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Trends in the Incidence of *Clostridioides difficile* Infection in Adults and the Elderly Insured by Medicaid Compared to Commercial Insurance or Medicare Only

Margaret A. Olsen, PhD, MPH^{1,2}, Dustin Stwalley, MS¹, Andrew D. Tipping, MA^{1,*}, Matthew R. Keller, MS¹, Holly Yu, MSPH³, Erik R. Dubberke, MD, MSPH¹

¹Department of Medicine, Washington University School of Medicine, St. Louis, MO

²Department of Surgery, Washington University School of Medicine, St. Louis, MO

³Pfizer Inc., Pearl River, NY

Abstract

Objective: Few data are available to quantify the *Clostridioides difficile* infection (CDI) burden in U.S. adults depending on Medicaid insurance status.

Methods: Retrospective cohort study to identify adults coded for CDI from 2011–2017 in MarketScan Commercial and Medicaid (25–64 years) and CMS Medicare (≥ 65 years) databases. CDI was categorized as healthcare facility (HCA) and community associated (CA). CDI incidence rates were compared by year, insurer, and age group.

Results: The overall CDI incidence in the elderly was 3.1-fold higher in persons insured by Medicare + Medicaid compared to Medicare only (1,935 vs. 618/100,000 PY), and 2.7-fold higher in younger adults with Medicaid compared to commercial insurance (195 vs. 73/100,000 PY). From 2011–2017 HCA-CDI rates declined in the younger Medicaid population (124.0 to 95.2/100,000 PY, $p < 0.001$), but were stable in those commercially insured (25.9 to 24.8/100,000 PY, $p = 0.33$). In the elderly HCA-CDI rates declined from 2011–2017 in the Medicare only (403 to 318/100,000 PY, $p < 0.001$) and Medicare + Medicaid populations (1,770 to 1,163/100,000 PY, $p < 0.002$). Persons with chronic medical and those with immunocompromising conditions insured by Medicaid had 2.8- and 2.7-fold higher CDI incidence compared to the commercially insured, respectively. The incidence of CDI was lowest in Medicaid and commercially insured younger adults without chronic medical or immunosuppressive conditions (67.5 and 45.6/100,000 PY, respectively).

Conclusions: Although HCA CDI incidence decreased from 2011–2017 in elderly and younger adults insured by Medicaid, the burden of CDI remains much higher in low income adults insured by Medicaid.

Primary contact: Margaret A. Olsen, PhD, MPH, Division of Infectious Diseases, Washington University School of Medicine, 4523 Clayton Ave., St. Louis, MO 63110, Phone: 314-454-8320, Fax: 314-454-5392, molsen@wustl.edu. Secondary contact: Erik R. Dubberke, MD, MSPH, Division of Infectious Diseases, Washington University School of Medicine, 4523 Clayton Ave., St. Louis, MO 63110, Phone: 314-454-8296, Fax: 314-454-5392, edubberk@wustl.edu.

*Current address: Missouri Institute of Mental Health, St. Louis, MO

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Clostridioides difficile is the most common cause of healthcare-associated infection and increasingly recognized as an important pathogen in the community.¹ Using laboratory data from ten states participating in the Emerging Infections Program (EIP), the Centers for Disease Control and Prevention (CDC) estimates there were over 462,000 cases of *C. difficile* infection (CDI) in 2017.² CDI is associated with increased risk for hospitalization, skilled nursing care, long-term care facility transfer, healthcare costs, and death.^{3–6} Much remains unknown regarding risk for CDI in younger adults, since most studies focus on infection in the elderly. In addition, there are few data about risk of CDI in adults insured by the Medicaid program, who have higher comorbidity burden compared to adults in general.^{7,8} Better understanding of CDI burden in younger adults and in those insured by Medicaid is needed to develop newer prevention strategies that can be applied to not just the elderly, but also to younger and medically vulnerable adults.^{9,10}

The IBM MarketScan[®] Commercial and Multi-State Medicaid Databases include inpatient and outpatient medical claims that can be used to study persons <65 years old. The Chronic Condition Warehouse database contains medical claims for persons enrolled in fee-for-service Medicare plans. We used these data to determine CDI incidence based on type of health insurance in U.S. adults from 2011–2017.

