Supporting Information for:

Development of a High-Performance Sliding Microneedle-Lateral flow immunoassay strip Device for Ultra-Rapid Point-of-Care Diagnosis

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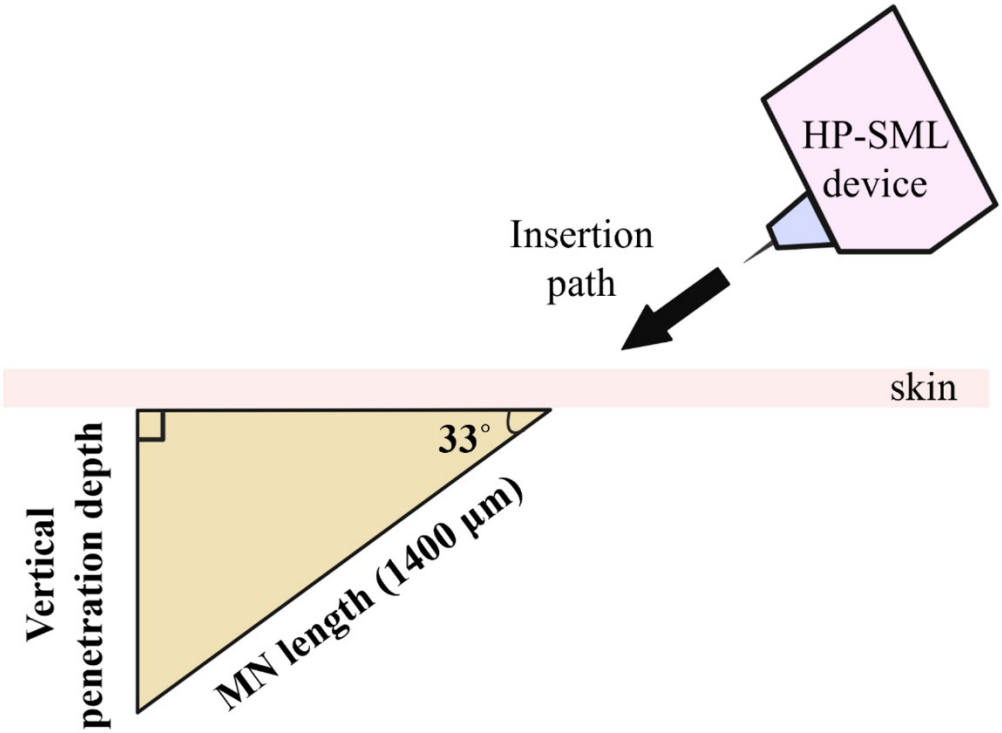


Figure S1. Figure S1. A schematic diagram illustrating microneedle insertion parameters using the HP-SML device. The vertical penetration depth is 750 µm, and the insertion angle is 33°. The schematic was created using BioRender.

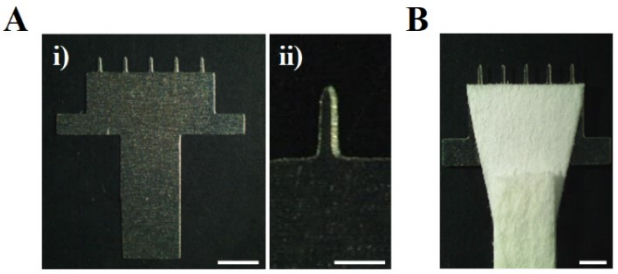
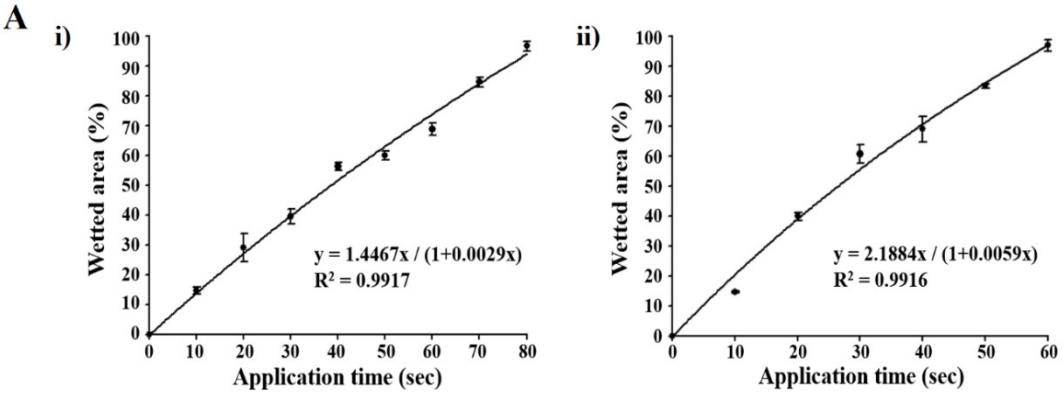


Figure S2. (A) Optical images of a 750 µm stainless Microneedle (MN) array: (i) Overview showing the array (scale bar = 2 mm) and (ii) Magnified view of a single MN (scale bar = 1 mm). (B) Optical images of filter paper-affixed MNs with lengths of 750 µm (scale bar = 1 mm).

