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Pandemic and hospital avoidance: Evidence from the 2015 Middle East respiratory syndrome outbreak in South Korea

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A B S T R A C T
Existing literature shows that people exhibit disease avoidance behaviors in response to contagious disease outbreaks. We examine hospital avoidance behaviors during the 2015 Middle East respiratory syndrome (MERS) outbreak in South Korea. The outbreak provides an excellent setting for the analysis because unlike the coronavirus disease-19 (COVID-19) situation, no mandatory lockdown was imposed during the outbreak, and the economic impact was also not large. Hence, reduced hospital visits are likely to reflect the public’s intention to avoid hospitals to protect themselves from getting infected with MERS. Moreover, the outbreak did not spread to the entire country and vanished after a short period of time, allowing us to consider the affected regions as the treatment group and the other regions as the control group without much concern of confounding by other factors. The data come from a government agency, which assesses (national) health insurance claims made by hospitals, and hence cover all outpatient visits in the country. We find that people reduced outpatient visits by about 17% in response to the MERS outbreak, and the response was the most intense when new cases were reported most frequently.

1. Introduction

Existing literature shows that during contagious disease outbreaks, people exhibit disease avoidance behaviors. For instance, behaviors reported in response to the HIV outbreak include pregnancy avoidance (Kaida et al., 2011; Moore et al., 2014), reduced frequency of sexual activity (Gregson et al., 1998), and increased condom usage (Ahituv et al., 1996). Following outbreaks of respiratory diseases such as the severe acute respiratory syndrome (SARS) in 2003 and the novel influenza virus A (H1N1) pandemic in 2009, hospital avoidance (Bennett et al., 2015) and increased handwashing (Jones and Salathe, 2009; Agüero and Beleche, 2017) were reported.1

Among these behaviors, we examine hospital avoidance. Unlike practices like handwashing, hospital avoidance could worsen health; hence, a policy intervention is necessary so that patients can seek health care services without fear of infection. Relatedly, De Rosa et al. (2020) found that heart attack fatality rates rose in Italy during March 12–19, 2020, which coincided with the coronavirus disease-19 (COVID-19) outbreak, possibly due to a reduction in admissions for acute myocardial infarction.

For our analysis, we use the 2015 Middle East respiratory syndrome (MERS) outbreak in South Korea. The outbreak is appropriate for analysis in that this disease had never been known to the country and the first death was reported only 10 days after the outbreak began, coming as an unexpected health shock to the public. Nevertheless, unlike the COVID-19 situation, where the policy of social distancing or stay-at-home was implemented, no such policy was imposed during the MERS outbreak, possibly because most of the infections occurred in hospitals, which implies that reduced outpatient visits, if any, were likely due to the public’s own intention to avoid contracting the disease, and not because of any governmental mandate. Relatedly, previous studies that estimated the impact of COVID-19 on healthcare utilization (Alé-Chilet et al., 2020; Ziedan et al., 2020; Chatterji and Li, 2021) likely include the effect of mandatory policies of lockdown, in addition to the effect of voluntary behaviors such as hospital avoidance. Alé-Chilet et al. (2020) found that non-respiratory emergency visits in Chile dropped by 57% in mid-March 2020, Ziedan et al. (2020) found a 40% drop in outpatient visits in the U.S. after the first week of March 2020, while Chatterji and Li (2021) reported that the number of outpatient visits per provider in the U.S. fell by 67% in the week of April 12, 2020.

MERS did not spread to the entire country and vanished after a short period of time, allowing us to consider the affected regions as the treatment group and the other regions as the control

1 The public also exhibits avoidance behaviors in response to non-contagious disease outbreaks including pregnancy avoidance following the Zika outbreak in South America (Junior and Rasul, 2019; Gamboa and Lesmes, 2019) and avoidance of a school-leaving examination in response to the dengue outbreak in Colombia (Barron et al., 2019).

