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Hand hygiene in hospitals: anatomy of a revolution

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SUMMARY

Healthcare-associated infections (HAIs) affect hundreds of millions of individuals worldwide. Performing hand hygiene is widely accepted as a key strategy of infection prevention and control (IPC) to prevent HAIs, as healthcare workers' contaminated hands are the vehicle most often implicated in the cross-transmission of pathogens in health care. Over the last 20 years, a paradigm shift has occurred in hand hygiene: the change from handwashing with soap and water to using alcohol-based hand rubs. In order to put this revolution into context and understand how such a change was able to be implemented across so many different cultures and geographic regions, it is useful to understand how the idea of hygiene in general, and hand hygiene specifically, developed. This paper aims to examine how ideas about hygiene and hand hygiene evolved from ancient to modern times, from a ubiquitous but local set of ideas to a global phenomenon. It reviews historical landmarks from the first known documented recipe for soap by the Babylon civilization to the discovery of chlorine, and significant contributions by pioneers such as Antoine Germain Labarraque, Alexander Gordon, Oliver Wendell Holmes, Ignaz Philip Semmelweis, Louis Pasteur and Joseph Lister. It recalls that handwashing with soap and water appeared in guidelines to prevent HAIs in the 1980s; describes why alcohol-based hand rub replaced this as the central tool for action within a multi-modal improvement strategy; and looks at how the World Health Organization and other committed stakeholders, governments and dedicated IPC staff are championing hand hygiene globally.

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Introduction

Healthcare-associated infections (HAIs) affect hundreds of millions of individuals worldwide [1]. HAIs affect patients from all areas of health care, but certain groups are at particular risk. Patients who suffer from chronic diseases, have multiple comorbidities, are either very young or very old, or have a reduced immune response tend to be most vulnerable [2]. The financial burden of HAIs on health systems is huge, but is still not well-quantified as it varies greatly between countries [3]. Moreover, HAIs are often due to multi-drug-resistant microorganisms [4]. Trying to treat these infections increases the use of antibiotics in hospitals, and antibiotics are the main driver to multi-drug resistance [5].

Infection prevention and control (IPC) is essential, and hand hygiene as a key IPC intervention is widely accepted as the cornerstone for preventing HAIs. Today, hand hygiene with alcohol-based hand rub (ABHR) is the standard of care worldwide. But how did this paradigm shift from handwashing with soap and water to ABHRs occur? Looking at both the ancient and modern history of hygiene, and hand hygiene specifically, allows us to put this global revolution into context and analyse how such a change was implemented across so many different cultures and geographic regions [6,7].

Throughout history, humans have often had lamentable personal hygiene with the exception of their hands. In modern times, although our culture is comparatively obsessed with cleanliness, adherence to hand hygiene remains low [8]. The success of the World Health Organization (WHO) in making hand hygiene a worldwide standard of quality care is remarkable, not least because of the prerequisite commitment and dedication of thousands of individuals and institutions around the globe.

For most of history, we have to contend with a profound lack of written records. Historians can only give dates to records that can be proven, although a particular behaviour or activity may have been far more ancient than its first written record. Due to this dearth of documentation, it is also difficult to pinpoint the moment and place where the focus shifted from hygiene in general to hand hygiene in particular. It is for this reason that this paper explores some of the earlier ideas and approaches to hygiene.

From 2800 BC to the Middle Ages

The first known documented recipe for soap is from the Babylonian civilization in Mesopotamia, and was found inscribed on a clay tablet describing a mixture of fats boiled with ashes [9]. Ancient Egyptians also made a type of soap, mixed from animal fat and vegetable oil and alkaline salt, as documented on a papyrus from 1500 BC (Ebers Papyrus) [10]. In that culture, washing the hands and body was performed for both hygienic and spiritual reasons. The purpose of hygiene was often partially due to superstitious fear, stemming from the lack of knowledge about the spread of disease. An ancient Mesopotamian text shows how an exorcist explained the sickness of a patient: 'He has come into contact with a woman of unclean hands..... or his hands have touched one of unclean body' [11]. During the same period, Israelites also had a hygiene culture related to both health and religious purification [12]. After certain types of physical contamination, including touching some bodily fluids or those with skin disease, people were supposed to bathe and were thought to remain unclean for a time after, already implying an understanding of lasting contamination of the skin despite washing [13].

