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Analysis of factors affecting the length of hospitalization of patients with *Clostridioides difficile* infection: a cross-sectional study

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Abstract

Background *Clostridioides difficile* infection (CDI) is an infectious disease caused by the gram-positive, anaerobic bacterium *C. difficile*. The vulnerable populations for CDI include the elderly, immunocompromised individuals, and hospitalized patients, especially those undergoing antimicrobial therapy, which is a significant risk factor for this infection. Due to its complications and increased resistance to treatment, CDI often leads to longer hospital stays. This study aimed to determine the average length of hospital stay (LOS) of Polish patients with CDI and to identify factors affecting the LOS of infected patients.

Methods The study analyzed medical records of adult patients treated with CDI in one of the biggest clinical hospitals in Poland between 2016–2018. Information encompassed the patient's age, LOS results of selected laboratory tests, number of antibiotics used, nutritional status based on Nutritional Risk Screening (NRS 2002), year of hospitalization, presence of diarrhea on admission, systemic infections, additional conditions, and undergone therapies. The systematic collection of these variables forms the foundation for a comprehensive analysis of factors influencing the length of stay.

Results In the study period, 319 patients with CDI were hospitalized, with a median LOS of 24 days (min–max = 2–344 days). The average LOS was 4.74 days in 2016 (median = 28 days), 4.27 days in 2017 (median = 24 days), and 4.25 days in 2018 (median = 23 days). There was a weak negative correlation (Rho = -0.235, $p < 0.001$) between albumin level and LOS and a weak positive correlation between NRS and LOS (Rho = 0.219, $p < 0.001$). Patients admitted with diarrhea, a history of stroke or pneumonia, those taking certain antibiotics (penicillins, cephalosporins, carbapenems, fluoroquinolones, aminoglycosides, colistin), and those using proton pump inhibitors, exhibited longer hospitalizations (all $p < 0.001$) or unfortunately died ($p = 0.008$). None of the individual predictors such as albumin level, Nutritional Risk Screen, pneumonia, stroke, and age showed a statistically significant relationship with the LOS ($p > 0.05$). However, the multivariate regression model explained a substantial portion of the variance in hospitalization length, with an R-squared value of 0.844.

Conclusions Hospitalization of a patient with CDI is long. Low albumin levels and increased risk of malnutrition were observed in longer hospitalized patients. Longer hospitalized patients had pneumonia, stroke, or surgery, and were admitted for a reason other than CDI.

Keywords *Clostridioides difficile* infection, Length of hospitalization, Length of stay, Nutritional Risk Screening

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Text box 1. Contributions to the literature

- Reveals prolonged hospitalization trends in Polish *Clostridioides difficile* infection (CDI) patients, emphasizing significant healthcare burden.
- Identifies factors contributing to extended length of hospital stays (LOS), including low albumin, high nutritional risk scores, and specific comorbidities.
- Highlights associations between extended LOS and certain antibiotics, proton pump blockers, and CDI-related symptoms.
- Strengthens global CDI management strategies, enhancing public health responses to this challenging infection.

Background

Clostridioides difficile infection (CDI) is an infectious disease caused by gram-positive, anaerobic bacteria [1], which produce toxins that damage the intestinal mucosa, causing diarrhea [2]. Patients with *C. difficile* have varied presentations: asymptomatic carriage, mild forms with self-limiting diarrhea, and severe forms with intestinal obstruction and septic shock. The course of the disease varies from asymptomatic carriage, mild forms with self-limiting diarrhea to generalized forms with intestinal obstruction and septic shock [3].

The *C. difficile* produce spores can survive for many months in the hospital environment [4]. Spores are resistant to drying, high temperature and commonly used alcoholic disinfectants [5, 6]. Infection is transmitted by the fecal–oral route through contact with patient feces or contaminated surfaces [7].

The typical population for CDI is the elderly, immunocompromised and hospitalized patients or those on antimicrobial therapy, which is a major risk factor for this infection [8, 9]. In this regard, *C. difficile* is a multidrug-resistant (MDR) pathogen that has been recognized by the US Centers for Disease Control and Prevention (CDC) as an urgent threat due to antimicrobial resistance (AMR) [10].

Currently, the worldwide incidence of CDI is reported around 49.36 per 100,000 population annually, with a worrying increase in both hospital and community rates [11]. In Poland, the number of CDI cases in 2018 was 11,592, and this compares with 4,728 cases in 2013 [12]. The morbidity of CDI in Poland from 2016 to 2021 ranged from 26.4 to 30.4 cases per 100,000 residents. In 2022, there was a drastic increase in the number of infected people, the incidence rate was 55.5 cases per 100,000 inhabitants [13].

