CRITICAL PATH INSTITUTE

An integrative roadmap for a new era of kidney replacement therapies

Abstract

Innovation in kidney replacement is entering a transformative era. Although precision medicine has driven major breakthroughs in disease-specific therapies, progress in translating next-generation kidney replacement strategies into practice has lagged. This updated Roadmap highlights a shift toward bold, integrative approaches that merge engineering, biology and patient-centred design. Emerging directions include reimagining filtration and tubular function through biomimetic membranes, cellular systems and organ-on-chip technologies, and simultaneously exploring microbiome modulation and sorbent-based strategies to reduce the uraemic toxin burden. Beyond improving survival, new solutions are being shaped by priorities of mobility, sustainability and quality of life, pointing toward wearable and implantable systems that move care beyond the clinic. Biologic frontiers such as xenotransplantation and stem cell regeneration are opening pathways to potentially curative therapies, although challenges in safety, equity and scalability remain. Central to these efforts is the need to embed patient perspectives and ensure that innovations align with lived experiences. This integrative approach calls for renewed investment, regulatory clarity and cross-sector collaboration to accelerate translation of advances into equitable therapies redefining the future of kidney health.

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