Ancient civilizations discovered soap and its effects without knowing the chemical mode of action. The soap molecule is the result of saponification between a base (ashes or alkaline salt) and an acid (vegetable oil or animal fat). The molecule is bipolar; it has a hydrophilic (polar) 'head' and hydrophobic (non-polar) 'tail' [14]. In contact with water, the dirt (oil and grease that are hydrophobic) on our skin is surrounded by soap molecules and creates a micelle (hydrophilic) [15]. The micelles can then mix with water and be removed from the skin.

In the ancient Greek text The Characters of Theophrastus, one of the characters, 'Nastiness' is described as someone not washing his hands. By the second century AD, the Greek physician Galen of Pergamon recommended soap for both medicinal and cleansing uses [14]. The Roman civilization brought on another type of hygiene practice through the spread of public bathhouses.

The Middle Ages following the end of the Roman Empire were a dark period for hygiene in Europe, but apparently hand hygiene was still important [8]. There was widespread soap production in Gaul in the seventh century, and by the 13th century, soap making had become widespread in the larger towns in England. During that time, there began to be the first exportation of Spanish olive-oil-based soap to England [16]. By the 17th century, cleanliness in general had come back into fashion in Western civilization, and there was a booming international soap trade [16,17].

Numerous religious texts describe hand hygiene rituals (see Table I.17.1 in WHO Guidelines on Hand Hygiene in Health Care), many of which are still practised in modern times [12]. The Islamic religion speaks about repeating ablutions before prayer, which takes place five times a day, and the Prophet Mohammed urged his followers to wash their hands frequently [18]. In the Sikh religion, hand hygiene is seen as 'not only a holy act, but an essential element of daily life' [19]. In Japanese Buddhism, washbasins called 'tsukubai' are located outside of temples so that visitors can cleanse their hands and mouths [20]. Religious or cultural norms in some West African countries dictate that hands must be cleansed before bringing anything to one's lips [18].

From the discovery of chlorine to Semmelweis and Pasteur

In more recent times, the evolution of hand hygiene progressed in two parallel paths: chemistry-based discoveries concerning disinfectants, and medical discoveries concerning the possible relationship between hygiene and health.

Chemist Carl Wilhem Scheel was the first to synthesize chlorine in the 1770s. The chemist was conducting an experiment, treating black magnesia (pyrolusite) with muriatic acid (hydrochloric acid), when he noticed a gas developed [21]. It was only in 1810 that the English chemist Humphry Davy named it 'chlorine' and recognized it as an element [22]. The element would be the basis for disinfectant research, as well as the well-known 'Labarraque solution' [23]. Currently known as 'bleach', the sodium hypochlorite solution was created in the 1820s by French chemist and pharmacist Antoine Germain

Labarraque (Figure 1). It then became widely used as a disinfectant and deodorizer [24]. Forty years later, this work on antisepsis would serve as the basis for Dr Louis Pasteur's germ theory of disease.

By the end of the 18th century, Dr Alexander Gordon (Figure 1) had published the Treatise on the Epidemic Puerperal Fever of Aberdeen, which rightly defined the bodies of healthcare workers (HCWs) as possible sources of contagion [25]. Gordon advocated a preventive strategy: 'The patient's apparel and bedclothes ought either to be burnt or thoroughly purified; and the nurses and physicians who have attended patients affected with the puerperal fever, ought carefully to wash themselves and to get their apparel properly fumigated before it be put on again.' As with many new ideas, his work engendered significant opposition and its importance was not sufficiently recognized [26].

Two physicians in the mid-1800s, Oliver Wendell Holmes and Ignace Philip Semmelweis (Figure 1), recognized the importance of clean hands in the context of recent developments in hygiene. Holmes was a well-known jurist and physician who published a booklet in 1843 entitled 'Puerperal Fever, as a Private Pestilence', where he postulated that doctors' hands were the source of germ transmission [27,28]. A few years later, Semmelweis, while working in Vienna, showed that 'cadaverous particles' transmitted by HCWs' hands caused disease to spread in the hospital. His intervention promoted hand hygiene by applying a chlorinated lime solution before delivering babies, and its implementation led to a dramatic reduction in maternal mortality [29]. His advocacy to change HCWs' behaviour was, however, not well received. He was rejected by his peers, lost his job, and subsequently moved back to his home country, Hungary. There, he implemented the same interventions and made the same observations, but his work was not accepted either. He ended up being admitted to an insane asylum, and died shortly thereafter, without ever seeing the impact of his genius. Although he had little success

Figure 1. Six pioneers of hygiene.

among his contemporaries, Semmelweis is today known as the father of hand hygiene [30].

