Supplementary Table S4. Overview of cross-sectional surveys assessing bacterial contamination of soaps used for hand hygiene in healthcare settings in low- and middle-income countries. Country income level is based on the data from the World Bank (World Bank2022) at the year of publication of the article. Product names are listed as mentioned in the referred articles; in case of brand names or jargon, the generic name is written in brackets and italics. The product categories (antiseptics/disinfectants) are listed according to the categories mentioned in the referred articles. Bacterial names are listed as mentioned in the referred articles, names according to actual nomenclature (*List of Prokaryotic names with Standing in Nomenclature* and updated species names were used [33]) are written between brackets and used in the "Summary/Comment". When written in brackets; the term "*modified Kelsey-and-Maurer*" was not used in the original articles but has been added for all articles using a dilution of the liquid product in nutrient broth and subsequent plating on solid culture media. Abbreviations: AST = antibiotic susceptibility testing, CFU/ml = colony forming units/ml, CLSI = Clinical Laboratory Standards Institute US, previously "NCCLS", ID = Identification, LIC = low-income country, MIC = middle income country.

Author – Year **Country (income level)** **Setting**	**Study design, products assessed, findings**	**Methods** **Risk factors (assumed or observed)**
Subbannayya 2005 India (MIC) Tertiary hospital	Objective: to assess the contamination of products, triggered by the observation that bar soap becomes slimy after a few days of use Design: Cross-sectional study; in-use bar soap (n = 12) and liquid (n = 10) soap samples; no detail about sample selection and inclusion ("hospital wards") Products: Bar soap and liquid soap; no information about the origin and whether plain or antiseptic soap Contamination ratios and contaminating flora: Bar soap: all 12 samples contaminated, bacterial counts > 10^5 CFU/ml *Pseudomonas aeruginosa* (n = 12), one with also *Staphylococcus aureus* Liquid soap: no growth	Methods Sample selection not described Bar soap: 10 µl of dissolved sample inoculated on blood and MacConkey agar media Liquid soap: 1/10 dilution in nutrient broth, next 10µl spread on blood and MacConkey agars, Incubation at 37°C for 24 – 48 hours, neutralizer used, type not specified) (*modified Kelsey-and-Maurer*) ID by conventional phenotypical methods No AST Risk factors: Observed: "slimy" (humid) aspect of the soap
Afolabi 2007 Nigeria (LIC) Tertiary (n = 1) and secondary (n = 2) hospitals	Objective: to assess the contamination of products to compare isolates from soap with those of patients (wound specimens) Design: Cross-sectional study: in-use soap products, comparison with clinical isolates: 36 bar and 7 liquid soap samples Two bar soap samples were antiseptic, the remaining were plain. Samples in hospital wards, neonatal units and theatres; no details about sample selection, ("all wards"). Products: Bar soap and liquid soap (antiseptic and plain); branded bar soaps, commercially procured Contamination ratios and contaminating flora: Bar soap (antiseptic and plain): 14/36 (38.9%) Receptacles: 27/36 (75.0%) Liquid soap (antiseptic and plain soap): no result provided Contaminating flora (total 48 isolates) : *Pseudomonas aeruginosa* (79.1%), *Klebsiella pneumoniae* (14.6%), *Staphylococcus aureus* (4.3%), *Serratia marcescens* (2.0%). Contamination ratios and contaminating flora according to the bar soap condition:	Methods Sample selection not described Bar soap: swabbing surface of soap and boxes, blood and MacConkey agar plates, no neutralizer, incubation at 37°C for 24 – 48h. ID by conventional phenotypic methods AST: disk diffusion, CLSI guidelines, version not mentioned but AST results not displayed Risk factors: Observed: only 4/36 bar soap samples were kept in a box (with a second layer, 13 were kept directly on the sink)

	Very dry: none out of 5 samples contaminated Dry: 3/9 samples contaminated, all 3 by *P. aeruginosa* Wet/moist: 13/19 samples contaminated: *P. aeruginosa* (n = 11), *K. pneumoniae* (n = 2) Soap in pool of water 3/3 samples, all 3 *P. aeruginosa* Bar soap boxes and sinks (31 isolates): *P. aeruginosa* (67.7%), S. aureus (6.5%), *K. pneumoniae* (3.2%), *Serratia marcescens* (3.2%) Contamination ratios of bar soap per hospital: tertiary: 32.2%, secondary: 71.4% and 25.0% Comparison with clinical isolates from wound samples: No relatedness (different ID and antibiotic resistance profile) between soaps' isolates and clinical isolates	Assumed: based on culture results, contamination of bar soaps was assumed to be related to moisture and/or duration in-use; contamination was assumed to occur through hand contact and the receptacles were considered as the source of contamination (by the sludge accumulating in the receptacle).
