Editorial: Smart City Technologies for Pandemic Control without Lockdown

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The return of COVID-19 outbreaks in Singapore in mid-April shows that successful control at one point in time does not guarantee an end to the pandemic. However, at least at the point of this editorial's writing (29 April 2019), South Korea has shown remarkable success. The U.S. and UK have had 179 and 319 deaths per million, respectively and even Germany, the least hit in Western Europe, has had 73. In contrast, South Korea's death count per million remains at 5. This gap is likely to grow further because South Korea experienced its peak 50 days ago while the European and North American countries just passed or are still heading toward their peaks. More remarkable is that South Korea has achieved this feat without lockdown.

In this editorial, we will explain how smart city technologies have been mobilised in patient tracing in South Korean cities. It is not easy to define which technology constitutes smart city technology and what does not. In this paper, we will limit our discussion to technology related to urban infrastructure, human mobility and local government administration. Other technologies, such as AI-based lung cancer diagnostic systems, are not discussed here. We do not cover the non-technological issues associated with pandemic control in this editorial either because other recent publications such as Sonn and Lee (2020) and Park, Choi and Ko (2020) deal with those issues.

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Contact tracing is a standard part of pandemic control. What is interesting about the South Korean strategy is that South Korea has utilised smart city technology to improve the effectiveness and efficiency of its contact tracing. Here is how that approach has worked.

An epidemiological investigator in the Korea Center for Disease Control and Prevention (KCDC) first interview each patient to find out potential contacts. In most cases, interviewing has proven sufficient. However, in some cases, patients have tried to conceal their past mobility for various reasons. For example, members of a socially stigmatised organisation may have tried to hide their membership and those in socially stigmatised jobs may have attempted to not reveal their place of work. In other instances, patients simply don't have a clear memory. In situations like these, the CDC or local government epidemiological investigator can request mobility data through police. That measure is possible only when the Minister of Health and Welfare declares a health emergency, which is the case now.

Once permission has been granted by the police, the epidemiological investigator obtains mobile phone location data from the patient's mobile network provider and the patient's cashless transaction data from banks. A common misunderstanding is that global positioning system (GPS) functionality is needed to locate the phone. The mobile network provider always knows where the phone is with or without GPS because a mobile phone is always connected to one to three transceivers that are closest to the phone. By looking at which transceiver the phone is connected to when, the mobile network provider keeps a record of the phone's location. The density of transceivers determines the accuracy of the location record. South Korea has an extremely dense distribution of transceivers, 860,000 throughout the country, which makes South Korea one of the most densely covered territory of the world. (MOLIT, 2020) Credit card transaction records can serve the same purpose. More than 95% of transactions in South Korea are cashless, which is by far the highest percentage in the world. This means banks know where someone has been. (MOETI, 2016)

Another important source of patient mobility is transportation cards. (Shin, et al. 2020) While we could not find any reliable source of data, it is relatively safe to assume that absolute majority of Koreans use a transportation card in its physical card or as a chip embedded in a credit card or as an app in a mobile phone because such payment provides significant discounts of fares. As such, local governments and their transportation agencies have data on people's mobility through transportation card payment. Unlike some other countries, the South Korean transportation card requires touch-out as well as touch-in, so these records constitute good origin-destination data.

These three data sources are complementary. The transportation card records offer a rough picture of someone's movement. Mobile phone location data are interruption-free but there is some margin of error, namely up to 60 meters. On the other hand, cashless transaction records obviously have many interruptions, but they show the exact location of transactions.

Once the epidemiological investigator obtains the data, details are filled in by interviews and CC-TV recordings. The data come from high-techy sources but the work process is labour-intensive, which was imporved on 26 March by introduction of COVID-19 Epidemiological Investigation System that facilitates data request and approval and automize visualisation. This system, partly related to an earlier Smart City Data Hub that Daegu City has been developing since April 2019, was developed by a public thinktank called Korea Electronics Technology Institute in collaboration with various businesses. The system connects police, the Credit Finance Association, the three mobile network providers of the country, and 22 credit card companies. Here is how it works: If an epidemiological investigator of KCDC request data of a confirmed patient, a text message is automatically sent to the police offer's phone, who logins the system and approves. The approval makes the system automatically requests the mobile network provider to offer the patient's phone location records. The person in charge of the records within mobile network provider is notified by a text message, logins the system, and send the phone location records. For most of patients, the mobile network provider can send credit card transaction records as well because most users of credit card in South Korea receives transaction records in SMS. This whole process normally takes 10 minutes, which is substantial improvement from 5-24 hours of time that took before introduction of the system. (Choi, 2020; The Government of the Republic of Korea, 2020)

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An urban historian of the future might record the COVID-19 pandemic as the first pandemic that the human race face with all necessary urban infrastructure installed already, but still fail to utilise such infrastructure. In the past, infrastructure was installed in the aftermath of pandemic. The 1831, 1837, and 1854 cholera outbreak in London was mainly due to inadequate drinking water and sewage infrastructure. It was only 1958 when London finally built sewage network. In Philadelphia, Pennsylvania, only in 1908, after numerous lives were lost in several rounds of typhoid fever and cholera, the local government cleaned up houses and businesses in the riverbank that had been contaminating the river and created Fairmount Park. Unlike those times, cities, at least major ones in the high- and middle-income economies, had smart city technology that could help trace contacts but only a few such as Taiwan and South Korea utilised such infrastructure properly. Further discussion on better use of smart city technology in pandemic control as well as potential privacy problems is needed in the pages of *International Journal of Urban Sciences* and other venues.

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