

GIS-based Accessibility Study for Emergency Response to Traffic Crashes Along BRT 1 Corridor in Dar es Salaam, Tanzania

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Background

Post-crash response is increasingly recognised as a core pillar of road safety systems, yet in many rapidly urbanising African cities, emergency service planning remains weakly integrated with transport corridor design and traffic operations. Along Dar es Salaam's Bus Rapid Transit (BRT) Phase 1 corridor, recurrent crashes occur within highly congested mixed-traffic environments where delays in emergency access may increase injury severity and mortality. While previous efforts have focused primarily on crash prevention, limited evidence exists on whether emergency services are spatially positioned to respond effectively to crash locations along high-demand transit corridors. Generating spatially explicit evidence on emergency accessibility is therefore essential for informing practical interventions that can directly improve survivability after crashes.

Aim

This study aims to evaluate the spatial accessibility of emergency response services to traffic crashes along the Dar es Salaam BRT Phase 1 corridor and identify optimisation strategies for reducing response times in high-risk areas.

Method

A GIS-based analytical framework was applied using historical crash records obtained from the Traffic Police, geolocated emergency facilities (police and fire and rescue stations, hospitals/ambulances, and towing services), and corridor network data.

The existing BRT Phase 1, 21-km corridor was divided into three operational segments to support spatial comparison and interpretation zones (Kimara–Ubungo Maji, Ubungo Maji–Manzese, and Manzese–Kivukoni).

Kernel Density Estimation (200-m bandwidth) was applied to identify crash hotspots and concentrated demand zones. Network-based proximity analysis estimated emergency travel times under prevailing traffic conditions, and location–allocation modelling tested alternative resource placement scenarios to minimise corridor-wide response times.

Results

Crash density analysis revealed persistent hotspot clusters around Ubungo, Msimbazi, and Kariakoo, indicating concentrated emergency response demand. Response performance differed significantly by service type: police facilities showed comparatively faster accessibility (approximately 30–40 minutes), whereas fire and rescue services experienced longer delays (35–45 minutes), reflecting limited spatial coverage. Tow services recorded the longest delays, often exceeding 45 minutes.

Peak-period congestion increased estimated response times by 30–50%, highlighting a strong interaction between traffic operations and emergency effectiveness. Location–allocation scenarios demonstrated that targeted repositioning or addition of emergency resources near hotspot areas could substantially improve overall accessibility and reduce response times.

Conclusions

- Existing emergency facility locations do not optimally align with identified crash hotspots, contributing to avoidable delays.
- Congestion significantly amplifies response times, emphasising the need to integrate traffic operations with emergency planning.
- GIS-based hotspot and location–allocation analyses provide a practical decision-support tool for urban road safety management.
- Strategic relocation or augmentation of fire/rescue and towing services near high-risk zones could improve post-crash outcomes and strengthen corridor safety performance.