Antibiotic therapy, hospitalization and older age are the three main factors contributing to the onset of infection [12]. Stool tests are the basis for diagnosing the disease. In hospital diagnosis, the most common tests are immunoenzymatic tests detecting toxins A and/or B, NAAT (nucleic acid amplification test) detecting a fragment of bacterial DNA, screening immunoenzymatic test detecting glutamate dehydrogenase. Stool cultures with evaluation of toxin secretion are used in doubtful cases [14, 15]. Vancomycin, fidaxomicin, metronidazole, bezlotoxumab, and fecal transplants and live biotherapeutic products are used to treat the infection [16]. In the case of complicated forms, surgical treatment may be necessary [17–19].

This study aimed to determine the average length of hospital stay (LOS) of polish patients with CDI and to identify factors affecting the LOS of infected patients. This goal will be achieved by analyzing selected quantitative and qualitative variables in relation to LOS.

Methods

Sample and settings

The study analyzed cases of adult patients treated at the Jan Mikulicz-Radecki University Clinical Hospital in Wroclaw, Poland, from 2016 to 2018 who were diagnosed with CDI. It is the largest hospital in Lower Silesia and one of the largest in Poland. It had 75,954 hospitalizations in 2016, 79,376 hospitalizations in 2017, and 104,936 hospitalizations in 2018, after expanding the hospital by several departments. It is a university hospital with the highest level of reference, admitting adults and children.

Medical records

The patients' clinical data were obtained by analyzing the patients' medical records. The relationships between the LOS and the following CDI-centric variables were analyzed [19]:

Disease severity (Nonsevere, severe and fulimant)

Severe CDI is characterized by: body temperature >38.5°C, leucocyte count >15 × 109/L, rise in serum creatinine, i.e. >50% above the baseline. Additional supporting factors, when available are distension of the colon, pericolonic fat stranding or colonic wall thickening at imaging,
Fulminant CDI (Severe-complicated CDI) has the same criteria as severe CDI and additionally: hypotension, septic shock, elevated serum lactate, ileus, toxic megacolon, bowel perforation or rapid deterioration of the patient,

Recurrence vs. initial disease (whether the current CDI episode was a recurrence or the initial episode,
Treatment received (including specific antibiotics used for CDI treatment, surgical interventions, and adjunct therapies),
Laboratory tests (e.g., albumin level, C-reactive protein, white blood cell count),

Nutritional status (based on Nutritional Risk Screening 2002),
Presence of comorbidities (e.g., pneumonia, stroke, hypertension, diabetes),
Community-Acquired vs. Hospital-Acquired CDI (classified based on whether the CDI symptoms and diagnosis occurred within the first 48 hours of hospital admission (community-acquired) or more than 48 hours after admission (hospital-acquired),
Length from Admission to CDI Diagnosis (time in days from hospital admission to CDI diagnosis).

The hospital diagnosed CDI in patients who had symptoms of CDI and:

A positive stool test for toxins A and B by latex testing (immunoenzymatic method),
Or a positive screening test for glutamate dehydrogenase (GDH) and a positive stool test for toxins A and B by latex testing (immunoenzymatic method),
Or a positive nucleic acid amplification test (NAAT).

If a patient had multiple results of a particular laboratory test, the earliest result obtained since admission to the hospital was used in the analysis. This was to minimize the effect of treatment on the variable and help predict the LOS.

Nutritional assessment

Nutritional Risk Screening (NRS 2002) was used to evaluate the nutritional status of patients. It is a screening test used to assess health risks related to nutritional status. [19] In Poland, according to the Regulation of the Minister of Health, all patients hospitalized in hospital wards should have their nutritional status assessed. In children and adolescents, centile grids are used for this, in adults, scales: Nutritional Risk Screening (NRS) of 2002 or Subjective Global Assessment of Nutritional Status (SGA) [20]. The NRS evaluates: BMI: body mass index, reduced food intake over the past week, the amount of unintentional weight loss expressed as a percentage of body weight, the presence of additional medical conditions, the patient's age; patients over 70 years old receive an additional point on the scale. The scale can be scored from 0 to 7 points. A score of 3 points or more indicates a higher risk of malnutrition-related complications and indicates the need to include nutritional treatment. In patients with a score of less than 3 points, the scale should be repeated after 7 days of hospitalization [19].

Statistical analysis

The normality of the distribution of the variables was verified by the Kolmogorov–Smirnov test. In tables for variables with a normal distribution, the mean and standard deviation for both groups are given. For non-parametric tests, the median and interquartile range are given. The LOS of patients infected with CDI did not have a normal distribution, so instead of the mean and standard deviation, the median and interquartile distribution were determined. The average LOS of all adult patients during the study period was obtained from the hospital database. Relationships between LOS and the dichotomous variable were verified using the Mann–Whitney test. Relationships between LOS and a qualitative variable with more than 3 categories were verified using the Kruskal–Wallis test. Relationships between quantitative variables were verified using the Spearman rank correlation test, and in the case of more than two compared variables, using the Kruskal–Wallis test with the Dunn test with Bonferroni correction as a post-hoc test. The significance level in the study was $p=0.01$. This level of significance was used because of the small number of patients in some of the compared groups, this was to reduce the probability of considering random results as statistically significant. Also, the multivariate regression analysis was conducted to identify the significant factors related to the LOS for patients with CDI. The variables included in the model were albumin level, Nutritional Risk Screen, pneumonia, stroke, and age. The analysis was performed using R 4.4.1. software (https://cran.r-project.org).

