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EFFECTIVE CLEANING PRACTICES

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Introduction

Cleaning is a multifaceted process whose effectiveness depends on a wide range of factors. When discussing the effectiveness of cleaning work, cost-efficiency is often highlighted, but it is not the only form of efficiency.

The aim of this report is to shed light on the key elements of efficiency in cleaning services. It is based on the recent research published complemented by project team's knowledge, experience and expertise in the field to provide a comprehensive overview. The objective is to provide as comprehensive an overview as possible of the different dimensions of efficiency and to explore how the utilisation of research evidence can enhance overall performance.

Scientific research on cleaning is conducted particularly in laboratory and hospital settings, where the removal of microbial contamination is essential to prevent the spread of healthcare-associated infections. For that reason, this review likewise places emphasis on studies carried out in hospital environments, although the findings have been considered more broadly to encompass other types of premises.

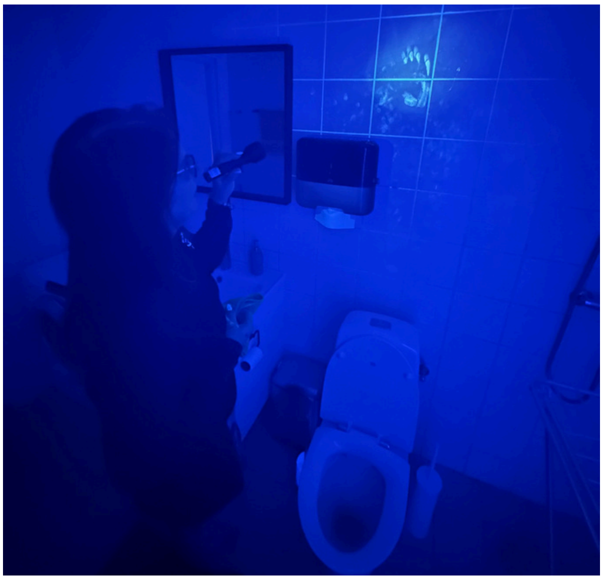
The report draws on selected studies that illuminate different aspects of efficiency. According to the project plan of CleanMind Initiative, the aim was to conduct a thorough analysis of these articles to highlight best practices and evidence-based conclusions and present the findings in a simplified and practical format, making them suitable for use in training materials and instructional guides.

Observations from previous projects

The inspiration for this report arose from the Erasmus+ projects carried out between 2021 and 2024: **PandemicClean – Safe and Effective Cleaning in Pandemic Situations and ErgoClean – Cleaning Ergonomics to Prevent Occupational Diseases and Accidents.**

Pandemic Clean

In the PandemicClean project, a total of 1,010 ATP and microbiological test samples were taken from school classrooms and toilet facilities before and after cleaning.
The tests demonstrated that surface cleaning was not always successful; in some cases, certain surfaces were actually dirtier after cleaning than before. Although the results showed considerable variation, several conclusions could nevertheless be drawn.



- It is important to identify the contact surfaces in each space together with the cleaner so that cleaning can be properly targeted. The touch-surface mapping carried out in the project revealed high ATP levels before cleaning.

- Instead of speaking only about an aseptic order of work, it would be useful to refer to aseptic cleaning more broadly. The principle of working “from clean to dirty” can be difficult to follow, as we do not always know the level of contamination in every space during each cleaning session. Therefore, greater emphasis should be placed on how the work is carried out aseptically. The concept of aseptic cleaning should be clearly defined so that cleaners can apply it in changing situations.

- Achieving microbiological cleanliness is not only about which chemical is used; the overall cleaning method also has a significant impact.

- Cleaning machines should be used for floor cleaning wherever possible, and especially in spaces where the floor is a contact surface.

- Cleaning cloths should be folded to approximately the size of the palm. This makes it easier to apply even pressure to the surface and to ensure that the entire surface is cleaned thoroughly.

- The spread of dirt via cleaning cloths can be reduced by turning a folded microfibre cloth to a clean side after each contact surface.

- Increasing cleaning frequency is not effective if the methods used do not remove dirt efficiently.

- Instructions should emphasise the outcome, for example: “Remove dirt from the door handle by wiping it with a damp microfibre cloth”, rather than simply “Wipe the handle with a damp microfibre cloth.” The result is more important than the method alone.

- The amount of dirt affects the cleaning outcome. A key challenge is that microorganisms are not normally visible. Therefore, it may be useful to measure surface cleanliness from time to time before and after cleaning in order to understand the actual situation.

- Cleaners need feedback on the achieved level of cleanliness in order to learn the most effective methods.

- Sufficient time must be allocated for cleaning surfaces.

- Surface materials and their condition affect how easily dirt and microorganisms can be removed. Worn surfaces may be difficult to clean effectively.

- Deep cleaning is effective, but its impact is short-lived if routine maintenance cleaning continues in the same way as before.

- The motivation and skills of the cleaner are crucial.

ErgoClean

The aim of the ErgoClean project was to identify the 20 most common risk factors in cleaning work and to produce guidance materials to help reduce accidents, occupational diseases, and the physical strain caused by these risks.

