

Trends in Hospitalizations for Celiac Disease in the United States

Eric P. Borrelli*

University of Rhode Island College of Pharmacy, Kingston, Rhode Island, United States

*Corresponding author: ericborrelli@my.uri.edu

Abstract Celiac disease is a severe autoimmune disease that results in patients having an intolerance to gluten. Patients that have celiac disease and ingest gluten can have gastrointestinal related adverse effects. There is currently no cure or treatment for celiac disease outside of a diet consisting of strict adherence to a 100% gluten free diet. However, adherence to a strict gluten free diet is difficult and patients may consume food that is cross-contaminated with gluten which can cause adverse effects that can lead to medical treatment or hospitalizations. Currently, there is only limited published data detailing hospitalizations for celiac disease in the United States. This study analyzed trends in hospitalizations for celiac disease in the United States by utilizing the National Inpatient Sample (NIS) of the Healthcare Cost and Utilization Project net (HCUPnet) using the primary diagnosis code 579.0 celiac disease. The study analyzed total discharges, length of stay for hospitalizations from 1995-2014, as well as mean cost per hospitalizations from 2006-2014. Total number of hospital discharges for celiac disease was trending upward from 1995 to 2014 varied from a low of 391 discharges in 1996 to a high of 1405 in 2010. The mean length of stay varied from a high of 8.69 days in 1996 to a low of 4.88 days in 2014. The mean cost per hospitalization varied from a high of \$11,510 in 2013 to a low of \$9,247 in 2014. Until there is a cure or therapeutic treatments available, celiac disease will continue to cause hospitalizations and contribute to the cost of healthcare in the United States.

Keywords: *celiac disease, acute, presentation*

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1. Introduction

Celiac disease (CD) is a severe autoimmune disease that causes patients to have an intolerance to gluten. Several studies have indicated that in the United States, around 0.5 to 1 percent of the population has CD [1,2,3]. Although the median age of diagnosis of CD is around 50 years old, studies indicate there is a similar number of patients diagnosed below the age of 18 compared to patients above the age of 65 [4,5,6]. There are many potential symptoms associated with CD and some of the most common include diarrhea, weight loss, and abdominal pain [7]. Malabsorption of important nutrient such as vitamin b12, calcium, and iron is common and along with the diarrhea and weight loss may be some of the reasons that patients with CD have growth issues and tend to be short in stature [7,8,9,10]. Evidence supports the theory that CD can be hereditary and occurs in patients who have Human Leukocyte Antigens (HLA) HLA-DQ2 and HLADQ8 haplotypes [11,12,13]. In severe cases, CD can lead to digestive cancers which can be fatal [14]. There is increasing evidence that patients with celiac disease are at a higher risk of having additional autoimmune diseases such as Hashimoto's thyroiditis, Grave's disease, type 1 diabetes mellitus (T1DM), inflammatory bowel disease (IBD) and Crohn's disease [15,16,17,18]. There is currently no cure for CD. As of

now, there is also no currently approved therapeutic medication for CD, however, there are some therapeutic agents currently in clinical trials. The only therapy available for CD is a strict adherence to a 100% gluten free diet [19]. Compliance with a strict gluten free diet can be difficult as foods can be contaminated with traces of gluten in the process of preparing. Even some products like prescription or over-the-counter (OTC) medications may contain gluten and result in adverse reactions and events. In some instances, these adverse reactions may require medical treatment and/or hospitalizations. Several studies have been completed trying to analyze the cost burden of CD [20,21,22]. One study in the United States analyzed the cost of hospitalizations for CD for the year of 2014 and discovered that the mean cost per hospitalization was \$9,247 and the national aggregate cost was \$7,413,355 [20]. There is limited data analyzing the cost and description of hospitalizations in the United States for CD. This study tried to analyze and describe the recent trends of hospitalizations for CD in the United States.

