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Incentivizing accredited social health activists to reduce prehospital delay in stroke

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Objectives: Offering incentives to Accredited Social Health Activists (ASHAs) for escorting stroke patients is a novel approach to reducing prehospital delay. This study evaluates the effectiveness of this strategy.
Methods: In this quasi-experimental pilot study, an incentive of INR 300 was provided to the ASHAs in Diamond Harbour-II (DH-II) block of West Bengal, India, from December 2024 to May 2025, for escorting stroke patients to Diamond Harbour Government Medical College and Hospital (DHGMCH) within 3 h of onset. Diamond Harbour-I (DH-I) block served as a control. Stroke awareness campaigns were conducted in these two blocks from June 2024 to May 2025.
Results: The study included 36 patients from DH-I and 40 from DH-II. A higher percentage of patients from DH-II reached DHGMCH within 3 h (60% vs. 30.6%, P = 0.01) and within 4.5 h (70% vs. 50%, P = 0.07). Multivariable logistic regression indicated that patients in DH-II were more likely to arrive at DHGMCH within 4.5 h (adjusted odds ratio 3.72, 95% confidence interval 1.25–11.04) and within 3 h (adjusted odds ratio 4.59, 95% confidence interval 1.57–13.43).
Conclusion: Offering incentives to ASHAs for escorting stroke patients may help decrease prehospital delays.

KEYWORDS
accredited social health activist, community health workers, India, prehospital delay, stroke

Introduction

Stroke is a medical emergency that requires early recognition and treatment to reduce morbidity and mortality [1–3]. The development of reperfusion therapies such as thrombolysis and thrombectomy has improved outcomes in ischemic stroke [4]. These treatments can only be administered within a specific time window, and their benefits decrease as the onset-to-treatment time increases [5–9]. Reperfusion therapies are not available in all types of hospitals. A facility equipped with a computed tomography (CT) scanner, thrombolytic drugs, and 24/7 trained healthcare personnel is considered a stroke-ready hospital where thrombolysis is performed. Thrombectomy is performed only in facilities with a cath lab and intervention neurologists, neurosurgeons, or radiologists. Globally, the proportion of acute ischemic stroke patients receiving reperfusion therapies remains low, mainly due to delayed arrival at stroke-ready hospitals and thrombectomy

centers [10, 11]. The causes of this prehospital delay are multifaceted [12–14]. Multiple strategies have been implemented to reduce this prehospital delay, including stroke awareness campaigns, strengthening Emergency Medical Services (EMS), and prenotification systems [15]. In India, Accredited Social Health Activists (ASHAs) are community health workers (CHWs) who play a critical role in primary healthcare delivery and are key stakeholders in implementing public health programs. Incentives are provided to ASHAs for activities outlined by the National Health Mission (NHM) [16]. Using ASHAs for stroke identification, secondary prevention, and establishing an acute stroke care pathway has shown promising results [17]. ASHAs may be trained to identify acute stroke in the community and mobilize such patients to the nearest stroke-ready hospital as early as possible. Providing incentives to ASHAs for escorting acute stroke patients to a stroke-ready hospital may reduce prehospital delay and increase the number of thrombolysis procedures. The main theoretical concept behind this study is performance-based financing, which has emerged as a strategic instrument to improve the effectiveness, equity and efficiency of health systems worldwide [18–20]. This pilot study was conducted to evaluate the impact of such incentives on prehospital delay.

Methods

This quasi-experimental pilot study was conducted from June 2024 to May 2025 in the Diamond Harbour Health District (DHHD) of West Bengal, India. Two blocks within the DHHD were selected for this study: Diamond Harbour-I (DH-I) and Diamond Harbour-II (DH-II). These blocks have populations of 156,166 and 190,801, respectively. Both are situated near the Diamond Harbour Government Medical College and Hospital (DHGMCH), the region's only stroke-ready facility. DHGMCH receives telemedicine guidance from a neurologist at the Institute of Postgraduate Medical Education and Research (IPGMER), Kolkata, via West Bengal's Swasthya Ingit Telestroke Program.