Professional cleaning is classified as moderately heavy work. Both statistics and the surveys conducted in the project indicate that musculoskeletal disorders are common in the profession. The project examined the physical workload of cleaning work using smart clothing technology.
Based on the results, 20 instructional videos and guidance materials were produced, emphasising working methods that minimise physical strain as much as possible. However, some level of physical workload cannot always be avoided if the main objective of cleaning work – clean surfaces – is to be achieved.

The materials produced in the ErgoClean project are available at **ergoclean.eu**.

What is cleaning efficiency

When we talk about the efficiency of a cleaning service, we often mention how many square meters are cleaned in a certain time. However, in this case, we are talking about productivity, not efficiency.

When it comes to cleaning services, it is important to distinguish between **productivity** and **efficiency**.

Productivity indicates the number of square meters cleaned or tasks completed in the working time used.

$$\text{Cleaning productivity} = \frac{\text{Output (m2 or pcs)}}{\text{Input (h)}}$$

Efficiency describes the optimisation of work quality and resource use without waste. In cleaning services, this means, for example, the best choices of cleaning chemicals, equipment, and machines, the smoothness of work, and working methods that get surfaces clean in one go.

It can be described by the formula:

$$\text{Cleaning Efficiency} = \frac{\text{Output (Cleaned area x Quality achieved)}}{\text{Input (Resources)}}$$

In cleaning services, inputs are the resources used to achieve output, for example, the use of time, labour, and costs.

So, productivity s a quantitative measure, efficiency reflects the effectiveness of the process and is a key consideration from the ESG standpoint. Productivity is better the larger the area or the more objects are cleaned in a given time. However, high productivity in cleaning services is not efficient if the set level of cleanliness is not achieved. On the other hand, it is not efficient to exceed the set level of cleanliness, because it usually requires more time than designed.
There is no single formula for cleaning efficiency. Efficiency has different dimensions. We can highlight, for example, the efficiency of the use of time, resources or labour, as well as quality and costs.

Table 1. Different dimensions of cleaning efficiency.

Dimension	Example
Time efficiency	Completing tasks faster without compromising quality outcomes.
Resource efficiency	Reducing waste of cleaning agents, water, and electricity.
Labor efficiency	Maximising worker productivity by using ergonomic tools and clear workflows.
Quality efficiency	Ensuring that cleanliness meets hygiene and safety standards on the first attempt.
Cost efficiency	Achieving the same or better results with lower operational costs.

One perspective to look at the efficiency of cleaning work is the key performance indicators (KPIs). **Ginthotavidana and Waidyasekara (2021) identified 46 KPIs for hospital cleaning services that significantly influence service quality, efficiency, and customer satisfaction.** They categorised these indicators into four perspectives: the financial perspective (8 KPIs), the customer perspective (8 KPIs), internal processes (18 KPIs), and learning and growth (12 KPIs). According to their study, the four most important KPIs are as follows: service quality level, efficiency level of housekeeping staff, motivation level of housekeeping staff, and value for money. The article did not include the calculation formulas for these KPIs, but the annex of this report presents common formulas for calculating different KPIs.

The efficiency of a cleaning service can be influenced by improving productivity and delivering the agreed quality with less input. Some key elements of efficiency are discussed below.

Key elements of cleaning efficiency

The foundations of cleaning work efficiency are established during the service process design phase, in which management plays a crucial role. It provides the opportunities and creates the conditions that enable cleaners to use their expertise to deliver the agreed level of quality efficiently.

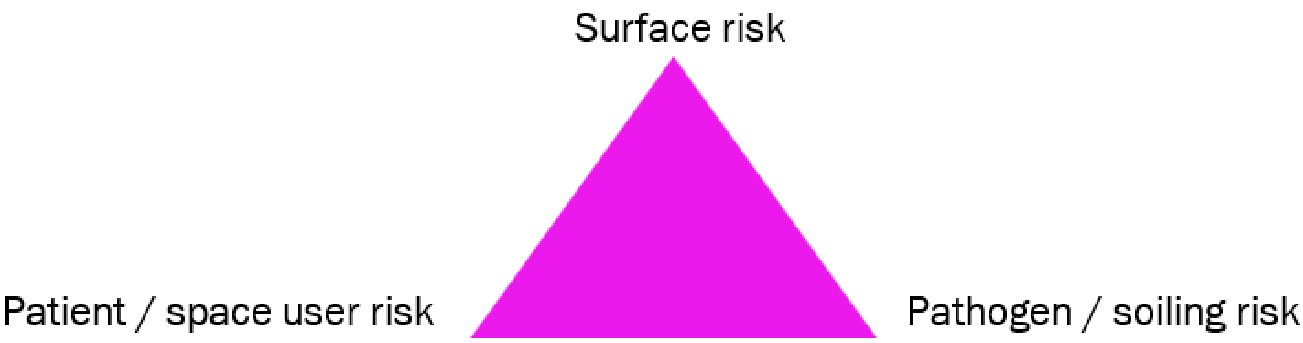
Management

Assadian et al. (2021) state that to enable effective cleaning and disinfection, good management of all personnel-related aspects is extremely important. This includes adequate staffing ratio, remuneration, equipment, training, supervision, and team communication.
Mitchell et al. (2025) point out that the core principles in environmental cleaning process are planning, implementation of a cleaning program, and sustainability (see Figure 1).

Figure 1. Process for efficient cleaning management.

