



1. Swab Printing Process

The swabs were printed using Formlabs Surgical Guide (biocompatible photopolymer) resin in a rectangular array suspended from a “raft” that allowed personnel to handle the print without touching the swabs (Figure 2a). Print time was approximately 15-17 hours, and after trial and error (that extended beyond the data collection in this study), the process was optimized to print up to 324 swabs in a single batch.

Post-printing, the build platform was transferred to the wash station (Figure 2b), where the swab raft was immersed in a circulating 99% isopropyl alcohol bath for nominally 20 minutes to remove excess resin. The build platform was then raised to allow the swab raft to dry for 30 minutes. The swab raft was then separated from the build platform and cured in a FormCure station, supported by a custom-built stand that oriented the long axis of the swabs downward to prevent the swabs from deflecting (Figure 2c). After the swab raft cured for 90 minutes at 60 C, they were rested and cooled for a minimum of ten hours in a curing station. Finally, the swabs were transferred to plastic holding containers (Figure 2c). Swabs were individually packaged and autoclaved prior to use. For quality control, three swabs were removed from each raft for dimensional measurements using a micrometer and calipers. Mechanical testing was also performed using an Instron Universal Testing Machine to measure the force required to break the swab at the break point as well as the maximum deflection at breakage.

After the quality control step, a final visual inspection was performed to detect debris or flash on the swab or handle, misprints, or a tacky/sticky finish. Misprints were recorded and discarded.