Disaster Nephrology in Portugal: A Call for National Preparedness

Maria Manuel Guerra[1,2,], Diana Santos[2,3], Maria Inês Roxo[1,2], Bruno Pepe[1,2,3], Luís Santos[2,3], João Figueiredo Martins[2,3], Nuno Moreira Fonseca[2,4,5], Patrícia Branco[1,2,5]*

1. Serviço de Nefrologia do Hospital de Santa Cruz, Unidade Local de Saúde Lisboa Ocidental, Carnaxide, Portugal
2. Centro Clínico Académico de Lisboa, Lisboa, Portugal
3. Serviço de Nefrologia do Hospital das Forças Armadas, Pólo de Lisboa, Lisboa, Portugal
4. Serviço de Nefrologia do Hospital Curry Cabral, Unidade Local de Saúde de São José, Lisboa, Portugal
5. iNOVA4HEALTH, NOVA Medical School | Faculdade de Ciências Médicas, Universidade NOVA de Lisboa, Lisboa, Portugal

https://doi.org/10.71749/pkj.113

Keywords: Acute Kidney Injury; Disaster Planning; Disasters; Emergency Medical Services; Nephrology; Portugal

The rising frequency of natural and man-made disasters has underscored the vulnerability of chronically ill patients, particularly those dependent on renal replacement therapies such as hemodialysis. Although catastrophe nephrology has gained attention in recent years, it has traditionally focused on acute kidney injury resulting from mass trauma. In contrast, the continuity of care for chronic dialysis patients during emergencies remains a critical yet often under-recognized challenge. In Portugal, where nearly 13 000 individuals depend on regular dialysis, any interruption in treatment during a disaster may rapidly become life-threatening.

This perspective paper stems from discussions held during the IV "Rim do Desportista" Scientific Meeting, organized by the Nephrology Department of the Hospital das Forças Armadas on May 23rd, 2025. The 2025 edition was dedicated to the theme "Rim na Catástrofe" ("Kidney in Catastrophe") and brought together civilian and military experts in nephrology, internal medicine, intensive care, emergency medical services and fire brigades for a multidisciplinary discussion on this emerging topic.

We submit this paper to share the results of a series of thought experiments and simulations developed for, and presented during, the meeting. To support these exercises, the authors conducted a nationwide survey to determine the number of dialysis stations available across public and private facilities. This information was then combined with publicly available data from ANADIAL (Associação Nacional de Centros de Diálise) on patient distribution. Using these two data sources, seven hypothetical disaster scenarios were modeled: earthquakes, floods, cyclonic storms, wildfires, infrastructure collapse, and water contamination, to assess the resilience of Portugal's dialysis infrastructure. The simulations, which we will now describe, aimed to estimate reserve capacity, and propose phased, realistic strategies for emergency response.

Portugal's geography and infrastructure present significant vulnerabilities. In a simulated magnitude 7.3 earthquake affecting Lisbon, nearly half of the region's dialysis units would become inoperative, displacing more than 1900 patients. By expanding to four daily shifts and coordinating interregional transfers, all displaced patients could theoretically be accommodated within 72 hours. This highlights the feasibility of a phased response strategy, with initial local containment followed by regional redistribution, provided that pre-established protocols, sufficient staffing, and real-time data systems are in place.

Smaller-scale events revealed additional vulnerabilities. For example, a fire in a major urban center could displace more than 80 dialysis patients. While most could be relocated, complex cases such as those with hepatitis B or requiring hospital-level monitoring pose significant logistical and clinical challenges. Standardized evacuation protocols are therefore essential, including clear guidance on when reinfusion procedures may be bypassed to prioritize life-saving care.

Coastal and climatic risks place additional strain on dialysis services. A cyclonic storm affecting Nazaré and Alcobaça would involve the relocation of 237 patients, requiring nocturnal dialysis and rapid staff mobilization. Similarly, flooding in the Algarve could disable several

Received: 16/08/2025 **Accepted:** 10/10/2025 **Published Online:** 06/11/2025 **Published:** 19/11/2025

* **Corresponding Author:** Maria Manuel Guerra | mmacoelho@ulslo.min-saude.pt | Avenida Professor Dr. Reinaldo dos Santos, 2790-134, Carnaxide

units, leaving more than 400 patients without local treatment options. In such circumstances, long-distance transfers and reorganized transport schedules would be unavoidable, particularly for elderly patients dependent on medical transport. These scenarios underscore the need for interregional agreements and robust communication systems.

