

2021 Hand Hygiene Research Summary



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About the Research Summary

For the past 10 years, the Global Handwashing Partnership has synthesized the latest hand hygiene research through annual research summaries. These summaries provide the latest research, key findings, and guidance on hand hygiene best practices for program implementers and researchers. Since the start of the COVID-19 pandemic in early 2020, handwashing with soap and water has been an important measure to prevent the spread of coronavirus with heightened focus for its cross-cutting impacts on reducing the transmission of other diseases. This summary covers peer-reviewed publications published in 2021 (methodology described in [Annex 1](#)) and compliments lessons learned from the past year to promote hand hygiene.

Research Highlights for 2021

Research highlights from 2021 are summarized in this section with key findings categorized by the following themes:

- Health and Non-Health Impacts of Hand Hygiene
- Hand Hygiene Access and Supplies
- Determinants and Interventions for Hand Hygiene Behavior Change in Various Settings
- The Impact of COVID-19

Health and Non-Health Impacts of Hand Hygiene

Hand hygiene has been promoted as an effective preventive measure against various health-related issues, including diarrheal diseases, undernutrition, and neglected tropical diseases. In a case-control study conducted in the Kersa and Omo Nada districts of Ethiopia, handwashing at critical times was a significant inverse predictor of childhood malnutrition ([Soboksa et al., 2021](#)). Handwashing at critical times was assessed through information about mothers/caregivers' handwashing behavior after defecation, before handling food/water, before feeding a child, or after cleaning the child's stool. Mothers who did not practice handwashing at critical times were 2.58 times more likely to have a child experiencing malnutrition than those who washed their hands regularly ([Soboksa et al., 2021](#)). One community-based cluster randomized controlled trial in Dire Dawa, Ethiopia examined handwashing impact on diarrheal incidence in children under 5, with intervention households given two bars of plain soap and handwashing promotion materials and control households continuing existing handwashing practices with no additional information. A 41% reduction in diarrheal incidence was recorded for the intervention group in relation to the control, indicating that even this level of handwashing promotion is an effective means of reducing childhood diarrhea ([Solomon et al., 2021](#)).

Other publications focused on other health impacts of handwashing, such as parasites and healthcare-associated infections ([Barnes et al., 2021](#); [Odoyo et al., 2021](#); [Dzator et al., 2021](#)). A cross-sectional study in Mongolia assessed the use of a **One Health Approach** to address shared pathogens, emphasizing the need for increased water, sanitation, and hygiene (WASH) infrastructure to prevent zoonotic enteric parasites, especially in rural herding households ([Barnes et al., 2021](#)). Other studies also indicated handwashing at critical times could significantly lower bacterial loads and reduce total and new confirmed cases of COVID-19 and other healthcare-associated infections ([Odoyo et al., 2021](#); [Dzator et al., 2021](#)).

Apart from health-related outcomes, studies included in this review showcased economic benefits for hand hygiene, highlighting the cost-effectiveness of hand hygiene. A pilot program in Bangladesh assessed the acceptability and feasibility of a low-cost handwashing intervention in elementary schools that included providing practical infrastructure, affordable supplies, and a pathway to institutionalize improved hygiene practices ([Sultana et al., 2021](#)). An observational study in Quebec, Canada found that investing in resources to support hand hygiene is a low cost and cost-effective way to prevent healthcare-associated infections ([Tchouaket Nguemeleu et al., 2021](#)). These studies illustrate what is already known - that cost-effectiveness is a key benefit for hand hygiene to achieve public health and other goals.

A new study on the economic costs of basic hand hygiene provided an answer to what has been less known - the cost of universal hand hygiene. [Ross et al., \(2021\)](#) developed a model to estimate the economic costs of basic hand hygiene in domestic settings in 46 least developed countries. Based on the model, the represented cost of hand hygiene behavior change promotion is US\$0.47 per person, representing 4.7% of median government expenditure and 1% of annual aid receipts among least developed countries ([Ross et al., 2021](#)). For the first time, there are estimates of recurrent or total costs of hand hygiene interventions in domestic settings.

