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Crisis response of nursing homes during COVID-19: Evidence from China

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ABSTRACT

COVID-19 has become a worldwide socio-economic crisis, and almost all organizations need urgent response to stem its impacts. Based on a web-based survey of the nursing homes (NHs)’ administrators in China, a fuzzy comprehensive evaluation shows that 72% of the NHs have better crisis response performance than the average. A CATREG model is constructed to explore the influencing factors. The results indicate that among contextual factors, public-private partnership NHs and urban NHs show better outcomes. Residents with higher self-prevention sense and NH’s with stronger response-ability suggest more favorable crisis response performance. Besides, younger administrators with higher education levels and behave more actively to COVID-19 will lead to more excellent outcomes.

1. Introduction

The unprecedented COVID-19 (coronavirus disease 2019) began to spread in early 2020 and has become more than a health crisis but a complex socio-economic crisis worldwide.¹ As of April 7, 2020, 121 446 people have been confirmed with the disease, and 67767 deaths have been reported worldwide. Approximately 211 countries, areas, or territories have reported outbreaks.² From January 19th to January 28th, 2020, the pandemic spread to 34 provinces across China in just ten days.

COVID-19’s epidemiological transmission features include being infective to all populations. Existing studies find that the elderly population with chronic health conditions or compromised immune systems is at greater risk of being infected and becoming severe (Li et al., 2020; Wang et al., 2020). After the epidemic outbreak, many nursing homes (NHs) have seen community transmission incidence, which means they are high-risk places for virus infection (Barnett & Grabowski, 2020). The general environment of NHs and the vulnerability of their residents provide favorable conditions for the rapid spread of respiratory diseases (Lansbury et al., 2017).

For NHs, this new epidemic poses a significant threat to their operation. It is necessary to take urgent measures to stem the impacts within a limited time, which is a typical crisis response (Pearson & Clair, 1998; Rosenthal et al., 1989). In the early days of the outbreak,

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¹ UNDP: SOCIO-ECONOMIC IMPACT OF COVID-19 https://www.undp.org/content/undp/en/home/coronavirus/socio-economic-impact-of-covid-19.html.

² https://www.who.int/emergencies/diseases/novel-coronavirus-2019.

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Chinese Ministry of Civil Affairs issued the Infection prevention and control (IPC) guidelines on COVID-19 for NHs\(^3\) on January 28, 2020, followed by a second edition on February 7.\(^4\) After that, all NHs performed closed management and a series of prevention measures. According to the results reflected in the early period (up to January 31, 2020), the epidemic has not been spreading in Chinese NHs.\(^5\)

Chinese NHs have achieved good results in their response to the epidemic. Therefore, the main aim of this paper is to explore the crisis response of NHs in the early stage of COVID-19, especially the influencing factors of its crisis response performance. After the outbreak of COVID-19, administrators from two hundred NHs in China participated in the web-based survey. The paper uses the fuzzy comprehensive method to establish the evaluation system of the IPC performance of NHs and takes that as the crisis response outcomes. This is followed by constructing a CATRED model to explore the influencing factors of crisis response effectiveness. The predictors include NHs’ contextual factors and administrators’ responses. Combined with the regression results, the theoretical contribution and policy implications of improving NHs’ resilience to the crisis are discussed.

2. Literature review

The comparison of organizations’ crisis responses can be made by comparing the effectiveness of crisis management (Reilly, 1993). Organizational crisis management theory is used to explore the crisis response performance of NHs. The impact of a crisis on the organization is often salient and disruptive (Bundy et al., 2017). Unlike routine organization management in a stable environment, which generally centered on efficiency management (Globerson, 1985), crisis management in a complex dynamic environment is a series of dynamic strain processes (Fink and American Management Association, 1986). Prior literature on organizational crisis management (Barton, 1990; Doepel, 1991; Lagadec, 1987) are generally scattered since researchers come from different disciplines, and systematic research has not yet been formed (Shrivastava, 1993). Organizational crisis management means that managers adopt systematic strategies and behaviors according to the development law of crisis events and the characteristics of different stages of the crisis, which aim to avoid or reduce the threat brought by the crisis with the least resources in the shortest time (Pearson & Clair, 1998). The available human and material resources should be mobilized in time for crisis management before the situation becomes uncontrollable to prevent the crisis from spreading and to minimize losses (Crupi et al., 2003). The sudden outbreak of COVID-19 is undoubtedly a crisis that NHs need to deal with appropriately. NHs’ administrators need to formulate and implement crisis management plans quickly to minimize the risk of outbreaks in the organization.

