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COVID-19 vaccine rollout—scale and speed carry different implications for corruption

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Abstract

The sanctioning of different coronavirus vaccines (with some approved by regulators for public delivery, and others in the pipeline) has met with relief by many sections of the public and the government. However, partly due to the damages associated with the pandemic and the ensuing euphoria over vaccines’ arrival, some of the challenges are mostly being ignored or are not recognized. This paper identifies some pitfalls and drawbacks in vaccine delivery. We argue that the somewhat unique tension between the speed of vaccine delivery and its scale can create opportunities for corrupt behavior that are often at odds with effective means to check abuse. While data on instances of abuse will emerge over time, it is useful to point out different avenues of abuse so that some preventive government actions can be undertaken. Specifically, we argue that the potential for out of turn delivery of vaccines and the stockpiling by unauthorized agents creates incentives for corruption, with the public or bureaucrats initiating corrupt transactions. An understanding of the potential avenues for corruption should guide the formulation of appropriate corruption-control policies and similar challenges that will be faced by policy makers in addressing future pandemics.

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1. Introduction

The fight against the COVID-19 pandemic saw a glimmer of hope in early 2021 with the arrival and testing efficacy of a number of vaccines. The public and policymakers around the world have sighed a collective relief, although the delivery and dissemination of the vaccines to meet global demand that already stands at 10 billion doses remains a formidable exercise. Recognizing the logistical challenges, numerous efforts are being undertaken to ensure timely delivery of vaccines, prioritize vaccinations across population groups, and minimize any wastage.

All of the attention on vaccine delivery has failed to acknowledge/address one important and very likely occurrence—the possibility of corruption. Corrupt behavior pervades almost every aspect of economic interactions where there are favors to be had (mostly, but not exclusively, with the involvement of corrupt government bureaucrats). In the case of the COVID vaccines, the life and death issues associated with the virus and the involvement of the government in multiple stages of the development and dissemination of the vaccines have potentially created some unique avenues for corrupt transactions. In one respect, the invention and development of the coronavirus vaccines have features of the development of any innovation, with issues of potential rent-seeking (Goel (2003)). More specifically, in the development of new drugs, firms could bribe the regulator (e.g., the FDA (Federal Drug Administration) in the United States) to expedite the approval process and/or alter the allocation of a drug between prescription-only or over-the-counter sale classifications.

Despite the relatively recent nature of the COVID-19 pandemic, a body of formal research is emerging examining various (economic and other) aspects, although some data are either unavailable or coming out with a lag (see Alfano & Ercolano (2020); Asongu et al. (2020); Baldwin et al. (2020); Bayram & Shields (2021); Farzanegan et al. (2020); Goel & Haruna (2021); Goel & Nelson (2021); Goldberg et al. (2011); Ioannidis et al. (2020); Price & van Holm (2021); Kumar et al. (2021); Nelson (2021a, 2021b); Yum (2020)). The aspects related to corruption in the vaccine rollout process have not yet been formally examined. Broadly speaking, this research ties to the corruption of science (British Medical Journal (2020); Chabner (2020)).

While one could defer to the findings of that line of investigation in studying the rollout of the coronavirus vaccines, there are some unique aspects related to vaccine dissemination that warrant renewed and somewhat special attention. In particular, there is another layer of government intervention related to vaccine availability in addition to the testing phase; here, the government is also directly or indirectly involved in the delivery phase of the vaccine. Since the testing and delivery arms of the government are mostly separate, there are a number of potential avenues for corruption that we will discuss below.

Even at a cursory glance at the global vaccination landscape, evidence for systemic vulnerabilities to corruption abounds and the implications of corruption are dire. The global rollout of approved vaccines proved to be—at least in the initial stages—much slower than had been promised by central authorities. Different groups have been lobbying to get preferential admin-

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1 For broader discussions of epidemics, see Alfani and Murphy (2017), Jordà et al. (2020), Karlsson et al. (2014).
2 https://www.nature.com/articles/d41586-020-03370-6
3 Farzanegan (2021) studies the effects cross-country corruption on COVID-19 deaths, while Gallego et al. (2020) study the linkage between corruption and procurement in Columbia.
4 For a related example, see https://www.washingtonpost.com/health/2021/01/05/florida-nursing-home-covid-vaccine/
5 https://www.theguardian.com/world/2021/jan/05/covid-vaccinations-slow-start-around-world-dose-reality
istration of the vaccine,⁶ and there are reports of related scams emerging.⁷ These abuses need to be checked not just for fairness and equality, but any abuse, given the nature of the disease, can amount to unnecessary loss of life. Vaccine nationalism, arguably a form of international corruption, has also created vastly different COVID-19 realities in different parts of the world. While Western nations race towards fully inoculating their populations by the end of summer or fall 2021, less wealthy nations are left struggling to source vaccines for even their most vulnerable. For example, according to the Africa Centres for Disease Control and Prevention, the continent aims to vaccinate about 35% of its population by the end of 2021 and another 25% in 2022; at such a pace, the African continent would not reach herd immunity until 2023 or later (https://www.sciencemag.org/news/2021/02/unprotected-african-health-workers-die-rich-countries-buy-covid-19-vaccines). Moreover, corruption in the delivery and distribution of vaccines would compound existing misinformation and distrust of vaccine safety and efficacy; without faith in the process, the public may be less likely to comply with public health guidelines and therefore less likely to collectively achieve herd immunity. Consequently, the potency of vaccines in containing the COVID-19 pandemic is as tied to their physical formulation as it is to the public’s faith in the process through which they were developed, distributed, and administered, and safeguarding against abuses during vaccine rollout is a critical public health matter.