What does this mean? Overall, the studies included in this review reinforce what is already known and provide additional context to the impacts of hand hygiene. Handwashing at key times continues to be an important inverse predictor for diarrheal diseases, malnutrition, neglected tropical diseases, and a range of other diseases. In addition, new estimates on the cost of hand hygiene in domestic settings provide tangible numbers for resource allocation. Further evidence on the relative costs and cost-effectiveness of various hand hygiene promotion interventions would enable more efficient investment and bring us closer to achieving universal hand hygiene.

Hand Hygiene Access and Supplies

As a key driver of hand hygiene behavior, we examined the critical role of access and supplies, including the availability, design and placement, and operation and maintenance of hand hygiene facilities (e.g., soap, sanitizer, water access).

Studies noted positive associations between income, education level, and use of handwashing facilities ([Jacob & Kazaura, 2021](#); [Sempewo et al., 2021](#)). Yet, large disparities remain among the most marginalized. A cross-sectional study using data from the Household Water Insecurity Experiences study found that nearly one in four households were unable to practice consistent handwashing across 23 low and middle-income countries due to inadequate access to hand hygiene facilities ([Stoler et al., 2021](#)). Another study reported a household's socioeconomic status and willingness to pay for water were associated with the presence and utilization of water and soap for handwashing. This cross-sectional study conducted among Ugandan households assessed willingness to pay for water during the COVID-19 crisis ([Sempewo et al., 2021](#)). Despite the importance of water in practicing better hand hygiene, households were compelled to restrict water utilization to reduce their water bills during the start of the COVID-19 pandemic, which proved to be a significant factor for household handwashing frequency ([Sempewo et al., 2021](#)). These studies suggest the need to invest in effective strategies for hand hygiene infrastructure to ensure frequent handwashing can be practiced and sustained, particularly among more marginalized households.

Proximity and placement of hand hygiene facilities are also critical to ensure hand hygiene practices at key times. In healthcare facilities, accessible hand hygiene facilities are critical to ensure hand hygiene at appropriate times. An observational study in Zanzibar, Tanzania reported that the room design and placement of hand hygiene facilities were significantly associated with increased hand hygiene compliance among birth attendants, managerial staff, and mothers in the maternity ward ([de Barra et al., 2021](#)). Closer proximity or convenience to the availability of sinks, soap, hand gel, hand towels, and other hand hygiene supplies encouraged more consistent hand hygiene practice. In household settings, one study suggests there may be a relationship between shared facilities and handwashing practice. This cross-sectional study conducted in Bangladesh reported a strong association between handwashing facilities without soap and households that had shared toilets with other households; this is because soap was kept inside household dwellings and farther from the handwashing area ([Ahamad et al., 2021](#)).

Furthermore, our analysis underscores the importance of alternative products and innovative methods for hand hygiene. In situations where water supply is not consistent, there is growing evidence that handrubs or hand

sanitizers are effective for pathogen removal ([Chirani et al., 2021](#); [Aodah et al., 2021](#); [Lanfer and Reifegerste, 2021](#)). Innovative products may also provide stopgap solutions in low-resource settings. An efficacy trial of the [SuperTowel](#) found that the product was effective in removing pathogens from hands, even if used with contaminated water ([Torondel et al., 2021](#)). Recent field tests for the [Autarky Handwashing Station](#), which treats and recycles handwashing water without the need for external water input, show high acceptability and functionality ([Sutherland et al., 2021](#)). These products offer valuable, niche interventions that could be leveraged in humanitarian emergencies and other resource-constrained settings.

What does this mean? Access to basic hand hygiene services, supplies, and facilities is an important determinant for improved hand hygiene practice and behavior. Disparities in availability remain both between and within countries. Where water is not accessible, using alternatives, such as alcohol-based handrubs and innovative products, have been proven to reduce contamination on hands. Beyond availability, placement and proximity of hand hygiene facilities is an important factor for consistent hand hygiene practice and should be considered in both program and institutional design.

Determinants and Interventions for Hand Hygiene Behavior Change in Various Settings

While access and supplies are necessary to ensure hand hygiene behavior, access alone is not enough to change hand hygiene behavior. Behavior change efforts must address a range of behavioral determinants, enabling factors, individual motives, and barriers which may differ based on the setting. In this section, we examine a range of determinants that influence hand hygiene behavior and interventions to support sustained behavior change in various settings.

