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# Evaluating the Effects of Organizational Environment on Patient-Perceived Hospital Discharge Readiness Among Patients with Acute Myocardial Infarction During Public Health Emergencies: An Observational Study



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# Evaluating the Effects of Organizational Environment on Patient-Perceived Hospital Discharge Readiness Among Patients with Acute Myocardial Infarction During Public Health Emergencies: An Observational Study


## ABSTRACT

**Aims:** To evaluate the effects of the organizational environment on hospital discharge readiness during public health emergencies.

**Design:** An observational study.

**Methods:** A regression-discontinuity design approach was employed to assess the impact of the organizational environment on hospital discharge readiness. Adult patients diagnosed with acute myocardial infarction and discharged from the Cardiac Critical Care Unit of a tertiary hospital in Shanghai, China, were recruited. Spearman correlation analysis was conducted to examine the associations between multiple factors at individual and organizational levels and hospital discharge readiness across three stages of pandemic policy changes.

**Results:** A total of 411 patients were included in the analysis. The regression-discontinuity analysis revealed a significant discontinuity at the cut-off, indicating that policy-driven changes in the organizational environment during public health emergencies were associated with a 21.61% reduction in hospital discharge readiness. Additionally, family functioning and the quality of nursing discharge education were significantly associated with discharge readiness across all three pandemic stages.

**Conclusions:** These findings demonstrate that patient-perceived hospital discharge readiness is significantly influenced by changes in the organizational environment during public health emergencies. Future research should focus on developing targeted discharge preparation programs that allow for organizational adaptation in response to emergencies, such as pandemics or natural disasters.

**Implications for patient care:** Organizational responses to public health emergencies need to prioritize enhancing discharge preparedness. This includes bolstering family involvement and ensuring that nurses are adequately trained to provide effective discharge education, especially when healthcare resources are strained.

**Impact:** The findings underscore the importance of adaptable and resilient discharge planning and transitional care, particularly in public health emergencies. Fostering an organizational environment that supports seamless discharge processes can significantly improve patient readiness for post-hospital care**.**

**Reporting Methods:** Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement.

**Patient or Public Contribution:** No patient or Public Contributions.

**Key words:** transitional care; regression-discontinuity design; hospital discharge; acute myocardial infarction; organizational factors; public health emergencies; COVID-19

**Contribution to Global Clinical Community**

- This study underscores the importance of healthcare systems globally adapting to unforeseen crises while ensuring the continuity of high-quality patient care.
- It highlights the critical roles of family involvement, nursing education, and policy-driven organizational changes, advocating for flexible and resilient discharge strategies to support patients during emergencies in various healthcare settings.

## 1. Introduction

Acute myocardial infarction (AMI) is a leading cause of mortality worldwide, with approximately 9 million deaths annually (WHO, 2020). The damage of AMI extend beyond the acute event, impacting patients' physical health, psychological well-being

and quality of life after discharge (Radaideh et al., 2024). Due to poor adherence to long-term treatment plans, inadequate discharge education and difficulties in accepting a diagnosis of cardiovascular disease as a chronic condition, patients who have had an AMI often face significant discharge challenges (Hydzik et al., 2021; Kosobucka et al., 2022; Rotvig et al., 2021). Studies have shown process-related factors (i.e., unit, nurse and patient characteristics), structure-related factors (i.e., teaching of self-care and symptom management) and organizational factors related to the hospital environment are thought to influence patient-perceived readiness for hospital discharge (Mabire, Bachnick, Ausserhofer, & Simon, 2019). While previous studies have predominantly examined individual determinants of discharge readiness, less attention has been given to the role of environmental and organizational factors. In particular, during public health emergencies (PHEs) such as the COVID-19 pandemic, abrupt policy changes and instability within the healthcare system have introduced additional challenges, potentially exacerbating discharge difficulties. However, the extent to which changes in the organizational environment during PHEs influence hospital discharge readiness remains insufficiently explored (Wallace et al., 2023).

## 2. Background

Discharge preparation is crucial for patients with AMI, as inadequate transitional care can lead to poor outcomes. A five-year analysis revealed that 19% of hospitalized patients who have had an AMI did not survive, highlighting the link between mortality and cardiovascular risk factors such as hypertension, hyperlipidemia, diabetes, and smoking (Rohani et al., 2022). One in every 40 patients experiences a recurrent AMI within one year, with over one-third of these events occurring within the first 30 days post-discharge (Song et al., 2020). This underscores the critical importance of discharge preparation and transition for patients who have experienced an AMI. Higher levels of readiness for hospital discharge are associated with a reduced risk of readmission or mortality within the first 30 days, better management of modifiable factors such as diet, physical activity, and medication adherence, and improved long-

term recovery. This, in turn, helps mitigate the risk of further cardiovascular complications, such as recurrent heart attacks and heart failure (Hu, 2024; Kolarczyk et al., 2023; Lau et al., 2016; Rotvig et al., 2021).

Readiness for hospital discharge refers to patients' ability to manage their care in the community following a transition from acute care (Titler & Pettit, 1995). Effective discharge preparation depends on patients' psychological and demographic factors, such as educational attainment, as well as the duration of hospitalization and rehabilitation (Hydzik et al., 2021). Additionally, family interdependence and the ability to cope with communication-related stress are crucial for facilitating a smooth transition (Poh et al., 2020), particularly in managing emotional distress and functional dependence (Presciutti et al., 2024). However, existing research predominantly focuses on individual or nurse-centered factors while overlooking the broader organizational environment, which is particularly critical during public health emergencies. The COVID-19 pandemic, for example, created unprecedented challenges in hospital management, staffing, and patient care continuity, with lockdowns, healthcare delays, and workforce shortages significantly disrupting care delivery (Wallace et al., 2024). Studies indicate that hospital admissions for AMI declined during the first lockdown without a corresponding reduction in 30-day mortality rates (Lavie et al., 2022). Patients with AMI experienced significantly longer times from symptom onset to hospital admission during the pandemic and nearly three times the risk of developing complications compared to prior periods (Gramegna et al., 2020; Tomasoni et al., 2020). This disruption has led to higher out-of-hospital mortality rates for these patients (Braiteh et al., 2020; Santi et al., 2021; Solomon et al., 2020). The lack of research on organizational influences during crises hinders the development of adaptive discharge programs, underscoring the need for strategies that ensure continuity of care in emergency settings.

The organizational environment is fundamental to effective discharge preparation, particularly during the transition from routine operations to public health

emergencies. Donabedian's structure-process-outcome paradigm provides a framework for evaluating hospital discharge quality from an organizational perspective, emphasizing the role of resources and interventions (Donabedian, 2005). Key organizational environment, including traits such as the nursing workforce, leadership, support, skill mix, and staffing, significantly impact discharge readiness (Mabire, Bachnick, Ausserhofer, & Simon, 2019) and dynamically adjust in response to health policy changes (Aarons et al., 2012; Tangcharoensathien et al., 2017). These factors interactively influence the ability and willingness of both patients and clinicians to engage in shared decision-making, a key component in the quality of nursing discharge education (Hendriks & Lee, 2020). Additionally, the clinical professional practice environment can serve as both a barrier and a facilitator to discharge readiness in patients with myocardial infarction (Monfared et al., 2024). While individual factors related to discharge readiness are well-established, there remains a gap in understanding how integrated organizational efforts, guided by health policy, enhance preparedness for discharge.

Failing to account for the dynamic nature of organizational contexts when evaluating factors influencing hospital discharge readiness may lead to inaccurate assessments of transitional care quality (Meleis et al., 2000). This is especially relevant in public health emergencies, which involve complex health, social, and economic consequences that disproportionately affect vulnerable populations (WHO, 2019). Organizational instability during events such as the COVID-19 pandemic has had a lasting effect on discharge readiness for patients who have had an AMI, necessitating additional interventions to mitigate adverse outcomes amid heightened hospital strain (Glance et al., 2023). Organizational challenges, including caregiver absence (Wallace et al., 2024), resource strain, and expedited discharge, also hinder patient-perceived readiness for hospital discharge (Rodrigues et al., 2024). These findings emphasize the need for further investigation into the interplay between organizational, individual, and family factors in hospital discharge, providing valuable insights for enhancing crisis preparedness and management in healthcare systems.

## 3. Study objectives

This study aimed to evaluate the impact of the organizational environment on readiness for hospital discharge during public health emergencies. The specific objectives were: 1) to assess the differences in organizational environment changed by public health policies and their effects on patient-perceived discharge readiness in PHEs; 2) to validate the effect of policy-driven organizational changes on discharge readiness; 3) to identify additional independent factors influencing discharge outcomes in relation to organizational environment changes.

## 4. Materials and Methods

### 4.1. Study Design

This study utilized an observational design as a baseline component of the Acute Myocardial Infarction Adaptation Promotion Program. This program focuses on evaluating discharge readiness and providing guidance for long-term cardiac rehabilitation and comprehensive management of AMI, with the overarching aim of preventing hospital readmission (Wang et al., 2023). The findings were reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement.

### 4.2. Study Setting

This study was conducted in the Cardiac Critical Care Unit (CCU) of a tertiary hospital with four campuses in Shanghai, China. The CCU managed patients with acute myocardial infarction across these campuses, which operated as designated hospitals adhering to pandemic control policies. Based on these policies, three distinct stages of hospital managerial measures were identified: Stage 1 (January 24, 2021, to March 28, 2022), Stage 2 (March 29, 2022, to February 23, 2023), and Stage 3 (February 24, 2023, to November 23, 2023). Across three successive stages, the organizational environment was faced with increasingly severe challenges of abrupt public health

emergencies, necessitating adjustments in hospital management, nursing workforce allocation, and family involvement in patient care (see **Table 1**).

In Stage 1, under normal care conditions, patients with AMI received transitional care services upon discharge, which included baseline health assessments such as heart ultrasounds for follow-up and potential readmission. Family caregivers were permitted to visit the CCU under strict health screening protocols. The implementation of a citywide lockdown in Shanghai on March 28, 2022, which means the shift from Stage 1 to Stage 2. During the lockdown period, nurses were required to remain in the hospital for one-month shifts, and CCU inpatients lost access to family companionship. Discharge planning became increasingly reliant on the coordination of care with community-based health services, while traffic restrictions and community lockdowns created substantial barriers to hospital readmissions, further complicating post-discharge care (Blomström-Lundqvist, 2020; Schmitz et al., 2021). Following the nationwide epidemic prevention measures implemented on February 23, 2023, significant disruptions in hospital operations emerged, marking the shift from Stage 2 to Stage 3. In Stage 3, with the relaxation of epidemic prevention policies, COVID-19 infections surged, straining medical resources, including hospital beds, equipment, and healthcare personnel, and necessitating quicker bed turnover. To minimize infection risks, home discharge became the preferred option for patients, with family caregivers assuming a greater role in post-discharge care and receiving discharge education from nurses. These stages of organizational change led to shifts in nurse-to-patient ratios, recorded as 1:1.33, 1:1.25, and 1:1.33 across the three stages, reflecting fluctuating hospital resource pressures and staffing demands.

**Table 1. Stages and Evolution of the Organizational Environment Over the Study Timeline**

### 4.3. **Participants**

Using a cluster sampling method, attending nurses recruited patients who met the

following eligibility criteria: (1) aged 18 years or older; (2) diagnosed with acute myocardial infarction by a cardiologist and having undergone percutaneous coronary intervention (PCI); (3) planned for discharge to home; and (4) fluent in Mandarin or the local dialect. Data were collected from these patients within 24 hours prior to their planned discharge with patients written consents.

### 4.4. **Study Instruments**

#### 4.4.1. Demographic and Background Information.

An investigator-developed questionnaire, informed by studies on individual factors influencing readiness for hospital discharge, was used to collect demographic and background data. This included sex, age, marital status, religion, education level, occupation, monthly family income, post-discharge caregiver involvement, alcohol and smoking behaviours, weekly exercise frequency and duration, regularity of daily routine, all of which were collected via patient self-report. Additionally, digital medical records were utilized to gather information regarding healthcare payment methods, basic medical history, and prescribed medications.

#### 4.4.2. Readiness for Hospital Discharge Scale (RHDS).

Readiness for hospital discharge was measured using the RHDS, specifically the Chinese version adapted by Lin et al. (Lin et al., 2014), based on the original work by Weiss and Piacentine (Weiss & Piacentine, 2006). The scale comprises 12 items, organized into three dimensions: Personal Status (3 items), Extramural Hospital Coping Capacity (5 items), and Expected Support (4 items). Each question is scored on a scale of 0–10, with higher total scores indicating greater readiness for discharge. The Cronbach's α for the English version is 0.89 for the total scale (Weiss & Piacentine, 2006). For the Chinese version, Cronbach's α values are 0.89 for the overall scale, and 0.73, 0.90, and 0.89 for the three subscales, respectively (Lin et al., 2014). In this study, the Cronbach's α was 0.82 for the overall scale, with 0.85, 0.87, and 0.84 for the three subscales, respectively.

