

# *Clostridium Difficile* Hospitalizations in Louisiana: A 10 Year Review

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*Clostridium difficile* (CD) is a common cause of diarrhea in hospitalized patients and can cause more serious intestinal conditions such as pseudomembranous colitis, toxic megacolon, perforations of the colon, sepsis, and even death. *Clostridium difficile* associated disease (CDAD) is mainly a health care associated illness. Known risk factors for CDAD are antibiotics, gastrointestinal surgery/manipulation, long length of stay in health care settings, serious underlying illness, a compromised immune system, and advanced age (>65+). In 2004 a new epidemic strain of CD was identified as causing hospital outbreaks in several states. This new strain is more virulent and is more resistant to fluoroquinolone antibiotics. The Healthcare Cost and Utilization Project (HCUP) analyzed hospitalization discharge rates of CDAD in the United States (US) between 1993 and 2005 and reported that hospital discharges for CDAD doubled between 2001 and 2005. This study was done to see if Louisiana had similar trends in CDAD rates compared to the rest of the nation. Discharge records from the Louisiana Hospital Inpatient Discharge Database (LAHIDD) were analyzed for CDAD rates between 1999 and 2008 and were compared to the HCUPnet national estimates in the US. Trend and variance analyses were performed to compare demographics within Louisiana and overall trends to the US. Our results show that Louisiana had similar trends of CDAD rates compared to the US over the past 10 years. Furthermore, Louisiana also had a doubling of CDAD rates from 2001 to 2005.

## INTRODUCTION

*Clostridium difficile* (CD) is a spore-forming, gram-positive anaerobic bacterium that produces two enterotoxins: toxin A and toxin B. It is shed in feces and spread via fecal-oral transmission. Common dissemination includes contaminated surface, device, material, or person who comes into contact with the CD spores. CD is a common cause of diarrhea in hospitalized patients and can cause more serious intestinal conditions such as pseudomembranous colitis, toxic megacolon, perforations of the colon, sepsis, and even

death. *Clostridium difficile* associated disease (CDAD) is mainly health care associated illness (80%), but community acquired CDAD (20%) are also of concern.<sup>1,2</sup> Known risk factors for CDAD are antibiotics, gastrointestinal surgery/manipulation, long length of stay in health care settings, serious underlying illness, a compromised immune system, and advanced age (>65+).<sup>3-5</sup>

CDAD is not a reportable medical event in Louisiana; however, it has been considered as a reemerging infectious

disease.<sup>2,6-9</sup> In the past 10 years incidence and mortality rates of CDAD have increased. In 2004 a new epidemic strain of CD was identified as causing hospital outbreaks in several states. This new strain is more virulent, with an ability to produce large quantities of toxins A and B and is more resistant to fluoroquinolone antibiotics.<sup>1,6</sup>

In April 2008, the Agency for Healthcare Research and Quality (AHRQ) released their CDAD in US Hospitals, 1993-2005 statistical brief. The analysis was done through the Healthcare Cost and Utilization Project (HCUP). HCUP databases bring together the data collection efforts of state data organizations, hospital associations, private data organizations, and the federal government to create a national information resource of patient-level health care data. They reported that the number of hospital discharges with CDAD more than doubled from 2001 to 2005, primarily affecting the elderly, and patients with complex comorbidities.

The goal of this study is to assess the trends within the state to determine if they are consistent with the rest of the nation.

## METHODS

This is a descriptive study of time trends to analyze CDAD discharge records from the Louisiana Hospital Inpatient Discharge Database between 1999 and 2008. The International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) code (008.45) was used to identify cases of CD as their main or secondary discharge diagnosis. Louisiana Hospital Inpatient Discharge Database is a comprehensive, population-based repository containing inpatient discharge data submitted to Department of Health and Hospitals (DHH)/Office of Public Health (OPH) by hospitals within Louisiana. Temporal patterns of CDAD incidence within the population and all-hospitalized patients were analyzed. These data were compared to the HCUPnet national estimates on hospital use for all patients from the HCUP Nationwide Inpatient Sample (NIS).<sup>10</sup> Population statistics for Louisiana and the United States

were gathered from the US Census 2000 and for each year, extrapolations were made to estimate the population for the current year.<sup>11</sup>