Existing research on organizational crisis management combines organization theory and crisis management theory, focusing on the concept (Valackiene, 2011), procedure (Waller et al., 2014; Williams et al., 2017) and framework (Mikusová and Horváthová, 2019). Some scholars also discuss the management strategy of the organization after the crisis (Mitroff et al., 1988; Sturges, 1994; Coombs, 1995, 2006) and management performance (Lachtar & Garbolino, 2012) from the perspective of crisis response, as well as the influence of organizational contextual factors, leaders (James et al., 2011) and management team (Waller et al., 2014), and other stakeholders (Stephens et al., 2005) on crisis management performance. Management performance refers to the effectiveness of achieving management objectives. Effective crisis management is manifested in the successful prevention of the crisis or minimizing the short-term and long-term impact of the crisis (Pearson & Clair, 1998). After the outbreak of COVID-19, the crisis response performance of NHs can refer to the outcome of prevention and control of the epidemic. Whether their prevention and control are timely and effective is the key to responding to the epidemic crisis.

The review shows some gaps in the literature. First, existing research on crisis management is mostly related to economic crises and environmental crises, and less discussion of public health emergencies crises. Secondly, the research objects are mostly companies, and there is less research on crisis management of non-profit organizations such as NHs. Besides, many studies have found that organizational contextual factors and leadership can affect organizational management performance (Hambrick & Mason, 1984; Boyne et al., 2006; O’Toole & Meier, 2011, 2004; Andrews & Johansen, 2012). However, few scholars use empirical methods to discuss which contextual factors and managerial characteristics will affect crisis response performance and how. Within this context, the paper aims to evaluate the crisis response performance of Chinese NHs after the outbreak and explore the impact of organizational contextual factors and administrators’ characteristics on the crisis response outcome based on a national cross-sectional survey.

3. Methodology

3.1. Data source

Two hundred administrators from different parts of China participated in a web-based survey during February 1–10, 2020 (after the publication of the first national COVID-19 IPC guidelines for NHs) to investigate their COVID-19 management performance in the early stage of the outbreak. The questionnaire includes NHs’ contextual factors, IPC measures, administrators’ main characteristics, and behavioral attributes after the outbreak of COVID-19.

Concerning the contextual factors of NHs, there are 90 private NHs, accounting for 45%; 45 public-private partnership NHs, accounting for 22.5%; and 65 state-owned NHs, accounting for 32.5%. More than one-fifth of the NHs are in the urban-rural integration

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\(^3\) http://www.gov.cn/xinwen/2020-01/28/content_5472755.htm.

\(^4\) http://www.mca.gov.cn/article/xw/tzgg/202002/20200200024221.shtml.

\(^5\) http://www.nhc.gov.cn/xcs/fkdty/202001/914723e57818485fb30bf995c57989de.shtml.
area. More than 80% of the elderly residents in the surveyed NHs have a sense of self-prevention, and 87.5% of the NHs reported having a strong ability to deal with the epidemic. Regarding the main characteristics of the administrators, more than 60% of them are female. The administrators’ age distribution is between 30 and 60 years old, and 68% of them have received a bachelor’s degree or above. (see Table 1)