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group without much concern of confounding by other factors (e.g., economic condition). That is, the disease was introduced by a single man in the country in May 2015, and the last new case was reported in early July, with the outbreak recording a total of 186 patients and 38 deaths (see Fig. 1 for the number of cases and deaths). The 186 cases were reported mostly in four northwestern regions out of 16 regions in the country, namely Seoul, Gyeonggi, Chungnam, and Daejeon, with the first patient being a resident of Chungnam (see Fig. A.1 for a map of the country).

We use 2011–2015 monthly level data on the number of outpatient visits to the following five departments: internal medicine, pediatrics, family medicine, otolaryngology, and general practice. Because MERS is a respiratory disease, patients in need of treatment at any of these clinics would have been likely to avoid visits in an effort to protect themselves from getting infected in the hospital. The data come from the National Health Insurance Review & Assessment Service, which assesses health insurance claims made by hospitals. Because the country has a universal health insurance system, the data cover all insurance claims made in the country. Further, because South Korea does not allow remote treatment, all claims are based on in-person treatments.

This study contributes to the literature in the following ways. First, although many studies have examined disease avoidance behaviors, only a few, especially studies on COVID-19, have examined hospital avoidance or the effect on the number of hospital visits. By presenting new evidence, our study expands the literature and highlights the need for policy intervention to discourage hospital avoidance. Second, many studies have examined disease avoidance behaviors through surveys asking how people respond to a particular disease (e.g., Jones and Salathe, 2009; Kaida et al., 2011; Agüero and Beleche, 2017), but like Bennett et al. (2015) and the COVID-19 studies described previously, our study is based on real data, which are likely to reflect people’s behaviors in response to contagious disease outbreaks more clearly. Third, as described, because South Korea has a national health insurance system, the data used in this study cover every outpatient visit in the country and are therefore representative of the population.

Lastly, the relatively small number of MERS cases in the country means hospital visits from those infected with the disease would have been few, so there is no likelihood of bias arising from their visits. The incidence of COVID-19, on the other hand, is relatively high (about 34,000 cases in South Korea as of November 30, 2020), so hospital visits from infected persons are likely to lead to an underestimation of the effect on hospital avoidance.

The findings are as follows. People reduced their outpatient visits in response to the MERS outbreak. In June 2015, when the greatest number of cases was recorded, the number of outpatient visits to the five clinics decreased by 11.7%. We also found a 5.5% decline in July, while no significant effect was found in May, August, and afterward. The results are robust to the exclusion of the neighboring regions from the analysis, which implies that those residing in the four affected regions did not receive health care services in neighboring regions and that there is no resultant upward-bias.

The remainder of this paper is organized as follows. Section 2 provides a background on the 2015 MERS outbreak in South Korea; Section 3 describes the data; Section 4 describes the empirical strategy; Section 5 presents the results; and Section 6 concludes the paper.

2 The 2015 MERS outbreak in South Korea

MERS is a contagious respiratory disease that originated in Saudi Arabia in 2012. The disease spreads slowly, but has a high fatality rate. As of September 2019, about 2,500 cases and 850 deaths were reported in 27 countries. In South Korea, the disease was introduced by a single man who traveled to the Middle East in April–May 2015. He was diagnosed on May 20 after returning from the trip, and subsequent infections were reported in those who had come in contact with him in hospitals that he had visited before the diagnosis.

Until July 4, when the last new case occurred, a total of 186 cases were reported. Among them, 18 cases were reported in May, 164 cases in June, and 4 in July. In addition, 161 cases, or 87% of the total were reported in four regions, Gyeonggi (70), Seoul (54), Daejeon (24), and Chungnam (13), with the other 12 regions having one to five cases each. Because the first MERS patient was a resident of a city in Chungnam and had visited hospitals in the province, Gyeonggi, and Seoul before diagnosis, the cases were concentrated in those regions. The first death occurred on June 2015.
1, just 10 days after the outbreak began, followed by the second and third deaths on June 3, with the country reporting a total of 38 deaths.