Stroke awareness activities were routinely conducted in these two blocks from June 2024 to May 2025. The campaigns focused on stroke recognition, the 'golden hour of stroke,' and the importance of reaching a stroke-ready hospital (DHGMCH in this study) as early as possible. ASHAs from both blocks were trained to identify stroke cases using BEFAST (Balance, Eyes, Face, Arm, Speech, Time) symptoms [21]. Total 294 ASHAs (131 from DH-I and 163 from DH-II) received this training and orientation. The thrombolysis window in AIS is 4.5 h [5, 6]. The median door-to-needle (DTN) time in the Swasthya Ingit Telestroke Network hospitals is 75 min (IQR 25) [22]. Therefore, the campaigns emphasized arriving within 3 h at DHGMCH. ASHAs were instructed to educate family members during house-to-house visits about BEFAST symptoms and to contact her immediately if any family member exhibits such symptoms. Upon receiving this information, ASHAs were advised to send the patient directly to DHGMCH as soon as possible, so suspected stroke patients could access emergency care within 3 h of symptom onset. They were also instructed to inform DHGMCH about these patients. DH-II block was selected as the intervention block, and DH-I block served as the control. ASHAs from DH-II were eligible to receive an incentive of INR 300.00 if they accompanied any suspected stroke patient to the emergency department of DHGMCH within 3 h of symptom onset. ASHAs in West Bengal earned INR 6250.00 per month from various incentives and honoraria during the study period [23]. Hence, the proposed incentive was approximately 5% of their monthly income. A suspected stroke patient is someone who has suddenly developed one or more BEFAST symptoms [21]. If such a patient is later found to be a stroke mimic, the accompanying ASHA still qualifies for the incentive. Training was provided to the ASHAs of DH-II, staff at the Emergency Department of DHGMCH, and health administrators of DHHD and DHGMCH regarding the incentive, its claim, and disbursement. The incentive scheme began in December 2024. No incentives were provided to the ASHAs of the DH-I block.

All suspected stroke cases arriving at the emergency department of DHGMCH from the DH-I and DH-II blocks between December 2024 and May 2025 were included in this study. Both ischemic and hemorrhagic stroke cases were included. Transient ischemic attack (TIA) and stroke mimics were also included if they met the criteria for a suspected stroke case. Patients with a final diagnosis of stroke (ischemic or hemorrhagic), TIA, or stroke mimic were excluded if they did not exhibit at least one of the BEFAST symptoms. Additionally, patients who did not consent to participate in the study were also excluded. Because this was a short-duration pilot study, no sampling technique was employed.

The primary outcome was the proportion of patients arriving within 3 h of symptom onset. The secondary outcomes included the proportion of patients arriving within 4.5 h of symptom onset and the median onset-to-door (OTD) time, defined as the interval between symptom onset and arrival at the study hospital (DHGMCH). If symptoms were noted upon waking, the interval from waking to arrival at the study hospital was recorded as the onset-to-door time, because interventions to reduce prehospital delay cannot begin during sleep.

Written informed consent was obtained from all patients included in this study. Ethical approval was granted by the Research Oversight Committee of the Institute of Postgraduate Medical Education and Research (IPGMER), Kolkata, India (IPGME&R/IEC/2024/Misc/007).

Demographic data and clinical parameters were recorded on a case form. Patients and their family members were asked about their understanding of the "golden hour of stroke." Statistical analysis was performed using SPSS version 23 (IBM Corporation, Chicago, USA). The data showed a non-normal distribution. The Chi-square test and Fisher's exact test were used to compare categorical variables, while the Mann-Whitney U test was employed for continuous variables. A multivariable logistic regression analysis was conducted to identify associations between the outcome and independent variables. We included variables with a P-value <0.25 in univariate analysis in the multivariable logistic regression. Statistical significance was set at a P-value <0.05 with a 95% confidence interval (CI). The adjusted odds ratio (aOR) was used to quantify the strength of associations. Missing data were handled with multivariate imputation by random forests using predictive mean matching. The estimates assume independent observations. With two blocks, the confidence intervals may be too narrow, making it difficult to distinguish between the block effect and the intervention effect.

