

a custom R script. Analyses of pathways, upstream regulators, and causal networks were conducted using ingenuity pathway analysis (IPA). **Results:** The molecular signatures of acne skin and the effect of PM2.5 on skin in vitro were compared at 3 levels: (1) gene expression, (2) pathway activity, and (3) upstream regulators. Significant concordant overlaps of both upregulated ( $P < 3e-23$ ) and downregulated DEGs ( $P < .005$ ) were observed in acne skin and PM2.5-exposed keratinocytes. However, for the PM2.5-exposed 3D skin model, significant overlap with acne skin was only observed for upregulated DEGs ( $P < 8e-14$ ). Fold changes of DEGs in both acne and PM2.5-exposed data sets showed significant correlation (Pearson correlation coefficient  $> 0.6$ ;  $P < .001$ ). An IPA analysis identified 13 pathways commonly enriched in acne and PM2.5 data sets, including IL17, IL6, Toll receptor PPAR, LXR-RXR, and acute-phase response pathways. Common upstream regulators were further identified including TNF $\alpha$ , NF $\kappa$ B, CAMP, AhR, and IL17A. Finally, causal network analysis revealed several potential hub regulators shared in acne pathogenesis and PM2.5-exposed skin, including HIF1 $\alpha$ , TNF, IL1 $\alpha$ , and CCL5. **Conclusions:** Our analysis revealed significant concordant molecular signatures between acne and PM2.5-exposed skin. Biological insights from this study offer clues that build the causal links between air pollution and acne pathogenesis.

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**Impact of environmental pollution on skin antimicrobial peptide genes expression revealed by transcriptome profiling**

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**Objectives:** Pollution exposure is associated with several dermatological conditions including acne, atopic dermatitis, and psoriasis. Antimicrobial peptides (AMPs) are key effectors of innate defense, and some AMPs are involved in inflammatory skin conditions. In this study, we aimed to characterize expression changes of human AMPs under different in-vitro pollution exposures. **Methods:** RNA-seq profiling was conducted on normal human primary epidermal keratinocytes (NHEK) treated with either a vehicle control, or benzo[a]pyrene (BaP) and on pigmented living skin equivalent models (pLSE) treated with either a vehicle control, ozone, or vehicle exhaust. Differential expressed genes (DEGs) were identified with R scripts. DEGs of PM2.5 were obtained from the literature and the GEO database. Also, 180 human AMP genes were obtained from a UDAMP database. UpSetPlot was used to plot DEGs overlaps. MetaVolcano was used to identify frequently changed AMPs. **Results:** We used in-house and published transcriptome profiles to identify AMP genes that displayed altered expression under in-vitro pollution exposure. Of the 180 AMP genes under investigation, 37 showed significant changes in expression in at least 1 of the 5 experiments. Using MetaVolcano, 13 AMP genes were identified to be frequently and consistently changed. Several AMPs associated with inflammation and skin diseases were frequently upregulated, including S100A8, S100A9, LCN2, HBD3, RNASE7, and CXCL1. Only 3 frequently downregulated AMP genes were identified, including CXCL14, which is reported to be a non-inflammatory AMP that is highly expressed in healthy skin and is downregulated in skin diseases. **Conclusions:** The data sets suggest that expression of both proinflammatory and homeostatic AMPs can be perturbed by pollution. These findings provide new clues to explain how pollution affects skin innate defense, host-microbe interactions and contributes to abnormal skin conditions. Normalizing aberrant AMP expression may be a potential approach to treat pollution associated skin disorders in the future.

