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Antiseptic and Disinfectant Utilization Patterns at Tlemcen University Hospital Center: A Five-Year Epidemiological Study

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ABSTRACT

Introduction: Disinfectants and antiseptics are integral components of hospital infection control policies; however, their overuse can lead to microbial resistance, a growing concern in healthcare settings. This study aims to analyze the consumption patterns of antiseptics and disinfectants across various departments of Tlemcen University Hospital Center (CHU), providing insights into their usage over a five-year period and helping inform strategies for more responsible use.
Methods: Data on the consumption of Povidone iodine (PVI) and various disinfectants across 20 departments over a five-year period (2015–2019) were obtained from the pharmacy and relevant CHU departments. Statistical analysis was conducted using SPSS version 25. Chi-square tests were employed to compare categorical data, and ANOVA was used to assess trends in consumption over time.
Results: The results revealed a decline in PVI consumption to 13.5% in 2019, while disinfectant use increased by 29.1%, possibly due to a reduction in surgical procedures and an increase in medical admissions. Notably, consumption patterns varied across departments, with surgical services showing higher disinfectant use compared to medical services.
Conclusion: Given the extensive use of antiseptics and disinfectants, we recommend implementing strategies to reduce their overuse, such as periodic audits of antimicrobial consumption and educational programs for healthcare professionals to mitigate the risk of microbial resistance.

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INTRODUCTION

Within the hospital environment, medications, antiseptics, and disinfectants play a vital role in the prevention and treatment of infectious diseases (1). Antiseptics are antimicrobial substances used locally on living tissues such as skin or mucous membranes to destroy or inhibit the reproduction of microorganisms, distinguishing them from disinfectants due to their lower toxicity. Disinfectants, on the other hand, are local antimicrobial agents used on inert or inanimate surfaces, as their application to living tissues can cause irritation and/or toxicity (2). Some antiseptics and disinfectants share common characteristics, such as irritation, contact dermatitis, and urticaria, and they must be carefully used at minimal bactericidal concentrations (3). Currently, Povidone iodine and Chlorhexidine are the most commonly consumed preoperative skin antiseptics (4), while chlorine and polyphenol-based products are the most frequently used hospital disinfectants for surfaces, objects, and skin (5). However, these antimicrobial solutions remain measures employed to reduce microbial contamination in the hospital setting. Inappropriate and irrational use of these agents leads to bacterial resistance, which is a primary cause of healthcare-associated infections, representing a global public health problem and a major concern in healthcare facilities (6).

The use of antiseptics and disinfectants is a challenging target to control in healthcare institutions, often resulting in a lack of precise management. Regulating their appropriate consumption and improving their levels of clinical application can reduce the burden of resistance and the incidence of nosocomial infections. Previous studies on the resistance of pathogenic bacteria to antimicrobials are well-documented; however, comprehensive epidemiological studies assessing the annual consumption of antiseptics and disinfectants in the hospital environment are lacking. In Algeria, specifically at the University Hospital Center of Tlemcen, no similar study has been conducted before. In this regard, our objective is to discuss the use of disinfectants and antiseptics, highlighting the most commonly used ones and the departments with the highest consumption. This provides an overview to inform medical personnel about the need to improve such practices in order to reduce the emergence and spread of resistant bacterial strains. While overuse of antiseptics and disinfectants leads to microbial resistance, it also imposes significant financial burdens on healthcare institutions due to the high costs of purchasing these products. Furthermore, inappropriate use can cause adverse reactions in patients, such as dermatitis, or contribute to the development of environmental contamination. A recent study in Algeria highlighted the rising rates of Pseudomonas aeruginosa resistance in hospital settings, specifically in the Tlemcen region, which underscores the critical need for improved antimicrobial stewardship.

METHODS

Data Collection

This study aims to analysed data on the use of antiseptics and disinfectants in a CHU (University Hospital Center) in Tlemcen, Algeria, with an average capacity of 646 beds over a five-year period from 2015 to 2019. All consumption data of antiseptics and disinfectants were provided by the hospital pharmacy service and relevant departments.

