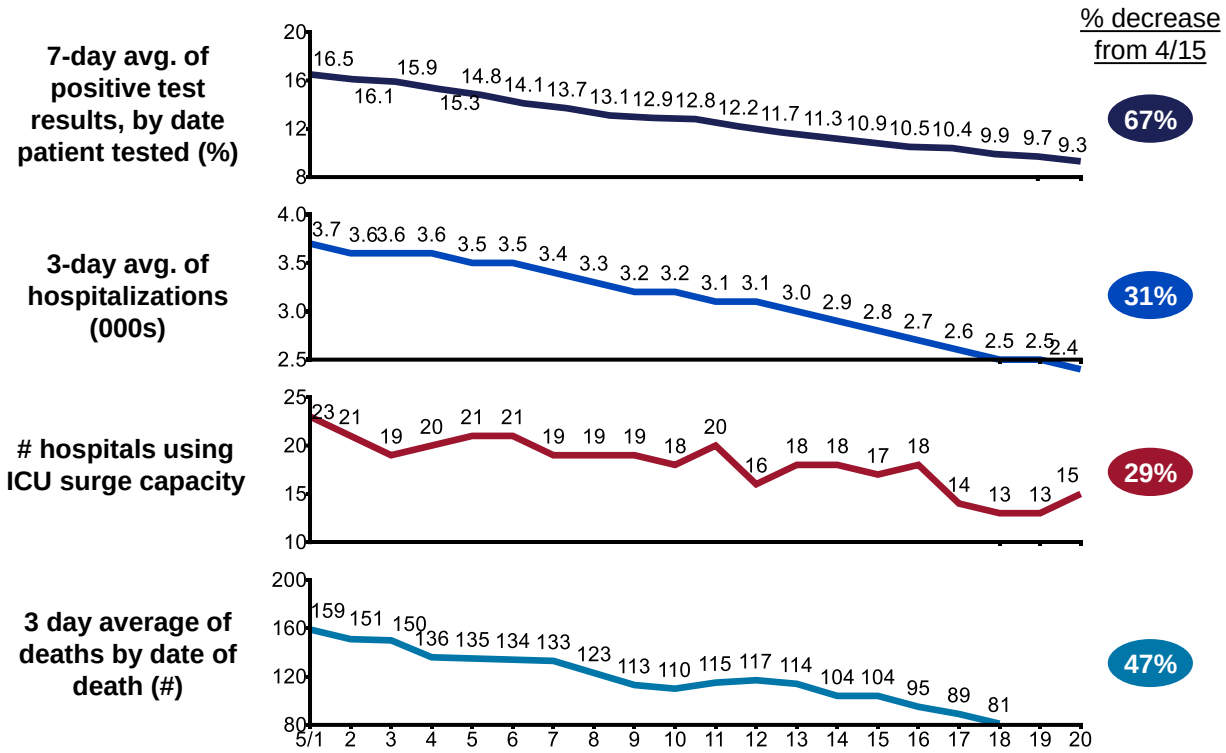
Massachusetts Re-Opening Public Health Dashboard

Below is the status as of **May 18, 2020:**

	Indicator	Status
1	COVID-19 positive test rate	🟢
2	Number of individuals who died from COVID-19	🟡
3	Number of patients with COVID-19 in hospitals	🟡
4	Healthcare system readiness	🟡
5	Testing capacity	🟢
6	Contact tracing capabilities	🟡

Legend
- 🟢 Positive trend
- 🟡 In progress
- 🔴 Negative trend

Referenced Detailed Indicators



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

Source: Bain Capital Partners analysis

The MA Plan: Working Norm Guidance

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

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"

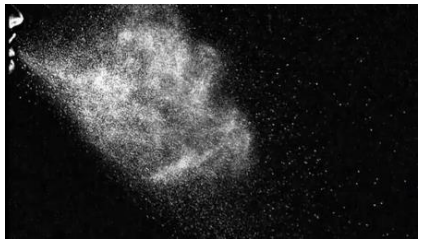
- Masks provide a barrier to a large portion of your face, limiting spread from touching contaminated surfaces

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



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

	Droplets Released	Size of Particles
Breathing	~ 500 – 3,000 / 10 min	○
Speaking	~ 3,000 – 30,000 / 10 min	○ ⟷ ◯
Coughing	~ 3,000 / event	○ ⟷ ◯
Sneezing	~ 30,000 / event	○ ⟷ ◯

How Masks Reduce R_T

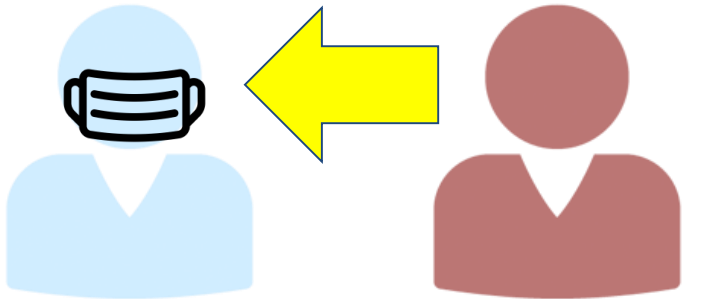
- Risk of exposure to the virus a function of (1) **viral load in droplets** exposed to and (2) **time exposed** to droplets
- **Large particles** carry more of the virus but fall to the ground much faster than **small particles**
- **Masks reduce exposure to viral load via:**
  - **Containment of the 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

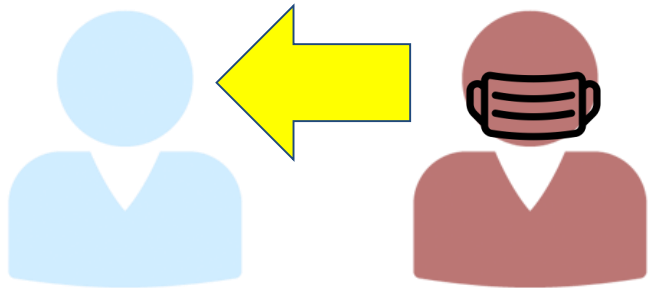
Mask Usage is About Egress

Protecting the Wearer (Ingress)



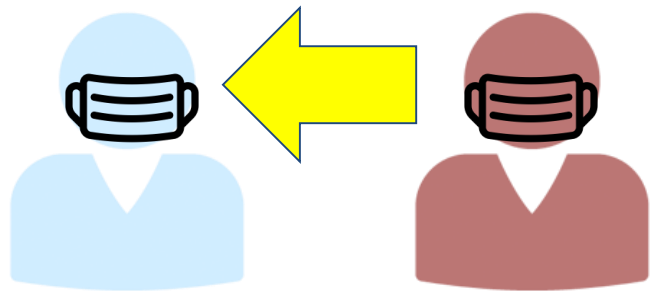
- **Cloth masks ineffective at protecting wearer** from inhaling infected particles
- Protecting the wearer requires **medical grade mask** (surgical mask, N95)

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



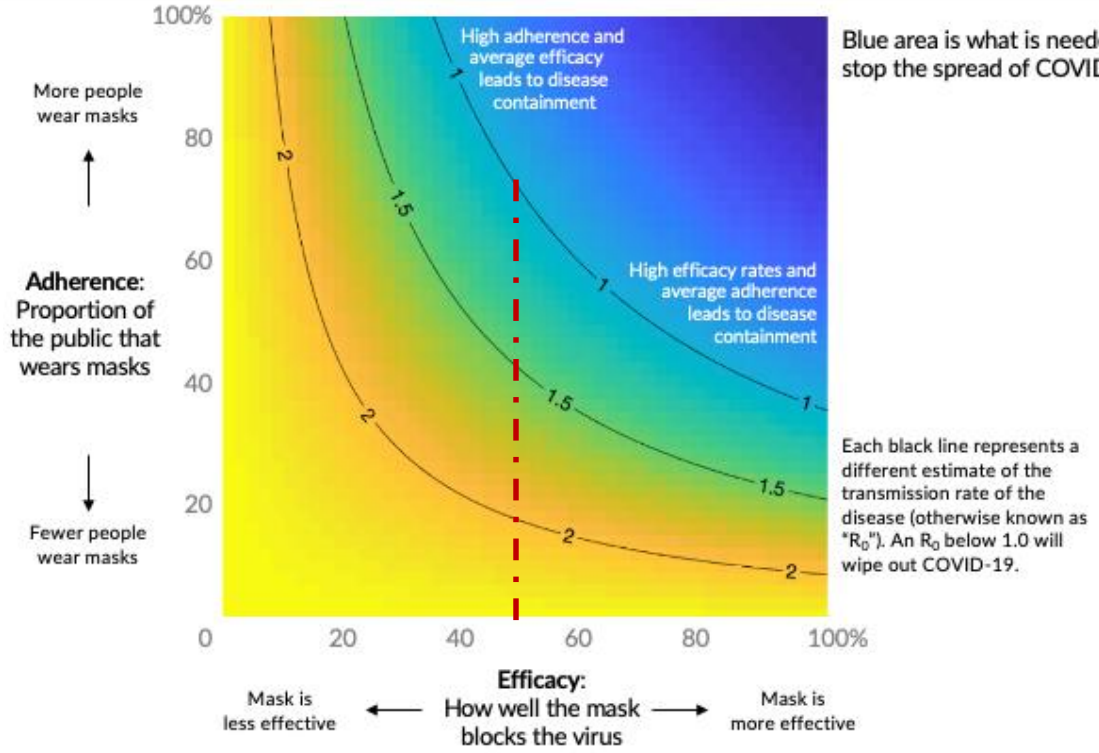
- **The best scenario: everyone wears a mask**
- Egress dramatically reduced, and some impact on ingress as well