## STATISTICAL ANALYSIS

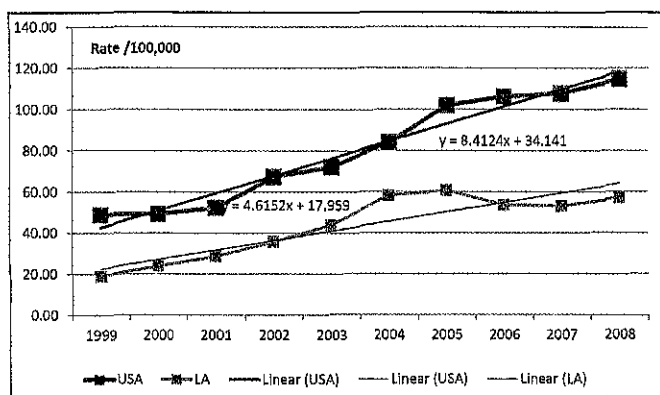
Chi square for trend was analyzed with Epi Info version 6.0; all other data analyses were performed on Microsoft Office Excel 2007. The incidence rates of hospital cases of CDAD were expressed as cases per 100,000 population. F-test analyses were done to test for equality of variance. If the variances were equal, a two-sample t-test assuming equal variances was performed. Likewise, if the variances were not found to be equal, a two-sample t-test assuming non equal variances were performed. Two-sample t-tests were performed on the following groups: sex, race, and mortality. ANOVA analyses were performed on age groups to assess if there were differences in the group means. Time trend analyses were performed for each group (CDAD hospitalization rates, CDAD mortality rates, and CDAD case-fatality rates) using least-square regression. A test was considered significant if the p-value was less than or equal to 0.05.

## RESULTS

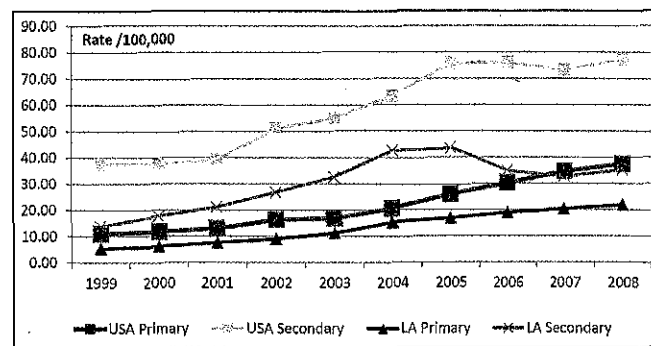
### CDAD in Louisiana

There were a total of 19,174 cases of CD in hospitalized patients in Louisiana between 1999 and 2008, ranging from 800 to 2,500 a year. The rates increased from 1999 to 2005, declined slightly from 2006 to 2007 and returned to its previous peak in 2008. Louisiana had a statistically significant positive increase of CDAD over the past 10 years, ( $\chi^2$  test for trend 1466, P-value 0.00000). The US shows the same consistent increase of CDAD over the past 10 years and both Louisiana and the US show a highly significant correlation (F 41.99, P-value 0.0002, Multiple R 0.92) (Figure 1).

Trend analyses of primary and secondary diagnoses of CDAD in Louisiana over the past 10 years showed a highly significant increase of CDAD ( $\chi^2$  987, P-value 0.00000,  $\chi^2$  629, P-value 0.00000, respectively). The correlation of primary



**Figure 1.** *Clostridium difficile* associated disease (CDAD) hospitalization rates per 100,000 in the US and Louisiana (LA), 1999-2008.



**Figure 2.** Hospitalization rates per 100,000 for primary and secondary diagnosis, US and Louisiana (LA), 1999-2008.

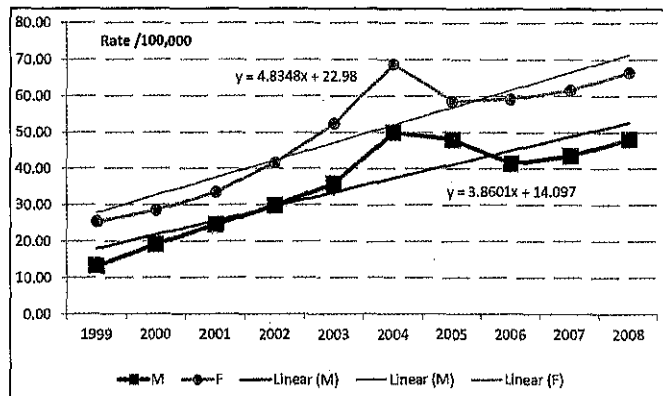


Figure 3. *Clostridium difficile* associated disease (CDAD) diagnosis rates per 100,000 among hospitalized patients by sex in Louisiana (LA), 1999-2008. M=Male, F=Female.

