Drinkable, liquid *in situ*-forming and tough (LIFT) hydrogels for gastrointestinal therapeutics

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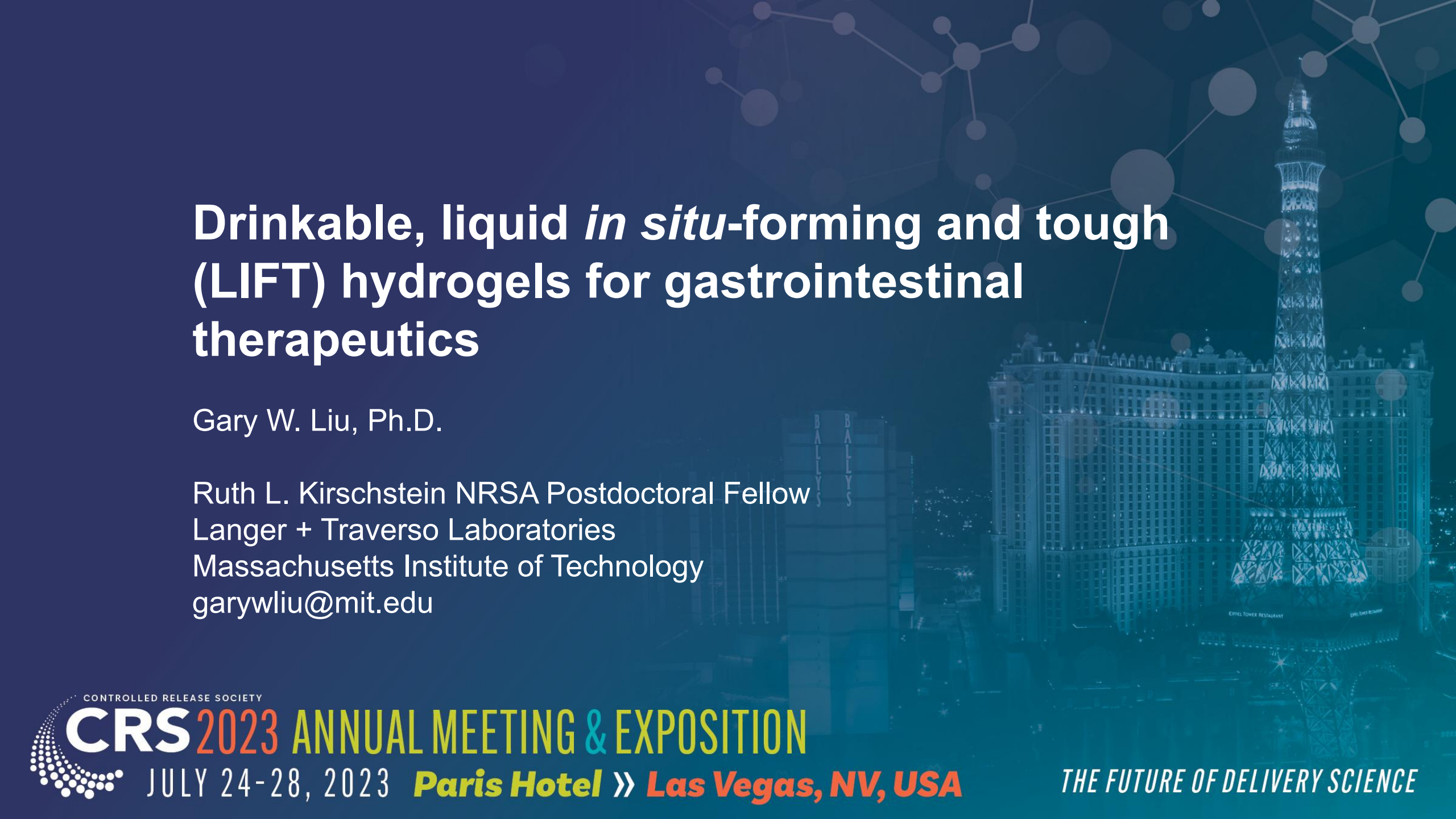
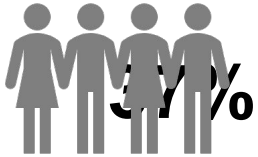