3.2. Data analysis

3.2.1. Fuzzy comprehensive evaluation method

Regarding how to achieve effective IPC in NHs and other similar health organizations, the WHO proposes that such IPC should be composed of several multimodal strategies and core parts (World Health Organization, 2018). The core parts include IPC procedures and guidelines, professional knowledge training, health monitoring, and the maintenance of the institution’s environment. The IPC measures of infectious diseases in NHs include the identification and control of the sources of infectious diseases in the early stage, the complete IPC management mechanism, the cleaning of the institutional environment and the personal protection of the organizations’ staff (Simor, 2002; Lansbury et al., 2017). Thus, IPC in NHs needs to maintain the care of the elderly population while also preventing and controlling the virus (Gomolin et al., 1995). Research shows that effective IPC measures can significantly reduce such organizations’ infection rates (Storr et al., 2017).

Referring to the internal and external dimensions of crisis control proposed by Coombs (Coombs, 1995), this paper divides the performance evaluation index into two parts: internal IPC and external joint IPC. Specifically, studies have shown that the improvement of IPC awareness and the IPC behavior of staff (Edwards et al., 2012; Aboelela et al., 2007) are positively correlated the improvement of

### Table 1

Contextual factors of NHs and main characteristics of administrators.

| Category                              | n  | %    |
|---------------------------------------|----|------|
| Ownership                             |    |      |
| State owned NHs                       | 65 | 32.5 |
| Public-private partnership NHs        | 45 | 22.5 |
| Private NHs                           | 90 | 45.0 |
| Region                                |    |      |
| Urban area                            | 80 | 40.0 |
| Rural area                            | 75 | 37.5 |
| Urban-rural integration area          | 45 | 22.5 |
| Residents’ self-prevention sense      |    |      |
| Almost all of them have               | 87 | 43.5 |
| Most of them have                     | 76 | 38.0 |
| Half of them have                     | 17 | 8.5  |
| A few of them have                    | 17 | 8.5  |
| Few of them have                     |  3 | 1.5  |
| NH’s ability to deal with the epidemic|    |      |
| Very strong                           | 100| 50.0 |
| Strong                                |  75| 37.5 |
| Normal                                |  22| 11.0 |
| Weak                                  |  13| 1.5  |
| Very weak                             |   0| 0.0  |

| Gender                                |    |      |
| Male                                  | 68 | 34.0 |
| Female                                | 132| 66.0 |

| Age (years)                           |    |      |
| 20–30                                 | 27 | 13.5 |
| 31–40                                 | 49 | 24.5 |
| 41–50                                 | 60 | 30.0 |
| 51–60                                 | 58 | 29.0 |
| >60                                   |  6 | 3.0  |

| Education level                       |    |      |
| Under primary school level            |  1 | 0.5  |
| Primary school                        |  4 | 2.0  |
| Junior school                         | 14 | 7.0  |
| High school                           | 45 | 22.5 |
| Bachelor’s degree                     |118 | 59.0 |
| Master’s degree or above              |  18| 9.0  |

Source: Calculated by the authors.

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6 World Health Organization. Improving infection prevention and control at the health facility: interim practical manual supporting implementation of the WHO Guidelines on Core Components of Infection Prevention and Control Programmes[R]. World Health Organization, 2018.
4. Results

The evaluation factors can be represented by a vector $V = \{ V_1, V_2, ..., V_{13} \}$. As different IPC measures have different effects, the weight coefficient can reflect the degree of their prevention and control effects. A pairwise comparison matrix is applied to determine the weights of different measures. According to the Zadeh definition of judgment scale,\(^7\) the rule is to compare the importance of two types of measures and produce a score in the scale.(see Table 4) The standardized weight coefficient set $W_0 = \{ W_0^1, W_0^2, ..., W_0^{13} \}$ is obtained with the square root methods ($W_i = \sqrt[13]{\prod_{j=1}^{13} W_0^j}$). The results are normalized.

According to the standardized weight coefficients, most effective measures include developing and implementing a context-specific

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\(^7\) CATREG analysis was developed by the DTSS research group of Leiden University.