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

Source: Howard, J.; Huang, A.; Li, Z.; Tufekci, Z.; Zdimal, V.; van der Westhuizen, H.; von Delft, A.; Price, A.; Fridman, L.; Tang, L.; Tang, V.; Watson, G.L.; Bax, C.E.; Shaikh, R.; Questier, F.; Hernandez, D.; Chu, L.F.; Ramirez, C.M.; Rimoin, A.W. Face Masks Against COVID-19: An Evidence Review; https://medium.com/the-atlantic/the-real-reason-to-wear-a-mask-e6405abbc484

Theoretical Effectiveness of Masks

Theoretical Mask Use Impact on R_T



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

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

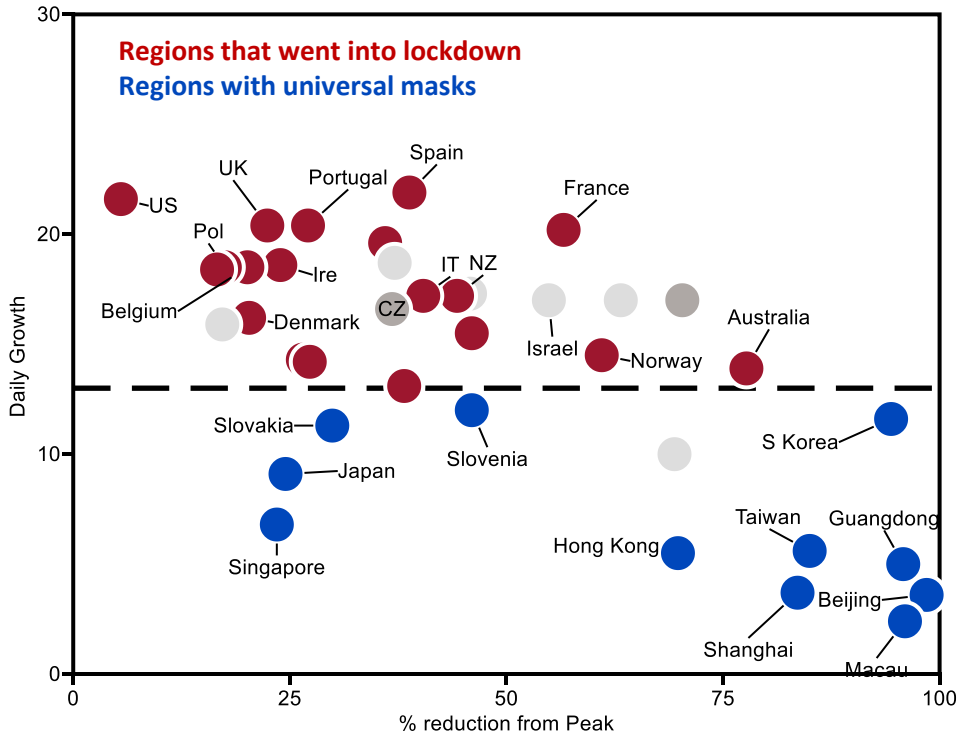
Scarf	100% Cotton Masks	Tea Towel	Surgical Masks	N95
49%	51%	72%	89%	95%+

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

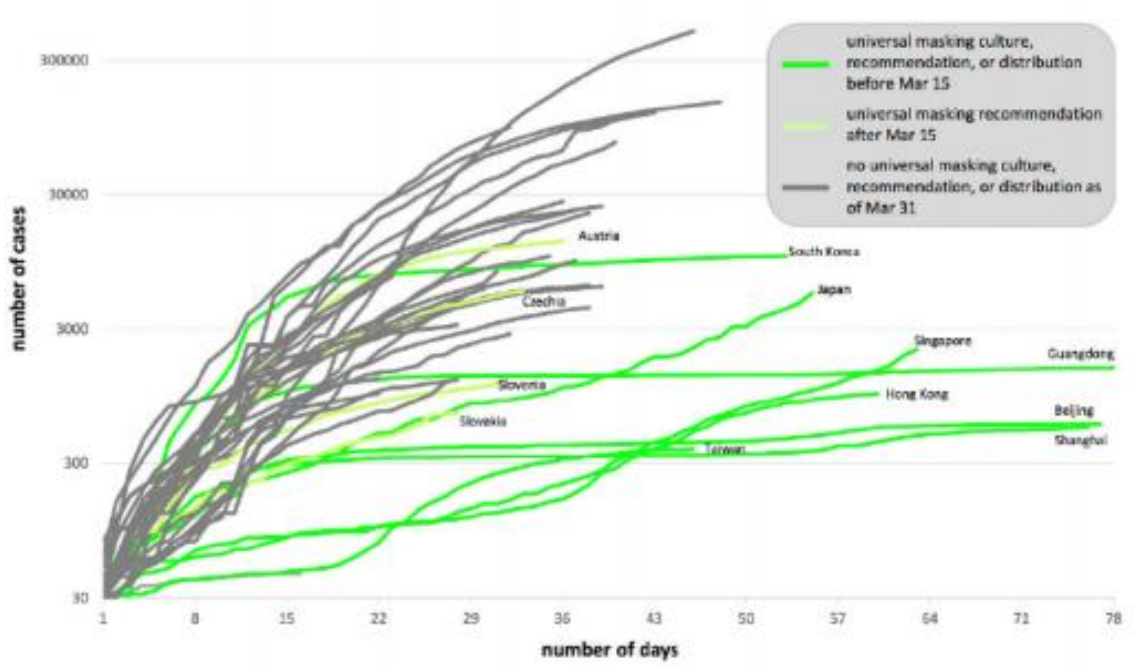
Source: The Atlantic, L Tian et al, "Calibrated Intervention and Containment of the COVID-19 Pandemic" (2020); "Testing the Efficacy of Homemade Masks: Would They Protect in an Influenza Pandemic?", Anna Davies, Katy-Anne Thompson, Karthika Giri, George Kafatos, Jimmy Walker, Allan Bennett; MacIntyre, Cauchemez, Dwyer, Seale, Cheung, Browne, Fasher, Wood, Gao, Booy, and Ferguson. "Face Mask Use and Control of Respiratory Virus Transmission in Households"

Country Case Studies: Mask Usage vs. Case Growth

Broad Regional Sampling



Cases: Highlighting Mask Usage



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

Mask Type	Use Case	Small Particle Filtration[1]	Large Particle Filtration	Reusable?	Comfort	Cost	Supply Constraints
N95 	**High risk** medical situations	**95%+**	✓	✓ *Up to 5x, needs advanced cleaning (i.e., UV)*	**Low/Med** *Max usage 8hrs*	**~$1 / mask** (normally)	**Significant constraints**
3-ply, non-woven disposable *(Surgical / Procedural)* 	**Surgical** (medical use) **Procedural** (medical and non medical use) **General use** ear loop mask	**70-90%** **Up to 50-70%**	✓	✓ *Isolate for 72+ hours*	**High**	**~$0.10 / mask** (normally)	**Some constraints** on surgical / procedural **Minimal constraints** on general use 3-ply
Cloth 	**Short-term solution** when surgical masks unavailable	**~50%**	✓	✓	**Varies**	**~$5 / mask**	**No constraints**

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

Non-woven mask deep-dive

Types of Non-Woven Masks

Not recommended | **Provides incremental filtration relative to cloth masks**

Flat Mask

Flat masks
(no filter layer disclosed)

3-ply masks

3-ply only
(With a filter, but no disclosure on what the filter is)

Melt-blown filters used

Melt-blown filter media
(But no ASTM specification)

Medical grade masks used by healthcare workers

ASTM Level (none, 1, 2)

ASTM Level 3

"General Use" Masks

"Procedural" or "Isolation" Masks

"Surgical" Masks

50-70% Small Particle Filtration

70-90% Small Particle Filtration

- Disposable flat face mask
- **No information** on number of layers or material

- 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**

- Historically **used 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**

- 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)

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**

Need a broad education campaign to help public understand how to effectively use masks

Sources: Bain & Co; Doremalen, Morris, Holbrook, Gamble, Williamson, Tamin, Harcourt, Thornburg, Gerber, Lloyd-Smith, Wit. "Aerosol and Surface Stability of SARS-CoV-2 as Compared with SARS-CoV-1" ; https://www.hopkinsmedicine.org/health/conditions-and-diseases/coronavirus/coronavirus-how-to-care-for-your-face-mask

Mask Supply Chain Overview

Manufacturers

- **Three major types** of manufacturers:
  - **Large Asian based (~80% of supply)**
  - Medical Integrated Distributor / Manufacturers (e.g. Medline)
  - High End Technical (e.g. 3M)
- **Responsible for getting masks tested** (either through a 3rd party or self testing) in order to clear certain FDA certifications
- Many larger manufacturers create **both surgical and procedural masks**

Dasheng MEDLINE 3M

*"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

Distributors

- Distributors buy **~80%** masks **from overseas manufacturers** and sells to domestic consumers
- **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

MEDLINE HENRY SCHEIN safety today GRAINGER

*"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

Consumers

- **Healthcare providers are the largest consumers of surgical & procedural masks** (e.g. hospitals, dentists , nursing homes)
- **Industrial / construction** companies largely use non-FDA approved masks (e.g. dust masks, industrial N95 masks)
- While **healthcare demand has slowed**, there is **potential for resurgence** as the US and other countries begin to reopen:
  - Chance of a **second wave of infection**
  - **Reintroduction of elective procedures**
  - **Mass adoption of mask wearing** by the general public and the broader workforce

MASSACHUSETTS GENERAL HOSPITAL South Cove Manor at Quincy Point Rehabilitation Center HOME DEPOT