The first step in planning is always a risk assessment. **Assadian et al. (2021) describe the key components of risk assessment in hospital cleaning, but their framework also provides a useful starting point for developing cleaning programmes in other settings.** The risk assessment considers risks related to the patient (user of the space), the surface, and the presence of pathogens (dirt on the surface) (Figure 2).

Figure 2. Elements of risk assessment. Modified from Assadian et al. (2021)



When assessing risks related to space users, factors such as their vulnerability are evaluated. For surfaces, considerations include e.g. how easily they can be cleaned, they durability of cleaning chemicals, and the identification of frequently touched surfaces. Identifying the type and amount of contamination is also crucial. In hospital environments, the persistence, antibiotic resistance and primary mode of transmission of pathogens are crucial.

Planning of cleaning work and program involves choosing the most efficient cleaning tools, machines and chemicals, cleaning schedules, task lists, and division of responsibilities.
Implementation of a cleaning program covers education, training, audits and feedback which are discussed later in this report.
Sustainability means that, regardless of whether cleaning services are provided in-house or outsourced, cleaning is always part of a wider whole that requires recognition from both the employer and the client organisation. Management must also ensure the continuous training of cleaning staff as new professional knowledge becomes available and provide opportunities for career progression.
The supervisors and management of a cleaning service organisation can also have a great influence on the work atmosphere which affects staff attendance and absenteeism, turnover rate, and motivation thus also affecting work efficiency.
Rutala and Weber (2019) summarise the formula for effective practice as follows: Education + time + supervision = improved outcomes.

Cleaning work

The aim of cleaning is to remove dirt from surfaces. The level of cleanliness required depends, among other things, on the type of the space and its users.

Dirt can be divided into different groups, e.g., according to composition, adhesion, and the need for removal. Dirt can be visible or invisible. Removing invisible microbial dirt is challenging, especially if the microbes form biofilms. **The occurrence of biofilms has also been studied on dry surfaces in hospitals. Weber et al. (2023) state in their article that biofilms have been observed on more than 90% of the surfaces studied even after terminal cleaning and that biofilms contain many different microbial species and also multidrug-resistant pathogens.** They emphasise that current surface cleaning methods are inadequate. The key elements of surface cleaning include the cleaning chemicals, tools, machines, working methods and the thoroughness of cleaning work. The result, how well the dirt is removed from the surfaces, depends on the whole: how well the cleaning agents, equipment, and methods have been chosen to suit the type of dirt being removed, and how carefully the work is carried out.

Cleaning chemicals

Cleaning agents are divided into neutral, alkaline and acidic according to pH. Simply put, neutral cleaners are effective in removing water-soluble dirt, alkaline cleaners in removing greasy dirt, and acidic cleaners in removing different kinds of deposits. Different stains require different types of cleaning products, depending on what the stain is made of and what kind of surface it is on.

Cleaning agents or disinfectants can be used to eliminate microbes from surfaces. Cleaning agents detaches the microbes from the surface onto the cleaning tool and thus removes them from the surface. Disinfection kills the microbes on the surfaces. There are several types of disinfectants, and their effectiveness varies against different microbes and spores.

The effectiveness of a cleaning product in use depends not only on its composition but also on correct dosing. Using too much product can make it necessary to rinse the surface to prevent residues from building up. Overdosing also increases costs, places an unnecessary burden on the environment, and may damage surface materials. Using too little product can increase the need for physical effort, which puts extra strain on the worker.

Disinfectants are used to kill microbes on surfaces. They are needed to stop diseases from spreading through surfaces, especially in healthcare settings and during epidemics and pandemics. At these times, careful cleaning of frequently touched surfaces is especially important.

During the COVID-19 pandemic, there was a lot of discussion about how long disinfectants need to stay on a surface to work properly. Instructions often say that disinfectants should be left on for several minutes. These times are based on the EN standard tests according to which the disinfectant has been tested. There are different laboratory tests available for different microbes, and they specify the test procedure including contact time which varies depending on the standard but is usually several minutes. Most tests are based solely on the contact time of the disinfectant; no mechanics is used. In practice it can be difficult that the surface stays wet that time. However, research article by Rutala and Weber (2019) argues that one minute is enough to kill most germs. Studies also found that leaving the disinfectant on for longer did not make it work better. However, it is important to remember that most studies emphasise that the surface should be cleaned before using a disinfectant. Dirt inactivates the disinfectant's ability to kill microbes.

The main function of cleaning agents and disinfectants is to remove dirt and microbes from surfaces. However, there are risks associated with using cleaning and disinfectant products. They can cause harm to human health, environment and surface materials thus causing costs.

According to Salonen et al. (2024) there is a broad consensus that cleaning chemicals are the most common cause of occupational asthma, asthma symptoms, and rhinitis. Frequent, low-level exposure to irritants including chlorine, ammonia, hydrochloric acid, chloramine, and sodium hydroxide can cause symptoms. Also, occupational exposure to quaternary ammonium compounds increases the risk of rhinitis and asthma. Cleaning products in spray form have more harmful health effects than other application types of cleaning agents.

