

The Heartbeat Engine for Continuous Post-Discharge Surveillance in Elderly Chinese Heart Failure Patients

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Sites: Shanghai · Beijing · Guangzhou N: 300 patients · ≥65 years

21.97M
PROJECTED HF BURDEN IN CHINA BY 2035

35%
BASELINE 180-DAY REHOSPITALIZATION RATE

30-40 min
AUTONOMOUS AGENT MONITORING CYCLE

ABSTRACT

Heart failure affects 13.1 million adults in China, with rehospitalization rates critically elevated after discharge. This protocol describes a prospective, two-arm RCT evaluating **OpenClaw's Heartbeat Engine** — an autonomous AI surveillance platform — against standard care in 300 elderly patients (≥65 yrs) across three tertiary cardiac centres. The primary endpoint is 180-day all-cause hospitalization, analyzed via Cox proportional hazards regression and intention-to-treat principles. Secondary endpoints include KCCQ-12 quality of life, medication adherence, and nurse burden.

INTRODUCTION & CONTEXT

Heart failure is among China's most pressing public health crises. Current projections estimate the HF population will grow from 13.1 million today to nearly 22 million by 2035, driven by accelerating demographic aging and urbanization.

Post-discharge care is the critical vulnerability. The 180-day rehospitalization rate following acute decompensation remains extremely high, imposing an enormous economic burden that China's community health infrastructure is ill-equipped to absorb — particularly given the absence of standardized, technology-enabled in-home surveillance systems operating at scale.

Wearable-based and conversational AI remote monitoring approaches have recently shown promise in cardiac care (Gao et al., 2026; Olivella et al., 2026), yet no trial has tested a fully autonomous, continuously operating AI scheduler in this specific population within China's healthcare context.

RESEARCH QUESTIONS

- Does the Heartbeat Engine significantly reduce 180-day all-cause hospitalization compared to standard care in elderly Chinese HF patients?
- Does continuous AI-driven monitoring yield a clinically meaningful improvement (≥5 points) in KCCQ-12 quality-of-life scores?
- Can wearable-derived physiological deterioration signals provide actionable advance warning before unscheduled healthcare utilization?
- What is the effect of the intervention on medication adherence and nurse escalation burden?

RESEARCH OBJECTIVES

The primary objective is to determine whether the Heartbeat Engine's cron-based autonomous AI coordination is associated with lower 180-day all-cause hospitalization compared with standard care. Secondary objectives examine its effect on disease-specific quality of life (KCCQ-12), medication compliance, and the operational workload placed on community nursing staff.

