

K-SHIELD: An AI-Enabled Statewide Emergency Health Intelligence Platform For Real-Time Hospital Selection And Emergency Resource Coordination in The State of Keralam, India

S. Shreya Paramesvari*

Carmel Higher Secondary School, Easwaravilasam Road, Cotton Hill, Vazhuthacaud, Thiruvananthapuram, Kerala – 695014, India. Email: shreyaparamesvari@gmail.com

Abstract

Background: Emergency healthcare requires rapid assessment, transport and access to an appropriate treatment facility. The K-SHIELD, Keralam Statewide Health Intelligence for Emergency Incidents, Life Saving and Disaster Response, report identifies limited real-time visibility of ICU beds, trauma facilities, ventilators, specialists, diagnostic services, emergency department capacity and blood availability as an important coordination gap.

Methods: K-SHIELD was developed as a conceptual digital-health system design. The proposed architecture integrates Government and private hospitals, ambulance services, emergency control centres, police, fire and rescue services, disaster-management agencies, blood banks and public-health authorities through a secure cloud-based platform. Its AI decision-support engine combines patient, hospital, geographic and operational parameters.

Results/Expected Results: The proposed framework is expected to improve real-time resource visibility, support faster hospital selection, facilitate pre-arrival hospital preparedness, reduce avoidable inter-hospital transfers and strengthen disaster coordination. No clinical effectiveness results are claimed because the system remains a proposed framework.

Conclusion: K-SHIELD provides a structured framework for integrating real-time health intelligence, AI-assisted decision support and emergency-service coordination. Prospective pilot evaluation is required to establish technical feasibility, safety, recommendation accuracy, acceptability and clinical effectiveness.

Keywords: Artificial Intelligence; emergency healthcare; digital health; emergency medical services; ambulance decision support; hospital resource management; GIS; disaster management; interoperability.

1. Introduction

Emergency healthcare is a time-critical component of health-system performance. Patients with road traffic injuries [3], acute cardiac events, stroke, severe trauma, burns, poisoning, maternal emergencies and other acute conditions require rapid assessment, timely transport and access to definitive care. The K-SHIELD report emphasizes the importance of timely intervention during the Golden Hour concept [1, 2].

Keralam has an extensive network of Government and private healthcare institutions distributed across districts [23]. However, operational information is commonly maintained within institution-specific systems. Emergency responders may therefore have difficulty determining current ICU occupancy, trauma capacity, ventilator availability, specialist coverage, diagnostic services, blood availability and emergency-department workload at the time a patient requires transport [9, 11].

The source report identifies fragmented information systems, manual communication, delayed hospital selection, limited statewide resource visibility, limited disaster coordination and absence of predictive decision support as key challenges [7, 8]. These gaps may contribute to treatment delays, avoidable referrals, ambulance delays [12, 13], emergency-department congestion and inefficient use of available capacity.

Advances in Artificial Intelligence, Geographic Information Systems, GPS, cloud computing, mobile communication,

IoT and healthcare interoperability standards create an opportunity to develop integrated emergency decision-support infrastructure [14, 17]. K-SHIELD was conceptualized as a statewide emergency health intelligence layer that complements existing systems.

1.1 Aim

To develop a conceptual framework for an AI-enabled statewide Emergency Health Intelligence Platform that integrates emergency healthcare resources and supports real-time, patient-specific destination-hospital decision support in Keralam.

1.2 Objectives

- Establish a statewide Emergency Health Intelligence Platform integrating emergency healthcare stakeholders.
- Provide real-time visibility of critical healthcare resources.
- Support AI-assisted selection of an appropriate hospital for emergency patients.
- Reduce emergency treatment delays during the Golden Hour.
- Improve access to specialized and definitive emergency care.
- Minimize avoidable inter-hospital patient transfers.
- Optimize utilization of existing emergency healthcare infrastructure.
- Strengthen disaster preparedness and multi-agency emergency coordination.

2. Methods

Study design: This manuscript presents a conceptual health-informatics and digital-health system design based on the K-SHIELD Final Report. It is not a clinical trial, diagnostic-accuracy study or prospective implementation study. Accordingly, the Results section describes proposed functions and expected outcomes rather than measured effects.

Design framework: The system was organized around four requirements identified in the report: statewide emergency-resource visibility; patient-specific destination decision support; real-time ambulance-hospital coordination; and centralized situational awareness for emergency and disaster management.

System boundary: Participating hospitals, ambulance services, emergency control centres, police, fire and rescue services, disaster-management agencies, blood banks, diagnostic centres and public-health authorities form the proposed ecosystem. Existing hospital information systems remain institutional systems of record; K-SHIELD acts as an interoperable coordination and intelligence layer.