*"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

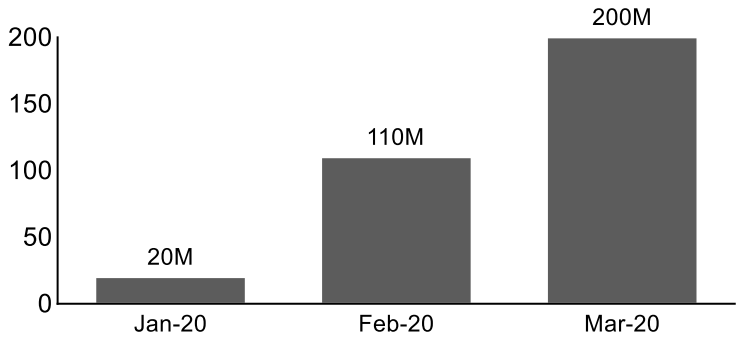
3-Ply Mask Supply

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

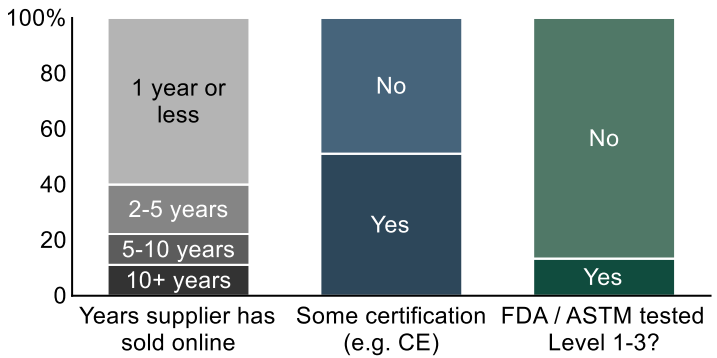
Daily Chinese medical mask production



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

Results for "3-ply Masks" Found on Alibaba



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"*

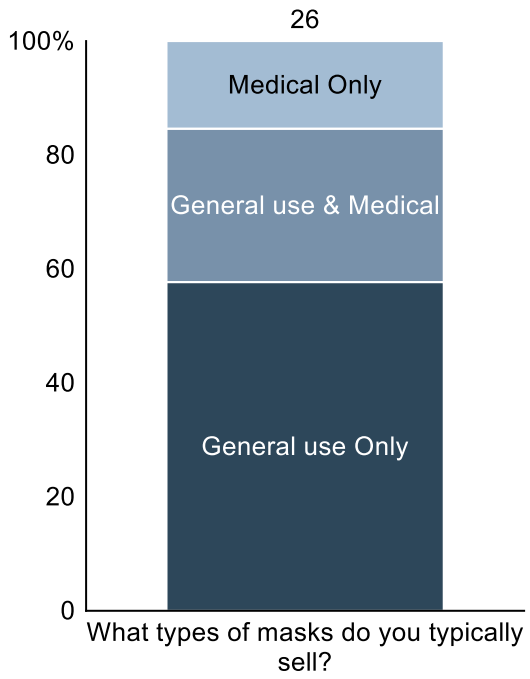
Supply Chain Director, Mt. Sinai Hospital

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

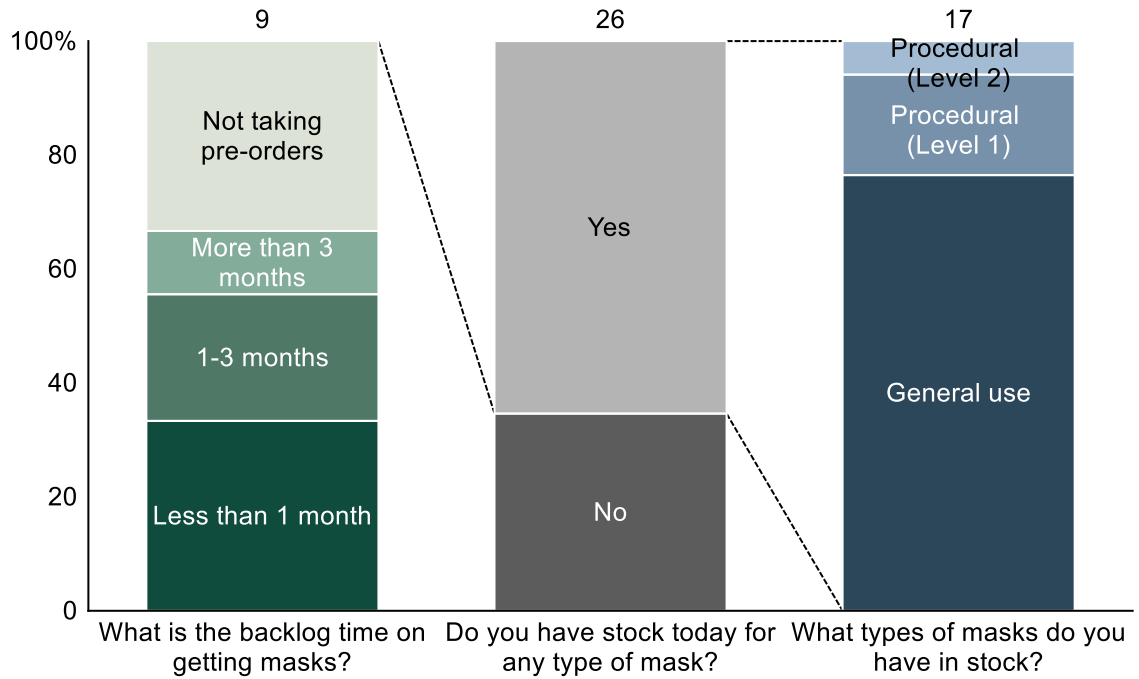
Source: Bain & Co citing Chinese National Development and Reform Commission, South China Morning Post, NPR, WSJ, Alibaba (first page of results, N=45), market participant interviews

MA Distributor Survey

Count of responses
(Total N=26)



Count of responses (Total N=26)



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

A majority of distributors have general use masks in stock today, but for larger orders, lead times can be over 1 month

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

Distributors: list of potential distributors for Mass employers

Distributor	Phone #	Masks in Stock?*
AB&J International	347-399-9843	Yes
Abbott Ball Company	860-236-5901	Yes
Associated Bag	800-926-6100	Yes
Central Equioment LLC	508-758-3758	Yes
Conlon Products	9786828482	Yes
Darby Dental Supply	800-645-2310	Yes
DocPPE	888-493-5554	Yes
Fastenal	864-569-7070	Yes
Fisher Scientific	800-766-7000	Yes
Get a mask.store	848-206-6398	Yes
Go Green Solutions	978-852-7977	Yes
Harrison Shrader	207-312-4991	Yes
Lane Printing & Advertising	7817674450	Yes
Northern Safety	800-571-4646	Yes
Safety Today	800-837-5900	Yes
Unination	646-661-1500	Yes
Ace Surgical Supply	800-441-3100	No
Airgas	855-625-5285 X4805	No
Atlantic Paper and Supply	(401) 725-0950	No
Bound Tree Medical	800-533-0523	No
CAM Office Services	791-932-9868	No
Contollo	(508) 841-5822	No
DetraPel	617.514.7777	No
Henry Schein	800-772-4346	No
Noble Supply & Logistics	508-944-5722	No

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

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)

Sample PPE for hair salon

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**

Sample PPE

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**

Sample PPE for screening staff

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

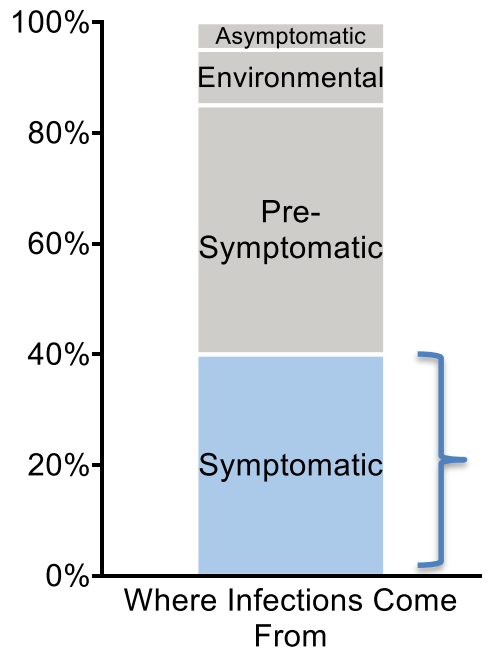
Note: Gloves to be changed after each "task"; hands must be washed between glove changes
Sources: Bain & Co, McKinsey, BCP Analysis

Workplace Norms Agenda

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

Self-Diagnosis

Where Infections Come From



Estimated **~40%** of infections come from a currently symptomatic individual

Symptom	% of Cases	Conceptual "Difficulty" to Report
Fever	**64%**	Low
Sinus Pain	**50%**	Low
Cough	**46%**	Low
Expectoration	**32%**	Low
Chills	18%	Low
Difficulty breathing	11%	Low
Diarrhea	6%	Low
Vomiting	3%	Low
Altered sense of smell	**44%**	Medium
Stuffy nose	**25%**	Medium
Sore throat	13%	Medium
Headache	13%	Medium
Joint or muscle pain	10%	Medium
Fatigue	18%	High

"No Regret" symptoms that are easier to monitor – consider recommending staying home with 1-2