Results

In the period from 2016 to 2018, 319 patients with CDI were hospitalized at the University Clinical Hospital in Wroclaw. The median LOS for all patients was 24 days, with an interquartile range of 25 days (IQR = 15–40 days). The shortest hospital stay was 2 days, the longest was 344 days. The histogram of the LOS of patients is presented in Fig. 1.

Table 1 presents an analysis of the length of hospital stay depending on the year of hospitalization. Differences between medians for specific years were not statistically significant. The average LOS at the University Clinical Hospital in specific years was: in 2016: 4.74 days, in 2017: 4.27 days, in 2018: 4.25 days. The median LOS in the following years was: 28 in 2016, 24 in 2017, 23 in 2018. The hospitalization of a patient with CDI was long-term, exceeding 5 times the average hospital stays.

Analysis of the length of hospital stay depending on quantitative variables

Table 2 presents the results of the analysis of selected quantitative variables in patients hospitalized with CDI depending on the LOS. The analysis showed a weak negative correlation (Rho = -0.235, $p<0.001$) between albumin level and LOS. It was observed that the lower

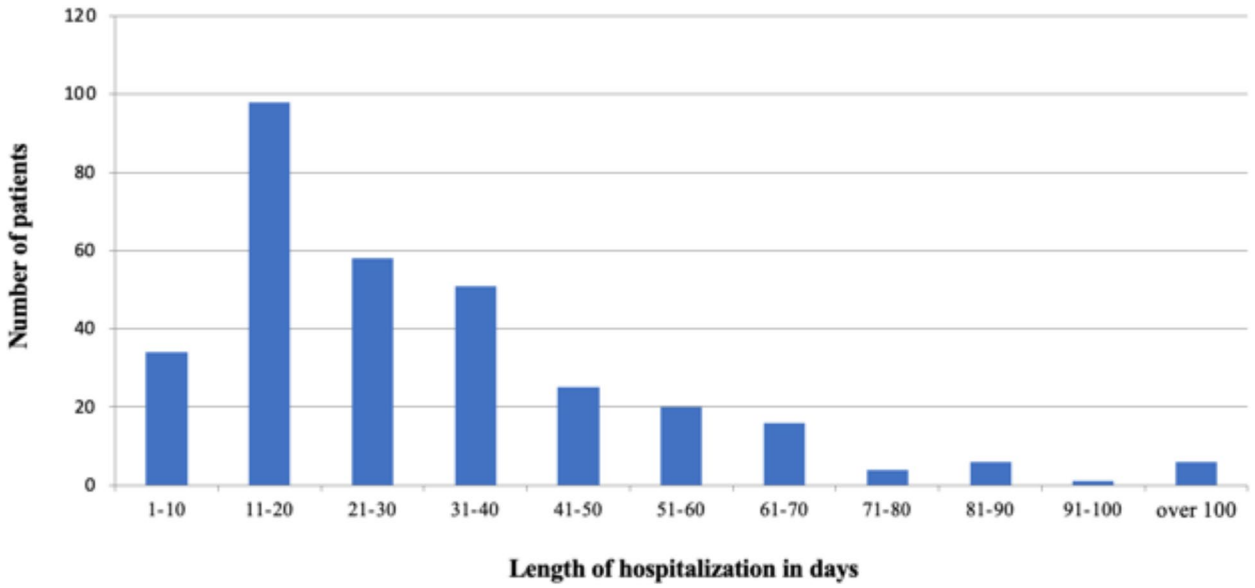

Fig. 1 Number of patients by LOS

Table 1 Analysis of the LOS depending on the year of hospitalization of patients with CDI treated at the University Clinical Hospital in Wroclaw in 2016–2018

Year of hospitalization	2016	2017	2018	*P*-Value
Number of patients	79	118	122	
Length of hospitalization (LOS [days]) (median [IQR])	28 [26]	24 [23]	23 [21.75]	0.490

the albumin level was, the longer the hospital stay was (Fig. 2). The correlation is so weak that it is not visible in the presented chart.

The analysis of quantitative variables also showed a weak positive correlation between the nutritional status of patients expressed in the Nutritional Risk Screening 2002 and the LOS (Rho 0.219, $p<0.001$). It was observed that the more points a patient received on the scale (the risk of complications related to nutritional status was higher), the longer the hospitalization was. Nutritional status analysis was usually performed at hospital admission, so the relationship obtained has predictive value. The results of the analysis are shown in Fig. 3.