Studied Services

A descriptive cross-sectional survey data on antiseptic and disinfectant consumption were collected across 20 departments at Tlemcen University Hospital Center (CHU) over a five-year period (2015-2019). A summary of the departments surveyed is provided in Table 1.

Table 1. Departments Surveyed for Antiseptic and Disinfectant Consumption at Tlemcen University Hospital Center (2015-2019)

Category	Departments
Surgical Services	General Surgery A, Surgical Block A, General Surgery B, Traumatology Service, Traumatology Block, Ophthalmology, Neurosurgery, Urology
Medical Services	Nephrology, Gastroenterology, Hematology, Pulmonology, Oncology, Cardiology, Neurology, Infectious Diseases, Internal Medicine, Dermatology
Specialized Units	Intensive Care Unit (ICU)

Category	Departments
Emergency Services	Emergency Medical Surgical Services (UMC)

Types of Antiseptics and Disinfectants

The types of antiseptics and disinfectants used were categorized as follows (Table 2):

Table 2. Classification of Antiseptics and Disinfectants Used at Tlemcen University Hospital Center

Category	Description/Examples
Surface Disinfectants	Products used for cleaning hospital surfaces, including bacteranios, surfanios, and detergent disinfectants for high surfaces (DDSH).
Medical Instrument Disinfectants	Used for sterilizing surgical instruments, such as steranios, hexanios, alkaline detergent for surgical instrumentation, rinsing neutralizer for instrumentation with alkaline products (RN), and oxy-aniolysis (disinfectant for hemodialysis machines).
Surface/Instrument Disinfectants	Products used on both surfaces and instruments, such as Anios Special.
Hydro-alcoholic Solutions for Hands	Alcohol-based hand hygiene products like Manugel.
Mild Soap	Basic cleaning agents.
Representative Antimicrobial Substances	Includes hydrogen peroxide, 90% alcohol, 10% Povidone-iodine (PVI - Betadine), and other substances like didecyldimethylammonium chloride, alkylbenzyldimethylammonium chloride, polyhexamethylene biguanide chloride, 2% glutaraldehyde, and N-(3-aminopropyl)-N-dodecylpropane-1,3-diamine.

Data Processing

Data were processed using SPSS version 25 for statistical analysis, including chi-square and ANOVA tests, with a significance level set at 0.05.

RESULTS

Consumption Units for Antiseptics and Disinfectants

The consumption of antiseptics and disinfectants was measured in standard units, as reported by the CHU. For Povidone iodine (PVI), the unit of consumption was a 125 ml bottle (1 antiseptic unit = 125 ml), while disinfectants were measured in 5-liter containers. An exception was made for high-surface disinfectant detergent, where the unit of measurement was 750 ml.

Use of Antiseptics in the Studied Departments

Iodine derivatives, particularly Povidone iodine (PVI), accounted for a significant portion of antiseptic use. Consumption trends show an initial increase in PVI use during the first three years (2015-2016), peaking in 2017 at 23.6% of total consumption. However, there was a notable decline in the following two years, dropping to 13.5% by 2019 (Figure 1).

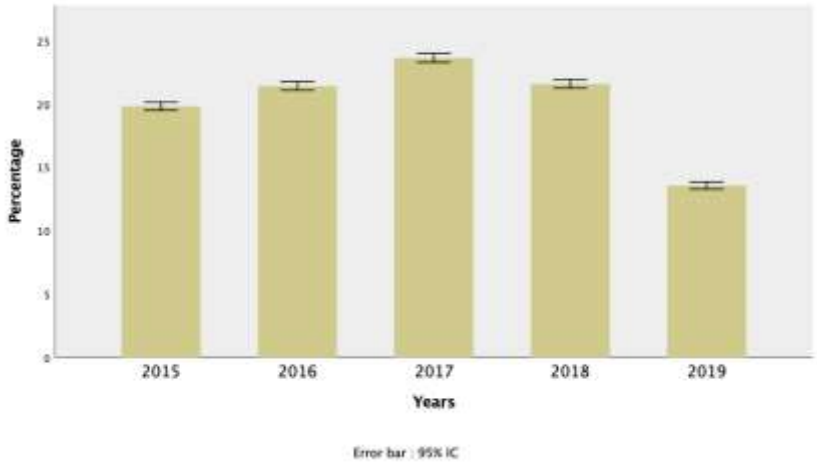

Figure 1. Use of Povidone iodine from 2015 to 2019 in various studied departments.

