



Research Article

Evaluation and Challenges on the Hygiene Quality of Environmental Surfaces and Staff Hands in Elderly Care Institutions in Guangxi, 2024

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Abstract

The environmental quality of elderly care institutions is directly associated with the health of their residents. The elders are particularly vulnerable to environmental risk factors. However, deficiencies in environmental disinfection are common across many elder care institutions. Targeted research on the environmental quality of these facilities is of substantial practical significance for the protection of the health of elderly residents. In this study, 37 elderly care institutions across Guangxi were surveyed between August and December 2024. Frequently touched environmental surfaces and staff hands were sampled, and the total number of aerobic colony-forming units (CFU) were determined. The total number of aerobic colony count on each sample ≤ 10 CFU/cm² is defined as qualified. A total of 1312 samples were collected. The overall qualification rate of the samples was 60.44%, with a qualification rate of 66.70% for environmental surfaces and 40.63% for staff hands. The qualification rate of tables and chairs (46.04%) and public activity utensils (48.31%) in public activity areas were relatively low. The qualification rate of total aerobic colonies on nurses' hands was the highest at 77.14%, while the qualification rates on the hands of cleaning staff and cooks were lower, at 30.95% and 7.84% respectively. The hygiene quality of environmental surfaces and staff hands in the surveyed elderly care institutions is substandard. Measures should be introduced to standardize the management and improve the hygiene quality of elderly care institutions.

Keywords

Elderly Care Institutions, Disinfection, Quality, Investigation, Monitoring, Environmental Surfaces, Staff Hands

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1. Introduction

According to the National Bureau of Statistics of China, the population aged 60 and above accounted for 22% of the national total in 2024 [1]. The continuous expansion of China's elderly population, coupled with rising living standards, has generated an increasing demand for high-quality elderly care services. This demographic shift has concomitantly given rise to a range of economic, medical, and nursing challenges [2]. Consequently, elderly care has become a pressing concern demanding urgent attention from the government, families, and all sectors of society [3]. Currently, the majority of older adults receive home-based care, while a proportion opt for community-based or institutional arrangements.

Access to medical services has been identified as a pivotal determinant shaping older adults' care decision-making. As home-based care proves increasingly inadequate in meeting the complex medical and nursing needs of the aging population, a growing proportion of older adults are transitioning to community-based integrated care models [4]. These models are designed to deliver individualized professional support, contingent upon the specific health status and functional capacity of older adult [5].

The environmental hygiene of elderly care institutions constitutes a critical determinant of resident health. Owing to immuno-senescence and age-related decline in physiological resilience, older adults are disproportionately susceptible to environmental risk factors [6, 7], including microbial contamination, poor indoor air quality, and inadequate sanitation [2]. However, deficiencies in environmental disinfection and routine health management remain prevalent across many facilities. Consistent with this concern, the relevant literature indicates that the overall pass rate of environmental and facility hygiene sampling in Chinese elderly care institutions is generally low [8-10]. Substandard infection control protocols, irregular hygiene monitoring, and insufficient ventilation are commonly observed problems. These deficiencies heighten the risk of respiratory infections, dermatological conditions, and other environment-related morbidities among residents. Given the direct impact of institutional hygiene on resident health outcomes, targeted research is urgently warranted to establish evidence-based environmental quality standards specific to geriatric care settings. Such inquiry carries considerable practical significance- not only for mitigating preventable health risks and informing regulatory frameworks, but ultimately also for safeguarding the well-being of the institutionalized elderly population.

The present study aims to analyze the disinfection quality of selected elderly care institutions in Guangxi, thereby providing insights into the health management practices in elderly care institutions.

2. Methods

The evaluation was a part of administrative surveillance

programme. A total of 37 elderly care institutions across 4 prefecture-level cities in Guangxi were monitored between August and December 2024. Classified by institution type, the 37 elderly care institutions were as follows: 11 were institutional elderly care facilities (29.73%), 14 were integrated medical and elderly care institutions (37.84%), 1 was a community-based elderly care facility (2.70%), and 11 were private non-enterprise units (29.73%). Samples were collected from frequently touched surfaces and staff hands, and transferred for laboratory testing within 4h at room temperature. Each institution was surveyed once in the morning after cleaning and disinfection, and before working.