\(^8\) See Appendix
response plan, implementing closure management, measuring the elderly's temperature every day, and helping older adults take precautions to prevent getting COVID-19. These four measures are carried out from the prevention and control of NHs as a whole and susceptible individual, based on the prevention and control guidelines for COVID-19 control, effectively reduce the number of cases and the effective contact rate, thus improving the effectiveness of the control and prevention.

To see whether the matrix is consistent in showing the preferences, a consistency test is conducted. $\lambda_{\text{max}}$, Consistency Index(CI) and Consistency Ratio(CR) are shown in Table 5($\text{CI} = \frac{\lambda_{\text{max}} - n}{n - 1}$, $\text{CR} = \frac{\text{CI}}{\text{RI}}$, $I = 13$).

The results show that the matrix have an CR < 0.1 which means that it is valid and pass the consistency test.
The appraisal grade is divided into two levels, one is the measures that the NH has not taken, and the other is the measures being implemented. Therefore, the set of appraisal grades can be written as \( U = \{ u_j \} \), \( j = 1, 2 = \{ 0, 1 \} \), \( j \) is the number of levels in the appraisal. The evaluation is meant to produce a mapping from \( V \) to \( U \). For an evaluation factor \( V_i \), \( p_{ij} \) represents the fuzzy membership degree of evaluation factor \( V_i \) to \( U_j \) (Klawonn, 2006). The membership degree \( p_{ij} \) in this study is 100% if the NH has already implemented the measure and it is 0 if the NH has not done that. \( S_i \) is the score of \( V_i \), which can be calculated as \( S_i = p_{ij} \cdot u_j \). The NHs’ IPC performance function is as follows:

\[
C_{IPC} = \sum_{i=1}^{13} W_i^0 \cdot S_i + \varepsilon = 0.084S_1 + 0.063S_2 + 0.112S_3 + 0.146S_4 + 0.010S_5 + 0.189S_6 + 0.012S_7 + 0.015S_8 + 0.048S_9 + 0.036S_{10} + 0.020S_{11} + 0.026S_{12} + 0.238S_{13} + \varepsilon
\]

After calculation, the essential characteristics of the NHs’ IPC performance in China are shown in Table 6, and a scatter chart of the results is shown in Fig. 1.

Although the IPC performance of most NHs is relatively high, there are still some NHs that did not perform well enough at the beginning of the epidemic. In the research of crisis management, some scholars proposed that the contextual factors of organizations and administrators’ response to crisis significantly affect crisis response performance (Hambrick & Mason, 1984; Coombs, 1998; Roux–Dufort, 2007; Dayton and Bernhardsdottir, 2015). Therefore, using the essential characteristics of NHs to proxy for the contextual factors, the main characteristics and behavioral attributes of administrators to proxy for administrators’ response to the COVID-19 crisis. The following study will examine how the organizations’ contextual factors and administrators’ responses influence organizational crisis management outcomes.

4.2. Regression results

The p-value of the regression model is 0.000, which means that it is statistically significant. All the variables’ tolerance values are greater than 0.1, which means that there is no multicollinearity between the variables, further showing the model’s validity in a statistical sense.(see Table 7) The influence of predictors on dependent variables should consider both the coefficients and quantified categories. The transformation plots of significant variables are shown in Fig. 2.

The regression results show that among the essential characteristic of NHs, the Ownership is significant at the 1% level and its coefficient is 0.164, and the quantified values sorted from smallest to largest are those of private NHs, state-owned NHs, and public-private partnership NHs. In other words, the IPC performance of public-private partnership NHs is the highest, followed by that of state-owned NHs, while that of private NHs is the lowest.

Region, Residents’ self-prevention sense, and NH’s ability to deal with the epidemic indicate significant at 5% level. Region’s coefficient is 0.087, and the quantified values of urban area NHs, rural area NHs and urban-rural NHs gradually decrease. When all other conditions are held constant, the IPC outcome of NHs in urban areas are higher than those in rural areas, while the IPC performance of urban-rural integration NHs is the lowest.