Analysis of length of hospital stay depending on quantitative variables

Table 3 presents the results of the analysis of qualitative variables impact on the LOS in patients with CDI. The median LOS and the interquartile range (IQR) were expressed in days. The analysis of qualitative variables depending on the LOS showed that patients admitted with diarrhea, patients with stroke (history or current hospitalization), with pneumonia, taking penicillins, cephalosporins, carbapenems, fluoroquinolones, aminoglycosides, colistin, proton pump inhibitors, and patients who died were hospitalized longer.

Multivariate analysis identifying the predictors of longer hospitalization

Table 4 and Fig. 1 provide a detailed overview of the multivariate regression analysis results including community-acquired vs. hospital-acquired CDI and the length from admission to CDI diagnosis. The R-squared value for the model was 0.874, indicating that approximately 87.4% of the variance in the LOS can be explained by the included variables. The analysis revealed that disease severity, recurrence of CDI, specific treatments received, community-acquired vs. hospital-acquired status, and the length from admission to CDI diagnosis were significant predictors of longer hospitalization (Fig. 4).

Severe cases of CDI were significantly associated with longer hospitalization ($p=0.006$). Patients with recurrent CDI experienced longer hospital stays compared to those with initial disease ($p=0.018$). This suggests that recurrent episodes may be more challenging to manage and require prolonged treatment. The specific treatment regimens used for CDI were borderline significant predictors of longer hospitalization ($p=0.052$). Hospital-acquired CDI was significantly associated with longer hospital stays ($p=0.045$), indicating that infections acquired during hospitalization are more severe or complicated. A

Table 2 Analysis of selected quantitative variables of patients hospitalized with a disease related to CDI at the University Clinical Hospital in Wroclaw in 2016–2018 depending on the LOS

Analyzed variable	Median or Mean	Interquartile range (IQR) or Standard deviation (SD)	Spearman's Rho (Spearman's rank correlation coefficient)	*P*-Value
Age [years] (mean [SD])	72.08	16.74	0.102	0.069
Erythrocyte sedimentation rate [mm/h] (median [IQR])	36	37	- 0.057	0.588
C-reactive protein level [mg/l] (median [IQR])	56.57	117.8	- 0.050	0.374
Procalcitonin [ng/ml] (median [IQR])	0.25	0.725	- 0.123	0.059
White blood cell count [10^3/µl] (median [IQR])	9.72	6.42	0.031	0.576
Platelet count [103/µl] (median [IQR])	238	148.25	- 0.067	0.233
Red blood cell count [million/µl] (males) (mean [SD])	4.01	0.84	- 0.063	0.463
Red blood cell count [million/µl] (women) (mean [SD])	3.85	0.72	- 0.027	0.716
Hematocrit (men) [%] (mean [SD])	36.26	7.19	- 0.040	0.637
Hematocrit [%] (women) (mean [SD])	34.53	6.16	0.017	0.820
Hemoglobin [g/dl] (men) (mean [SD])	11.98	2.49	- 0.033	0.695
Hemoglobin [g/dl] (women) (mean [SD])	11.27	2.01	- 0.010	0.890
Sodium [mmol/l] (mean [SD])	138.05	5.72	0.042	0.461
Potassium [mmol/l] (mean [SD])	4.10	0.74	0.007	0.899
Magnesium [mg/dl] (mean [SD])	1.96	0.43	0.025	0.672
Creatinine [mg/dl] (median [IQR])	1.08	0.825	- 0.026	0.650
Urea [mg/dl] (median [IQR])	46	41.25	0.018	0.760
Calcium [mg/dl] (mean [SD])	8.95	0.96	0.018	0.792
Total protein [g/dl] (mean [SD])	5.79	1.03	- 0.035	0.607
Albumin [g/dl] (mean [SD])	2.86	0.73	- 0.235	**< 0.001**
Nutritional Risk Screen (mean [SD])	2.01	1.41	0.219	**< 0.001**

