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Editorial

'One size does not fit all' – customizing hand hygiene agents, messages, and interventions

Prevention of healthcare-associated infections (HCIs) is paramount in any healthcare context due to associated morbidity, mortality, high resource use, and increasing levels of antimicrobial resistance [1]. Hand hygiene is critical in preventing transmission of pathogens via the hands of healthcare workers (HCWs), thus contributing much to the prevention of HCIs and antimicrobial resistance spread [2–4].

This issue of the Journal publishes a series of papers on diverse hand hygiene topics, including bench efficacy studies of hand hygiene agents, a systematic review on virucidal efficacy of ethanol, the validation of national hand hygiene metrics, and novel methods to change HCW behaviour [5–12]. Hand hygiene is a crucial component of infection prevention and control, with ever-growing trends, diversity, and dynamics of peer-reviewed publications worldwide [13].

Ethanol is a widely recognized antimicrobial agent, frequently used nowadays in hand-rub formulations [14,15]. Both isopropyl alcohol 75% (v/v) and ethanol 80% (v/v) are listed as Essential Medicines by the World Health Organization (WHO) in the category 'alcohol-based hand rub' (ABHR) [15]. In a systematic literature review, Kampf provides new insights into the spectrum of virucidal activity of ethanol [5]. Publications were included if reporting data on reduction of viral infectivity in suspension tests (the large majority) or on contaminated hands [5]. This systematic review addresses an interesting question; however, it must be kept in mind that, according to international norms (European Norm, EN 14885), whereas the spectrum of antimicrobial activity of ABHRs used in healthcare must include bacteria and yeasts, virucidal activity is not mandatory [16]. Findings of this review suggest that ethanol concentration of 95% is associated with the highest virucidal activity [5]. However, skin tolerance of such high levels of ethanol is likely to be worst, resulting in desiccant and deleterious effect on hands, thus negatively influencing acceptability by HCWs [14]. We congratulate Kampf for this comprehensive review, but respectfully hold reservations regarding the recommendation to consider the most prevalent viruses in healthcare facilities when selecting a suitable virucidal ABHR solution; i.e. to customize the choice of ABHR agents for different hospital wards [5]. Our first reservation is that the clinical relevance of laboratory findings on the virucidal activities of different ABHR solutions is lacking; this makes it difficult to determine whether the benefits of higher

ethanol concentrations would outweigh the risks from negatively influencing their acceptability to HCWs. Second, because prevalent viruses change periodically, and may even coexist, the process of periodically switching products could logistically become extremely complex in clinical practice. Third, and importantly, making available different ABHR agents for different healthcare facility areas and/or at different times would send out confusing messages to HCWs, including that some ABHRs are better than others. In our institution, the same isopropyl-based hand rub (75%, v/v) has been used widely and in large amounts since 1995 throughout all clinical areas, with continuously decreasing hospital-wide HCI rates and in the absence of uncontrolled viral or bacterial outbreaks. Nevertheless, studies of virucidal efficacy of ABHR agents are important and should progress to clinical studies measuring their impact on infection rates or microbial spread as outcomes.

Wilkinson *et al.* conducted a 'much-needed study' addressing the antimicrobial efficacy of foams [6]. The authors compared the efficacy of 60% isopropanol (isopropyl alcohol) and 80% ethanol in three hand-rub formats, namely: rinse, gel, or foam, following the European Norm (EN 1500) laboratory testing conditions; they found no significant differences. This is a cornerstone study, because the different delivery formats could potentially modify the antimicrobial efficacy of alcohols. Even more important, however, is that the different formats influence the real conditions of use by HCWs, such as the volume applied, the duration of hand friction and the time requested for hands to dry. Furthermore, the delivery format also influences HCWs' skin tolerance and acceptability, thus heavily impacting on the frequency of use (i.e. compliance with the 'five moments') [17]. Arguably gel and foam formats overall enhance acceptability due to offering wider options to HCWs, but we know very little about the real conditions of use of these formats and how they might impact on the overall prevention of HCI. Since 'one hand rub does not fit all', we welcome, in addition to the antimicrobial efficacy studies, clinical research with the real conditions of use of the different formats and with meaningful outcomes (as HCI or antimicrobial resistance cross-transmission reduction) [18]. Respectful of individual preferences at the University of Geneva Hospitals (HUG), HCWs have been offered the choice of individual pocket-sized ABHR of the same agent (isopropyl alcohol, 75% v/v) in either a rinse or a gel format for the past 15 years; around one-third of HCWs prefer the gel, whereas two-thirds prefer the rinse [19].

Patient participation is increasingly recognized as a key component in redesigning healthcare to ultimately improve patient safety in many parts of the world [20,21]. In hand hygiene promotion, it has been proposed to educate and

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empower patients to remind HCWs to clean their hands [20,21]. This was tested at HUG in a cluster-randomized controlled clinical trial; together with other strategies it proved helpful but quite difficult to implement widely [22]. Successful patient participation strategies are, however, multifold. Because patients' hands may have a role to play in pathogen cross-transmission, Wilkinson *et al.* conducted a study to evaluate the antimicrobial efficacy of a hand wipe intended to be used by patients compared with handwashing with soap and water [7]. In the absence of an approved methodology for testing wipes, they evaluated modified EN hand tests for assessing the efficacy of the hand wipe. The antimicrobial hand wipe, when applied according to a standardized procedure by experts for 60 s, was statistically non-inferior to the reference standard handwashing with soap and water. Importantly, however, this study was targeting patient hand hygiene and, thus, using handwashing with soap and water as the standard was appropriate. A totally different story was told by Ory *et al.* when the use of wipes was tested for HCWs' hand hygiene action [23]. Our group showed that hand wiping with or without impregnation with an alcohol-based hand-rub solution was clearly inferior to hand rubbing with an ABHR [23]. In other words, wiping cannot replace hand rubbing with alcohol for daily patient care by HCWs.