The government did not announce the details of the patients until early June, such as the city where the patients resided and the hospitals they visited, although the outbreak itself was announced on the day the first patient was diagnosed.\(^5\) In addition, although some schools were closed for a few days in June,\(^6\) no mandatory mask-wearing or lockdown was implemented, possibly because most infections occurred in hospitals. The government declared a de facto end to the disease on July 28, while the official end was declared in December.

The disease had not been known to the public before the outbreak began in the country, and no vaccine and effective treatment was available. Further, while the fatality rate was reported by news media to be 40% based on data from Middle Eastern countries, three deaths were reported in less than 15 days after the first case occurred. Hence, it is very likely that people exhibited avoidance behaviors in response to the outbreak. The response is evident from the Google search volume. Fig. 2 shows that searches related to face mask and hand sanitizer in 2015 were much higher in late May and early June, or immediately after the outbreak, compared to other times that year. Indeed, Lee\(^5\) (2015) reported that face mask sales were up on May 30–31 by 709%, compared to the preceding week. Going by this intense response, it is likely that people also avoided hospital visits.

3. Data

The data on the number of outpatient visits come from the National Health Insurance Review & Assessment Service, which assesses health insurance claims made by hospitals.\(^7\) The data are at the region/year–month/department level and cover claims made during 2011–2015. For the analysis, we use the following five departments: internal medicine, pediatrics, otolaryngology, family medicine, and general practices. We aggregate the claims from these departments, resulting in 960 observations (\(= 16\) regions \(\times 5\) years \(\times 12\) months).

Over the five years, a total of 1.80 billion claims were made, and about 50% of them were from hospitals in the four affected regions, which reflects the fact that half the population resides in the area of Seoul and Gyeonggi. In addition, each year saw 0.34 (2011) to 0.37 (2014) billion claims, and each month recorded a daily average of 0.81 million (August) to 1.08 million (April) claims. Lastly, claims from internal medicine were the highest at 1.02 billion, followed by pediatrics and otolaryngology at 0.34 and 0.27 billion claims, respectively.\(^8\)

\(^5\) Although the details were not announced until early June, it is possible that people in the affected regions learned about the outbreak through informal information channels. Tai and Sun (2007) reports that there was an informal spread of information during the 2003 SARS outbreak in China.

\(^6\) The spring semester is from March to July, while the fall semester is from September to December.

\(^7\) The data can be obtained by making a request at https://opendata.hira.or.kr/home.do.

\(^8\) The numbers for family medicine and general practice were 97 million and 71 million, respectively.
Fig. 3 shows the daily average of outpatient visits to the five clinics in each month. The five clinics are internal medicine, pediatrics, family medicine, otolaryngology, and general practice. The four affected regions are Seoul, Gyeonggi, Chungnam, and Daejeon, and other regions are the other 12 regions.

The parameters of interest are betas, and they indicate the effect of MERS on the number of outpatient visits in a percentage form. An estimate of, say, $-0.10$ means that the disease reduces the number by 10%. We expect the largest effect in June, because, as shown in Fig. 1, the maximum number of cases was reported during that month, with almost every day recording new cases. In addition, although the outbreak was announced on the day the first patient was diagnosed, the details of the patients, such as their place of residence and the hospitals they visited, were not announced until early June.

The estimates for betas indicate changes in outpatient visits due to improved health as a result of disease avoidance behavior such as mask-wearing and hand hygiene, in addition to hospital avoidance during sickness to prevent MERS infection. Because mask-wearing and hand hygiene could be attributed to the intention to protect their health and thus avoid a hospital visit to prevent MERS infection, we consider reduced outpatient visits due to health protection behavior to be an indirect form of hospital avoidance. It is noteworthy that a decline in outpatient visits due to this behavior is likely to be relatively small, because the number of people suffering from ailments like the common cold which are preventable by mask-wearing and hand hygiene is the least in June, July, and August. Further, although increased hygiene can improve health (e.g., Agüero and Beleche, 2017), any health improvement that is substantial enough to deter hospital visits is not very likely in a sanitized country like South Korea.