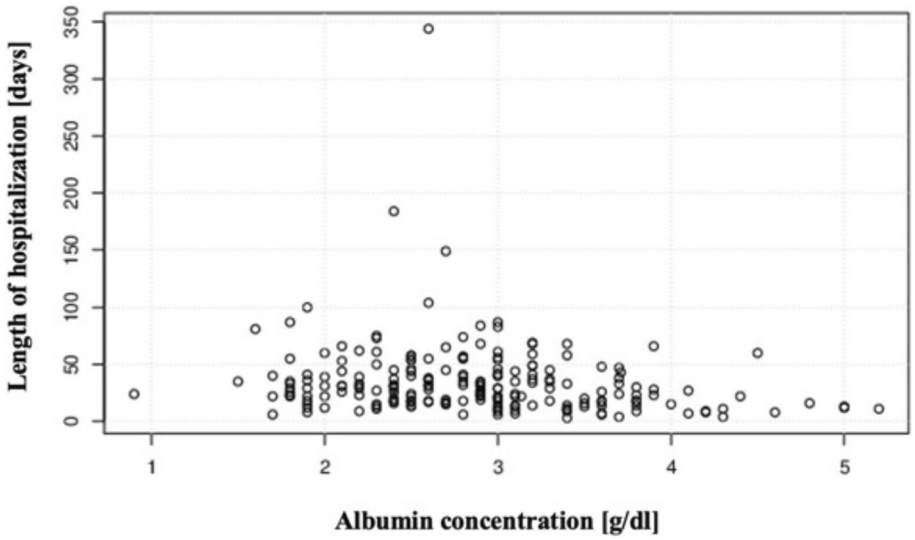

Fig. 2 Correlation analysis of albumin concentration and LOS of patients with CDI

longer time from admission to CDI diagnosis was borderline significant in predicting longer hospital stays ($p = 0.054$) (Table 4).

Discussion

Comparing the LOS of patients from different countries is challenging due to the varying healthcare models in each country. In some models of healthcare, there is a strong emphasis on minimizing costs, shortening

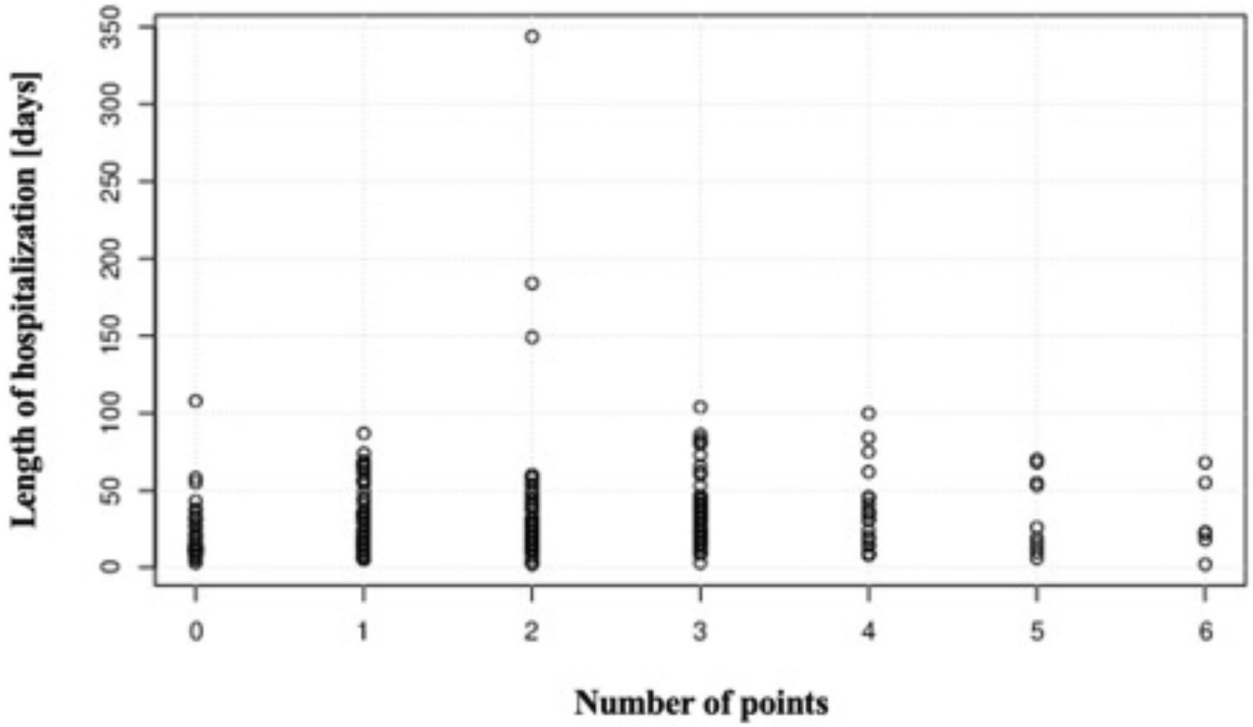

Fig. 3 Correlation analysis of nutritional status 2002 and LOS of patients with CDI

hospital stays and continuing treatment in outpatient settings. In a meta-analysis including 957,175 patients from 42 studies between 2005 and 2015 with CDI hospitalized in U.S. hospitals, the average LOS was 11.1 days (90% confidence interval 8.7–13.6 days) [20]. In contrast, in a study that included patients hospitalized in Australian hospitals between 2005 and 2015, the average LOS ranged from 16.08 to 18.69 days [21]. Also, in Belgian hospitals between 2012 and 2013, the average LOS for patients with CDI was 13.53 days, standard deviation 11.95 days [22]. In Poland, at the University Clinical Hospital in Krakow and at St. Anne's Hospital in Miechow in 2011–2013, the median LOS of patients with CDI was 11 days (interquartile range of 9 days). It was therefore more than twice as short as the value obtained in our study [23].