Herruzo *et al.* describe a novel two-step approach for surgical hand preparation with a surgical scrub at the beginning and an additional aqueous antiseptic 2–3 min leave-on application with the same active biocidal agent [8]. The proposed procedure is reported to be of equivalent or even of superior bactericidal activity compared to the EN 12791 standard. WHO recently published guidelines for the prevention of surgical site infection (SSI), recommending surgical hand preparation to be performed either by scrubbing with a suitable antimicrobial soap and water or by using a suitable ABHR [24,25]. The evidence from the systematic reviews supporting these guidelines showed no difference between hand rubbing and hand scrubbing in reducing SSI incidence. ABHR formulations were more effective in reducing colony counts on hands than scrubbing with water and antiseptic or plain soap [24,25]. Surgeons have indicated preference towards ABHRs, primarily due to the reduced procedure time, and better tolerability and acceptability [25]. The total procedure requires 2–3 min and some ABHRs are effective even in 1.5 min, which is notably less than the 2–3 min recommended by Herruzo *et al.* for the additional aqueous chlorhexidine leave-on application only [8]. Increasing (i.e. more than doubling) the time to perform surgical hand preparation is clearly undesirable considering time constraints on the operative room team. Thus, the clinical relevance of the proposed procedure remains uncertain. Furthermore, skin dryness, irritability, allergies and resistance induced by the additional use of chlorhexidine leave-on application are of additional concern. Kampf raises similar concerns, and questions the validity of the data obtained with chlorhexidine formulations and the relevant advantage for the alternative antiseptic [9]. When selecting an agent for surgical hand preparation, healthcare facilities should procure formulations with proven efficacy according to international standards and take into consideration preferences of the target population, leaving some degree of possible customization [18,26].

The provision of hand hygiene agents in the absence of an associated behavioral modification strategy is known to be

ineffective [27]. Education, monitoring hand hygiene compliance and providing HCWs with performance feedback, reminders in the workplace, and institutional safety climate have been established as integral parts of multi-modal hand hygiene improvement initiatives and practices [17,19,28–30]. Some papers published in this issue of the Journal are dealing with behavioural interventions to influence hand hygiene compliance. Interestingly, Dalziel *et al.* aimed to validate the volume of ABHR used as a national hand hygiene surrogate measure of compliance, based on the assumption that 3 mL of ABHR was used for each hand hygiene action [10]. They determined that, in practice, the volume of ABHR being used is ~1 mL per action, leading to an artificially low proxy measure of compliance. The use of this measure as a surrogate marker for hand hygiene compliance deserves further validation [31,32]. Despite its many limitations, ABHR consumption could be used as a proxy measure of system change and to monitor and compare trends year after year. Importantly, the results of this exploratory study allowed revisiting prior estimates of the national proxy measure of hand hygiene compliance from 5.7 to 17 hand hygiene moments per bed-day. This is more consistent with data from direct monitoring of hand hygiene actions obtained from different healthcare facilities worldwide [31]. The study also highlights again that HCWs are not applying the recommended volume of ABHR for effective hand hygiene action, which is problematic and should be addressed through education; in particular, the volume of ABHR used should ideally be customized to the HCW's hand size [33,34].

In a very interesting and innovative approach, Gould *et al.* used a theory-driven survey combined with cluster analysis to explore the opinion of 121 critical care nurses about hand-hygiene-related issues [11]. Their findings revealed three main clusters of opinion forming significant groups: positive attitudes, pragmatism, and scepticism. The findings suggest that educational and promotional hand hygiene interventions might be more successful when targeting the needs of HCWs in the different clusters. First, the intervention should contain an evangelistic message to meet the needs of HCWs holding predominantly positive attitudes. Second, it should secure HCW engagement, especially of those feeling insecure in their hand hygiene practice. Third, it should address the needs of HCWs holding predominantly sceptical opinions by presenting the best and most recent evidence on hand hygiene effectiveness. Greater persuasion may be needed to encourage those who are sceptical about the importance of hand hygiene [27,35]. The findings here highlight the importance of considering the service-user perspective, i.e. the clinician, when hand hygiene interventions are planned and implemented. Yet, clinician views are rarely considered at the planning phase of new infection prevention and control interventions. Further similar studies that explore beliefs and behaviour of other HCWs including doctors are needed [27]. Similarly, Marra *et al.* reviewed interventions designed to improve hand hygiene compliance through positive deviance methods for developing accountability among HCWs [36]; compliance improved with reductions in HCAs following the intervention. Thus, 'one size does not fit all', and hand hygiene education and promotion should be customized.

Reminders in the workplace are key tools to prompt and remind HCWs about the need for performing hand hygiene at indicated times and using the appropriate technique [17,19,28–30,37]. Caris *et al.* investigated whether behavioral

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