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**Effectiveness of interventions increasing surgical hand hygiene compliance at Hung Vuong Hospital**

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**Objectives:** Surgical handwashing is one of the most important measures to prevent surgical site infection (SSI). We evaluated the effectiveness of the intervention program on surgical handwashing compliance of healthcare workers (HCWs) at Hung Vuong Hospital. **Methods:** This research was conducted from July 2019 to November 2019 in 3 phases. In the first phase, we determined the surgical handwashing compliance rate before the intervention. In the second phase, we implemented an intervention bundle as follows. We provided reminders of compliance in the form of video screen and automatic timers at surgical handwashing sinks. We provided links and QR codes for online access and live streaming of instructional videos on implementation of the hospital's surgical hand sanitation procedures in the surgical handwashing area. We conducted direct monitoring to remind and guide HCWs to follow the procedures in combination with camera surveillance to accurately reflect compliance. Finally, we provided feedback in multiple steps: feedback to individual, feedback to head of department or department heads, cited names in briefings and sent names to the general planning department to suspend surgery privileges. In the third phase, we re-evaluated the surgical handwashing compliance rate after the intervention. **Results:** The total number of surgical handwashing checklists observed before and after the intervention was 787. The surgical handwashing compliance rate improved significantly from 48.8% to 71.8% (PR, 2.7; 95% CI, 1.98-3.57;  $P < .01$ ). The compliance rate in camera monitoring also increased from 22.1% to 57.9% (PR, 4.8; KTC 95%, 3.14-7.47;  $P < .01$ ). The compliances rates of both surgeons and scrub nurses improved significantly after the intervention ( $P < .01$ ). Conducting the new surgical handwashing procedure increased from 90.2% to 99.5% after this intervention. **Conclusions:** This intervention program improved surgical handwashing compliance of HCWs.

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**Observational study of handwashing sink activities in the inpatient setting**

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**Objectives:** The use of handwashing sinks for activities other than hand hygiene (HH) is associated with higher rates of  $\beta$ -lactamase-producing

Enterobacteriaceae. However, little has been published about the handwashing sink activities in Singapore hospitals. We explored the handwashing sink activities in a tertiary-care hospital in Singapore. **Methods:** Five trained shadow observers conducted this observational study between December 18 and 21, 2018 (6 hours per day: 07:00–09:00, 09:30–11:30, and 12:30–14:30) in acute-care general wards. We divided the handwashing sink activities by healthcare workers (HCWs) and non-HCWs (ie, visitors, caregivers, and relatives) and by HH- and non-HH-related activities. We used Stata version 15 software for the analysis. The study was approved by the Institutional Review Board of the National Healthcare Group, Singapore (DSRB no. 2020/01257). **Results:** In total, 657 handwashing sink activities were recorded [HCWs, 475 (72.3%) and non-HCWs, 182 (27.7%)]. Of the 475 HCW handwashing sink activities, 451 (94.9%) were HH-related, 10 (2.1%) were for patient nutrition, 7 (1.5%) were for environmental care, 6 (1.3%) were for medical equipment cleaning, and 1 (0.2%) was patient personal-item cleaning. Of the 182 handwashing sink activities by non-HCWs, 117 (64.3%) were HH related, 30 (16.5%) were for patient nutrition, 21 (11.5%) were for personal hygiene, 14 (7.7%) were patient personal-item cleaning. The distribution of handwashing sink activities differed significantly ( $P < .01$ ) between HCWs and non-HCWs. The odds of non-HH-related handwashing sink activities among non-HCWs was 10× higher than among HCWs (OR, 10.44; 95% CI, 5.98–18.23;  $P < .01$ ). **Conclusions:** Handwashing sinks use for non-HH-related activities is higher among non-HCWs than HCWs. Further studies are needed to understand the impact of non-HH handwashing sink activities on nosocomial infections and ways to reduce them.