Louis Pasteur (Figure 1), best known for inventing the process of pasteurization and his work on the principles of vaccination, also supported that micro-organisms are the cause of diseases [31]. He postulated and helped confirm that germ transmission could result from a contaminated environment. Pasteur is described as a fanatic of hand hygiene himself, and as having been almost obsessively concerned with the risk associated with hand-to-hand as well as hand-to-environment contact. Had he been working in a hospital, Pasteur would surely have been among the very first hospital epidemiologists. Due to his contributions to germ theory, many physicians began to sterilize their instruments and bandages, disinfect wounds, sterilize milk for children, etc. [32].

Modern developments

The period of 1870–1900 could be seen as the first modern period in hospital infection prevention and control [33]. Joseph Lister (Figure 1) applied germ theory to the ideas of asepsis and antisepsis in surgery. The result of this work was his creation of a carbolic acid spray that he tried to implement as an antiseptic [34]. By 1867, he published his method of antiseptic surgery in *The Lancet* [33]. This spray became widely used after Lister's invention gave him the name, 'the father of modern surgery' [35]. Alexander Ogston, (who also discovered *Staphylococcus aureus*), made this spray popular in his hospital in Aberdeen, and demonstrated that bacteria could be killed by both heat and carbolic acid [36].

The next 100 or so years were relatively stagnant in terms of hand hygiene development, and the next significant step in its evolution took shape in the 1970s and 1980s. One year after the 1974 launch of the landmark Study on the Efficacy of Infection Control (SENIC), the US Centers for Disease Control and Prevention (CDC) published a review on handwashing that acknowledged it as 'the most important procedure in preventing nosocomial infections', and the first national hand hygiene guidelines were published in 1983 [37]. By the mid-1980s, handwashing with soap and water was a key part of the CDC guidelines on HAI prevention [29]. Around the same time, some European countries began using ABHR formulations to complement the standard use of soap and water. In 1995 and 1996, the CDC/Healthcare Infection Control Practices Advisory Committee in the USA recommended that either antimicrobial soap or a waterless antiseptic agent should be used [38,39] for cleansing hands upon leaving the rooms of patients with multidrug-resistant pathogens.

Today, hand hygiene is the single most important tool to prevent cross-transmission of pathogens in hospitals through the hands of HCWs [19,40]. At first glance, having HCWs perform hand hygiene correctly seems to be a simple intervention [41]. Yet somehow, 150 years after Semmelweis attempted to transform care practices, HCW compliance with hand hygiene remained very low. Before the 1990s, monitored and reported accounts of HCW compliance stagnated around 20–30% and never exceeded 40% [42,43]. Once the low compliance was observed, the next step was to assess why it was so low. The main reason was the method: Semmelweis' work was virtually forgotten and handwashing with soap and water was still the recommended approach for hand hygiene [44]. Although washing hands with soap and water is efficacious, it takes time, and this was shown to be the major factor for low compliance with its practice [45]. The time needed to access a sink, turn on the water, apply the soap, rub hands for the recommended duration to ensure antimicrobial efficacy, rinse hands, dry hands, and return to the patient's side is simply too long! A revolution was needed.

In 1994, while conducting a large hospital-wide study on the epidemiology of hand hygiene, the research group at the University of Geneva Hospitals (HUG) demonstrated that time constraint was the most significant risk factor for non-compliance with practices, even after controlling for major confounders (Figure 2) [45]. They observed that the greater the number of opportunities for handwashing, the lower the compliance. The observation was consistent across hospital wards and departments. They also observed that the intensity of patient care was predictive of the number of opportunities for hand hygiene; the higher the intensity of patient care, the more opportunities there were. Nurses in critical care had an average of 22 opportunities for hand hygiene per hour of patient care, with this number increasing to 30 opportunities per hour for nurses in post-anaesthesia care units [46].

