Research Article

Effectiveness of a Precise Control Strategy against the COVID-19 Omicron BA.5 Variant in Macao

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Abstract

Background: More than two years into the global, coronavirus disease (COVID-19) constantly changes through mutation. Omicron BA.4 and BA.5 lineages are new, dominating lineages that will develop in the near future. Macao, a Special Administrative Region (SAR) of China, is the first region to have a BA.5 wave without a previous, COVID-19 outbreak. Since the emergence of Omicron BA.5 into the community, the Macao SAR government implemented the precise control strategy and controlled the outbreak within 6 weeks. The aim of this article was to introduce a new control strategy against COVID-19 Omicron BA.5 in Macao and showed its effectiveness. **Methods:** We analyzed the data, during 18 Jun to 2 Aug 2022, and summarized our experience in implementing a precise control strategy for the Omicron BA.5 outbreak. **Results:** This wave lasted for 6 weeks. In total, 1821 cases were diagnosed, of which 1177 (64.6%) cases were detected because of contact tracing; 784 (43.0%) cases were detected from a restricted period; and 664 (36.5%) cases were related to the target population from 8 different occupations. Comparing with community, the proportion of case finding increased progressively in the restricted period with time. **Conclusion:** Our policy successfully contained the COVID-19 Omicron BA.5 outbreak. Our experience could provide a reference for the control strategy against COVID-19 Omicron BA.5 in other regions.

Background

COVID-19 infections have been reported for over two and half years. The World Health Organization (WHO) identified the Omicron variant as the fifth variant of concern of COVID-19 on 26 November 2021. The evolution of the COVID-19 Omicron lineage continues, and the BA.4 and BA.5 lineages are new, dominating lineages of Omicron variants in the near future. It was first detected in January and February 2022 in South Africa [1]. Since then, the Omicron BA.4 and BA.5 had been detected in multiple countries. Macao was no exception; the first case of the BA.5 lineage emerged on 18 June 2022 and then spread across the community. One article review [2] concluded that the Omicron variant causes mild, clinical symptoms but is more infectious than earlier variants. The spread of Omicron was important implications, might require urgent public health interventions to limit transmission, and reduced morbidity [3], especially in crowded region. Approximately 86.6% of the population in Macao completed at least two doses of COVID-19 vaccination [4], but immune escape of the Omicron variant resulted in reduced efficacy of existing vaccines and an increased risk of reinfection [5] coupled with treatment and detection failures [6]. However, Macao is a densely populated region in the world with mass population mobility and an aging population. Information from the Statistics and Census Service of Macao [7] at the end of December 2021 indicated population density of 20,703 persons per square kilometer. The total population was 683,200, including 16.5% of the nonresident population and approximately 5% of the population who worked or studied in Macao but lived in neighboring cities. The four previous (Alpha, Beta, Delta, and Omicron BA1 and 2) COVID-19 pandemic did not occur in Macao, and the population could not attain natural immunity against COVID-19. For the protection of the health care system and public health, a precise control strategy was one of the effective policies against the COVID-19 Omicron BA.5 variant in Macao.

The aim of this article was to provide a reference for a control strategy against COVID-19 Omicron BA.5 in Macao and showed its effectiveness.

Methods

Precise control strategy

A precise control strategy was a region-specific and multilevel approach to outbreak prevention and control that was a science-based, targeted measure. These approaches were based on the risk identification and outbreak situations of different areas or target groups. For example, if someone was identified as COVID-19 case, case-related locations and contacts would be restricted and traced. A higher risk level had more restricted response measures. The aim was to control the outbreak and decrease the effect on the population if possible.

Risk identification

Based on transmission risk, the population was separated into 3 groups using health QR codes presented in green, yellow, and red. The results provided a reference for differentiated, response measures. The green code meant "entry permitted," which indicated that the individual had not been in contact with any COVID-19 case; the yellow code stood for "self-health management," which indicated casual contact or declaration of having fever, acute cough, or shortness of breath; and the red code suggests "entry denied," which indicated that the individual had contacted with a COVID-19 case, including confirmed cases, suspected cases, or close contact or travel-related situations. Individuals with red codes must be isolated or quarantined.

We also used buildings as region-specific units and identified the units in the red and yellow zones. The red code zone was restricted, and the high-risk area in which the health codes of the population in this area were red. The yellow code zone was a precautionary zone, and the control measure of the yellow health code was implemented.

Definition

- **Case finding from restricted periods:** cases were found in red code zones and socially isolated or -quarantined facilities.

- **Community case:** any cases were detected from community, including close contact, citywide and target population screening, and others.