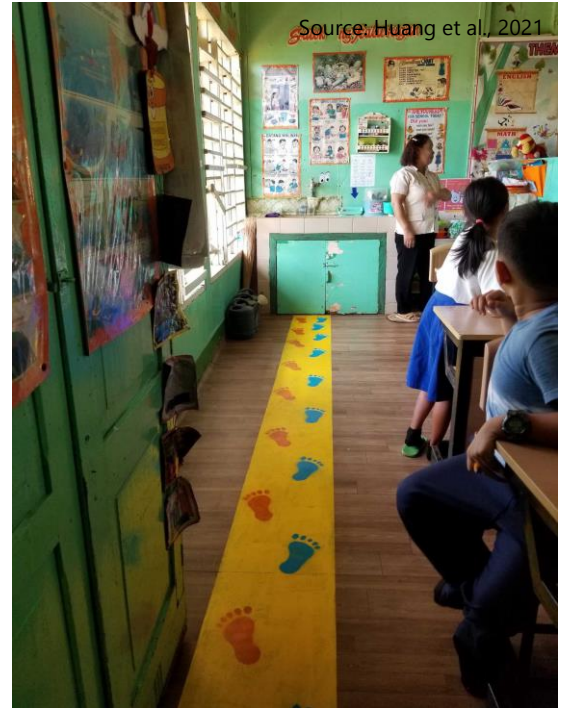
Domestic Settings

Hand hygiene in domestic settings is associated with a range of sociodemographic factors and behavioral determinants. Studies included in our analysis reported household knowledge, access to proximal facilities, sociocultural norms, and perceived susceptibility to illnesses as key determinants for hand hygiene behavior among households ([Bennion et al., 2021](#); [Qazi and Anwar, 2021](#)). Successful interventions addressed a range of determinants to improve hand hygiene, considering household needs, level of understanding, beliefs, and sociocultural norms for positive behavior change. A cluster-randomized controlled trial in rural Democratic Republic of Congo focused on community-led multicomponent interventions to double household access to WASH facilities and improve handwashing practices by 17% after toilet use ([Quattrochi et al., 2021](#)). Another cluster-randomized controlled trial in urban Cote d'Ivoire utilized a social norm-based handwashing intervention combined with disgust-inducing messages and the provision of handwashing stations to increase handwashing practice after toilet use ([Amon-Tanoh et al., 2021](#)). Lastly, a cross-sectional study in Peshawar, Pakistan found that when behavior change communication programs are done with community needs, level of understanding, beliefs, and sociocultural norms in mind, all the domains of hand hygiene showed statistical improvement (e.g., handwashing before meals, before cooking, before feeding a child, after defecation ([Qazi and Anwar, 2021](#))).

Educational Institutions

Hand hygiene activities in educational settings focused on increasing knowledge and practice through behavior change approaches. Studies conducted within educational institutions focused on school-based hygiene education, aiming to improve hygiene habits through lessons or activities conducted by teachers or parents ([López et al., 2021](#); [Schmidtke and Drinkwater, 2021](#); [Santhosh et al., 2021](#)). Some studies emphasized the role of parents and teachers in influencing child handwashing behaviors and reported knowledge, perceived disease susceptibility, and perceived self-efficacy to perform hand hygiene as important factors to promote hand hygiene behavior among students ([Schmidtke and Drinkwater, 2021](#); [Mitchell et al., 2021](#)).

Successful interventions addressed challenges in understanding and motivation among children to engage in protective behaviors like handwashing. A pilot intervention in Bangladesh trained teachers to lead behavior change communication sessions to encourage students' handwashing before eating, after defecating, and after cleaning school toilets. Four weeks post-intervention, 45% of students reported handwashing before eating, 83% after defecation, and 100% after cleaning the toilet ([Sultana et al., 2021](#)). A cluster randomized controlled trial in the Philippines examined the use of nudges to increase handwashing practices among students ([Huang et al., 2021](#)). This study drew from previous work to incorporate contextual cues (e.g., painted footpath, arrow sticker to handwashing station) and visual reminders (e.g., behavioral illustrations, eye stickers), doubling handwashing rates across treatment schools compared to control schools.



Educational institutions provide an important context to promote hand hygiene behavior, especially to the next generation. Limitations for hand hygiene support in schools include access to basic handwashing facilities, especially in low and middle-income countries.