FIGURE 2 — CONSORT TRIAL FLOW

Enrolment, randomization & analysis · three tertiary cardiac centres

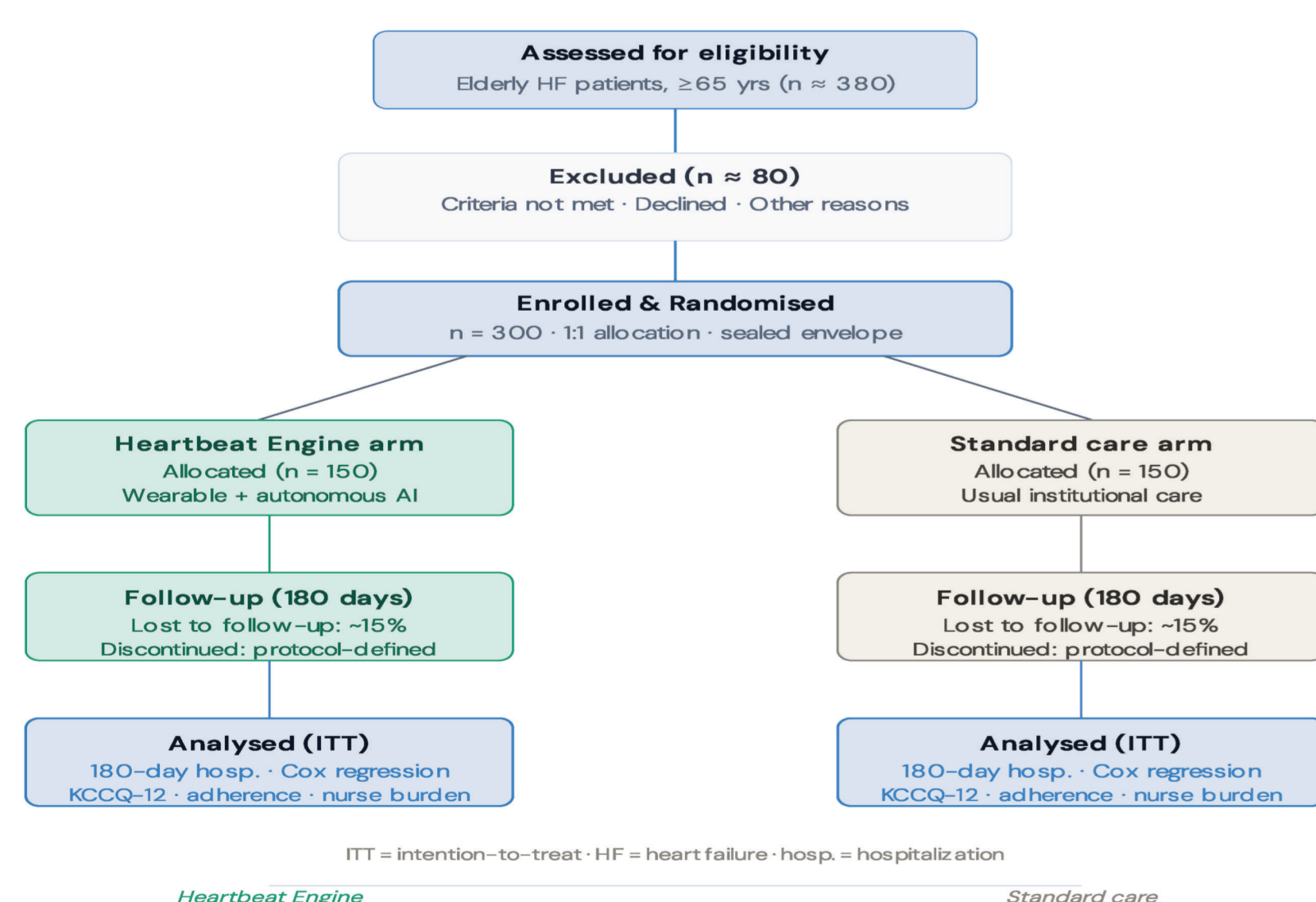
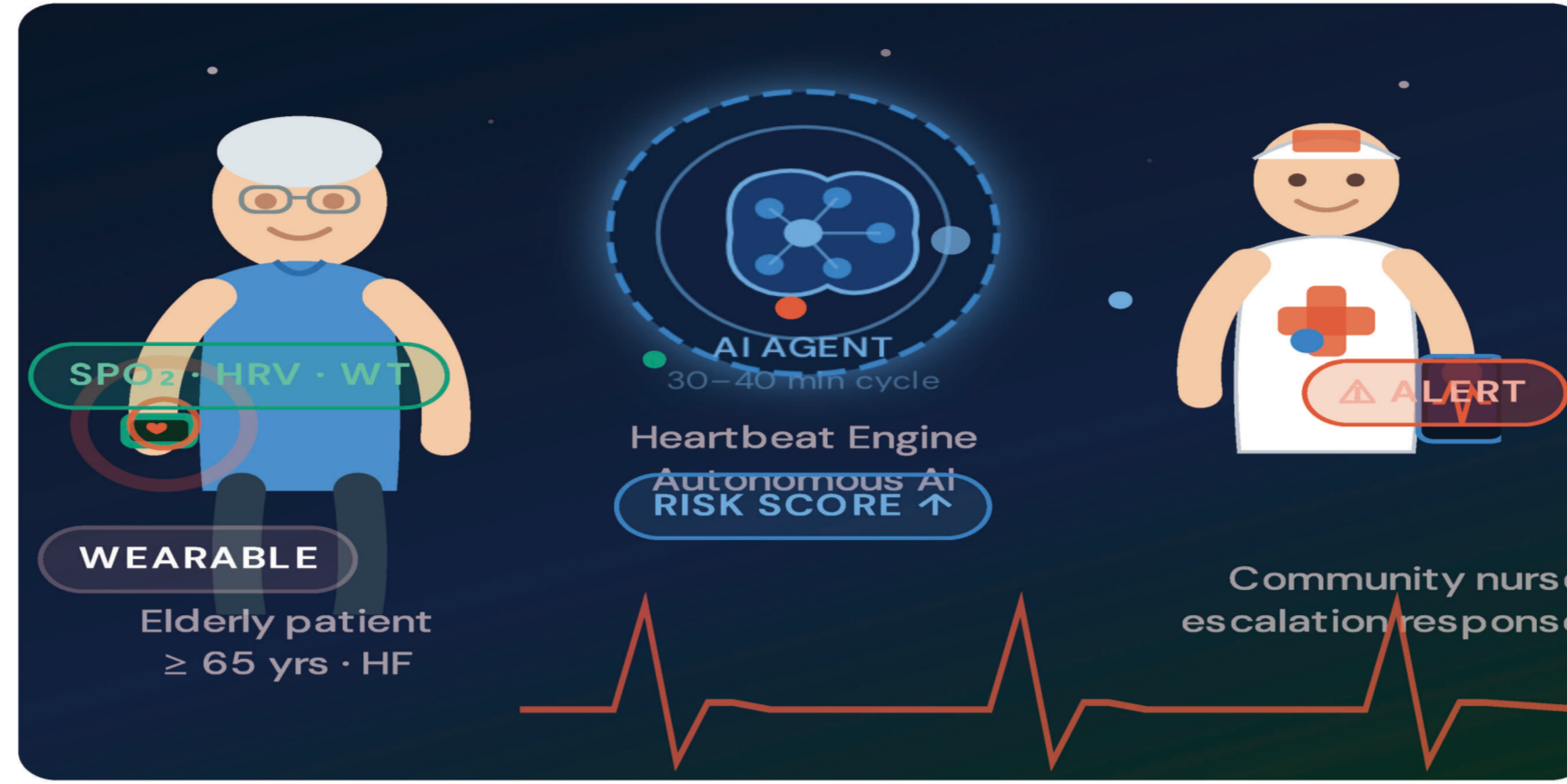