The variables chosen for this study were selected based on their known or hypothesized impact on the LOS for patients with CDI. It is well-established that more severe cases of CDI are associated with worse clinical outcomes and longer hospital stays due to the increased need for medical intervention and monitoring. Recurrent CDI often indicates a more complicated and persistent infection, likely requiring extended treatment and hospitalization compared to initial episodes. Also, different treatment regimens and their effectiveness can significantly influence the duration of hospitalization. More aggressive treatments or those requiring prolonged administration may extend LOS. It should be noted that the source of infection can affect LOS, with hospital-acquired infections often being associated with more severe cases due to exposure to more virulent strains and higher levels of comorbidities. Moreover, delays in diagnosing CDI can lead to prolonged hospital stays due to the late initiation of appropriate treatment. Factors such as albumin level, nutritional status (NRS), and comorbidities (e.g., pneumonia, stroke) reflect the overall health and resilience of the patient. Poor nutritional status, lower albumin levels, and the presence of significant comorbidities are indicators of frailty and can lead to longer recovery times.

In summary, the average duration of hospitalization of patients with CDI according to the analyzed literature, ranges from 11 to 19 days. The influence of variables on the LOS of patients with CDI is an extremely rarely discussed topic in the literature. The present study is one of the few addressing this topic. The multivariate regression analysis identified several factors that collectively influence the LOS for patients with CDI. Although individual predictors did not reach statistical significance, the model explained a substantial portion of the variance in hospitalization length, with an R-squared value of 0.844. This indicates that approximately 84.4% of the variability in the LOS can be attributed to the combined effect

Table 3 Analysis of selected qualitative variables of patients hospitalized with CDI at the University Clinical Hospital Wroclaw in 2016–2018 depending on the LOS

Analyzed variable	No	Yes	*P*-Value
Admission with diarrhea (median [IQR])	29 [27.25]	15 [5.5]	**< 0.001**
Urinary tract infection (median [IQR])	24 [21.5]	27.5 [27.25]	0.026
Pneumonia (median [IQR]	22 [21.5]	34 [36]	**< 0.001**
Sepsis (median [IQR])	23 [23.25]	31 [37.5]	0.012
Use of penicillins (median [IQR])	20 [19]	32.5 [34.75]	**< 0.001**
Use of cephalosporins (median [IQR])	18 [19]	31 [19]	**< 0.001**
Use of carbapenems (median [IQR])	20 [19]	41 [34]	**< 0.001**
Use of fluoroquinolones (median [IQR])	19.5 [19]	33 [26]	**< 0.001**
Use of aminoglycosides (median [IQR])	22[21]	48.5[36.5]	**< 0.001**
Use of macrolides (median [IQR])	24 [24]	29 [37]	0.091
Use of sulfamethoxazole and trimethoprim (median [IQR])	24 [23.5]	30 [26.25]	0.126
Use of colistin (median [IQR])	23 [22]	56 [38]	**< 0.001**
Stroke (median [IQR])	22 [22]	34 [24]	**< 0.001**
Dementia (median [IQR])	23 [23.5]	30 [31.25]	0.014
Hypertension (median [IQR])	23 [22]	24 [25]	0.465
Ischemic heart disease (median [IQR])	25 [25]	22 [28]	0.373
Myocardial infarction (median [IQR])	24 [23.75]	26 [27]	0.465
Heart failure (median [IQR])	24 [27.5]	26.5 [22.75]	0.250
Atrial fibrillation (median [IQR])	24 [25]	24 [23]	0.384
Diabetes (median [IQR])	24 [24]	24 [27]	0.826
Renal failure (median [IQR])	24 [24.25]	24 [26.5]	0.803
Pressure ulcer (median [IQR])	23 [24]	33 [24]	0.020
Operation (median [IQR])	22 [22.25]	41 [31]	**< 0.001**
Hypothyroidism (median [IQR])	24.5 [25.75]	22 [24]	0.459
Anemia (median [IQR])	22 [22]	26 [25]	0.097
Active neoplastic process (median [IQR])	25 [26]	22 [22]	0.093
Use of proton pump blockers (median [IQR])	19 [20.5]	29 [27]	**< 0.001**
Use of ranitidine (median [IQR])	24 [24]	25 [28.75]	0.704
Death (median [IQR])	22.00 [21.5]	32.00 [37]	**0.008**

Table 4 Multivariate regression analysis of factors affecting the LOS for CDI patients