- **Case finding through contact tracing:** cases were detected from a socially isolated or -quarantined facilities, red code zones, and close contact.

- **Target population:** individual or group had more opportunities to suffer COVID-19 infection based on epidemiological evidence. There were eight occupations were successively identified as target populations during this period including security staff, cleaner staff, delivery staff, drivers of public transport, property managers, catering staff, site workers, and domestic helpers who live in dormitories.

The strategy and working stage in the 6 weeks of the outbreak

Since the first case was detected, the government started a precise control strategy according to the "Contingency plan for large-scale COVID-19 epidemic". It has five phases and includes the following, specific components: (1) implement community control measures; (2) conduct epidemiological investigation, screening, and testing; (3) prepare sufficient quarantine and treatment facilities; (4) provide transportation and livelihood support; and (5) mass communication with the residents.

The Work could be Separated into Four Stages

- **Stage 1 (first and second weeks):** This was the beginning of the outbreak. The first case emerged on 18 June 2022, state of immediate prevention was declared at 01:00 on 19 June 2022. Since then, the key measures included 3 rounds of citywide, Nucleic Acid Testing (NAT) and COVID-19 Rapid Antigen Testing (RAT), intense NAT for target populations and individuals in target areas, and the free supply of KN95 facial masks. The government had also tightened social-distancing measures to reduce public traffic, social functions, and crowd gatherings to the greatest extent, such as restaurant only provided take-out service, the suspension of educational activities in higher-education institutions and non-tertiary education schools, the limitation of public transportation and service, and the closure of some places with high-risk transmission. The aim was to avoid a rapid surge in the cases of COVID-19.

- **Stage 2 (third week):** We started the intense, citywide NATs and RATs. During the stage, the whole populace completed a NAT every two days as well as a RAT daily. At the same time, we tightened social distancing to a more stringent level. A mobile specimen collection group was established for individuals who were highly suspected to suffer COVID-19 and had to NAT. The aim of this stage was generally to decrease the number of cases in the community and most of hidden case were restricted.

- **Stage 3 (fourth and fifth weeks):** Cases in the community decreased, and the next target was to achieve zero new cases in the community. We continued the intensive, citywide NATs and RATs. To greatly reduce the movement of people in the community, nonessential business was suspended, including gambling industry that is economic pillar of Macao, and 12 days of a "relatively static" management was announced.

- **Stage 4 (after fifth week):** It was a "Consolidation" and

"Stable" period. While cases in the community reached zero, we could restore the economic and social order generally. However, we had to keep partial control measures, such as NAT and RAT, for some target populations. While there were not new case in community for 10 days, state of immediate prevention was terminated on 2 August 2022.

Statistical analysis

Data was collected from government medical system during 18 Jun to 2 August 2022. Descriptive statistics were used for the analysis of collected data including gender, age, nationality, symptom, COVID-19 vaccination and case of death. The $\chi2$ test was used to compare independent categorical variables between groups. A P value of <0.05 was considered statistically significant. We analyzed the new case findings from different sources from two aspects. One was comparing the case between a restricted period and the community. The second was analyzing whether the case was found via contact tracing or target population.