Surgical services were the highest consumers of PVI, with 41.1% of the total PVI used across all departments over five years. Consumption remained steady at 38.6% in 2015 and 2018, with an average rate of 42.7% in other years. UMC also showed high consumption rates in 2015 and 2018 (38.9%), but this decreased in 2019 to 33.2%. The consistent use in medical services (16.8%) and the relatively low consumption in the ICU (5.7%) suggest different departmental needs and practices. Interestingly, the ICU experienced a slight increase in PVI use in 2019, reaching 7.7% (Figure 2).

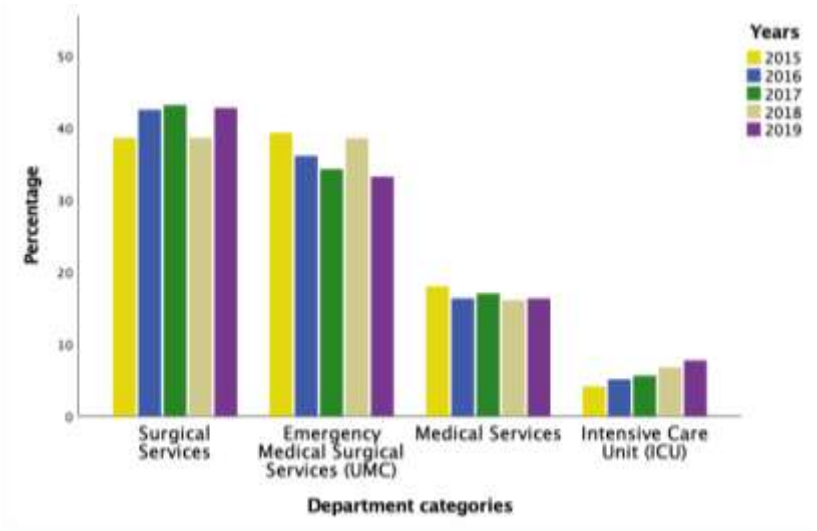

Figure 2. Use of Povidone iodine by department categories and year.

The chi-square test confirmed significant differences ($p < 0.05$) in PVI use across the five years, indicating that the observed fluctuations are statistically significant. The strong relationship between PVI consumption and department categories ($C = 0.72$, $0.5 < C < 0.8$, $p = 0.000$) suggests that variations in departmental practices and patient volume could have influenced usage patterns. For instance, increased surgeries or procedural changes in certain departments, such as surgical services, may have contributed to the observed trends.

Use of Disinfectants in the Studied Departments

In 2019, overall disinfectant consumption across all departments reached a peak of 29.1%, as shown in Figure 3. Disinfectants for medical instruments, mild soaps, and hydro-alcoholic solutions were used extensively during the

first three years, with consumption rates reaching 24%, 22.5%, and 24.3%, respectively, in 2017. These percentages increased by 2019, with disinfectants for medical instruments increasing to 37.4%, mild soaps reaching 23.6%, and hydro-alcoholic solutions growing to 26.4%. Notably, 2018 saw a decrease in the use of these products.

Changes in disinfectant consumption, especially the significant rise in 2019, could be attributed to several factors. Hospital policy changes, such as increased infection prevention protocols or response to emerging infections, could have led to more frequent use of disinfectants. External factors, including budget allocations or availability of specific disinfectant brands, may have also played a role in the observed changes. The three and a half times increase in the consumption of disinfectants for medical instruments in 2019 compared to 2015 suggests that a specific focus on sterilization and infection control may have driven this rise. Similarly, the doubling of surface disinfectant consumption from 12.4% in 2015 to 27.2% in 2019 could reflect a heightened awareness of surface contamination or shifts in hospital procedures.