Solid drugs may post challenges against medication compliance

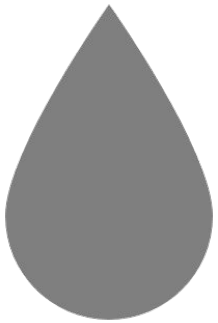
>70% of children prefer liquids



57% of adults have difficulty swallowing

may lead to missed doses, crushed pills, or death

Bridging the advantages of solid and liquid drugs could expand drug access

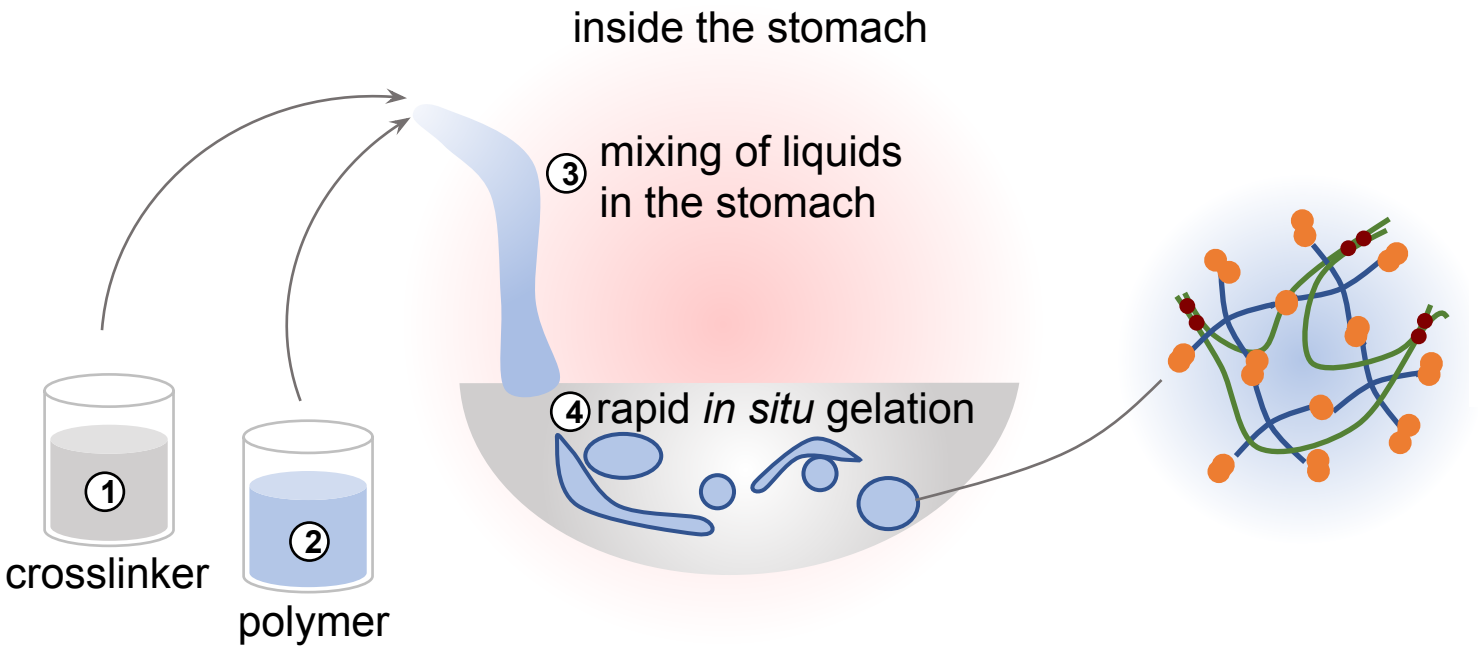


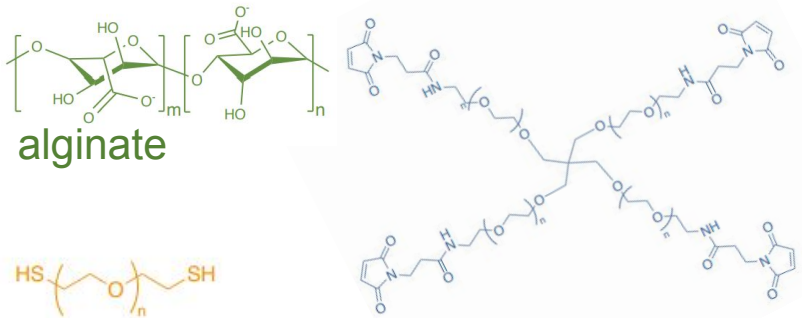
easy to swallow

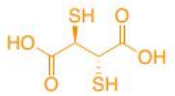