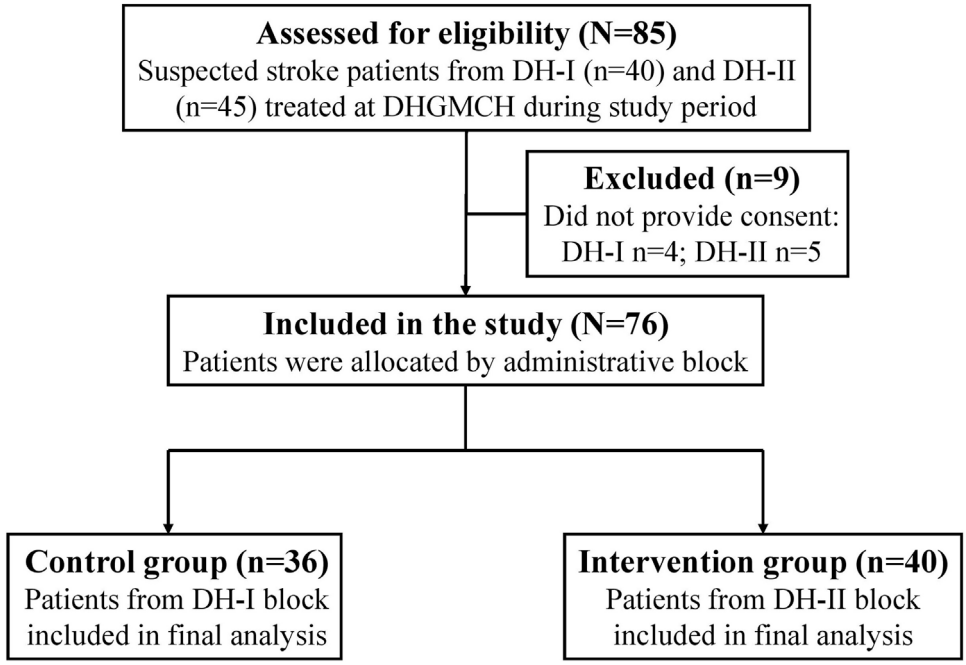

FIGURE 1
Patient flow diagram (India, 2024–2025).

Results

Between December 2024 and May 2025, 40 suspected stroke patients from DH-I block and 45 from DH-II block were treated at DHGMCH. Of these, 36 patients from DH-I and 40 from DH-II provided consent and were included in our study. Figure 1 shows the patient enrolment flow. Table 1 presents the demographic parameters and clinical characteristics of the two groups. There was no statistically significant difference between the DH-I and DH-II groups in age, sex distribution, distance from DHGMCH, annual income, knowledge of the golden hour of stroke, time of symptom onset, being alone at symptom onset, wake-up symptoms, stroke recognition by the patient or family member, stroke type, vascular risk factors, past history of stroke or TIA, family history of stroke, most presenting symptoms, or National Institutes of Health Stroke Scale (NIHSS) score. The only baseline clinical feature showing a statistically significant between-group difference was vomiting at presentation, which was more frequent in the DH-I group than in the DH-II group (27.8% vs. 10.0%, P = 0.04). The median OTD time in the DH-II group is 139 min (interquartile range or IQR 319), which is significantly lower compared to the DH-I group (268 min, IQR 540, P = 0.02). Although there is no significant difference between the two groups regarding the proportion of patients arriving within 4.5 h (70% vs. 50%, P = 0.07), a significantly higher proportion of patients in the DH-II block arrived at DHGMCH within 3 h (60% vs. 30.6%, P = 0.01). Based on univariate analysis, we included the following variables in the multivariable logistic regression: time of onset (day vs. night), type of stroke (ischemic vs. hemorrhagic), NIHSS score, history of smoking, and presence of visual impairment. Multivariable logistic regression analysis revealed that patients in the DH-II group have higher odds of arriving at DHGMCH within 4.5 h (aOR 3.72, 95% CI 1.25–11.04) and within 3 h (aOR 4.59, 95% CI 1.57–13.43). After adjustment for vomiting, which differed significantly between groups, the aOR was 4.86 (95% CI 1.61–14.72) for arrival within 3 h and 3.72 (95% CI 1.22–11.38) for arrival within 4.5 h.