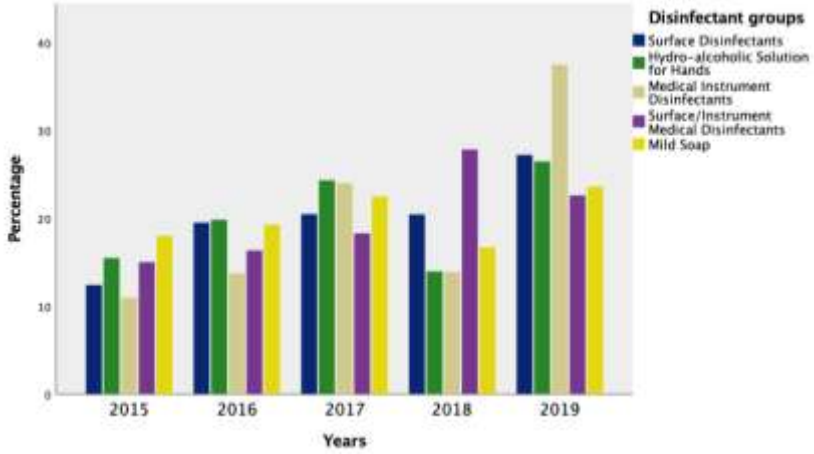

Figure 3. Use of disinfectants from 2015 to 2019 in various studied departments.

Use of Disinfectant Groups for Each Department Category

Medical Services:

In medical services, the highest consumption of disinfectants occurred in 2019, at 30.7%. This increase was particularly marked in the use of disinfectants for medical instruments, which saw a dramatic rise in 2017 (26.9%), four times higher than in 2015 (5.8%). Such trends may reflect an intensified focus on instrument decontamination protocols, potentially in response to new infection control guidelines or hospital-acquired infection (HAI) prevention strategies. Consumption of surface disinfectants and mild soap remained relatively stable, indicating more consistent practices, but the noticeable increase in hydro-alcoholic solutions in 2019, reaching 26.1%, may reflect growing concerns over hand hygiene and infection control (Figure 4).

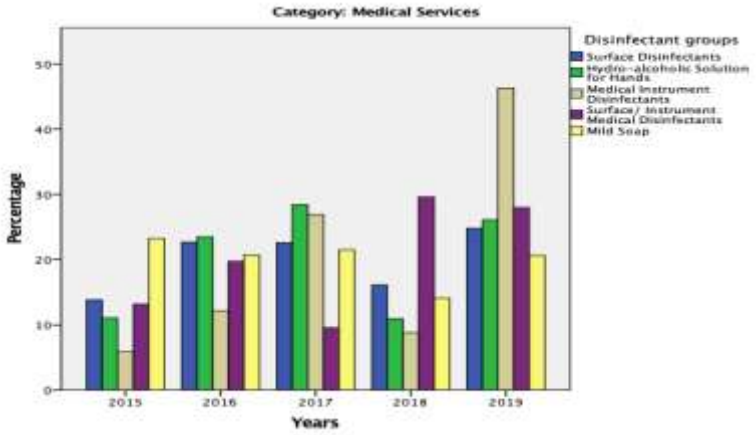

Figure 4. Use of disinfectant groups over five years-medical services.

Surgical Services

Surgical services recorded the highest disinfectant consumption in 2019 (27.9%). Medical instrument disinfectants increased steadily, with a significant rise in 2019 to 32.5%, twice as much as in 2015 (14.9%) and 2016 (13.9%). This increase might be attributed to heightened sterilization protocols in response to patient safety concerns. The rising trend in surface disinfectant use, from 11.2% in 2015 to 26% in 2019, and mild soap consumption, which doubled in 2019, also suggests that there may have been an institutional focus on reducing cross-contamination and improving infection control measures. (Figure 5).

