Dialysis in crisis: Delivering renal replacement therapy in disasters, conflicts, and resource-constrained settings

Sourabh Sharma[1], Rasha Darwish[2], Sanjay Kalra[3], Sabine Karam[4]

Abstract

Access to dialysis during crises such as natural disasters, armed conflicts, pandemics, or in low-resource settings remains a significant global challenge. Vulnerable populations requiring chronic or acute dialysis are disproportionately affected by disruptions in infrastructure, supply chains, human resources, and water or power availability. This article explores the operational, clinical, ethical, and logistical challenges faced while delivering dialysis in crisis scenarios. Drawing from global case studies including earthquakes in Japan, war zones in Gaza, water-stressed regions, and lessons from the COVID-19 pandemic, this paper highlights feasible models of care, outlines adaptive strategies, and proposes a framework to improve dialysis delivery during emergencies.

Keywords: Crisis, Conflict, Dialysis, Disaster management, Emergency medicine, Humanitarian Health, Peritoneal Dialysis, Renal replacement therapy

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Introduction

Dialysis, a life-sustaining therapy for patients with kidney failure, is acutely vulnerable to disruptions caused by emergencies. Whether it is the sudden devastation from a natural disaster, systemic collapse during armed conflict, or ongoing fragility in under-resourced health systems, dialysis services often become unsustainable in crises.[1,2] Patients undergoing dialysis are especially dependent on regular access to complex infrastructure- including electricity, clean water, sterile consumables, trained personnel, and specialized equipment- making them among the most at-risk populations during emergencies. Interruptions, even for a few days, can lead to severe complications or death.[1,3] In low- and middle-income countries (LMICs), where baseline healthcare capacity is already limited, these challenges are magnified. Moreover, the increasing frequency of extreme weather events and geopolitical conflicts further underscores the urgency of preparing dialysis systems for resilience.[4,5]

This article addresses key questions: How can dialysis be maintained when systems collapse? What models have worked? And how can nephrology communities prepare proactively for the future?

Table-1: Typologies of crises affecting dialysis services.

Type of Crisis	Description	Impact on Dialysis	Real-World Examples
Natural Disasters	Earthquakes, floods, hurricanes disrupting infrastructure	Water shortages, damaged machines, transport disruption, hospital collapse	Earthquakes in Japan, Haiti, Turkey
Armed Conflicts	War, occupation, political instability	Destroyed facilities, blockades, staff exodus, electricity/fuel crisis	Gaza, Syria, Ukraine
Epidemics/Pandemics	Widespread infectious outbreaks like COVID-19	Staff shortages, equipment diversion, access restrictions, infection risk	COVID-19 global pandemic
Resource Constraints	Chronic underfunding, poverty, systemic health inequity	Limited machines/sessions, inadequate consumables, lack of trained personnel	Sub-Saharan Africa, parts of rural South Asia

Typologies of Crises Affecting Dialysis Services

Dialysis care can be affected by a wide range of crisis types, each with its own operational and clinical consequences. Table 1 categorizes these into four broad types: natural disasters, armed conflicts, epidemics/pandemics, and chronic resource constraints. Natural disasters, such as earthquakes and floods, can destroy infrastructure, impede transport, and disrupt water and electricity supplies- elements critical for haemodialysis (HD).[6] Armed conflicts further exacerbate these challenges by causing prolonged insecurity,

[1]Department of Nephrology, Vardhman Mahavir Medical College and Safdarjung Hospital, New Delhi, India; [2]Kasr Alainy Faculty of Medicine, Cairo University. Egypt; [3]Department of Endocrinology, Bharti Hospital, Karnal, India; University Centre for Research & Development, Chandigarh University, Mohali, India; [4]Division of Nephrology and Hypertension, University of Minnesota, Minneapolis, Minnesota, USA.

Correspondence: Sanjay Kalra,. **Email:** brideknl@gmail.com

ORCID ID: 0000-0003-1308-121X

Table-2: Dialysis modalities in crisis scenarios with strengths and challenges.