The estimates could be biased in the following ways. First, we use the remaining 12 regions as a control group. Considering that these regions also had MERS patients albeit a small number of them (one to five each), their residents are also likely to have avoided hospital visits, which is a factor for underestimation. However, based on Fig. 3 which shows a slowed decrease in the number of outpatient visits in June 2015 for these regions, bias from this factor is not likely to be large. Second, because no city- or province-level lockdown was imposed during the outbreak, people living in the four affected regions possibly visited neighboring regions for health care services, increasing the number of outpatient visits in those regions, which is a factor for overestimation. This behavior is comparable to out-migration from those in regions where a natural disaster such as a hurricane occurs (Currie and Rossin-Slater, 2013). For a robustness check, we exclude four neighboring regions, namely, Incheon, Gangwon, Chungbuk, and Jeonbuk, from the analysis to check for possible bias.

12 In 2014, each of the three months recorded about 50% of outpatient visits for a cold compared to February, which recorded the most such visits at 7.5 million. The cold data can be downloaded from https://opendata.hira.or.kr/home.do.
13 Agüero and Beleche (2017) found that increased handwashing following the H1N1 pandemic of 2009 reduced the rate of Mexican children with acute diarrhea, which affects 11% of children under five. While, according to World Bank, at least 85.8% of Mexicans used basic sanitation services in 2011, the rate for South Korea was 100% in that year and afterward. The related data can be downloaded from the following World Bank site: https://databank.worldbank.org/reports.aspx?source=311&series=SH.STA.BASS.ZS.
Third, although the outbreak ended in a short time, it possibly affected the economic condition of the affected regions, which could have had an impact on the residents’ income and consequently, the demand for health care services. One possible scenario is that an increase in job losses due to the disease outbreak and the following economic downturn led to reduced income and reduced demand for health care services, which is a factor for overestimation. Another scenario is that job losses improved health, possibly due to reduced smoking or obesity (Ruhm, 2000), leading to reduced health care demand. For a robustness check, we control for the regional unemployment rate in the analysis to check for possible bias. Lastly, some hospitals that treated MERS patients (before diagnosis) were forced to close down to prevent nosocomial infection, which is a factor for overestimation, but the bias from this factor is not likely to be large considering that people were not likely to visit such hospitals even if they were not closed.

5. Results

Fig. 4 shows that MERS significantly reduced the number of outpatient visits to the five clinics in the first and second month after the outbreak (June and July of 2015) by 11.7% and 5.5% (17.2% in total), respectively. However, we found no effect for May, possibly because the first case was reported on the 20th of that month and no patient details were provided at the time. In addition, there was no evidence of a rebound in August and afterward, which implies that hospital avoidance during the outbreak did not cause any severe health problems.\(^\text{14}\)

The effect size of 17.2% is smaller than the estimate in Bennett et al. (2015), who found that SARS reduced outpatient visits in Taiwan by 30% during the four months of March–June 2003. The difference is possibly due to the shorter duration of MERS. The effect size in our study is also smaller than the findings of 40% to 67% in the COVID-19 studies presented in the Introduction section, possibly because those studies examined the situation under lockdown. Moreover, in the case of the U.S., lost jobs during the pandemic likely led to lost health insurance and consequently reduced hospital visits.\(^\text{15}\)

We conduct three robustness checks. First, we exclude one region at a time to examine whether a particular region drives the finding of Fig. 4. In Table 1, column (1) excludes Gyeonggi, column (2) excludes Seoul, and so on. Although excluding Daejeon reduces the estimate size the most, and excluding Chungnam increases the size, the results for the first and second month after the outbreak are robust. The estimates are \(-0.143\) to \(-0.094\) for the first month after the outbreak, and the estimates are \(-0.075\) to \(-0.045\) for the second month after the outbreak. For the second robustness check, we exclude the four neighboring regions from the analysis to check whether those residing in the four affected regions used medical services in these neighboring regions, which could lead to an overestimation. As shown in Fig. 5, the estimates for the first and second month after the outbreak are not that different from the estimates shown in Fig. 4. They are \(-0.129\) and \(-0.060\), which are significant at the 1% level.