2. Methods

To evaluate the trends in hospitalizations in the U.S. for CD, an analysis of the United States National Inpatient Sample (NIS) was conducted utilizing the Healthcare Cost and Utilization Project Net (HCUPnet) [23]. The primary diagnosis code of 579.0, celiac disease, for the years

1995-2014 was examined in the analysis. The Agency for Healthcare Research and Quality (AHRQ) is a federal agency within the United States Department of Health and Human Services (HHS). AHRQ sponsors HCUP and HCUPnet. HCUPnet is a free online query system available to the public that provides information and statistics on hospitalizations and emergency room visits in the United States [24]. The outcomes examined in the analysis annually were total number of discharges, mean length of stay (LOS) in days, and mean cost per hospitalization in U.S. dollars. The cost per hospitalization is only available via HCUPnet starting in the year 2006, therefore, the analysis of annual mean cost had to be adjusted to the timeframe of 2006-2014. All costs were adjusted to 2014 United States dollars using the Gross Domestic Product (GDP) health expenditure price index [25].

3. Results

3.1. Trends in Number of Discharges

The time frame from 1995-1998, which was the first four years that we measured, had the four lowest numbers of annual discharges for CD (Table 1). There were 476 discharges in 1995, 391 discharges in 1996, 510 discharges in 1997, and 476 discharges in 1998 (Figure 1). The number of annual discharges then rose every year over the course of seven-year span from 2000-2006 with 667 discharges in 2000 and 1286 discharges in 2006. In 2010, there were 1,405 discharges which was the most of any year during this 20-year span. The following four years resulted in an annual decrease each subsequent year with there being 1,151 discharges in 2011, 1,015 discharges in 2012, 985 discharges in 2013, and 805 discharges in 2014.

3.2. Trends in Length of Stay

The length of stay for hospitalizations for CD has decreased over the 20-year span from what was first

looked at in 1995 compared to where it ended in 2014 (Figure 2). The length of stay was highest during the first five years analyzed from 1995-1999. The length of stay per hospitalization per year during this time frame was 7.76 days in 1995, 8.69 days in 1996, 7.97 days in 1997, 8.37 days in 1998, and 8.02 days in 1999 with the year of 1996 having the highest mean length of stay out of any year during this 20-year span. The length of stay decreased every year over a seven-year span from 1998-2004 with length of stay decreasing to 5.32 days in 2004. The length of stay rose each of the next two years to 6.67 days in 2005 and 6.82 days in 2006. Then, over another seven-year span from 2006-2012, the length of stay decreased every year to 5.32 days per hospitalization in 2012. The length of stay rose in 2013 to 5.85 days before decreasing to its lowest value during the 20-year span of 4.88 days in 2014.

Table 1. Total U.S. Inpatient Hospital Discharges for Celiac Disease from 1995-2014

Year	Number of Discharges	Length of Stay (Days)
1995	476	7.76
1996	391	8.69
1997	510	7.97
1998	476	8.37
1999	783	8.02
2000	667	7.18
2001	770	6.78
2002	811	6.32
2003	966	6.39
2004	1011	5.32
2005	1196	6.67
2006	1286	6.82
2007	1212	6.25
2008	1162	6.01
2009	1194	5.95
2010	1405	5.53
2011	1151	5.52
2012	1015	5.32
2013	985	5.85
2014	805	4.88