Dissecting the foundations of such corruption, we argue that the tension between the speed of vaccine rollout (with the goal of vaccinating the maximum number of people quickly) and the scale of the rollout (with the goal of making the vaccine available to every citizen who desires to be vaccinated) create somewhat unique, and often conflicting, implications for corrupt behavior (see Fig. 1, where the scale of the rollout has a positive relation with corruption but the effect of

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⁶ https://www.cnn.com/2020/12/14/health/jockeying-for-covid-vaccine/index.html; https://edition.cnn.com/2020/12/21/politics/vaccine-lawmakers-backlash/index.html
⁷ https://www.cnn.com/2020/12/15/us/covid-vaccine-scams-trnd/index.html
speed could go either way). Thus, policymakers would have to be extra vigilant to curb corruption and achieve their objectives in controlling the pandemic.

The invention-development-diffusion trilogy as depicted in Fig. 2 is well-documented in the economics of technological change literature as the three sequential stages in the innovation process. Invention is the conception of the new idea (for a new process or a new product) and the building of a prototype, development is the testing of the prototype for reliability, safety, and accuracy, while diffusion is the availability/dissemination of an innovation to the intended clientele (see DiMasi et al. (2016)). These three stages are involved in any innovation, with the relative time spent in each stage varying with the complexity, novelty, and support related to each endeavor.

Each stage also introduces its own unique challenges and considerations, the tradeoffs of which are of direct relevance to the vaccine rollout. Regarding the balance between scale and speed, the invention and development stages of the vaccines policymakers are most concerned with speed (e.g., speed development and testing a vaccine), while the diffusion stage is where the tension between scale and speed comes into play, with potentially some unique implications for corrupt behavior.

In certain innovations, the government intervenes before the innovation is marketed to the public (e.g. before the diffusion stage) to ensure safety and reliability (see Wouters et al. (2020)). Examples include the testing of automobiles for their crashworthiness, testing of drugs for their side effects, etc. In one sense, the regulatory approval stage associated with coronavirus vaccines is similar to the one faced by other drugs to ensure adverse side effects are accounted for, the public informed accordingly, and whether the drug/vaccine is to be available only through a

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8 Of course, governments can and do intervene at the preceding stages sometimes—e.g., through invention grants and development support, but these interventions are either politically driven or on a case-by-case basis. The pre-diffusion intervention is generally qualitatively different as it is aimed at reducing or eliminating negative externalities from an innovation hitting the market.
doctor’s prescription. However, with worldwide deaths attributed to COVID-19 standing at more than three million and new daily cases continuing to spike upward at the time of this writing (https://www.worldometers.info/coronavirus/coronavirus-death-toll/), there is an unprecedented urgency to develop and disseminate suitable vaccines to check the spread of the disease in as timely a manner as possible (see Persad et al. (2020)). While some nations like Israel have been successful in vaccinating a substantial proportion of their population, most developing nations face challenges in procuring and administering vaccines. The challenge is further complicated as the virus mutates into new strains, calling into question whether or not vaccines originally developed to combat the disease are still effective, and questions about potentially adverse side effects of taking vaccines remain. As a result, the vaccine rollout faces another layer of regulatory oversight in ensuring smooth delivery, minimal wastage, and orderly delivery of the vaccine. This additional layer of government intervention, one that is likely to be performed by different government agencies than the ones that granted regulatory approval for dispensation, warrants that the coronavirus vaccine dissemination process be analyzed somewhat differently than that for other drugs.

The goal of this paper is to point out possible corruption opportunities that can occur at the various stages of the vaccine development and dissemination stages. These should help policymakers design some proactive stances that could mitigate such corrupt occurrences. Furthermore, experts predict more frequent and deadlier pandemics going forward. A better understanding today of potential corruption “pressure points” of future campaigns to fight these threats should also prove useful (see Goel et al. (2020)). Even at a broader level, designing effective corruption-control policies remains a challenge worldwide.

Given the nature of the underlying disease, any check on the abuse of the vaccine can potentially translate into saving lives and achieving more equitable outcomes (both within and across nations) in addition to checking the abuse of public funds. We consider two alternative scenarios in the vaccine dissemination stage: (i) the public offering a bribe to expedite the delivery of the vaccine; and (ii) offering a bribe to obtain vaccines to sell in the gray market. These are presented in Fig. 3 and are discussed further below. We turn next to a discussion of the tension between the scale (or magnitude) and speed of the vaccination rollout and implications for corruption.

2. Scale versus speed of vaccine rollout and implications for corruption

After the development of the vaccine, as has taken place in a few cases (with others underway), policymakers have to contend with the dual objectives of scale (mass rollout) and speed of delivery. However, scale and speed are intrinsically at odds with each other in all different contexts, and the coronavirus vaccine is no exception—see Fig. 1. As stated above, this tension is especially relevant in the diffusion/dissemination stage.