Variable	Coefficient	Std. Error	t-Statistic	P-Value
Intercept	-2.702	120.454	-0.022	0.983
Disease severity (severe)	8.134	2.945	2.761	**0.006**
Recurrence vs. initial disease	5.349	2.231	2.398	0.018
Specific CDI treatment	6.173	3.174	1.945	0.052
Community-acquired vs. hospital-acquired CDI	4.874	2.715	1.796	0.045
Length from admission to CDI diagnosis	2.894	1.503	1.927	0.054
Albumin level	-1.324	25.945	-0.051	0.962
Nutritional Risk Screen	5.849	6.631	0.882	0.428
Pneumonia	3.373	6.174	0.546	0.614
Stroke	-2.329	5.064	-0.460	0.669
Age	0.174	0.603	0.289	0.787

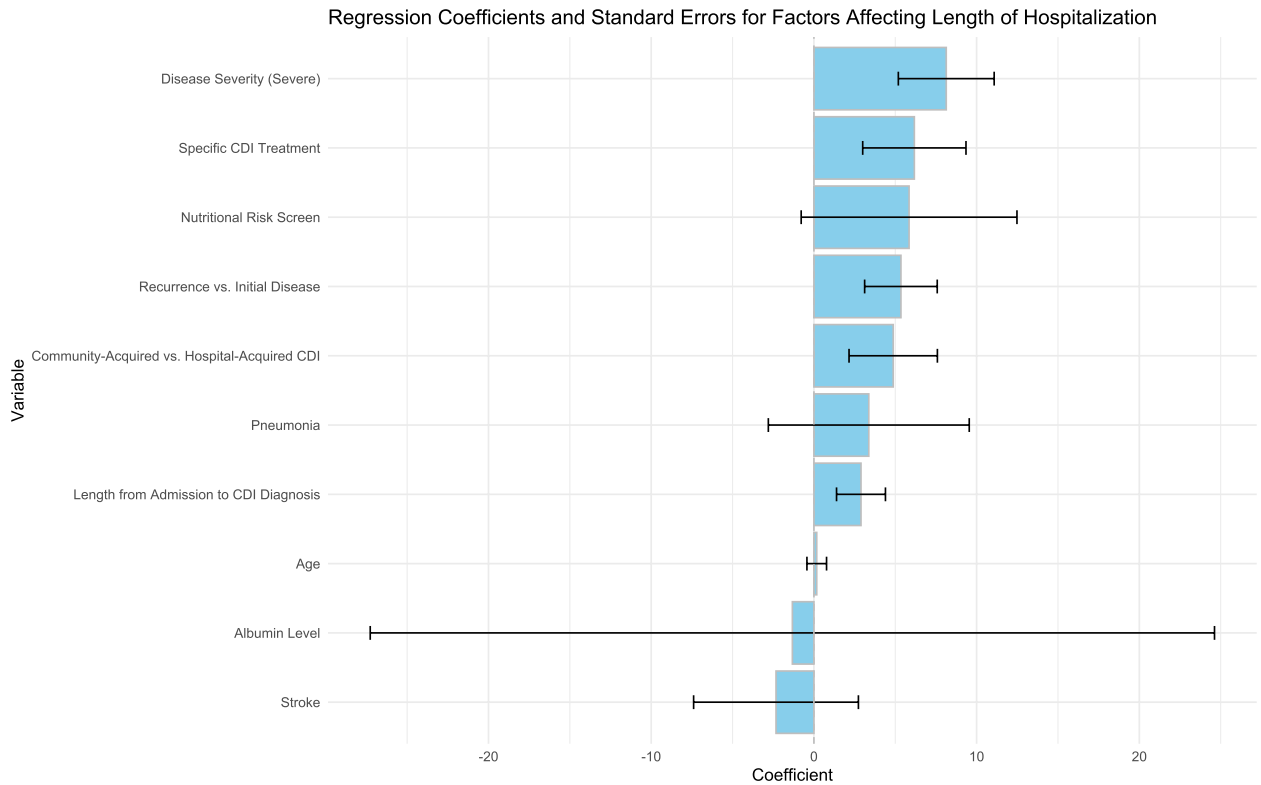

Fig. 4 Regression coefficients and standard errors for factors affecting LOS

of the studied variables: albumin level, Nutritional Risk Screen, pneumonia, stroke, and age.

Lower albumin levels are associated with longer hospital stays, reflecting poor nutritional status and severe illness. This relationship was not statistically significant ($p=0.962$), likely due to the small sample size. Higher nutritional risk scores correlate with longer hospital stays, indicating that patients at higher nutritional risk face more complications and slower recovery. This relationship was not statistically significant ($p=0.428$). The presence of pneumonia is linked to longer hospitalizations, highlighting it as a serious complication that can extend recovery time. This relationship was not statistically significant ($p=0.614$). Surprisingly, a history of stroke is associated with shorter hospital stays. This counterintuitive result was not statistically significant ($p=0.669$) and may require further investigation. Older patients tend to have slightly longer hospital stays, consistent with the expectation that age-related comorbidities and slower recovery contribute to extended hospitalization. This relationship was not statistically significant ($p=0.787$).