The observed between-group effect size for arrival within 3 h was moderate to large, with an absolute increase of 29.4% in DH-II compared to DH-I. The Cohen's h was 0.60 (95% CI 0.15–1.05). These findings suggest that the pilot study was reasonably powered.

Among the suspected stroke cases in the DH-II block, 13 patients (32.5%) were accompanied by ASHAs, and all reached DHGMCH within 4.5 h. Of these, 11 (84.6%) arrived within 3 h. In the DH-II group, 46.4% of patients arriving within 4.5 h and 45.8% of those arriving within 3 h were escorted by an ASHA. Multivariable logistic regression analysis of the DH-II group shows that patients escorted by an ASHA had higher odds of arriving at DHGMCH within 3 h (aOR 5.92, 95% CI 1.09–31.94). However, no such association was found in patients arriving within 4.5 h. The escort was not randomized in this group, which might have introduced confounding, and these findings are therefore exploratory.

A total of 10 ASHAs received incentives for bringing AIS patients to DHGMCH within 3 h. One ASHA received the incentive twice for two different patients. Two ASHAs brought AIS patients between 3 and 4.5 h after stroke onset. These ASHAs were ineligible for the incentive. The remaining patients who arrived within 4.5 h were brought by their relatives and neighbours. Among them, two patients' relatives contacted the ASHA after symptom onset. In these cases, the ASHAs were working in a distant area at that time, and they asked the patient's relatives to go directly to DHGMCH without waiting for them. In the case of five stroke patients, the ASHAs were informed more than 4.5 h after symptom onset, and the respective ASHAs in these cases asked the relatives to take the patients to DHGMCH. The ASHA did not escort these

TABLE 1 Demographic and clinical details of the study population (N = 76) (India, 2024–2025).

