

Large-Scale In House Production of Viral Transport Medium and 3' N95 Mask Disinfection Using Universally Available Materials

VTM: Kenneth P Smith^{1,2}, Annie Cheng¹, Amber Chopelas^{#1}, Sarah DuBois-Coyne^{#1,3}, Ikram Mezghani^{#4}, Shade Rodriguez^{#1}, Mustafa Talay^{#5}, **James E Kirby**^{6,2} ¹Dept. Pathology, BIDMC, ²HMS, ³Depart. Biochemistry, U MA Boston, ⁴Dept, Surgery, BIDMC, ⁵Dept. Molecular & Cellular Biology, Harvard University, [#]Contributed equally. N95 Mask: Katelyn E. Zulauf,^{#a,b} Alex B. Green,^{#a} Alex N. Nguyen Ba,^c Tanush Jagdish,^{d,e} Dvir Reif,^f Robert Seeley,^g Alana Dale,^g and **James E. Kirby**^h; ^aDet. Pathology, BIDMC, ^bHMS, ^cDept. Organismic and Evolutionary Biology, Harvard University ^dProgram for Systems, Synthetic, and Quantitative Biology, Harvard University, ^eCenter for Computational and Integrative Biology, MGH, ^fDepart. Molecular and Cellular Biology, Harvard Univ., ^gEnvironmental Health and Safety Department, BIDMC, ^{h,6}Corresponding author, [#]Contributed equally.

Viral Transport Medium (VTM) for SARS-CoV-2 diagnostic laboratory testing – NONE available!



Nine personnel in two isolated VTM production teams

Sourced available pre-sterilized medium (HBSS, FBS, antibiotics), CDC VTM recipe with added phenol red for visual QC



KP Smith, PhD, with permission

Sourced tubes from donors around Boston (until commercial supplies available)

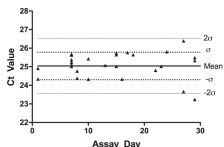
Tissue culture rooms in CLS6 (8 biosafety cabinets)

Liquid handling automation

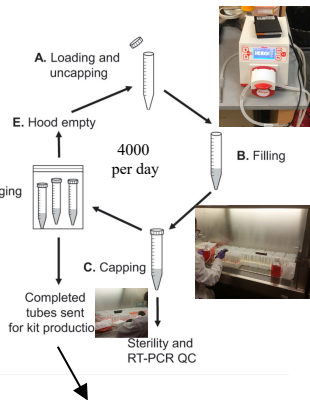
Rock climbing tape (donated) to prevent repetitive use injury

Accelerated stability testing Arrhenius equation – pharmaceutical approach 2 weeks to predict >4 month room temperature outdate, sterility, robust support of SARS-CoV-2 RT-qPCR

Daily QC (each run/lot)



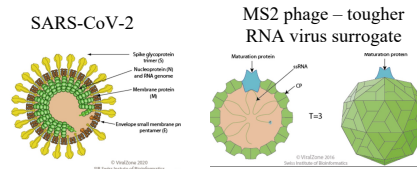
Mean Ct value over 30 days of the stability test. Ct values were calculated for each sample at each time point. Error bars represent standard deviation. *p < 0.05, **p < 0.01, ***p < 0.001.



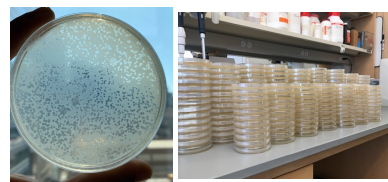
12 member kit assembly team (added 3-D printed swabs et al.) in Leventhal Conference Room

>100,000 VTM collection kits for all of BILH. Production March –June 2020, used into fall of 2020.

N95 mask disinfection for reuse

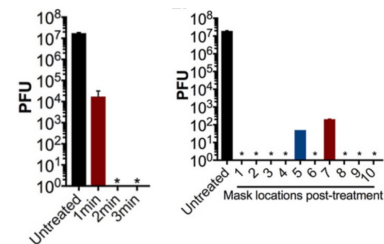


Titering MS2 virus plaques



Method

1. Add concentrated M2 RNA phage virus to mask.
2. Glass dish, 1/4 cup water, grocery store web mesh, rubber band, microwave 3 minutes
3. Count phage plaques (number of viable virus remaining) compared with no treatment control



1. MS2 phage = norovirus >> tougher than SARS-CoV-2
2. > 6log₁₀ MS2 virus titer reduction.
3. Performed 20X without loss of N95 fit or filtration
4. Battelle vaporized hydrogen peroxide system: >\$ 6 million, centralized
5. Microwave decontamination, point-of-use, <\$10 setup using existing microwave