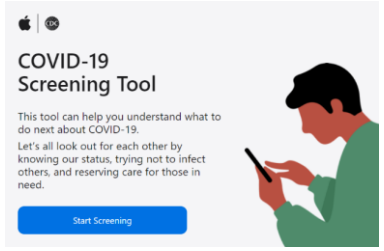
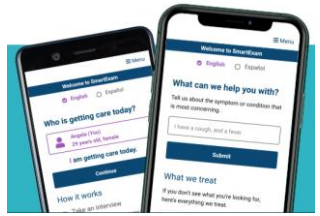
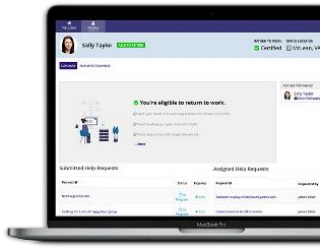
Harder symptoms to track / easier to mistake for something else (i.e., allergies) – consider recommending staying home with 2-3+

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 Univeristy, Scientists to Stop COVID-19

Self-Diagnosis: How to Administer

Lower Cost → Higher Cost

	Paper Survey	Apple / CDC	Other Free Apps	Low Code Solution	Custom Solution
Description					
	Printed checklist employee submits on arrival if able to work	Public health-app that provides recommended action based on symptoms	Apps from startups & larger corps (e.g. MSFT, Buoy Health, Bright.MD)	Low code workforce mgmt & crisis response app that includes symptom reporting	In-house app that can track symptoms, issue guidance and communicate w/ employees
Ability to Verify	Manual	Requires screenshots	Varies	Yes	Yes
Cost	Free / Low	Free	Free	Low	Low to medium
Customizability	Medium	Limited	Varies	High	High

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

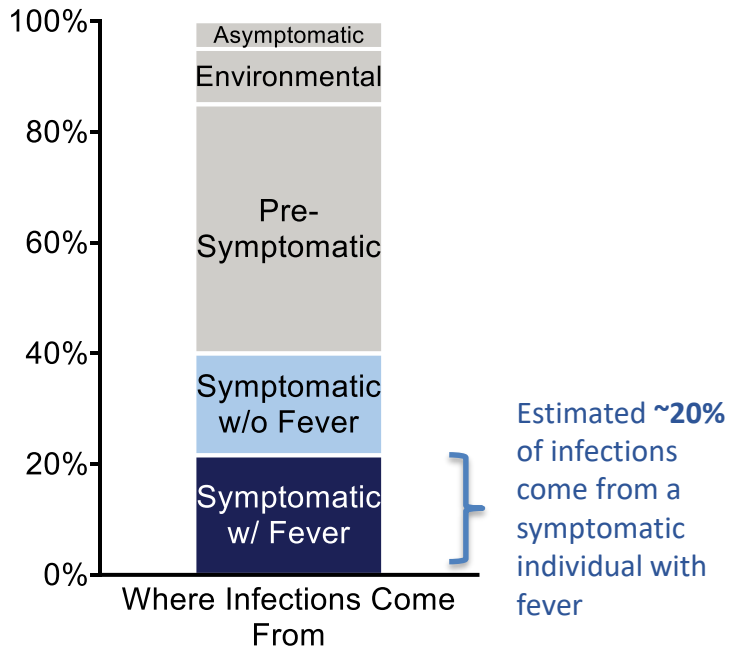
Source: Bain & Co

Workplace Norms Agenda

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

Employer Screening Effectiveness

Where Infections Come From



Estimated **~20%** of infections come from a symptomatic individual with fever

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 Univeristy, Scientists to Stop COVID-19

Employer Screening Tools & Case Studies

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

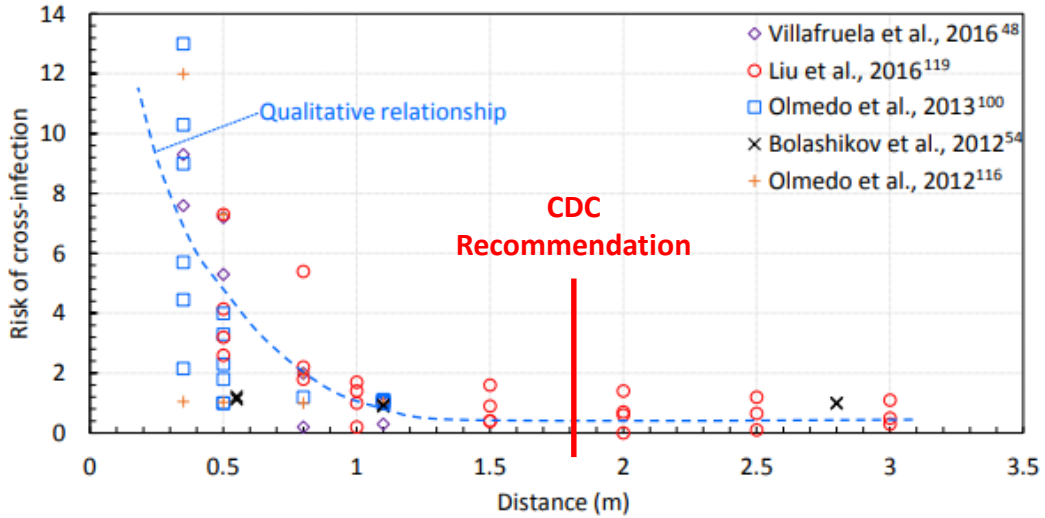
Source: Bain & Co, company websites, press releases, literature review

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

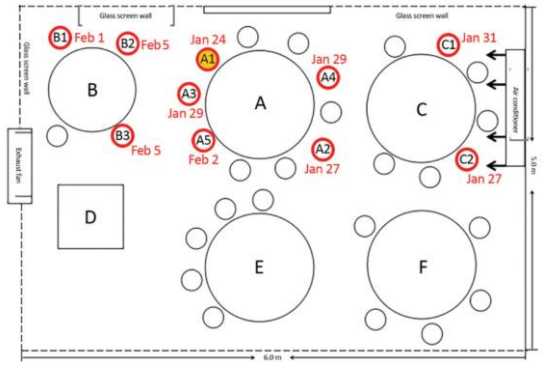
- Ventilation and air flow
- Indoor vs outside space
- Positioning and posture of individuals
- Duration of exposure
- Activities performed by individuals (e.g., talking, sneezing, exercising)

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

Source: Ai and Melikov. “Airborne Spread of Expiratory Droplet Nuclei Between the Occupants of Indoor Environments: A Review”. 2018.

"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

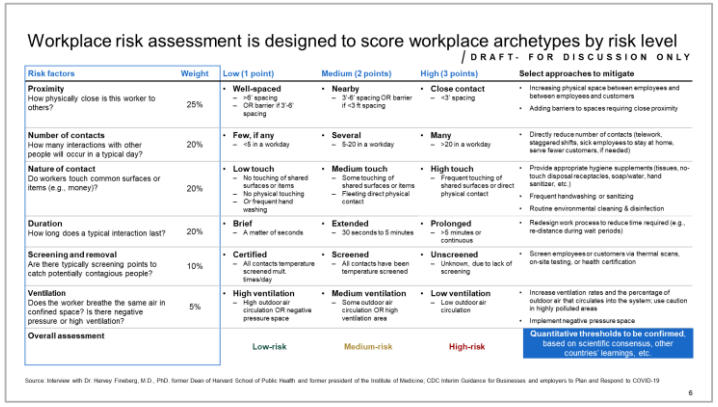
Broad policies against large gatherings are critical to avoid additional "super spreader events" that rapidly spread the virus

Source: Frieden and Lee, CDC "Identifying and Interrupting Superspreader Events – Implications for Control of Severe Acute Respiratory Syndrome Coronavirus 2"; Jonathan Kay (https://quillette.com/2020/04/23/covid-19-superspreader-events-in-28-countries-critical-patterns-and-lessons)

Workplace Reconfiguration

Reconfiguration needs will vary by workplace

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



Workplace risk assessment is designed to score workplace archetypes by risk level
/ DRAFT- FOR DISCUSSION ONLY

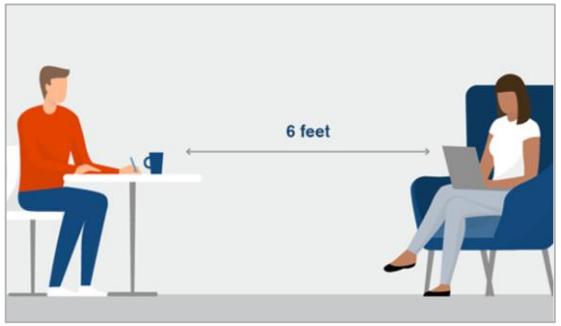
Risk factors	Weight	Low (1 point)	Medium (2 points)	High (3 points)	Select approaches to mitigate
Proximity How physically close is this worker to others?	25%	• **Well-spaced** – >6' spacing – OR barrier if 3'-6' spacing	• **Nearby** – 3'-6' spacing OR barrier if <3 ft spacing	• **Close contact** – <3' spacing	• Increasing physical space between employees and between employees and customers • Adding barriers to spaces requiring close proximity
Number of contacts How many interactions with other people will occur in a typical day?	20%	• **Few, if any** – <5 in a workday	• **Several** – 5-20 in a workday	• **Many** – >20 in a workday	• Directly reduce number of contacts (telework, staggered shifts, sick employees to stay at home, serve fewer customers, if needed)
Nature of contact Do workers touch common surfaces or items (e.g., money)?	20%	• **Low touch** – No touching of shared surfaces or items – No physical touching – Or frequent hand washing	• **Medium touch** – Some touching of shared surfaces or items – Fleeting direct physical contact	• **High touch** – Frequent touching of shared surfaces or direct physical contact	• Provide appropriate hygiene supplements (tissues, no-touch disposal receptacles, soap/water, hand sanitizer, etc.) • Frequent handwashing or sanitizing • Routine environmental cleaning & disinfection
Duration How long does a typical interaction last?	20%	• **Brief** – A matter of seconds	• **Extended** – 30 seconds to 5 minutes	• **Prolonged** – >5 minutes or continuous	• Redesign work process to reduce time required (e.g., re-distance during wait periods)
Screening and removal Are there typically screening points to catch potentially contagious people?	10%	• **Certified** – All contacts temperature screened mult. times/day	• **Screened** – All contacts have been temperature screened	• **Unscreened** – Unknown, due to lack of screening	• Screen employees or customers via thermal scans, on-site testing, or health certification
Ventilation Does the worker breathe the same air in confined space? Is there negative pressure or high ventilation?	5%	• **High ventilation** – High outdoor air circulation OR negative pressure space	• **Medium ventilation** – Some outdoor air circulation OR high ventilation area	• **Low ventilation** – Low outdoor air circulation	• Increase ventilation rates and the percentage of outdoor air that circulates into the system; use caution in highly polluted areas • Implement negative pressure space
Overall assessment		Low-risk	Medium-risk	High-risk	**Quantitative thresholds to be confirmed,** based on scientific consensus, other countries' learnings, etc.