Zeiny 2009 Iraq (MIC) Tertiary hospital	Objective: to assess the contamination of products and to compare bar versus liquid soap for contamination Design: Cross-sectional study: in-use samples of bar (n = 50, no data about manufacturing) and liquid (n = 44, commercially procured) soaps. No details about sampling methods and places. Products: Bar soap and liquid soap (trace of formaldehyde as preservative), branded products commercially procured Contamination ratios and contaminating flora: Bar soap: 30/50 (60.0%) Contaminating flora (total 44 isolates): *P. aeruginosa* (41.0%), *Escherichia coli* (13.6%), *Acinetobacter baumannii* (11.4%), *Escherichia coli* (n = 6), *Enterobacter (Klebsiella) aerogenes* (n = 5), *Enterobacter cloacae* (n = 2), *Staphylococcus aureus* (n = 2), *Proteus penneri, Candida* spp., *Corynebacterium diphtheriae, Chryseobacterium indologenes and Flavobacterium brevis (Empedobacter brevis)* (each one isolate) Liquid soaps: 7/44 (15.9%) Contaminating flora (total 6 isolates): *P. aeruginosa* (n = 4), *Proteus penneri* and *Flavimonas oryzihabitans (Pseudomonas oryzihabitans)* (each one isolate) Bar soap more contaminated than liquid soap ($p < 0.05$)	Methods Sampling at the sinks of toilets and working rooms of the wards Bar soap: swabbing wet surface parts Liquid soap: swabbing tip of dispenser, dipped into 1 ml saline, next inoculation of 10 µl on blood and eosin methylene blue agar, incubation at 37°C for 22 – 24h (direct plating) ID by conventional phenotypical methods No AST Risk factors Observed: Keeping bar soap in wet/moist conditions No reprocessing procedure for liquid soap containers and dispenser system
Aktas 2010 Turkey (MIC) Tertiary hospital	Objective: to assess the contamination of products and study clonal relatedness of the contaminating flora Design: Cross-sectional study: in-use samples of bar (n = 5) and liquid (n = 388) soaps. Different ward sampled and stratified (patients, doctors' and nurse rooms, toilets); no details about sample selection. Liquid soaps comprised 361 hospital products (all plain soap) and 22 private (procured by patients) soaps. Original containers and cans used to distribute soap to the wards were assessed too. Products: Bar soap and liquid soap, no information about the origin Contamination ratios and contaminating flora: Bar soap: 0/5 Liquid soaps: 44/378 (11.6%), 1 from antiseptic soap, all but one single isolate Contaminating flora (37 isolates): *Pseudomonas aeruginosa* (n = 16, 43.2%), *Enterobacter aerogenes* (*Klebsiella aerogenes*) (n = 9), *Escherichia coli* (n = 8), *Klebsiella pneumoniae* (n = 6), *Enterobacter cloacae* (n = 3), *Serratia marcescens* (n = 2), and *Klebsiella oxytoca* (n = 1) Other findings:	Methods Sample selection not described No information about laboratory work-up ID: no information. No AST Clonal relatedness studied with Pulsed Field Gel Electrophoresis (PFGE) Risk factors Observed: No reprocessing before refill Prolonged use of container before refill Topping-up Containers with open or spoiled lid

	No relation of contamination ratio with sampling (morning versus afternoon) No growth from original containers and plastic cans used for distribution Contamination ratio in samples from toilets tended to be lower than in other rooms No clonal relatedness (Pulsed Field Gel Electrophoresis) among isolates from *P. aeruginosa, Enterobacter* spp. *E. coli* and *K. pneumoniae*	Faster circulation and replenishment of soap in toilets compared to other rooms
Caetano 2011 Brazil (MIC) Secondary hospital	Objective: to assess the contamination of products Design: Cross-sectional survey, 59 in-use liquid soap dispensers in the hospital, sampling at the start of use, during use and at the end of use Products: Plain liquid soap, branded and commercially procured Contamination ratios and contaminating flora: Overall, 33/59 (56%): 24 from wall-mounted dispensers, 7 from original bottles in use, and 2 from original sealed bottles, bacterial counts between $2x10^3$ to $2.1x10^6$ CFU/ml Contaminating flora: *Burkholderia cepacia* (n = 14), *Pseudomonas putida* (n = 9), *Pseudomonas aeruginosa* (n = 3), *Klebsiella pneumoniae* (n = 3), *Enterobacter