A



B

i)

750 µm	10s	20s	30s	40s	50s	60s	70s	80s
Absorbent area Avg ± std (%)	14.8 ±1.2	29.2 ±4.8	39.6 ±2.5	56.4 ±1.4	60.1 ±1.5	68.9 ±2.0	84.7 ± 1.62	96.8 ±1.62
Absorbent volume Avg ± std (µL)	0.26 ±0.02	0.58 ±0.12	0.85 ±0.07	1.44 ±0.06	1.60 ±0.07	2.06 ±0.11	3.20 ± 0.15	4.60 ± 0.24

ii)

1400 µm	10s	20s	30s	40s	50s	60s
Absorbent area Avg ± std (%)	14.8 ±0.2	40.0 ±1.3	60.8 ±3.2	69.1 ±4.2	83.5 ±0.8	97.1 ±1.9
Absorbent volume Avg ± std (µL)	0.26 ±0.00	0.86 ±0.04	1.64 ±0.15	2.08 ±0.25	3.09 ±0.07	4.64 ±0.29

Figure S3. (A) Graphs and trend formulas showing the relationship between the wetted area of the filter paper on the MN and the application time of the HP-SML device incorporating (i) 750 µm MNs and (ii) 1400 µm MNs to SRB-containing agarose gel. (B) Tables presenting the absorption area and absorption volume over time using the HP-SML device incorporating (i) 750 µm MNs and (ii) 1400 µm MNs. The tables display averages ± standard deviations derived from three replicates.

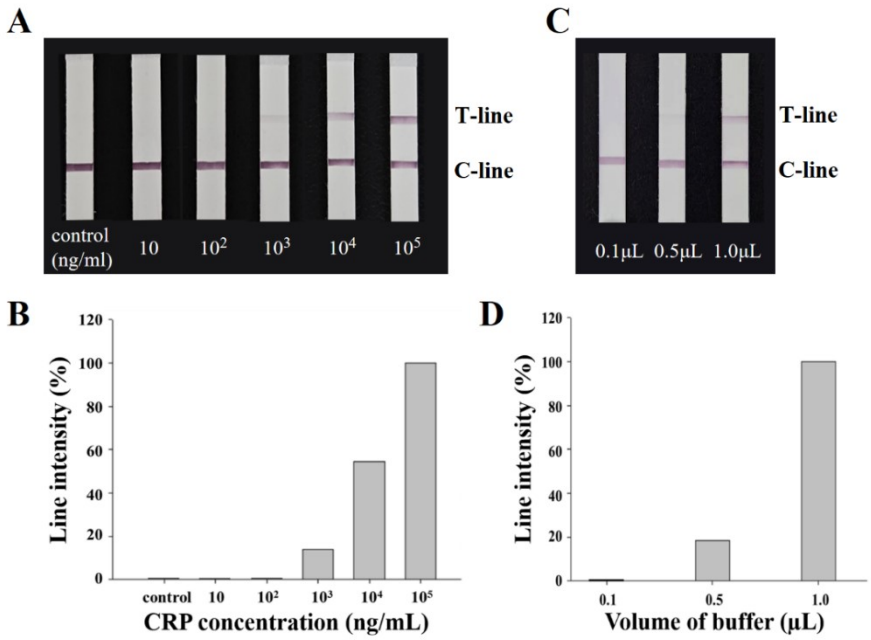


Figure S4. (A) Optical images of LFAs showing CRP detection with 1 μL CRP solution and 99 μL running buffer using HP-SML device. (B) The detection limit of LFAs illustrated by the intensity of the test line (A), analyzed using ImageJ software. (C) Optical images of LFAs showing CRP detection at a concentration of 10^3 ng/mL with different CRP sample volumes of 0.1, 0.5, and 1 μL (the remaining volume, excluding the CRP solution, up to 100 μL was used as a running buffer). (D) The detection limit of the LFA illustrated by the intensity of the test line (C), analyzed using ImageJ software.

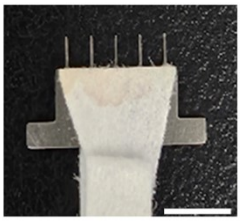


Figure S5. Image of ISF extraction by MNs after applying the HP-SML device to rat skin for 35 seconds. (scale bar = 2 mm).