The high condition number (3.95e+03) suggests potential multicollinearity, which occurs when predictors are highly correlated with each other. Multicollinearity can inflate standard errors and make it difficult to determine the individual effect of each predictor. Future studies should address this by either increasing the sample size or using techniques to reduce multicollinearity, such as principal component analysis or ridge regression.

Our study's findings, while specific to the University Clinical Hospital in Wroclaw, have implications that could be generalized to other hospitals, particularly those with similar healthcare settings and patient demographics. The median LOS observed in our study was significantly longer compared to reports from hospitals in the U.S., Australia, and Belgium. This discrepancy may be attributed to differences in healthcare practices, patient management strategies, and resource availability. Despite these differences, the factors identified as influencing hospitalization length, such as albumin levels, nutritional status, and comorbid conditions like pneumonia and stroke, are common across various healthcare settings. Thus, our findings underscore the importance of a multifaceted approach in managing CDI patients, emphasizing nutritional support and careful management of comorbidities to potentially reduce hospitalization duration.

Study limitations

This study has several limitations that should be acknowledged. Firstly, it was conducted at a single center, the

University Clinical Hospital in Wroclaw (Poland), which may limit the generalizability of the findings to other settings. The patient population and healthcare practices at this hospital may not be representative of other hospitals, particularly those in different regions or countries with varying healthcare systems. Secondly, the retrospective nature of the study and the reliance on medical records may introduce biases related to data accuracy and completeness. Additionally, some variables that could influence hospitalization length, such as the severity of CDI and specific treatment regimens, were not included in the analysis. Future research should address these limitations by incorporating multi-center data and prospective study designs to validate and extend the findings. The primary aim of our study was to analyze factors affecting the LOS specifically in patients with CDI. As such, we did not include a comparator group of non-CDI patients. The focus was on understanding the internal variability within the CDI patient group rather than comparing them with another group.

Future research

We acknowledge that having a comparator group could provide additional insights into whether CDI itself or other factors are primary contributors to extended LOS. We recommend that future studies include a matched or unmatched comparator group to comprehensively evaluate these differences. Such a design would enable a more robust understanding of the direct impact of CDI on hospitalization length relative to other conditions. Also, future studies should consider a larger, more diverse patient population across multiple hospitals to validate our findings and enhance their generalizability. Additionally, standardizing the criteria for hospitalization and discharge in CDI patients can help reduce variability and improve the comparability of results across different healthcare systems. While we acknowledge that including CDI disease severity classification would greatly strengthen this study, the current limitations in the availability of detailed clinical records and the retrospective nature of the study make it impossible to collect additional data on this variable at this stage. We recommend that future prospective studies systematically document CDI severity to enhance the robustness of the analysis and provide more detailed insights into its impact on hospitalization length.

Conclusions

The hospitalization of a patient with CDI is prolonged. Low albumin levels and high NRS scores were observed in patients with longer hospitalizations. Patients with pneumonia, stroke during hospitalization or in the past, surgery, and were admitted for a reason other than CDI, patients who used proton pump inhibitors and patients who received any of the following antibiotics during hospitalization: penicillins, cephalosporins, carbapenems, fluoroquinolones, aminoglycosides, colistin were hospitalized longer. No such relationship was observed for patients treated with macrolides or sulfamethoxazole and trimethoprim. This study confirmed that chosen factors collectively explain a substantial portion of the variability in hospitalization length, highlighting the need for a multifaceted approach in managing CDI patients to reduce hospitalization durations.

Abbreviations

AMR	Antimicrobial resistance
CDC	Centers for Disease Control and Prevention
CDI	Clostridioides difficile infection
LOS	Length of hospital stay
NAAT	Nucleic acid amplification test
NRS 2002	Nutritional Risk Screening

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Authors' contributions

Both JD, PP and MB made contributions to the study conception and design. JD, PP and MB were responsible for methodology of the study. MB was responsible for data acquisition and analysis. JD, PP, ŠM and MB performed results interpretation. JD, KM, and MB actively participated in drafting the manuscript. JD, PP, ŠM and KM played a crucial role in critically revising the manuscript. JD and PP supervised the project. All authors have provided their final approval for the version to be published.

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Availability of data and materials

The datasets generated and/or analyzed during the present study are available from the corresponding author (PP) upon reasonable request.

Declarations

Ethics approval and consent to participate

This study was approved by the local Bioethics Committee of the Wroclaw Medical University, Poland (approval no. KB–611/2018). The study adhered to the principles of the Helsinki Declaration and Good Clinical Practice. All participants provided written informed consent to participate in the study.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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