2.1. Ethics Approval

Ethical review was not required for this study according to the Ethics Committee of the Guangxi Center for Disease Control and Prevention. This study was conducted as part of the routine hygiene surveillance programme mandated by public health administrative authorities. It involved non-invasive sampling techniques, the use of anonymized data, and no experimental intervention or collection of identifiable participant information. All participants were informed of the sampling procedure and the purpose, and verbal consent for cooperation was obtained prior to the commencement of sampling.

2.2. Sampling and Detection of Environmental Surfaces

Following routine cleaning and disinfection procedures in the elderly care institutions, on-site environmental surface sampling was conducted. Samples were collected from a range of high-touch surfaces including handrails, desks and chairs in public activity areas, public activity utensils, door handles, public goods (appliances), and other high-touch surfaces such as elevators and faucets.

A sterile 5 cm × 5 cm sampling template was placed on the target surface. A cotton swab moistened with sterile sampling solution containing neutralizers (phosphate buffer solution with 0.5% Tween 80+0.2% sodium thiosulfate+0.1% lecithin) was then rubbed horizontally and vertically 8 times within the template area. The shaft of the swab that had come into contact with the operator's hand was snapped off, and the swab tip was placed into a 10 mL test tube containing sampling solution. The sampling tube was vortexed for 20s using a vortex mixer. Subsequently, 1.0 mL of the eluted sample was transferred into a sterile petri dish in two duplicates, mixed with normal nutrient agar, and incubated at 36 °C for 48 h. The total number of aerobic colony counts was then counted and calculated as CFU/cm²: average CFU in 2 plates × 10/sampling size.

2.3. Sampling and Detection of Staff Hands

Hygiene samples of staff hands were collected from doctors, nurses, nursing staff/care workers, cleaning staff and cooks, at the time hands washed or completed hand hygiene and were dry. The 5 fingers of the participant being sampled were held together, and a cotton swab soaked in sterile sampling solution containing neutralizers (phosphate buffer solution with 0.5% Tween 80+0.2% sodium thiosulfate+0.1% lecithin) was wiped twice from the base to the tip of the finger along the flexor surface of two fingers. The sampling surface of each hand fingers was defined approximately 30 cm². Then placed the tube directly into a test tube containing 10 mL of sampling solution. The laboratory testing methods and procedures were consistent with those applied in environmental surfaces. The total number of aerobic colony counts was calculated as CFU/cm²: average CFU in 2 plates ×10/60 cm².

2.4. Benchmark

The program was conducted according to the Disinfection

Monitoring and Evaluation Work Programme (2024). The benchmark is referred to Hygienic Standard of Hospital Disinfection (GB 15982-2012) [11], Hygienic Standard for Disinfection in Elderly Care Institutions (DB61/T 1846-2024) [12], and Hygienic Management Standard for Elderly Care Institutions (DB12/T 1334-2024) [13], the benchmark for the total number of aerobic colonies on the surfaces of each environmental surfaces and staff hands is ≤ 10 CFU/cm².

3. Results

A total of 1312 samples were collected from 37 elderly care institutions, including 997 from environmental surfaces and 315 from staff hands (Table 1). The overall qualification rate of all samples was 60.44% (793/1312). Specifically, the qualification rate for environmental surfaces was 66.70% (665/997), while the qualification rate for staff hands was 40.63% (128/315) (Table 2).

Table 1. Sample distribution.

Items	Guilin	Beihai	Baise	Qinzhou	Total
Environmental surfaces	302	90	305	300	997
Staff Hands	94	30	89	102	315
Total	396	120	394	402	1312

Table 2. Qualification rates of environmental surfaces and staff hands.