4.4.3. Quality of Discharge Teaching Scale (QDTS).

Nurses' quality of discharge teaching was assessed using the Chinese version of the QDTS, originally developed by Weiss et al.(Weiss et al., 2007) and adapted by Binghua Wang (Bing-Hua et al., 2016). The scale consists of three dimensions: Required Discharge Information (6 items), Actual Obtained Information (6 items), and Discharge Teaching Skills and Effects (12 items). Each item is scored on a scale of 0–10, with higher scores indicating better quality of discharge teaching. For the Chinese version, the Cronbach's α for the overall scale is 0.79, and for the four subscales, it ranges from 0.58 to 0.83 (Bing-Hua et al., 2016). In this study, the Cronbach's α for the overall scale was 0.83, and for the subscales, it was 0.94, 0.85, and 0.85, respectively.

4.4.4. Self-Rating Scale of Systemic Family Dynamics (SSFD).

Family dynamic traits were assessed using the 23-item Chinese version of the SSFD, developed by Yu et al. (Yu et al., 2014). The SSFD includes four dimensions: Family Atmosphere (FA), Individuation (IN), System Logic (SL), and Illness Concepts (IC). Items are rated on a five-point scale, yielding total scores from 23 to 115, with higher scores indicating stronger family function. Widely used in Chinese populations, the SSFD has proven effective in healthcare contexts, particularly in assessing family function related to patients' psychological and psychosocial health (Shi et al., 2022; Yang et al., 2021). In this study, the Cronbach's α for the overall scale was 0.80, with values of 0.71, 0.60, 0.84, and 0.75 for the four subscales, respectively.

4.5. **Data collection**

After obtaining permission from the authors to use the scales, a pilot survey was conducted to test the questionnaire's clarity, relevance, and integration into clinical practice. This pilot involved 20 patients and included preparatory training for nurses to ensure accurate administration and facilitate patient understanding. The pilot data were excluded from the final analysis and were solely used to assess the operational aspects of the data collection process. The pilot also examined the clarity of

instructional materials and the practical integration of the survey into standard nursing workflows. Six nurses per shift were trained to incorporate questionnaire distribution into their discharge responsibilities. Qualified nurses, acting as bedside professional caregivers for patients who had experience an AMI, distributed paper questionnaires to participants within 24 hours of their planned discharge. These nurses received comprehensive training to ensure consistent administration of the survey and to address any participant questions. To encourage engagement and ensure data accuracy, the study emphasized confidentiality and voluntary participation, assuring patients of their anonymity. The CCU nurse manager supervised data collection in alignment with the study protocol to ensure timely resolution of any issues and adherence to methodological standards. Key responsibilities included preparation of the questionnaires, overseeing the timing of survey distribution, facilitating communication with patients to obtain informed consent, and verifying the completeness of survey responses. Regular audits conducted by additional investigators further ensured data integrity throughout the process. Missing or incomplete responses were documented for follow-up. This rigorous approach aimed to enhance the quality and reliability of the study findings.

The data collection process began in January 2021 and followed a structured protocol. A total of 489 patients responded to the survey by November 2023. Of these, 411 (84.04%) were included, while 78 participants were excluded from the analysis due to incomplete responses or inconsistencies in reported discharge times. These exclusions were primarily attributed to disruptions caused by the COVID-19 pandemic, including: (1) rapid bed turnover during the nationwide easing of restrictions, which led to accelerated transfers from the CCU to general cardiology wards within the same hospital, resulting in classification as discharged from the CCU; (2) communication barriers during lockdown periods, when family visitation was restricted, limiting caregiver support for questionnaire completion; and (3) breakdowns in community coordination, such as transportation delays, which caused discrepancies between recorded discharge times and actual patient departures, as some patients remained

hospitalized while awaiting community-based support services.

### 4.6. **Data analysis**

Data management was conducted using Excel, with analysis performed using SPSS 26.0 (IBMCorp, 2019) and Stata 18.0 software (StataCorp, 2023), along with additional Stata packages (Calonico et al., 2017; Cattaneo et al., 2018). Sample size determination was guided by the Fisherian inference framework for Regression Discontinuity Designs, which optimizes bandwidth selection to ensure valid inference in finite samples (Cattaneo et al., 2023). In this study, the bandwidth selection test identified the 50% optimal bandwidth (–4.33 to 4.33) as most appropriate, with a statistically significant p-value of 0.019 (< 0.05), confirming an adequate and statistically valid sample size **(see Supplementary Table 1).**

To address study objective 1—evaluating the impact of organizational changes driven by public health policies on discharge readiness during the COVID-19 pandemic across three stages, this study employed regression discontinuity in time (RDiT), an extension of the regression discontinuity design (RDD) tailored for time-series data. In this approach, time was treated as a continuous variable, with policy interventions assigned based on predefined temporal thresholds (Yu et al., 2022). RDiT was chosen for three primary reasons: (1) it isolates the causal impact of policy changes while minimizing confounding factors (Maciejewski & Basu, 2020); (2) it accommodates imprecise policy implementation timings, allowing for causal estimation by comparing outcomes before and after the policy cut-off (Kim, Lee, Oh, & Park, 2022); and (3) it helps quantify the impact of difficult-to-measure policy changes using a temporal cutoff. The analysis followed established guidelines (Calonico et al., 2024), the analysis incorporated key steps, including model specification, graphical representation of discontinuities, establishment of the analytical framework, robustness testing, and validation, while also accounting for potential issues related to imperfect compliance.

In the RDiT framework, model specification involved three key components: (1)

discharge time, measured weekly, as the running variable; (2) the nationwide epidemic prevention policy implemented on February 23, 2023, as the time cut-off; and (3) COVID-19 control policy changes as the treatment variable. Before this cut-off, strict control measures were enforced, whereas after this point, policies were assumed to have been lifted. The RHDS scores served as the outcome variable (see **supplementary Table 2**). Additionally, several covariates, identified through a comprehensive literature review, were incorporated to adjust for potential confounding factors (Maciejewski & Basu, 2020). In this context, "discontinuity" refers to a shift in the probability of being influenced by organizational environmental changes—specifically, the policy-driven adjustments introduced during public health emergencies—upon crossing the designated temporal threshold (Calonico et al., 2024). To visualize the relationship between RHDS scores and time, binned scatterplots were generated using global polynomial regression (see **supplementary Figure 1**). Additionally, local polynomial regression was performed to assess the impact of organizational changes driven by public health policy on patient-perceived discharge readiness during COVID-19. A "jump" (discontinuity) at the cutoff indicated a shift in the organizational environment, with the magnitude of the jump representing the local average treatment effect (LATE), estimating the causal effect.

For objective 2, the robustness and validity of the causal estimates were assessed through a series of sensitivity analyses, including changing polynomial test (see **supplementary Figure 2)**, continuity tests (see **supplementary table 3**), bandwidth sensitivity tests (see **supplementary table 4**), rectangular kernel test, covariate test (see **supplementary table 5**), and placebo test (see **supplementary table 6**).

For objective 3, multivariable linear regression analyses were conducted to identify independent factors associated with discharge outcomes in relation to organizational environment changes, considering individual characteristics, family dynamic variables, and the quality of nursing discharge teaching across the three stages. Statistical significance was defined as $P < 0.05$.

### 4.7. Ethical Statement

This study adhered to the principles of the Declaration of Helsinki. Ethical approval was obtained from the hospital's ethics committee (Approval No. KY2021-098-B). All participants were informed of the study objectives and provided written consent before participating at the time of hospital discharge. All collected data were securely stored in the hospital, with access restricted to authorized personnel only.

## 5. RESULTS

### 5.1. Participant Demographics

A total of 411 patients were included in the data analysis. The mean age of participants was 62.17 years, with a standard deviation of 0.59. The majority of participants were male (82.48%), married (91.71%), and retired (62.04%). Most participants (90.02%) reported no religious affiliation, and 31.39% had completed junior high school education. Regarding family income, 33.58% of participants reported a monthly income between 4,000 and 8,000 CNY, equivalent to approximately 550 to 1,100 US dollars. The majority of participants (86.61%) were covered by medical insurance. In terms of lifestyle habits, 65.45% of participants had no history of alcohol consumption, while 57.42% reported the smoking behaviour. A substantial proportion (81.02%) followed a regular daily schedule, and 60.83% exercised three to four times per week, typically for less than 30 minutes per session (46.71%). Involved post-discharge caregivers for most participants were family members (63.02%). Regarding physical health, 47.69% had hypertension/hyperlipidemia/diabetes, and 49.88% were taking between seven and ten different medications (see **Table 2**).

**Table 2. Participants' characteristics (n=411).**

### 5.2. Casual Effect of Organizational Environment on Patient-Perceived Hospital Discharge Readiness During Public Health Emergencies

#### 5.2.1. Patient-Perceived organizational environment factors and Hospital

**Discharge Readiness**

One-way analysis of variance was conducted to compare RHDS, QDTS, and SSFD scores across the three stages defined by the identified time points. The lowest scores across all three measures were observed in Stage 2, corresponding to the period of strict lockdown policies that significantly disrupted the organizational environment. In contrast, the highest scores were recorded in Stage 3, following the relaxation of these measures (see **Supplementary Table 2**). A statistically significant difference was found in SSFD scores across the stages ($p < 0.001$), with Stage 2 showing the lowest level of patient-perceived family support.

### 5.2.2. Effect of Organizational Environment on Patient-Perceived Hospital Discharge Readiness

The regression analysis identified a statistically significant discontinuity at the cutoff point between Stage 2 and Stage 3, but not between Stage 1 and Stage 2. As illustrated in Figure 1, the estimated coefficient of -21.612 corresponds to the average treatment effect, indicating that the public health policy changes, marked by the initiation of nationwide epidemic prevention measures on February 23, 2023, were associated with a 21.612 percentage point reduction in readiness for hospital discharge (SE = 7.082, 95% CI: -35.387 to -7.837, P = 0.002). In contrast, no statistically significant discontinuity was observed at the Stage 1 to Stage 2 transition. The estimated coefficient was –20.452 (SE = 10.727; 95% CI: –47.487 to 0.573; P = 0.057), indicating that organizational changes during this earlier phase were not associated with a significant change in discharge readiness.

**Figure 1. Regression-discontinuity design with optimal bandwidth and default triangular kernel in order 4 across three stages.**

### 5.2.3. Robustness checks and validation

To confirm the validity of the observed discontinuity, multiple robustness checks were conducted. Continuity tests indicated no significant discontinuities in covariates

except for weekly exercise duration (Coef. = 1.411, p > 0.05, 95% CI: 0.538 to 2.284) and QDTS scores (Coef. = –14.006, p > 0.05, 95% CI: –27.719 to 0.293), supporting covariate balance at the cutoff (see **Supplementary Table 3**). Bandwidth sensitivity tests revealed consistent results, with lwald values remaining significantly negative (*P* < 0.05) and overlapping confidence intervals, which affirmed the stability of the estimated treatment effect across different bandwidths (see **Supplementary Table 4 and Supplementary Figure 3**). Kernel sensitivity tests comparing rectangular and triangular kernels revealed only a minor change in the lwald estimate (Δ = 0.241), with the treatment effect remaining statistically significant (p = 0.001), further substantiating the reliability of the RDiT model (see **Supplementary Table 5** and **Supplementary Figure 4 and 5**). Additionally, covariate-adjusted models yielded a significant local average treatment effect (lwald = –22.962; SE = 4.481; 95% CI: –31.745 to –14.178; p < 0.001) (P < 0.001), confirming the exchangeability of the running variable (see **Supplementary Table 5** and **Supplementary Figure 4**). Placebo tests yielded effects close to zero compared to the main treatment effect estimate of –19.727%, further validating the cutoff and affirming the robustness of the model (see **Supplementary Table 6).**

### 5.3. Association between Influencing Factors and Readiness for Hospital Discharge Across Three Stages

Across all three stages, higher SSFD scores (family support) and QDTS scores (quality of discharge teaching) were significantly associated with greater discharge readiness. In Stage 1 (regular COVID-19 prevention), older age was negatively associated with RHDS scores (β = –0.324; 95% CI: –0.492 to –0.156; P < 0.001), while higher education (β = 2.336; 95% CI: 0.793 to 3.878; P < 0.001) and lower family income (β = –1.793; 95% CI: –3.272 to –0.314; P < 0.001) were significantly associated with higher discharge readiness (see **Table 3**).

**Table 3. Associations Between Individual, Family, and Organizational Factors and RHDS Scores Across Three Stages of COVID-19 Policy Change (N = 411).**

## 6. DISCUSSION

This study is the first to explore the effects of the organizational environment on patients' perceived readiness for hospital discharge among individuals who have experienced acute myocardial infarction during the Covid-19 pandemic. Utilizing a regression discontinuity design, the findings indicate that shifts in public health policy can drive substantial organizational environment change, which subsequently impacts patients' perceptions of discharge preparedness.