As the final robustness check, we estimated the effect by controlling for the regional unemployment rates,\(^\text{16}\) because MERS possibly had an impact on the economic condition of the affected regions. As shown in Fig. A.2, on the 2015 unemployment rates, the rate increased in June, especially in Seoul and Gyeonggi. However, we found that the estimation results did not change. That is, when controlling for the rates, the estimated effects for the two months are 11.6% and 5.4%. This result implies that MERS worsened the economic condition of the affected regions, but this outcome did not affect demand for health care services.

6. Conclusion

Existing literature shows that people tend to exhibit disease avoidance behaviors when there is a contagious disease outbreak. Hospital avoidance is one of these behaviors, which has not been

\(^{14}\) We also estimated the effect using all other types of clinics including orthopedics and ophthalmology, and found significant effects only in June and July. However, as expected, the effects were smaller: 7.5% and 1.6%, respectively, which implies that patients in need of treatments from other departments also avoided hospitals. The result of this analysis is available upon request.

\(^{15}\) The U.S. unemployment rate soared to 14.7% in April 2020 from 4.4% in March of the same year (the rate for April 2019 was 3.6%). The data can be downloaded from https://www.bls.gov/charts/employment-situation/civilian-unemployment-rate.htm.

\(^{16}\) The unemployment data are from the National Statistical Office’s website at https://kosis.kr/statHtml/statHtml.do?orgId=101&tblId=DT_1DA7104S&conn_path=dl.
Table 1
The effect of MERS on log number of outpatient visits to the five clinics excluding one region at a time.

| Dependent variable = Log number of outpatient visits | Gyeonggi (1) | Seoul (2) | Daejeon (3) | Chungnam (4) |
|------------------------------------------------------|-------------|-----------|-------------|-------------|
| Exclusion of                                        |             |           |             |             |
| First month after the outbreak                      | -0.117***   | -0.115*** | -0.094***   | -0.143***   |
| (0.037)                                              | (0.037)     | (0.024)   | (0.022)     |             |
| Second month after the outbreak                     | -0.051**    | -0.051**  | -0.045**    | -0.075***   |
| (0.023)                                              | (0.024)     | (0.021)   | (0.010)     |             |
| Adjusted R$^2$                                       | 0.998       | 0.998     | 0.999       | 0.999       |
| Number of observations                               | 900         | 900       | 900         | 900         |

Standard errors are in parentheses. They are calculated by clustering within a region/year. First (second) month after the outbreak means June (July) 2015. The five clinics are internal medicine, pediatrics, family medicine, otolaryngology, and general practice. Column (1) excludes Gyeonggi from the analysis, and so on. Other independent variables are the same as the analysis in Fig. 4.

***Significant at the 1% level.
**Significant at the 5% level.

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analyzed much in previous studies. We examined this behavior during the 2015 MERS outbreak in South Korea, which resulted in 186 cases and 38 deaths. We found that the MERS outbreak reduced the number of outpatient visits in the first two months after the outbreak by 17.2%.

Although hospital avoidance could worsen health, we did not find any evidence that outpatient visits rebounded after the outbreak ended (Fig. 4), which implies that the avoidance did not cause severe health conditions. The absence of such evidence is possibly due to the short duration of the outbreak, which lasted from late May to early July. Considering that other infectious diseases like COVID-19 can last longer than MERS, a policy intervention is necessary to encourage people to visit hospitals for treatment without any fear of infection. Promoting remote health care services, which are currently not available in the country, could be an option. Future research should discuss other options in addition to remote health care services.

**Declaration of competing interest**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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**Appendix**

See Figs. A.1 and A.2.

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