Healthcare Facilities

Studies included in this analysis followed previous recommendations to utilize a **multi-faceted approach** to enhance health workers' knowledge while also supporting material availability, improving basic infrastructure, and promoting behavioral habit formation ([Tantum et al., 2021](#)). An observational study conducted in Cambodia found that while the proximity of handwashing supplies greatly influenced the likelihood of midwives practicing hand hygiene after deliveries, they were also highly influenced by psychological and contextual factors including environmental norms, workload, and inadequate knowledge about infection risk ([Nalule et al., 2021](#)). A mixed-methods study conducted in Liberian hospitals suggests that sustaining hand hygiene behavior in healthcare settings requires low-cost solutions, such as local hand sanitizer production ([Tantum et al., 2021](#)).

Furthermore, with increased attention around hand hygiene to prevent the spread of coronavirus, many articles provided useful suggestions and recommendations for enhanced hand hygiene practice and access in healthcare facilities. Placing hand hygiene facilities or resources in more proximal and accessible locations to health personnel has been found to promote hand hygiene behavior ([de Barra et al., 2021](#)). Likewise, some studies suggested additional steps to the handwashing technique, encouraging people to focus handwashing on the most neglected areas of the hand (i.e., palm and fingertips) to improve efficacy ([Bajaj et al., 2021](#); [Öncü and Vayisoğlu, 2021](#)).

Public Spaces and Workplaces

Compared to the [2020 handwashing research summary](#), more studies focused on hand hygiene in public spaces or workplaces over the past year. The increased focus on hand hygiene behavior in these settings may be due to the COVID-19 response (see *The Impact of COVID-19 Section* for more detail). Many studies included in this analysis assessed the impact of COVID-19 on individual hand hygiene practices and the various social and environmental factors that have impacted handwashing behavior in public spaces. An observational study in Ghana assessed hand hygiene behaviors among shoppers and shopkeepers, noting low rates of handwashing before entering shops despite the increased availability of handwashing facilities ([Fielmua et al., 2021](#)). This finding ties back to the *Hand Hygiene Access and Supplies Section*, reinforcing the notion that while access is a critical determinant for handwashing behavior, it is not sufficient on its own.

Overall, studies in public spaces and workplaces found significant associations with individuals' perceived barriers, benefits, and self-efficacy and handwashing behavior ([Niu et al., 2021](#); [Hsing et al., 2021](#)). While the use of technology to access hand hygiene information was associated with increased knowledge and optimal hand hygiene behavior ([Niedfeldt et al., 2021](#)), perceived individual self-efficacy remained the strongest predictor for hand hygiene in public and workplace settings ([Hsing et al., 2021](#)). Despite COVID-19 preventive policies and the observable increase in hand hygiene behavior in recent years ([Szczyka et al., 2021](#)), long-term behavior change remains to be seen.

What does this mean? Behavioral determinants for hand hygiene vary across settings. Findings from 2021 publications suggest that gaps remain in our understanding of the individual nuances that can affect a person's handwashing behavior. Formative research to understand the target audience and their key motivators should be used. When designing and implementing handwashing programs, it is important to design interventions that are context-appropriate to support sustained handwashing practice. A range of behavior change frameworks exist and should be utilized to identify and conceptualize the behavioral determinants that programs should ultimately target.

The Impact of COVID-19

Many studies included in this analysis pointed to the increased attention to hand hygiene as part of the COVID-19 response. In this section, we examine the impact of COVID-19 on hand hygiene progress.

The COVID-19 pandemic provides a significant context change, with new safety recommendations, such as mask-wearing and physical distancing. This context change also provides an opportunity for new hand hygiene habits. A cross-sectional study among households in rural India recorded new handwashing junctures (key times), including after returning home and before donning/removing face masks ([Bauza et al., 2021](#)). Leveraging this shift toward other behaviors, such as mask-wearing, offers new opportunities to pave the way for new handwashing habits and should be considered when designing new behavior change programs.