Dhama et. al (2021) highlight the risks of disinfectants which can affect the product user, the environment, and surfaces. Neidhöfer et al. (2023) state that the overuse and improper use of disinfectants favor the development and spread of antimicrobial resistant organisms, which may increase the risk of healthcare-associated infections in the future. So, the need-based use, correct dosing and contact times are very important.

Tsompou and Kocherbitov (2025) state in their article that more than 60% of the surfactants produced globally end up in aquatic ecosystems, where they contaminate water and adversely affect aquatic organisms. For this reason, considerable efforts have been invested in the development of cleaning chemicals with a lower environmental impact.

To reduce health and environmental risks and damage to surface materials, new products have been developed alongside traditional cleaning agents. In this report, we present research results related to purified water and microbial-based products (probiotics).

Purified water is produced from tap water using various filtration methods. In the process salts, minerals, metals, and other impurities are removed from the water.

Tsompou and Kocherbitov (2022) compared the cleaning efficiency of tap water, purified water, ultrapure water, a NaCl solution, and an anionic surfactant solution (sodium dodecyl sulfate, SDS) in removing fatty soil (Vaseline) and oily soil (olive oil). The tests were conducted in a laboratory setting and focused on the effectiveness of the solutions.

The results show that both grades of purified water removed over 90% of the accumulated fatty soil from the surface, whereas tap water removed 75%. The SDS solution removed the deposited layer 100%.

They observed that alternating the use of a detergent solution and purified water on consecutive days may yield better results than using detergent alone.

Jakobsson and Wachtmeister (2024) compared the effectiveness of a mildly alkaline detergent, tap water, ultrapure water and Z-water in removing different types of soil and microbes from four different surface materials. The studies were conducted both in a laboratory setting and in a school environment.

Surface cleanliness was assessed both before and after cleaning using visual inspection, fluorescence measurements, and ATP and microbiological analyses.

The results showed considerable variation, and only a few findings were statistically significant. The researchers concluded that none of the cleaning chemicals could be unequivocally identified as the best option for surface cleaning when used together with a high-quality microfibre cloth. The results for Z-water were somewhat better than those for the other chemicals, which was likely due to its strong alkalinity (pH > 11).

Tsompou and Kocherbitov (2025) investigated, under laboratory conditions, the ability of tap water, purified water, ultrapure water, and a NaCl solution to remove olive oil from hydrophobic and hydrophilic surfaces using different water alkalinity, different salt solutions, multiple washing cycles, and temperatures.

The study demonstrated how challenging it is to remove hydrophobic soils, such as olive oil, from hydrophobic surfaces (e.g. plastic). Without surfactants, multiple cleaning cycles and higher temperatures were required to achieve a clean surface.
When removing oil from a hydrophobic surface, tap water was unexpectedly found to be more effective than purified water, which, according to the study, was due to differences in tap water pH. The cleaning efficiency of purified water improved significantly when its pH was increased to above 10.
The increased alkalinity of the purified water grades not only enhanced their cleaning performance on hydrophobic surfaces but also achieved 100% cleaning efficiency on hydrophilic surfaces.

Microbial-based cleaning products contain live micro-organisms, such as Bacillus spores, and are marketed for their potential to clean surfaces and displace pathogens. In most studies, the focus has been on the ability of these products to inhibit conditions that allow harmful micro-organisms to survive on surfaces.

Neidhöfer et al. (2023) and Fijan et al. (2024) report that studies indicate that the use of microbial-based products can significantly reduce the number of pathogens on surfaces and thereby lower the incidence of healthcare-associated infections. However, further research is needed to confirm the effectiveness of probiotics as a stand-alone cleaning agent in hospital settings. The ability of probiotics to reduce the risk of hospital-acquired infections depends on several factors, including the bacterial strain used, the product dosage and the method of application.

Fijan et al. (2024) also criticise the use of the term "probiotic" in the context of surface cleaning, as by definition probiotics must be administered to humans or animals either orally or applied to the skin. They therefore use the term "microbial-based products" for agents intended for surface cleaning.

Zinn et al. (2025) investigated five "Effective Microorganisms" (EM) preparations – a mixture of lactic acid bacteria, photosynthetic bacteria and yeasts – and evaluated their efficacy by analysing their microbial composition, testing their cleaning performance in accordance with industry standards, and assessing their antimicrobial activity under DIN EN 13697. Co-culture experiments and simulations of repeated application were also conducted.

The results showed that three out of five EM-based cleaning products performed similarly to, or worse than, the reference cleaner. In co-culture experiments, the initial EM concentration was crucial for microbial establishment. Undiluted EM showed limited activity against Staphylococcus aureus, Escherichia coli and Serratia marcescens, but coexisted with Aspergillus brasiliensis without displacing it. No EM growth was detected in the presence of Candida albicans.
Simulated repeated application on soiled surfaces confirmed that EM neither improved nor impaired cleaning efficacy, nor did it lead to persistent microbial colonisation of surfaces.
In summary, the researchers conclude that although EM-based cleaners demonstrated antimicrobial effects under certain conditions, they did not achieve superior cleaning performance or sustained microbial control compared with conventional cleaning formulations.

Falagas et al. (2025) compiled research comparing probiotic-based products with conventional cleaning agents and disinfectants in laboratory and real-world settings.