Variables	DH-I block (n1 = 36)	DH-II block (n2 = 40)	P value
Age in years [median (IQR)]	62.5 (15.0)	63.5 (15.5)	0.67
Sex: Male (%) Female (%)	20 (55.6) 16 (44.4)	21 (52.5) 19 (47.5)	0.79
Distance from DHGMCH in kilometers [median (IQR)]	7.1 (8.0)	7.9 (9.6)	0.06
Annual income in INR [median (IQR)]	120,000 (120,000)	120,000 (108,000)	0.88
Knowledge of golden hour of stroke (%)	7 (19.4)	4 (10.0)	0.20
Onset time: Day (%) Night (%)	20 (55.6) 16 (44.4)	28 (70.0) 12 (30.0)	0.19
Alone at symptom onset (%)	1 (2.8)	4 (10.0)	0.21
Symptoms noticed upon waking up (%)	9 (25.0)	4 (10.0)	0.08
Stroke recognition by patient or family member (%)	12 (33.3)	13 (32.5)	0.94
Type of stroke: Ischemic (%) Hemorrhagic (%)	24 (66.7) 12 (33.3)	29 (72.5) 11 (27.5)	0.58
Risk factors:			
Diabetes mellitus (%)	11 (30.6)	11 (27.5)	0.77
Hypertension (%)	11 (30.6)	14 (35.0)	0.68
Hyperlipidemia (%)	0	2 (5.0)	0.27
Atrial fibrillation (%)	1 (2.8)	0	0.47
Smoking (%)	8 (22.2)	10 (25.0)	0.78
Past history of stroke or TIA (%)	10 (27.8)	9 (22.5)	0.59
Family history of stroke (%)	6 (16.7)	10 (25.0)	0.37
Symptoms:			
Loss of balance (%)	21 (58.3)	17 (42.5)	0.17
Visual disturbance (%)	7 (19.4)	3 (7.5)	0.11
Facial asymmetry (%)	17 (47.2)	19 (47.5)	0.98
Limb weakness (%)	26 (72.2)	33 (82.5)	0.28
Speech impairment (%)	32 (88.9)	30 (75)	0.12
Altered consciousness (%)	3 (8.3)	5 (12.5)	0.42
Headache (%)	4 (11.1)	2 (5.0)	0.29
Vomiting (%)	10 (27.8)	4 (10.0)	0.04*
Sensory abnormality (%)	0	0	-
Seizure (%)	3 (8.3)	6 (15.0)	0.29
NIHSS score [median (IQR)]	10 (7.0)	11 (7.5)	0.83
Onset-to-door time in minutes [median (IQR)]	268 (540)	139 (319)	0.02*
Number of patients arriving at DHGMCH within 4.5 h (%)	18 (50.0)	28 (70.0)	0.07
Number of patients arriving at DHGMCH within 3 h (%)	11 (30.6)	24 (60.0)	0.01*

*P value significant at <0.05 with 95% confidence interval.
IQR, Interquartile range; DHGMCH, Diamond Harbour Government Medical College and Hospital; INR, Indian Rupee; TIA, Transient ischemic attack; NIHSS, National Institutes of Health Stroke Scale.

patients. During the monthly program performance review meetings, key barriers were identified, including delayed stroke recognition, delayed reporting to ASHAs, poor road conditions in remote areas, unavailability of vehicles at odd hours, lack of money to arrange patient transportation, and a preference for alternative medicine and private health setups among patient relatives.

Discussion

Prehospital delay significantly affects stroke outcomes. Delays in reaching a hospital remain a major obstacle to reperfusion therapies in AIS worldwide [1–3, 24]. Data from the Swasthya Ingit Telestroke Program in West Bengal, India, showed that approximately 42% of AIS patients arrived at a

stroke-ready hospital within 4.5 h [22]. Many patients arriving after 3 h could not be thrombolyzed due to intrahospital delays, reflected by a median door-to-needle time of 75 min (IQR 25) [22]. Public awareness of stroke symptoms, risk factors, and treatments remains low, especially in India [25]. In our study population, only one-third of stroke cases were recognized by patients or family members, and about 14.5% knew about the "golden hour of stroke." Community health workers play a vital role in increasing stroke awareness, promoting prevention, and identifying acute strokes to alert the nearest stroke-ready facility [17, 26]. ASHAs, being part of the community, can mobilize and guide stroke patients to appropriate hospitals, helping reduce delays. Engaging community health workers to escort acute stroke patients to stroke-ready facilities shows promise, and our study confirms this approach can lower prehospital delays. Although stroke awareness campaigns increased the percentage of patients arriving within the thrombolysis window (4.5 h) in the DH-I block compared to baseline data for West Bengal, incentivizing ASHAs further improved this percentage in the DH-II block and significantly shortened the onset-to-door time compared to DH-I. More importantly, these incentives increased the proportion of patients arriving within 3 h of symptom onset, which is critical for thrombolysis given the intrahospital delays. Analysis of the DH-II group also showed that ASHA-accompanied patients had higher odds of arriving within 3 h. However, the wide confidence interval precludes a strong conclusion.