Source: Interview with Dr. Harvey Fineberg, M.D., PhD. former Dean of Harvard School of Public Health and former president of the Institute of Medicine; CDC Interim Guidance for Businesses and employers to Plan and Respond to COVID-19

6

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?

Recommended Best Practices in Appendix

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
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- Distancing & Workplace Configuration
- Ventilation
- **Sanitization**

Sanitization Recommendations

Mandatory Protocols in MA Plan

- Provide **hand washing capabilities** throughout the workplace
- Ensure **frequent hand washing** by employees and **adequate supplies** to do so
- Provide **regular sanitization of high touch areas**, such as workstations, equipment, screens, doorknobs, restrooms throughout work site

Key Sanitization Recommendations

- Continuously sanitize **common & high-tough areas**
- Ask employees to **wipe down workstations at end of each day**
- Use **appropriate EPA-approved disinfectant**
- Install **hand sanitizers** in common areas and next to entries
- Use **signage to clearly mark** the last time an area was cleaned

How Frequently to Clean

High-Touch — Every 2-3 hrs

Handles, Elevator Buttons

Med-Touch — 3-4x / day

Lobby Furniture

Low-Touch — Once / day

Windows, Cabinets

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

Walmart
Save money. Live better.

- Sanitizing kitchen and break areas after usage; providing hand sanitizers and disinfectant wipes in high-traffic areas
- Maintaining **social distancing standards**

THE VENETIAN
LAS VEGAS

- Four-occupant maximum
- Providing all guests with complimentary PPE kits
- Increased cleaning of high-touch surfaces
- Placing signs explaining protocol in all lobbies

GM

- 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

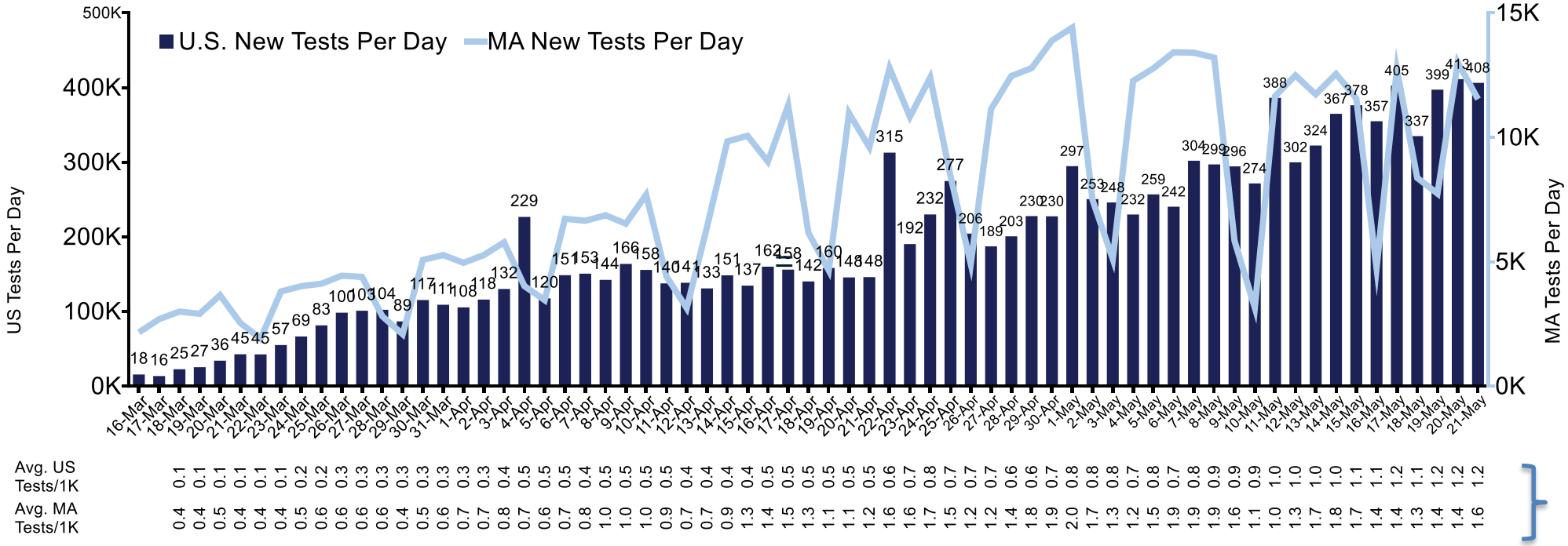
Source: Bain Capital Partners analysis

Group B: Testing & Tracing

- **Testing Targets & Approach**
- **Tracing Approach**

Reminder: Current Testing Capacity

New Tests Per Day



Week ending 5/21

2.7M
US tests

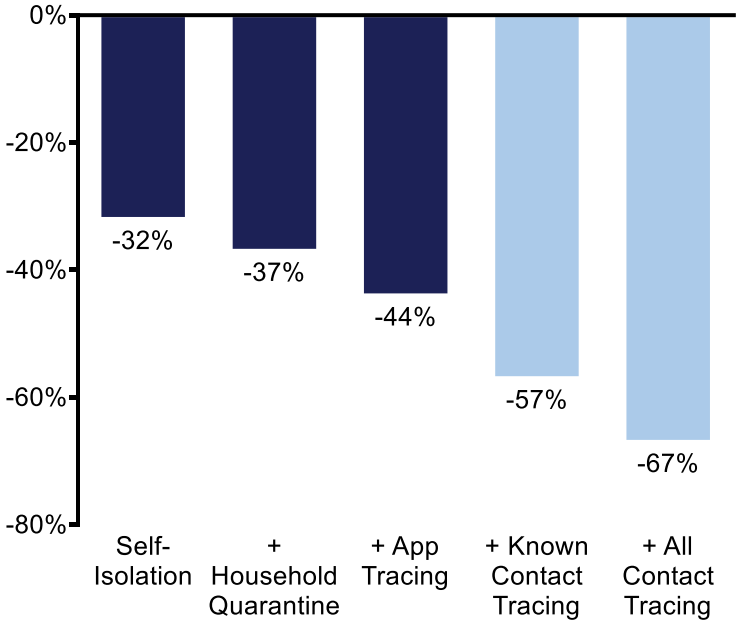
70K
MA tests

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

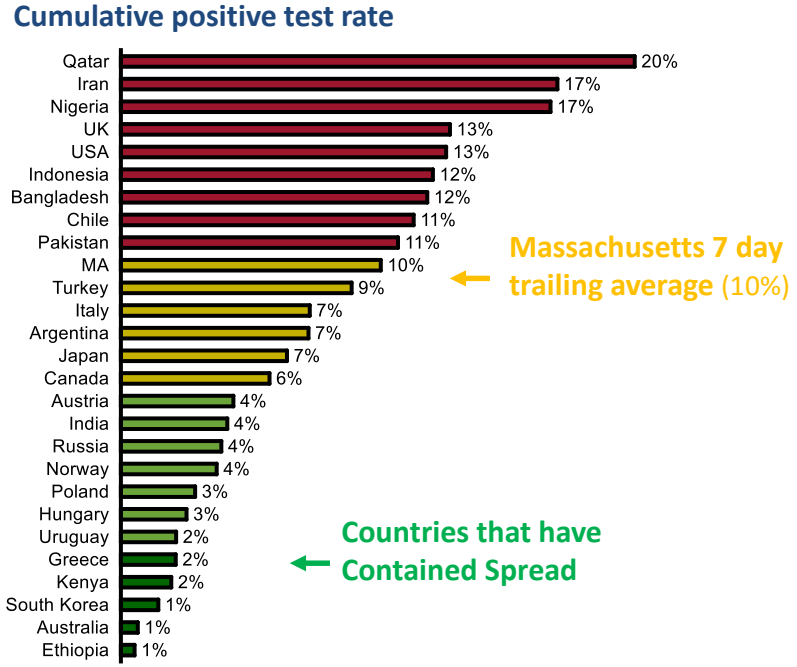
Reminder: Why Testing is Critical

Effective at Reducing Rt



Testing and tracing strategies can more than double the impact on Rt of self-isolation alone