METHODS

This study employed a retrospective cohort design using the 2010–2017 Medicare Chronic Condition Warehouse 5% random sample and the IBM[®] MarketScan[®] Commercial and Multi-State Medicaid Databases. Eligibility criteria for the MarketScan populations included age 25–64 years and for the Medicare population age 65 and older with Parts A and B fee-for-service and no health maintenance organization enrollment. Persons with continuous enrollment in Medicare but no claims during the study time frame were excluded, to ensure persons were alive and using their health benefits.

Patients coded for CDI from 2011–2017 were identified using ICD-9-CM diagnosis code 008.45 and ICD-10-CM diagnosis codes A04.71 and A04.72 in the Inpatient, Outpatient Services, or Facility Header files (MarketScan), and the Inpatient, Outpatient, Carrier (i.e., physician) or Skilled Nursing Facility files (Medicare). The date of CDI onset was defined as the first date with a coded diagnosis of CDI, unless coding for diarrhea or claims for bacterial stool cultures or *C. difficile* testing were available to define an earlier onset.¹¹ To avoid misclassification of recurrent CDI as an incident case, at least 84 consecutive days without coding for CDI was required to be eligible for another incident CDI episode.

The MarketScan and Medicare populations were divided into groups based on enrollment in Medicaid (using dual status indicators in the Medicare data). CDI episodes were categorized as healthcare-associated (HCA, including hospital-onset, other facility onset, healthcare facility associated, and indeterminate classification) or community-associated (CA) using standard surveillance definitions,¹² as described previously.¹³ Long-term care facility stay was identified in the Medicare data using the Centers for Medicare & Medicaid Services Minimum Data Set v3.0 assessment of nursing home patients. For the MarketScan data we used a validated algorithm to identify residents of long-term care facilities.¹⁴ We categorized

CDI as hospitalized if CDI was coded during a hospitalization, or non-hospitalized if CDI was diagnosed and treated solely outside of a hospitalization.

To determine subgroups at higher risk of CDI in the MarketScan population we calculated one-year CDI incidence rates from 2012 to 2017 based on coding for chronic medical, immunocompromising, or neither chronic medical nor immunocompromising conditions in the first year of insurance enrollment beginning in 2011.^{15,16} Chronic medical and immunosuppressive conditions included those identified as indications for pneumococcal vaccination in non-elderly adults.¹⁷ In calculation of CDI incidence, individuals coded for both chronic medical and immunocompromising conditions were counted only in the immunocompromising category.

Statistical Analysis

CDI incidence rates were calculated using all person-years (PY) of observation from 2011–2017 and individually for each year by insurer and by age group. Comparisons of incidence rates by age group and year were performed using PROC Genmod in SAS software (Cary, NC) with Poisson link and offset using $\log(\text{PY})$.¹⁸ Tests for linear trend were performed using PROC GLM. Comparisons of incidence rates between commercially- and Medicaid-insured individuals were performed using MedCalc Version 20.018 Software (MedCalc Software Ltd., Ostend, Belgium).

The prevalence of chronic medical and immunosuppressive conditions in the MarketScan Medicaid compared to commercial populations was determined using two one-sided t-tests (TOST) in SAS using PROC TTEST. The null hypothesis for the TOST test is that prevalence values are different, and thus a significant result indicates equivalence. We used equivalence ranges of $\pm 2.5\%$ and $\pm 5.0\%$ for conditions with prevalence $< 10\%$ and $> 10\%$, respectively.¹⁹

RESULTS

From 2011–2017, 78,166 CDI episodes were identified in 71,668 elderly persons in the Medicare data, for an overall incidence of 798/100,000 PY. Of this, 52,242 episodes occurred in persons insured by Medicare only and 25,924 in persons dually insured by Medicare + Medicaid. Approximately 27% of the younger Medicaid population were Black, and in the elderly population 14% of persons insured by Medicare + Medicaid were Black compared to 4.5% of the Medicare only population (Table 1). The overall incidence from 2011–2017 was 618/100,000 PY in persons insured by Medicare alone and 3.1-fold higher (1,935/100,000 PY) in persons dually insured by Medicare + Medicaid ($p < 0.001$). In the same time period, 102,240 CDI episodes were identified in 90,587 persons aged 25–64 years in the MarketScan Commercial, and 28,024 episodes in 24,047 persons in the Medicaid database. The overall incidence from 2011–2017 in younger adults was 73/100,000 PY in commercially insured and 2.7-fold higher (195/100,000 PY) in those insured by Medicaid ($p < 0.001$). CDI incidence by year and Medicaid status for the two populations are shown in Supplemental Table 1.

