What Caused Dire Clusters ? ~Analysis of Nosocomial COVID-19 Outbreaks in Kyoto City, Japan From the 1st Wave Through 3rd Wave in 2020/21

Miki Nagao (mnagao@kuhp.kyoto-u.ac.jp)
Kyoto University: Kyoto Daigaku

Takeshi Ikeda
Kyoto City Center

Yasufumi Matsumura
Kyoto University: Kyoto Daigaku

Masaki Yamamoto
Kyoto university

Taro Noguchi
Kyoto university

Satomi Yukawa
Kyoto university

Research Article

Keywords: Nosocomial transmission, COVID-19 infection, index case, attack rate

Posted Date: May 26th, 2021

DOI: https://doi.org/10.21203/rs.3.rs-531546/v1

Abstract

Fifteen COVID-19 nosocomial clusters occurred in the first year of the pandemic in Kyoto City, involving 232 in-hospital patients and 157 healthcare workers (HCWs). Among them, 40 percent of index cases were HCWs. The in-hospital mortality rate among patients was 18.1%, whereas the mortality rate in the Kyoto City area during the study period was 1.79%. The time needed to contain outbreaks was shorter in hospitals with full-time infection control personnel assigned.

Background

Since the initial outbreak, Coronavirus disease 2019 (COVID-19) has spread worldwide, claiming > 3,000,000 lives (https://covid19.who.int/. Accessed May 11, 2021). In addition to its global impact, COVID-19 has alerted the healthcare community to the dangers of nosocomial infection. Nosocomial outbreaks are problematic because of the poor associated prognosis in the presence of underlying diseases in patients and crippling of the entire healthcare system due to the discontinuation of services by medical institutions. To date, nosocomial infection by COVID-19 has been discovered and reported in numerous healthcare facilities on a global scale; however, concise analysis of nosocomial clusters is limited. [1–3] In this study, we clarified the characteristics and impact of nosocomial clusters that occurred in Kyoto City in the first year of the pandemic in order to examine preventive measures.

Results

Kyoto City is the capital of Kyoto Prefecture, with 1.4 million inhabitants, and more than 70% of COVID-19 cases in Kyoto Prefecture are from Kyoto City. We analyzed nosocomial clusters that included 5 or more COVID-19 cases of hospitalized patients and healthcare workers (HCWs) in Kyoto City from March 2020 to February 2021. There were three epidemic waves of COVID-19 infections from March 2020 to February 2021 in Japan, among which the 3rd wave led to the highest number of patients. [4] There were 15 clusters in 14 hospitals, which included a total of 459 COVID-19 cases: 145 HCWs, and 282 hospitalized patients. COVID-19 patients discharged from the cluster hospitals caused secondary clusters in subsequent facilities. There were 32 secondarily infected cases outside of the hospital who became infected via transmission from the primary COVID-19 cases. (Table)

Suspected index cases of clusters were HCWs in 6 (40%) of the 15 clusters. In all 6 cases, a symptomatic staff member continued to work, which may have led to the spread of the infection. Of the 9 cases in which patients were considered to be the index cases, 4 cases were transferred from other facilities, and 2 cases were suspected to have been infected by family members visiting the hospitals. As many as 61.9% of HCWs and 65.3% of patients with COVID-19 developed symptoms during the course of clusters. The in-hospital mortality rate among patients was 18.1%, and the mean time to death was 11.4 days. The mortality rate in the Kyoto City area during the study period was 1.79%.