Results

The timeline and key measures were in Figure 1. This wave lasted 6 weeks and resulted in zero new positives in the community within 5 weeks. Of the 1821 COVID-19 cases, 6 (0.33%) were dead with an overall incidence of 2.5 per 1000 population in this wave of the COVID-19 Omicron BA.5 outbreak. The median age was 39 years (ranging from 2 months to 100 years), 937 (51.5%) were female, and 1107 (60.8%) were Macao resident. Non-Macao resident (0.63%) was more likely suffered from COVID-19 then Macao resident (0.19%), P-value was <0.05. In all cases, 705 (38.7%) and 1116 (61.3%) were symptomatic and asymptomatic, respectively. The individual, who had received at least two dose vaccinations, among COVID-19 cases (77.7%) was significantly lower than general population (86.6%), P-value was <0.05.
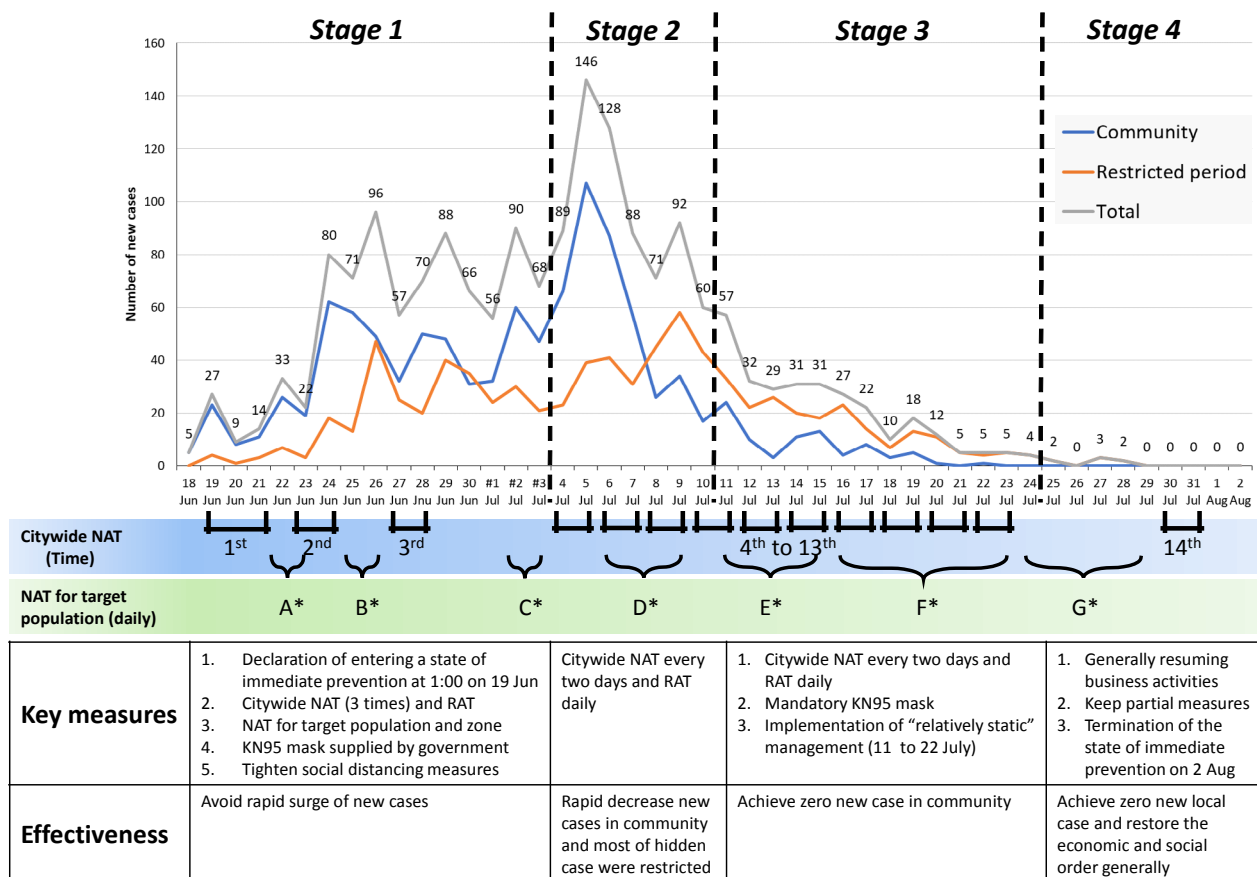
Figure 1: The timeline and key measures about COVID-19 Omicron BA.5 outbreak in Macao.