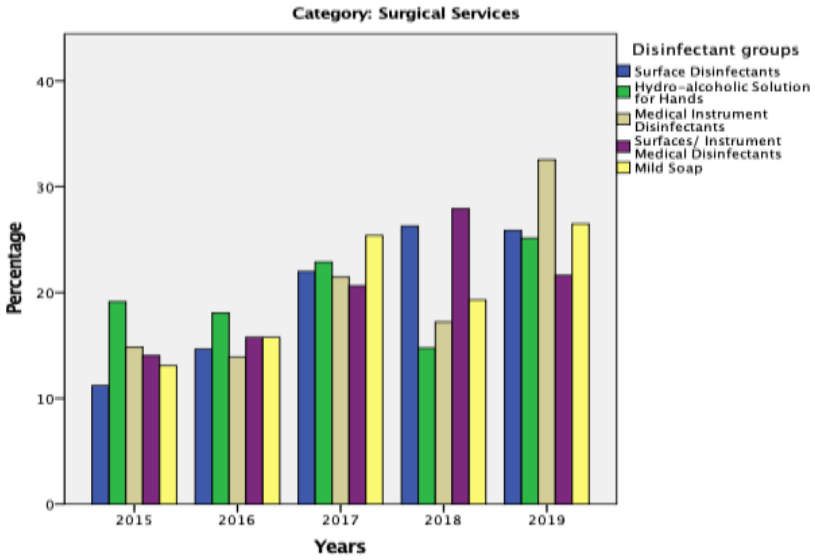

Figure 5. Use of disinfectant groups over five years-surgical services

Emergency Medical-Surgical Services (UMC)

UMC experienced the highest disinfectant consumption in 2019 (30.5%). Notably, the use of surface disinfectants surged from 20.8% in 2017 to 44.6% in 2019, likely due to changes in cleaning protocols and an increase in the variety of disinfectants used. The significant rise in hydro-alcoholic solution consumption (33.9% in 2019) could reflect efforts to improve hand hygiene practices within this high-risk department (Figure 6).

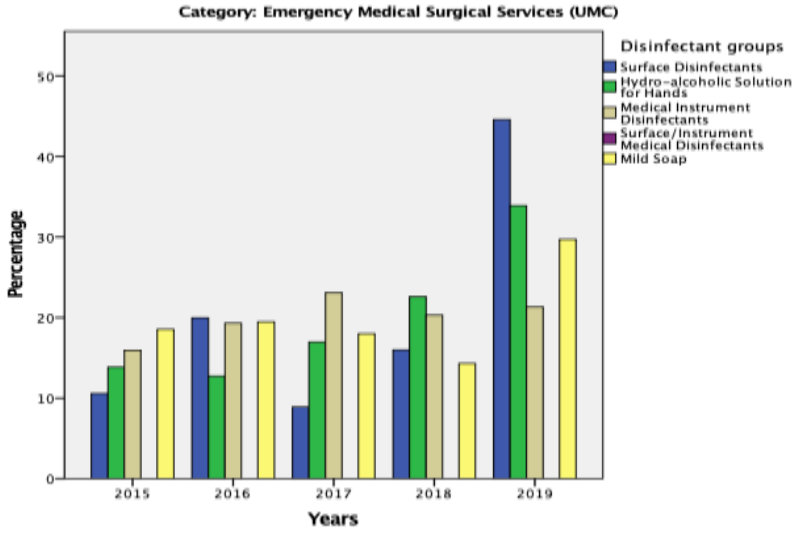

Figure 6. Use of disinfectant groups over five years – UMC.

Intensive Care Unit (ICU)

The ICU exhibited unique patterns in disinfectant use. Mild soap consumption increased from 2015 to 2017 (24.8%), then declined in 2018 and 2019. Surface disinfectant consumption peaked in 2018 at 34.2%, likely reflecting the department's focus on controlling infection through frequent surface cleaning and sterilization. The increased use of hydro-alcoholic solutions in 2019 suggests an institutional emphasis on hand hygiene and infection prevention in this critical-care setting (Figure 7).