controlled release
mechanical toughness

T-1000, *Terminator 2: Judgment Day*

LIFT hydrogels could bridge the advantages of liquid and solid drugs



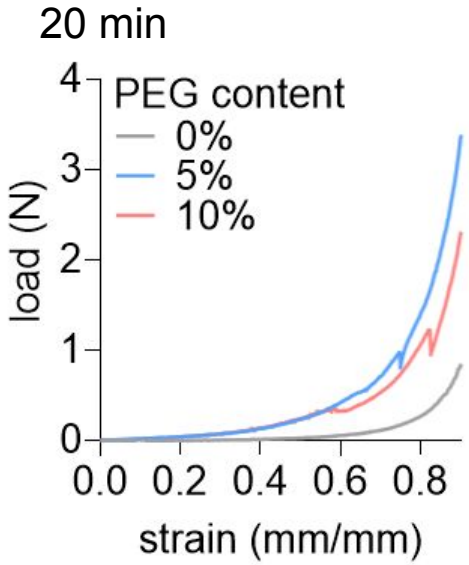


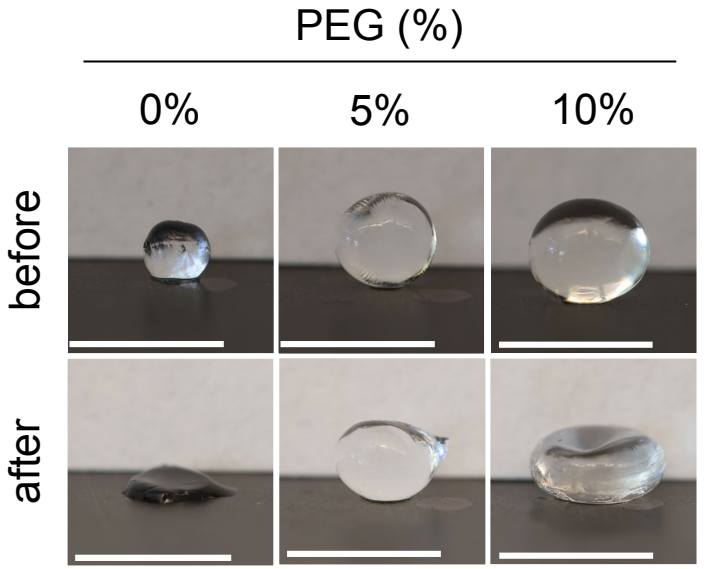


Ca^{2+}

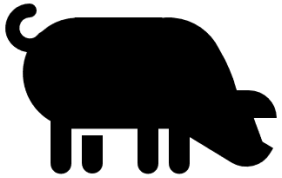
calcium

LIFT hydrogels can quickly form at timescales relevant to gastric transport



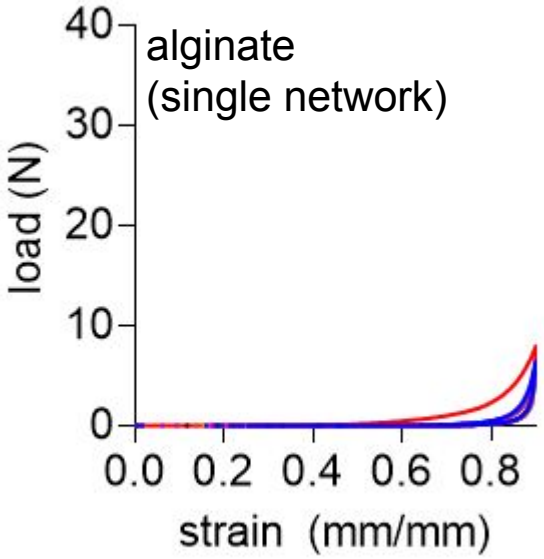


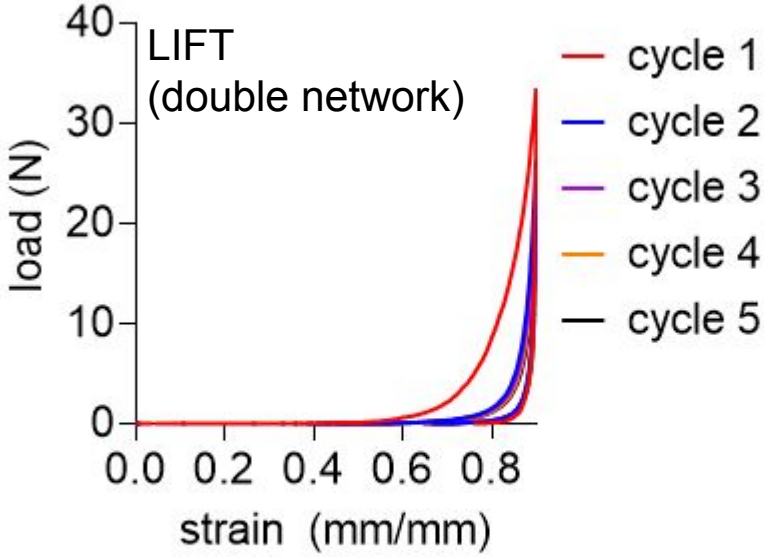
