# BIOMARKER-RESPONSIVE DRUG DELIVERY SYSTEMS FOR CONTROLLED RELEASE OF OPIOIDS AND OPIOID ANTAGONISTS

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## Technology description

One of the major limitations of opioids, a class of analgesics used for pain management, is their narrow therapeutic range lacking a substantial difference between lethal and therapeutic doses. Opioid-induced toxicity leads to hypoventilation (respiratory depression), resulting in an increased concentration of $CO_2$ and a decreased concentration of $O_2$ in blood plasma. When administered, an overdose of opioid can cause an individual to cease breathing entirely, which is rapidly fatal without treatment. Opioid antagonists, such as naloxone and naltrexone, are effective in blocking the toxic effects of opioids; however, it is difficult to determine when such administration should be made. Thus, there is an urgent need to develop drug delivery systems that provide controlled release of opioids and opioid antagonists in response to a toxicity biomarker to prevent the lethal consequences of opioid overdose.

Dr. Thayumanavan has developed novel hydrogel-based drug delivery systems for biomarker-responsive, controlled release of opioids and opioid antagonists. Biomarker $CO_2$ associated with opioid-induced toxicity is used as an external trigger to both release an opioid antidote and stop the release of an opioid from their respective nanogel or macrogel delivery vehicles. While nanogels enable intravenous, intramuscular administration, macrogels can be used for oral delivery. The novel hydrogel compositions developed by Dr. Thayumanavan enable the delivery vehicles to expand and contract in response to changes in the $CO_2$ concentration, resulting in timely and controlled dosing of the opioid and opioid antidote drugs.

## Application area

Pain management for battlefield and clinical applications

## Advantages

Individualized and safe drug delivery that prevents opioid overdose

Biomarker-mediated automatic, controlled drug release

Novel hydrogel compositions providing tailored responses to $CO_2$

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