A key finding of this study is the significant decline in patients' perceived readiness for hospital discharge following the relaxation of COVID-19 lockdown measures in Shanghai. The transition from Stage 2 to Stage 3 was associated with a 21.6 percentage point reduction in discharge readiness, indicating a substantial and immediate impact of the policy shift. This decline likely reflects increased hospital turnover and accelerated discharges driven by the post-lockdown surge in infections, which constrained the delivery of face-to-face health education and disrupted communication among healthcare providers, patients, and caregivers. Beyond organizational strain, the decrease in readiness also underscores the broader physical and psychological burdens experienced by patients during this period. Individuals recovering from AMI faced heightened vulnerability due to the long-term cardiovascular sequelae of COVID-19 (Raman et al., 2022), compounding concerns about recovery and mortality risk. Hospitalization during periods of high COVID-19 incidence was associated with increased 30-day mortality and readmission rates (Glance et al., 2023). Patients also reported elevated stress and health-related anxieties(Goda et al., 2021), while the sudden spike in healthcare demand placed additional burdens on families and clinical staff (Dhuper et al., 2022). These findings highlight how public health emergencies can produce enduring disruptions in discharge preparation and underscore the need for systems-level interventions to support safe transitions of care during crisis periods (Ryan et al., 2023).

Another notable finding relates to the transition from Stage 1 to Stage 2, characterized

by Shanghai's citywide emergency lockdown and hospital-level organizational changes, which corresponded to a 20.5 percentage point decline in discharge readiness, though this was not statistically significant ($p = 0.057$). Hospitals' prior experience with stringent infection control may have mitigated immediate disruptions, leading to more gradual effects of organizational adjustments. Adaptation periods and buffering mechanisms likely delayed impacts on clinical practice. Nonetheless, intensified restrictions placed significant physical and emotional strain on healthcare staff, limiting their ability to adequately prepare patients for discharge (Lancet, 2023). The surge in infections disrupted standard care processes, delaying usual care and preventing healthcare providers from fully addressing discharge preparation (Kang et al., 2020; Zhang et al., 2021). This situation raised concerns that, without proper discharge preparation, patients might face increased risks of adverse outcomes, including readmissions for cardiac events (Rattka et al., 2020). Prior research has demonstrated that hospitals with robust nursing work environments are more effective at implementing discharge planning, thereby improving patient outcomes (Carson et al., 2016; Lasater et al., 2024; Wang, Shao, et al., 2024). These findings highlight the need to strengthen hospital preparedness and invest in nursing workforce capacity during non-crisis periods to enhance discharge outcomes during future public health emergencies (Mohtady Ali et al., 2025).

This study confirmed that individual-level factors, such as age and education, independently influence discharge outcomes within the context of organizational environment changes affecting family visitation and discharge policies (Mabire, Bachnick, Ausserhofer, Simon, et al., 2019). Consistent with prior research, family support plays a pivotal role in reducing hospital readmissions during transitional care (Chartrand et al., 2023; Eskes et al., 2023; Levoy et al., 2022). Family caregivers are instrumental in identifying medication-related issues, providing financial assistance, and alleviating emotional distress (Lin et al., 2022; Tobiano et al., 2021). As highlighted by Eskes et al., family involvement is integral to both discharge planning and post-hospital care (Eskes et al., 2023). The presence of a partner during the initial phase of

discharge has been shown to be particularly beneficial for Patients who have had an AMI (Qin et al., 2022). However, public health emergencies often lead to sudden disruptions in family dynamics, complicating caregiving roles (Guo et al., 2021). Therefore, nurses should deliver targeted education to patients and families, especially during lockdowns or ward isolation, as effective health education enhances caregiving preparedness and improves post-discharge outcomes (Cherlin et al., 2013). This study further emphasizes the critical role of nurses' discharge teaching in enhancing patient readiness for discharge. Healthcare workers' response capacities during public health emergencies are vital in maintaining discharge readiness. Researches have suggested that experienced and mentally resilient healthcare workers, particularly nurses, exhibit stronger response capacities compared to physicians (He et al., 2024; Tang et al., 2022; Wang, Lian, et al., 2024). These findings underscore the importance of future research on health system resilience and the dynamics between patients and nursing professionals to optimize workforce planning for high-risk populations, such as patients with AMI.

### 6.1. **Implications for the future research and clinical practice**

Ensuring the continuity and quality of routine healthcare services during public health emergencies is critical, particularly in transitional care processes such as discharge preparation and chronic disease management with the nurse central to the transitional process. Hospital administrators are encouraged to develop adaptable clinical support systems capable of rapid implementation in response to major policy shifts. These systems may include digital discharge guidance tools, multi-modal patient education platforms (e.g., telehealth consultations), and strengthened communication channels between nursing staff and family caregivers. Future research should rigorously examine organisational stressors—such as nursing burnout, resource shortages, and delays in care delivery—and their impact on discharge readiness during crises. Quantitative studies are warranted to monitor the prevalence of these stressors among patients with AMI, employing validated burnout assessment

instruments tailored to cardiac care providers. Furthermore, prospective cohort studies leveraging dedicated AMI registries across multiple institutions are needed to elucidate the longitudinal effects of care disruptions on patient outcomes, including readmission rates, cardiac functional recovery, and health-related quality of life, particularly among patients affected by COVID-19-related complications or those whose care pathways were significantly disrupted.

In addition, the critical role of family support in discharge readiness necessitates further exploration. Greater emphasis should be placed on systematically incorporating family caregivers into discharge planning and enhancing their engagement through targeted educational interventions and this could be facilitated by nurses. These interventions should address critical domains such as medication adherence, early identification of clinical deterioration, and the promotion of healthy behaviors among AMI survivors. Moreover, the preparedness and resilience of healthcare professionals—particularly nursing staff—constitute a foundational element of effective care delivery during public health emergencies. Strategic workforce planning, encompassing the establishment of rapid-response teams supported by emergency responders, should be prioritized to strengthen care capacity. Equally critical is the evaluation of institutional policies designed to support healthcare professionals engaged in intensive, high-stakes patient care. Empirical analyses of hospitals employing diverse mental health support strategies may yield valuable insights into best practices for safeguarding workforce well-being and maintaining the continuity of high-quality care in crisis situations.



### 6.2. **Limitations**

This study acknowledges several limitations that should be considered when interpreting the findings. The sample was collected from a single tertiary hospital, which may limit the representative of the population. Future research should aim to expand the scope by including multiple hospitals across different regions to enhance the external validity of the findings. Additionally, while the RDiT methodology is a

powerful tool for causal inference, its application in this study warrants further discussion (Dang & Trinh, 2021). The simultaneous implementation of policies across all observations may lead to an underestimation of cross-sectional differences due to spatial correlation. Furthermore, when utilizing a small bandwidth near the cutoff, there may be insufficient observations for accurate calculations, prompting researchers to rely on samples further from the cutoff, which could compromise the accuracy of the results(Hausman & Rapson, 2018). Consequently, the estimates derived from RDiT reflect not only the causal treatment effect but also potential unobserved factors such as sorting, anticipation, adaptation, and avoidance, which cannot be tested directly. Therefore, the extent to which the results should be interpreted as purely reflecting the causal treatment effect depends on future advancements in the methodology. Additionally, the study treated the general effects of organizational contexts as a comprehensive factor without detailed examination. Future investigations should refine the specific effects of various components of organizational contexts, such as workforce allocation and family involvement, on readiness for hospital discharge, particularly in the context of public health emergencies.

## 7. CONCLUSION

This study highlights the significant impact of organizational environments on patient-perceived hospital discharge readiness among populations with acute myocardial infarction during PHEs. The findings emphasize the imperative for healthcare systems worldwide to formulate adaptive policies and implement support programs that optimize discharge processes and ensure continuity of care amid PHEs. Establishing resilient, evidence-based, and nurse-led discharge preparedness protocols is essential to enhance healthcare system responsiveness and improve patient outcomes in the face of future health crises.

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# Evaluating the Effects of Organizational Environment on Patient-Perceived Hospital Discharge Readiness Among Patients with Acute Myocardial Infarction During Public Health Emergencies: An Observational Study


## ABSTRACT

**Aims:** To evaluate the effects of the organizational environment on hospital discharge readiness during public health emergencies.

**Design:** An observational study.

**Methods:** A regression-discontinuity design approach was employed to assess the impact of the organizational environment on hospital discharge readiness. Adult patients diagnosed with acute myocardial infarction and discharged from the Cardiac Critical Care Unit of a tertiary hospital in Shanghai, China, were recruited. Spearman correlation analysis was conducted to examine the associations between multiple factors at individual and organizational levels and hospital discharge readiness across three stages of pandemic policy changes.

**Results:** A total of 411 patients were included in the analysis. The regression-discontinuity analysis revealed a significant discontinuity at the cut-off, indicating that policy-driven changes in the organizational environment during public health emergencies were associated with a 21.61% reduction in hospital discharge readiness. Additionally, family functioning and the quality of nursing discharge education were significantly associated with discharge readiness across all three pandemic stages.

**Conclusions:** These findings demonstrate that patient-perceived hospital discharge readiness is significantly influenced by changes in the organizational environment during public health emergencies. Future research should focus on developing targeted discharge preparation programs that allow for organizational adaptation in response to emergencies, such as pandemics or natural disasters.

**Implications for patient care:** Organizational responses to public health emergencies need to prioritize enhancing discharge preparedness. This includes bolstering family involvement and ensuring that nurses are adequately trained to provide effective discharge education, especially when healthcare resources are strained.

**Impact:** The findings underscore the importance of adaptable and resilient discharge planning and transitional care, particularly in public health emergencies. Fostering an organizational environment that supports seamless discharge processes can significantly improve patient readiness for post-hospital care**.**

**Reporting Methods:** Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement.

**Patient or Public Contribution:** No patient or Public Contributions.

**Key words:** transitional care; regression-discontinuity design; hospital discharge; acute myocardial infarction; organizational factors; public health emergencies; COVID-19

**Contribution to Global Clinical Community**

- This study underscores the importance of healthcare systems globally adapting to unforeseen crises while ensuring the continuity of high-quality patient care.
- It highlights the critical roles of family involvement, nursing education, and policy-driven organizational changes, advocating for flexible and resilient discharge strategies to support patients during emergencies in various healthcare settings.

## 1. Introduction

Acute myocardial infarction (AMI) is a leading cause of mortality worldwide, with approximately 9 million deaths annually (WHO, 2020). The damage of AMI extend beyond the acute event, impacting patients' physical health, psychological well-being

and quality of life after discharge (Radaideh et al., 2024). Due to poor adherence to long-term treatment plans, inadequate discharge education and difficulties in accepting a diagnosis of cardiovascular disease as a chronic condition, patients who have had an AMI often face significant discharge challenges (Hydzik et al., 2021; Kosobucka et al., 2022; Rotvig et al., 2021). Studies have shown process-related factors (i.e., unit, nurse and patient characteristics), structure-related factors (i.e., teaching of self-care and symptom management) and organizational factors related to the hospital environment are thought to influence patient-perceived readiness for hospital discharge (Mabire, Bachnick, Ausserhofer, & Simon, 2019). While previous studies have predominantly examined individual determinants of discharge readiness, less attention has been given to the role of environmental and organizational factors. In particular, during public health emergencies (PHEs) such as the COVID-19 pandemic, abrupt policy changes and instability within the healthcare system have introduced additional challenges, potentially exacerbating discharge difficulties. However, the extent to which changes in the organizational environment during PHEs influence hospital discharge readiness remains insufficiently explored (Wallace et al., 2023).

## 2. Background

Discharge preparation is crucial for patients with AMI, as inadequate transitional care can lead to poor outcomes. A five-year analysis revealed that 19% of hospitalized patients who have had an AMI did not survive, highlighting the link between mortality and cardiovascular risk factors such as hypertension, hyperlipidemia, diabetes, and smoking (Rohani et al., 2022). One in every 40 patients experiences a recurrent AMI within one year, with over one-third of these events occurring within the first 30 days post-discharge (Song et al., 2020). This underscores the critical importance of discharge preparation and transition for patients who have experienced an AMI. Higher levels of readiness for hospital discharge are associated with a reduced risk of readmission or mortality within the first 30 days, better management of modifiable factors such as diet, physical activity, and medication adherence, and improved long-

term recovery. This, in turn, helps mitigate the risk of further cardiovascular complications, such as recurrent heart attacks and heart failure (Hu, 2024; Kolarczyk et al., 2023; Lau et al., 2016; Rotvig et al., 2021).