Figure 2. CONSORT flow diagram for the Heartbeat Engine multicentre RCT.

THE HEARTBEAT ENGINE — SYSTEM OVERVIEW

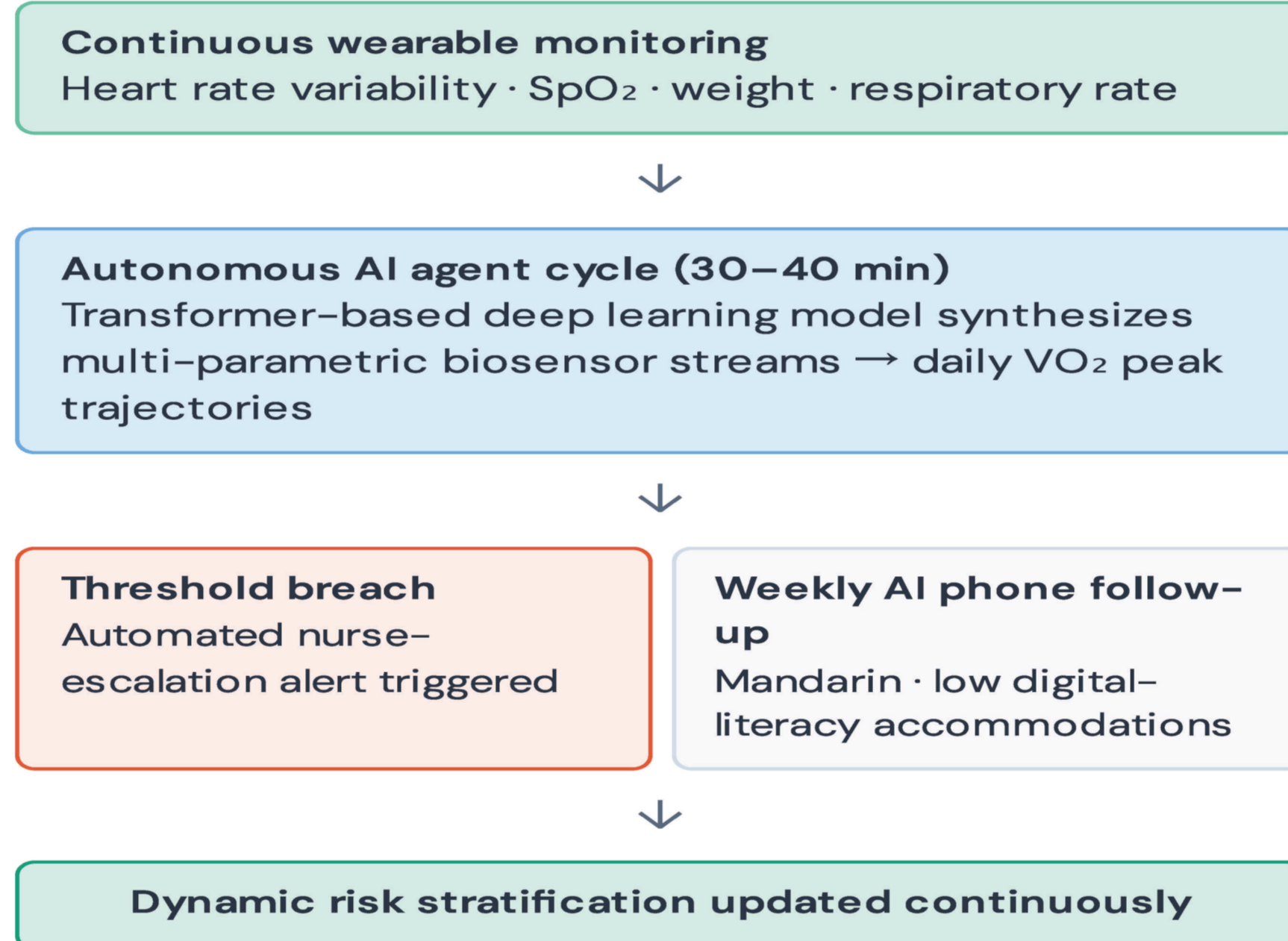


Animated schematic. The Heartbeat Engine continuously collects multi-parametric wearable data (SpO₂, HRV, weight) from elderly HF patients at home. An autonomous AI agent cycles every 30–40 minutes to update each patient's risk trajectory, triggering community nurse escalation when physiological thresholds are breached.

STUDY DESIGN & PARTICIPANTS

Prospective, two-arm, parallel-group RCT. Participants are adults aged ≥65 years with confirmed HF diagnosis, recruited at tertiary cardiac centres in Shanghai, Beijing, and Guangzhou. A sample of 300 patients (150 per arm) is required, calculated assuming a 35% baseline 180-day hospitalization rate, an anticipated risk ratio of 0.70, 80% power, and 15% dropout allowance.