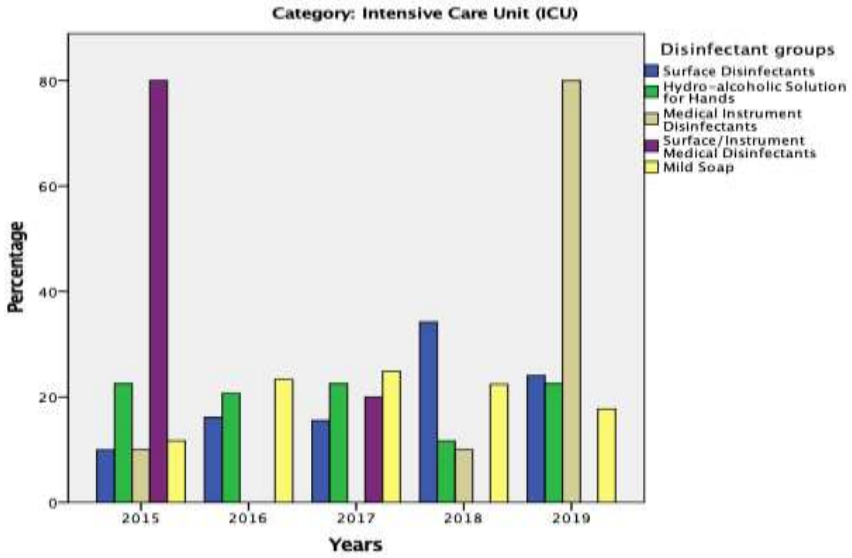

Figure 7. Use of disinfectant groups over five years – ICU.

The chi-square tests confirmed significant differences ($p < 0.05$) for all departments, suggesting that departmental practices, patient care protocols, and possibly external factors (such as availability and cost of disinfectants) influenced usage trends. The contingency coefficient analysis further revealed a weak to moderate relationship between disinfectant consumption and departmental categories, with UMC ($C = 0.22$), medical services ($C = 0.30$), and the ICU ($C = 0.37$) showing moderate relationships, while surgical departments had a weak relationship ($C = 0.14$).

DISCUSSION

Despite the widespread and uncontrolled use of antimicrobials in our hospitals, an epidemiological investigation into the consumption of antiseptic and disinfectant products has been conducted for the first time in Algeria. This study took place at the University Hospital Center (CHU) of Tlemcen in western Algeria and focused on analysing the annual usage of these products from 2015 to 2019 (considering the COVID-19 context).

The most commonly used preoperative skin antiseptic at CHU Tlemcen is Povidone Iodine (PVI), renowned for its short-acting, broad-spectrum bactericidal effects, including sporicidal, fungicidal, and virucidal properties. These attributes offer significant advantages over other antiseptics (9). PVI is applied to wounds and for the preparation of skin and mucous membranes before surgical procedures. At CHU, the standard practice involves using 10% PVI for clean, contaminated, and infected wounds (10). In 2017, the total PVI consumption across all departments was 23.6% (1,691 liters/year), which dropped to 13.5% (970 liters/year) by 2019. This decline could be attributed to shortages, reduced departmental demand, or imposed restrictions.

Both PVI and Chlorhexidine Gluconate (CHG) have been widely used for infection prevention for over six decades (11). Several studies recommend CHG as a more effective preoperative skin antiseptic than PVI [4,12-14]. However, PVI is used as an alternative in cases of CHG allergies (15). Notably, CHG remains inaccessible at CHU Tlemcen.

From 2015 to 2019, a total of 7,157 liters of PVI were used at CHU, averaging 1,431 liters/year—significantly lower than the average consumption of 2,556 liters/year in a typical Japanese hospital (16). Among the departments, the UMC consumed the highest quantity, with 2,608 liters over five years (36.4% of the total). The eight surgical departments collectively accounted for 41.1% (2,938 liters), or 367 liters per department, as PVI is heavily used for surgical preparations, including patient skin antisepsis, healthcare personnel handwashing, and disinfecting healthy skin before invasive procedures (2,14,17).