Data domains: Proposed inputs include patient assessment, hospital resource status, location and travel conditions, ambulance status, hospital workload and disaster-related load. The report specifically identifies ICU and trauma beds, ventilators, emergency occupancy, operating-theatre readiness, CT/MRI availability, blood inventory, specialist availability, ambulance locations, traffic and incident location.

AI decision support: The proposed engine groups variables into patient, hospital, geographic and operational parameters. Patient variables include age, emergency category, GCS, pulse, blood pressure, oxygen saturation, ECG findings, respiratory status, trauma severity and consciousness [24]. Hospital variables include ICU and ventilator availability, trauma capability, emergency occupancy, specialists, diagnostics, blood-bank inventory and operating-theatre readiness. Geographic variables include GPS, distance, travel time, traffic, road closures and weather. Operational variables include ambulance availability, hospital workload, predicted waiting time, referral patterns and disaster load.

Interoperability and security: The report proposes secure APIs and standards-based interfaces, with alignment to national digital-health initiatives including ABDM and HL7 FHIR. Security-by-design measures include encryption, authentication, role-based access control, multi-factor authentication, audit trails, secure APIs, security monitoring and disaster recovery.

Implementation: A phased model is proposed: district pilot, regional expansion and statewide rollout. The pilot is

intended to validate technical performance, interoperability and operational workflows before wider deployment.

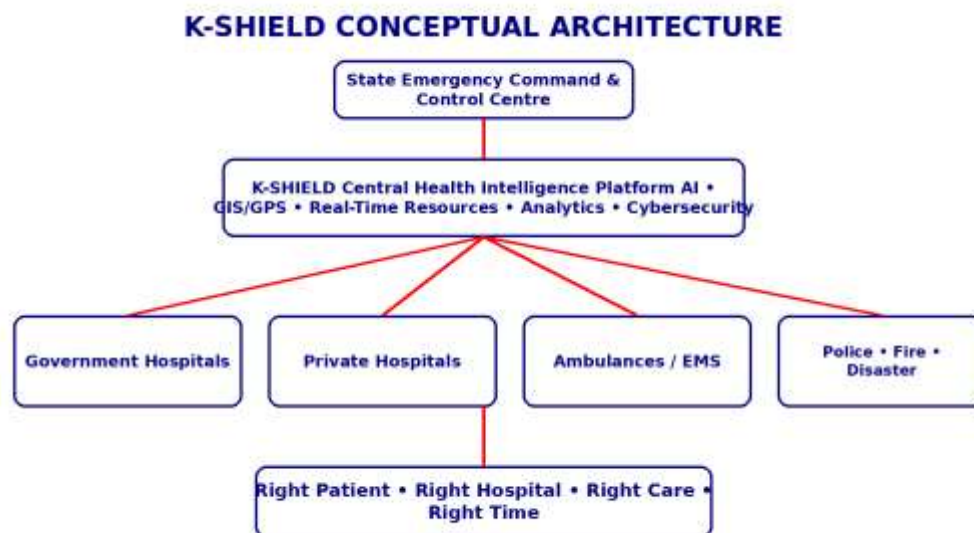


Figure 1. Conceptual architecture of K-SHIELD.

Table 1. Proposed K-SHIELD data domains and decision-support role

Domain	Illustrative variables	Role
Patient	Emergency category, GCS, vital signs, ECG, trauma severity	Characterize urgency and required care
Hospital	ICU, ventilators, trauma capacity, specialists, diagnostics, blood, OT readiness	Assess facility capability
Geographic	GPS, distance, travel time, traffic, road closures, weather	Assess accessibility
Operational	Ambulance status, hospital workload, waiting time, disaster/referral load	Adapt to changing conditions

3. Results / Expected Results

The resulting K-SHIELD framework consists of an integrated statewide emergency health-intelligence ecosystem with a central cloud platform, hospital resource-management interfaces, an AI decision-support engine, an ambulance decision-support platform and a State Emergency Command & Control Centre [18, 19].

3.1 Hospital Resource Visibility

Participating hospitals are proposed to provide or exchange current information on critical-care capacity, emergency workload, diagnostics, specialists, blood-bank inventory and operating-theatre readiness. Automated synchronization through secure APIs is proposed where technically feasible; otherwise, authorized personnel may update information through secure dashboards.

3.2 Ambulance Decision Support

The ambulance platform is designed to combine GPS navigation, digital patient assessment, AI-assisted hospital recommendation, alternative hospital options, traffic monitoring and estimated time of arrival. Receiving hospitals

can be notified in advance, allowing emergency teams to prepare before arrival.

