The following are recommendations from the WUSM Student COVID-19 Recovery Think Tank. They are based on data reviewed up to **May 7, 2020** and thus subject to change. These recommendations do not necessarily reflect the intuitional policies or opinions of Washington University School of Medicine.

At the end of March 2020, 94% of US population is under stay-home or shelter-in-place order (1,2). With more than 70,000 American died to date, COVID-19 has no doubt is a serious disease that needs implementation of aggressive public health policy (3). However, with over 27 million people filed for unemployment, general public and business sectors have significant concerns for global and personal economic impact of social distancing (4,5). Additionally, social distancing has adversely affected the condition among patient with mental health such as depression and substance abuse (6). While majority of US population support remaining in stay-home order, in necessary, following the recommendation of health experts, numbers of states is either lifting the order or has active plan to end stay-home order and reopen the business soon (7,8,9). However, key plans for safer reopening including the expansion of testing, availability of human resource for contact tracing upon second wave, development of effective treatment options and vaccines are still remains unaddressed (10). Here, we discussed general consideration related to reopening, and propose a plan for phased opening to protect health safety while allowing relaxation of the social distancing.

**Balance of infection control and economy in reopening**

Prolonged or intermittent social distancing may have long-term economical consequence such as recession and high unemployment rate (11,12). On the other hand, cautious approach to systematically and slowly opening the economy with close surveillance to the COVID transmission rates may cause slow recovery of economy and individual cash inflow. Reopening of societal functions and businesses while maintaining the safety and the health of workers requires fair balance of public health, national economy. The process of reopening will require tradeoff of short-term personal financial stability and long-term global economical recovery. Recent studies suggest that economical value of lives saved by social distancing outweigh the cost(13,14). Another states that stronger pandemic response yield better economic recovery (15,16,17). These studies suggest that aggressive public health measure such as stay-home order have long-term benefit more than early reopening with focus on short-term personal benefits. However, there are many who are affected in the short-term. One estimate is that 61% of all Americans have $400 or less in emergency savings (18). There are protests in multiple states, including North Carolina, Michigan, California, and Washington (19,20,21,22).

Regardless of the approaches that nation takes for reopening, the process would be a painful time for everyone.

To safely reopen the society, there need to be ways to distribute the economical and emotional burden across citizens at every socioeconomical level to achieve the balance. For example, in the setting of prioritized reopening of business subsections, monetary support such as stimulus check to sustain standard quality of living for those who are asked to stay home and take a pay cut.

**General strategies for reopening**

 There are multiple strategies by which we could relax measures taken against the COVID-19 pandemic. One approach is based on geography: for locations (e.g. cities, states) with lower disease prevalence, a complete relaxation of measures could be pursued; this is illustrated by several states reopening but places such as NYC maintaining shelter-in-place restrictions (). This approach allows rapid reopening of the economy throughout the location, and it enables every citizen in the area to return to work with equal opportunity. However, reopening without careful infection control and surveillance of COVID-19 would likely lead to a resurgence of COVID-19, possibly worse than before.

Another approach is to allow all sectors to reopen but limit their operating capacity, as seen in Texas, where businesses can operate at “25% capacity (23).” This number is easy to envision for places with a seating capacity, such as restaurants, salons, theatres, but it can be more difficult to imagine for other businesses, such as fitness centers or hobby-shops. Reopening at reduced capacity limits the number of active workers and customers to a business; in principle, this could enable the business to then enforce physical distancing of employees and customers to lower the chance of disease exposure. With proper physical distancing of symptomatic patient through self-isolation, secondary transmission rate within the household was 0%, in contrast to 16.3% without isolation. (24) This supports that physical distancing is sufficient and effective to prevent secondary transmission even within a confined environment. limited number of workers would also allow for easier monitoring of COVID-19 and reduced rates of transmission in case of an outbreak. However, any limitations to the number of returning workers would inevitably leave some unemployed or furloughed, and it may be difficult to ensure that workers are not discriminated against. Related to this is the concept of work sharing, an employment arrangement in which multiple people are retained as a part timer for a job normally fulfilled by one full time worker (25). Their pay is split among the workers, while allowing them to maintain benefits and cash inflow. In the case of Northeastern Japan earthquake in 2011, companies like Toyota took work sharing approach to maintain both factory productivity (business) and employment (individual worker).

A third approach may have been to only lift restrictions for people who are immune to SARS-CoV2, as determined by some type of antibody certificate, though as described in our considerations on antibody certificates, we do not think this is currently feasible. If such an approach were taken, it is likely that testing for COVID-19 and any certification of immunity would be prioritized for those at high-risk of exposure, such as essential healthcare workers and primary responders. These measures of infection control are like requirements for hospital workers to have annual flu vaccines and routine TB testing.