Comparatively, a 2006 study in Japan by Shiraishi et al. [18] showed PVI was predominantly used for surgical handwashing in most hospitals. Similarly, a 2006 study in Iran by Bahar et al. (19) found PVI reduced 96.58% of microorganisms, including staphylococci, streptococci, and E. coli, during surgical handwashing. Additionally, PVI serves as the prophylactic agent for elective eye surgeries at concentrations of 5-10% (20). In Morocco, Akrim et al. reported in 2018 that PVI was the primary antiseptic used in operating rooms (100%) and the ICU (40%) (21). In this study, the ICU at CHU consumed 411 liters of PVI over five years, primarily for peripheral intravenous catheter site disinfection, oral care for intubated patients, and daily baths for ICU patients (17).

Medical departments at CHU recorded low PVI consumption (16.8%; 1,200 liters, or 120 liters per department), likely due to the absence of operating rooms. PVI was mainly used for wound care and aseptic procedures such as medical device placements, including cardiac implantable electronic devices and central venous catheters (12,16,17,23). Similarly, in Korea, Park et al. (10) demonstrated that 10% PVI and alcohol were commonly used for skin preparation before intravenous catheterization.

While antibiotics are crucial during the perioperative period, prioritizing appropriate antiseptic usage is essential (16). Antiseptics are generally better tolerated and less likely to induce bacterial resistance than antibiotics (24). At CHU, PVI consumption varied significantly by year and department, as confirmed by chi-square analysis (P=0.000). Antiseptics and disinfectants play a vital role in healthcare settings to prevent the cross-transmission of pathogens (3). Common reservoirs of pathogens include healthcare personnel hands, hospital equipment, and contaminated surfaces (5,7). Effective hygiene measures are necessary to disinfect these areas and reduce the spread of pathogens (3).

Between 2015 and 2019, CHU Tlemcen used 131,023 liters of disinfectants across all departments. The year 2019 recorded the highest consumption (38,239 liters; 29.1%), while 2015 recorded the lowest (18,200 liters), likely due to fewer hospitalizations or budget constraints. Disinfectants for medical instruments (45,825 liters; 34.9%) and mild soap (42,870 liters; 32.7%) were the most used, followed by surface disinfectants (22,013 liters; 16.8%), alcohol-based hand sanitizers (13,120 liters; 10.01%), and surface/instrument disinfectants (7,195 liters; 5.4%).

Medical instruments are categorized as critical, semi-critical, or non-critical based on their risk of pathogen transmission (6). Disinfectants for medical instruments, such as Steranios (2%), were widely used at CHU due to their efficacy against bacteria, spores, fungi, and viruses (15,26). These disinfectants are essential for maintaining the hygiene of heat-sensitive medical devices used in surgeries and emergencies. However, long-term use of certain disinfectants, such as those containing quaternary ammonium compounds or glutaraldehyde, may promote bacterial resistance, as demonstrated in studies by Cowley et al. (25), Jaouhar et al. (27), and San et al (7).

Alternating disinfectants and preparing solutions frequently are crucial steps to maintaining their effectiveness and preventing resistance (7,28). Additionally, disinfectants such as Surfanios (used for floor cleaning) and sodium hypochlorite are effective against microorganisms and widely recommended for routine cleaning (17,29,36). CHU showed consistent efforts in surface disinfection, although consumption varied between departments (Table 3).

Hand hygiene, critical in reducing hospital-acquired infections, was relatively underutilized at CHU, with hydro-alcoholic solution consumption being notably low in medical and surgical services. While UMC personnel demonstrated higher usage due to frequent patient contact, the ICU and surgical services recorded inadequate consumption levels, raising concerns about infection prevention protocols. Similar observations applied to mild soap consumption, despite its longstanding recommendation for handwashing in healthcare (37).

Surgical site infections contribute to a 3% mortality rate, underscoring the importance of proper surgical handwashing (19). Studies highlight that combining alcohol-based hand disinfection with appropriate antiseptic use provides optimal protection against nosocomial infections (15,19). Therefore, CHU Tlemcen must address gaps in antiseptic and disinfectant utilization to improve infection control and patient safety.

Table 3. Use of the studied disinfectants over the five years of the study.