Both scale and speed have implications for corrupt behavior. With regard to scale, large rollouts are associated with bureaucratic red tape and greater issues for potential rent-seeking, both with

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9 https://www.worldometers.info/coronavirus/
10 https://www.hopkinsmedicine.org/health/conditions-and-diseases/coronavirus/a-new-strain-of-coronavirus-what-you-should-know
11 https://thehill.com/changing-america/well-being/550479-cdc-investigating-2-new-reports-of-blood-clot-cases-linked-to
12 One could argue that the scale-speed tradeoff considered here is somewhat broader than the textbook equity-efficiency tradeoff. Whereas equity considerations can apply to a small subset of a population, in the context of the vaccine, the equity is considered for the whole population (in other words, the objective is to fairly cater to the whole population).
implications for greater corruption (see Guriev (2004)). The speed-corruption linkage, however, is less clear and the effect on corruption could go either way. On the one hand, greater speed precludes the formation and execution of effective checks and balances (increasing corruption) and perhaps invite greater scrutiny by the media. On the other hand, corrupt networks (between bribe takers and bribe givers, or collusions among bribe takers or among bribe givers) take time to be formed and might not materialize with greater speed of rollout (reducing corruption). Furthermore, scale deepens stress fractures already present in health care and enforcement. This ambiguity would inhibit the formulation of effective anti-corruption measures in this context, but a recognition of different aspects is nevertheless an important first step.

Next, we draw on the invention-development-diffusion paradigm from the economics of technical change to further add formal structure to the discussion.

3. Corruption at the drug development, and approval stages

Governments around the globe have been involved in the financing of vaccine research, development, and manufacturing with private companies.\textsuperscript{13,14} This creates several opportunities for

\textsuperscript{13} For further details, see https://en.wikipedia.org/wiki/COVID-19_vaccine#cite_note-can-funding-54.
\textsuperscript{14} Whether or not the US government was a participant in financing the development of the Pfizer vaccine is a matter of some dispute. See, for example, https://www.npr.org/sections/health-shots/2020/11/24/938591815/pfizers-coronavirus-vaccine-supply-contract-excludes-many-taxpayer-protections.
corrupt activity, including in the formulation of contracts for public-private partnerships and the jockeying for the priority of discovery/market share. The broader issues of private sector corruption are discussed in Goel et al. (2015), and Guriev (2004) models the linkage between corruption and government red tape.

Using the invention-development diffusion framework, Fig. 2 presents an overall structure where potential corruption could occur due to regulatory intervention. At the drug approval stage, the regulatory body (like the FDA in the United States) intervenes to ascertain the health consequences and side effects of the new drug. The government wants to make sure that public health, both in the short and long term, is not compromised for private gain by the drug developers. Accordingly, translating drug discoveries from the research bench to the patient bedside requires extensive regulatory testing atop the initial investment into R&D. Regulatory approval, which entails several phases of clinical testing that benchmark new drugs against industry and governmental standards, can take over a decade and exacts a significant monetary and time cost. Reflecting the magnitude of investment at stake in drug development, studies estimate the cost of successfully developing a single new drug to be in the billions, with less than 12% of drugs that reach clinical trials ultimately achieving regulatory approval (DiMasi et al. (2016)). The lengthy development timeline coupled with the high likelihood of failure in clinical trials makes novel drug development into an especially risky innovation sector, thus providing greater incentive for corrupt activity. Furthermore, the hefty monetary costs of drug development often necessitate several stakeholders that play different roles at various stages of drug development (Goel (2001)). Basic biological research is primarily driven through government funding sources such as the U.S.’s National Institutes of Health (NIH) or private foundations such as the Howard Hughes Medical Institute (HHMI), whereas later-stage development and clinical testing are funded by venture capitalists, angel investors, pharmaceutical companies, medical institutions, and/or other governmental agencies. Shifting sources of funding and compartmentalized oversight of development at different stages preceding approval invite opportunities for corruption (see Mellman & Eisen (2020)).

In the context of the COVID-19 vaccines, the time-consuming and deliberative process of approval is made even more complex by the urgency and scale of development, as evidenced by the more than 250-odd potential COVID-19 vaccines in development globally. The regulator can deny approval, ask for further testing, or mark a drug as prescription-only (rather than over-the-counter). All these factors have a significant bearing on firms’ profitability.

For public health emergencies, some governments can make use of an expedited processes to authorize the use of a new drug outside of the normal approval process. This speed can undermine governance, inhibit the formation of corrupt relations, and breed nepotism (Bartolini & Santolini (2017); Lambdorff & Teksoz (2005)). This presents the potential for rent-seeking when corrupt regulators seek bribes for expedited approval or other preferential treatment. However, this rent-seeking is less likely to take place in high-profile approvals like the coronavirus vaccines, given

15 Corruption can, however, occur between private firms, as noted by Goel et al. (2015).
16 https://www.ncbi.nlm.nih.gov/books/NBK50972/#:~:text=While%20basic%20discovery%20research%20is,
pharmaceutical%20companies%20or%20venture%20capitalists
17 https://www.dhl.com/global-en/home/about-us/delivered-magazine/blog/delivered-blog-larry-stonge/preparing-
for-the-challenge-of-covid-19-vaccine-logistics.html
18 Firms are allowed to file for patents while they are awaiting regulatory approval. Corruption could also occur at the patenting stage, with bribes offered or solicited to grant, speed up, or set patent scope (Goel (2002, 2003)).
19 In the U.S., this is known as Emergency Use Authorization. Other countries, such as the U.K., have similar provisions for expedited approvals.
all of the media and public scrutiny. On the other hand, inventors have an elevated incentive to offer bribes for expedited or preferential treatment, especially when a rival drug is also on the horizon (as in the case of the coronavirus vaccines).