According to the available evidence, probiotic-based cleaning solutions may be at least as effective as traditional disinfectants and detergents in healthcare environments. In several studies, they reduced surface pathogen levels – particularly Staphylococcus species – sometimes to a greater extent than conventional methods, although the differences were often not statistically significant.
Probiotic products may also inhibit biofilm formation and reduce the abundance of antimicrobial resistance genes.
As can be seen, the research findings are not always consistent. Further studies are needed, particularly in real-world settings. More information is also required on the safe use of these products. As probiotics consist of live micro-organisms, they could theoretically cause opportunistic infections in immunocompromised patients. Further research is also needed to assess the risks associated with inhalation exposure and potential long-term effects.

Tools, machines and cleaning methods

There is little scientific research on the effectiveness and comparison of cleaning equipment, cleaning machines and robots. Efficiency is also challenging to study, especially in real-world settings, as the effectiveness of a tool or method is influenced by multiple factors, as illustrated in Figure 3.

Figure 3. Factors affecting the efficiency of surface wiping to remove microbes

Modified from the article Sattar, S. A. & Maillard, J-Y. 2013. The crucial role of wiping in decontamination of high-touch environmental surfaces: review of current status and directions for the future.

However, there are quite many studies showing that microfibre cleaning cloths and mops have better cleaning performance compared to other fibre materials. A microfibre cleaning tool can reduce the need for chemicals in the cleaning process. Antonsson and Lindskog (2019) compared tap water, ultra-pure water and cleaning solutions in stair cleaning using a microfibre mop. The researchers found that tap water combined with microfibre works well for cleaning stairs. In addition to achieving good cleaning results, tap water is also a good option from environmental, workplace, and cost perspectives.

Voorn et al. (2026) tested the ability of different cloth materials and disinfectants to reduce microbes on a hard, non-porous surface. Four liquid cleaning and disinfecting solutions (hydrogen peroxide, ethoxylated alcohol, quaternary ammonium compounds (Quat and Quat2), and a water control) were tested with three wiping materials: microfiber, polypropylene, and cotton. Hydrogen peroxide wipes showed the best bactericidal effect and transferred the least bacteria between surfaces. Polypropylene wipes performed better than cotton by removing more bacteria and spreading fewer to other areas. Cotton and microfiber wipes with ethoxylated alcohol, Quat, and Quat2 kept viable bacteria on the wipe, which increased cross-contamination.

Maloney et al. (2022) studied the environmental footprint of single-use versus reusable cleaning cloths with three disinfectants containing chlor, isopropyl alcohol or quaternary ammonium compounds (QAC). Isopropyl alcohol had the highest environmental impact among the disinfectants. The most environmentally sustainable option for cleaning clinical surfaces was a microfibre cloth used with a quaternary ammonium compound. This was mainly due to its production and washing processes. However, it may still harm the environment. Microfibre cloths can release small fibres during washing, which may cause plastic pollution and affect aquatic life and human health. The least sustainable option was cotton used with isopropyl alcohol

A good cleaning result requires the use of clean equipment only. Microfibre cloths and mops need machine washing at the temperature recommended by the manufacturer, good drying, handling with clean hands, and hygienic storage, for example in a box with a lid.

Several studies show that both wiping and mopping methods can spread dirt. This can be prevented by taking a new, clean cloth and mop when moving from one room to another, or from one surface to another in high-hygiene areas.

Pre-preparing cleaning cloths and mops in the cleaning room helps ensure good cleaning performance and reduces water use. Cleaning solutions do not need to be transported on cleaning trolleys, and cloths and mops are not rinsed during use; instead, they are sent for washing after being used in each room.

Rutala and Weber (2019) state that if a mop is rinsed in a cleaning solution, the solution should be changed after cleaning 3–4 rooms or at least every hour.

Cleaning machines are generally considered more effective than manual tools. **This is shown, for example, in a study carried out in Sweden (Antonsson 2010), which compared two floor cleaning methods in three different situations:** 1) daily cleaning with a scrubber dryer, a Twister pad and tap water, 2) cleaning with a scrubber dryer, a Twister pad and tap water 1–2 times per week, with dry mopping on other days, and 3) daily dry mopping.

The results were compared with methods using a cleaning solution both in the scrubber dryer and in moist mopping. Dirt removal was measured before and after cleaning using dust measurements (BM Dustdetector), and bacterial reduction was measured using Hygicult TPC, which measures total bacterial count.

When a **scrubber dryer** was used daily with tap water, the floor was on average 35% cleaner and there were 61% fewer bacteria after cleaning. When the floor was cleaned with the machine and tap water 1–2 times per week, the floor was 21% cleaner and there were 80% fewer bacteria after cleaning compared to before.

With **dry mopping or moist mopping** with a cleaning solution, there was no difference in cleanliness or bacterial levels before and after cleaning. After moist mopping, the number of bacteria could even be higher than before the floor was cleaned.

Manual wiping and mopping methods can be classified in different ways according to the amount of cleaning solution used. In the Nordic countries in particular, four methods are recognised: dry, damp, moist, and wet. In some countries, only two methods are distinguished: dry and wet.

The cleaning method is chosen based on the type of dirt and how firmly it is attached to the surface. Technique also plays an important role in surface cleaning. During the COVID-19 pandemic, the rule “one wipe, one direction, one surface” was highlighted in order to prevent the spread of dirt and microbes.

