

Monitoring Pancreatic α -Amylase of Postoperative Patients with Droplet-Based Microfluidics

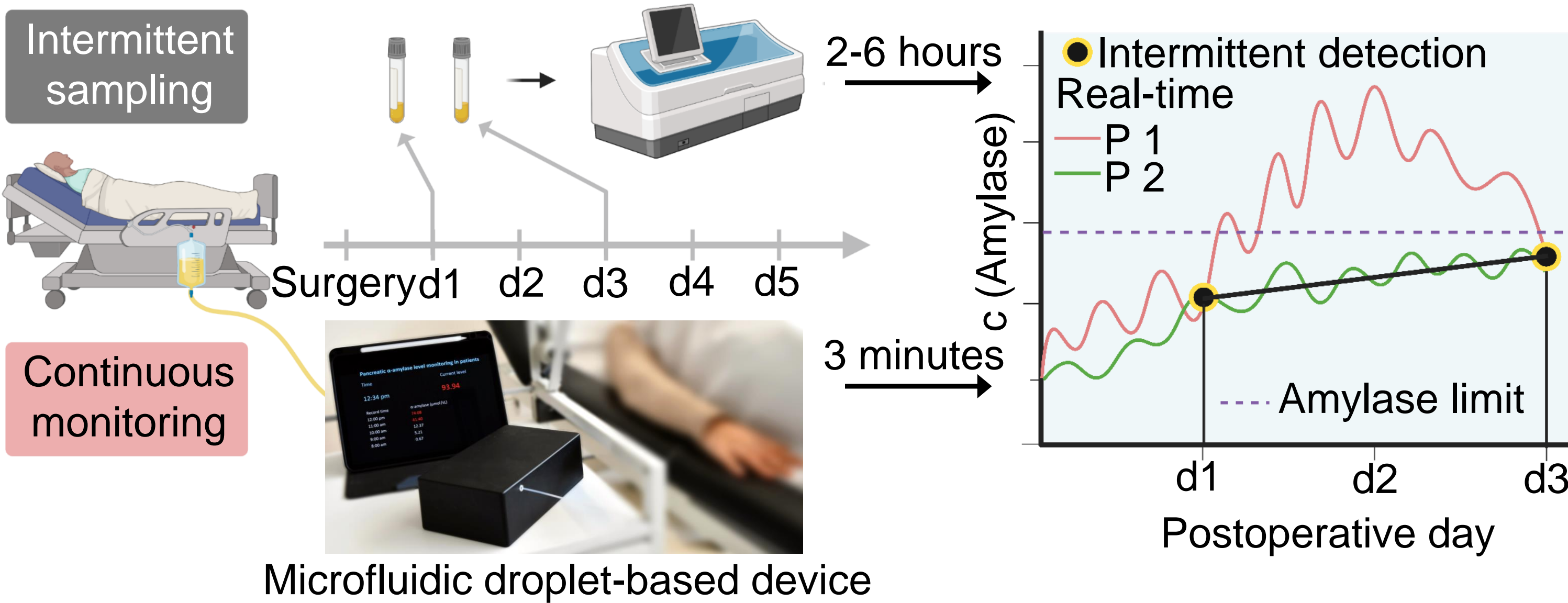


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Introduction

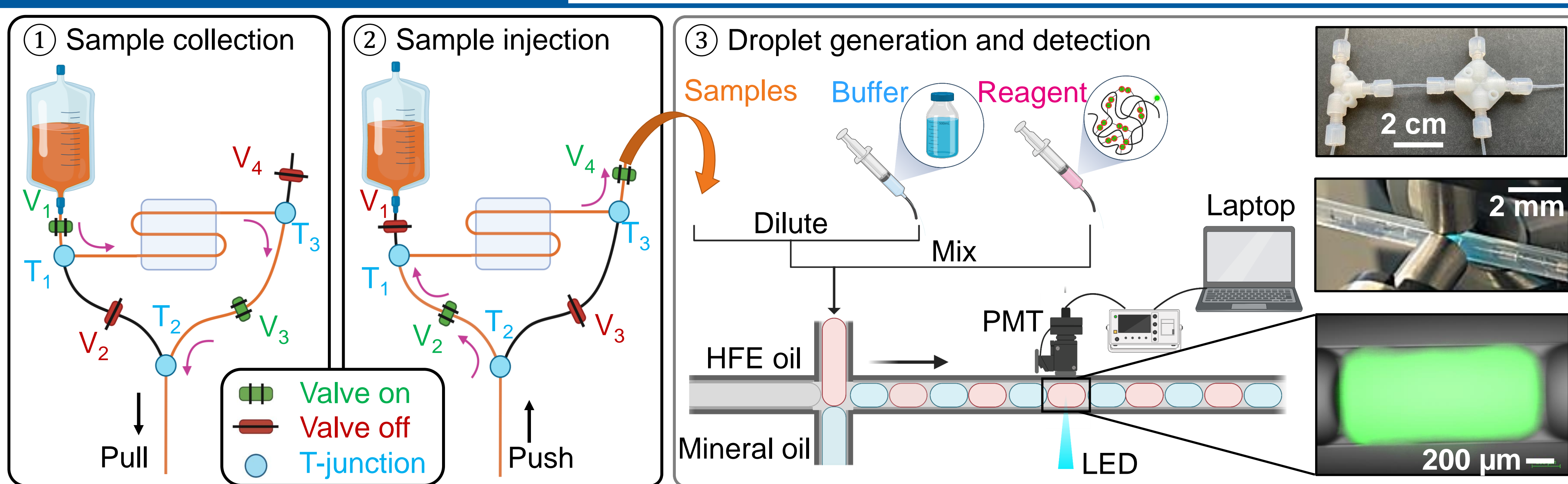
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- Postoperative complications after pancreatic surgery are frequent and can be life-threatening. Current clinical strategies quantify α -amylase activity intermittently, resulting in delayed treatment.
- The **portable droplet-based microfluidic device** is capable of **real-time monitoring** α -amylase activity.
- This strategy significantly improves the determination time (**3 min**) and detection limit (**7 nmol/s-L**) and reduces sample and reagent requirement (**10 μ L**).