INTERVENTION: HEARTBEAT ENGINE



OUTCOMES & ANALYSIS

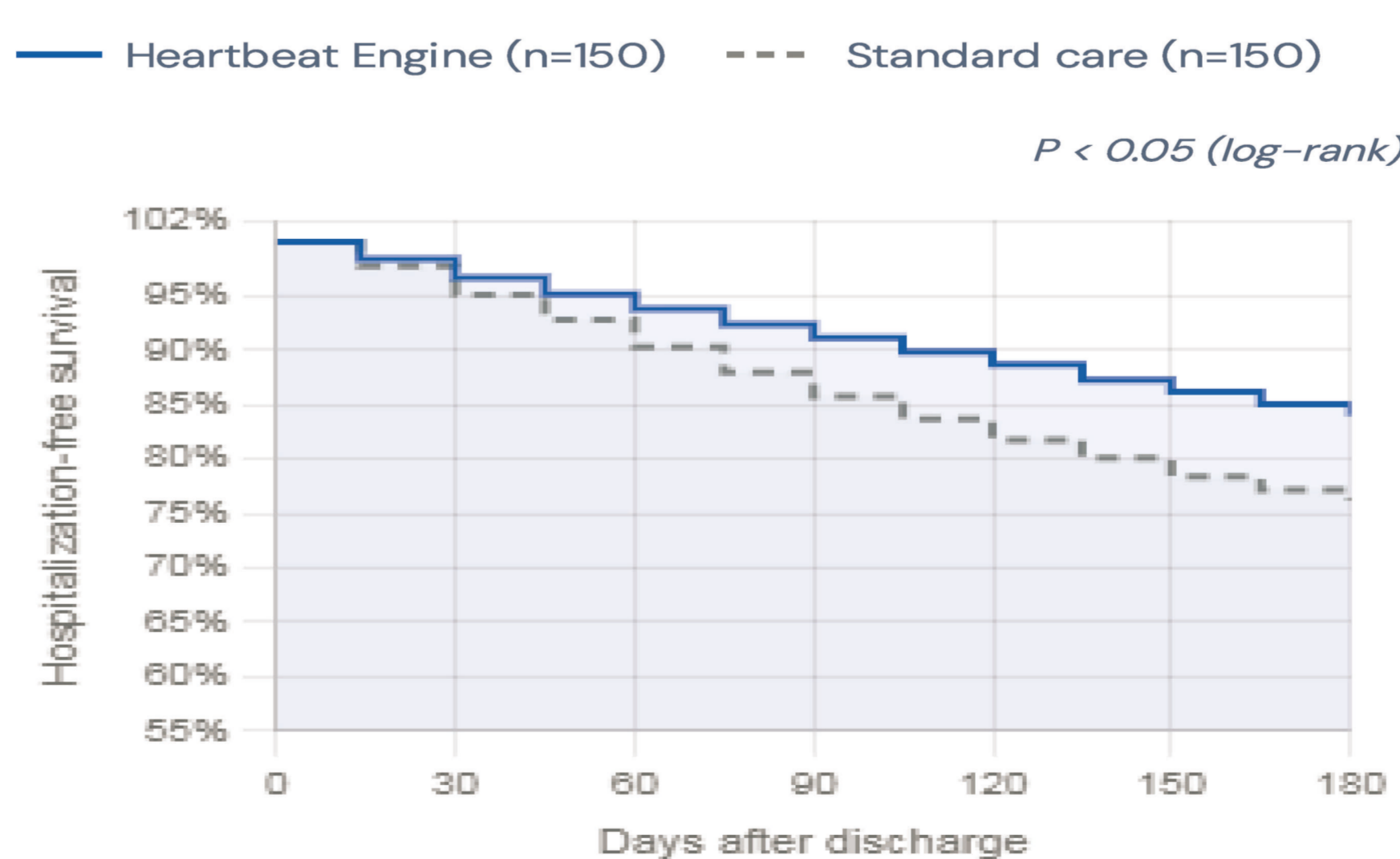
PRIMARY OUTCOME
180-day all-cause hospitalization
Cox proportional hazards regression · intention-to-treat analysis

QUALITY OF LIFE KCCQ-12 Target ≥5 pt improvement	ADHERENCE Medication Self-report + pharmacy records
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Control arm receives standard discharge care per usual institutional protocols, with no active AI monitoring component.

FIGURE 1 — KAPLAN-MEIER SURVIVAL CURVE

180-day hospitalization-free survival · anticipated ITT results (n = 300)



At risk	Day 0	Day 30	Day 60	Day 90	Day 120	Day 150	Day 180
HBE arm	150	144	138	131	125	120	117
Std care	150	140	129	118	110	103	98

Figure 1. Stepped curves represent time-to-first-hospitalization events. Shading = 95% CI. Risk table shows patients remaining at risk at each 30-day interval. HBE = Heartbeat Engine; Std = standard.

ANTICIPATED KEY FINDINGS

- Hospitalization** Statistically significant reduction in 180-day all-cause hospitalization in the Heartbeat Engine arm, consistent with an anticipated risk ratio of 0.70.
- Quality of life** Clinically meaningful KCCQ-12 improvement of ≥5 points, reflecting symptom burden relief and functional capacity gains.
- Medication** Improved medication adherence attributable to AI-assisted follow-up and weekly Mandarin-language conversational phone protocol.
- Early warning** Wearable biosensor streams expected to generate actionable physiological deterioration signals ahead of unscheduled healthcare utilization.

FIGURE 3 — MULTI-DOMAIN OUTCOME PROFILE

Anticipated benefit across all endpoints · normalised 0–100 scale (higher = more favourable)