3.3 AI-Assisted Hospital Recommendation

The core proposed output is a dynamic recommendation of an appropriate healthcare facility for a specific emergency. The framework does not define suitability solely by geographic proximity; it considers patient requirements, hospital capability, resource availability, travel conditions and operational workload together.

3.4 State Emergency Command and Control

The SECCC is proposed as the operational nerve centre of the platform. Dashboards would provide visibility of emergency incidents, ambulance movements, hospital capacity, disaster situations, alerts and public-health intelligence.

3.5 Disaster Response

During floods, landslides, cyclones, industrial accidents, epidemics and mass-casualty incidents, K-SHIELD is proposed to support coordinated distribution of patients according to available hospital capacity and resources.

3.6 Expected Effects

The framework is expected to reduce Golden Hour treatment delays, improve access to specialized emergency care and reduce avoidable inter-hospital transfers. Operationally, it is expected to improve visibility and utilization of ICU beds, ventilators and emergency facilities, reduce ambulance delays and strengthen hospital-emergency-service coordination. These remain proposed outcomes requiring empirical validation.

K-SHIELD OPERATIONAL WORKFLOW



Figure 2. Proposed K-SHIELD operational workflow.

AI DECISION-SUPPORT FRAMEWORK

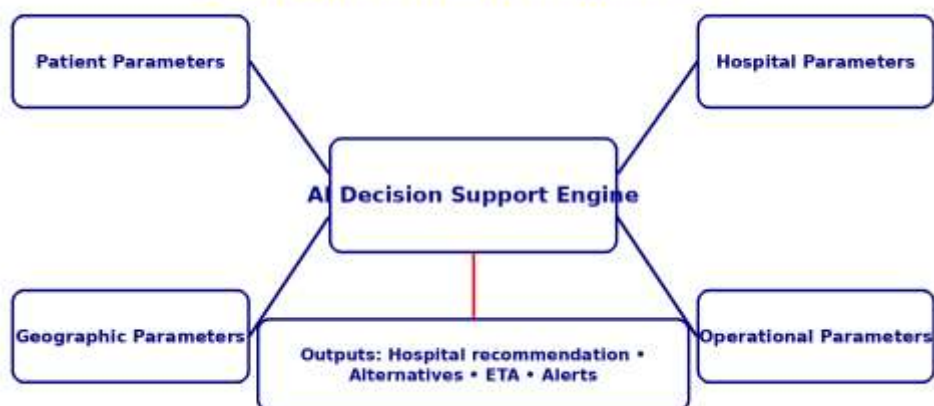


Figure 3. Conceptual AI decision-support framework.

Table 2. Proposed functional modules

Module	Primary function
Hospital Resource Management	Maintain critical-resource status and emergency capacity
Emergency Bed Management	Provide visibility of ICU/HDU/trauma capacity
Ambulance Management	GPS tracking, assessment, routing and destination support
AI Decision Support	Integrate clinical, resource, geographic and operational variables
GIS Mapping	Visualize incidents, resources, routes and hazards
Emergency Command Dashboard	Statewide operational visibility and alerts
Disaster Management	Coordinate resources and patient distribution during major events
Predictive Analytics	Forecast demand and potential shortages

4. Discussion

The K-SHIELD framework addresses a central emergency-healthcare coordination problem: the difference between the existence of healthcare resources and the ability of emergency responders to identify and use those resources at the required time. The report describes an environment in which individual institutions maintain operational information while statewide emergency coordination remains fragmented.

A distinguishing feature is the proposed combination of clinical, hospital, geographic and operational variables. A conventional nearest-hospital approach may not identify a facility capable of providing the definitive care required. K-SHIELD instead proposes patient-specific decision support that considers hospital capability and current resources while accounting for travel conditions and workload.

The proposed model is broader than a bed-availability dashboard. It connects emergency transport, hospital preparedness, command-centre monitoring and disaster coordination. This creates a feedback loop in which the statewide operational picture can inform local destination decisions and local resource changes can update the wider picture.

The proposed approach is conceptually aligned with integrated emergency-care principles emphasizing timely care across the emergency pathway and with all-hazards disaster-risk-management approaches. [1-5]

Interoperability is a key design consideration [20]. K-SHIELD is proposed to work with rather than replace existing hospital systems. Standards-based exchange could reduce duplication and support integration with India's digital-health ecosystem [21, 22]. The report identifies HL7 FHIR and ABDM as relevant directions.

