SMART INDIA HACKATHON 2025

25084 - EARTHQUAKE STABILISED DIALYSIS SYSTEM FOR PATIENT SAFETY DURING SEISMIC EVENTS.

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PROBLEM STATEMENT

- India faces significant risk during earthquakes affecting dialysis patients relying on continuous treatment.
- Existing dialysis infrastructure lacks seismic protection, risking treatment interruptions and patient safety.
- Proposal: A seismic-stabilized dialysis system integrating multi-layer seismic isolation and active gyroscopic stabilization.
- Aim: Ensure uninterrupted dialysis during seismic events to safeguard patient lives.

FOR WHOM?

- For policymakers, healthcare administrators, and disaster management authorities to guide infrastructure planning and emergency health strategy.

- For chronic kidney disease patients who depend on continuous dialysis treatment, as they are the ultimate beneficiaries of service protection during earthquakes.

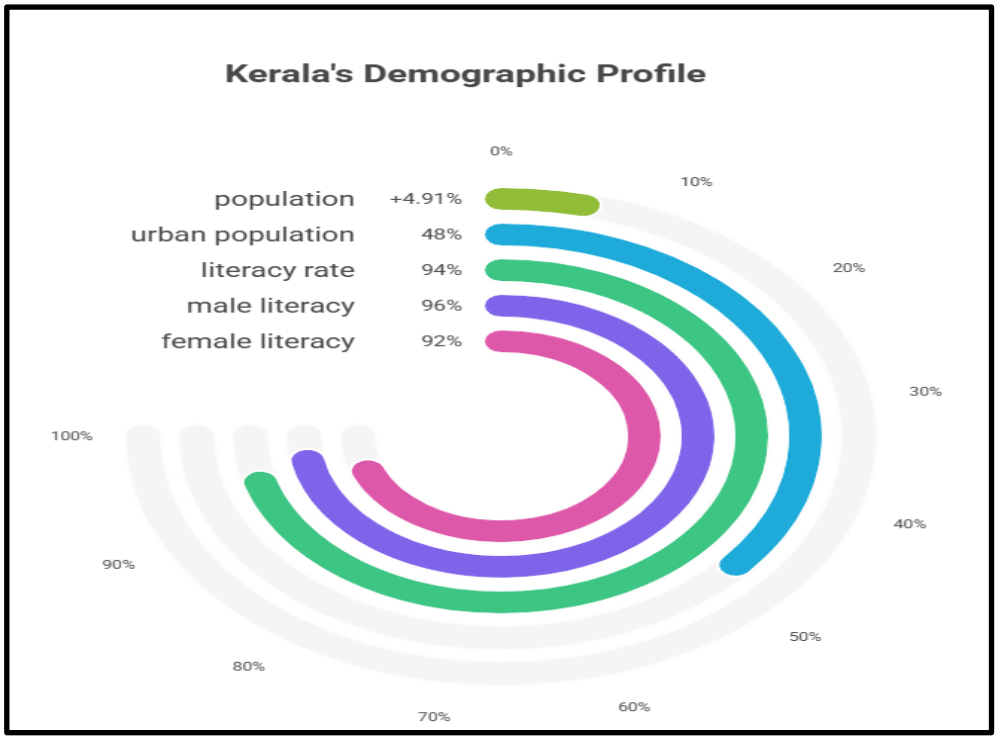
FOR WHAT?

- To ensure uninterrupted and safe dialysis treatment during seismic events by developing and implementing stabilisation systems and earthquake-resistant technology.
- To reduce the risk of treatment interruptions and prevent avoidable patient harm or mortality during earthquakes.

KERALA POPULATION STATISTICS

- Estimated population of Kerala in 2025: approximately 3.53 to 3.6 crore (35.3 to 36 million).
- Population growth rate slowed, with a 4.91% increase since 2011 census.
- Male population: about 1.6 to 1.7 crore.
- Female population: about 1.7 to 1.9 crore.
- Sex ratio: roughly 1084 females per 1000 males, above the national average.
- Population density: approximately 860 persons per km^2.
- Urban population comprises about 48% of total population.
- Literacy rate approximately 94%, with male literacy around 96% and female literacy above 92%.

- Kerala is known for high healthcare standards and a relatively stable demographic profile.