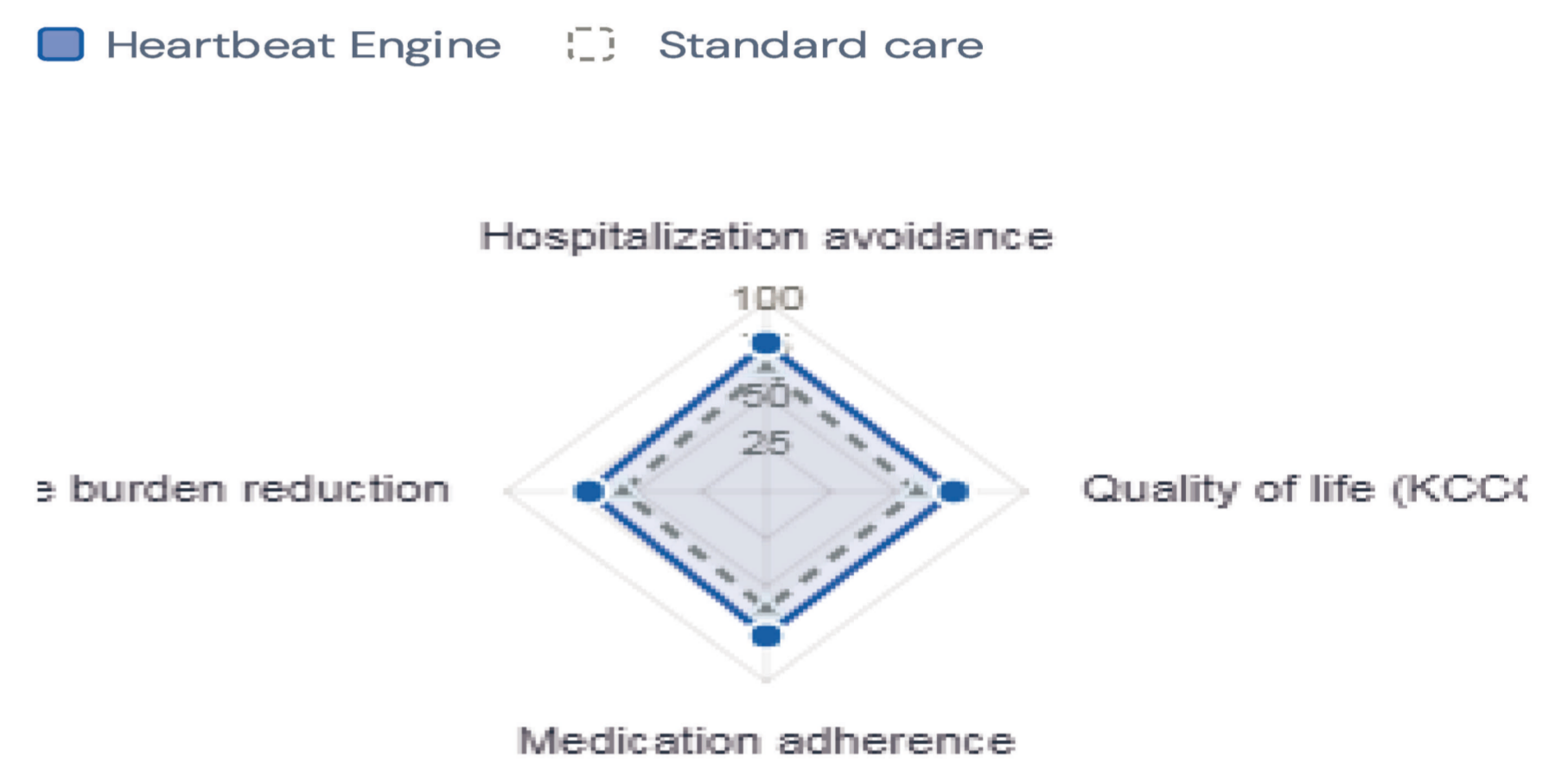


Figure 3. Scores normalised 0–100. Hospitalization avoidance = 100 minus 180-day all-cause rate. QoL = KCCQ-12 (0–100 domain). Adherence = proportion of prescribed doses taken (%). Nurse burden reduction = inverse of mean weekly escalations per patient, scaled.

PRACTICAL IMPLICATIONS

- Scalable national model:** Community-health-aligned architecture deployable across China's tiered health system without bespoke hospital infrastructure.
- Policy relevance:** Evidence to inform national post-discharge HF management guidelines targeting China's rapidly aging population.
- Equity-conscious design:** Mandarin-language AI telephony and low digital-literacy accommodations ensure accessibility beyond urban, technology-literate cohorts.
- Nursing workforce efficiency:** Autonomous escalation logic concentrates nurse attention on genuinely deteriorating patients, addressing a key system constraint.
- Economic burden reduction:** Preventing rehospitalizations yields substantial downstream savings, strengthening the health economic case for AI-enabled remote care.

SELECTED REFERENCES

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