Items	Total samples	Qualified samples	Qualification rate (%)
Environmental surfaces	997	665	66.70
Corridor or staircase handrails	293	189	64.51
Desks and chairs in public areas	202	93	46.04
Public activity utensils	178	86	48.31
Door handles	148	140	94.59
Desks and chairs in separate rooms	130	122	93.85
Public goods (appliances)	30	21	70.00
Others (elevators, faucets, etc.)	16	14	87.50
Staff Hands	315	128	40.63
Doctors	12	7	58.33
Nurses	35	27	77.14
Nursing staff / care workers	141	62	43.97
Cleaning staff	42	13	30.95
Cooks	51	4	7.84

Items	Total samples	Qualified samples	Qualification rate (%)
Others (management, teachers, etc.)	34	15	44.12
Total	1312	793	60.44

Table 3. Distribution of the total number of aerobic colony counts.

Rang of colonies (CFU/cm ²)	Environmental surfaces (n=997)		Hands (n=315)	
	Samples	Proportion (%)	Samples	Proportion (%)
≤10	665	66.70	128	40.63
11-100	197	19.76	99	31.43
≥101	135	13.54	88	27.94

3.1. Environmental Surfaces

Ranked from highest to lowest, the qualification rates of environmental surfaces were as follows: door handles (94.59%), desks and chairs in separate rooms (93.85%), other sites (elevators, faucets, etc.) (87.50%), public goods (appliances) (70.00%), corridor or staircase handrails (64.51%), public activity utensils (48.31%), and desks and chairs in public areas (46.04%). Overall, the qualification rate of door handles, and desks and chairs in separate rooms was relatively high, while desks and chairs in public activity areas and public activity utensils accounted for relatively low qualification rates.

The total number of colony counts ranged from 0 to 5.96 × 10³ CFU/cm², with a median and inter-quartile range(P25, P75)2.0(0.3, 25.0)CFU/cm². Among the 997 samples, 66.70% yielded a total colony count ≤ 10 CFU/cm², 19.76% presented a colony count in the range of 11 CFU/cm² to 100 CFU/cm², and 13.54% exhibited a total colony count ≥ 101 CFU/cm² (Table 3).

3.2. Staff Hands

Arranged from highest to lowest, the qualification rates of staff hands were as follows: nurses (77.14%), doctors (58.33%), other personnel (management, teachers, etc.) (44.12%), nursing staff/care workers (43.97%), cleaning staff (30.95%), and cooks (7.84%). Nurses presented the highest qualification rate, while cleaning staff and cooks recorded lower qualification rates.

The total number of colony counts on staff hands ranged from 0 to 4.95 × 10³ CFU/cm², with a median and inter-quartile range(P25, P75)20(3.1, 153.0)CFU/cm². The proportion of the samples with a total colony count ≤ 10 CFU/cm² was 40.63%, the proportion of samples with colony counts between 11 CFU/cm² and 100 CFU/cm² was 31.43%, and the

proportion of samples exhibited colony counts ≥ 101 CFU/cm² was 27.94% (Table 3).

4. Discussion

Analysis of environmental surfaces and staff hands from the surveyed elderly care institutions shows that the overall qualification rate is below the expected hygiene standard, and needs improvement.

The overall qualification rate for environmental surfaces was 60.44%, which is consistent with most relevant findings reported within China [14]. Qualification rates were relatively high for door handles, desks and chairs in separate rooms, whereas rates for tables, chairs, and shared equipments in communal activity areas were notably low. These findings suggest that the hygiene management of public areas is still inadequate, especially for high-frequency contact surfaces. Approximately 33% of samples exceeded 10 CFU/cm² in the total colony numbers. It is recommended that elderly care institutions strengthen routine cleaning and disinfection practices, with particular emphasis on tables, chairs, and shared equipments in public areas. Such measures would enhance overall health management, curb microbial proliferation, and contribute to a clean and hygienic living environment.

