

Abstract

How does a health system's return to specialist supply depend on the capacity constraints that convert specialists into delivered care—and why can large input expansions leave aggregate outcomes unmoved? Despite extensive evidence that healthcare inputs often fail to produce marginal health gains, the structural reason for this flat dose–response relationship is rarely identified mechanistically. This thesis addresses that gap by examining how emergency physician supply affects out-of-hospital cardiac arrest (OHCA) outcomes in Japan, and why the effect is conditional on prefecture density. Japan provides an ideal setting: a complete national OHCA registry, a more than two-fold expansion in emergency physician supply over 2008–2022, and a steep, persistent geographic maldistribution of physicians that generates within-country variation in capacity exposure. Using a balanced prefecture-year panel of 47 prefectures over 2008–2023 ($N = 752$), linking the All-Japan Utstein Registry to physician-supply and EMS-capacity data, this thesis employs two-way fixed-effects and density-stratified subgroup designs. The findings reveal a sharply conditional structure. In the aggregate, physician supply has no detectable effect on transport time, one-month survival, or neurologically favorable survival. This null masks strong heterogeneity: in high-density prefectures an additional physician per 100,000 reduces transport time by 0.72 minutes ($p = 0.015$) and raises one-month survival by 0.0032 ($p = 0.049$), while low-density effects are null throughout. The pattern is rationalized by an EMS-capacity-saturation mechanism, corroborated by two independent signatures—a steeper physician–dispatch slope where capacity binds, and a concentration of the transport-time reduction in the scene-to-hospital interval. Physician supply improves OHCA outcomes only where hospital-acceptance capacity binds, implying that supply expansion treated as a uniform national lever overstates its return.

Keywords: out-of-hospital cardiac arrest; emergency physician supply; EMS capacity; health-input productivity; prefecture panel; density heterogeneity; Japan