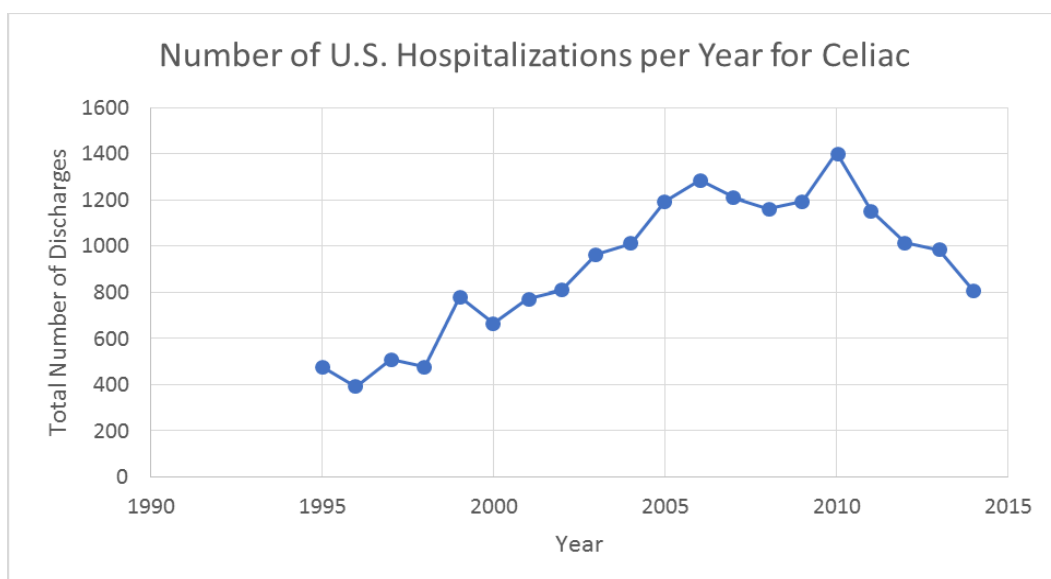


Figure 1. Number of U.S. Hospitalizations for Celiac Disease per Year

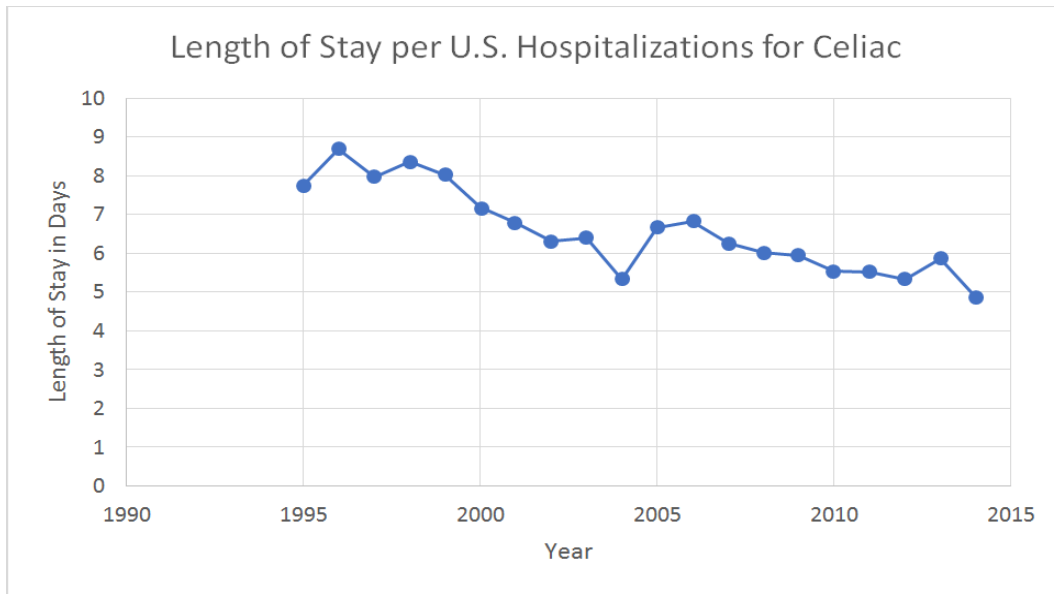


Figure 2. Mean Length of Stay per Hospitalizations per Year in the United States from 1995-2014