Readiness for hospital discharge refers to patients' ability to manage their care in the community following a transition from acute care (Titler & Pettit, 1995). Effective discharge preparation depends on patients' psychological and demographic factors, such as educational attainment, as well as the duration of hospitalization and rehabilitation (Hydzik et al., 2021). Additionally, family interdependence and the ability to cope with communication-related stress are crucial for facilitating a smooth transition (Poh et al., 2020), particularly in managing emotional distress and functional dependence (Presciutti et al., 2024). However, existing research predominantly focuses on individual or nurse-centered factors while overlooking the broader organizational environment, which is particularly critical during public health emergencies. The COVID-19 pandemic, for example, created unprecedented challenges in hospital management, staffing, and patient care continuity, with lockdowns, healthcare delays, and workforce shortages significantly disrupting care delivery (Wallace et al., 2024). Studies indicate that hospital admissions for AMI declined during the first lockdown without a corresponding reduction in 30-day mortality rates (Lavie et al., 2022). Patients with AMI experienced significantly longer times from symptom onset to hospital admission during the pandemic and nearly three times the risk of developing complications compared to prior periods (Gramegna et al., 2020; Tomasoni et al., 2020). This disruption has led to higher out-of-hospital mortality rates for these patients (Braiteh et al., 2020; Santi et al., 2021; Solomon et al., 2020). The lack of research on organizational influences during crises hinders the development of adaptive discharge programs, underscoring the need for strategies that ensure continuity of care in emergency settings.

The organizational environment is fundamental to effective discharge preparation, particularly during the transition from routine operations to public health

emergencies. Donabedian's structure-process-outcome paradigm provides a framework for evaluating hospital discharge quality from an organizational perspective, emphasizing the role of resources and interventions (Donabedian, 2005). Key organizational environment, including traits such as the nursing workforce, leadership, support, skill mix, and staffing, significantly impact discharge readiness (Mabire, Bachnick, Ausserhofer, & Simon, 2019) and dynamically adjust in response to health policy changes (Aarons et al., 2012; Tangcharoensathien et al., 2017). These factors interactively influence the ability and willingness of both patients and clinicians to engage in shared decision-making, a key component in the quality of nursing discharge education (Hendriks & Lee, 2020). Additionally, the clinical professional practice environment can serve as both a barrier and a facilitator to discharge readiness in patients with myocardial infarction (Monfared et al., 2024). While individual factors related to discharge readiness are well-established, there remains a gap in understanding how integrated organizational efforts, guided by health policy, enhance preparedness for discharge.

Failing to account for the dynamic nature of organizational contexts when evaluating factors influencing hospital discharge readiness may lead to inaccurate assessments of transitional care quality (Meleis et al., 2000). This is especially relevant in public health emergencies, which involve complex health, social, and economic consequences that disproportionately affect vulnerable populations (WHO, 2019). Organizational instability during events such as the COVID-19 pandemic has had a lasting effect on discharge readiness for patients who have had an AMI, necessitating additional interventions to mitigate adverse outcomes amid heightened hospital strain (Glance et al., 2023). Organizational challenges, including caregiver absence (Wallace et al., 2024), resource strain, and expedited discharge, also hinder patient-perceived readiness for hospital discharge (Rodrigues et al., 2024). These findings emphasize the need for further investigation into the interplay between organizational, individual, and family factors in hospital discharge, providing valuable insights for enhancing crisis preparedness and management in healthcare systems.

## 3. Study objectives

This study aimed to evaluate the impact of the organizational environment on readiness for hospital discharge during public health emergencies. The specific objectives were: 1) to assess the differences in organizational environment changed by public health policies and their effects on patient-perceived discharge readiness in PHEs; 2) to validate the effect of policy-driven organizational changes on discharge readiness; 3) to identify additional independent factors influencing discharge outcomes in relation to organizational environment changes.

## 4. Materials and Methods

### 4.1. Study Design

This study utilized an observational design as a baseline component of the Acute Myocardial Infarction Adaptation Promotion Program. This program focuses on evaluating discharge readiness and providing guidance for long-term cardiac rehabilitation and comprehensive management of AMI, with the overarching aim of preventing hospital readmission (Wang et al., 2023). The findings were reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement.

### 4.2. Study Setting

This study was conducted in the Cardiac Critical Care Unit (CCU) of a tertiary hospital with four campuses in Shanghai, China. The CCU managed patients with acute myocardial infarction across these campuses, which operated as designated hospitals adhering to pandemic control policies. Based on these policies, three distinct stages of hospital managerial measures were identified: Stage 1 (January 24, 2021, to March 28, 2022), Stage 2 (March 29, 2022, to February 23, 2023), and Stage 3 (February 24, 2023, to November 23, 2023). Across three successive stages, the organizational environment was faced with increasingly severe challenges of abrupt public health

emergencies, necessitating adjustments in hospital management, nursing workforce allocation, and family involvement in patient care (see **Table 1**).

In Stage 1, under normal care conditions, patients with AMI received transitional care services upon discharge, which included baseline health assessments such as heart ultrasounds for follow-up and potential readmission. Family caregivers were permitted to visit the CCU under strict health screening protocols. The implementation of a citywide lockdown in Shanghai on March 28, 2022, which means the shift from Stage 1 to Stage 2. During the lockdown period, nurses were required to remain in the hospital for one-month shifts, and CCU inpatients lost access to family companionship. Discharge planning became increasingly reliant on the coordination of care with community-based health services, while traffic restrictions and community lockdowns created substantial barriers to hospital readmissions, further complicating post-discharge care (Blomström-Lundqvist, 2020; Schmitz et al., 2021). Following the nationwide epidemic prevention measures implemented on February 23, 2023, significant disruptions in hospital operations emerged, marking the shift from Stage 2 to Stage 3. In Stage 3, with the relaxation of epidemic prevention policies, COVID-19 infections surged, straining medical resources, including hospital beds, equipment, and healthcare personnel, and necessitating quicker bed turnover. To minimize infection risks, home discharge became the preferred option for patients, with family caregivers assuming a greater role in post-discharge care and receiving discharge education from nurses. These stages of organizational change led to shifts in nurse-to-patient ratios, recorded as 1:1.33, 1:1.25, and 1:1.33 across the three stages, reflecting fluctuating hospital resource pressures and staffing demands.

**Table 1. Stages and Evolution of the Organizational Environment Over the Study Timeline**

### 4.3. **Participants**

Using a cluster sampling method, attending nurses recruited patients who met the

following eligibility criteria: (1) aged 18 years or older; (2) diagnosed with acute myocardial infarction by a cardiologist and having undergone percutaneous coronary intervention (PCI); (3) planned for discharge to home; and (4) fluent in Mandarin or the local dialect. Data were collected from these patients within 24 hours prior to their planned discharge with patients written consents.

### 4.4. **Study Instruments**

#### 4.4.1. Demographic and Background Information.

An investigator-developed questionnaire, informed by studies on individual factors influencing readiness for hospital discharge, was used to collect demographic and background data. This included sex, age, marital status, religion, education level, occupation, monthly family income, post-discharge caregiver involvement, alcohol and smoking behaviours, weekly exercise frequency and duration, regularity of daily routine, all of which were collected via patient self-report. Additionally, digital medical records were utilized to gather information regarding healthcare payment methods, basic medical history, and prescribed medications.

#### 4.4.2. Readiness for Hospital Discharge Scale (RHDS).

Readiness for hospital discharge was measured using the RHDS, specifically the Chinese version adapted by Lin et al. (Lin et al., 2014), based on the original work by Weiss and Piacentine (Weiss & Piacentine, 2006). The scale comprises 12 items, organized into three dimensions: Personal Status (3 items), Extramural Hospital Coping Capacity (5 items), and Expected Support (4 items). Each question is scored on a scale of 0–10, with higher total scores indicating greater readiness for discharge. The Cronbach's α for the English version is 0.89 for the total scale (Weiss & Piacentine, 2006). For the Chinese version, Cronbach's α values are 0.89 for the overall scale, and 0.73, 0.90, and 0.89 for the three subscales, respectively (Lin et al., 2014). In this study, the Cronbach's α was 0.82 for the overall scale, with 0.85, 0.87, and 0.84 for the three subscales, respectively.

4.4.3. Quality of Discharge Teaching Scale (QDTS).

Nurses' quality of discharge teaching was assessed using the Chinese version of the QDTS, originally developed by Weiss et al.(Weiss et al., 2007) and adapted by Binghua Wang (Bing-Hua et al., 2016). The scale consists of three dimensions: Required Discharge Information (6 items), Actual Obtained Information (6 items), and Discharge Teaching Skills and Effects (12 items). Each item is scored on a scale of 0–10, with higher scores indicating better quality of discharge teaching. For the Chinese version, the Cronbach's α for the overall scale is 0.79, and for the four subscales, it ranges from 0.58 to 0.83 (Bing-Hua et al., 2016). In this study, the Cronbach's α for the overall scale was 0.83, and for the subscales, it was 0.94, 0.85, and 0.85, respectively.

4.4.4. Self-Rating Scale of Systemic Family Dynamics (SSFD).

Family dynamic traits were assessed using the 23-item Chinese version of the SSFD, developed by Yu et al. (Yu et al., 2014). The SSFD includes four dimensions: Family Atmosphere (FA), Individuation (IN), System Logic (SL), and Illness Concepts (IC). Items are rated on a five-point scale, yielding total scores from 23 to 115, with higher scores indicating stronger family function. Widely used in Chinese populations, the SSFD has proven effective in healthcare contexts, particularly in assessing family function related to patients' psychological and psychosocial health (Shi et al., 2022; Yang et al., 2021). In this study, the Cronbach's α for the overall scale was 0.80, with values of 0.71, 0.60, 0.84, and 0.75 for the four subscales, respectively.

4.5. **Data collection**

After obtaining permission from the authors to use the scales, a pilot survey was conducted to test the questionnaire's clarity, relevance, and integration into clinical practice. This pilot involved 20 patients and included preparatory training for nurses to ensure accurate administration and facilitate patient understanding. The pilot data were excluded from the final analysis and were solely used to assess the operational aspects of the data collection process. The pilot also examined the clarity of

instructional materials and the practical integration of the survey into standard nursing workflows. Six nurses per shift were trained to incorporate questionnaire distribution into their discharge responsibilities. Qualified nurses, acting as bedside professional caregivers for patients who had experience an AMI, distributed paper questionnaires to participants within 24 hours of their planned discharge. These nurses received comprehensive training to ensure consistent administration of the survey and to address any participant questions. To encourage engagement and ensure data accuracy, the study emphasized confidentiality and voluntary participation, assuring patients of their anonymity. The CCU nurse manager supervised data collection in alignment with the study protocol to ensure timely resolution of any issues and adherence to methodological standards. Key responsibilities included preparation of the questionnaires, overseeing the timing of survey distribution, facilitating communication with patients to obtain informed consent, and verifying the completeness of survey responses. Regular audits conducted by additional investigators further ensured data integrity throughout the process. Missing or incomplete responses were documented for follow-up. This rigorous approach aimed to enhance the quality and reliability of the study findings.

The data collection process began in January 2021 and followed a structured protocol. A total of 489 patients responded to the survey by November 2023. Of these, 411 (84.04%) were included, while 78 participants were excluded from the analysis due to incomplete responses or inconsistencies in reported discharge times. These exclusions were primarily attributed to disruptions caused by the COVID-19 pandemic, including: (1) rapid bed turnover during the nationwide easing of restrictions, which led to accelerated transfers from the CCU to general cardiology wards within the same hospital, resulting in classification as discharged from the CCU; (2) communication barriers during lockdown periods, when family visitation was restricted, limiting caregiver support for questionnaire completion; and (3) breakdowns in community coordination, such as transportation delays, which caused discrepancies between recorded discharge times and actual patient departures, as some patients remained

hospitalized while awaiting community-based support services.

### 4.6. **Data analysis**

Data management was conducted using Excel, with analysis performed using SPSS 26.0 (IBMCorp, 2019) and Stata 18.0 software (StataCorp, 2023), along with additional Stata packages (Calonico et al., 2017; Cattaneo et al., 2018). Sample size determination was guided by the Fisherian inference framework for Regression Discontinuity Designs, which optimizes bandwidth selection to ensure valid inference in finite samples (Cattaneo et al., 2023). In this study, the bandwidth selection test identified the 50% optimal bandwidth (–4.33 to 4.33) as most appropriate, with a statistically significant p-value of 0.019 (< 0.05), confirming an adequate and statistically valid sample size **(see Supplementary Table 1).**

To address study objective 1—evaluating the impact of organizational changes driven by public health policies on discharge readiness during the COVID-19 pandemic across three stages, this study employed regression discontinuity in time (RDiT), an extension of the regression discontinuity design (RDD) tailored for time-series data. In this approach, time was treated as a continuous variable, with policy interventions assigned based on predefined temporal thresholds (Yu et al., 2022). RDiT was chosen for three primary reasons: (1) it isolates the causal impact of policy changes while minimizing confounding factors (Maciejewski & Basu, 2020); (2) it accommodates imprecise policy implementation timings, allowing for causal estimation by comparing outcomes before and after the policy cut-off (Kim, Lee, Oh, & Park, 2022); and (3) it helps quantify the impact of difficult-to-measure policy changes using a temporal cutoff. The analysis followed established guidelines (Calonico et al., 2024), the analysis incorporated key steps, including model specification, graphical representation of discontinuities, establishment of the analytical framework, robustness testing, and validation, while also accounting for potential issues related to imperfect compliance.

