**Graphical abstract**

Mild pyrolysis of polysaccharide dextran and 1,8-diaminooctane formcarbonized nanogels (CNGs) through controlled cross-linking and carbonization. The CNGs exhibit strong bactericidal activity, even in saline solution, by disruption of bacterial membranes, toxin absorption, and bacterial decolonization in the intestinal tract for AHPND therapy caused by *Vibrio* infections.