In the analysis of cases between the restricted period and the community, 783(43.0%) were detected from the restricted period, and 1038 (57.0%) were detected from the community. The proportion of case finding increased progressively in the restricted period with time (Figure 2). In the community, close contact as well as citywide NATs and RATs were observed in 394 cases (21.6%), 283 cases (15.5%), and 239 cases (13.1%), respectively (Figure 3). In total, 1177 (64.6%) cases were detected from individuals via contact tracing. In addition, 664 (36.5%) cases were related to the target population from 8 different occupations (Figure 3).
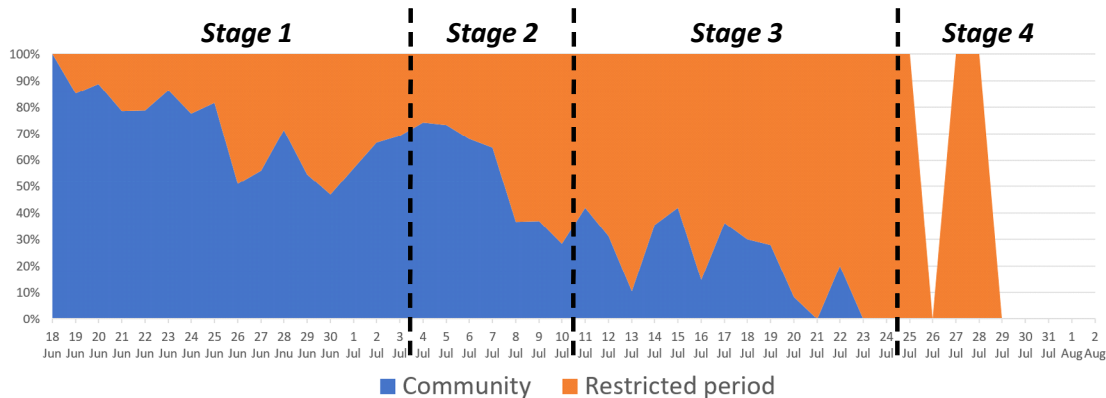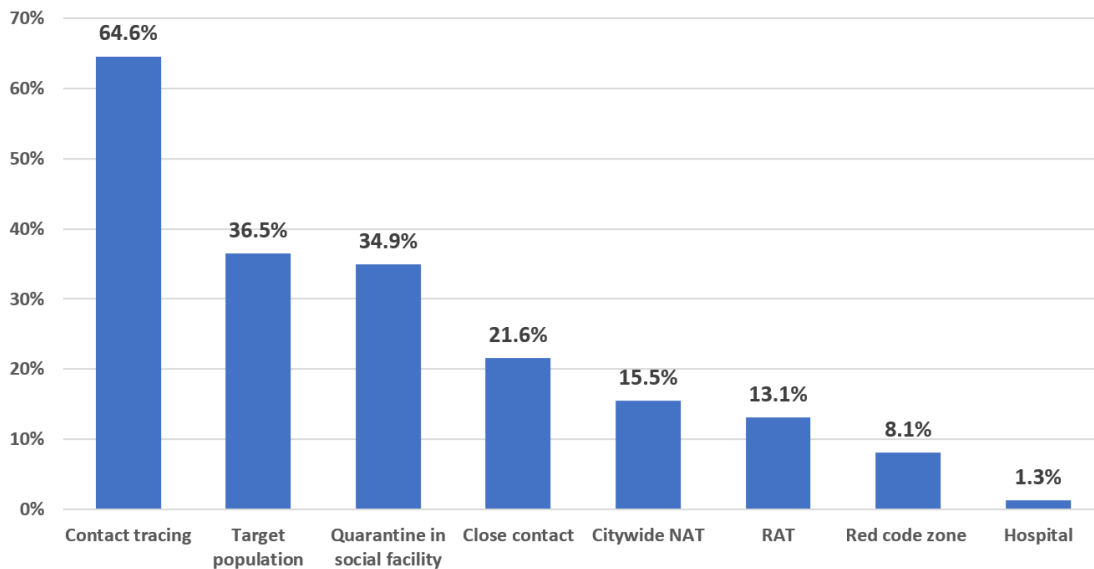

Figure 2: Proportion of case finding between community and restricted period during this outbreak.

Note: Single case may be overlapped in different sources

Figure 3: The case finding from different sources.

Discussion

Almost immediately after the emergence of the COVID-19 Omicron BA.5 variant in Macao on 18 June 2022, the government implemented a precise control strategy. With the increasing number of community transmissions, our strategy successfully contained the outbreak and achieved zero new cases in the community within 5 weeks. In this strategy, we advocated for the multiple-level, early identification and quarantine or isolation of all suspected and confirmed cases. Although our strategy rested on mass testing, intense surveillance, isolation, and quarantine, it balanced public health, individual rights, and society to the greatest extent. With the European countries, that allowed less stringent interventions, waved of Omicron BA.4 and BA.5 as an example, it resulted in a rise in hospitalizations, ICU admissions, and deaths compared with previous waves [8].

To cut off the source of infection thoroughly, China initiated the employment of cabin hospitals and obtained successful experience that played a crucial role in the prevention and treatment of COVID-19 cases and quickly solved the problem of insufficient beds in existing hospitals [9]. Other alternative measures, such as the use of hotels [10] or home isolation, have also been provided for cases with mild cases in some regions. During the outbreak, in Macao, hotels, community health facilities, and public health clinical centers prepared for the isolation of cases who had low, medium, and high medical requirements, respectively. It could additionally provide over 5000 beds in total and was enough for this outbreak.

Our data supported that COVID-19 vaccines could offer protection to people. The COVID-19 mortality rate in Macao during this period was among the lowest reported worldwide since the COVID-19 pandemic began [11].Six deaths were caused by this wave in individuals who were between 88 and 100 years old with comorbidities. However, the closed-loop management of nursing rooms had also played an important role in the identification and management of elderly individuals. In the following, we discussed our key work and experience in controlling COVID-19 Omicron BA.5 of Macao based on the stage of the strategy.