Incidence of Healthcare and Community Associated CDI

HCA-CDI rates declined significantly from 2011–2017 in the MarketScan Medicaid population (124.0 to 95.2/100,000 PY, $p = 0.028$), but remained stable in the commercially insured population (25.9 to 24.8/100,000 PY, $p = 0.85$, Figure 1A, Supplemental Table 2). The percentage of CDI cases categorized as HCA decreased from 67.6% to 56.8% in those insured by Medicaid and from 42.5% to 31.6% in the commercially insured (Supplemental Figure 1). In the Medicare population, HCA-CDI rates declined significantly from 2011–2017 in both the Medicare only (403 to 318/100,000 PY, $p < 0.001$) and Medicare + Medicaid populations (1,770 to 1,163/100,000 PY, $p = 0.002$, Figure 1B, Supplemental Table 2). CA-CDI rates increased slightly from 2011–2017 in the MarketScan Medicaid population (59.4 to 72.5/100,000 PY, $p = 0.14$) but more substantially in the commercially insured population (35.0 to 53.7/100,000 PY, $p = 0.003$, Figure 1C, Supplemental Table 2). CA-CDI rates increased significantly in the Medicare only population (197 to 297/100,000 PY, $p < 0.001$), but did not change in the Medicare + Medicaid-insured population from 2011–2017 (347 to 358/100,000 PY, $p = 0.62$, Figure 1D, Supplemental Table 2).

Incidence of Healthcare and Community Associated CDI by Age Group

Incidence rates of HCA from 2011–2017 by age group are shown in Figure 2 and Supplementary Table 3. The incidence of HCA-CDI rose significantly with age in younger and elderly persons insured by Medicaid. The HCA CDI incidence rates were lowest in commercially insured younger adults in all years. The reduction in HCA incidence in those insured by Medicaid from 2011–2017 was most pronounced in the older age groups in both the younger adult (50–64 years) and elderly (75 and older) populations.

Rates of CA-CDI increased with age in younger commercially and Medicaid insured adults and elderly persons insured by Medicare only (Figure 3, Supplemental Table 4). Although CA CDI rates increased with age in older Medicare + Medicaid dually insured adults, the trend of increasing rates with age was not significant from 2014–2016.

Incidence of CDI Treated During a Hospitalization

Rates of CDI treated in-hospital in the younger Medicaid-insured MarketScan population decreased from 151.9 in 2011 to 116.8/100,000 PY in 2017 ($p = 0.022$). In contrast, rates of CDI treated in-hospital in the commercially insured population were stable from 2011 to 2017 (35.8 to 36.6/100,000 PY, respectively, $p = 0.28$). In the Medicare + Medicaid population rates of CDI treated in-hospital decreased significantly from 2011–2017 (1,201 to 778/100,000, $p = 0.004$), while CDI treated in-hospital in the Medicare only population decreased from 363 to 299/100,000 PY during this time frame ($p = 0.007$, Supplemental Figure 2, Supplemental Table 5).

Incidence of CDI in Younger Adults with and without Chronic Medical and Immunosuppressive Condition

To further investigate disease burden in the younger MarketScan population by payer we determined the prevalence and CDI incidence in persons coded for chronic medical and immunocompromised conditions. For comparison we determined CDI incidence in persons with neither chronic medical nor immunocompromised conditions.

The prevalence of chronic medical conditions was 17.2% in persons aged 25–64 insured by Medicaid compared to 8.6% in the commercially insured (nonequivalent, 5% threshold). The prevalence of immunocompromising conditions was slightly higher but equivalent in persons insured by Medicaid compared to commercially insured (4.7% and 3.6%, respectively). The prevalence of chronic medical conditions increased progressively with age, with prevalence 2.2–2.8-fold higher in the Medicaid compared to commercially insured population (Figure 4). The prevalence of immunocompromising conditions was similar in those aged 25–34 years, but increased with age more in the MarketScan Medicaid compared to commercially insured persons (Medicaid:private prevalence ratios 1.9 and 1.8 in the two older age groups, Figure 4).