Considering that handwashing with soap and water is a 1–2-min procedure, it was clear that HCWs, and nurses in particular, were not technically able to comply with recommendations [47]. From an epidemiological perspective, in order to be effective, hand hygiene needed a way to become compatible with the reality of patient care. ABHR was the tool that could make such a revolution possible.

Alcohol-based hand rub: a revolution in patient care

Using ABHR instead of handwashing with soap has several key advantages: it is more effective, acts faster, can be made available at the point of patient care, and is generally better tolerated by skin than soap and water [19]. (However, when hands are visibly soiled or contaminated with spore-forming organisms, washing hands with soap and water is the preferred method for hand hygiene [19]). In contrast to the antimicrobials used in medicated soaps, there is no bacterial or viral resistance to alcohol at the concentrations used in ABHRs [19,48]. Rubbing hands with ABHR also reduces the need for water, which avoids bacterial growth in the environment and does not disadvantage low-resource settings where water is scarce.

Between 1995 and 1998, HUG implemented the first multimodal strategy to facilitate the change from soap and water handwashing to handrubbing with ABHR; as a result, compliance with hand hygiene improved significantly hospital-wide [43]. System change, as one component of the multi-modal strategy, was obtained by promoting the systematic use of pocket-sized ABHR by HCWs during patient care, and was supported by multiple training and education sessions, posters and workplace reminders, frequent monitoring and feedback of HCW practices, as well as promotion of the institutional safety climate around infection control and hand hygiene practices. HCW compliance improved from 48% to 66% on average, and a parallel reduction was observed in HAI rates and spread of multi-resistant organisms (Figure 3). The impact of the multi-modal intervention was sustained and large cost-savings were demonstrated after eight years [49].

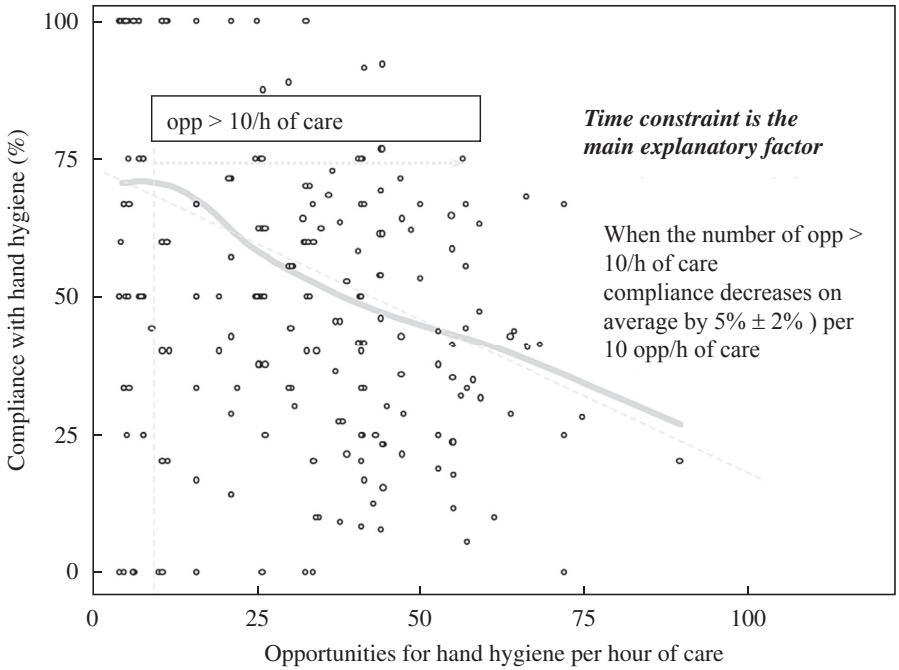

Figure 2. Relation between the number of opportunities (opp) for handwashing and compliance with its practice. Modified with permission from Pittet *et al*. Ann Intern Med 1999;130:126.

This intervention and its publication in *The Lancet* in 2000 [43] can be considered as a tipping point in hand hygiene history; experts from around the world came to visit HUG and started replicating the intervention. The so-called 'Geneva model of hand hygiene promotion' was implemented across the world and on various levels, from single institutions to country-wide initiatives [50–53].