Success in Other Countries



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

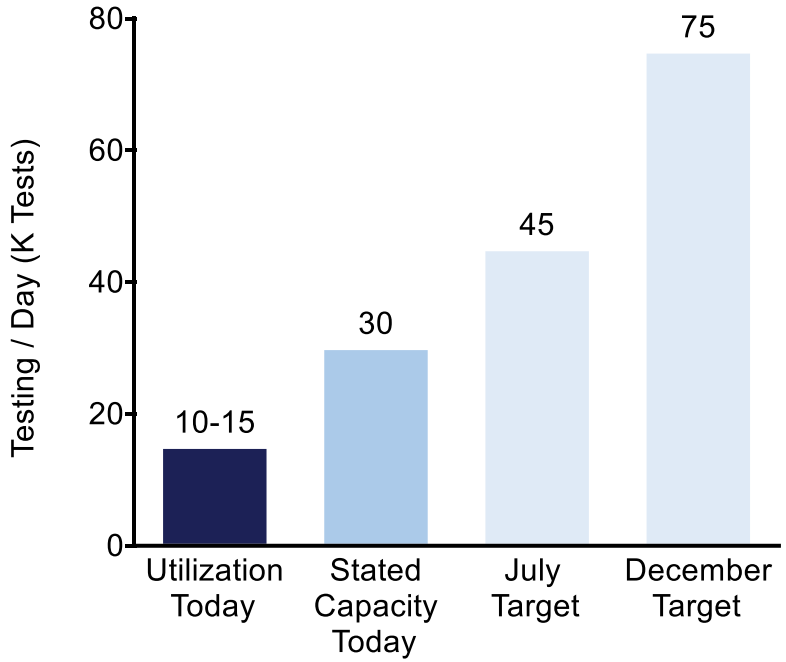
Testing data is the underlying driver for public health officials, businesses and individuals to inform policy

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



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

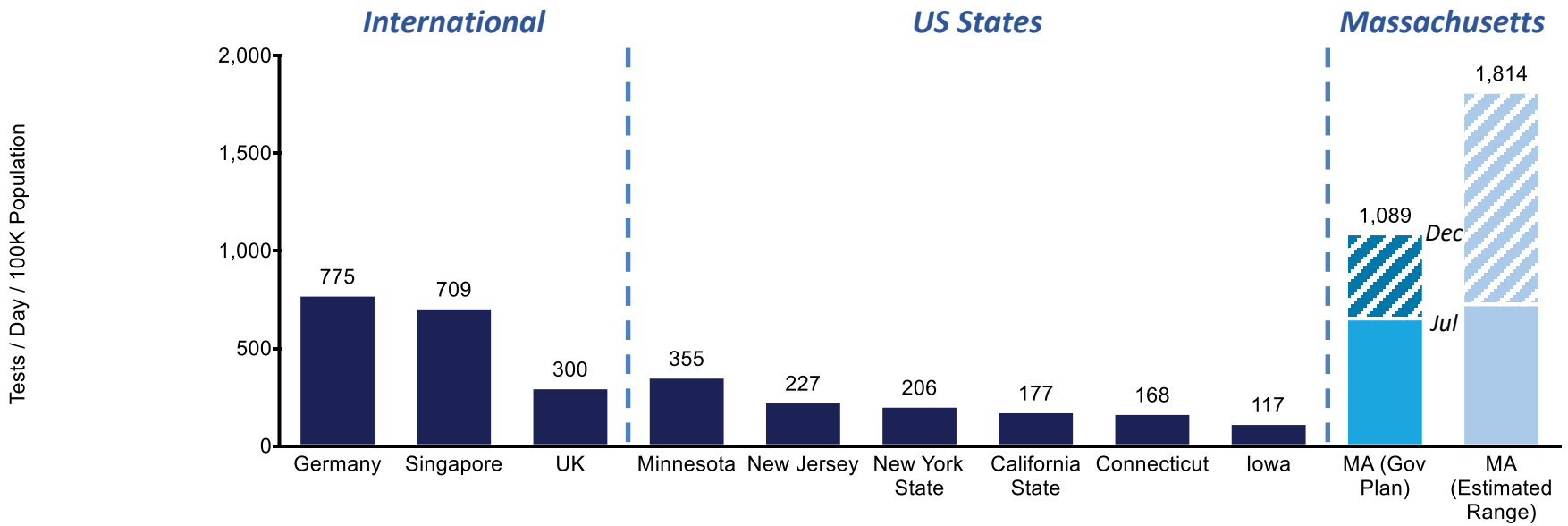
Public / Press Reactions Generally Supportive:

- *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



	Germany	Singapore	UK	Minnesota	New Jersey	New York State	California State	Connecticut	Iowa	MA (Gov Plan)	MA (Estimated Range)
Test Target (K/Day)	643	40	200	20	20	40	70	6	10	75	50-125
Population (M)	83.0	5.6	66.7	5.6	8.8	19.5	39.5	3.6	8.5	6.9	6.9

Source: Bain & Co, State Benchmarking

Testing: Strategic Framework & Approach

Strategy

A Strategic Objective

Today

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

B Type & Innovation

Today

- *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*

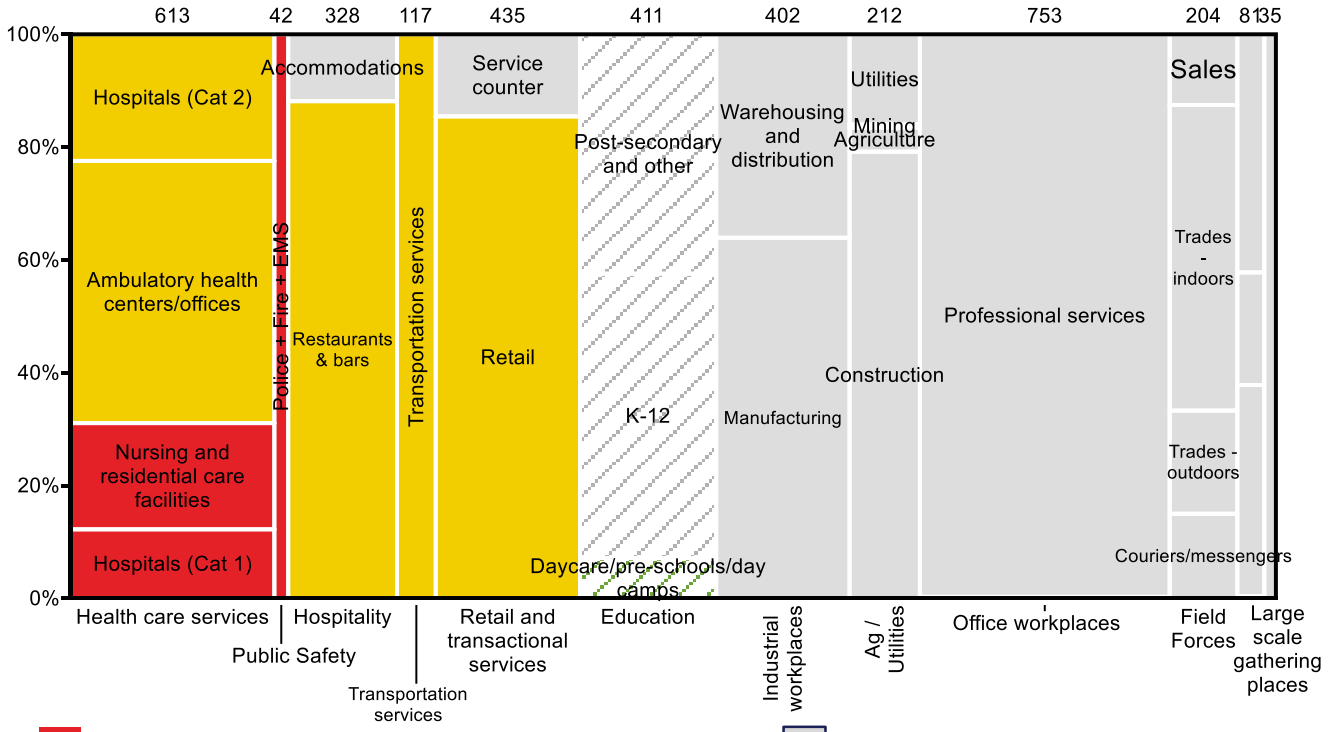
Note: *Serology Testing Incremental & another source of surveillance*

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

Ⓐ Testing Strategy: Critical Populations

Critical Populations for Testing Focus

Massachusetts Labor Force Breakdown (Total 3.6M)



Highest Risk – make available proactive testing

High Risk– capacity permitted proactive testing

Lower risk – rely on symptomatic + contact testing

Included in Back to School Surge

High Risk Populations

Nursing / Assisted Living	***54K***
Elderly Public Housing	***71K***
Prisons / Homeless	***28K***