COVID-19 has also brought non-traditional actors to the table, with the amplification of hand hygiene messages significantly increasing throughout the pandemic. A cross-sectional study explored platforms such as TikTok in disseminating hand hygiene messages and as a way to influence individual perceptions of handwashing behavior ([Basch et al., 2021](#)). Findings indicate that while these platforms provide a powerful mechanism to engage a wide audience, particularly among younger audiences, opportunities to cover important hand hygiene concepts have not been fully realized. This could be an important tool to demonstrate and encourage hand hygiene behavior in the future and should be leveraged within programs. Furthermore, some studies reported increased hand hygiene prioritization among national and local governments, with some governments committing to **actionable roadmaps** for hand hygiene ([Shaikhain et al. 2021](#); [Marcenac et al., 2021](#)).

In addition to changes in behavior and policy, some studies examined the secondary effects of COVID-19. A cross-sectional study in South Korea found that consumers doubled their handwashing frequency due to COVID-19 ([Choi et al., 2021](#)). As a result of more frequent handwashing, studies noted the increased prevalence of several skin conditions, such as hand eczema, noting a significant association between higher hand hygiene frequency (more than 10 times a day) and the development of these conditions ([Binte Aamir et al., 2021](#); [Techasatian et al., 2021](#); [ZahrAllayali et al., 2021](#); [Marraha et al., 2021](#)). These effects may be important to consider, especially for product development.

As COVID-19 continues, it is critical to understand the impact it has on hand hygiene. Over 50% of publications included in our final analysis mentioned COVID-19, pointing to the need to build on lessons learned from COVID-19 response.

Conclusion and Recommendations

This summary is reflective of the emerging findings around hand hygiene across various settings. While there has been significant hand hygiene progress over the last year, disparities persist around the world. Further research focused on systems-level interventions and process evaluations is needed to better understand how efforts may be improved. Based on the research published in 2021, consider the following:

- **Leverage the COVID-19 pandemic for long-term behavior change.** As discussed in this summary, the COVID-19 pandemic introduced new behaviors, such as mask-wearing and physical distancing. This context change creates a window of opportunity to not only create new behaviors but piggyback on existing habits. Timing interventions around this major change provide a unique impetus to instill new

handwashing habits. Hand hygiene promotion activities in this context should be designed with the long-term in mind to prevent future outbreaks.

- **Build on innovative technologies to improve hand hygiene access and practice.** There has been a focus on innovative hand hygiene facilities and sustainability of hand hygiene services, including regular supply of soap and water and provision of operation and maintenance as part of COVID-19 response. This is especially true in resource-limited areas (see *Hand Hygiene Access and Supply Section* for more details). With the goal to ensure sustainable services, innovations can play a large role in sustaining services and improving hand hygiene access and practice.
- **Utilize the latest tools and evidence to advocate for more hand hygiene funding.** For the first time, a [hand hygiene costing tool](#) for domestic settings is available (see *Health and Non-Health Impacts of Hand Hygiene Section* for more details). These estimates provide tangible costs and showcase the return on investment for hand hygiene interventions. Using this tool and other evidence can strengthen the case for hand hygiene advocacy to national governments and other funders as they determine funding priorities.
- **Conduct further research on hand hygiene costs.** Despite the development of the new costing tool, a significant research gap remains for hand hygiene costs and return on investment. The latest research focuses on hand hygiene in a specific context (domestic settings) among 46 low and middle-income countries. Further research and initiatives should focus on additional countries and contexts to further understand the costs needed for sustainable universal hand hygiene.
- **Maximize collective efforts around hand hygiene to create sustained change.** The sector is well-positioned to capitalize on the momentum generated in recent years. There is strong political will, increasing attention on hand hygiene from other sectors, and a growing evidence base of effective approaches that should be utilized when developing and implementing plans for national hand hygiene coverage. Building on the long-term coordination mechanism of the [Global Handwashing Partnership](#), and leveraging lessons learned from initiatives developed in recent years, such as the [Hand Hygiene for All Initiative](#), [COVID-19 Hygiene Hub](#), and [Hygiene Behavior Change Coalition](#), may be key to achieving sustained change.

Overall, this analysis builds on the existing evidence base for hand hygiene and reinforces what is already known in many ways. All studies included in this summary are available [here](#). As we look toward the future, it is important to continue to take stock of the latest evidence and build on key findings to identify and share hand hygiene best practices.