The AI component requires particular caution because emergency destination decisions can have direct clinical consequences. AI outputs should therefore remain decision-support recommendations subject to qualified clinical judgment, established emergency protocols and human oversight. Before deployment, the recommendation engine should undergo retrospective testing, simulation and prospective pilot validation.

4.1 Governance and Implementation

A statewide platform would require clear governance, standardized definitions of resource availability, data stewardship, accountability for data accuracy, cybersecurity oversight and mechanisms for clinician and ambulance-team feedback. The report proposes a dedicated operational unit under the Department of Health & Family Welfare as a possible governance mechanism.

4.2 Safety and Ethical Considerations

Patient safety should remain the primary design principle. The system should display data freshness, identify uncertainty or incomplete information, provide transparent recommendation rationale where feasible and maintain audit logs. Human override should be available. Privacy controls should limit patient-identifiable information to authorized users.

4.3 Evaluation Framework

The next research phase should prospectively evaluate the platform in a selected district before statewide deployment. Evaluation should include technical, operational, user-centred and clinical endpoints.

Table 3. Proposed pilot evaluation indicators

Domain	Indicator	Measurement concept
Technical	Recommendation availability	Proportion of eligible incidents receiving a recommendation
Technical	Data freshness	Time since last validated resource update
Operational	Destination-selection time	Time from assessment to destination decision
Operational	Ambulance performance	Dispatch-to-arrival and turnaround intervals
Operational	Avoidable transfers	Proportion requiring secondary transfer
Hospital	Pre-arrival preparedness	Proportion of notified hospitals confirming preparedness
User	Usability	Structured feedback from ambulance and hospital users
Clinical	Patient outcomes	Outcomes selected after ethics and clinical review

5. Limitations

This manuscript describes a proposed system and therefore does not provide clinical trial results, measured mortality reduction, validated AI accuracy, cost-effectiveness estimates or statewide operational performance data. Expected benefits are hypotheses derived from the proposed architecture and objectives. Real-world effectiveness will depend on data quality, hospital participation, interoperability, connectivity, user adoption, governance and algorithm performance.

The source report does not provide a finalized numerical implementation budget; it identifies budget categories and states that the final budget should be refined after technical assessment, stakeholder consultation and pilot implementation.

6. Future Research

Future work should develop a formal technical specification, data dictionary, interoperability profile, AI model-selection methodology, validation dataset and clinical governance framework. Retrospective historical-case testing could first evaluate whether recommendation logic identifies clinically appropriate destination facilities. Simulation studies could test performance under changing hospital capacity, traffic congestion and mass-casualty conditions. A pilot should subsequently evaluate usability, data completeness, system availability, recommendation accuracy, response time and operational outcomes. If acceptable safety and performance are demonstrated, larger prospective studies could examine clinical and health-system outcomes.

7. Conclusion

K-SHIELD is a proposed AI-enabled statewide Emergency Health Intelligence Platform intended to transform emergency healthcare coordination through real-time resource visibility, patient-specific decision support, ambulance connectivity and centralized emergency intelligence. Its architecture integrates hospitals, emergency transport and response agencies through a common digital ecosystem.

The principal contribution is the proposed integration of patient, hospital, geographic and operational information into a coordinated emergency destination decision-support process. The platform also extends beyond individual emergencies to support statewide situational awareness and disaster coordination.

K-SHIELD should therefore be regarded as a promising health-informatics system design requiring structured pilot implementation and empirical validation. Its ultimate value will depend on whether it can safely reduce decision delays, improve coordination and optimize healthcare resources while maintaining privacy, interoperability and

human clinical oversight.

Declarations

Ethics approval and consent

Not applicable to this conceptual system-design manuscript. Future studies involving patient-level data should obtain appropriate ethics approval and consent or applicable waiver.

Funding

The author declares that no funding was received from any government, commercial, institutional, or other external source for the development or preparation of this manuscript.

Conflict of Interest

The author declares that there is no conflict of interest related to this manuscript or the proposed K-SHIELD system.

Data availability

No patient-level dataset was analysed for this conceptual manuscript.

Acknowledgement

The author gratefully acknowledges the institutional support, guidance, and encouragement provided by Carmel Higher Secondary School, Vazhuthacaud, Thiruvananthapuram, Kerala, India, in the conceptualisation and development of K-SHIELD (Keralam Statewide Health Intelligence for Emergency Incident, Life-Saving and Disaster Response). Special appreciation is extended to the Director, Sr. Renita; the Principal, Smt. Jolly George; the teaching and non-teaching staff members; and the parents for their valuable encouragement and support throughout the ideation, concept development, content preparation, and manuscript writing process. Their contributions and cooperation are sincerely appreciated in supporting the development and proposed publication of this concept paper.

