# Infection Control Practices and Incidence of Infections among Hemodialysis Patients: A Historical Benchmark Study from Sharkia Governorate, Egypt

**1,2 Mahmoud Hassanein Muhammad Hassanein**

¹Department of Internal Medicine, Faculty of Medicine, Ain Shams University, Cairo, Egypt
²Prince Sultan Kidney Center, King Salman Armed Forces Hospital, Tabuk, Kingdom of Saudi Arabia

**Corresponding Author:** Mahmoud Hassanein Muhammad Hassanein, **Email:** MHassanein@nwafh.med.sa, mahmuodd1984@gmail.com, **Phone:** +966552973010

## ABSTRACT

**Background:** Infections are a major cause of morbidity and mortality among hemodialysis (HD) patients worldwide, second only to cardiovascular disease. In Egypt, the burden of infection-related complications remains substantial, particularly due to high prevalence of HCV and frequent use of central venous catheters (CVCs).

**Objectives:** This study aimed to evaluate adherence to CDC recommendations on infection control in a local HD unit and to assess the incidence and risk factors of infections among chronic HD patients.

**Methods:** A prospective cohort study that involved 123 patients undergoing maintenance HD. It was conducted in 2015. Infection control practices were audited using CDC checklists. Patients were followed for six months for new infections, including vascular access infections and HCV seroconversion. Associations with demographic and clinical variables were analyzed using Chi-square tests and independent t-tests.

**Results:** The incidence proportion of infections was 16.2% (20/123), corresponding to an incidence rate of 0.027 cases per patient-month. The most frequent infections were cellulitis (6.4%), abscesses (4.8%), and bacteremia (3.2%). Female sex and lower serum albumin levels were significantly associated with infection ($p < 0.05$). Compliance with CDC infection control measures was generally high, although use of masks during catheter procedures and soap cleansing before AVF cannulation were not routinely performed.

**Conclusion:** This study provided a historical snapshot of infection control practices and outcomes in an Egyptian HD unit at 2015. The findings served as a valuable baseline for future evaluations of infection prevention efforts in similar settings.
**Keywords:** Hemodialysis, Infection control, CDC guidelines, Egypt, Vascular access, Albumin.

## INTRODUCTION

End-stage renal disease (ESRD) patients undergoing chronic hemodialysis (HD) face a profoundly elevated and pervasive risk of infections, which collectively account for approximately 20% of all mortalities within this vulnerable population, consistently ranking as the second leading cause of death, surpassed only by cardiovascular etiologies [1-3].

Analysis of historical data from 1993 to 2006 revealed that United States hospitalization rates specifically attributed to infections among HD patients escalated by 34%, with vascular access-related infections, particularly catheter-related bloodstream infections (CRBSIs), more than doubling during this period, thereby highlighting a continually growing public health burden [1].

ESRD patients exhibit a unique and heightened susceptibility profile due to a confluence of predisposing factors, including profound compromise of both innate and adaptive immunity, the inherent necessity for repeated vascular access manipulations, persistent exposure to indwelling invasive devices, and frequent direct contact with healthcare workers. These elements collectively contribute to significantly elevated infection rates and severe potentially life-threatening complications such as compassing sepsis, infective endocarditis, and osteomyelitis [4-7].

In the specific context of Egypt, these already formidable clinical challenges are further exacerbated by the well-documented historical prevalence of hepatitis C virus (HCV) infection among the dialysis patient cohort,

adding an additional layer of epidemiological complexity to effective infection control [8].

This epidemiological landscape unequivocally highlights the paramount necessity of stringent adherence to robust infection control protocols, including the comprehensive, multi-faceted programs recommended by

the Centers for Disease Control and Prevention (CDC) that meticulously encompass routine environmental disinfection, rigorous vascular access care, and continuous, evidence-based staff training initiatives to prevent pathogen transmission [9,10].

Consequently, this investigative study was specifically designed to rigorously assess the degree to which established CDC infection control guidelines were systematically implemented within a local HD unit, and concurrently to meticulously characterize the incidence and identify the salient risk factors associated with infections prevalent in this particular patient population during the defined observation period. By comprehensively documenting both prevailing practices and observed clinical outcomes during that timeframe, this work offers a critical historical baseline against which the efficacy of future improvements and evolving infection control strategies can be systematically evaluated within Egyptian dialysis settings.

## MATERIALS AND METHODS

**Study Design and Setting:** This was a prospective cohort study conducted over six months in 2015 at a HD unit in Sharkia Governorate, Egypt.

**Study Population:** We enrolled 123 patients with ESRD on maintenance HD, receiving thrice-weekly sessions (4 hours each) using low-flux polysulfone dialyzers.

**Infection Control Audit:** CDC's Dialysis BSI Prevention **Follow-up and outcomes**
Patients were monitored for new infections (vascular access infections, HCV seroconversion, and other nosocomial infections defined per WHO (2002) criteria).