LIFT hydrogels form in *in vivo* porcine stomachs



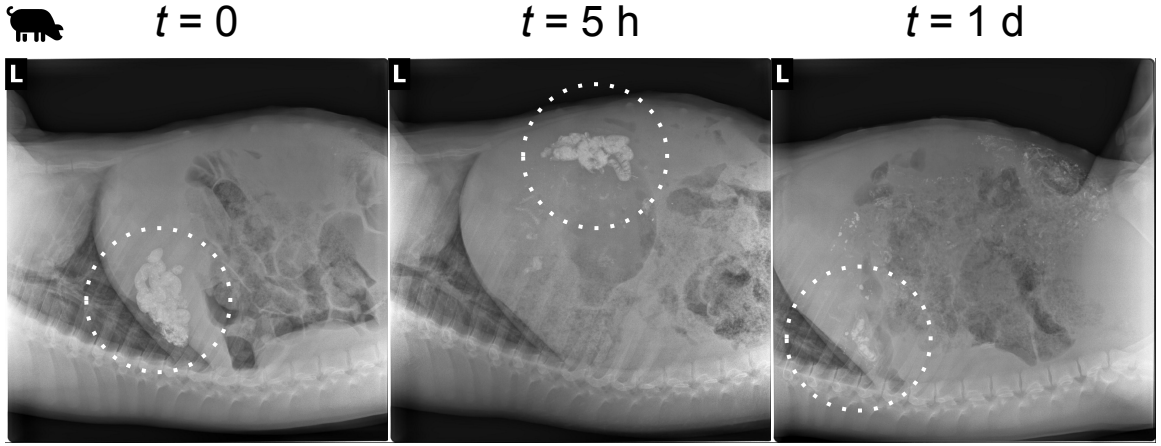
endoscopic administration in pig

5 cm



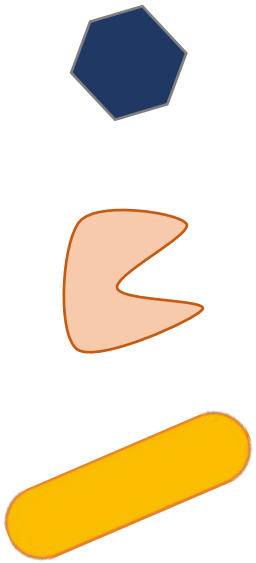


LIFT hydrogels are safely cleared



time	ALP (U/L)	AST (U/L)	ALT (U/L)	BUN (mg/dL)	creatinine (mg/dL)
baseline	131.0 ± 25.7	18.7 ± 4.0	41.7 ± 6.8	8.7 ± 0.6	1.1 ± 0.1
24 h	132.3 ± 22.5	22.3 ± 17.2	41.7 ± 6.1	12.7 ± 4.5	1.2 ± 0.2
48 h	115.0 ± 16.5	22.3 ± 5.5	38.7 ± 5.9	9.0 ± 1.7	1.1 ± 0.2