Students

Student Population	***~1.5M***

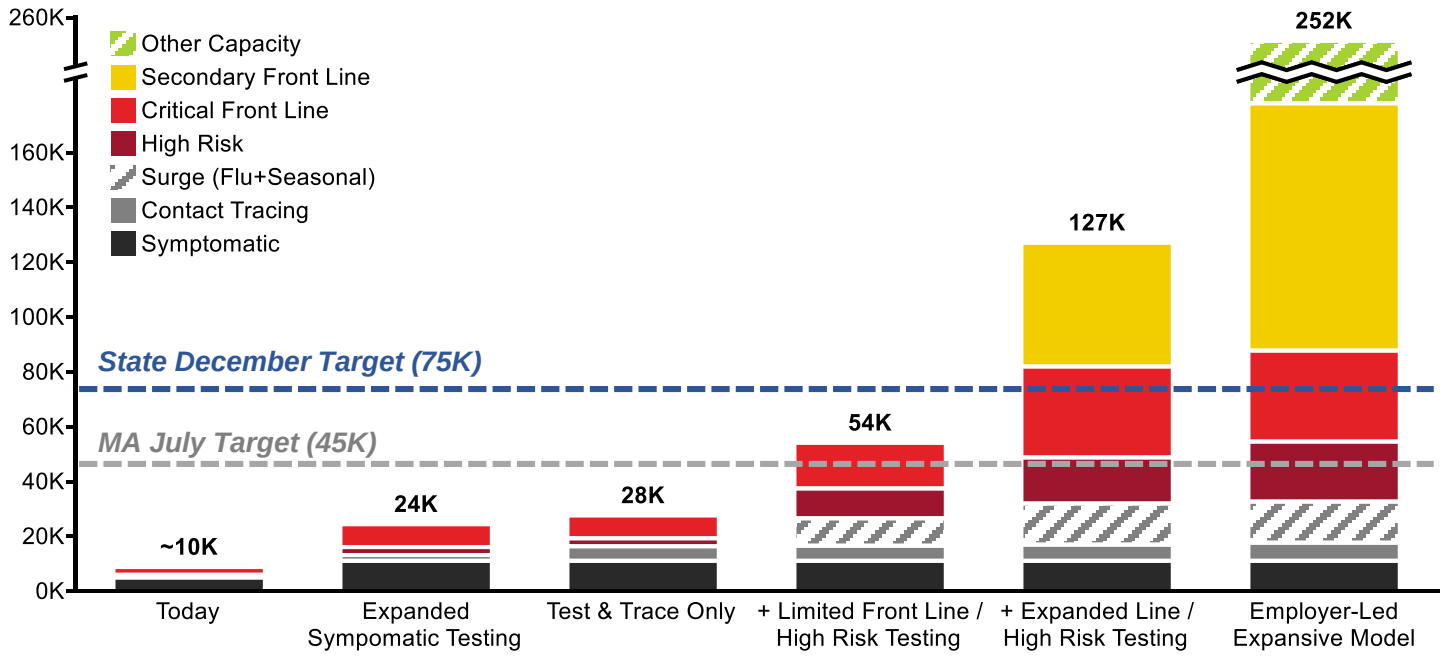
Capacity

- ***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-domiciled)*
- ***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)*

Source: MA Quarterly Employment Census, Bureau of Labor Statistics, Mass.Gov Senior Housing, US Census Data, Bain & Co analysis, Bain Capital Partners Analysis

Ⓐ Testing Strategy: Summary Range of Options

Strategic Approach & Required Testing Capacity



	Today	Expanded Sympomatic Testing	Test & Trace Only	+ Limited Front Line / High Risk Testing	+ Expanded Line / High Risk Testing	Employer-Led Expansive Model
Monthly Cost (@$30-50/test)	15-25M	20-35M	25-40M	50-85M	110-190M	230-380M
Est. Test+ rate	~12%	~4%	~4%	~2%	~1%	<1%
High Risk		Monthly →		1 / 2 wks	Weekly	Weekly
Critical Front Line		Monthly →		1 / 2 wks	Weekly	Weekly
2nd Front Line		Limited →		Limited	Monthly	1 / 2 wks

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

Population		Massachusetts	California	New York	District of Columbia	Maryland	Texas
Target groups for testing, communicated in state testing strategy	**Testing (per week/100K):**	• May 19: 1,283 tests • May 5: 1,144 tests	775 512	1,251 948	1,185 775	647 534	713 437
	Symptomatic	✓ *(emphasis)*	✓ *(emphasis)*	✓	✓	✓	✓ *(emphasis)*
	Asymptomatic with exposure	✓	✓	✓	✓	✓	✓
	High risked population *(Ages 65 and above, etc.)*	✓	✓	✓	✓	✓	✓
	Healthcare workers and first responders	✓	✓	✓ *(emphasis)*	✓ *(emphasis)*	✓	✓
	Essential workers *(Child care / workers, delivery etc.)*	✗	✓	✓	✗	✗	✗
Doctors note required *(based on interviews with local clinic/ pharmacies)*	**With symptoms**	✗	✗	✗	✗	✓	✗
	Without symptoms	✓	✗	✓	✗	*Limited*	✗

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

List of all testing sites in Massachusetts can be found here: https://www.mass.gov/doc/ma-covid-19-testing-sites/download

Over 200+ testing locations across Massachusetts

Hospitals
- Majority of hospitals are testing for COVID19

Other medical facilities
- Certain urgent care centres, walk-in clinics, family medical facilities, etc. are testing for COVID

Mobile testing sites
- Mobile testing sites have been set-up to provide greater access to testing for certain populations (i.e. nursing homes)

Drive-thru
- Several drive-thru facilities have been set up specifically to test for COVID (e.g. pharmacies, schools, retail etc.)

What you need to do to get tested

Symptomatic individuals[1] or closed contacts of COVID cases
- Contact a testing site
- Doctor's note not required (confirmed with call benchmarking at testing locations)

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."*

Note: [1]Symptomatic 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

Ⓑ Testing Strategy: Test Types & Innovations

	PCR	Antigen	PCR Pooling	Antibody (Serology)
	• **Viral DNA/RNA test** from nasal/throat or saliva • Samples typically **processed in scale clinical labs or large hospitals** with complex testing equipment	• **Nasal swab test to detect viral surface proteins (antigens)** • Samples typically **processed in at-home, at doctor's offices or clinics** with $500 readers	• **Pooling of PCR samples** to run same process reducing cost for low-risk testing • **Useful for large populations like colleges**	• **Detection of the antibody response to the virus** • **Backwards looking surveillance tool** • Samples typically processed In large hospital or clinical **labs**
Timing	**Early** (can detect ~2-3 days before symptoms present)	**Later than PCR** (often detection commences in line with onset of symptoms)	**Early** (in line with PCR testing)	**During or after-the-infection**
Accuracy	**High** (95% sensitivity) reported but lower (80%) in practice	**Medium** (80% PCR sensitivity) lower in practice (limited data)	**High** same as PCR, but requires additional follow up testing	**Medium** with false positives (~5%) a concern
Commercial Cost	**Medium** (~$100+ fully-loaded cost, ~$30-50 'at cost')	**Low** (~$20-30 fully-loaded cost)	**Low** (~$15-20 pooled / test)	**Medium** (~$50-120 cost)

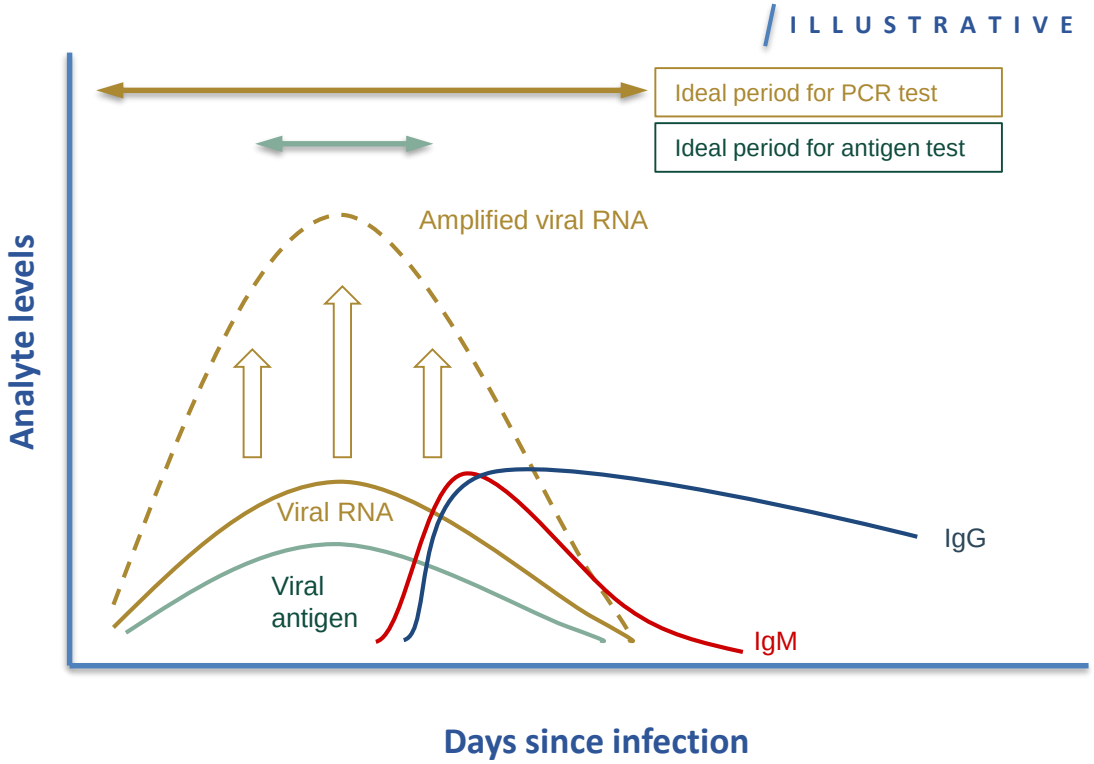
Sources: FDA, CDC, Bain & Company Analysis, Ginko Bioworks: "How to deploy millions of COVID-19 tests per day", expert interviews

Ⓑ Testing Strategy: Sensitivity of Antigen & PCR Tests

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 suggests **PCR test are also more sensitive**
  - PCR EUA filings: ~95-100% sensitivity rates *(real world sensitivity rates cites ~66-85%)*
  - Antigen EUA Filings[1]: ~80-85% sensitivity rates *(real world rates to be determined)*