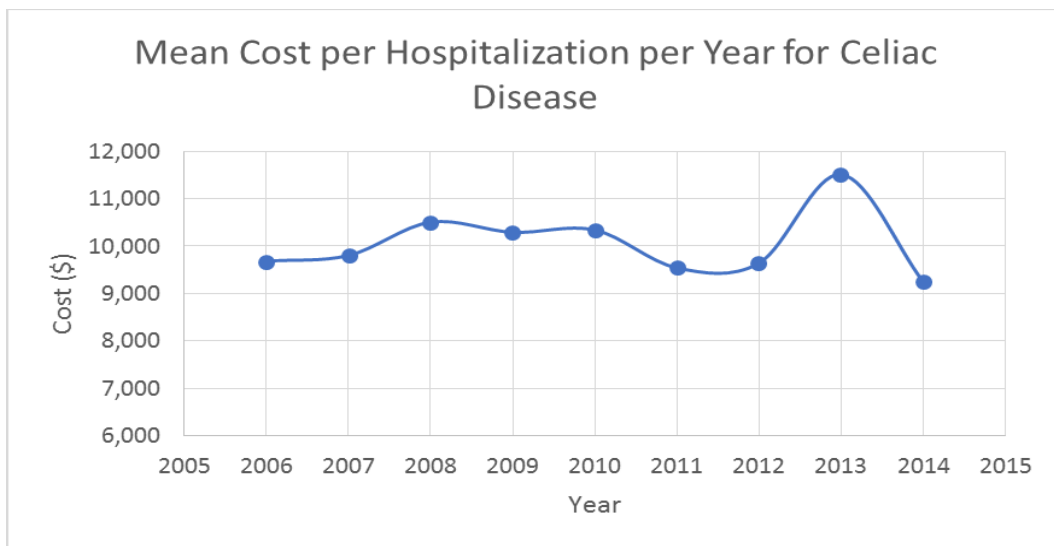


Figure 3. Mean Cost per Hospitalization per Year for Celiac Disease in the United States from 2006-2014

3.3. Trends in Mean Cost

The mean cost per hospitalization was similar between the nine years after being adjusted to 2014 U.S. dollars (Table 2). The costs varied between a low of \$9,427 in 2014 and a high of \$11,510 in 2013 (Figure 3). The rest of the years the mean cost per hospitalization varied by less than \$1,000 (\$9,543 to \$10,506).

Table 2. Mean Cost per Hospitalization for Celiac Disease per Year from 2006-2014

Year	Mean Cost (\$)
2006	9,684
2007	9,805
2008	10,506
2009	10,293
2010	10,341
2011	9,543
2012	9,644
2013	11,510
2014	9,247

4. Discussion

This study tried to describe the trend in number of hospital discharges for CD in the United States over a twenty-year period and the trends in mean cost of hospitalization in the U.S. over a 9-year period. The number of hospitalizations for CD was trending upward from the beginning of the study timeframe of 1995 until 2010. After 2010, the trend for hospitalizations has been decreasing. The increasing trend until 2010 supports previous studies which indicate the increasing prevalence and diagnosis of CD in the United States and north America [26]. This study indicates that the LOS for CD has been trending downward from the beginning of the study timeframe until the end (1995-2014). This increase of diagnosis may be due to several factors such as improvement of physician awareness of CD, advancement in diagnostic technology, and/or environmental and dietary factors [1,26,27,28,29]. The increase in physician awareness may also lead to earlier the diagnosis, and therefore the sooner the treatment can begin which would

lead to a shorter hospitalization stay. Outside of the fluctuation in mean hospital costs between 2013 and 2014, the mean costs per hospitalization stayed constant with little variation. Evidence shows that LOS and cost per hospitalization go together and if there was a decrease in LOS, cost would expect to decrease as well [20,24,30,31,32]. For this study, although LOS trended downward, costs stayed relatively the same. Further research is needed to analyze what may have caused the deviation from the norm.

5. Conclusion

Over a twenty-year period, the number of hospitalizations in the United States for CD was trending upward from 1995 until the year 2010 which they started trending downward until 2014. The LOS for hospitalization in the U.S. for CD was trending downward from 1995 until 2014. Mean costs per hospitalization for CD stayed fairly constant for a 7-year period of 2006 through 2012 until they considerably increased in 2013, then came back down in 2014 to the previous range. Further research is needed to analyze the cost burden of CD on the United States healthcare system. With no approved medication treatments or cures, CD will continue to cause hospitalizations and contribute to the cost of healthcare in the United States.

Statement of Competing Interests

The author has no financial funding or conflict of interest to disclose.

List of Abbreviations

CD: Celiac disease; GI: gastrointestinal; T1DM: Type 1 Diabetes Mellitus; IBD1: irritable bowel disease; NIS: National Inpatient Sample; HCUP: Healthcare Cost and Utilization Project; AHRQ: Agency for Healthcare Research and Quality; HHS: Health and Human Services; LOS: length of stay; GDP: Gross domestic product

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