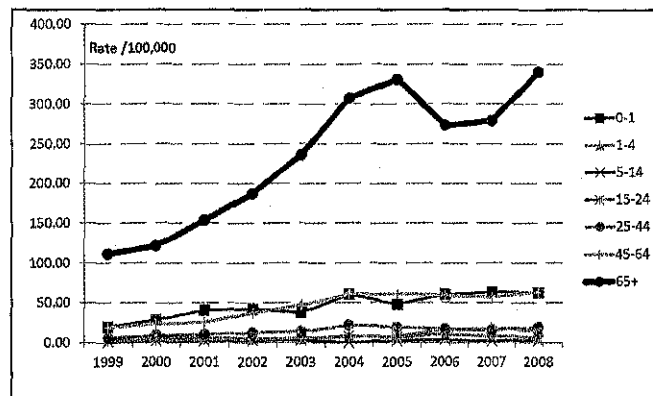


Figure 4. *Clostridium difficile* associated disease (CDAD) hospitalization rates per 100,000 by age in Louisiana (LA), 1999-2008.

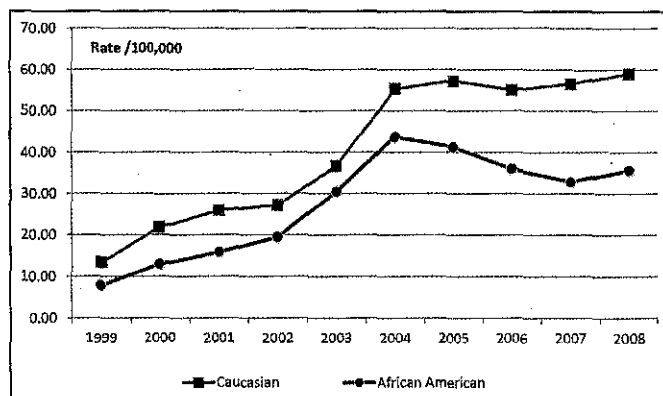


Figure 5. *Clostridium difficile* associated disease (CDAD) hospitalization rates per 100,000 by race in Louisiana, 1999-2008.

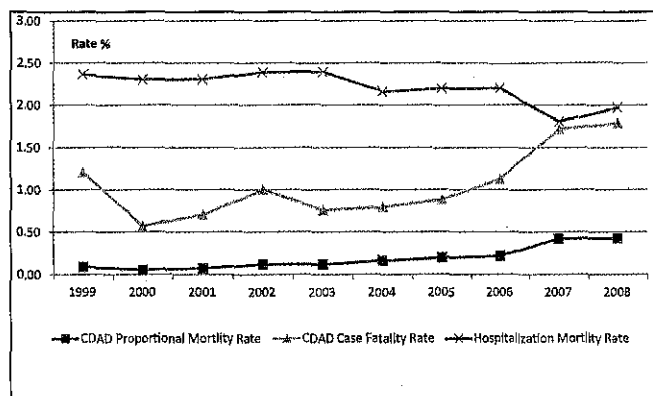


Figure 6. Mortality rates: all hospitalizations compared to *Clostridium difficile* associated disease (CDAD) proportional mortality and CDAD case fatality rates in Louisiana, 1999-2008.

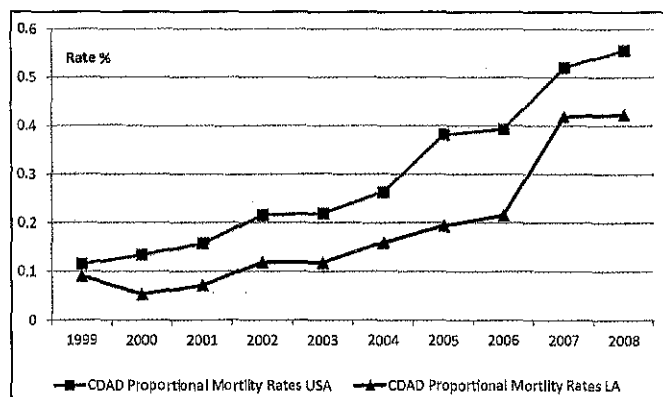


Figure 7. *Clostridium difficile* associated disease (CDAD) proportional mortality rates in the US and Louisiana (LA), 1999-2008.