Robots

Cleaning robots have developed rapidly in recent decades, and their use has also increased in professional cleaning. Autonomous floor-cleaning robots vacuum, mop, scrub and sweep surfaces efficiently without human intervention. Cleaning robots are also used to clean stairs, swimming pools, windows, ventilation ducts, and tanks. **Megalingam et al. (2025) note that each environment sets its own technical requirements for robots.** For example, stair cleaning requires 3D environmental perception and balance control, whereas window cleaning in high-rise buildings demands reliable adhesion and safety mechanisms.

There is already some research evidence on the efficiency of robotic cleaning. Megalingam et al. (2025) highlight findings showing that the use of floor-cleaning robots can reduce water consumption by up to 85% compared with traditional scrubber dryers. Robots also save staff working time and therefore reduce labour costs. Studies on cleaning performance indicate that, in test conditions, dust removal efficiency has reached up to 80%, and coverage rates of 95–97% have been achieved through route-planning algorithms.

Butaney et al. (2025) state that AI-based navigation methods reduce robots' unnecessary movement and energy consumption, thereby improving efficiency when cleaning large areas. Robots may also be able to detect soiled areas with up to 90% accuracy, which enhances both productivity and cleaning outcomes. In institutional environments, robots can replace human labour in areas that are hazardous or ergonomically challenging. This may reduce accidents and sickness absence, and consequently lower personnel costs.

The introduction of robots can also be beneficial in situations where there are difficulties in recruiting or retaining cleaning staff.

Thoroughness of cleaning

Especially in hospital environments, studies have examined the cleanliness of frequently touched surfaces. These surfaces are critical to clean because they can spread disease-causing microbes. **Rutala and Weber (2019) state that only about half of frequently touched surfaces are cleaned during routine cleaning when there is no monitoring.**

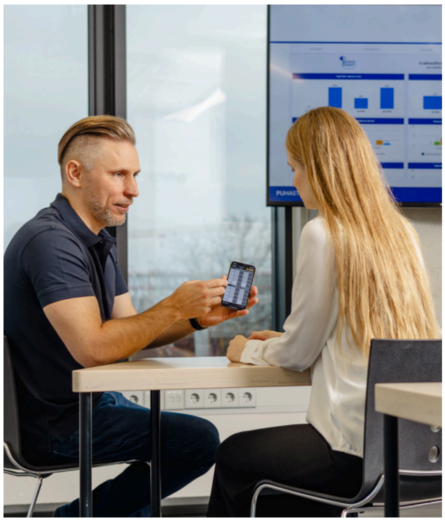
From the perspective of cleaning effectiveness, it is important to identify these touch surfaces. **Assadian et al. (2021) classify cleanable surfaces into low-touch and high-touch surfaces.** Low-touch surfaces include floors, walls and, in hospital settings, surfaces outside the patient area. High-touch surfaces can enable the transmission of infections. Identifying these surfaces is important in all cleaning environments, and they must be cleaned regularly and thoroughly.

Rutala and Weber (2019) argue that poor surface cleanliness after cleaning is more often due to inadequate thoroughness rather than a faulty product or method.

Competence of the cleaner

Mitchell et al. (2025) state that effective, efficient and consistent cleaning requires recognised and valued expertise. Training should not focus solely on the specific skills and competencies needed for individual tasks, such as the use of equipment or the correct dosing of cleaning agents. Neither a single training session is sufficient to ensure sustained competence or long-term adherence to good practice.

To reinforce the skills gained during training, educators should explain the rationale behind the methods used. This approach helps staff understand not only "how" to perform tasks, but also "why" they are carried out in a particular way. Integrating educational elements into training programmes also supports the development of problem-solving and decision-making skills, enabling staff to respond effectively in situations that cannot be simulated in a classroom setting.



In recent years, the benefits of comprehensive training programmes for developing cleaners' competence have been explored. For example, the Researching Effective Approaches to Cleaning in Hospitals (REACH) project included five components: training, technique, product, audit, and communication (Hall et al., 2020).

Training sessions for environmental services teams addressed the impact of environmental cleaning on healthcare-associated infections (HAIs), clarified cleaning roles and responsibilities, and provided instruction on implementing the REACH cleaning bundle.
The technique component emphasised the importance of a clearly defined and consistent cleaning sequence, the daily cleaning of high-risk frequent-touch points (FTPs), and the use of sufficient pressure and appropriate movement during cleaning.

The product component provided guidance on the correct use and application of cleaning agents and disinfectants.

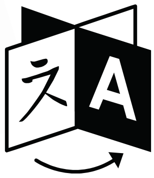
Audit activities were conducted monthly using ultraviolet (UV) fluorescent marker technology. Gel markers, invisible to the naked eye, were applied to selected surfaces and were expected to be completely removed through routine cleaning. After cleaning, the marked areas were checked to determine whether the gel had been removed. Staff received individual feedback on audit results, and summary reports were shared with environmental services teams and hospital clinical governance committees.

The communication component aimed to raise the profile and recognition of environmental services staff and their work. It encouraged daily contact between cleaning staff and ward managers and promoted the inclusion of cleaning staff representatives in relevant clinical governance committees.

