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Telemedicine in ER Care Via 5G AR: Cross-Sectional Comparisons

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INTRODUCTION

Patients in rural areas face substantial barriers to medical care compared with those in metropolitan centres because of limited access to health resources and expertise. These disparities are especially consequential in emergency care, where minutes matter and avoiding preventable delays in decision-making and procedures can significantly improve patient outcomes. Recent advances in augmented reality (AR), particularly when combined with 5G connectivity, enable real-time, expert-to-bedside guidance across distance. We implemented a 5G-enabled, AR-assisted remote-teaching platform (5G-RHS) that links a tertiary hospital with remote clinics to support frontline clinicians during emergency care. This study describes the implementation protocol and presents basic pre/post comparisons to assess whether trauma care processes improved after 5G-RHS was introduced.

MATERIALS AND METHODS

5G-RHS was developed to connect Emergency Room (ER) teams at three satellite sites with emergency specialists at a tertiary hospital. We collected monthly ER trauma data from these three sites, spanning 6 months of pre-implementation (January-June 2022) and 36 months of post-implementation (July 2022-June 2025). Fourteen clinical measures were evaluated, including Early Warning rate, FAST (Focused Assessment with Sonography for Trauma) time, transfusion preparation time, total case volume, and mortality rate. We summarized characteristics overall. For pre- vs. post-5G-RHS comparisons, we applied Welch's t-tests and Mann-Whitney U tests. To examine cross-sectional year-over-year differences, we compared January-June across 2022-2025 using pairwise Welch contrasts. Two-sided p-values < 0.05 were considered statistically significant.

RESULTS AND DISCUSSION

Results from *pre/post 5G-RHS tests* showed a higher Early Warning rate ($p < 0.001$), faster time-critical steps (e.g., FAST ($p = 0.006$), and transfusion preparation ($p < 0.001$)), and greater case volume ($p < 0.001$); these differences were statistically significant between groups, indicating increased operational efficiency. Mortality in severe cases showed no evidence of worsening ($p = 0.624$), suggesting that faster processes did not compromise quality. Table 1 presents detailed characteristics and comparisons for selected measures.

The *cross-sectional year-to-year analysis* illustrates broad trends (Figure 1 highlights selected measures). Some measures exhibited immediate changes after 5G-RHS introduction (e.g., Early Warning percent, FAST time), others showed gradual, sustained improvements (e.g., Preoperative time), and some appeared insensitive to the intervention (e.g., ICU days). These patterns align with real-world implementation: a new guidance tool can accelerate recognition and certain procedures, while capacity gains may not translate into shorter ICU stays.

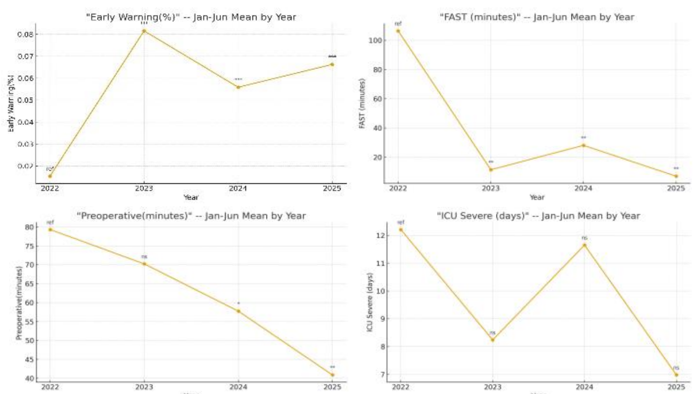

Fig 1 Year-to year comparisons of selected measures.

CONCLUSIONS

Implementing 5G-RHS allow physicians in remote clinics to connect with experts in tertiary hospitals and improve management efficiency of critical trauma patients without decreasing quality. AR-assisted remote teaching appears feasible, safe, and scalable for strengthening rural emergency care; larger, longer evaluations should confirm generalizability and value.

Table 1: Characteristics and statistical test results for selected measures.

	Pre_mean	Post_mean	Welch_p	MW_p
LOS Severe (days)	17.452	14.938	0.327	0.409
ICU Severe (days)	12.207	9.970	0.319	0.279
FAST (minutes)	106.500	18.624	0.006	0.001
Transfusion(minutes)	76.370	39.233	0.000	0.010
Preoperative(minutes)	79.322	56.732	0.014	0.010
Total Cases(n)	23.833	162.504	0.000	0.000
Early Warning (%)	0.015	0.064	0.000	0.000
Mortality of Severe (%)	0.107	0.112	0.624	0.321