**Ethics approval and consent to participate:**
Approved by Ain Shams University Faculty of Medicine Ethics Committee. Informed consents were obtained from all patients. The study adhered to the Helsinki Declaration throughout its execution.

*Statistical* Collaborative checklists were used to audit compliance with infection control practices, including:

- Routine station disinfection,

- Catheter connection and disconnection protocols,

- Exit site care,

- AVF/AVG cannulation and decannulation procedures.

### Analysis
Potential risk factors for infection, including age group, sex, DM status, HCV status, CVC use, receipt of blood transfusions, and serum albumin and hemoglobin

levels, were analyzed. Categorical data were evaluated using Chi-square tests, and continuous variables were compared using independent samples t-tests. A p-value ≤ 0.05 was considered statistically significant.

## RESULTS

### Incidence and types of infection

- Overall infection incidence proportion: 16.2% (20/123).
- Incidence rate: 0.027 cases/patient-month.
- Most common infections: Cellulitis (6.4%), abscesses (4.8%), bacteremia (3.2%), with isolated cases of HCV seroconversion and septic arthritis (each 0.8%).

**Table 1:** Risk factor analysis

| Factor | Infection Group (n=20) | Non-infection Group (n=103) | p-value |
|---|---|---|---|
| Female sex | 45% | 17.4% | <0.05 |
| Mean serum albumin | 3.5 ± 0.49 g/dL | 4.1 ± 0.44 g/dL | <0.01 |
| DM | 15% | 11.7% | NS |
| HCV positivity | 40% | 40.8% | NS |
| CVC use | 35% | 18.4% | NS |
| Blood transfusions | 90% | 95.1% | NS |
| Mean Hb | 8.36 ± 0.43 g/dL | 8.48 ± 0.47 g/dL | 0.28 |

*NS: not significant.*

Notably, masks were not routinely worn during catheter procedures, and soap cleansing before AVF cannulation was omitted. An antibiotic spray replaced ointment at catheter exit sites. Antibiotic-heparin locks were used for CVCs, and HCV-positive patients were dialyzed in a designated isolation area. The unit employed advanced water treatment (RO systems, carbon filters, UV disinfection and regular microbiological testing).

## DISCUSSION
This study provided a historical snapshot (from 2015) of infection rates and infection control practices within a hemodialysis (HD) unit situated in Sharkia Governorate. The observed incidence of infections, recorded at 16.2%, demonstrates alignment with international epidemiological observations pertaining to dialysis-related infections,

thereby robustly emphasizing the persistent and inherent vulnerability of patients undergoing HD.

Female sex and hypoalbuminemia emerged as statistically significant risk factors for infection in this cohort, a finding that largely is consistent with extant literature linking compromised nutritional status and potentially gender-related physiological or care disparities to an elevated susceptibility to infection [11, 12].

While other factors such as diabetes mellitus, Hepatitis C Virus (HCV) status, central venous catheter (CVC) use, and histories of blood transfusions demonstrated higher proportional associations with infection, these associations did not achieve statistical significance within the confines of this particular study, likely attributable to the inherent limitations imposed by the specific sample size.

Auditing of infection control protocols revealed generally high adherence to established guidelines promulgated by the Centers for Disease Control and Prevention (CDC), signifying a commendable baseline of practice.

Nevertheless, specific areas identified for potential enhancement included the consistent use of masks during catheter handling procedures and meticulous pre-cannulation site cleansing. The proactive implementation of antibiotic lock solutions and the establishment of dedicated HCV stations within the unit further reflected targeted and adaptive strategies designed to mitigate localized infectious challenges [13].

## STRENGTHS AND LIMITATIONS

A major strength of this study is its prospective design and structured audit of CDC infection control measures. However, as a single-center study with modest sample size, results may not be generalizable across all Egyptian dialysis units. The study's univariate analysis approach also limits assessment of independent risk factors. Future multicenter studies with sufficient event rates should apply multivariate logistic regression to more robustly identify independent predictors. Because data were collected in 2015, it serves primarily as a historical baseline against which future improvements can be benchmarked.

### Adaptation from original thesis work

This article is adapted from a Master's thesis originally submitted in 2015. The data and preliminary analyses were derived from that work, which has been extensively revised into a scientific manuscript.

## CONCLUSION

This study provided a historical snapshot of infection control practices and outcomes in an Egyptian HD unit at 2015. The findings served as a valuable baseline for future evaluations of infection prevention efforts in similar settings.

## DECLARATIONS

- **Ethics approval and consent to participate:** Approved by Ain Shams University Faculty of Medicine Ethics Committee and informed consents were obtained from all patients.

- **Consent for publication:** Not applicable.

- **Availability of data and materials:** Data supporting the findings are available from the corresponding author upon reasonable request.

- **Competing interests:** None declared.

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