The study demonstrated that implementing this multi-modal cleaning bundle not only improved the performance, knowledge and attitudes of environmental services staff, but also had the potential to reduce the presence of clinically significant hospital pathogens. **According to White et al. (2019) the trial generated approximately AUD 147,500 in cost savings from preventing healthcare-associated infections. In addition, infections prevented under the cleaning bundle produced a net monetary benefit of around AUD 1.02 million, showing substantial economic return when health benefits were also considered.**

However, improvements achieved through training initiatives are not necessarily permanent. **Furlan et al. (2019) found that surface cleanliness levels began to decline two months after training. Continuous education and reinforcement are therefore essential.**

Language skills



Cleaning staff can originate from different countries which can cause a communication gap because of missing language skills. Recently, the importance of literacy, numeracy, and communication skills among cleaning staff has been highlighted. Aspire2 Workplace Communication (2024) notes in its white paper that these skills are essential for understanding instructions, reporting and documentation, as well as interacting with clients.

The white paper states that investing in the development of literacy, numeracy, and communication skills delivers tangible benefits. Efficiency increases, as literacy and numeracy skills help employees work more effectively, reduce errors, and improve productivity. Safety is enhanced, as a better understanding of safety guidelines and chemical handling reduces the risk of accidents. Customer relationships improve, as employees who communicate clearly and professionally with clients foster trust and loyalty, potentially increasing client retention. Career progression opportunities are strengthened, as staff with these core skills are better prepared for promotions and professional development, supporting workforce retention and job satisfaction.

Strömmer (2016) studied language learning in cleaning work. The research suggested that cleaning jobs offer only very limited opportunities for language acquisition. A cleaner may be isolated from the work community of their cleaning company and work on the premises of a client organisation, where they are not recognised as a member of the workplace community. One reason for exclusion may also be language proficiency.
Strömmer suggests that, to increase interaction, cleaning supervisors could introduce new employees to clients and highlight their language skills. Working alongside a colleague who speaks the local language could also have enabled the cleaner to take fuller advantage of the second-language learning opportunities available on the job.
Assadian et al. (2021) highlight that training materials and protocols should be adapted to the language and educational level of the staff and should be easy to understand. High-quality training is essential so that cleaners understand the importance of efficient environmental cleaning and work processes. Regular training and monthly face-to-face feedback help ensure that performance is optimised and good performance is maintained.

The importance of feedback

To ensure the effectiveness of cleaning work, feedback is essential. Numerous studies show that providing feedback improves the cleaning performance and the cleanliness of surfaces.

There are several ways to gather information for feedback. Visual inspection of surfaces provides information on the removal of visible dirt but does not reveal invisible contaminants, such as microbes.

- Monitoring of cleaning work shows how thorough the cleaning is, for example whether all high-touch surfaces are cleaned. Fluorescent markers can also be applied to touch surfaces, and after cleaning, the thoroughness can be assessed using ultraviolet (UV) light.
- ATP measurements provide information on the amount of organic matter on surfaces, but do not indicate the level of microbial contamination.

- Microbiological testing measures the actual microbial load on surfaces.
- The choice of measurement method depends on the situation and the type of information required.

Summary

The efficiency of cleaning consists of many factors. The table below gives examples of these factors.

Table 2. Examples how cleaning efficiency can be improved

	Cost efficiency	Time efficiency	Labour efficiency	Resource efficiency	Quality efficiency
Management	A good working atmosphere reduces absenteeism and turnover	The correct cleaning schedule reduces waiting times Knowledge of areas of responsibility reduces wasted working time	Providing continuing education and training	Correct choice of cleaning chemicals, tools and machines reduces waste	Correct choice of cleaning chemicals, tools and machines Staying updated on new cleaning technologies Regular quality assessments and feedback help to align work correctly and improve quality
Cleaning work	Correct dosing of detergents Using tap water when possible Using machines	Correct choice of chemicals Robots Need-based cleaning activities and frequencies	Correct choice and dosing of detergent Invest in ergonomic and high-quality equipment Pre-preparing of cloths and mops improves ergonomics and reduces strain Using robots	Multipurpose chemicals Pre-preparing of cloths and mops gives product and water savings	Correct choice and dosing of cleaning agents Using disinfectants when necessary Machines, robots Microfibre products Correct wiping and mopping techniques Thorough cleaning of contact surfaces
Competence of the cleaner	Better cleaning skills and ergonomics reduce workload and sick leave	Correct choice of methods and better cleaning skills lead to efficiency	Ability to prioritise high-touch and high-traffic zones	Ensures the correct use of cleaning equipment and method knowledge so that dirt is removed with minimum resources	Correct techniques The cleaner knows how to evaluate the quality of her / his own work
Giving feedback	Helps in targeting cleaning work Fewer corrective actions, fewer extra costs	Helps in targeting cleaning work, less unnecessary work	Helps in targeting cleaning work	Ensures the correct use of cleaning equipment and method knowledge	Improves cleaning performance

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EXAMPLES OF KPIs

QUALITY & PERFORMANCE KPIs

1. **Cleaning Quality Score (Audit Score)**

A percentage score showing how well an area meets cleaning standards based on inspections.

$$\text{Quality Score} = \frac{\text{Points Achieved}}{\text{Total Possible Points}} \; x \; 100$$