Modality	Strengths in Different Crisis Situations	Challenges	Adaptive Strategies
Haemodialysis	-Effective for hyperkalemia and fluid overload-Mobile units possible in disaster zones	-High dependency on water, power, machines-Not feasible in infrastructure collapse	Shift reduction, portable machines, mobile dialysis buses
Peritoneal Dialysis	-Highly suitable in earthquakes/war zones where infrastructure is damaged-Can be used at home/shelters	-Risk of peritonitis-Supply chain dependency for dialysate and disposables	Simplified CAPD protocols Community/caregiver training
CRRT	-Ideal for unstable ICU patients in epidemic settings (e.g., COVID-19)	-Requires ICU setting, anticoagulation management, expensive consumables	Preset kits, tele-ICU support, anticoagulation standardization
SLED/PIRRT	-Adaptable in overwhelmed ICUs-Reduced machine and staff time	-Requires flexible prescription-Limited familiarity in some centres	Training modules, Use in hybrid ICU models

damaging health facilities, and restricting access to fuel and consumables.[3] Epidemics such as COVID-19 have diverted healthcare personnel and overwhelmed ICUs, limiting both chronic and acute dialysis access.[7] Finally, chronic under-resourcing in many low- and middle-income countries creates systemic barriers to reliable dialysis even in peacetime.[8]

Dialysis Modalities in Crisis Scenarios

Dialysis delivery during crises depends significantly on the chosen modality. Each form- HD, peritoneal dialysis (PD), continuous renal replacement therapy (CRRT), and hybrid options like SLED (Sustained low efficiency dialysis) or PIRRT (Prolonged intermittent renal replacement therapy)- has specific strengths and limitations under crisis conditions. Table 2 summarizes how different modalities adapt to resource constraints and emergencies.

Haemodialysis, while the most commonly available and effective for rapid correction of electrolyte and fluid imbalances, depends heavily on clean water, electricity, and functioning dialysis machines. In contrast, PD can be advantageous during infrastructure collapse due to its minimal requirements for power and equipment, although infection control and supply chains are major concerns. CRRT is often used in ICUs for unstable patients, but demands a high level of technical expertise and consumable availability. SLED and PIRRT represent more resource-efficient alternatives, particularly suitable in overwhelmed or under-equipped critical care settings.[9]

Lessons Learned

Real-world case experiences help illuminate practical challenges and successful strategies. During the Gaza conflict, dialysis services faced complete disruption in multiple centres, with mortality exceeding 40% in some units. Despite the humanitarian crisis, coordination with international aid organizations and simplified treatment protocols allowed partial resumption of dialysis under constrained conditions.[10] Similarly, during the Fukushima earthquake and subsequent nuclear crisis in Japan, pre-existing disaster preparedness plans enabled the successful evacuation and continuation of therapy for paediatric patients on PD and HD.[11] This case exemplifies the value of simulation-based training, communication networks, and inter-facility collaboration.

In regions like Sub-Saharan Africa, chronic water scarcity has prompted innovations such as dry dialysate protocols and solar-powered water purification units. These adaptations are not just for emergencies but represent sustainable long-term strategies.[12] The COVID-19 pandemic tested dialysis services worldwide.[7] Hospitals reallocated staff and machines to critically ill patients, often deprioritizing chronic care. CRRT circuits had to be adapted for high-efficiency use, including anticoagulation strategies to reduce filter clotting and reduce staff exposure. These diverse cases reflect the importance of flexibility, innovation, and proactive planning in delivering dialysis under duress.

Conclusion

Dialysis patients are among the most vulnerable during crises, and maintaining renal replacement therapy in such contexts demands innovation, preparedness, and adaptability. Real-world experiences- from natural disasters in Japan to conflict zones like Gaza- highlight the critical importance of diverse modalities, local capacity building, and emergency planning. Embedding crisis-resilient dialysis strategies into routine health systems is essential. The nephrology community must continue to advocate for equitable access, develop flexible protocols, and support global collaboration to ensure continuity of life-saving care- even in the most challenging settings.

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