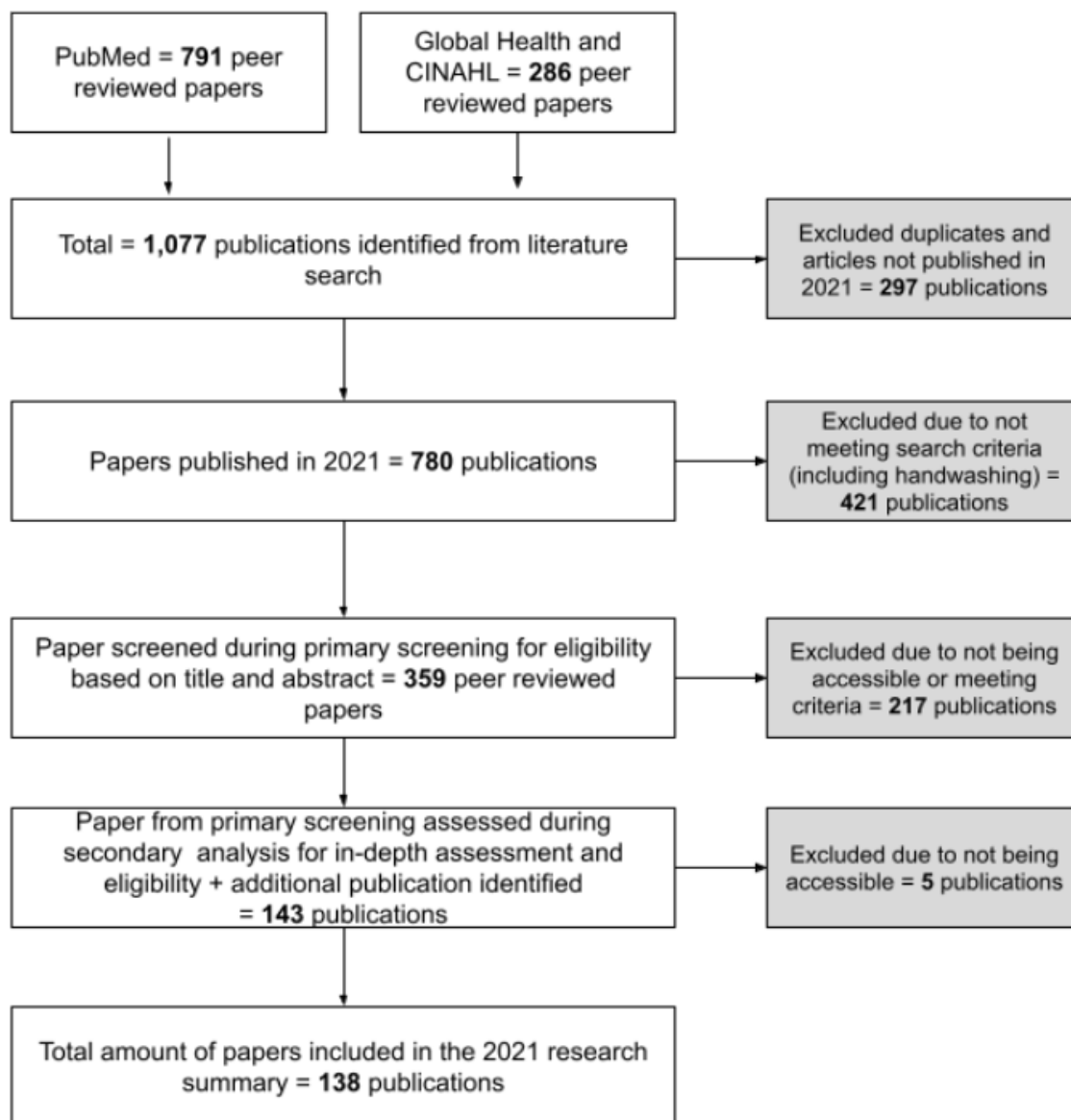
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ANNEX

Annex 1: Research Analysis

Below is a visual representation of the literature review process that was conducted to identify and assess the publications included in this research summary.



From the initial database search, a total of 1,077 publications were identified. Initial eligibility criteria include:

1. Article is published between January 1, 2021 thru December 31, 2021.
2. Article includes relevant hand hygiene terms in its title and/or abstract.
3. Article is free to access (non-gated).

Following these initial criteria, 718 articles were excluded from our review, leaving 359 articles to undergo a more detailed primary screening.