LIFT hydrogels as a platform for a variety of drug classes

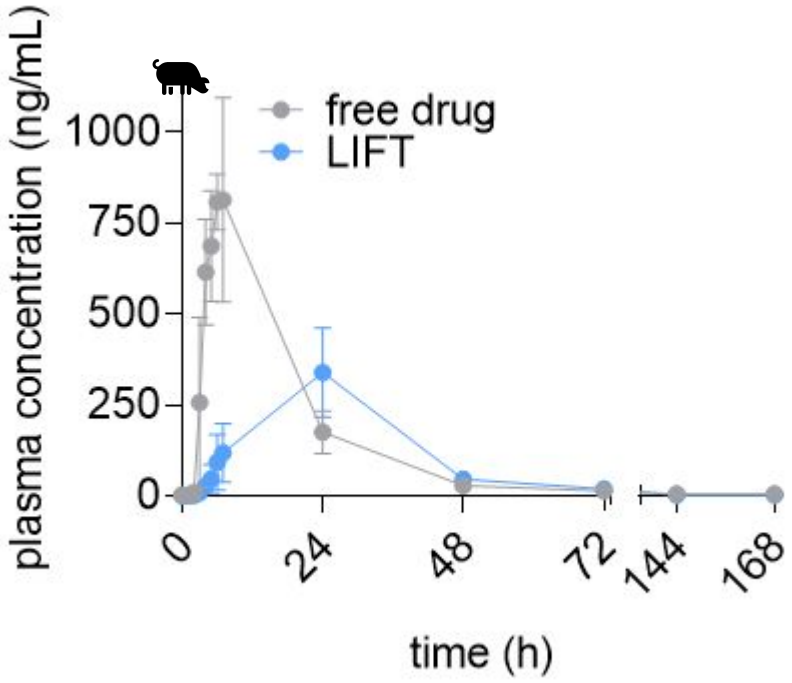


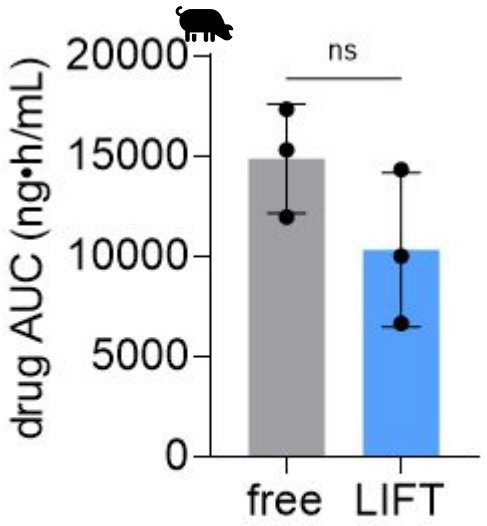
small molecules

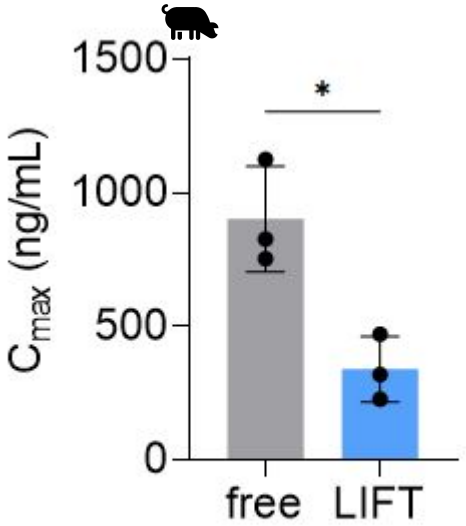
enzymes

therapeutic bacteria

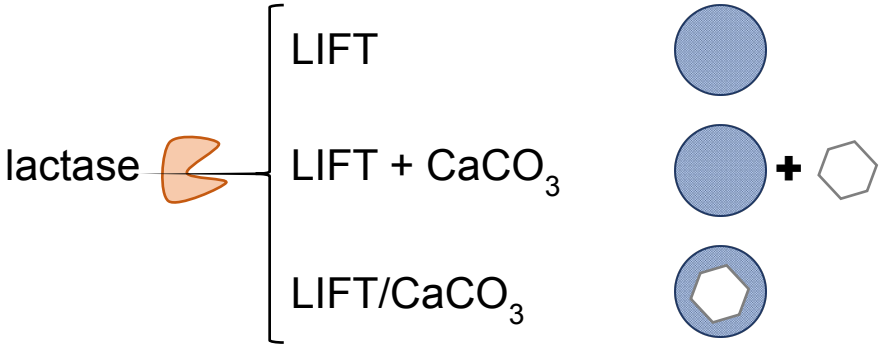
LIFT hydrogels can modulate drug pharmacokinetics