In the RDiT framework, model specification involved three key components: (1)

discharge time, measured weekly, as the running variable; (2) the nationwide epidemic prevention policy implemented on February 23, 2023, as the time cut-off; and (3) COVID-19 control policy changes as the treatment variable. Before this cut-off, strict control measures were enforced, whereas after this point, policies were assumed to have been lifted. The RHDS scores served as the outcome variable (see **supplementary Table 2**). Additionally, several covariates, identified through a comprehensive literature review, were incorporated to adjust for potential confounding factors (Maciejewski & Basu, 2020). In this context, "discontinuity" refers to a shift in the probability of being influenced by organizational environmental changes—specifically, the policy-driven adjustments introduced during public health emergencies—upon crossing the designated temporal threshold (Calonico et al., 2024). To visualize the relationship between RHDS scores and time, binned scatterplots were generated using global polynomial regression (see **supplementary Figure 1**). Additionally, local polynomial regression was performed to assess the impact of organizational changes driven by public health policy on patient-perceived discharge readiness during COVID-19. A "jump" (discontinuity) at the cutoff indicated a shift in the organizational environment, with the magnitude of the jump representing the local average treatment effect (LATE), estimating the causal effect.

For objective 2, the robustness and validity of the causal estimates were assessed through a series of sensitivity analyses, including changing polynomial test (see **supplementary Figure 2)**, continuity tests (see **supplementary table 3**), bandwidth sensitivity tests (see **supplementary table 4**), rectangular kernel test, covariate test (see **supplementary table 5**), and placebo test (see **supplementary table 6**).

For objective 3, multivariable linear regression analyses were conducted to identify independent factors associated with discharge outcomes in relation to organizational environment changes, considering individual characteristics, family dynamic variables, and the quality of nursing discharge teaching across the three stages. Statistical significance was defined as $P < 0.05$.

### 4.7. Ethical Statement

This study adhered to the principles of the Declaration of Helsinki. Ethical approval was obtained from the hospital's ethics committee (Approval No. KY2021-098-B). All participants were informed of the study objectives and provided written consent before participating at the time of hospital discharge. All collected data were securely stored in the hospital, with access restricted to authorized personnel only.

## 5. RESULTS

### 5.1. Participant Demographics

A total of 411 patients were included in the data analysis. The mean age of participants was 62.17 years, with a standard deviation of 0.59. The majority of participants were male (82.48%), married (91.71%), and retired (62.04%). Most participants (90.02%) reported no religious affiliation, and 31.39% had completed junior high school education. Regarding family income, 33.58% of participants reported a monthly income between 4,000 and 8,000 CNY, equivalent to approximately 550 to 1,100 US dollars. The majority of participants (86.61%) were covered by medical insurance. In terms of lifestyle habits, 65.45% of participants had no history of alcohol consumption, while 57.42% reported the smoking behaviour. A substantial proportion (81.02%) followed a regular daily schedule, and 60.83% exercised three to four times per week, typically for less than 30 minutes per session (46.71%). Involved post-discharge caregivers for most participants were family members (63.02%). Regarding physical health, 47.69% had hypertension/hyperlipidemia/diabetes, and 49.88% were taking between seven and ten different medications (see **Table 2**).

**Table 2. Participants' characteristics (n=411).**

### 5.2. Casual Effect of Organizational Environment on Patient-Perceived Hospital Discharge Readiness During Public Health Emergencies

#### 5.2.1. Patient-Perceived organizational environment factors and Hospital

**Discharge Readiness**

One-way analysis of variance was conducted to compare RHDS, QDTS, and SSFD scores across the three stages defined by the identified time points. The lowest scores across all three measures were observed in Stage 2, corresponding to the period of strict lockdown policies that significantly disrupted the organizational environment. In contrast, the highest scores were recorded in Stage 3, following the relaxation of these measures (see **Supplementary Table 2**). A statistically significant difference was found in SSFD scores across the stages ($p < 0.001$), with Stage 2 showing the lowest level of patient-perceived family support.

### 5.2.2. Effect of Organizational Environment on Patient-Perceived Hospital Discharge Readiness

The regression analysis identified a statistically significant discontinuity at the cutoff point between Stage 2 and Stage 3, but not between Stage 1 and Stage 2. As illustrated in Figure 1, the estimated coefficient of -21.612 corresponds to the average treatment effect, indicating that the public health policy changes, marked by the initiation of nationwide epidemic prevention measures on February 23, 2023, were associated with a 21.612 percentage point reduction in readiness for hospital discharge (SE = 7.082, 95% CI: -35.387 to -7.837, P = 0.002). In contrast, no statistically significant discontinuity was observed at the Stage 1 to Stage 2 transition. The estimated coefficient was –20.452 (SE = 10.727; 95% CI: –47.487 to 0.573; P = 0.057), indicating that organizational changes during this earlier phase were not associated with a significant change in discharge readiness.

**Figure 1. Regression-discontinuity design with optimal bandwidth and default triangular kernel in order 4 across three stages.**

### 5.2.3. Robustness checks and validation

To confirm the validity of the observed discontinuity, multiple robustness checks were conducted. Continuity tests indicated no significant discontinuities in covariates

except for weekly exercise duration (Coef. = 1.411, p > 0.05, 95% CI: 0.538 to 2.284) and QDTS scores (Coef. = –14.006, p > 0.05, 95% CI: –27.719 to 0.293), supporting covariate balance at the cutoff (see **Supplementary Table 3**). Bandwidth sensitivity tests revealed consistent results, with lwald values remaining significantly negative (*P* < 0.05) and overlapping confidence intervals, which affirmed the stability of the estimated treatment effect across different bandwidths (see **Supplementary Table 4 and Supplementary Figure 3**). Kernel sensitivity tests comparing rectangular and triangular kernels revealed only a minor change in the lwald estimate (Δ = 0.241), with the treatment effect remaining statistically significant (p = 0.001), further substantiating the reliability of the RDiT model (see **Supplementary Table 5** and **Supplementary Figure 4 and 5**). Additionally, covariate-adjusted models yielded a significant local average treatment effect (lwald = –22.962; SE = 4.481; 95% CI: –31.745 to –14.178; p < 0.001) (P < 0.001), confirming the exchangeability of the running variable (see **Supplementary Table 5** and **Supplementary Figure 4**). Placebo tests yielded effects close to zero compared to the main treatment effect estimate of –19.727%, further validating the cutoff and affirming the robustness of the model (see **Supplementary Table 6).**

### 5.3. Association between Influencing Factors and Readiness for Hospital Discharge Across Three Stages

Across all three stages, higher SSFD scores (family support) and QDTS scores (quality of discharge teaching) were significantly associated with greater discharge readiness. In Stage 1 (regular COVID-19 prevention), older age was negatively associated with RHDS scores (β = –0.324; 95% CI: –0.492 to –0.156; P < 0.001), while higher education (β = 2.336; 95% CI: 0.793 to 3.878; P < 0.001) and lower family income (β = –1.793; 95% CI: –3.272 to –0.314; P < 0.001) were significantly associated with higher discharge readiness (see **Table 3**).

**Table 3. Associations Between Individual, Family, and Organizational Factors and RHDS Scores Across Three Stages of COVID-19 Policy Change (N = 411).**

## 6. DISCUSSION

This study is the first to explore the effects of the organizational environment on patients' perceived readiness for hospital discharge among individuals who have experienced acute myocardial infarction during the Covid-19 pandemic. Utilizing a regression discontinuity design, the findings indicate that shifts in public health policy can drive substantial organizational environment change, which subsequently impacts patients' perceptions of discharge preparedness.

A key finding of this study is the significant decline in patients' perceived readiness for hospital discharge following the relaxation of COVID-19 lockdown measures in Shanghai. The transition from Stage 2 to Stage 3 was associated with a 21.6 percentage point reduction in discharge readiness, indicating a substantial and immediate impact of the policy shift. This decline likely reflects increased hospital turnover and accelerated discharges driven by the post-lockdown surge in infections, which constrained the delivery of face-to-face health education and disrupted communication among healthcare providers, patients, and caregivers. Beyond organizational strain, the decrease in readiness also underscores the broader physical and psychological burdens experienced by patients during this period. Individuals recovering from AMI faced heightened vulnerability due to the long-term cardiovascular sequelae of COVID-19 (Raman et al., 2022), compounding concerns about recovery and mortality risk. Hospitalization during periods of high COVID-19 incidence was associated with increased 30-day mortality and readmission rates (Glance et al., 2023). Patients also reported elevated stress and health-related anxieties(Goda et al., 2021), while the sudden spike in healthcare demand placed additional burdens on families and clinical staff (Dhuper et al., 2022). These findings highlight how public health emergencies can produce enduring disruptions in discharge preparation and underscore the need for systems-level interventions to support safe transitions of care during crisis periods (Ryan et al., 2023).

Another notable finding relates to the transition from Stage 1 to Stage 2, characterized

by Shanghai's citywide emergency lockdown and hospital-level organizational changes, which corresponded to a 20.5 percentage point decline in discharge readiness, though this was not statistically significant ($p = 0.057$). Hospitals' prior experience with stringent infection control may have mitigated immediate disruptions, leading to more gradual effects of organizational adjustments. Adaptation periods and buffering mechanisms likely delayed impacts on clinical practice. Nonetheless, intensified restrictions placed significant physical and emotional strain on healthcare staff, limiting their ability to adequately prepare patients for discharge (Lancet, 2023). The surge in infections disrupted standard care processes, delaying usual care and preventing healthcare providers from fully addressing discharge preparation (Kang et al., 2020; Zhang et al., 2021). This situation raised concerns that, without proper discharge preparation, patients might face increased risks of adverse outcomes, including readmissions for cardiac events (Rattka et al., 2020). Prior research has demonstrated that hospitals with robust nursing work environments are more effective at implementing discharge planning, thereby improving patient outcomes (Carson et al., 2016; Lasater et al., 2024; Wang, Shao, et al., 2024). These findings highlight the need to strengthen hospital preparedness and invest in nursing workforce capacity during non-crisis periods to enhance discharge outcomes during future public health emergencies (Mohtady Ali et al., 2025).

This study confirmed that individual-level factors, such as age and education, independently influence discharge outcomes within the context of organizational environment changes affecting family visitation and discharge policies (Mabire, Bachnick, Ausserhofer, Simon, et al., 2019). Consistent with prior research, family support plays a pivotal role in reducing hospital readmissions during transitional care (Chartrand et al., 2023; Eskes et al., 2023; Levoy et al., 2022). Family caregivers are instrumental in identifying medication-related issues, providing financial assistance, and alleviating emotional distress (Lin et al., 2022; Tobiano et al., 2021). As highlighted by Eskes et al., family involvement is integral to both discharge planning and post-hospital care (Eskes et al., 2023). The presence of a partner during the initial phase of

discharge has been shown to be particularly beneficial for Patients who have had an AMI (Qin et al., 2022). However, public health emergencies often lead to sudden disruptions in family dynamics, complicating caregiving roles (Guo et al., 2021). Therefore, nurses should deliver targeted education to patients and families, especially during lockdowns or ward isolation, as effective health education enhances caregiving preparedness and improves post-discharge outcomes (Cherlin et al., 2013). This study further emphasizes the critical role of nurses' discharge teaching in enhancing patient readiness for discharge. Healthcare workers' response capacities during public health emergencies are vital in maintaining discharge readiness. Researches have suggested that experienced and mentally resilient healthcare workers, particularly nurses, exhibit stronger response capacities compared to physicians (He et al., 2024; Tang et al., 2022; Wang, Lian, et al., 2024). These findings underscore the importance of future research on health system resilience and the dynamics between patients and nursing professionals to optimize workforce planning for high-risk populations, such as patients with AMI.

### 6.1. **Implications for the future research and clinical practice**

Ensuring the continuity and quality of routine healthcare services during public health emergencies is critical, particularly in transitional care processes such as discharge preparation and chronic disease management with the nurse central to the transitional process. Hospital administrators are encouraged to develop adaptable clinical support systems capable of rapid implementation in response to major policy shifts. These systems may include digital discharge guidance tools, multi-modal patient education platforms (e.g., telehealth consultations), and strengthened communication channels between nursing staff and family caregivers. Future research should rigorously examine organisational stressors—such as nursing burnout, resource shortages, and delays in care delivery—and their impact on discharge readiness during crises. Quantitative studies are warranted to monitor the prevalence of these stressors among patients with AMI, employing validated burnout assessment

instruments tailored to cardiac care providers. Furthermore, prospective cohort studies leveraging dedicated AMI registries across multiple institutions are needed to elucidate the longitudinal effects of care disruptions on patient outcomes, including readmission rates, cardiac functional recovery, and health-related quality of life, particularly among patients affected by COVID-19-related complications or those whose care pathways were significantly disrupted.