The total number of contact tracing PCR tests for 14 clusters was 10,104, with 721 tests per hospital and 22.0 tests per COVID-19 case on average. The average times taken from detection of the first COVID-19 case in the hospital to expanded testing for contact tracing were 7.3 days in the 1st and 2nd waves, and 2.9 days

in the 3rd wave, indicating that expanded testing was done in a shorter period of time in the 3rd wave. The average time taken for cluster containment was 33 days. Regarding the impact on the health care delivery system, all hospitals where clusters occurred restricted hospitalization, and outpatient clinics were closed in 8 of the 15 cases. In addition, 22 cases were secondarily infected by family members or friends after being discharged from the cluster facility, and infection via 2 patients transferred to other hospitals subsequently led to a new cluster of 31 people. Five of the 14 facilities had full-time infection control personnel (ICP). Although attack rates, time to expanded testing, and in-hospital mortality of COVID-19 patients did not differ by the status of ICP assignment, the average time to contain clusters was significantly shorter in facilities with full-time ICP. (Table, Figure)

Discussions

This is the first report of the concise analysis of nosocomial clusters in Japan. As indicated in this report, nosocomial clustering has devastating consequences in terms of the prognosis of patients and crippling of the healthcare system both for COVID-19 and non-COVID-19 patients.

When a COVID-19 cluster occurs, close contacts are identified, isolated, and tested and infection control measures are strengthened while waiting for the cluster to end. Previous reports focused on the transmission risk and prognosis of COVID-19 patients, and did not examine the details of index cases that contribute to countermeasures against the introduction of COVID-19 to hospitals. In this study, a number of cases were due to transmission via health care workers. The risk of infection among medical personnel is considered to be higher than that among the general public, and the appropriate use of protective equipment is required. [5] On the other hand, as HCWs live in the community (not quarantined), they are at risk of becoming infected depending on the infection status in the community. As such, HCWs need to behave as if they are asymptomatic carriers of COVID-19 and adopt measures to prevent themselves from spreading the infection.

Testing is one of the key strategies to tackle with COVID-19. A low threshold for testing facilitates the prompt identification of cases that can be managed by isolation or quarantine, as it has been demonstrated that there are high proportions of asymptomatic and, more importantly, pre-symptomatic individuals. In Japan, it was reported that the PCR testing system was lagging behind those of other countries (accessed as of 11 May 2021 https://ourworldindata.org/coronavirus-testing#how-many-tests-are-performed-each-day), but, in the 3rd wave, the time between index case identification and expanded testing was improved compared with the 1st and 2nd waves. In addition, in Kyoto City, the time needed to contain clusters was shorter in facilities with full-time IPCs. Furthermore, facilities with full-time IPCs tended to have lower staff attack rates. (Table) The establishment of a solid chain of command by full-time IPCs and hospital executives may be necessary to contain the situation.

Since huge amounts of medical resources such as personnel involved in contact tracing and PCR testing are required to contain clusters, it is important to adopt measures to prevent introducing the disease to a hospital population. The PCR screening test at the time of admission is not a panacea, and some cases are inevitably missed. As Abbas et al. stated, it may be suitable to perform broad-scale screening of both

patients and HCWs, including asymptomatic individuals, in the event that COVID-19 cases are identified on “non-COVID” wards to help identify a potential outbreak situation, and to be able to control it. [3]

Conclusions

According to our analysis, it is extremely important to expand testing to identify index cases and impose standard infection prevention measures, as well as implement sick-leave policies. Those countermeasures are “classic” and simple, and may be implemented much easier if a chain of command is established. We believe that nosocomial transmission can be controlled to some extent by analyzing and sharing the experience of nosocomial clusters indicated in this report in order to fill any gaps in knowledge.

Declarations

Availability of data and materials

The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Acknowledgments

We thank members of Kyoto City Health Center for providing COVID-19 public health responses and all the local infection preventionists in Kyoto City for their proactive efforts to contain clusters.

Funding

This work was supported by the COVID-19 Private Fund (to the Shinya Yamanaka Laboratory, CiRA, Kyoto University).

Contributions

MN, YM and MY designed the research and drafted the initial manuscript.TN, SY and TI helped the epidemiological analysis. All authors read, critically revised and approved the final manuscript.