Given the stakes, speed, and scrutiny at hand in the COVID-19 pandemic, even minor errors caught during the authorization process can give the semblance of corruption in vaccine development and approval. For example, as the AstraZeneca-Oxford vaccine sought regulatory approval in the United States in March 2021, officials at the National Institute of Allergy and Infectious Disease (NIAID) took the unprecedented step of publicly stating that AstraZeneca had used outdated data to reach the vaccine efficacy number it released the previous day. Though AstraZeneca quickly released revised results with updated data showing just a slightly lower efficacy, this episode reflects the tenuous grounds upon which public faith in vaccines is built and how regulators have accordingly chosen to operate with a heightened concern for the appearance of corruption (https://www.smithsonianmag.com/smart-news/revised-astrazeneca-data-show-its-covid-19-vaccine-76-percent-effective-180977356/).

Following regulatory approval, supply chain problems at the product manufacturing and roll-out can emerge, especially as demand ramps up rapidly (see Goel et al. (2021)). Special problems arise in the case of the coronavirus vaccines in that manufacturers face the simultaneous challenges of product development and building up production capacity. Supply chain lines for many staples of biomedical research and medicine, such as sterile tubes, reagents, and protective personal equipment (PPE), have already been stretched thin by the pandemic, and overburdened delivery networks have led to chronic shipping delays worldwide. Product inputs are derived from global suppliers that oftentimes must pass government scrutiny (the FDA in the U.S. case); however, urgency in addressing supply chain bottlenecks can prevent thorough examinations of new vendors. Political considerations can also lead to the hold-up of vaccine raw materials being shipped across nations. All of this creates the potential environment for corrupt activity at various points in the supply chain and with government regulators to meet contractual obligations for vaccine supply. Evidence of such corrupt activity during the pandemic, present even before any vaccines were widely approved internationally, can be seen in the distribution of government contracts for pandemic-related supplies. In Britain, for instance, the scramble to secure equipment led contracts to flow to politically connected and/or controversial companies with little or no relevant experience.

4. Corruption at the vaccination/dissemination stage

Competition among bribe payers raises bribes; competition among rent-seekers lowers bribes; on the other hand, speed can undermine both these, while also inhibiting “learning to be corrupt” (see Lambsdorff & Teksoz (2005)). The pandemic has strained/changed social stability and that might impact people’s propensities to engage in corrupt behaviors (Perugini & Vladislavlijević (2021)).

20 https://www.wsj.com/articles/pfizer-slashed-its-covid-19-vaccine-rollout-target-after-facing-supply-chain-obstacles-11607027787
21 https://www.fda.gov/news-events/congressional-testimony/covid-19-and-beyond-oversight-fdas-foreign-drug-manufacturing-inspection-process-06022020
22 https://www.hindustantimes.com/world-news/joe-biden-s-wartime-law-use-blocks-india-s-vaccine-rampup-101618984303659.html
23 https://www.nytimes.com/interactive/2020/12/17/world/europe/britain-covid-contracts.html.
In the coming months, global demand for COVID-19 vaccines will greatly exceed global supply. As of April 2021, there are around 13 vaccines approved for use around the world, with many more in various stages of development. The testing standards being utilized for these 13 vaccines were significantly different and vary in their transparency, causing different vaccines to have varying international appeal outside their country of origin. Much of the 2021 manufacturing capacity from the leading vaccine candidates had already been pre-ordered by many nations in the European Union, the United States, and several other wealthy nations. Such excess demand may present opportunities and incentives for potential suppliers to bribe government regulators around the globe to cut corners in the approval process in order to bring their vaccine to the market more quickly. As vaccines compete for developing markets, incentives arise for deliberate misinformation against and active campaigning for a favored vaccine. For example, officials at the U.S. State Department warned in March 2021 of a misinformation campaign by Russian intelligence agencies seeking to undermine confidence in Western vaccines (e.g. the Pfizer vaccine) in order to promote the sale of Russia’s Sputnik V vaccine, thus exemplifying the potential for distribution-stage corruption.

The supply chain for vaccine rollout is inherently fragile and there is significant evidence that foreign actors have initiated cyberattacks looking to disrupt its distribution. With the entire world grappling with the ramifications of a virus running rampant, few internationally regarded vaccines providing relief, and an unequal distribution of vaccines between wealthy and poorer countries (with vaccine access disparities also present within nations), incentives for intellectual property theft and rollout disruption are high. Cyberattacks on governments and medical systems worldwide over the course of the pandemic, many of which likely have yet to be discovered, make the intentional sabotage of vaccine rollout quite plausible. Using pre-COVID international data, Goel et al. (2020) have shown that supply chain constraints are positively related to corruption, although different dimensions of supply chains might have different effects on corruption.