Since this is a pilot project, the small sample size is the main limitation of our study. Based on the annual stroke incidence rate in West Bengal, we expected a much higher number of cases [27]. However, not all stroke cases are treated at DHGMCH; many patients seek care at private healthcare facilities and other government hospitals. Nearly 70% of India's healthcare is managed by the private sector [11]. A significant number of patients do not visit government or private healthcare facilities as they rely on quack remedies and alternative medicines [28]. Although the project was approved for 1 year, the incentive program could not start before December 2024 due to operational issues. As a result, the data collection period was shortened to 6 months, contributing to the lower number of cases. Although the two study groups were broadly comparable at baseline except for vomiting, we cannot rule out residual imbalance because of the small sample size and quasi-experimental design. DH-I group had more wake-up strokes compared to the DH-II group. Although this difference is not statistically significant, it might have introduced bias, as in wake-up stroke the start time of stroke is measured from the time the patient woke up. A separate analysis excluding the wake-up stroke cases showed an aOR of 11.43 (95% CI 2.35–55.53) for arrival within 3 h and an aOR of 5.07 (95% CI 1.37–18.68) for arrival within 4.5 h. Because the study included only two administrative blocks, multilevel modeling with block as a random effect was not performed, as the between-cluster variance could not be reliably estimated. Instead, we used multivariable logistic regression to adjust for relevant patient-level covariates. In future studies including multiple intervention and control blocks, mixed-effects logistic regression or generalized estimating equation models may be appropriate to account for clustering at the block, village, or ASHA level. The ASHAs of DH-II received additional training on the incentive claim process. This extra contact time with the research team might have increased motivation beyond the incentive. The 3-h arrival model has 35 events and 6 parameters, indicating approximately 5.8 events per variable, which is below the conventional minimum of 10 [29]. This explains the wide confidence intervals. Despite these limitations, this study shows that incentivizing community health workers to escort acute stroke patients to the nearest stroke-ready hospitals can reduce prehospital delay and increase the number of arrivals within the thrombolysis window in AIS.

In conclusion, minimizing prehospital delay is crucial in stroke management, and motivating community health workers can be effective. Results from this study show that incentivizing the ASHAs can reduce prehospital delay, enabling more patients to access reperfusion therapy. This strategy may be especially beneficial in resource-limited settings. A larger study could be conducted in a remote, resource-poor district to evaluate its effectiveness in real-world conditions. Implementing such incentives for ASHAs within the National Programme for Prevention and Control of Non-communicable Diseases (NPNCD) could lead to better stroke outcomes in India.

Data availability statement

The data is available upon reasonable request, subject to approval from the Department of Health and Family Welfare, Government of West Bengal.

Ethics statement

The studies involving humans were approved by Research Oversight Committee, Institute of Postgraduate Medical Education and Research, Kolkata, India. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

AD: Conceptualization, Data curation, Formal analysis, Writing – Original Draft. AS: Conceptualization, Formal analysis, Methodology, Writing – Original Draft. SN: Conceptualization, Data curation, Methodology, Project Administration. NM: Methodology, Project Administration, Resources, Supervision, Funding Acquisition. SD: Methodology, Project Administration, Resources, Supervision, Funding Acquisition. AB: Conceptualization, Methodology, Project Administration, Resources, Supervision. SwS: Methodology, Project Administration, Resources, Supervision, Validation. SaS: Data curation, Investigation, Resources, Software. DD: Data curation, Investigation, Resources, Software. BD: Data curation, Investigation, Resources, Software. GP: Investigation, Resources, Writing – Review and Editing. BS: Investigation, Resources, Writing – Review and

Editing. SH: Data curation, Investigation, Software, Visualization. MB: Methodology, Project Administration, Resources, Funding Acquisition. BR: Conceptualization, Funding Acquisition, Methodology, Project Administration, Resources, Supervision, Validation, Visualization, Writing – Review and Editing. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that they do not have any conflicts of interest.

Generative AI statement

The author(s) declared that generative AI was not used in the creation of this manuscript.

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