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#### Hand hygiene challenges among the ancillary team during the COVID-19 pandemic

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**Objectives:** Ancillary staff members perform operational support functions and play an active role in enhancing the patient care experience. Infection prevention practices among ancillary staff play a critical role in preventing transmission of microorganisms, which ensures the safety of patients. Low hand hygiene compliance was found among porters in a cross-institutional hand hygiene audit in 2021. A quality improvement team was formed to improve hand hygiene compliance, especially during the COVID-19 pandemic. **Methods:** A focus-group discussion and survey were conducted to understand hand hygiene knowledge and challenges among porters. Using the findings, the team initiated Glo-germ education tools, pocket alcohol hand-rub agents, pocket moisturizer, poster display, and a toolbox messaging system via conversion of group roll call to satellite-area roll call. Respective satellite teams were sent hand hygiene reminders, and prompt corrective action was taken following noncompliance events. Analytic comparisons of pre- and postsurvey data were performed using the  $\chi^2$  test, and  $P < .05$  was regarded as statistically significant. **Results:** In total, 572 ancillary staff participated in the survey. Knowledge of hand hygiene practices improved significantly following the interventions, as shown in the comparison of pre- and postintervention results: knowledge of the hand hygiene steps ( $P < .001$ ), knowledge of the duration of hand rub ( $P < .001$ ), and knowledge of duration of handwashing ( $P < .001$ ). Also, 295 staff members (97.68%) stated that implementation measures increased their awareness of the importance of hand hygiene. Moreover, the hand hygiene compliance rate improved from

77.8% to 100%. There were no significant differences related to sex ( $P = .089$ ), age group ( $P = .355$ ), years of working ( $P = .359$ ), education level ( $P = .268$ ), or difficulty in reading English ( $P = .906$ ). **Conclusions:** Evaluating staff hand hygiene knowledge and understanding the challenges faced among porters helped toward the development of appropriate interventions and assurance of success in project.

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#### Personal care formulations prove effective against evolving variants of SARS-CoV-2: Implications for public health and hygiene

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**Objectives:** Early in the COVID-19 pandemic, global health authorities identified and emphasized the importance of practicing proper hand hygiene to reduce the transmission of SARS-CoV-2 and to diminish the chances of becoming infected. It is well established in the scientific literature that surfactants and alcohols are capable of inactivating enveloped viruses such as SARS-CoV-2. However, given the novel nature of the virus, Unilever adopted an evidence-based approach to demonstrate virucidal efficacy of marketed bar soaps, liquid handwashes, and alcohol-based hand sanitizers against the original and selected variants of SARS-CoV-2. **Methods:** High titers of clinically isolated and laboratory-propagated SARS-CoV-2 strains were subjected to a range of selected proprietary formulations from Unilever at end-user-relevant dilutions, temperature, and contact duration, and were tested according to the internationally recognized ASTM E-1052 test protocol. **Results:** All tested personal-care formulations were effective against the parental SARS-CoV-2 strain as well as the  $\beta$  (beta) and  $\delta$  (delta) variants of concern. More specifically, bar soaps with a varying concentration of total fatty matter content and liquid handwashes with varying levels of total surfactants reduced the viral titer by >99.9% within 20 seconds. Alcohol-based hand sanitizers demonstrated >99.99% reduction of input viral load within 15 seconds of contact with the viral inoculum. **Conclusions:** In conclusion, we have provided empirical proof that well-designed personal-care formulations that act through generic physicochemical mechanism against the basic structure of the virus particle have high virucidal efficacy against the original and evolved SARS-CoV-2 variants. Furthermore, we argue that due to the broad-spectrum mode of action of these tested formulations, the continued practice of good hand hygiene practices with everyday products holds significant promise as an easily accessible, economic, and effective nontherapeutic public health intervention toward reducing the transmission of present and future variants of SARS-CoV-2 across communities and populations.

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#### Hand hygiene feedback card—Providing real-time feedback to improve hand hygiene compliance

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**Objectives:** Hand hygiene is widely recognized as the most effective practice for preventing healthcare-associated infections. Despite ongoing interventions and strategies implemented by the infection control committee, the compliance with and consistency in the hand hygiene practice remains a challenge. At times, staff are unaware when they are noncompliant with