On the demand side, lower- and middle-income countries may have to rely on the COVID-19 Vaccines Global Access (COVAX), a global initiative co-led by the World Health Organization and others to ensure equitable access globally to the vaccine. At present, over 80 countries have submitted expressions of interest or committed funding to contribute to the vaccine supply to nearly 100 low- and middle-income countries, but the rollout of this program has failed to meet expectations (https://www.bbc.com/news/world-56698854). Corrupt activity surrounding the details as to how this complex process plays out going forward would not be surprising. This would make the formulation of effective policies more challenging.

In the face of significant excess product demand, there are two broad avenues for corrupt behavior at the dissemination stage: (a) corruption in queueing or priority in vaccine administration; and (b) the hoarding of vaccines through corrupt means to exploit a potential black market. Corrupt behavior could be initiated either by the bureaucrat or the consumer.

24 https://www.nytimes.com/interactive/2020/science/coronavirus-vaccine-tracker.html
25 https://www.nature.com/articles/d41586-020-03370-6
26 https://www.wsj.com/articles/russian-disinformation-campaign-aims-to-undermine-confidence-in-pfizer-other-covid-19-vaccines-u-s-officials-say-11615129200
27 https://www.nytimes.com/2020/12/03/us/politics/vaccine-cyberattacks.html
28 In instances where regimes would make vaccinations compulsory rather than voluntary, one could envision instances where some people not wanting to be vaccinated might offer bribes to dodge the process.
4.1. Corrupt bureaucrat; honest consumer

A corrupt bureaucrat directly undermines the implementation and enforcement of government policies. One possibility is that the corrupt bureaucrat extracts rents to either provide preferential vaccination or provides extra vaccinations for the briber to profitably dispose of. Given the media scrutiny associated with the vaccine, this behavior seems less likely. However, as media attention dies down or with the differing checks on bureaucrats and differing levels of transparency across nations, this form of corruption remains a possibility that governments should consider.

The greater the degree of bureaucracy and decentralization in the implementation of a government’s vaccination regime, the greater the opportunity for this form of corruption. In the case of the United States, individual states are given autonomy in setting vaccination priorities, while local pharmacies, hospitals, and medical institutions are tasked with determining the logistical details of the vaccination process. At the state level, different states have created differing definitions for who constitutes an essential worker and where an individual falls in the vaccination line, decisions that may be influenced by rent-seeking. At the local level, institutions may tailor the vaccination effort to cater to specific individuals or sub-populations, and they may jockey with one another to obtain access to precious vaccine doses.²⁹

Medical recordkeeping and healthcare software are highly siloed from hospital system to hospital system, making collaboration and data-sharing inherently difficult between medical institutions. A heavy reliance on paper documentation of vaccination records, for example, may hinder local coordination of public vaccination. Since mass vaccination requires coordination between systems to ensure that a person is fully vaccinated (as is the case with vaccines requiring more than one dose), the historic inflexibility of medical recordkeeping in all but the most centralized of health systems means that there are plenty of opportunities for bureaucratic errors or corruption opportunities to crop up.³⁰

Although much of the international community has pledged to vaccinate their citizens free of charge, many countries’ medical infrastructure contain loopholes ripe for exploitation during the chaos of the pandemic. Taking the U.S. as an example, many local-level distributors of the vaccine may charge facility fees for vaccination visits, and protections for those that are uninsured or that experience an adverse medical reaction to vaccination necessitating hospitalization are limited or unclear, respectively.³¹ As a result, opportunities abound for bad faith actors to take advantage of uncertainties in the system to charge consumers fees amidst even a free vaccination drive.³²

These aspects would be compromised with scale and speed, again with implications for corruption (Fig. 1). For instance, medical record sharing is more challenging with a larger scale, further complicating the speed of communication.

²⁹ A specific institutional case of local-level corrupt activity is that of Stanford Medicine. Of the 5,000 doses in their first batch of vaccination, only 7 were initially scheduled to be given to high-exposure medical residents, with the rest earmarked for higher-ranking doctors and administrators with little to no in-person responsibilities during the pandemic. After protests by residents and media outcry, the vaccination schedule was amended. Source: https://www.npr.org/sections/coronavirus-live-updates/2020/12/18/948176807/stanford-apologizes-after-vaccine-allocation-leaves-out-nearly-all-medical-resid

³⁰ https://www.statnews.com/2020/12/02/covid19-vaccines-interoperability-data-hospitals

³¹ https://www.nytimes.com/2020/12/17/upshot/vaccines-surprise-bills.html

³² https://www.washingtonpost.com/health/2021/01/05/florida-nursing-home-covid-vaccine/
4.2. Honest bureaucrat; corrupt consumer

On the other hand, the bureaucrat (vaccine disseminator) may be honest, but the consumer might be the first to offer a bribe (which the bureaucrat might or might not accept). In this case, a number of opportunities for corrupt activity are possible with the rollout of the vaccines.

4.2.1. Consumer/perpetrator bribing to jump the queue to be vaccinated earlier

As vaccines begin to be disseminated, the first hurdle is to establish vaccination priority guidelines among groups of consumers and rules that will be used in establishing the placement of individuals/groups in the vaccine queue. In the U.S., recommendations will be suggested by a federal advisory board (e.g., the Centers for Disease Control and Prevention), but it will be left up to individual states to make their own dissemination rules. Early experience has shown that numerous groups, from farmers to bank tellers and drive-share companies, are all lobbying state policymakers for their placement near the front of the queue. This could be by individual consumers or by groups—consumer organizations or trade bodies lobbying/bribing for their members.\textsuperscript{33} Once the queue is established, individuals offering bribes at local vaccination sites to get the necessary shots outside of their turn seems to be quite possible.