Endorsement by the World Health Organization: 2005 and beyond

WHO launched the World Alliance for Patient Safety [54] in 2004. The organization became more actively involved in the initiative in 2005 with the First Global Patient Safety Challenge programme (Clean Care is Safer Care), the flagship of which was hand hygiene promotion. To date, more than 150 countries have signed the pledge promising to endorse hand hygiene, raise awareness of the burden and impact of HAIs, and commit to implementation of the WHO guidelines along with selected actions from other WHO strategies [29,55]. The organization published the first draft of the WHO Guidelines on Hand Hygiene in Health Care in 2006 and the final draft in 2009 [19], which outlined the WHO Multi-modal Hand Hygiene Improvement Strategy. This strategy consists of five components to be implemented in parallel: system change, training/education, evaluation and feedback, reminders in the workplace, and institutional safety climate. The guidelines also provides countries with an array of tools for facilitating implementation of the strategy, and aimed at facilitating both structural and behavioural change at the point of care in the context of a favourable institutional safety climate [56].

From 2006 to 2008, WHO tested the global implementation of the strategy with a quasi-experimental study at six pilot sites (55 departments in 43 hospitals) in Costa Rica, Italy, Mali, Pakistan and Saudi Arabia [7]. The implementation proved successful worldwide across all HCW categories, hospitals, hospital wards and departments, and country levels of development (Figure 4). Pilot testing also highlighted the importance of adaptation of the multi-modal strategy to local resources and access to ABHR, including the feasibility of the local production of ABHR [7,57,58]. In most of the countries studied, implementation was sustained over time. Additionally, as one part of maintaining the profile to support and influence sustainable improvement, regional and national promotion campaigns became common.

In 2007, 20 representatives of countries that had participated in such campaigns met in Geneva with the objective of strengthening the global response to HAI through a formal partnership of campaigning nations [59]. Subsequently, WHO facilitated a country campaign network called 'CleanHands-Net', and by 2015, over 50 nations/subnations met the criteria of implementing the campaign.

As an extension of the Clean Care is Safer Care programme, WHO also launched the SAVE LIVES: Clean Your Hands global campaign on 5th May 2009, marking the first international day of hand hygiene in health care [60]. The date chosen is a reference to the five moments for when to perform hand hygiene [61], and the five components of the multi-modal strategy. This annual event focuses on the continued global promotion, visibility and sustainability of the campaign, highlighting the importance of clean hands at the point of patient care [62]. Each year, WHO selects a theme (Table I) and develops related tools and promotional material around it. WHO provides a wide range of tools and materials to continue hand hygiene improvement, including a licence-free ABHR formulation to encourage local, on-site production and facilitate global access to ABHR. By 2015, ABHR was included in the WHO Essential Medicines List, meaning that access to it is as close to a human right as a medicine can get [63].