cloacae* (n = 2) and *Pseudomonas luteola* (n = 2). Bacterial counts between 4 020 and 105.000 CFU/ml. Other findings: Hospital wards with the largest numbers of contamination: (n = 14), dermatology clinics (n = 4), medical clinic (n = 3), pediatrics (n = 2), hematology (n = 1)	Methods Sample selection not described Sampling: 12 ml, centrifugation, filtration (0.22 µm filter), and serial 10-fold dilutions to assess bacterial counts Culture: blood, chocolate, MacConkey, Sabouraud media ID by conventional phenotypical methods No AST Risk factors Intrinsic product contamination Observed: extrinsic contamination: No adequate container's reprocessing (simple cleaning with water and soap, procedure of cleaning once a week not adhered to) Topping-up
Biswal 2015 India (MIC) Tertiary hospital	Objective: a to assess the contamination of products Design: Cross-sectional survey: in-use samples of bar (n = 99) and liquid (n = 60) soaps, (no information about the origin of products and whether plain or antiseptic soap), sampled in critical care areas Contamination ratio and contaminating flora: Bar soaps: 61/99 (61.6%) Contaminating flora: *Pseudomonas mendocina* (n = 17), *Corynebacterium* spp. (n = 12), *P. aeruginosa* (n = 11), *Acinetobacter haemolyticus* (n = 6), *Halomonas aquamarina* (n = 5), *Acinetobacter* spp. (n = 4), *Citrobacter* spp. (n = 3), *Arthrobacter* spp. (n = 2), and others. Liquid soaps: 2/60 (3.3%) Contaminating flora: *Citrobacter* spp., *Pseudomonas oleovorans*, and *K. pneumoniae* Liquid soap from unopened container: no growth Bar soaps more contaminated than liquid soaps ($p < 0.0002$)	Methods Sample selection not described Bar soap: swabs of surface and box, inoculated on MacConkey agar and Sabouraud Dextrose broth, use of neutralizer (no product detail) Liquid soap: after neutralization, inoculation of 200 µl into 1 ml of Sabouraud Dextrose broth and thioglycolate broth, inoculation of 100 µl on MacConkey agar (*modified Kelsey-and-Maurer*) Incubation at 37° for 48 hours ID: MALDI-TOF, no AST Risk factors Observed: wet/moist bar soap
	Objective: to assess the contamination of products	Methods Sample selection not described

Ahmad 2016 Palestine (MIC) Tertiary hospitals (n = 7)	Cross-sectional study: in-use samples liquid soaps (n = 105), no information about the origin of soaps and whether plain or antiseptic soap Contamination ratio and contaminating flora: Overall ratio: 18/105 (17.1%), no results mentioned for bacterial counts Contaminating flora from the 105 tested samples: coliforms 12.4%, *Pseudomonas* spp. 11.4%, yeasts 10.5%, and *Bacillus* spp. 5.7%	Serial 10-fold dilutions 10^2 – 10^3 – 10^4/ml; next plating of 100 µl on nutrient agar and selective agar plates, incubation at 35°C for 24-48 hours. No AST ID by conventional phenotypical methods Risk factors Assumed: Local manufacturing, Over-dilution
Altaher 2016 Palestine (MIC) Secondary hospital (n = 2)	Objective: to assess the bacterial contamination of products Design: cross-sectional study, two hospitals, 41 samples each, in-use containers of which 37 and 14 in each hospital were sealed), no information about the origin of soaps, and whether plain or antiseptic soap. (*Note that the term "sealed" is used to indicate "closed with a lid")* Contamination ratios and contaminating flora per hospital: Hospital 1, 41 soap samples including 37 from sealed containers: 3/41 (7.3%) *S. aureus* 1/41 (2.4%), other staphylococci 2/41 (4.8%), 20 -40 CFU/ml. Hospital 2, 41 samples including 14 from sealed containers): 25/41 (61.0%) *S. aureus* 12/41 (29.3%), other staphylococci 13/41 (31.7%), and *S. aureus* + other staphylococci 2/41 (4.8%), 5 – 400 CFU/ml. Observation and questionnaire study findings: Hospital 1 reprocessed containers with hypochlorite before refill whereas Hospital 2 reprocessed containers only by rinsing with water	Methods Sample selection not described Dilution 1/10 in NaCl 0.9%, inoculation of 10 µl on blood, MSA and MacConkey agars and MSA, incubation at 37°C for 24 hours (*modified Kelsey-and-Maurer*) ID by conventional phenotypical methods No AST Risk factors Observed: inadequate reprocessing of containers Assumed: prolonged use of containers