Disinfectant Groups	Types of Disinfectants	2015	2016	2017	2018	2019	Total
Hand Soaps	Regular Hand Soap	1543 18,0%	1651 19,3%	1928 22,5%	1430 16,7%	2022 23,6%	8574 100%
Hand Sanitizers	Hand Sanitizing Solution	00,0%	161 8,9%	638 35,1%	346 19,0%	674 37,1%	1819 100%
	Manugel Hand Sanitizer	406 50,4%	359 44,6%	0 0,0%	20 2,5%	20 2,5%	805 100%
Medical Instrument Disinfectants	Pre-Disinfectant for Instruments	00,0%	608 18,7%	876 27,0%	679 20,9%	1087 33,4%	3250 100%
	Hexanios	533 97,3%	15 2,7%	00,0%	00,0%	00,0%	548 100%
	High-Level Disinfectant for Devices	00,0%	267 7,0%	1264 33,3%	334 8,8%	1928 50,8%	3793 100%
	Steranios	473 70,8%	195 29,2%	00,0%	00,0%	00,0%	668 100%
	Alkaline Detergent for Surgical Instruments	0,0%	00,0%	00,0%	00,0%	183 100%	183 100%
	Neutralizing Rinse for Alkaline Instrumentation Products	00,0%	00,0%	00,0%	00,0%	184 100%	184 100%
	Hemodialysis Generator Disinfectant	00,0%	175 32,5%	57 10,6%	257 47,7%	50 9,3%	539 100%
Surface Disinfectants	Detergent Disinfectant for Floors and Surfaces	0 0,0%	115 78,8%	20 13,7%	53,4	64,1%	146 100%
	Surfanios	393 86,8%	60 13,2%	00,0%	00,0%	00,0%	453 100%
	Detergent Disinfectant for High Surfaces	507 15,1%	596 17,8%	717 21,4%	706 21,1%	825 24,6%	3351 100%
	Floor Disinfectant	00,0%	643 19,5%	747 22,6%	770 23,3%	1141 34,6%	3301 100%
Surface/Instrument Medical Disinfectants	Anios Special	216 26,4%	235 28,7%	263 32,1%	95 11,6%	10 1,2%	819 100%
	Daily Airway Disinfectant	00,0%	00,0%	00,0%	305 49,2%	315 50,8%	620 100%

CONCLUSION

In conclusion, our study underscores the urgent need to address the overuse of antimicrobial agents and disinfectants at CHU Tlemcen. While the general call to reduce antimicrobial usage is valid, actionable steps are required to implement meaningful change. We recommend the following strategies for hospital administrators and healthcare professionals to mitigate the impact of excessive antimicrobial use:

Implementing Regular Audits: Conduct frequent audits of antimicrobial use across various departments to ensure adherence to best practices and identify areas of overuse. These audits will provide a data-driven approach to managing antimicrobial consumption.

Strengthening Antimicrobial Stewardship Programs: Establish or enhance an antimicrobial stewardship program to oversee the appropriate prescription and use of antimicrobial agents. This should include educational initiatives to ensure staff are aware of the latest guidelines and the risks of overuse.

Targeted Disinfectant Protocols: Review and revise disinfectant use policies to ensure they align with infection control guidelines, promoting more judicious use of chemicals such as PVI. The use of alternative, less harmful disinfectants could be explored in consultation with infection control experts.

Ongoing Education and Training: Continuous education for healthcare staff on antimicrobial resistance and the importance of rational disinfectant use is critical. Regular training sessions, workshops, and updated guidelines should be incorporated into hospital practices to reinforce the importance of these efforts.

Furthermore, we stress the need for ongoing monitoring of antimicrobial resistance trends at CHU Tlemcen. Continuous surveillance will allow for early identification of emerging resistance patterns, facilitating timely interventions. The integration of a comprehensive monitoring system is essential for ensuring that antimicrobial stewardship remains effective over time. By adopting these strategies, CHU Tlemcen can contribute to global efforts to combat antimicrobial resistance, safeguard patient health, and improve infection control practices in the hospital setting.

AUTHOR'S CONTRIBUTION STATEMENT

All authors contributed equally to this work.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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