The coefficients of Residents’ self-prevention sense and NH’s ability to deal with the epidemic were negative, that is, the higher the institutional elderly population’s prevention awareness is, the stronger the institutional response-ability is, and the greater the IPC performance is.

Regarding the main characteristics of administrators, Age and Education level indicate significant at 1% level. Combined with transformed values, younger administrators perform better in COVID-19 response. The coefficient of administrators’ education level is 0.227, and the transformed plots suggest that the higher the administrators’ education level is, the greater the IPC performance will be. Gender indicates no significant effect on the NHs’ IPC performance.

Moving to administrators’ behavioral attributes, Knowledge of COVID-19’s transmission route and Effectiveness of medical information popularization on infection prevention and control emerge as statistically meaningful at 1% level. Knowledge of COVID-19’s essential characteristics, Measure body temperature every day, and Do not take public transportation show significant at a level of 5%. Knowledge of COVID-19’s main symptoms is statistically meaningful at 10% level.

The coefficients of Knowledge of COVID-19’s essential characteristics, Knowledge of COVID-19’s transmission route, and Knowledge of

| Mean  | Median | Standard deviation | Minimum | Maximum |
|-------|--------|--------------------|---------|---------|
| 0.8903 | 0.9865 | 0.1778             | 0.084   | 0.999   |

Table 6
Description of IPC index.

Data source: calculated by the authors.
COVID-19’s main symptoms are all negative. In other words, the less the administrators know about the COVID-19, the lower their facility’s IPC performance is.

The coefficient of Effectiveness of medical information popularization on infection prevention and control is 0.130. Thus, if the administrator thinks that just popularizing medical information is not enough, they will pay more attention to the implementation of prevention and control measures.

The coefficients of Measure body temperature every day and Do not take public transportation are −0.110 and −0.160. This indicates that the more attention the administrators pay to their own protection in daily behaviors, the more effective the IPC outcomes of the NHs they managed will be.

Table 7
CATREG results of the model.

| Variable name                                                                 | Beta  | df  | F    | Sig. | Tolerance |
|--------------------------------------------------------------------------------|-------|-----|------|------|-----------|
| X1 Ownership                                                                   | .164  | 2   | 18.621 | .000** | .820      |
| X2 Region                                                                       | .087  | 2   | 3.243 | .042** | .792      |
| X3 Residents’ self-prevention sense                                            | -.139 | 2   | 4.294 | .015** | .642      |
| X4 NH’s ability to deal with the epidemic                                      | -.151 | 2   | 3.895 | .022** | .768      |
| X5 Gender                                                                       | .064  | 1   | 2.539 | .113  | .706      |
| X6 Age(years)                                                                   | -.117 | 4   | 5.780 | .000***| .572      |
| X7 Education level                                                              | .227  | 4   | 5.615 | .000***| .359      |
| X8 Knowledge of COVID-19’s essential characteristics                           | -.168 | 1   | 3.981 | .048** | .501      |
| X9 Knowledge of COVID-19’s transmission route                                   | -.317 | 1   | 8.785 | .003***| .487      |
| X10 Knowledge of COVID-19’s main symptoms                                       | -.157 | 2   | 2.982 | .053*  | .513      |
| X11 Knowledge of the prevention and control measures formulated by the government | .058  | 2   | 3.338 | .714  | .810      |
| X12 Be concerned about the development of the epidemic                          | -.059 | 1   | 2.243 | .623  | .721      |
| X13 The feeling of going to crowded places                                      | .066  | 2   | 8.266 | .439  | .828      |
| X14 Effectiveness of medical information popularization on infection prevention and control | .130  | 3   | 6.862 | .000***| .387      |
| X15 Expected possibility of infection                                           | -.059 | 1   | 2.683 | .410  | .615      |
| X16 Increase the frequency of hand hygiene                                      | .112  | 1   | 1.269 | .262  | .558      |
| X17 Measure body temperature every day                                          | -.110 | 2   | 3.225 | .042** | .599      |
| X18 Wearing a mask in public                                                    | .112  | 1   | 1.302 | .255  | .583      |
| X19 Do not take public transportation                                           | -.160 | 1   | 4.194 | .042** | .505      |