Hands serve as a critical vehicle for the transmission of pathogenic microorganisms in daily elderly care activities. The hand hygiene methods in the survey include hand disinfection and hand washing, while hand drying methods include disposable paper towels and natural air drying. The disinfectants used for hand hygiene were alcohol-containing disinfection products, quaternary ammonium salt-containing disinfection products and other types of disinfection products. The survey revealed that the qualification rate of total colony numbers on the staff hands was only 40.63%, which is consistent with the findings reported by Yang Jin et al [15], yet lower than the levels documented in most existing studies [16, 17].

Significant differences in hand hygiene qualification rates across different occupational categories are indicated in this survey. Nurses achieved the highest qualification rate (77.14%), while cooks had the lowest rate (7.84%), showing occupational gradient. This distribution pattern may be closely related to job characteristics, levels of hand hygiene knowledge, and the strictness of practice standard implementation. Nurses often receive systematic hand hygiene training and are subject to stricter infection control supervision, and their relatively high qualification rate reflects the effectiveness of such training and oversight. In contrast, cleaning staff (30.95%) and cooks (7.84%) exhibited markedly lower qualification rates. This may be attributed to the relatively limited educational backgrounds and weaker hand hygiene knowledge reserves among these personnel, and the possibility that the hand hygiene behaviors are less frequently incorporated into routine infection surveillance, lacking sustained behavioral reinforcement mechanisms. Nursing assistants/care workers (43.97%) and other personnel (44.12%) showed intermediate-to-low qualification rates, suggesting that this population also carries infection transmission risks.

With respect to the distribution of total colony counts, the median hand surface bacterial count was 20 CFU/cm², ranging from 0 to 4.95×10^3 CFU/cm². Notably, only 40.63% of samples had colony counts ≤ 10 CFU/cm², while 27.94% had counts ≥ 101 CFU/cm², indicating that a considerable proportion of personnel failed to meet hand hygiene standards, posing substantial potential risks for cross-infection. Furthermore, the high variability in total colony counts (inter-quartile range: 3.1 – 153.0 CFU/cm²) suggests considerable heterogeneity in hand hygiene performance among individuals, underscoring the urgent need for targeted interventions focused on low-qualification-rate positions. In elderly care institutions, nursing staff typically provide care for multiple residents simultaneously and maintain long-term close contact with service recipients. If hand hygiene is not performed promptly after exposure to infectious sources, this can significantly facilitate the transmission of pathogenic microorganisms and the occurrence of nosocomial infections within the institution [18]. In addition, staff members in elderly care institutions are generally older, have lower educational levels [2, 19, 20]. Based on the above analysis, strengthening the standardized management of elderly care institutions, allocating competent technical personnel, carrying out standardized professional training [21], improving staff work motivation and participation, and optimizing the organizational workforce structure may synergistically improve the overall hygiene quality of elderly care institutions.

Health management should be positioned as a core component of infectious disease prevention and control systems in elderly care institutions. Disinfection serves as a critical measure to interrupt the transmission of pathogenic microorganisms, and is recognized as a cost-effective public health strategy for infectious disease prevention and control. As the demand for integrated medical and nursing services among the

older adult population continues to grow, this group not only requires basic daily care, but also expects accessible, efficient and sustained professional medical and nursing services [22]. Against this background, disinfection management and infection control in integrated medical-nursing elderly care institutions have been subjected to higher requirements. Such institutions are required to further strengthen professional training encompassing the correct use of disinfectants, the operation and maintenance of disinfection equipment, and standardized hand hygiene management [23]. Evidence suggests that professional interventions can enhance the cleaning and disinfection competency of nursing staff and improve the overall quality of environmental hygiene and disinfection [24, 25].

In conclusion, the current disinfection quality of elderly care institutions in Guangxi still needs improvement. It is recommended that professional training covering disinfection-related theoretical knowledge and operational skills, increase investment in disinfection-related facilities and equipment, and standardize the daily management and use of relevant supplies, so as to continuously improve the overall disinfection and hygiene quality of elderly care institutions.

Abbreviations

CFU Colony-forming Unit

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Author Contributions

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Data Availability Statement

The datasets used and analyzed during the current study can be available from the corresponding author on reasonable request.

Conflicts of Interest

The authors declare no conflicts of interest.

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