CDI incidence in those with chronic medical conditions was 2.8-fold higher in persons insured by Medicaid compared to commercially insured persons (432.7 vs. 156.1 PY, $p < .001$, Table 2). Similarly, the incidence of CDI was 2.7-fold higher in persons insured by Medicaid with an immunocompromising condition(s) compared to commercially insured persons (1359.9 vs. 504 PY, $p < .001$, Table 2). The incidence of CDI was much lower in persons with neither a chronic medical nor immunocompromised condition in both the Medicaid and commercially insured populations (67.6 and 45.6/100,000 PY, respectively). CDI incidence rates for all individual conditions were significantly higher in persons with Medicaid compared to commercial insurance (Table 2).

CDI incidence in persons with chronic medical conditions increased significantly with age ($p = 0.002$ in commercially-insured and $p < 0.001$ in the Medicaid-insured), although CDI incidence in all ages was higher in the Medicaid- than commercially-insured population (ranging from 2.3–3.6-fold, Figure 5). In contrast, CDI incidence in those with immunocompromised conditions increased slightly with age in the Medicaid population ($p = 0.05$) but was stable with increasing age in those commercially-insured ($p = 0.70$). As with chronic medical conditions, the incidence of CDI was much higher in Medicaid compared to commercially-insured persons with immunocompromised conditions in all age groups (ranging from 2.0–3.2-fold). Although CDI incidence increased with age in both commercially and Medicaid-insured persons with neither chronic medical nor immunocompromising conditions (both $p < .001$), the incidence rate ratio in those aged 60–64 vs. 25–29 years was greater in those insured by Medicaid (3.7) than commercially insured (2.5, Figure 5).

DISCUSSION

In this study we found that the overall burden of CDI from 2011–2017 was 3-fold higher in lower-income U.S. elderly persons dually insured by Medicare + Medicaid compared to elderly persons insured by Medicare only, and 2.7-fold higher in the younger population of Medicaid recipients compared to those privately insured. The yearly incidence of CDI declined substantially in elderly persons insured by Medicare + Medicaid, with a smaller decline in younger persons insured by Medicaid, due to decreases in HCA CDI. Similarly, rates of CDI resulting in a hospitalization declined by approximately one-third from 2011–2017 in both younger and elderly persons insured by Medicaid, with a smaller decrease in older persons insured by Medicare only. In younger commercially insured and elderly

persons with Medicare insurance only, CA CDI rates increased about 50% from 2011–2017. CA-CDI incidence also increased about 20% in younger adults with Medicaid insurance, but remained relatively stable in the elderly insured by both Medicare + Medicaid.

Higher risk of CDI in elderly persons dually insured with Medicaid, an indicator of low socioeconomic status, has been reported previously.³ Using New Mexico EIP data, Hudspeth found higher incidence of community-acquired CDI in census tracts with a higher proportion of uninsured persons and in Black and American Indian/Native Alaskan men and women.²⁰ Using 2014–2015 EIP data Skrobarcek found higher CA-CDI rates in lower-income U.S. census tracts and in tracts with a higher percentage of persons publically insured.²¹ Our work expands on these findings by demonstrating higher risk of CDI in both younger and elderly persons insured by Medicaid, including higher risk of HCA CDI across the age span in persons insured by Medicaid.