2. **Defect Rate / Non-Compliance Rate**

Percentage of inspection items that failed to meet standards.

$$\text{Defect Rate} = \frac{\text{Number of Defects}}{\text{Total Items Inspected}} \; x \; 100$$

3. **Reclean Rate**

Percentage of areas that require rework after inspection.

$$\text{Reclean Rate} = \frac{\text{Areas Requiring Reclean}}{\text{Total Areas Inspected}} \; x \; 100$$

4. **Complaint Rate**

Number of customer complaints relative to the size or volume of service. Formula per 1,000 m^2.

$$\text{Complaint Rate} = \frac{\text{Total Complaints}}{\text{Total Area (m2)}} \; x \; 1000$$

PRODUCTIVITY & EFFICIENCY KPIs

5. **Cleaning Time per Square Meter**

Average time required to clean one square meter.

$$\text{Time per m2} = \frac{\text{Total Cleaning Time (minutes)}}{\text{Total Area (m2)}}$$

6. **Output per Cleaner per Hour**

Amount of area cleaned by one cleaner in one hour. Useful for benchmarking teams or sites.

$$\text{Output per Hour} = \frac{\text{Total Area Cleaned}}{\text{Total Labor Hours}}$$

7. **Schedule Adherence**

How consistently tasks are completed on time.

$$\text{Schedule Adherence} = \frac{\text{Tasks Completed On Time}}{\text{Total Scheduled Tasks}} \, x \, 100$$

8. **Equipment Utilization Rate**

Tracks how effectively cleaning machines are used

$$\text{Utilization Rate} = \frac{\text{Actual Machine Use Time}}{\text{Total Available Machine Time}} \, x \, 100$$

WORKFORCE & STAFFING KPIs

9. **Staff Attendance / Absenteeism Rate**

Percentage of scheduled work hours lost due to absence.

$$\text{Absenteeism Rate} = \frac{\text{Absent Hours}}{\text{Scheduled Hours}}\ x\ 100$$

10. **Staff Turnover Rate**

Percentage of employees who leave during a given period. Helps identify retention issues.

$$\text{Turnover Rate} = \frac{\text{Employees Who Left}}{\text{Average Number of Employees}}\ x\ 100$$

11. **Training Completion Rate**

Percentage of employees who have completed required training. Ensures staff are certified and up to standard.

$$\text{Training Completion} = \frac{\text{Employees Trained}}{\text{Total Employees}}\ x\ 100$$

12. **Health & Safety Incidents**

Number of workplace accidents or near misses.

Formula: Often tracked as a simple count per month or per 1,000 hours worked

FINANCIAL KPIs

13. **Cost per Square Meter**

Total cost of cleaning divided by the area cleaned. A core metric for budgeting and pricing.

$$\text{Cost per m2} = \frac{\text{Total Cleaning Cost}}{\text{Total Area (m2)}}$$

14. **Labor Cost Percentage**

Percentage of total cleaning cost that comes from labor.

$$\text{Labor Cost \%} = \frac{\text{Labor Cost}}{\text{Total Cleaning Cost}}\ x\ 100$$

15. **Material & Chemical Cost per Site**

Tracks consumption and waste.

$$\text{Reclean Rate} = \frac{\text{Areas Requiring Reclean}}{\text{Total Areas Inspected}}\ x\ 100$$

16. **Contract Profitability**

Profit margin for a specific cleaning contract. Revenue vs. actual service delivery cost.

$$\text{Complaint Rate} = \frac{\text{Total Complaints}}{\text{Total Area (m2)}}\ x\ 1000$$

SUSTAINABILITY & ENVIRONMENTAL KPIs

17. **Chemical Usage per Square Meter**

Amount of chemicals used relative to area cleaned. Helps reduce environmental impact.

$$\text{Chemical Use per m2} = \frac{\text{Total Chemical Volume}}{\text{Total Area (m2)}}$$

18. **Water Consumption**

Total water used for cleaning operations.

$$\text{Water per m2} = \frac{\text{Total Water Used}}{\text{Total Area (m2)}}$$

19. **Waste Recycling Rate**

Measures how much waste is sorted and recycled.

$$\text{Recycling Rate} = \frac{\text{Recycled Waste}}{\text{Total Waste}} \ x\ 100$$

20. **Energy Use of Cleaning Equipment**

Tracks efficiency of machines.

Formula: $Energy\ Use = kWh\ consumed\ per\ month\ or\ per\ m^2$

CUSTOMER EXPERIENCE KPIs

21. **Customer Satisfaction Score (CSAT)**

Average rating given by customers after service. Often collected via surveys.

$$\text{CSAT} = \frac{\text{Sum of Ratings}}{\text{Number of Responses}}$$

22. **Net Promoter Score (NPS)**

Measures customer loyalty based on likelihood to recommend.

Formula: $NPS = \%\ Promoters - \%\ Detractors$

23. **Response Time to Requests**

Average time taken to respond to customer requests or complaints

$$\text{Response Time} = \frac{\text{Total Time to Respond}}{\text{Number of Requests}}$$

24. **Service Level Agreement (SLA) Compliance**

Percentage of tasks delivered according to contract.

$$\text{SLA Compliance} = \frac{\text{Tasks Meeting SLA}}{\text{Total Tasks}}\ x\ 100$$

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