In addition, the critical role of family support in discharge readiness necessitates further exploration. Greater emphasis should be placed on systematically incorporating family caregivers into discharge planning and enhancing their engagement through targeted educational interventions and this could be facilitated by nurses. These interventions should address critical domains such as medication adherence, early identification of clinical deterioration, and the promotion of healthy behaviors among AMI survivors. Moreover, the preparedness and resilience of healthcare professionals—particularly nursing staff—constitute a foundational element of effective care delivery during public health emergencies. Strategic workforce planning, encompassing the establishment of rapid-response teams supported by emergency responders, should be prioritized to strengthen care capacity. Equally critical is the evaluation of institutional policies designed to support healthcare professionals engaged in intensive, high-stakes patient care. Empirical analyses of hospitals employing diverse mental health support strategies may yield valuable insights into best practices for safeguarding workforce well-being and maintaining the continuity of high-quality care in crisis situations.

### 6.2. **Limitations**

This study acknowledges several limitations that should be considered when interpreting the findings. The sample was collected from a single tertiary hospital, which may limit the representative of the population. Future research should aim to expand the scope by including multiple hospitals across different regions to enhance the external validity of the findings. Additionally, while the RDiT methodology is a

powerful tool for causal inference, its application in this study warrants further discussion (Dang & Trinh, 2021). The simultaneous implementation of policies across all observations may lead to an underestimation of cross-sectional differences due to spatial correlation. Furthermore, when utilizing a small bandwidth near the cutoff, there may be insufficient observations for accurate calculations, prompting researchers to rely on samples further from the cutoff, which could compromise the accuracy of the results(Hausman & Rapson, 2018). Consequently, the estimates derived from RDiT reflect not only the causal treatment effect but also potential unobserved factors such as sorting, anticipation, adaptation, and avoidance, which cannot be tested directly. Therefore, the extent to which the results should be interpreted as purely reflecting the causal treatment effect depends on future advancements in the methodology. Additionally, the study treated the general effects of organizational contexts as a comprehensive factor without detailed examination. Future investigations should refine the specific effects of various components of organizational contexts, such as workforce allocation and family involvement, on readiness for hospital discharge, particularly in the context of public health emergencies.

## 7. CONCLUSION

This study highlights the significant impact of organizational environments on patient-perceived hospital discharge readiness among populations with acute myocardial infarction during PHEs. The findings emphasize the imperative for healthcare systems worldwide to formulate adaptive policies and implement support programs that optimize discharge processes and ensure continuity of care amid PHEs. Establishing resilient, evidence-based, and nurse-led discharge preparedness protocols is essential to enhance healthcare system responsiveness and improve patient outcomes in the face of future health crises.

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**Table 1.** Stages and Evolution of the Organizational Environment Over the Study Timeline

| Time period | Stage | Pandemic control policy | Changes in organizational environment | Nurse-to-Patient Ratio |
|---|---|---|---|---|
| Jan 24, 2021 – Mar 28, 2022 | Stage 1 | Regular COVID-19 prevention & control | Family visits allowed under strict screening<br>Transitional care services (e.g., health assessments, follow-up ultrasounds) | 1:1.33 |
| Mar 29, 2022 – Feb 23, 2023 | Stage 2 | Shanghai citywide emergency lockdown | Nurses worked in closed-loop shifts (1 month)<br>Family visits banned<br>Discharge planning reliant on strained community services | 1:1.25 |
| Feb 24, 2023 – Nov 23, 2023 | Stage 3 | Nationwide relaxation of epidemic prevention policies | Surge in infections strained resources (beds, staff)<br>Home discharge prioritized;<br>Nurses trained family caregivers | 1:1.33 |

**Table 2.** Participants' characteristics (N=411).

| | Stage 1 (n=198) | Stage 2 (n=117) | Stage 3 (n=96) | Total |
|---|---|---|---|---|
| Sex, n(%) | | | | |
| Male | 157(38.20) | 106(25.79) | 76(18.49) | 339(82.48) |
| Female | 41(9.98) | 11(2.68) | 20(4.87) | 72(17.52) |
| Age, Mean(SD) | 62.61(0.87) | 62.48(1.03) | 60.79(1.31) | 62.17(0.59) |
| Marital status, n(%) | | | | |
| Unmarried | 7(1.71) | 4(0.98) | 5(1.22) | 16(3.90) |
| Married | 186(45.37) | 104(25.37) | 86(20.98) | 377(91.71) |
| Divorced or widowed | 5(1.22) | 8(1.95) | 5(1.22) | 18(4.39) |
| Religion, n(%) | | | | |
| No | 178(43.31) | 108(26.28) | 84(20.44) | 370(90.02) |
| Buddhism | 15(3.65) | 5(1.22) | 10(2.43) | 30(7.30) |
| Christianity | 3(0.73) | 1(0.24) | 1(0.24) | 5(1.22) |
| Others | 2(0.49) | 3(0.73) | 1(0.24) | 6(1.46) |
| Educational level, n(%) | | | | |
| Primary school or below | 17(4.19) | 13(3.20) | 7(1.72) | 37(9.00) |
| Junior high school | 69(17.00) | 31(7.64) | 29(7.14) | 129(31.39) |
| High School or technical secondary school | 50(12.32) | 31(7.64) | 29(7.14) | 115(27.98) |
| Junior college | 27(6.65) | 10(2.46) | 14(3.45) | 51(12.41) |
| University | 30(7.39) | 21(5.17) | 16(3.94) | 67(16.30) |
| Postgraduate or above | 5(1.23) | 4(0.99) | 3(0.74) | 12(2.92) |
| Occupation, n(%) | | | | |
| On the job | 63(17.45) | 36(9.97) | 33(9.14) | 132(32.12) |
| Retired | 124(34.35) | 72(19.94) | 9(2.49) | 255(62.04) |
| Without a job | 11(3.05) | 9(2.49) | 4(1.11) | 24(5.84) |
| Monthly family income, n(%) | | | | |
| <4000 | 27(6.59) | 13(3.17) | 9(2.20) | 49(11.92) |
| 4000-8000 | 66(16.10) | 33(8.05) | 39(9.51) | 138(33.58) |
| 8000-12000 | 50(12.20) | 34(8.29) | 18(4.39) | 102(24.82) |
| 12000-16000 | 27(6.59) | 16(3.90) | 13(3.17) | 56(13.63) |
| >16000 | 27(6.59) | 21(5.12) | 17(4.15) | 65(15.82) |
| Post-discharge caregiver involvement, n(%) | | | | |
| By oneself | 62(15.09) | 30(7.30) | 31(7.54) | 123(29.93) |
| Others | 123(29.93) | 76(18.49) | 60(14.60) | 259(63.02) |
| Both | 13(3.16) | 11(2.68) | 5(1.22) | 29(7.05) |
| Healthcare payment method, n(%) | | | | |
| Self-financing | 12(2.92) | 11(2.68) | 6(1.46) | 29(7.06) |

| | | | | |
|---|---|---|---|---|
| Medical insurance | 172(41.85) | 97(23.60) | 87(21.17) | 356(86.61) |
| Others | 14(3.41) | 9(2.19) | 3(0.73) | 26(6.33) |
| Alcohol , n(%) | | | | |
| No | 125(30.41) | 70(17.03) | 74(18.00) | 269(65.45) |
| Yes | 73(17.76) | 47(11.44) | 22(5.35) | 142(34.55) |
| Smoking behaviours, n(%) | | | | |
| No | 82(19.95) | 49(11.92) | 44(10.71) | 175(42.58) |
| Yes | 116(28.22) | 68(16.55) | 52(12.65) | 236(57.42) |
| Weekly exercise frequency, n(%) | | | | |
| 0 | 2(0.35) | 0 | 0 | 2(0.48) |
| 1-2 times | 77(13.46) | 44(7.69) | 38(6.64) | 159(38.69) |
| 3-4 times | 198(34.62) | 117(20.62) | 96(16.78) | 250(60.83) |
| Weekly exercise duration , n (%) | | | | |
| <30 mins | 87(21.17) | 52(12.65) | 53(12.90) | 192(46.71) |
| 30-60 mins | 76(18.49) | 49(11.92) | 32(7.79) | 157(38.20) |
| >60 mins | 35(8.52) | 16(3.89) | 11(2.68) | 62(15.09) |
| Regularity of daily routine, n (%) | | | | |
| No | 41(9.98) | 20(4.87) | 17(4.14) | 78(18.98) |
| Yes | 157(38.20) | 97(23.60) | 79(19.22) | 333(81.02) |
| Previous medical history, n (%) | | | | |
| Diabetes/Hyperlipidemia/Hypertension | 105(25.55) | 69(16.79) | 22(5.35) | 196(47.69) |
| Others | 15(3.65) | 4(0.97) | 24(5.84) | 43(10.46) |
| No | 76(18.49) | 46(11.19) | 50(12.17) | 172(41.85) |
| Medications, n (%) | | | | |
| ≦6 | 54(13.14) | 44(10.71) | 45(10.95) | 143(34.79) |
| 7-10 | 105(25.55) | 59(14.36) | 41(9.98) | 205(49.88) |
| ≧11 | 14(3.41) | 8(1.95) | 6(1.46) | 28(6.81) |
| Unreported | 25(6.08) | 6(1.46) | 4(0.97) | 35(8.52) |

Note. *Percentages in parentheses represent the proportional distribution of each variable across the three stages and the overall sample, respectively..*

**Table 3.** Associations Between Individual, Family, and Organizational Factors and RHDS Scores Across Three Stages of COVID-19 Policy Change (N = 411).

| Variable | b (95% CI) | | | |
|---|---|---|---|---|
| | Stage 1 (n=198) | Stage 2 (n=117) | Stage 3 (n=96) | Total |
| **Individual-level factors** | | | | |
| Age | -0.324(-0.492, -0.156)*** | -0.090(-0.304, 0.125) | -0.137(-7.426, 7.833) | -0.198(-0.315, -0.081)*** |
| Educational level | 2.336(0.793, 3.878)*** | -0.455(-2.081, 1.171) | -1.346(-3.726, 1.033) | 0.708(-0.261, 1.678) |
| Occupation | -0.533(-4.020, 2.954) | 1.400(-2.227, 5.028) | 1.586(-4.656, 7.828) | 0.494(-1.778, 2.765) |
| Weekly exercise duration | -0.069(-2.299, 2.161) | 2.080(-0.716, 2.551) | 0.760(-3.332, 4.853) | 0.724(-0.815, 2.262) |
| Basic medical history | 2.586(-.752, 5.923) | -1.227(-5.124, 2.671) | -3.745(-8.986, 1.496) | -0.785(2.975, 1.406) |
| **Family-related factor** | | | | |
| Monthly family income | -1.793(-3.272, -0.314)* | 1.165(-0.559, 2.890) | 0.067(-2.206, 2.340) | -0.367(-1.316, 0.582) |
| The scores of SSFD | 0.226(0.089, 0.363)*** | 0.396(0.194, 0.597)*** | 0.341(0.103, 0.579)** | 0.288(0.189, 0.386)*** |
| **Organisation-related factor** | | | | |
| The scores of QDTS | 0.315(0.215, 0.416)*** | 0.239(0.139, 0.340)*** | 0.324(0.177, 0.471)*** | 0.299(0.237, 0.361)*** |
| *R-squared* | *0.346* | *0.448* | *0.420* | *0.343* |

Note. *RHDS: Readiness for Hospital Discharge Scale; QDTs: Quality of Discharge Teaching Scale; SSFD: Self-Rating Scale of Systemic Family Dynamics. Correlation analysis was first performed to identify potential relationships, followed by multivariable linear regression analyses to determine independent factors associated with discharge outcomes in the context of organizational environment changes.*

**P<0.05; **P<0.01; ***P<0.001.*

**Supplementary Table 1.** Bandwidth selection test.

| Bandwidth | Regression-discontinuity effect | | | | Bandwidth selection | |
|---|---|---|---|---|---|---|
| | Coef. | Std.Err | P | 95% CI | T | P |
| [-4.33, 4.33] | -21.612 | 7.082 | 0.002 | -35.387~-7.837 | -8.929 | 0.019 |
| [-8.65, 8.65] | -19.727 | 5.687 | 0.001 | -30.873~-8.581 | -5.281 | 0.086 |
| [-17.31, 17.31] | -12.280 | 4.226 | 0.004 | -20.562~-3.997 | -3.035 | 0.313 |

**Note.** *Sample size determination was based on the Fisherian inference framework for Regression Discontinuity Designs. Bandwidth selection plays a critical role in defining the effective sample size: a larger bandwidth includes more observations and increases statistical power but may introduce bias if the continuity assumption is violated beyond the local region. Accordingly, this study adopted the narrowest bandwidth that met statistical significance criteria. The bandwidth selection test identified the 50% optimal bandwidth as most appropriate (Bandwidth: –4.33 to 4.33; p = 0.019), with a p-value below 0.05 indicating a valid and statistically adequate sample size. The 50%, 100%, and 200% optimal bandwidths corresponded to intervals of [–4.33, 4.33], [–8.65, 8.65], and [–17.31, 17.31], respectively, as reported by the rdrobust command.*

**Supplementary Table 2.** Scores of RHDS, QDTs, and SSFD across three stages.

| | Mean±SD | | | | *P* |
|---|---|---|---|---|---|
| | Stage 1 (n=198) | Stage 2 (n=117) | Stage 3 (n=96) | Total | |
| The scores of RHDS | 83.85±0.94 | 82.69±1.14 | 84.14±1.24 | 83.59±0.63 | 0.65 |
| The scores of QDTs | 87.97±1.14 | 87.09±1.97 | 88.46±1.83 | 87.83±0.89 | 0.84 |
| The scores of SSFD | 70.33±0.84 | 67.80±0.96 | 72.66±1.03 | 70.15±0.55 | <0.001 |

Note. RHDS: Readiness for Hospital Discharge Scale; QDTs: Quality of Discharge Teaching Scale; SSFD: Self-Rating Scale of Systemic Family Dynamics. One-way analysis of variance (ANOVA) was conducted to examine group differences, assuming normality and homogeneity of variances.