Ethics declarations

Ethics approval and consent to participate

Need for approval for this study was waived by the Ethics Committee of Kyoto University Graduate School of Medicine (R2379).

Consent for publication

Not applicable.

Competing interests

None to declare.

Disclaimers

Not applicable

References

1. Barrett ES, Horton DB, Roy J, Xia W, Greenberg P, Andrews T et al. Risk Factors for Severe Acute Respiratory Syndrome Coronavirus 2 Infection in Hospital Workers: Results From a Screening Study in New Jersey, United States in Spring 2020. Open Forum Infect Dis. 2020 Oct 31;7(12):ofaa534.
2. Duy C, Nong VM, Van Ngo A, Doan TT, Nguyen TQ, Truong PT, Olson L, Larsson M. Nosocomial Coronavirus Disease Outbreak Containment, Hanoi, Vietnam, March-April 2020. Emerg Infect Dis. 2021 Jan;27(1):10–7.
3. Abbas M, Robalo Nunes T, Martischang R, Zingg W, Iten A, Pittet D, Harbarth S. Nosocomial transmission and outbreaks of coronavirus disease 2019: the need to protect both patients and healthcare workers. Antimicrob Resist Infect Control. 2021 Jan 6;10(1):7.
4. Karako K, Song P, Chen Y, Tang W, Kokudo N. Overview of the characteristics of and responses to the three waves of COVID-19 in Japan during 2020-2021. Biosci Trends. 2021 Mar 15;15(1):1-8.
5. Nguyen LH, Drew DA, Graham MS, Joshi AD, Guo CG, Ma W et al. Risk of COVID-19 among front-line health-care workers and the general community: a prospective cohort study. Lancet Public Health. 2020 Sep;5(9):e475-e483.

Table

Table

Overview of nosocomial clusters in Kyoto City from March 2020 to February 2021.

	Total	The 1st /2nd waves	The 3rd wave	P-value	With FT** infection preventionists	Without FT** infection preventionists	P-value
Number of nosocomial clusters	15	6	9		5	10	
Total number of beds involved in nosocomial clusters	889	264	625		217	672	
COVID-19 cases by demographics							
Number of COVID-19-infected healthcare workers (HCWs)	145	38	107		34	111	
Attack rate of HCWs	6.0%	4.9%	10.1%	0.26	1.8 %	9.9%	0.09
Number of COVID-19 patients	232	93	189		57	225	
Attack rate of patients	19.0%	14.2%	29.9%	0.19	7.4%	28.8%	0.11
Number of COVID-19 cases outside hospital*	49	41	8				
Total	459	172	304		91	336	
Number of cases with HCW as index case	6 (40.0%)	2 (33.3%)	4 (44.4%)	1.0	1 (20.0%)	5 (50.0%)	0.58
Number of cases with ** infection preventionist(s) present	5 (33.3%)	3 (50.0%)	2 (22.2%)	0.32			

* patients' family, patients' friends

** FT: full-time

	Total	The 1st /2nd waves	The 3rd wave	P-value	With FT** infection preventionists	Without FT** infection preventionists	P-value
Days from index case identification to first PCR testing for contact tracing (days, average, range)	4.7 (1–18)	7.3 (1–18)	2.9 (1–7)	0.09	2.8 (1–7)	5.6 (1–18)	0.33
In-hospital mortality (patients only)	18.1%	12.9%	15.8%	0.76	12.3%	15.5%	0.53
Days to contain clusters (days, average)	33.0(16–69)	29.5 (16–40)	35.2(22–69)	0.46	21.6 (16–25)	38.8 (23–69)	0.012
* patients' family, patients' friends							
** FT: full-time							