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



Note: [1]Only 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**

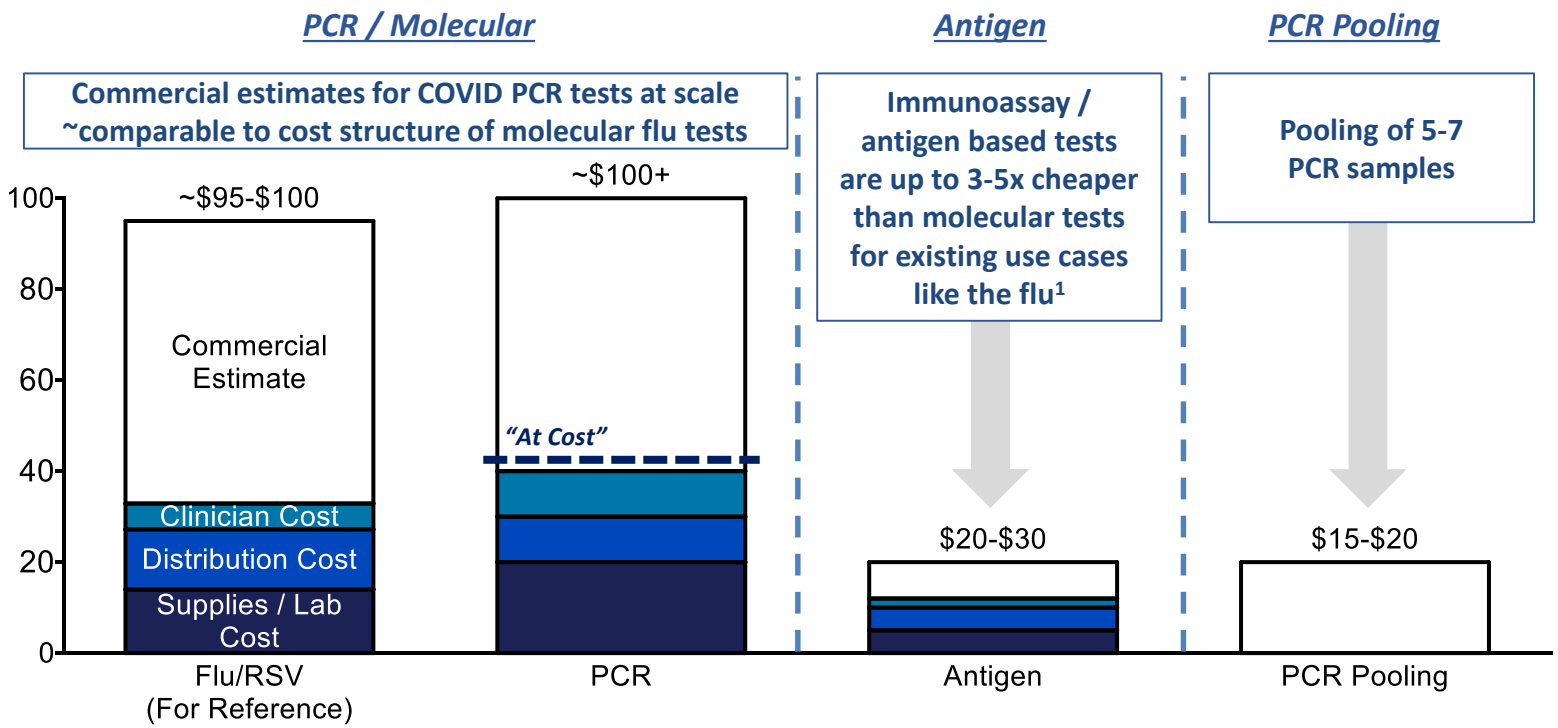
Quidel has received EUA and is producing tests that are compatible with their widespread machines
OraSure and E25Bio are developing at-home antigen tests in addition
Antigen test costs ~$20-$25 per test

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



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

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

Source: Expert Interviews, Bain & Company, Bain Capital Partners

Ⓓ Feasibility: Point of Collection Strategies (excluding home)

Testing at pharmacies & retail

E.g. Florida, New York, Conn.

- 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

E.g. Mass., New York, Conn.

- 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

E.g. Florida, Cali., Texas

- 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

E.g. Mass., Ohio, Mich.

- 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

E.g. Washington

- 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

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

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

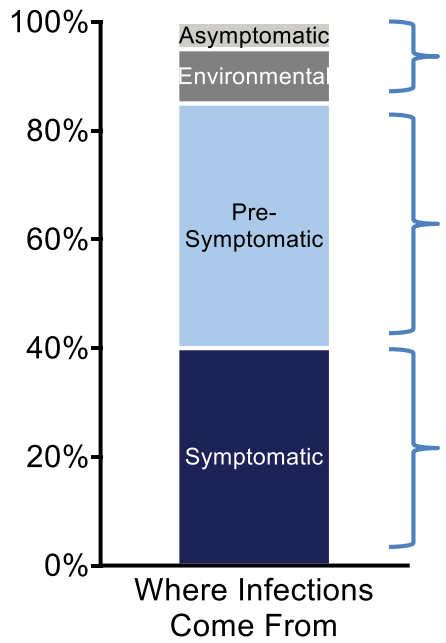
- **Define testing strategy** (who, how often, goals, etc.)
- **Contact a laboratory if testing is warranted,** to:
  - Secure testing capacity / sample kits
  - Understand specific requirements (i.e., doctors note)
  - Arrange logistics /
  - Discuss options for sample collection provider
- Develop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

Group B: Testing & Tracing

- **Testing Targets & Approach**
- **Tracing Approach**

Context: Importance of Tracing

Estimated COVID-19 Transmission Sources



True asymptomatic cases between **5%** (SK CDC study[1]) and 25% (CDC director high-end estimate[2])

45% of infections come from **pre-symptomatic** carriers

Only **40%** of infections come from **symptomatic** carriers

- If **only test and isolate people with symptoms**, can reduce R_T by **40% at most** – not be effective enough alone
- **Tracing and testing contacts** allows for identificatyion of pre-symptomatics, **reducing R_T by up to 85%**

Combining Testing with a thorough Tracing program will amplify the impact on reducing Rt

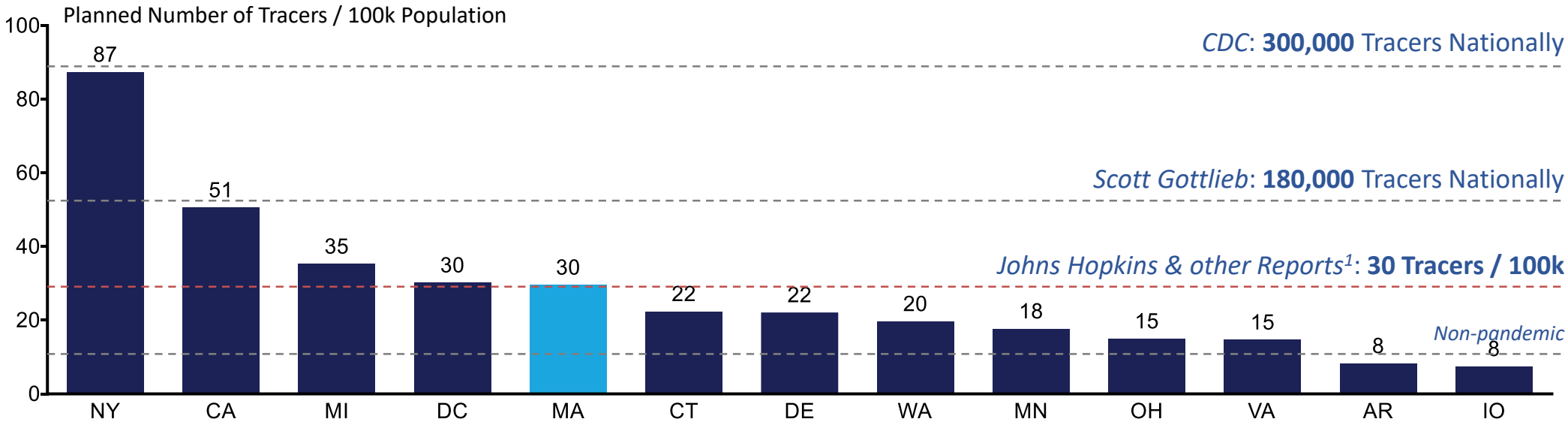
Source: "Quantifying SARS-CoV-2 transmission suggests epidemic control with digital contact tracing" by Luca Feretti, Chris Wymant, Michelle Kendall, Lele Zhao, Anel Nurtay, Lucie Abeler-Domer, Michael Parker, David Bonsall, Christophe Fraser, Oxford Univeristy, Tomas Pueyo

[1]"Coronavirus Disease Outbreak in Call Center, South Korea" by Park et. al

[2]CDC, Dr. Robert Redfield, NPR

Tracing Scale: Targets by State

Contact Tracer Scaling Plans by State



	NY	CA	MI	DC	MA	CT	DE	WA	MN	OH	VA	AR	IO
Planned Hires	16,000	17,000	3,400	148	1,700	500	200	800	900	1,065	1,000	50	200
X Increase [2] from Current	28.6x	5.7x	26.2x	2.3x	1.7x	1.7x	13.3x	1.1x	9.0x	1.6x	4.0x	0.3x	5.6x

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)

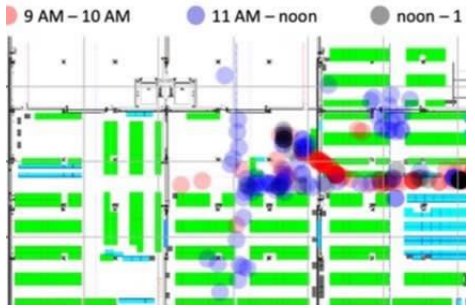
Tracing: Technology Solutions

Digital Tracing App Types

	Centralized	Decentralized
Description	Proximity tracking with storage and processing done **centrally** on server	Proximity tracking with storage and processing done **locally** on phone
Examples	Alipay Health Code; AC19	Corona100m; Trace-Together

Example Private Tracing Solutions

	pwc	microshare	LOCIX
Devices Used	Smartphone app	Badges, key rings, and wristbands	Smartphones, IoT sensors, asset trackers, appliances



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

- **A Workplace Norms**
  Develop workplace norms to minimize reoccurrence
- **B Testing & Tracing**
  Develop massive testing & tracing plan to be used to identify & contain virus spread

Source: Bain Capital Partners analysis