Lastly, related to the third approach is the concept of reopening certain sectors rather than lifting restrictions across all sectors. Several prioritization criteria could be considered, including exposure to non-employees, ease of contact tracing, and proximity to healthcare. Additionally, prioritization of workers in essential sectors (e.g. food production) may be critical to stabilize society and prepare for potential COVID-19 resurgence and second waves (26,27). Again, the major challenge in such an approach would be regulation to ensure that re-opening is done in a manner fair to all workers. Nevertheless, we feel that such an approach has the best infection surveillance and control while pursuing phased reopening of the economy. The Occupational Safety and Health Administration has published guideline on preparing workplaces for COVID-19 based on the traditional infection control strategies (28). Center for Disease Control also has made a recommendation for reopening workplaces during the COVID-19 pandemic (29).

**Optimal conditions of workers and workplace suitable for phased reopening**

1. Limited size of workers

Business with either limited number of employee or employer proactively reducing the number of workers simultaneously working in a same room allows better control of the infection rate by promoting social distancing within the workplace (30). Shelter-in-place promotes physical distancing by setting legal rules and closing down areas where social gathering can occur (31). Social distancing has helped “flatten the curve,” and as such, maintaining strict social distancing in workplaces, stores, and restaurants is essential to reducing COVID-19 resurgence (32,33). For businesses with limited number of workers, it is more feasible that they can reopen and enforce strict social distancing.

 Limited size of workers also restricts the number of potential infection, in case COVID-19 outbreak is detected at the workplace. Some groups of essential workers in healthcare systems takes team-based approach to separate a group of staff from another to prevent the entire workforce from being infected and to maintain adequate workforce in the case of outbreaks (34). If the COVID outbreak is detected with a member of a team, the team is taken off duty to contain the outbreak while maintaining the patient care by the other teams and teams on stand by (35,36) . Similar approach can considered in the rest of the society during reopening the society during the pandemic.

1. Limited contact with strangers

Shelter-in-place limits contacts among the strangers by restricting social gatherings. This prevent the rapid spread of the pathogen through chain reaction of exposure among unspecified number of strangers at unspecified location. These contacts are also difficult to track, requiring more time and resources (37,38). Workers at some business that involves customer service such as restaurants and café are inevitably at higher risk. Therefore, reopening of the jobs with high exposure risk to unspecified number of asymptomatic COVID carrier should be considered carefully or delayed (39). However, there are several logistical and regulatory issues to consider. Who will choose which type of business to reopen? Who will enforce the limited reopening of the business? Will employers and workers be amendable to these restrictions?

1. Traceable workers/minimal fluidity employee structure

 Migration of people increases the spread of pathogens from one regions to another (40). International travel of asymptomatic carrier is a common route of spread that led the development from COVID-19 endemic in Wuhan to world wide pandemic (41). Other forms of migration that should be considered is moving from one city to anther due to job availability, school matriculation, and nature of job that requires travel. In addition to the interregional migration, workers in jobs where the hiring is on day to day basis often switch jobs based on the job availability, potentially leading to the increased movement of workers within the community. These type of human movement makes it difficult to limit the contact with unspecific number of people and to trace in case of the outbreaks. Careful relaxation of social distancing in these business needs to be considered to prevent the second wave and re-implementation of shelter-in place (42,43). However, it is also important to consider that these workers are more likely to be vulnerable financially to stay-home order due to limited job security and personal financial stability (44). There need safety measures placed in order to protect these workers and their families from the financial turbulence of COVID-19 pandemic. US federal government has instituted series of fiscal policy to provide unemployment assistance, to support small businesses for retaining workers, and to allow paid sick and emergency leave for those infected (45). Additionally economic impact payment was issued to provide monetary relief during the stay-home order (46).

 Lastly, employment structure where workers can easily be monitored for symptoms for a period of time is optimal for infection prevention and containment. Because of the longer incubation period of COVID-19, infected workers may remain asymptomatic up to 2 weeks (47 ). This means that even if the workers are asymptomatic at the beginning of their job starting, they could be infected. Most employer of essential workers are currently monitoring them through daily screening prior to the start of work. Monitoring of COVID-19 status would also be beneficial to evaluate the effectiveness of physical distancing at workplace (48). Modeling studies suggested that serological testing during 50% relaxation of social distancing can avert 173,000 death while allowing 67% of US population to return to work (49).