Strategy on the Early (First) Stage

There is no doubt that more restricted strategies will lead to greater, potential economic impacts and affect the daily life of the population. However, the right time for the implementation of intervention strategies can result in the highest efficiency and lowest negative impact on society. Based on our data, although the number of cases generally increased initially, we could successfully keep the number of new cases at a stable level and prevent the rapid surge of cases. In the process of time, there were more case findings in the restricted period than in the community. However, this model of the incidence curve and flattened curve meant slowing the spread of the transmission so that the peak number of cases was reduced, and the health care system did not exceed its capacity [12].

Tightening social-distancing measures, contact tracing, citywide screening, intense testing of the target population, and community mobilization were key objectives in this stage. As resources for mass testing were highly unlikely to be available for immediate utilization, contact tracing [13] and identification of the target population were considered the first and most effective steps toward detecting hidden cases. Our data also supported that approximately two-third of cases were detected via contact tracing. This showed the key role of epidemiological surveillance in this strategy.

Although the high-risk population was being monitored through tracing, it cannot detect asymptomatic cases in the community. We utilized the citywide NATs and RATs to detect asymptomatic cases. We established 63 NAT stations and 3 mobile, specimen collection groups. Then, each population could walk to nearby stations and prevent cross-regional activities. In this wave, the Macao SAR government freely provided RAT kits for the entire population. RAT permitted new cases to isolate immediately and decreased their mobility in large-scale screening. High-frequency testing offered the potential to break chains of transmission and acted as an extra layer of protection in a comprehensive, public health response [14].

Strategy on the Middle (Second and Third) Stage

Measures in the early stage, which were effective in slowing transmission, were ineffective in completely eliminating the disease. However, because of the incubation period and increased transmissibility of Omicron, intense NATs and RATs were key measures to detect asymptomatic cases in the community. There were successful experiences from other cities [15]. After human resources were supported by China, 10 NATs were carried out continuously during this stage. RAT was also performed daily as well. With a combination of other measures, asymptomatic cases in the community were detected thoroughly. Compared with other cities during the COVID-19 pandemic, they experienced a plateau phase followed by a decline stage [16] that matched the evolution of the pandemic. We did not observe an obvious, plateau phase, and the incidence rapidly decreased from the peak and then reached zero in the community within 3 weeks. It was no doubt that the shorter the duration of outbreak, the lower the impact. Our strategy could decrease the negative impact to the greatest extent.

One study [17] showed that early transmission of COVID-19 was highly related to some occupations that might be related to poorer living and working conditions. This result was similar to our statistics. The 8 target occupations, were grassroots occupation, accounted for approximately one-third of all cases. And then, nearly 40% of case was non-Macao resident who usually worked as grassroots worker.

There were data from the early stage in the development of COVID-19 globally; if 100% of cases could have stayed at home after symptomatic onset, the infection risk would had been reduced by 60% compared with the condition of free movement [18] . To further reduce the movement of people in the community, the Macao SAR government announced 12 days of a "relatively static" management when the number of new cases dropped down from the peak. During this duration, most nonessential businesses and venues were suspended while activities deemed essential to the community and to the day-to-day lives of the members of the public continued under normal operation. Compared with other cities in China that implemented the "Dynamic zero" policy for Omicron, Shenzhen and Shanghai were successful and have implemented a complete lockdown of the city [19]. However, the zero COVID strategy broke down, and the hospital system became

overwhelmed in Hong Kong [20]. Macao could find a suitable policy for a small and crowd city. However, we could avoid a complete lockdown of the city or overwhelming the health system.

Strategy on the Late (Fourth) Stage

While there were zero cases in the community, the next stage was the "consolidation" and "stable" periods. The government began to relax social distancing and other measures in a gradual and orderly manner. Although we did not know the source of this wave until now, the threat was over temporarily. Until ten days of zero cases in the community, government department and most business activities recovered. To prevent the relapse of outbreak, we had to keep the suitable NATs and RATs for the target population temporarily.

Finally, we understand that there is no policy without impact, our strategy is as well. In addition to controlling the outbreak, there had also been psychosocial, economic, and political impacts. Our strategy was inevitable because some populations had suffered inconveniences in their daily lives. Social isolation or quarantine led to chronic loneliness and other psychological consequences. One article [21] agreed that with the timelines of the growing pandemic being uncertain, the isolation was compounded by mass panic and anxiety. Facing these challenges, we controlled this wave as quickly as possible; at the same time, psychologic support and multi-departmental cooperation had made great contributions to the care of these populations.

Conclusion

Outbreak-prevention policies should be designed based on the character of the region. Balancing the burdens current medical systems face and guaranteeing the populational needs were key to successfully containing COVID-19. We could find a suitable policy for Macao and our experience could provide a reference for the control strategy against COVID-19 Omicron BA.5 in other regions.

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