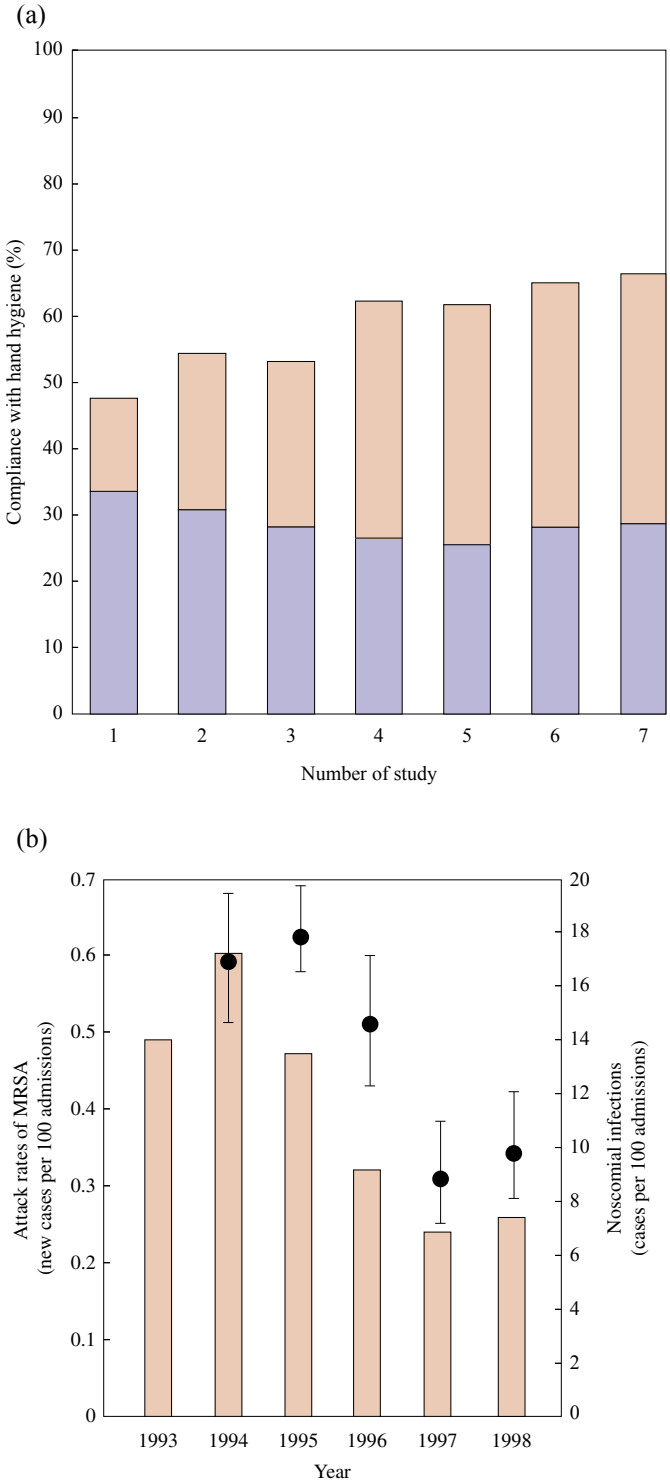

Figure 3. Trends in compliance with hand hygiene practices and rates of healthcare-associated infections and cross-transmission of meticillin-resistant *Staphylococcus aureus* (MRSA). (a) Hand hygiene compliance trend during seven consecutive hospital-wide surveys, University of Geneva Hospitals, 1994–1997. Intervention began after Survey 1. Compliance is indicated separately for handwashing (purple bars) and hand disinfection (pink bars). (b) Trends in prevalence of nosocomial infections (black circles) and annual attack rate of MRSA (pink bars), 1993–1998, University of Geneva Hospitals. Reproduced with permission from Pittet D, Boyce J. Lancet Infect Dis 2001; 1:9–20 [70]. Original data are published in Ref. [43].