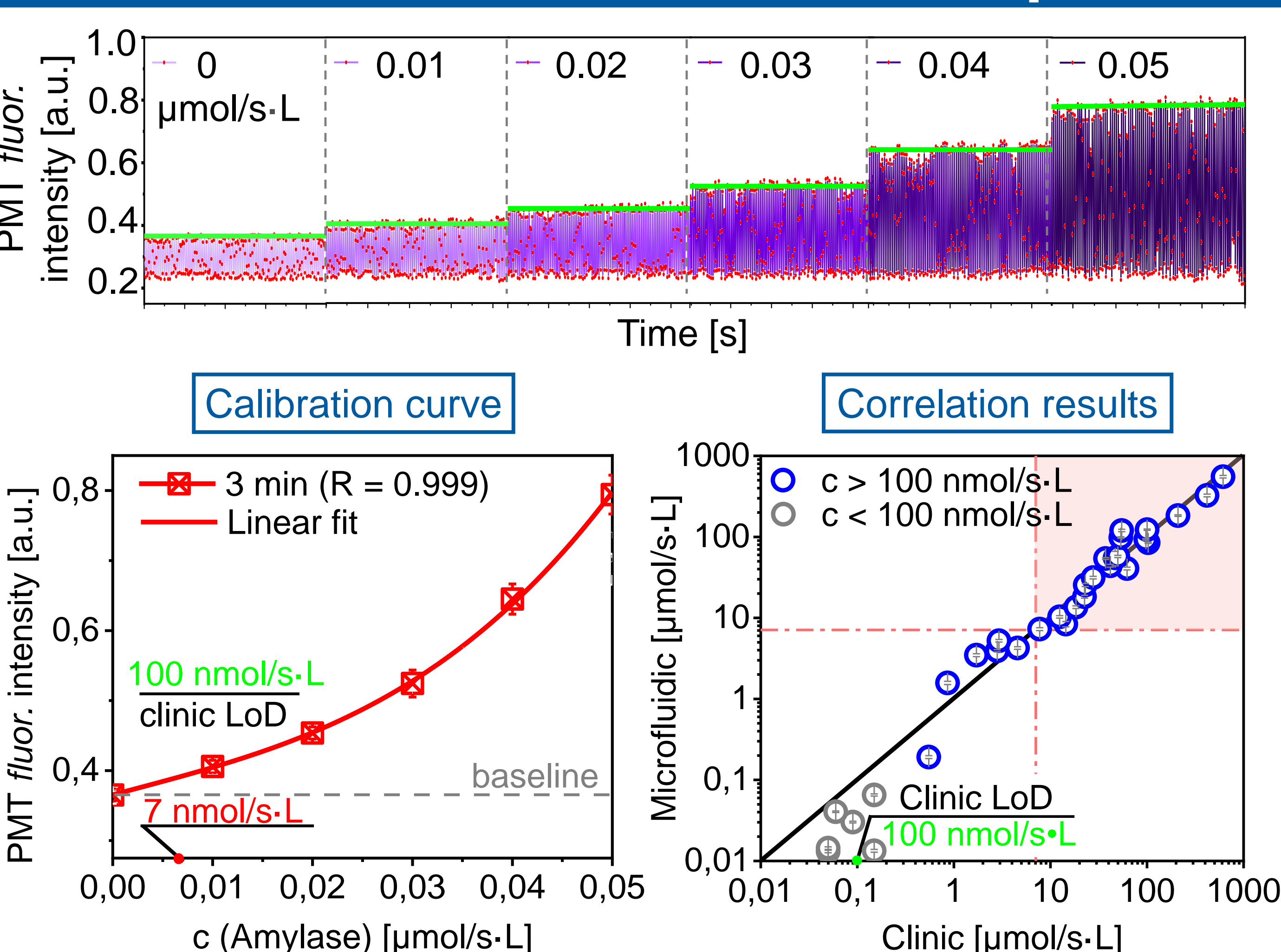
Methods	Gold Standard in Clinic	Microplate	Microfluidics
Detection method	Colorimetric	Fluorometric	Fluorometric
Sensitivity	> 6 U/L	> 0.72 U/L	LOD 0.42 U/L
Range	4.8 U/L - 1200 U/L	2 U/L - 50 U/L	0.5 U/L - 3 U/L
Detection time	1 h	20 min	1-3 min
Reagent requirement	1 kit for 1 assay (1-5 mL)	1 kit for 1 assay (1-5 mL)	1 kit for 50 assay (10 μL)
Sample requirement	1-5 mL (96 replicates, one 96-well plate)	1-5 mL (96 replicates, one 96-well plate)	10 μL (100 replicates, 100 droplets)
Real-time monitoring	No	No	Yes