To graphically illustrate this, Fig. 3 presents two demands, alternately considering the demand for expedited vaccine delivery (Fig. 3a), and the demand by underground operators (unscrupulous elements) to buy vaccines for black market sales through bribery. Without loss of generality, we can assume that the vaccine delivery price is zero—many governments, such as the government of the United States, have mandated that the public would not be charged for the vaccine since the development of the vaccine was subsidized with taxpayer dollars.\textsuperscript{34}

In Fig. 3a, the demand for expedited delivery the price can be viewed as the bribe, plus any potential penalties. $T$ is the time when the consumer (bribe payer) is officially scheduled to get the vaccine, and the bribe enables the delivery time to be reduced. The negative slope of the demand $Da1$ shows a higher bribe would reduce the demand and vice versa. Alternately, the rent extraction power of the bureaucrat is diminished as time $T$ approaches. The curve $Da1$ assumes a given level of institutional quality or governance.

Curve $Da2$ presents a scenario with heightened enforcement. Better enforcement increases the potential costs of corrupt acts, either through a greater probability of apprehension and/or more severe penalties. Demand $Da2$ is thus more elastic and this demand would fall to zero at a time before $T$—with heightened enforcement, the consumer does not find it worthwhile to offer a bribe when the official delivery date is around the corner, and heightened risk of apprehension does not make it worthwhile to offer a bribe to expedite delivery by a few days.

4.2.2. Consumer/perpetrator seeking to obtain vaccines for self or for arbitrage

Consumers could bribe to obtain vaccines for self-administration later or to be sold in the gray market. However, given the huge quantities of the vaccine being transported over large distances globally, storage requirements, the number of potential vaccines that may come on the market, the logistical challenge to keep track of all shipments and to distinguish spoilage in transportation from theft, etc., may be without parallel.

\textsuperscript{33} https://www.cnn.com/2020/12/14/health/jockeying-for-covid-vaccine/index.html
\textsuperscript{34} https://www.forbes.com/sites/leahrosenbaum/2020/12/18/the-feds-risky-billion-dollar-bet-on-moderna-pays-off-as-fda-authorizes-its-covid-19-vaccine/?sh=7db1ef4865ad
Another scenario—the demand by fraudsters to obtain vaccines—is presented in Fig. 3b. Fraudsters, depending on the black-market price, would demand multiple doses of the vaccine.\textsuperscript{35} So the demand curve Db1 shows a negative relation between the price (i.e., the gray market price or the bribe) and the quantity.\textsuperscript{36} At a sufficiently high bribe/price, the buyers just resign to the government vaccine (Q = 1) and wait for the scheduled delivery and drop out of the gray market.\textsuperscript{37}

Demand Db2 shows heightened enforcement in this market. Again, the demand curve becomes more elastic with better enforcement. These qualitative scenarios compare the two situations where corruption might occur and what effect an improvement in institutional quality/enforcement might have.

4.2.2.1. Consumer/perpetrator has no storage/transport or administering capabilities. Consumers face additional challenges when taking matters into their hands. For instance, some vaccines like the Pfizer vaccine need special handling at extreme temperatures. They have limited shelf life and are liable to lose their efficacy if not handled properly.\textsuperscript{38} A consumer without storage or administering capabilities would then be less likely to offer bribes to obtain vaccines.

The ultracold storage requirement for the Pfizer vaccine (and other candidates in the pipeline) introduces new stakeholders and contractors in the vaccine rollout phase that may not have a prior relationship with the government. These include both those involved in the storage and those providing supplies relevant to the vaccination operation (e.g., syringes, needles, PPE). Hastily negotiated contracts and an expanded bureaucracy create more avenues for corruption.

4.2.2.2. Consumer/perpetrator has storage/transport but no administering capabilities. A consumer who has storage capabilities but is unable to administer the vaccine (or check the efficacy of the vaccine) would likely be bribing to sell vaccines in the gray market (to poor or uninformed buyers). The United States and many other nations have pledged to provide the vaccine free of charge; however, gray markets may emerge domestically (a function of individuals looking to move up in the queue) and internationally (e.g. ferrying vaccines from a country that is providing them free of charge to those that aren’t). On the other hand, such a consumer would want at least two doses—one for self and one to bribe a potential health professional who is going to administer the shot.

4.2.2.3. Consumer/perpetrator has both storage/transport and administering capabilities. A consumer with both storage and administering capabilities would bribe to essentially run a parallel vaccination operation. However, the issues of credibility and reliability would remain with such a provider’s potential buyers.

\textsuperscript{35} The storage of some vaccines, such as the Pfizer vaccine, is somewhat challenging as it requires storage at extreme temperatures. This may be viewed as a transaction cost. A more challenging aspect for fraudsters would be convincing potential buyers of the authenticity and efficacy of the gray market vaccines.

\textsuperscript{36} Since the vaccines are demanded for resale, the timing is less important (compared to the demand for one’s own consumption).