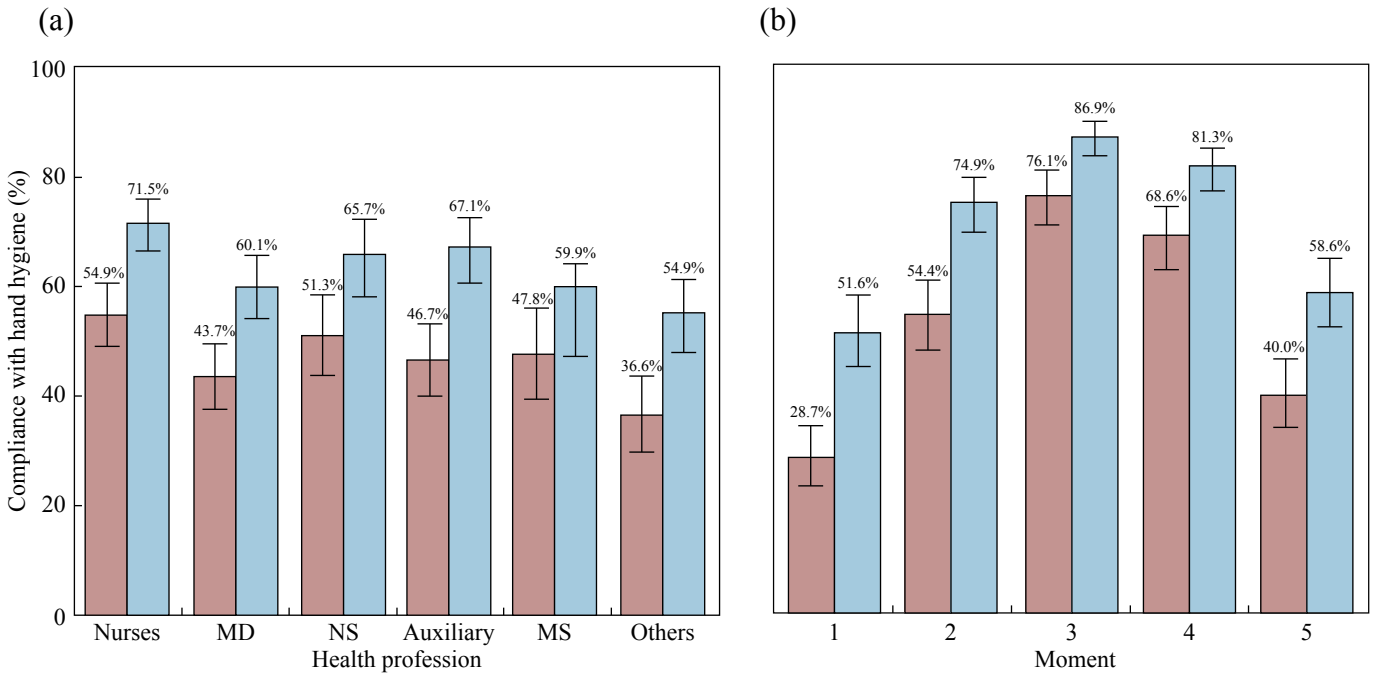

Figure 4. Effect of the implementation of the World Health Organization multi-modal strategy across (a) healthcare worker categories and (b) moments (indications) for hand hygiene; quasi-experimental study. Reprinted with permission from Allegranzi B *et al*. Lancet Infect Dis 2013;13:843–51. Error bars show 95% confidence intervals around the mean compliance. Observation periods before and after implementation lasted 3–4 months each. Moment 1 was before patient contact, Moment 2 was before an aseptic task, Moment 3 was after risk of exposure to body fluid, Moment 4 was after patient contact, and Moment 5 was after contact with patient surroundings. MD, medical doctor; NS, nursing student; MS, medical student.

The Hand Hygiene Self-Assessment Framework (HHSAF) was issued by WHO in 2010. This tool allows healthcare facilities (HCFs) to assess their own level of proficiency in implementing hand hygiene measures at an institutional level [64,65]. The HHSAF analyses a number of factors within each of the components of the multi-modal strategy, and scores institutions as inadequate, basic, intermediate or advanced, according to the number of points obtained. Additionally, it directs HCFs to the WHO tools relevant to each area of improvement necessary [64]. HCFs that are among the best institutions also have the possibility to apply for the Hand Hygiene Excellence Award run by an independent foundation, Clean Hands Save Lives (www.hhea.info).

HCFs have been encouraged to create their own action plans, in line with the concept 'Adapt to Adopt' (www.tinyurl.com/AdaptToAdopt). This initiative allows facilities from around the world to improve hand hygiene by adapting the materials for the multi-modal strategy in a way that is culturally relevant and adapted to available resources [7,44]. WHO has initiated two global surveys in 2011 and in 2015, inviting all HCFs to submit their own self-assessment. The aim was to give a global overview of hand hygiene activities and progress at HCF level. The majority of the over 2100 participating HCFs in 2011 were from developed countries and scored at an intermediate level. Research began to be published showing the upward trend in hand hygiene compliance linked to promotional campaigns [66]. When the global survey was repeated in 2015, the overall score increased significantly ($P < 0.001$) between 2011 and 2015 among HCFs that participated in both surveys [67]. Improvement was seen in HCFs worldwide, particularly in the Eastern Mediterranean, Europe and Western Pacific regions.

Due to the commitment of WHO and the high level of international involvement, hygiene compliance became a key indicator of patient safety and quality of care in health systems worldwide. Today, hand hygiene is not only the responsibility of individual HCWs, but has become an integral part of institutional responsibility and a key indicator of quality in health systems. As of June 2018, more than 21,000 healthcare facilities from 189 countries have registered their commitment to the campaign, supported by WHO's engagement of more than 140 Ministries of Health who signed a pledge to tackle HAIs. In addition, more than 50 individual national/subnational hand hygiene campaigns have been created [62].

The global hand hygiene revolution would not have been possible without a multitude of participating countries, institutions and individuals. To date, over 21,000 HCFs have signed on to the WHO campaign [68]. Organizations, such as CDC and Joint Commission in the USA, the National Health System in the UK, country-specific agencies, as well as infection control, infectious diseases and other specialized professional societies around the world have endorsed the strategy proposed by WHO, and consistently promoted hand hygiene improvement. Individual HCWs as well as IPC professionals and leaders spread awareness, create local hand hygiene improvement strategies, and often publish their work to enhance the body of evidence (see list of countries supporting the global annual campaign and ministries of health that have committed to the WHO pledge) [69]. The group 'Private Organizations for Patient Safety', has actively disseminated WHO hand hygiene campaign messages to HCFs and been proactive in creating and sharing new materials in support of WHO recommendations.