Detection Principle



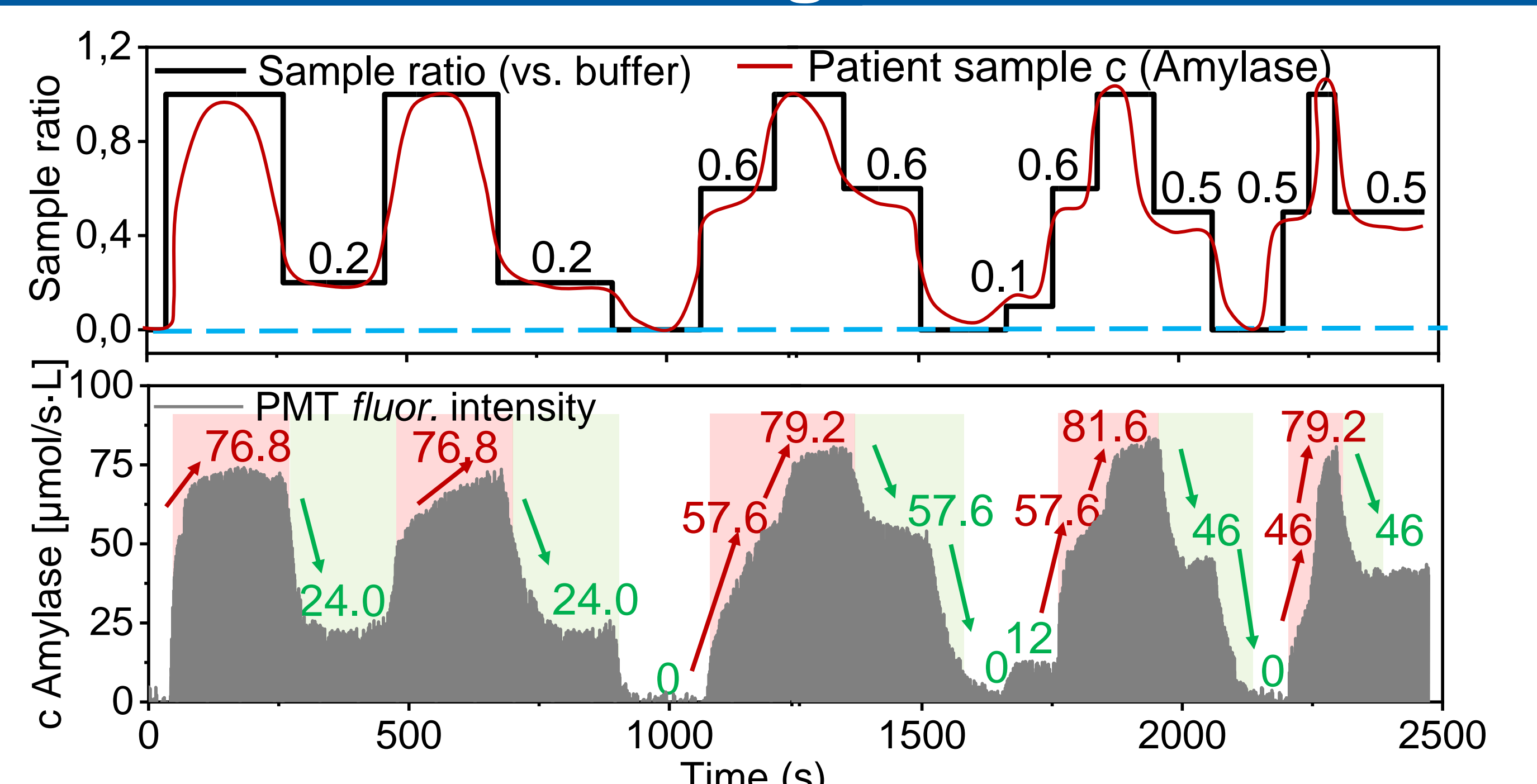
- Pancreatic drain liquid samples are collected and injected to the microfluidic system by switching valves
- Reagent, amylase, and buffer are mixed as an aqueous phase through T-junctions.
- Droplets formed at cross-junction after meeting HFE oil and mineral oil (spacer).
- Amylase reacts with the reagent, resulting in cleavage products emitting fluorescence.

Calibration Curve & Patient Sample Test



- Different amylase concentrations result in different fluorescence intensity
- Calibration curve determined at **3 min** with LoD of **7 nmol/s-L**
- Results of the clinical and microfluidic methods have a great linear correlation in a total of **32 patient samples**.

Continuous monitoring



- Amylase concentration (related fluorescence intensity) of the droplet sequence shows a quick response in amylase concentration fluctuations

Conclusion

- Droplet-based real-time detection of amylase offers improvement in LoD, detection time, and reagent requirements.
- All 32 samples results matched well with clinical measurements
- Rapid response of fluorescence intensity to sample concentration fluctuations indicates the method can be implemented to continuously monitor drain α -amylase activity of patients.

Outlook

X. Zhao *et al.*, Portable droplet-based real-time monitoring of pancreatic α -amylase in postoperative patients, submitted

- We expect this concept could be transferred to further relevant analytes, setting new standards of diagnostics, monitoring, and surgical care.
- We envision the potential utility of our technique in other clinical scenarios, e.g., detecting "anastomotic leakage in colorectal surgery" or "bile leaks in liver surgery" where our droplet-based analysis technique could be explored.