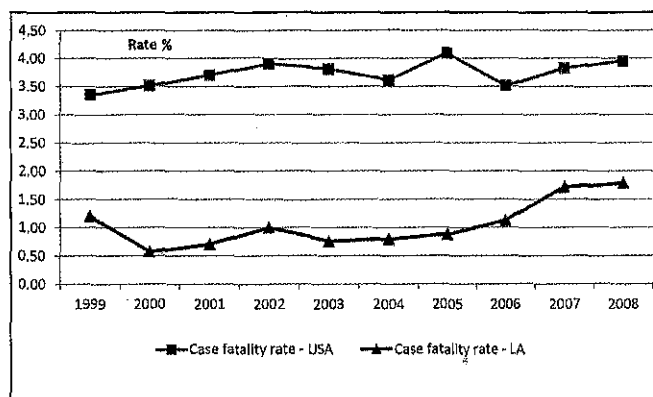


Figure 8. *Clostridium difficile* (CD) case fatality rates in the US and Louisiana (LA), 1999-2008.

and secondary diagnoses of CD between Louisiana and the US was statistically significant (F 171, P-value 1.12E-06, Multiple R 0.98 and F22, P-value 0.002, Multiple R 0.86, respectively) (Figure 2).

The rate of females with CDAD as a diagnosis was 1.4 times greater than the rate for males; however, both

groups experienced parallel increases from 1999 to 2008. The rate difference between sexes was statistically significant; females are more likely to have a CDAD compared to males, (p-value 0.03) (Figure 3).

The rate of CDAD in different age groups per 100,000 showed a large disparity between the elderly (65+)

compared to the rest of the population. The elderly had rate ratio differences ranging from five to 85 times compared to the other age groups in Louisiana, these differences were statistically significant (F 72, p-value 4.88E-24) (Figure 4).

Incidence rates of CDAD among hospitalized patients in Louisiana stratified by race indicate both increased - Caucasian rates per 100,000 were 1.5 times higher than African American rates between 1999 and 2008. However, this was not statistically significant (p-value 0.07) (Figure 5).

### CDAD Deaths

From 1999 to 2008, the average mortality rate during hospitalization in Louisiana was 2%. The average proportion of death attributed to CDAD during the past 10 years and CDAD deaths among all CDAD cases during the same time interval were 0.18% and 1.1%, respectively. Noteworthy, in the past 10 years hospital mortality rates have declined and CDAD mortality rates have risen from 1999 to 2008, but regression analysis still detect an inverse correlation between the two trends (F 44, P-value 0.0002, Multiple R 0.92). CDAD proportional mortality and case fatality rate trends are statistically significant over the past 10 years (F 34, P-value 0.0004, Multiple R 0.90) (Figure 6).

Louisiana and the US have statistically significant analogous trends in CDAD proportional mortality rates (F 98, P-value 9.23E-06, Multiple R 0.96) (Figure 7). However, their CDAD case fatality rates do not correlate, (F 0.46, P-value 0.52, Multiple R 0.233) (Figure 8).

### DISCUSSION

The national trends of CDAD (as reported by HCUP's national analyses) have been 1-doubling of CDAD cases from 2001-2005, and 2-higher severity and increased mortality. Louisiana is no exception to these trends. The case fatality rates did not correlate with the US for the entire period, but did show for the past three years a proportional increase similar as that of the US.

Louisiana had an overall increase in CDAD cases over the past 10 years; however, in 2006 and 2007 there was a subtle decline in CDAD cases. This was probably the result of a decline in all hospitalizations during that time frame, and was most likely the result of random variations over time. Additionally, Hurricane Katrina in 2005 caused shifts in the population, hospitals had to be closed, which most likely affected daily reporting procedures.

Health care workers are at greater risk of spreading CD if they do not wash their hands in between touching contaminated objects or individuals. CD is not killed by alcohol based hand sanitizer so strict adherence to hand washing with soap and water is imperative to reduce the risk of transmission. Additionally, surfaces of commonly used areas (bathrooms, kitchens, etc.) should be cleaned on a regular basis with household detergents or disinfectants. Continuous education on hospital health safety practices should continue to be a priority.

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