1. Awareness of workers for the consequence of further COVID spread

 Even with the implementation of above measure, the key to suppress the transmission of COVID is the workers’ understanding of the infection prevention and compliance with the control strategies (50,51,52). Workers needs to be vigilant about physical distancing in and outside of work. Self-restraining from the temptation of interacting with their colleague at workplace would be very difficult after the lift of social distancing. Educating the workers to promote the understanding of the mechanism of COVID transmission and preventative measure is essential. It is important for them to understand the economical and health consequence of the further spread of COVID in the community (53,54,55). Workers need to stay honest and responsible for reporting their symptoms and contacts in the case of infection (55,56,57).

There are several jobs that meets the above criteria, offering the best initial opening workplace as a pilot prior to large scale reopening. Here we offer recommendation and our rationale behind the choice of workplace.

**Proposal**

 We propose that research labs in academic institutions and pharmaceutical industries be included in the initial phased reopening of business. This limited scale opening of research labs will offer valuable data in evaluating the effectiveness and feasibility of proper infection prevention and prepare us for larger-scale reopening of business.

**Advantage of using research labs in academic institution and pharmaceutical industries as a “testing ground” for large scale reopening**

1. Limited size of workforce

Research labs and core facilities usually operate with limited number of researchers, technicians, and a lab manager consisting of 3~15 members. Researchers are the dominant workforce pushing the project forward. Heads of laboratory or principle investigators can implement shift work schedule of the researchers for necessary wet lab activities, in order to achieve recommended physical distancing and limit the number of worker concurrently present in the same room. Currently some laboratories maintain minimal research activities, allowing maximum of 2 essential workers present simultaneously in the same lab space. By implementing shift works schedule, some research activities can be recovered while ensuring the safety of the researchers. Lab meeting can be continue to be conducted through online meeting application. As for the researchers involved in dry lab activities such as bioinformatic projects, they can continue to work remotely from home to reduce the physical contacts and prioritize the wet lab activities that necessitates the physical presence in the lab.

1. Limited contact with unspecified personnel

Research laboratories offer isolated environment with limited exposure to outside workers and visitors. Unless collecting samples form patients, research does not require involving any physical contact. Daily research activity can be resumed effectively with minimal exposure to potentially asymptomatic COVID patients. Collaborations that require transfer of materials or model organisms from one researcher to another should be conducted in contact-free manner. Researchers at full time hire should be prioritized over part time worker and those with multiple jobs to limit the potential exposure.

1. Traceable workers

Advantage of reopening research laboratory initially is that all workers’ contact information is available at each institution, making them easy to be contacted, should there be a need for contact tracing upon COVID outbreak. If shift work schedule is implemented by the head of lab and the workers strictly follows it, the exposure would be limited and easily traced from the small number of researchers. Furthermore, many research institutions currently have hire freeze limiting the number of new lab personnel. This limits the migration of workers, limiting the exposure from workers switching jobs. If the effective testing becomes available at the institution that the lab is associated with, monitoring COVID serology of the workers could assess the effectiveness of physical distancing in the lab (24). Lastly, many of the academic institutions are located proximity to healthcare institute, making it easier to monitor potential future outbreaks.

1. General awareness for biohazard and infection control

Staff at research lab that is involved in biomedical researches are required to be trained with biological and chemical safety (58,59,60). Research staff are also required to use proper personal protective equipment (PPE) that is appropriate for biosafety levels of their research (61). Typical PPE involves use of gloves, lab coats, goggle, and masks. Personal hygiene is also strictly enforced (62,63,64,65). Better understanding of biosafety and infection control makes these lab workers to be ideal workers to initiate the reopening measure (66,67). Research lab are also used to be following regulatory compliancy and following strict research ethical as a part of daily practice (68,69,70). While we cannot predict that every lab worker will be compliant with the physical distancing measure and shift working, however, they are more likely to be tolerating to the new (71,72,73,74,75). Additionally, many institutions offer evidence-based information related to COVID (76,77,78). Laboratory workers are likely to have basic understanding of current COVID conditions and importance of the infection prevention measures that are currently implemented. They will also more likely be aware of the importance of the reporting in case of experiencing COVID symptoms (79,80,81). Laboratory workers are often also difficult to replace, improving their job security, because their nature of job requires substantial technical training. In contrast, employee in the other industry may be under increased pressure to perform, leading to higher behavioral risks. (82) Therefore, research lab may offer safe environment for truthfully reporting new onset of COVID symptoms without risking worker’s employment.

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