Island regions face distinct challenges. In the Azores, seismic events affecting Terceira, Faial, or Pico could critically disrupt dialysis capacity. Although São Miguel provides some surplus capacity, inter-island transfers rely on medical flights, ferries, and temporary housing. These constraints underscore the importance of mobile dialysis units and predefined airlift agreements tailored to the unique realities of island settings.

Infrastructure collapse also poses significant risks. A nationwide power blackout, such as the one that occurred in Portugal on the 28th of April, could jeopardize the continuity of dialysis care. Although most clinics are equipped with generators, their effectiveness during prolonged outages depends on uninterrupted fuel supply, which may be compromised by roadblocks or competing emergency demands. Contingency planning should therefore include fuel reserves, prioritized delivery agreements, and rapid activation protocols to prevent treatment disruption.

In conclusion, strengthening preparedness in Portugal requires the establishment of a national registry of dialysis capacity and patient distribution, enabling real-time coordination across facilities. A centralized Dialysis Emergency Coordination Program, operating under the Portuguese National Authority for Emergency and Civil Protection, should ensure the integration of nephrology into the broader national disaster response frameworks. Mobile dialysis units equipped with autonomous power, water, and supply systems must be available to stabilize patients in affected areas. Triage protocols should account for patient complexity, prioritizing care for those with infectious diseases, comorbidities, or acute kidney injury. Finally, disaster nephrology planning must extend beyond clinical care to include transport logistics, emergency housing, and unified communication platforms.

Preparedness is not optional - it is a clinical and ethical imperative. By strengthening coordination, infrastructure, and response protocols, Portugal can protect its most vulnerable patients and serve as a model for disaster nephrology worldwide.

Ethical Disclosures

Conflicts of Interest: The authors have no conflicts of interest to declare.
Financial Support: This work has not received any contribution grant or scholarship.
Provenance and Peer Review: Not commissioned; externally peer-reviewed.
Consent for Publication: Not applicable.

Contributorship Statement

MMG: Bibliographic research, data collection, drafting article, data collection.
DS: Drafting of the article, critical reviewing of the contect of the article, bibliographi research.
MIR, LS: Data collection, Bibliographic research, Critical review of the article.
BP: Data collection, bibliographic research. Drafting of article. Critical review of the article.
JFM: Data collection, critical review of the article.
NMF: Data collection, design of paper, bibliographic research, drafting of the article, critical review.
PB: Bibliographic research, critical review.
All authors approved the final version to be published.

REFERENCES

1. Guimarães SM, Ponce P. Catástrofes e diálise crónica: um plano de contingência. Rev Port Nefrol Hipert. 2006;20:263-80.
2. Kopp JB, Lempert K, Finne K. Disaster preparedness for patients with kidney disease. Nat Rev Nephrol. 2023;19:147-8. doi: 10.1038/s41581-023-00678-0.
3. Lempert KD, Kopp JB. Renal Failure Patients in Disasters. Disaster Med Public Health Prep. 2019;13:782-90. doi: 10.1017/dmp.2018.142.
4. Sever MŞ, Vanholder R, Lameire N. Disaster preparedness for people with kidney disease and kidney healthcare providers. Curr Opin Nephrol Hypertens. 2024;33:613-20. doi: 10.1097/MNH.0000000000001014.
5. Nihonyanagi R, Tsukasaki K, Itatani T, Nakai H, Toda D. Factors related to preparedness for emergency hemodialysis in the event of a natural disaster. Medicine. 2022;101:e29288. doi: 10.1097/MD.0000000000029288.
6. Smith RS, Zucker RJ, Frasso R. Natural Disasters in the Americas, Dialysis Patients, and Implications for Emergency Planning: A Systematic Review. Prev Chronic Dis. 2020;17:E42. doi: 10.5888/pcd17.190430.