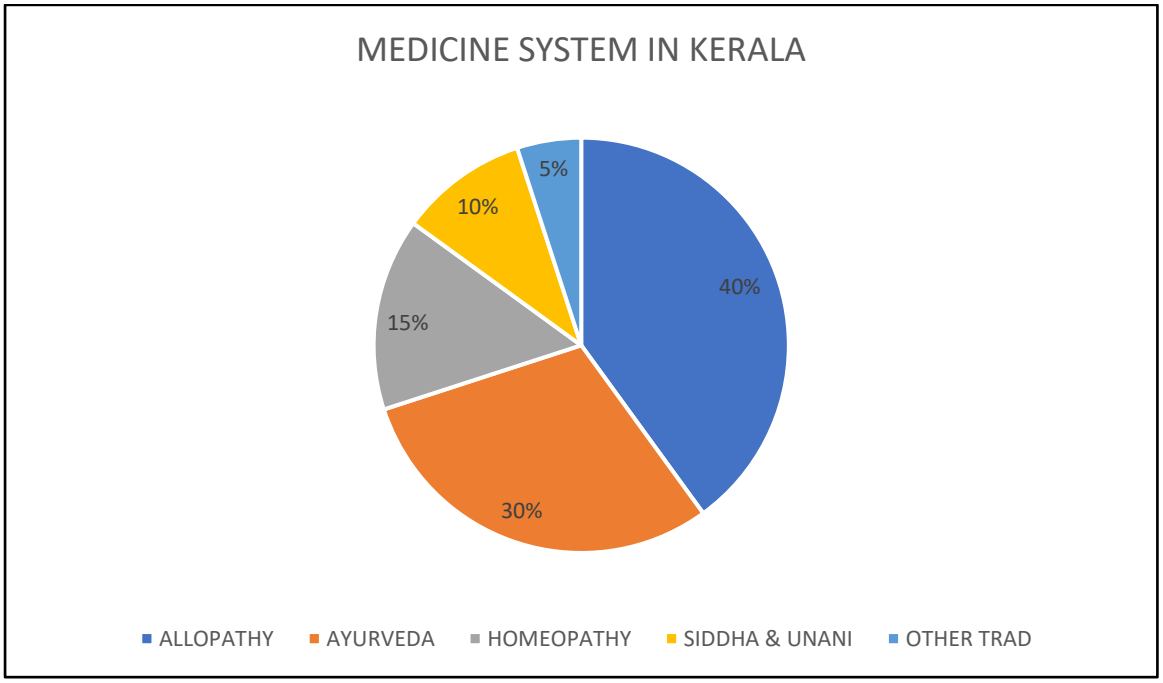
COMPREHENSIVE LIST OF HOSPITALS IN KERALA

[Kerala Hospital List - Public PDF]

MEDICINE SYSTEM IN KERALA

- Allopathy constitutes 40% of the medical systems practiced in Kerala, representing the modern medical care approach.
- Ayurveda makes up 30%, showing the strong presence of traditional Indian medicine in the region.
- Homeopathy accounts for 15%, reflecting an alternative medical system with moderate adoption.

- Siddha & Unani systems together represent 10%, indicating other traditional practices with a notable following.
- Other traditional medicine systems comprise 5%, covering various less common or miscellaneous healing practices.



NEPHROPLUS

NephroPlus is India's largest dialysis service provider, operating more than 350 centers across the country and overseas. It primarily delivers hemodialysis, peritoneal dialysis, home dialysis, and mobile dialysis services. While NephroPlus does not manufacture dialysis machines itself, it uses advanced machines from leading global manufacturers like Nipro, Fresenius, and Baxter, ensuring safe, reliable, and

high-quality dialysis care. Their model integrates medical technology with patient-centric services to improve the quality of life for people with kidney failure.

DIALYSIS MACHINE OVERVIEW

The dialysis machines used in NephroPlus centers function as artificial kidneys, removing toxins, excess salts, and water from the patient's blood. These machines are equipped with advanced safety features, ultrafiltration control, and automated monitoring systems. A commonly used model in NephroPlus centers is the Nipro Surdial 55Plus Hemodialysis Machine, known for its efficiency, reliability, and patient comfort.

TECHNICAL SPECIFICATIONS

- **Dimensions:** 280 × 420 × 1365 mm
- **Weight:** ~72 kg
- **Power Supply:** AC 230 V ±10%, 2000 VA consumption
- **Backup Battery:** ~30 minutes
- **Water Requirements:** 17–30 °C, pressure 0.05–0.74 MPa, flow ≥ 900 mL/min
- **Dialysate Flow Rate:** 300–800 mL/min
- **Blood Pump Flow Rate:** 10–600 mL/min
- **Ultrafiltration (UF) Range:** 0.00–5.00 L/hr, accuracy ±30 g/hr
- **Dialysate Temperature:** 34.0–39.0 °C
- **Heparin Pump:** 0.0–9.9 mL/hr with bolus option

- **Safety Features:** Air bubble detector, blood leak detector, pressure sensors, self-check, and multiple alarms
- **Disinfection Modes:** Heat disinfection, chemical rinse, daily/weekly scheduling
- **Special Functions:** Sodium and bicarbonate profiling, Kt/V dose estimation, data logging, and fast setup (~8 minutes).

SUPPORTING INFRASTRUCTURE IN NEPHROPLUS CENTERS

1. Water Treatment Plant (RO System): Provides ultrapure water for dialysis.
2. Dialysate Supply: Acid and bicarbonate concentrates mixed automatically by the machine.
3. Consumables: Dialyzers, bloodlines, AV fistula needles, filters, and disinfectants.
4. Power Backup: UPS and generators to ensure uninterrupted dialysis.
5. Safety Monitoring: Continuous alarms for leaks, air detection, conductivity errors, and pressure variations.
6. Electronic Health Records: Integration with NephroPlus IT systems for patient monitoring and reporting.

NEPHROPLUS UNIQUE SERVICES

- Dialysis on Wheels: Mobile dialysis units equipped with machines, RO plants, and trained staff.
- Home Hemodialysis: Safe dialysis at patient homes using portable machines.

- Dialysis on Call: On-demand dialysis at specific patient locations.
- In-Hospital Partnerships: Setting up dialysis units within existing hospitals.

CASE STUDY VISIT TO KG HOSPITAL

As part of our project on dialysis systems, our team conducted a case study visit to KG Hospital to collect detailed information about dialysis machines and the dialysis infrastructure. During the visit, we observed the operation of hemodialysis machines, including setup, monitoring, and the safety protocols followed by the hospital staff. We also collected data on the types of machines used, their technical specifications, water treatment systems, dialysate management, and the various safety and monitoring features implemented to ensure patient safety. The visit helped us understand the end-to-end dialysis process, the supporting infrastructure, and the role of trained personnel in delivering safe and efficient dialysis treatment.