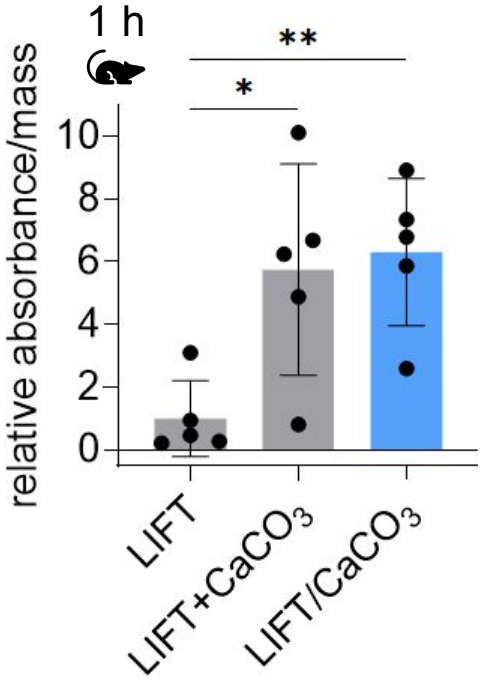


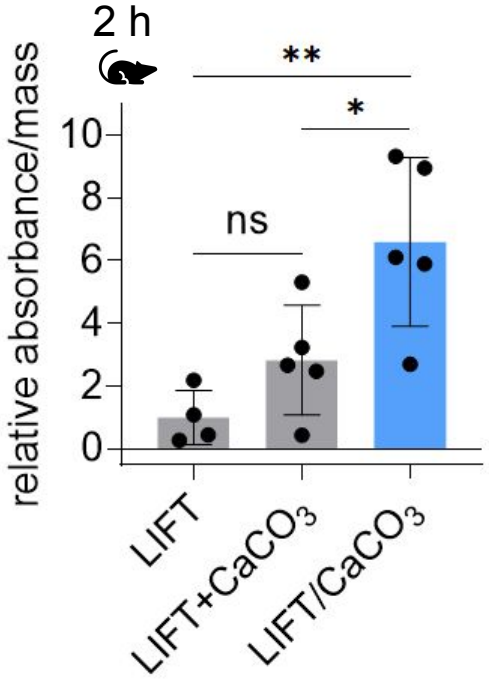




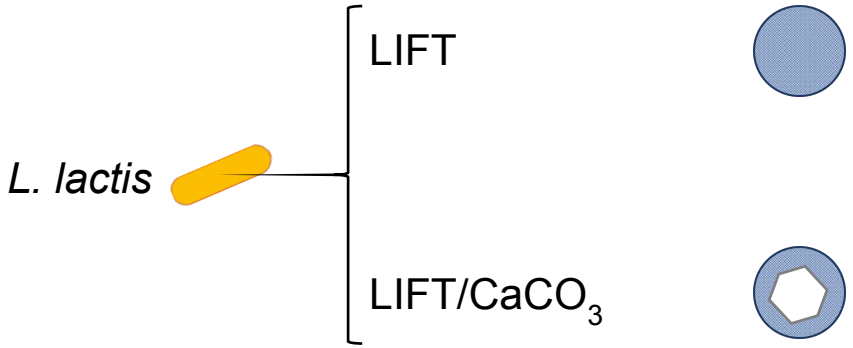
LIFT hydrogels can mitigate enzyme activity loss *in vivo*

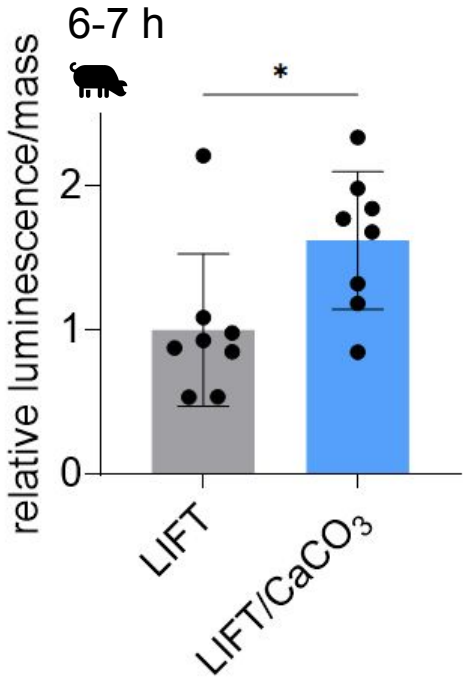






LIFT hydrogels can mitigate viability loss of therapeutic bacteria *in vivo*





Summary and conclusions

- LIFT hydrogels are mechanically tough and can crosslink *in vivo* in porcine stomachs
- materials are tolerated in porcine models and do not exhibit toxicity
- LIFT hydrogels can modulate the release and activity of a variety of therapeutic classes through co-encapsulating excipients
- “liquid pills” could expand access to advanced therapeutics for vulnerable patient populations

Acknowledgments

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