To investigate the higher CDI burden in younger adults insured by Medicaid, we determined the prevalence of chronic medical and immunocompromising conditions. We found the prevalence of chronic medical conditions was almost three-fold higher in adults aged 25–54 insured by Medicaid compared to those commercially insured, and the prevalence of immunocompromising conditions was almost 2-fold higher in Medicaid-insured adults aged 45–64 compared to those commercially insured. This is consistent with prior findings that more than 50% of non-elderly adults insured by Medicaid have at least one chronic condition, which is higher than the overall burden of chronic conditions in all adults (including the elderly).^{7,8} In analyses of CDI burden we found that the incidence of CDI was almost 3-fold higher in Medicaid-insured younger adults with a chronic medical condition(s) or with an immunocompromising condition compared to commercially insured adults. Medicaid- and commercially-insured younger adults without a chronic medical or immunocompromising condition had much lower incidence of CDI. The incidence of CDI increased substantially with age in persons with chronic medical conditions, especially in the Medicaid population. The finding of increased burden of CDI in persons with immunocompromising conditions is not surprising, since it is known that persons with diseases such as leukemia/lymphoma, end-stage renal disease, and others are at high risk of CDI.^{22,23} We speculate that the increased burden of CDI in persons with chronic medical conditions, particularly those insured by Medicaid, is likely due to high exposure to antibiotics. Antibiotic utilization is higher in persons with some chronic medical conditions (e.g., diabetes, chronic kidney disease, chronic lung disease, including asthma) than in persons without those conditions,^{23–26} even in the absence of documented infection.²⁷ The increased antibiotic exposure could explain the increased CDI incidence in these persons, particularly in comparison to those without a chronic medical or immunocompromising condition.

During the same time period as our study, the CDC EIP surveillance reported a decrease in HCA CDI from 93 to 67/100,000 persons, and corresponding increase in CA CDI (from 48 to 63/100,000 persons).² A similar increase in CA CDI occurred in Quebec from 2008 to 2015.²⁸ Consistent with the reported increase in CA CDI, the proportion of community acquired CDI in patients admitted to a Southeastern network hospital increased from 49% in 2013 to 61% in 2017.²⁹ The percentage of CDI categorized as CA also increased in

Veteran's Administration patients aged 18–64 years, ranging from 41% in 2011 to 56% in 2016, with higher CA proportions in younger compared to older veterans.³⁰

We found that the decrease in overall CDI incidence during this time period in persons insured by Medicaid was due to decrease in HCA CDI. In the Medicare-only population the decline in HCA rates from 2011 to 2017 was offset by the increase in CA CDI incidence, such that the overall CDI incidence increased slightly. Among persons insured by Medicaid, the decreases in HCA CDI incidence were most pronounced in the oldest age groups (50–64 years in the younger population and 75 years and older in the elderly). Similarly, we found that the incidence of CDI treated during a hospitalization decreased significantly in persons insured by Medicaid from 2011 to 2017 in both the younger population and elderly dually insured by Medicaid + Medicare, but changed only slightly for commercially and Medicare-only insured individuals.

The observed decrease in HCA CDI rates may be due in part to implementation of antibiotic stewardship programs in U.S. hospitals. By 2017 76% of acute care hospitals reported meeting the CDC's core stewardship elements, compared to 41% in 2014.^{31,32} Several investigators have found an association of antibiotic stewardship programs with decreased hospital-onset CDI,^{33–35} which may explain the decrease we and others noted in HCA CDI in recent years. In contrast, antibiotic stewardship programs have gained much less traction in the outpatient setting,^{36,37} despite the fact that the majority of antibiotics are prescribed in ambulatory settings and an estimated 30–50% of these antibiotic prescriptions are considered inappropriate.^{27,38} We speculate that the increased CA CDI rates, particularly in younger commercially insured and older persons with only Medicare coverage, may be due to continued over-utilization of antibiotics in the community, in addition to increasing use of nucleic acid amplification tests (NAAT), associated with increased CDI test positivity when used as a single test.³⁹ Although NAATs have been increasingly used for CDI testing in hospitals, the widespread implementation of antibiotic stewardship and also diagnostic stewardship programs may have indirectly resulted in less testing for CDI in hospitalized patients,^{40,41} contributing to the decrease in HCA rates observed in our study and by others.

Limitations of our study were the identification of CDI using ICD-9/10 diagnosis codes, which may result in inaccuracy, lack of information on antibiotic utilization in hospitals, and incomplete availability of outpatient prescriptions. The similarity of our overall calculated CDI incidence rates to those reported by the EIP system suggests that inaccuracy in CDI identification based on diagnosis codes was likely minimal. Our analyses of CDI incidence in the elderly was restricted to the fee-for-service population, and thus may not be generalizable to the elderly insured by Medicare Advantage plans.