Figures

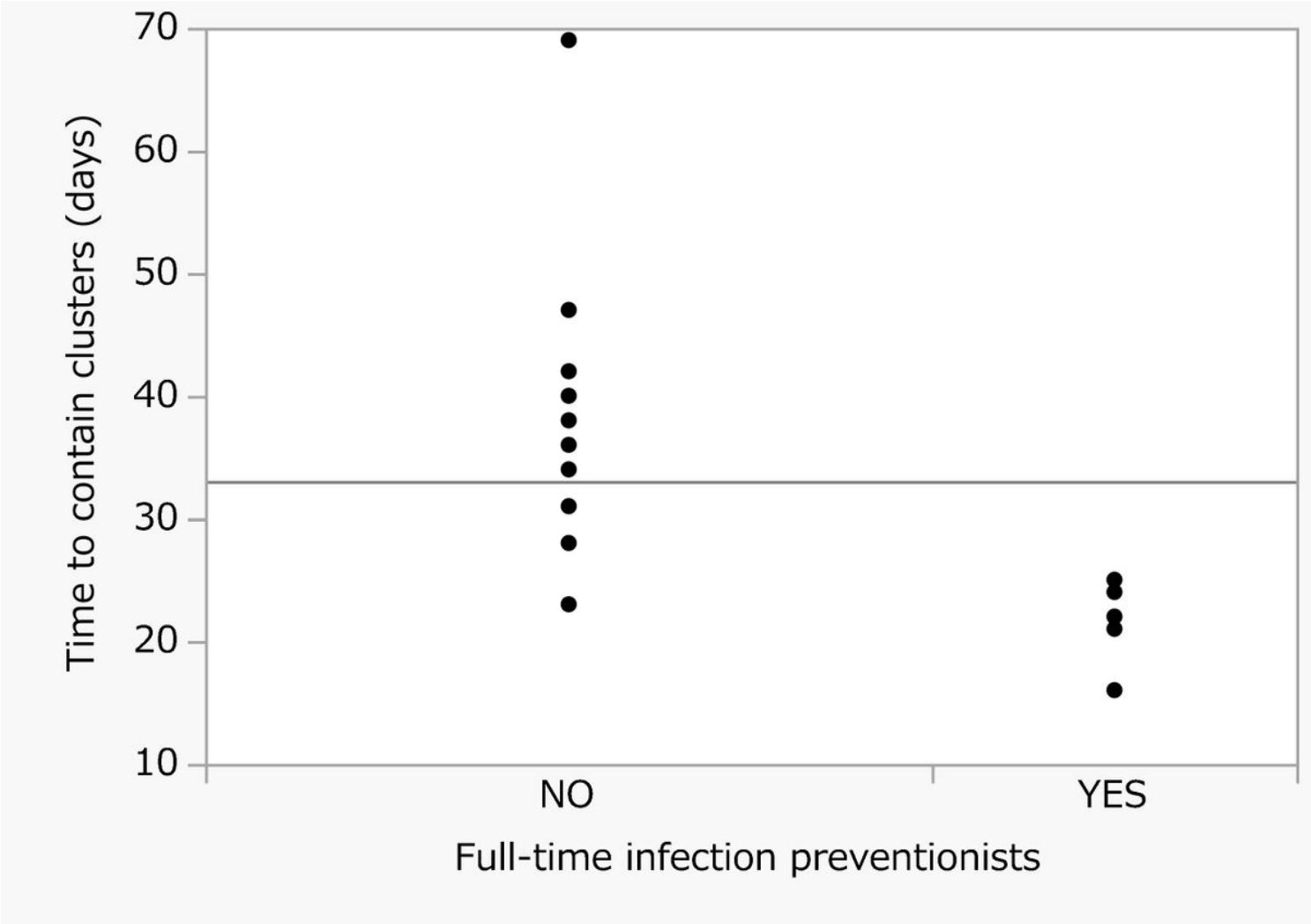

Figure 1

Time to contain nosocomial clusters by the presence of full-time infection preventionists. The average time to contain clusters was significantly shorter in facilities with full-time ICP indicating every-day intervention is needed to contain clusters as quick as possible.