Note: 1. *p < 0.10; **p < 0.05; ***p < 0.01.
2. $R^2 = .769$; Adjusted $R^2 = .720$. 
5. Discussion

The indiscriminate social and economic effects of COVID-19 will be felt with great intensity by all kinds of health care organizations. The NHs’ response performance to confront the crisis varies across the country. In the early stage of the outbreak, the IPC measures become essential for NHs to control the spread of the epidemic. The fuzzy evaluation of the NHs’ crisis performance suggests that Chinese NHs performed well to prevent and control the COVID-19 epidemic. This is due to the government’s “strong intervention” in the early stage of the outbreak and the “strict management” within the organizations. Regarding government intervention, it stems from the IPC guidelines for NHs formulated and issued by the Chinese Ministry of Civil Affairs after the COVID-19 outbreak, which provided timely guidance for infection prevention and control of NHs. Besides, given the shortage of personal protective products, medical resources, and disinfection facilities. Local government played an important role in this period, they gave urgently needed materials and technical support to the NHs. The organizations’ internal management mainly benefited from the fact that NHs generally follow the national IPC guidelines, especially the implementation of closed management and isolation measures.

The CATREG analysis indicates that the IPC performance of public-private partnership NHs is higher than that of private NHs and state-owned NHs. The result complements previous research that nonprofit NHs have better care quality than profit-making NHs under a “normal situation” (Aaronson et al., 1994; Harrington et al., 2002; Nyman, 1988). Unlike the “normal situation”, the outbreak of COVID-19 put NHs in a “crisis situation” with urgent and complex characteristics. Compared with traditional state-owned NHs under the hierarchical structure, the operation of social forces and the introduction of market mechanisms enable public-private partnership NHs to have the advantages of quick responses and high flexibility. These features help the public-private partnership NHs respond promptly to changes in the environment, which is very important for public health emergencies. Compared with profit-oriented private NHs, the government’s intervention in policy support, information sharing, supervision, and management can alleviate the problems of insufficient resources and loose management that often exist in private institutions and enhance their ability to deal with the unexpected crisis. It is worth noting that whether the environment is a “normal situation” or a “crisis situation”, public-private partnership NHs always show commendng results.

Besides, we find IPC performance of the NHs in the urban-rural integration area is lower than other area. This may because during China’s urbanization process, urban-rural integration areas are in the stage of transformation from rural to urban areas. In this stage, the actual management staff and mechanism of NHs are the same as in rural areas. However, it also needs to be gradually unified with the higher standards of urban NHs (Wang, 2017), which leads to the result that the management performance is not as good as expected in the practice process. With the advancement of urbanization, the situation will be gradually improved.
In addition, as WHO suggests that administrators in NHs should play a leading role in the entire prevention and control process, the main administrators are responsible for ensuring the rational allocation of various resources in organizations (World Health Organization, 2018). Existing researches conduct specific analysis from the aspects of administrators’ management style, experience (Anderson et al., 2003), skill levels (Arling et al., 2007), and personality characteristics or traits (McBride et al., 2006). This paper finds that among the managers’ main characteristics, gender indicates no significance, but their age and education level have significant influence on IPC performance. This result may because younger administrators with higher education will have a timely and clear understanding of the sudden crisis and thus take effective measures and plans to deal with the crisis. We also find that administrators who behaved more actively in personal prevention will lead to a more favorable performance of the whole NHs. The finding is consistent with the existing research showing how administrators can play a role in crisis response, in which the key is their understanding of the event itself and their coping methods (Pearson and Clair, 1998; Seeger et al., 2003; Wooten and James, 2008).