Table I
Themes and calls to action of SAVE LIVES: Clean Your Hands 5th May annual campaign

2009	Worldwide launch of the first annual campaign. The finalized WHO guidelines and associated toolkit are launched online. HCFs are invited to register for the campaign online.
2010	WHO profiled activities of health facilities, countries and regions. HCFs are asked to participate in a Hand Hygiene Moment 1 Global Observation Survey. WHO launched the HHSAF and asked HCFs to register for the first HHSAF global survey.
2011	The campaign calls to action are 'track your progress, plan actions and aim for hand hygiene sustainability'. HCFs are asked to submit their HHSAF results online for the first global report.
2012	WHO asked 'what's your plan?' and launched new template action plans. HCFs were invited to create their own plan based on their results using the HHSAF.
2013	WHO asked HCFs to continue to focus on hand hygiene monitoring and feedback and reminded them that patients have a voice too. WHO launched a summary update on approaches to monitoring and a literature review of automated/electronic systems for hand hygiene monitoring, tips for patients to participate in hand hygiene improvement and tips for implementing a patient participation programme (to add to existing patient engagement resources).
2014	The WHO call to action was to prevent the spread of antimicrobial-resistant germs and two global surveys were announced: a global prevalence survey on MDROs and a point prevalence global survey on use of surgical antibiotic prophylaxis. WHO issued a literature review on MDROs and the relationship with hand hygiene, a range of new posters and information for patients and consumers.
2015	The theme is 'Safety starts here'. The second HHSAF global survey is announced and the first social media messaging associated with the campaign is issued. HCFs are also encouraged to arrange a hand sanitizing relay and to try to break the world record.
2016	The theme is 'See your hands, hand hygiene supports safe surgical care'. A range of new promotional materials was launched with a focus on surgical services.
2017	The theme is 'Fight antibiotic resistance — it's in your hands'. The campaign messages were targeted at a range of key groups who can influence infection prevention and healthcare improvement. The evidence for hand hygiene as the building block for infection prevention and control was issued, as an extract from the new WHO guidelines on the core components for infection prevention and control programmes at the national and acute healthcare facility level.
2018 10th Anniversary	The theme is 'It's in your hands, prevent sepsis in health care'. Critically, alongside the hand hygiene promotional materials, new sepsis resources were launched including an infographic and new WHO factsheet.

HCFs, healthcare facilities; HHSAF, hand hygiene self-assessment framework; MDROs, multi-drug-resistant organisms; WHO, World Health Organization.

In conclusion, this brief overview of key moments and trends in the history of hand hygiene highlights the importance and complexity of a change that seems simple, and is easy to take for granted. The main aim of the collaboration between WHO and HCFs around the world is to lower HAI rates and the spread of antimicrobial resistance through continuous improvement of the quality and efficacy of hand hygiene implementation. There is still much research to be done and many opportunities to better understand HCW behaviour and to increase compliance as well as access to ABHR globally. In the future, research in hand hygiene will need to focus on improving HCW compliance across all staff categories, developing ever better tolerated and highly effective ABHRs, supporting sustained HCW behaviour change and campaign techniques, optimizing compliance monitoring and feedback though automatic systems. In developing countries, research needs to help make local ABHR production a sustainable and replicable model that strengthens communities over the long term.

Note

The authors alone are responsible for the views expressed in this article and they do not necessarily represent the views, decisions or policies of the institutions with which they are affiliated. WHO takes no responsibility for the information provided or the views expressed in this paper.

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Conflict of interest statement

Didier Pittet works with WHO in the context of the WHO initiative 'Private Organizations for Patient Safety — Hand Hygiene'. The aim of this WHO initiative is to harness industry strengths to align and improve implementation of WHO recommendations for hand hygiene in health care in different parts of the world, including in least developed countries. In this instance, companies/industry with a focus on hand hygiene and infection control related advancement have the specific aim of improving access to affordable hand hygiene products as well as through education and research. All listed authors declare no financial support, grants, financial interests or consultancy that could lead to conflicts of interest.

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