**Supplementary Table 3.** Continuity test of covariates.

| Variable | Coef. | Std.err. | *P* | 95%CI |
|---|---|---|---|---|
| Sex | 0.333 | 0.227 | 0.142 | -0.112~0.778 |
| Age | -10.496 | 5.813 | 0.071 | -21.889~0.898 |
| Marital status | -0.371 | 0.335 | 0.268 | -1.029~0.286 |
| Religion | 0.186 | 0.471 | 0.693 | -0.737~1.109 |
| Educational level | -0.510 | 0.824 | 0.536 | -2.124~1.104 |
| Occupation | -0.561 | 0.426 | 0.188 | -1.396~0.274 |
| Monthly family income | -0.633 | 0.829 | 0.445 | -2.258~0.992 |
| Post-discharge caregiver involvement | 0.167 | 0.374 | 0.655 | -0.566~0.900 |
| Healthcare payment method | 0.089 | 0.79 | 0.258 | -0.065~0.244 |
| Alcohol | -0.416 | 0.446 | 0.351 | -1.289~0.458 |
| Smoking behaviours | -0.188 | 0.368 | 0.610 | -0.911~0.534 |
| Weekly exercise frequency | 0.150 | 0.354 | 0.671 | -0.543~0.844 |
| Weekly exercise duration | 1.411 | 0.445 | 0.002 | 0.538~2.284 |
| Regularity of daily routine | 0.005 | 0.014 | 0.725 | -0.023~0.033 |
| Basic medical history | 0.460 | 0.335 | 0.169 | -0.195~1.120 |
| Medications | -0.011 | 0.367 | 0.977 | -0.731~0.709 |
| The scores of QDTS | -14.006 | 6.997 | 0.045 | -27.719~0.293 |
| The scores of SSFD | -2.093 | 3.670 | 0.534 | -8.697~4.510 |

Note. *To account for potential covariate discontinuities that could influence the outcome, continuity tests were conducted to assess regression discontinuity effects across covariates. A p-value of more than 0.05 indicated a significant continuity in conditional regression functions at the cut-off, which were included in the study. The scores for the Readiness for Hospital Discharge Scale (RHDS) were used to measure hospital discharge readiness, with higher scores indicating greater readiness. The Quality of Discharge Teaching Scale (QDTS) scores assessed the quality of discharge teaching, with higher scores reflecting higher quality. The Self-Rating Scale of Systemic Family Dynamics (SSFD) scores measured systemic family dynamics, with higher scores indicating stronger family dynamics. The p-values and 95% confidence intervals (CIs) were robust.*

**Supplementary Table 4.** Bandwidth sensitivity test.

| Bandwidth | | Coef. | Std.Err. | *P* | 95%CI |
|---|---|---|---|---|---|
| 50% optimal bandwidth | 4.326 | -21.612 | 7.082 | 0.002 | -35.387~-7.837 |
| 75% optimal bandwidth | 6.489 | -20.460 | 6.299 | 0.001 | -32.807~-8.114 |
| 100% optimal bandwidth | 8.653 | -19.727 | 5.687 | 0.001 | -30.873~-8.581 |
| 125% optimal bandwidth | 10.816 | -17.547 | 5.454 | 0.001 | -28.237~-6.858 |
| 150% optimal bandwidth | 12.979 | -15.268 | 5.119 | 0.003 | -25.301~-5.236 |
| 175% optimal bandwidth | 15.142 | -14.078 | 4.583 | 0.002 | -23.080~-5.075 |
| 200% optimal bandwidth | 17.305 | -12.280 | 4.226 | 0.004 | -20.562~-3.997 |

Note. *To validate the robustness of the estimated causal effect of policy-driven organizational changes on discharge readiness, careful attention was given to bandwidth selection, which critically affects the balance between estimation bias and variance. Narrow bandwidths reduce bias but may increase variance, while wider bandwidths improve precision at the risk of introducing bias. Bandwidth sensitivity analyses were conducted using the rdrobust command. Statistically significant results (P < 0.05) and consistent local average treatment effects across varying bandwidths confirmed the robustness of the findings. The corresponding p-values and 95% confidence intervals further supported the stability of the estimates across specifications.*

**Supplementary Table 5.** Rectangular kernel test and covariate test.

| | lwald | Std.err | *P* | 95%CI |
|---|---|---|---|---|
| Default triangular kernel without covariates | -19.727 | 5.687 | 0.001 | -30.873~-8.581 |
| Rectangular kernel | -19.727 | 5.687 | 0.001 | -30.873~-8.581 |
| Covariate test | -22.962 | 4.481 | <0.001 | -31.745~-14.178 |

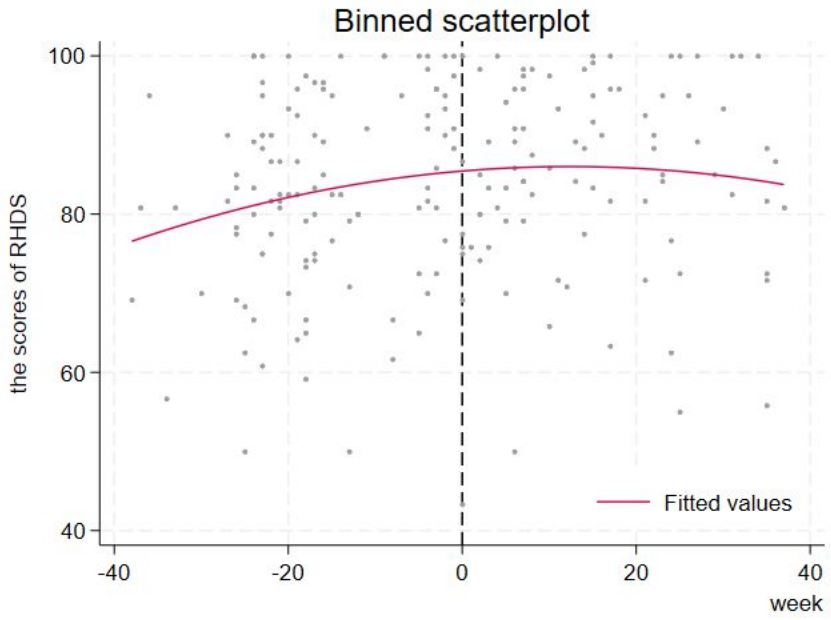
Note. *Both triangular and rectangular kernel functions were applied to estimate the treatment effect, with the triangular kernel utilizing weighted least squares regression and the rectangular kernel relying on ordinary least squares regression. The consistency of results across kernel types strengthened the reliability of the findings. To ensure the exchangeability of the running variable around the cutoff, only covariates demonstrating continuity (P > 0.05) were included in the Regression Discontinuity in Time (RDiT) model, as verified through continuity tests. The p-values and 95% confidence intervals (CIs) indicated robust estimates. The local Wald estimator (lwald) was used to assess the causal effect by comparing local average treatment effects on either side of the cutoff, particularly under the rectangular kernel specification.*

**Supplementary Table 6.** Placebo tests

| Cut-off | Coef. | Std.Err. | *P* | 95%CI |
|---|---|---|---|---|
| Before 3 weeks | -0.119 | 0.890 | 0.024 | -0.294~0.056 |
| Before 2 weeks | -0.116 | 0.305 | 0.373 | -0.715~-0.375 |
| Before 1 week | 0.331 | 0.206 | 0.303 | -0.073~0.735 |
| After 1 week | 0.213 | 0.406 | 0.559 | -0.582~-1.008 |
| After 2 weeks | -0.394 | 0.488 | 0.419 | -1.349~0.562 |
| After 3 weeks | -0.317 | 0.094 | 0.055 | -0.501~-0.134 |

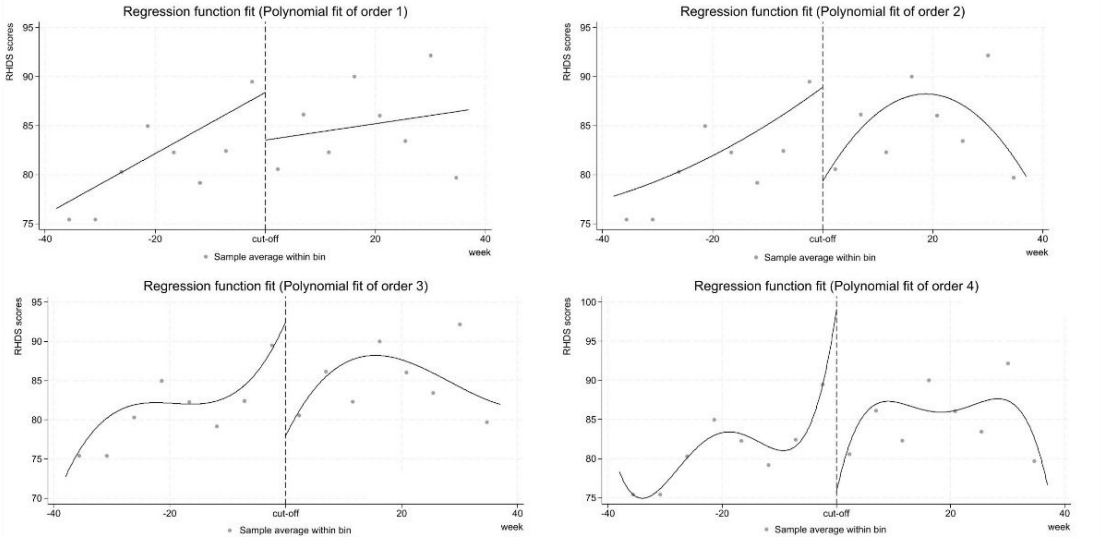
Note. *Placebo tests were conducted by shifting the cutoff date from the original policy intervention date (February 23, 2023) to alternative time points where no major public health policy changes occurred. These tests assessed whether significant discontinuities emerged in the absence of actual interventions. The resulting p-values and 95% confidence intervals (CIs) demonstrated robustness, further supporting the validity of the estimated causal effects.*

**Supplementary Figures.**



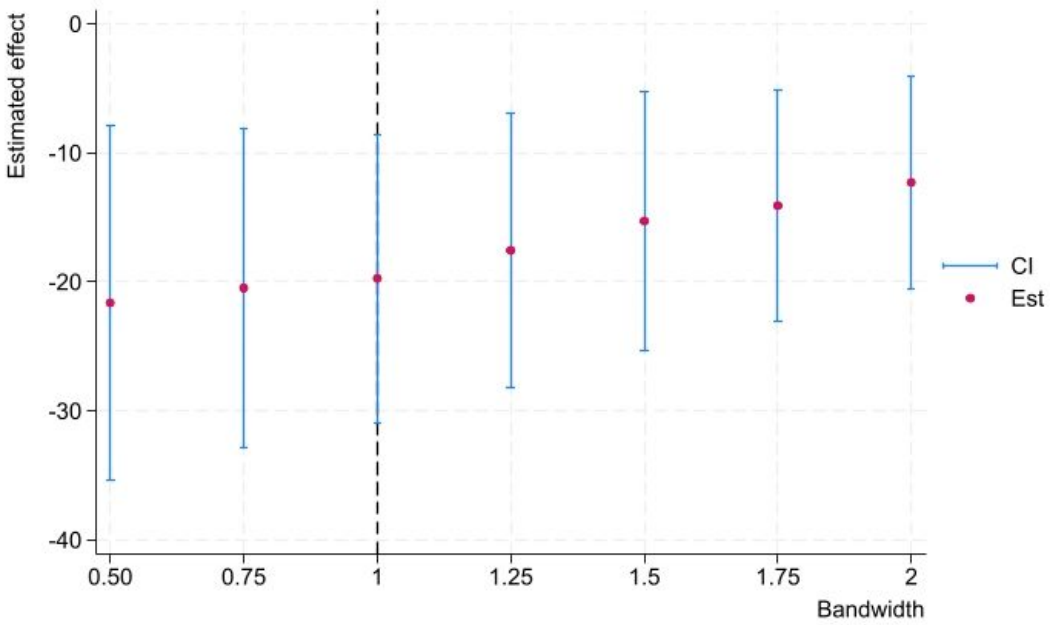

**Supplementary Figure 1.** Binned scatterplot and global polynomial regression curves illustrating the relationship between RHDS scores and time.