\textsuperscript{37} In the special case of the coronavirus dissemination, the consumer/perpetrator also faces special challenges with respect to vaccine storage (e.g., at a certain temperature) and administration (i.e., finding a complicit health professional to vaccinate).

\textsuperscript{38} https://investors.modernatx.com/news-releases/news-release-details/moderna-announces-longer-shelf-life-its-covid-19-vaccine
4.3. Both bureaucrat and consumer corrupt

In case both the bureaucrat and the consumer are corrupt, corrupt bargaining scenarios would emerge, with the relative bargaining powers of each party dictating the size of the bribe and the timing and magnitude of the delivery. In such cases, it is hard to draw general policy inferences as each case is different.

Formally, drawing on the general theoretical work of Goel (2013), one could envision how the timing of the corrupt relation between the bribe giver (vaccine consumer here) and the bureaucrat (official with vaccine access or stock) could impact the size and scope of corruption. If the consumer initiates the corrupt relation by bribing to get a vaccine (also see Fig. 3), he/she faces the chance that the bureaucrat might turn out to be honest and reject the offer. Furthermore, the honest official might choose to report the bribing consumer to enforcement, in which case these would be expected costs of offering the bribe (in terms of a monetary fine or imprisonment). In the event where the bureaucrat is also corrupt, both parties to the corrupt transaction would have to consider the expect costs of punishment if caught by some overseeing (audit) authority.

A similar consideration of expected punishment from bribery would occur if the bureaucrat initiates the corrupt transaction by demanding a bribe. In such an instance, the consumer might reject the offer and report the corrupt official.

Goel’s (2013) results show that the effectiveness of apprehension in curbing corruption depends upon whether higher bribes invite harsher fines. Furthermore, better paid bureaucrats demand smaller bribes. Based on this, one could envision that nations with better paid bureaucrats might not necessarily suffer less corruption, but the severity of corruption in such instances would be lower.

5. Institutional considerations in the face of speed/scale vaccine rollout

As is well known, strong and effective institutions act as a deterrent to all forms of corrupt activity in any context (Dimant & Tosato (2018)). Based on the extant literature, some institutional considerations that are particularly relevant in mitigating corruption surrounding all stages of the rollout of coronavirus vaccines are highlighted below.

5.1. Government stability/fragility/authoritarian regimes

The quality of the government institutions dictates the extent to which corruption prevails. The overall corruption literature has noted the role of good government quality in reducing corruption (Jetter & Parmeter (2018)). Authoritarian regimes, for example, might be at somewhat of an advantage in rolling out vaccines as there are fewer time-consuming checks and balances. On the other hand, such regimes generally have greater rent-extracting powers that can be used to maximize the self-interest of the autocrat—one instance might be to grant one vaccine preference in approval over another in consideration for bribe payments.

5.2. Centralized versus decentralized distribution plans

Nations also vary in terms of their structure of government and this has relevance for the vaccine distribution plan. For unitary states like the United Kingdom and China, the distribution
Further, in the context of vaccine distribution, a unified regulatory body is overseeing drug approval and its dissemination later. This could present a situation akin to regulatory hold-up, whereby drugs are approved initially but rents are extracted at the later dissemination stage.

Decentralized systems may have greater transparency and citizens have a basis to compare performance across jurisdictions. Both should work against corrupt activity. In contrast, more centralized systems are usually associated with relatively few political actors who exploit their power/position for personal gain. On balance, the available empirical evidence has pointed to more decentralized systems as enjoying lower overall levels of corruption on the part of government officials (Faguet (2014); Fisman & Gatti (2002); Goel et al. (2017); Martinez-Vasquez et al. (2017); Turnbull & Djoundourian (1993)).

In the present context, decentralized systems offer the advantage of rolling out vaccine delivery on a mass scale through devising a distribution scheme that is best tailored to meeting local needs. However, in this case, where speed is imperative, decentralized systems may be at a disadvantage where vaccine delivery centers around subnational governments such as local public health agencies that may be unprepared and lack resources to efficiently execute vaccine delivery. Provided little guidance, such local-level actors often lack the support to fully implement the last stage of the vaccination supply chain and are hindering the pace of vaccination in countries like the U.S. Further, regional differences in distribution plans may invite corrupt actors to exploit these differences for personal gain in a manner similar to what happens now in other areas such as tax avoidance. On balance, decentralized vaccine distribution plans that need to be rolled out quickly in the midst of a pandemic may create more opportunities for corrupt activity relative to a plan put in place by the central government.

5.3. Public versus private sector distribution

Some countries, such as the United States, are placing heavy reliance on the private sector and related infrastructure already in place to distribute the vaccine from the manufacturer to local users. In particular, the federal government has contracted with a private sector firm (McKesson) with experience in vaccine delivery during the H1N1 pandemic in 2009–10 to oversee the delivery of the Pfizer vaccine to specific locations as determined by the central government. Private sector firms such as FedEx and UPS are responsible for actual delivery to local sites. At that point, local private sector vaccinators (e.g. pharmacies) play an important role in their distribution plan.