Primary screening

This screening process aimed to further filter out publications that did not meet the eligibility criteria above and identify publications for more in-depth analysis. In this step, one reviewer screened titles and abstracts to assess whether the publication met our eligibility criteria and needed additional assessment. From the 359 articles that underwent a primary analysis screening, 217 were excluded from our final analysis. Articles were excluded based on initial eligibility criteria and/or limited focus on hand hygiene in the publication’s study design and findings. An initial composite scoring system was used to standardize how titles and abstracts were evaluated. Abstracts were screened and scored using the criteria below:

Criteria	Definition
Study Design	The study has a clearly focused research question and an appropriate study design to answer a hand hygiene-related research question. This includes studies with hand hygiene as a primary outcome or included a variable related to hand hygiene mentioned in the abstract. (0-2)
Valid and Reliable Results	The study presented valid and reliable results for its primary outcome. (0-1)
Practical Findings	The study presented useful findings for non-academic practitioners, noting whether studies included findings or novel approaches that would be particularly beneficial for global hand hygiene implementers. (0-2)

A total of 142 articles were identified for final analysis, which included a more in-depth review and evaluation of the publication. These articles received a range of initial composite scores from primary screening and were further evaluated in our final analysis based on more detailed criteria.

Research analysis

To further analyze the publications, a secondary analysis was conducted in which the entirety of each article was assessed. The purpose of this secondary analysis was to further assess the publication for its research quality and review findings as they relate to the practical nature of this summary. During this secondary analysis process, 143 publications were reviewed by three reviewers. This included the articles identified from the primary analysis and an additional article that was identified after the secondary process began.

Scores for the secondary analysis were calculated using the criteria on the following page.

Criteria	0	1	2
The study has clearly defined research questions	The study does not define a specific research question(s)	The study partially defines a research question(s)	The study sufficiently defines a research question(s)
The methods, sampling and data analysis process are clearly described and are appropriate to the research question	The study lacks clear methods, sampling, and/or data analysis process.	The study partially describes its methods, sampling and/or data analysis process.	The study includes a clear methods, sampling, and data analysis process.
Findings are discussed in relation to broader literature and reasonable implications drawn	The study does not mention findings in relation to broader literature and does not include any implications for its findings.	The study partially describes its findings in relation to broader literature and draws implications	The study clearly discusses findings in relation to broader literature and provides thoughtful discussion on implications drawn
Biases and limitations of the research are discussed	The study does not discuss biases or limitations of the research.	The study partially discusses biases and limitations of the research.	The study sufficiently discusses biases and limitations of the research.

Following the secondary analysis, 5 publications were excluded because they were gated publications, leaving 138 articles for our final analysis and publication. Out of the 138 papers that underwent a secondary analysis, 51 (37%) scored a 4 or less, 70 (50%) scored a 5-6, and 17 (12%) scored a 7 or higher. Studies that scored a 7 or higher provided insightful information and findings on hand hygiene or hand hygiene behavior as its primary outcome while also detailing how their findings related to the broader literature and provided explanations into the limitations of their studies and how it could be improved upon.

Study Characteristics

Publications were also classified by setting, economic classification, study design, and outcome focus. Of the publications assessed, more than half (54%) referenced or had a focus on the COVID-19 response method. For settings, 22% occurred in healthcare facilities, 22% in domestic environments, 17% in public spaces, 15% in education institutions, 3% in workplaces, and 1% in humanitarian settings. To provide an economic classification to each country, the [World Bank classification](#) tool was utilized. From this summary, 28% occurred in lower-middle-income countries, 21% in high-income countries, 17% in low-income countries, and 8% in upper middle countries. Of those, countries in Africa and South Asia are overwhelmingly represented. Publications in the summary consisted of a range of studies but with the most (57.5%) being cross-sectional in nature followed by literature reviews (8%). A more detailed breakdown of the study characteristics of the 138 publications is included in the table below. Definitions for the study characteristics are included in [Annex 2](#).