**Note.** *These plots visually represented the association between time (on the x-axis) and RHDS scores (on the y-axis), with separate visualizations for the pre- and post-cutoff periods. A positive association was observed between time (measured in weeks) and RHDS scores, indicating that changes over time were associated with variations in RHDS scores. The binned scatterplots (dots) represent local sample means over non-overlapping partitions (bins) of the running variable. These binned means capture the behavior of the data points and highlight any discontinuities away from the cutoff. The second component of the figure includes two smooth global polynomial regression curves for control and treatment units, offering a flexible global approximation of the regression functions on either side of the cutoff.*



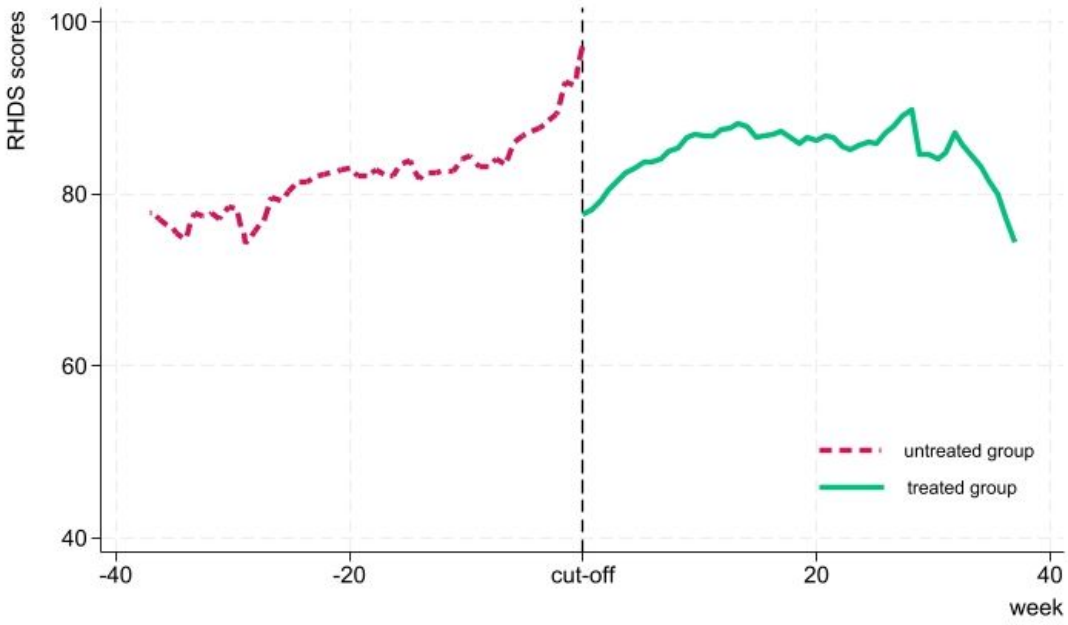

**Supplementary Figure 2.** Regression discontinuity effect plot of regression function fit in polynomial fit of order 1~4.

Note. *The selected polynomial order at optimal bandwidth was used to model time-varying treatment effects, ensuring the effectiveness of local polynomial model fitting. The polynomial regression models provide a locally weighted linear approximation of the outcome (RHDS scores) across different levels of the running variable (week). The binned dots represent local sample means over non-overlapping partitions (bins) of the running variable, effectively capturing the data's behavior and highlighting any discontinuities away from the cutoff.*

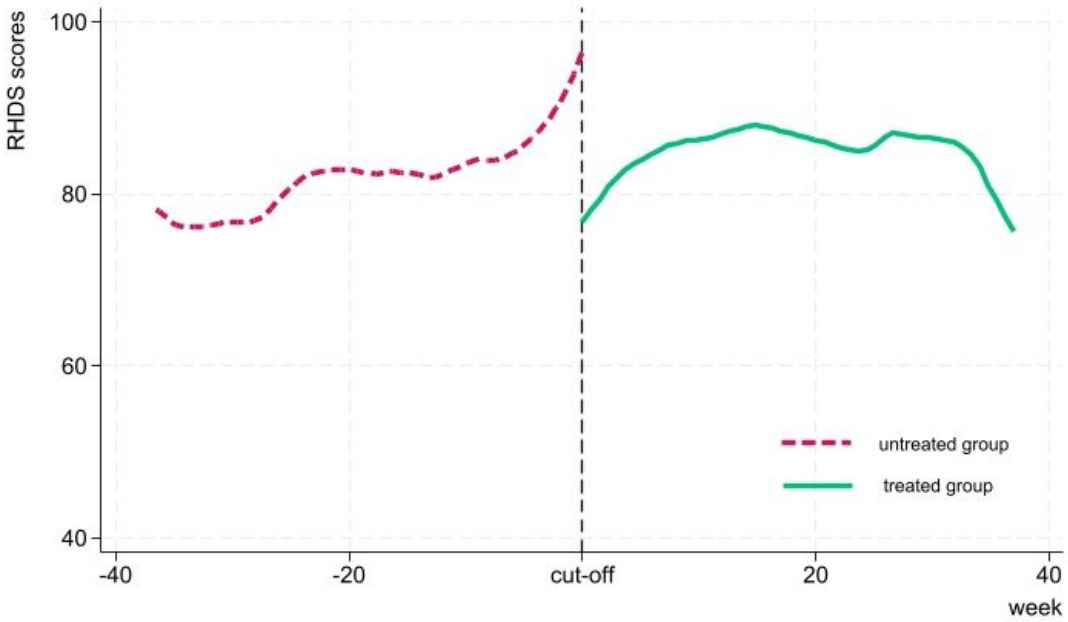



**Supplementary Figure 3.** Bandwidth: x times MSE-optimal bandwidth

Note. *Est: the estimation of the local average treatment effect.*




**Supplementary Figure 4.** Regression discontinuity plot for rectangular kernel test without covariates




**Supplementary Figure 5.** Regression discontinuity plot for covariate test in default triangular kenel

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

| | Item No | Recommendation | Page No |
|---|---|---|---|
| **Title and abstract** | 1 | (*a*) Indicate the study's design with a commonly used term in the title or the abstract | 1 |
| | | (*b*) Provide in the abstract an informative and balanced summary of what was done and what was found | 1-2 |
| **Introduction** | | | |
| Background/rationale | 2 | Explain the scientific background and rationale for the investigation being reported | 3-5 |
| Objectives | 3 | State specific objectives, including any prespecified hypotheses | 6 |
| **Methods** | | | |
| Study design | 4 | Present key elements of study design early in the paper | 6 |
| Setting | 5 | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection | 6 |
| Participants | 6 | (*a*) Give the eligibility criteria, and the sources and methods of selection of participants | 6-7 |
| Variables | 7 | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable | 7-10 |
| Data sources/ measurement | 8* | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group | 7-8 |
| Bias | 9 | Describe any efforts to address potential sources of bias | 8-9 |
| Study size | 10 | Explain how the study size was arrived at | 9 |
| Quantitative variables | 11 | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why | 8-13 |
| Statistical methods | 12 | (*a*) Describe all statistical methods, including those used to control for confounding | 9-13 |
| | | (*b*) Describe any methods used to examine subgroups and interactions | / |
| | | (*c*) Explain how missing data were addressed | / |
| | | (*d*) If applicable, describe analytical methods taking account of sampling strategy | / |
| | | (*e*) Describe any sensitivity analyses | 12-13 |
| **Results** | | | |
| Participants | 13* | (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed | 13 |
| | | (b) Give reasons for non-participation at each stage | / |
| | | (c) Consider use of a flow diagram | / |
| Descriptive data | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders | 13 |
| | | (b) Indicate number of participants with missing data for each variable of interest | 13 |
| Outcome data | 15* | Report numbers of outcome events or summary measures | 16 |

| | | | |
|---|---|---|---|
| Main results | 16 | (*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included | 16 |
| | | (*b*) Report category boundaries when continuous variables were categorized | 9-10 |
| | | (*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period | / |
| Other analyses | 17 | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses | 17-18 |
| **Discussion** | | | |
| Key results | 18 | Summarise key results with reference to study objectives | 18-20 |
| Limitations | 19 | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias | 21 |
| Interpretation | 20 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence | 21 |
| Generalisability | 21 | Discuss the generalisability (external validity) of the study results | 21 |
| **Other information** | | | |
| Funding | 22 | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based | Title page |

*Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

# Response Letter

Dear Editors and Reviewers,

Re: JAN-2024-4244.R2: Evaluating Organizational Environment Effects on Patient-Perceived Hospital Discharge Readiness During Public Health Emergencies: A Cross-Sectional Study

Thank you for your thoughtful and constructive feedback on our manuscript. We greatly appreciate your valuable comments and have carefully reviewed and addressed each of your suggestions.



| Comments | Response |
|---|---|
| **Comments from Review 1.** | |
| Specific comments<br><br>1. The manuscript could benefit from editing eg delete:<br><br>a. Evidence indicates that Hospitalization during periods of high COVID-19 incidence<br><br>b. Evidence suggests that Experienced and mentally resilient healthcare workers | **ACCEPTED.** Thank you for your detailed comments. These phrases have been removed as suggested. |
| 2. Add standard deviation to mean age of 62.17 years | **ACCEPTED.** Thank you for the comment. This has been revised in the Results section (5.1 Participant Demographics). It now reads: |

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| | *"A total of 411 patients were included in the data analysis. The mean age of participants was 62.17 years, with a standard deviation of 0.59."* |
| 3. Suggest deleting from conclusion Utilizing a regression-discontinuity design to, the analysis effectively isolated the impact of organizational changes from other confounding factors, providing robust evidence of their critical role. | **ACCEPTED.** Thank you for this valuable suggestion. We have deleted the sentence from the conclusion. |
| 4. Study participant characteristics could be added to abstract | **ACCEPTED.** Thank you for the helpful suggestion. We have amended the abstract to include participant characteristics. It now reads:<br><br>*"Adult patients diagnosed with acute myocardial infarction and discharged from the Cardiac Critical Care Unit of a tertiary hospital in Shanghai, China, were recruited."*<br><br>*Results: "A total of 411 patients were included in the analysis."* |
| **Comments from Reviewer 2.** | |
| 1. p7 line 25- a sentence was added in the revision that needs editing - it is not a complete sentence. | **ACCEPTED.** Thank you for your constructive suggestion. We have revised the sentence to:<br><br>"Following the nationwide epidemic prevention measures implemented on February 23, 2023, significant disruptions in hospital operations emerged, marking the shift from Stage 2 to Stage 3." |
| 2. section 4.5 the addition of the information on the pilot study is well | **ACCEPTED.** Thank you for pointing this out. A paragraph break has been added |

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| done. There needs to be a paragraph break to denote the beginning of the dialogue on the main study.<br><br>3. Mabire reference is listed twice in the reference list. | to clearly distinguish the pilot study from the discussion of the main study. The duplicate entry has now been removed from the reference list. |
| **Comments from Reviewer 3.** | |
| There looks to be a typo in the results on pg 14 line 54/55 "(Coef. =1.411, p > 0.05, 95% CI: 0.538 to 2.284)" | **ACCEPTED.** Thank you for your observation. The typo has been corrected. |
| I also wonder whether sensitivity analysis may be a better term than placebo. | **ACCEPTED.** Thank you for your thoughtful comment. We chose to use the term "placebo test" because it is commonly used in the context of robustness and validity checks in Regression Discontinuity in Time (RDiT) designs. Specifically, placebo tests aim to estimate parallel RDs in nearby geographical areas or at alternative time points where the treatment was not applied, thereby assessing the credibility of the main findings. While we recognize that terms like "sensitivity analysis" are also used in similar contexts, placebo test has been more widely adopted in the RDiT literature. For example, please see: Hausman, C., & Rapson, D. S. (2018). Regression Discontinuity in Time: Considerations for Empirical Applications. Annual Review of Resource Economics, 10, 533–552. https://doi.org/10.1146/annurev-resource-121517-033306 |

Thank you once again for your insightful comments, which have greatly contributed to improving the manuscript.