References

1. World Health Organization. WHO emergency care system framework. Geneva: World Health Organization; 2018. Available from: WHO Emergency Care System Framework
2. World Health Organization. Emergency care systems for universal health coverage: ensuring timely care for the acutely ill and injured. World Health Assembly resolution WHA72.16. Geneva: World Health Organization; 2019. Available from: WHO – WHA72.16
3. World Health Organization. Global status report on road safety 2023. Geneva: World Health Organization; 2023. Available from: WHO – Global Status Report on Road Safety 2023
4. World Health Organization. Health emergency and disaster risk management framework. Geneva: World Health Organization; 2019. Available from: WHO – Health Emergency and Disaster Risk Management Framework
5. World Health Organization. Emergency response framework (ERF), edition 2.1. Geneva: World Health Organization; 2024. Available from: WHO – Emergency Response Framework
6. World Health Organization. Tools for strengthening emergency care systems. Geneva: World Health Organization; 2019. Available from: WHO – Tools for Strengthening Emergency Care Systems
7. Reynolds TA, Stewart B, Drewett I, Salerno S, Sawe HR, Torlini J, et al. The impact of emergency medical services on the global burden of illness and injury: a global health research agenda. Bull World Health Organ. 2017;95(7):514-523.
8. Thind A, Hsia R, Mabweijano J, Hicks ER, Zakariah A, Mock CN. Prehospital and emergency care: updates from the Disease Control Priorities, 3rd edition. Lancet. 2015;385(9975):2020-2027.
9. Morley C, Unwin M, Peterson GM, Stankovich J, Kinsman L. Emergency department crowding: a systematic review of causes, consequences and solutions. PLoS One. 2018;13(8):e0203316. doi:10.1371/journal.pone.0203316.

10. Carter EJ, Pouch SM, Larson EL. The relationship between emergency department crowding and patient outcomes: a systematic review. *J Nurs Scholarsh*. 2014;46(2):106-115. doi:10.1111/jnu.12055.
11. Hoot NR, Aronsky D. Systematic review of emergency department crowding: causes, effects, and solutions. *Ann Emerg Med*. 2008;52(2):126-136.e1.
12. Centralized ambulance destination determination: a retrospective data analysis to determine impact on EMS system distribution, surge events, and diversion status. *Prehosp Emerg Care*. 2021.
13. Determining ambulance destinations when facing offload delays using a Markov decision process. *Comput Oper Res*. 2020.
14. Yi N, Baik D, Baek G. The effects of applying artificial intelligence to triage in the emergency department: a systematic review of prospective studies. *J Nurs Scholarsh*. 2025;57(1):105-118. doi:10.1111/jnu.13024.
15. El Arab RA, Al Moosa OA. The role of artificial intelligence in emergency department triage: an integrative systematic review. *Intensive Crit Care Nurs*. 2025.
16. Predicting emergency department disposition using machine learning and large language models to support proactive capacity management: a multicenter retrospective study. *BMC Emerg Med*. 2026.
17. Data-driven decision support in hospital resource planning: an artificial intelligence-based model proposal for emergency department demand. *Int J Med Inform*. 2026;216:106483.
18. World Health Organization. Framework for a public health emergency operations centre. Geneva: World Health Organization; 2015. Available from: WHO – Public Health Emergency Operations Centre Framework
19. World Health Organization. Handbook for developing a public health emergency operations centre. Part A: policies, plans and procedures. Geneva: World Health Organization; 2018. Available from: WHO – Handbook for Developing a PHEOC
20. HL7 International. FHIR: Fast Healthcare Interoperability Resources. Release 5. Ann Arbor (MI): HL7 International; 2023. Available from: HL7 FHIR Release 5
21. Ministry of Health and Family Welfare, Government of India. National Digital Health Blueprint. New Delhi: Ministry of Health and Family Welfare; 2019.
22. National Health Authority, Government of India. Ayushman Bharat Digital Mission (ABDM). New Delhi: National Health Authority; 2021. Available from: Ayushman Bharat Digital Mission
23. State Health Systems Resource Centre-Kerala. Referral Protocol 2025-26. Thiruvananthapuram: Government of Kerala; 2025. Available from: SHSRC Kerala – Referral Protocol 2025-26
24. World Health Organization. Global Emergency and Trauma Care Initiative (GETI). Geneva: World Health Organization. Available from: WHO – Global Emergency and Trauma Care Initiative