Study Characteristic	N	%
Setting		
Domestic Setting	31	22.00
Healthcare Facilities	31	22.00
Educational Institutions	21	15.00
Public Space	24	17.00
Workplace	4	3.00
Humanitarian Emergency	2	1.00
Undefined	25	18.00
Economic Classification		
Low income	23	17.00
Lower middle	39	28.00
Upper middle	11	8.00
High income	29	21.00
Not defined	36	26.00
Study Design		
Cross-sectional	79	57.25
Literature Review	11	8.00
Cohort	7	0.05
Case-control study	4	0.03
Formative	4	0.03
Microbiological	6	0.04
Randomized controlled trial	10	0.07
Policy Analysis	1	0.01
Not defined	15	0.11
Other	1	0.01
Outcome Focus		
COVID-19 related	74	54.00
Non-COVID-19 related	64	46.00

Annex 2: Definitions

Below are the definitions that were utilized to conduct the analysis of the 2021 research summary.

Setting	
	Definitions
Healthcare Facilities	Any location where healthcare is provided.
Domestic Setting	A setting involving the home or family, including households (a small group of persons who share the same living accommodation, who pool some, or all, of their income and wealth and who consume certain types of goods and services collectively, mainly housing and food).
Public Space	A public space refers to an area or place that is open and accessible to all people, regardless of gender, race, ethnicity, age, or socio-economic level. These are public gathering spaces such as plazas, squares, and parks. Includes markets, transport hub, and other public spaces.
Educational Institution	An educational institution refers to an institution for educating children, including pre-primary, primary, and secondary schools, and universities.
Workplace	A workplace refers to any to any premise or part of a premise which are made available to any person as a place of work.
Humanitarian Setting	Any setting with a type of crisis or emergency event, including humanitarian crisis, protracted emergencies, or armed conflict.

Publications released in 2021 were assessed for the presentation or inclusion of the following categories below.

Research analysis assessment category		
	Definition	Sub-categories
COVID-19	This term is used to identify studies with specific focus/emphasis on hand hygiene and COVID-19	
Services, facilities, and products	Papers that report on the availability, functionality, or design of hand hygiene-related services (e.g. water supply), facilities (e.g. handwashing stations) and products (e.g. soap and sanitizer)	Papers which: <ul style="list-style-type: none"> • Discuss the availability and access to hand hygiene services, products and facilities • Discuss the functionality, use, operation, and maintenance of services, products or facilities • Discuss the design feature and processes for hand hygiene facilities

Behavior	<p>Papers which focus on hand hygiene behavior including behavioral prevalence, technique, the determinants of behavior, the application or development of behavioral theory, the measurement of behavior and interventions to change behavior.</p>	<p>Papers which:</p> <ul style="list-style-type: none"> ● Map, assess or describe behavioral determinants (factors that influence hand hygiene behavior) ● Track hand hygiene prevalence, hand hygiene technique or measure changes in behavior over time ● Discuss or compare new or existing ways of measuring hand hygiene behavior ● Describe or assess new or existing theories that are related to or have been applied to hand hygiene ● Describe the process, impact, acceptability, feasibility or cost-effectiveness of hand hygiene behavior change interventions. This may include interventions that include 'software', 'hardware', and policy changes.
Health and non-health outcomes	<p>Papers which describe health outcomes of hand hygiene (including impacts on diarrhea, respiratory infections, NTDs, outbreak-related infections, nutrition, mental health, hospital-acquired infections, etc.), non-health outcomes (including impacts on wellbeing, education rates, productivity, economics, and other factors) or biological outcomes (e.g. pathogen removal rates)</p>	<p>Papers which:</p> <ul style="list-style-type: none"> ● Describe health outcomes including impacts on diarrhea, respiratory infections, NTDs, outbreak-related infections, nutrition, mental health, hospital-acquired infections, etc. ● Describe non-health outcomes including impacts on wellbeing, education rates, productivity, economics, and other factors ● Describe biological outcomes such as pathogen removal rates achieved through hand hygiene
Systems	<p>Papers which describe the ecosystem which supports hand hygiene including policies, coordination, financing, capacity development, and accountability to populations.</p>	<p>Papers which:</p> <ul style="list-style-type: none"> ● Describe or discuss coordination and partnerships for hand hygiene ● Map, analyze or describe the impact of policies and strategies for hand hygiene ● Discuss the costs of hand hygiene, and the financing which supports hand hygiene programs ● Assess hand hygiene capacity or describe opportunities for hand hygiene development ● Describe accountability to populations or community engagement processes throughout program life cycles