The distribution plans for many other countries are still in development and some may rely more heavily on public infrastructure and bureaucratic supply in the distribution process. This can

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39 https://www.technologyreview.com/2020/12/04/1013183/us-uk-and-china-covid-vaccine-who-gets-priority-decision
40 For examples in the US, see https://www.nytimes.com/2020/12/31/health/vaccine-distribution-delays.html; https://www.cleveland.com/open/2021/01/with-the-state-shirking-vaccine-planning-to-local-governments-some-are-concerned-if-ohio-will-be-ready-to-ramp-up-shots.html
41 https://www.hhs.gov/sites/default/files/strategy-for-distributing-covid-19-vaccine.pdf
42 https://www.hhs.gov/about/news/2020/11/12/trump-administration-partners-chain-independent-community-pharmacies-increase-access-future-covid-19-vaccines.html
create yet additional opportunities for corrupt activity to the extent that the distribution system put in place is not disciplined by the market or public transparency.  

5.4. Media oversight and the speed versus the scale of vaccine rollout

Beyond the quality of the government, oversight by the media also provides a layer of oversight over corruption. Press freedom can expose corrupt activity, with both political and legal consequences for those involved. Empirical studies have documented a negative relationship between media freedom and corruption (Bhattacharyya & Hodler (2015); Dimant & Tosato, (2018); Goel et al. (2012); Treisman (2000)). Press freedom, however, differs considerably across nations, with the internet acting as some sort of an equalizer (Goel et al. (2012)).  

Pandemic restrictions on movement and interaction narrow the investigative freedoms that journalists normally enjoy, while instances of corruption may exceed the public’s or legal court’s ability to process them in a timely manner.

The sheer magnitude of the rollout means that even intense media scrutiny may fail to highlight all but the most blatant and visible examples of corruption. Scale/speed can also undermine scrutiny—internal and external (media). The enforcement effects are shown in Figs. 3a and b. The concluding section follows.

6. Concluding remarks

This paper examines potential corruption issues associated with coronavirus vaccine deployment. The urgency associated with the vaccine rollout, with governments focusing on both the equity and efficiency aspects, has not permitted the public or the policymakers to focus on spillovers or unintended consequences. Whereas evidence of actual corrupt activity related to COVID-19 will emerge over time (and some of the related corruption might never come to light), we highlight potential spillovers of the rollout of the coronavirus vaccines on corruption, borrowing from the standard economics literature. The importance of controlling corruption related to the COVID-19 pandemic is increasingly being recognized internationally (Vrushi & Kukutschka (2021); https://worldjusticeproject.org/sites/default/files/documents/Corruption%20Design%20File%20V4.pdf).

In closing, we also provide some recommendations for checking corruption so that some preemptive policy initiatives could mitigate adverse outcomes. Besides the timely focus on the rollout of the coronavirus vaccines and implications for corruption, we are uniquely able to tie this to some structured formal discussion by bringing in the tension between the scale and speed of the vaccine rollout and drawing on the invention-development-diffusion paradigm.

- Greater transparency in the government’s involvement should reduce instances/opportunities for corrupt behavior. While this policy recommendation is straightforward, there are some unique challenges in the vaccine rollout, especially undermined by the tension between the scale and speed as noted above.
- Government involvement in the fight against the coronavirus should consider the potential spillovers on corruption and rent-seeking. Given the urgency with saving lives and controlling

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43 https://www.maersk.com/news/articles/2020/11/26/covid-19-vaccine-distribution-expectations-and-highlights/

44 There could, however, be corruption in the media as well. The extant literature has not considered this possibility in much detail.
the pandemic, it not clear whether the focus of most lawmakers is on these secondary but important aspects.

- Both equity and efficiency goals of public policy could be undermined with increases in corrupt practices. As argued, the equity considerations in this context are broader since the whole population needs to be equitably served (“jabbed”).
- Coordination across different government agencies might help reduce rent-seeking issues. However, the coordination efforts are time-consuming and could undermine the speed of rollout. Relatedly, policymakers should carefully weigh the relative costs and benefits of decentralization in the vaccine rollout process.
- Policymakers need to be cognizant of the tension between speed and scale in terms of implications on corruption as they roll out vaccines to combat the pandemic. However, given the high stakes in terms of the loss of lives and uncertain trends (with unexpected and sudden spikes in infections), it is not clear how one goal may be sacrificed in favor of the other.
- Vaccine delivery schemes left to local governments to determine may foster more corruption opportunities than delivery plans made more centrally.

Some of these issues will be resolved as real data come out, although corrupt activity by its very nature is a secretive undertaking. Nevertheless, it is our hope that this initial study, with some firm grounding in the literature and supporting anecdotes from the popular press, brings some of the rent-seeking issues with the vaccines to the forefront. Accurately forecasting the current pandemic has been a challenge (Ioannidis et al. (2020)), and the recent spikes in infections in Brazil (https://wwwnc.cdc.gov/travel/notices/covid-4/coronavirus-brazil) and India (https://wwwnc.cdc.gov/travel/notices/covid-4/coronavirus-india) have created greater concerns for the public and policymakers. It should also prove useful in addressing similar challenges that will be faced by policy makers in confronting pandemics of the future.

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45 https://www.washingtonpost.com/graphics/2020/health/covid-vaccine-states-distribution-doses/?itid=hp_pandemic-guide-box-1208
46 https://www.economist.com/leaders/2021/04/24/indias-giant-second-wave-is-a-disaster-for-it-and-the-world; https://www.economist.com/the-americas/2021/03/27/brazils-mismanagement-of-covid-19-threatens-the-world
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