This paper provides policy implications for the crisis response of Chinese NHs from both government and NH administrators’ perspectives. First, the government should optimize the intervention of NHs and grasp the scale and timing of interventions. In terms of the organizations’ operation, the government should make an orderly exit. Our important finding is that public-private partnership organizations’ management effectiveness is still better under the “crisis situation”. The government needs to actively introduce social forces and adopt market mechanisms to promote the privatization reform of NHs, which transforms more public organizations into public-private partnership organizations. This reform will make full use of the management advantages of public-private partnership NHs’ quick responses and great flexibility in confronting sudden public health events.

Second, the government’s intervention in elderly care organizations’ management should include more practical strategies. The government should extend the supervision and support of NHs in rural areas, especially in the rural and urban integration areas. For example, the crisis response level of these NHs could be raised by formulating suitable criteria, strengthening supervision, and increasing communication. Through resource reallocation, information sharing, and policy support, the crisis response ability of these NHs will be enhanced.

Third, the administrators’ role in preventing and controlling unexpected public health events in NHs is nonnegligible. The government’s traditional top-to-bottom bureaucratic structure begets an inadequate response to the crisis (Cheng, 2016). Therefore, it is necessary to pay attention to the manager’s role as the primary management subject in the early stage of the crisis. Furthermore, the administrators of NHs should expand their knowledge about the prevention and control of infectious diseases, especially for the elderly population. They should also apply risk perceptions into everyday practice and promote organizations’ crisis response.

These findings provide suggestions for improving the IPC ability of NHs. However, since this study’s purpose was to investigate the crisis response of NHs in the early stage of the COVID-19 epidemic, it can only reflect the IPC performance of NHs in the early stage of the epidemic outbreak. Longitudinal studies are needed to analyze the changes in IPC performance and the measures of NHs in the post-COVID-19 period. Further analysis should compare the COVID-19 management outcomes’ differences in all kinds of NHs to form a comprehensive understanding of the whole period of COVID-19 crisis response, which will provide a more comprehensive insight into the design and implementation of crisis response policies of NHs.

6. Conclusion

Unprecedented COVID-19 crisis requires unprecedented measures—a massive prevention and control effort is urgently needed everywhere (Zheng & Zhang, 2020). Existing researches rarely investigate the IPC practices of NHs in China after a sudden epidemic crisis. At the beginning of the COVID-19 epidemic, Chinese NHs immediately performed a series of IPC measures suggested by the government. More than 70% (72%) of the 200 NHs surveyed have more favorable crisis response outcomes above the average. The CATREG analysis indicates significant factors on the IPC performance of NHs (i.e., ownership, region, residents’ self-prevention sense, and NHs’ ability to deal with the epidemic). In other words, the higher the residents’ self-prevention sense, and the stronger NHs’ ability to deal with the epidemic, the stronger the IPC performance NHs is. Besides, public-private partnership NHs in urban areas performed better than other NHs.

Concerning administrators’ main characteristics (i.e., gender, age, and education level), age and education level indicate a significant influence on the IPC performance. Thus, younger administrators with education level usually achieve more desirable crisis response outcomes. Moving to behavioral attributes of administrators, the more administrators pay attention to their personal protection, the better the crisis response outcomes of organizations they in charge will be. To make NHs more resilient to unexpected public health events such as COVID-19, we call for optimizing government intervention to create conditions for the crisis prevention and control of NHs. Meanwhile, we also encourage that more attention should be paid to administrators’ role in crisis response.

CRediT authorship contribution statement

Yu Liang: Data curation, Investigation, Writing - original draft, Writing - review & editing. Junzhuo Xu: Conceptualization, Methodology, Software, Validation, Writing - original draft, Writing - review & editing.

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Appendix 1. Zadeh Judgement scale for comparing two elements

| Scale          | Meaning                                      |
|---------------|----------------------------------------------|
| 1             | The importance is the same.                  |
| 2             | The formers slightly more important than the latter. |
| 3             | The formers obviously more important than the latter. |
| 4             | The formers significantly more important than the latter. |
| 5             | The formers are a lot more important than the latter. |
| 2,4,6,8       | The intermediate scale of two adjacent scales above |
| Reciprocal    | The latter is more important than the former. |

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