The finding of higher risk in Medicaid-insured younger adults with underlying chronic medical conditions and in both commercially and Medicaid-insured younger adults with immunocompromising conditions is particularly important, suggesting heightened awareness of CDI risk and increased emphasis on appropriate utilization of antibiotics are needed in these medically vulnerable persons. Additional broad-based strategies to prevent CDI, including vaccination, are urgently needed to prevent morbidity and mortality, particularly in lower income persons.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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POTENTIAL CONFLICTS OF INTEREST

Margaret A. Olsen: Dr. Olsen reports receipt of grant funding from Pfizer in the past 36 months and personal fees from Pfizer for consulting work.

Dustin Stwalley: Mr. Stwalley reports stock ownership in Abbvie, Inc. and Bristol-Myers Squibb.

Erik R. Dubberke: Dr. Dubberke reports receipt of grant funding from Pfizer, Synthetic Biologics, and Ferring in the past 36 months and personal fees from Ferring, Rebiotix, Summit, Merck, Pfizer, and Seres.

Holly Yu: Ms. Yu is an employee of Pfizer, Inc.

None of the other authors report any conflicts of interest.

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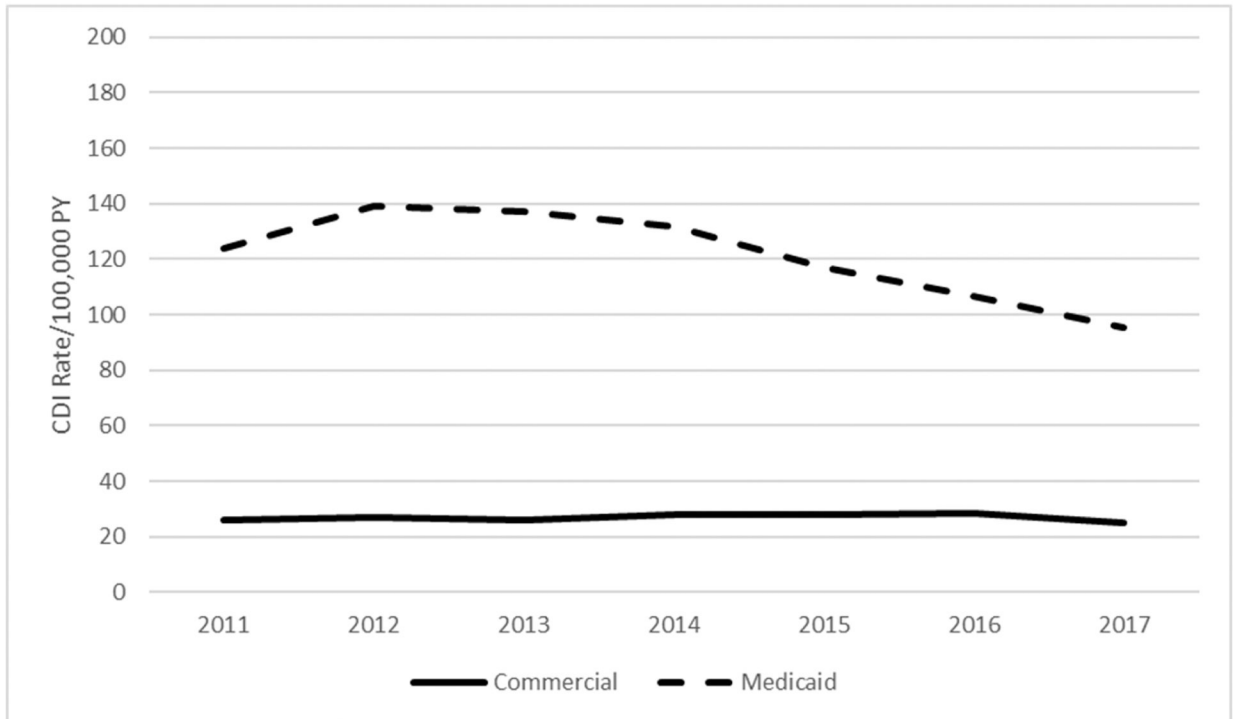
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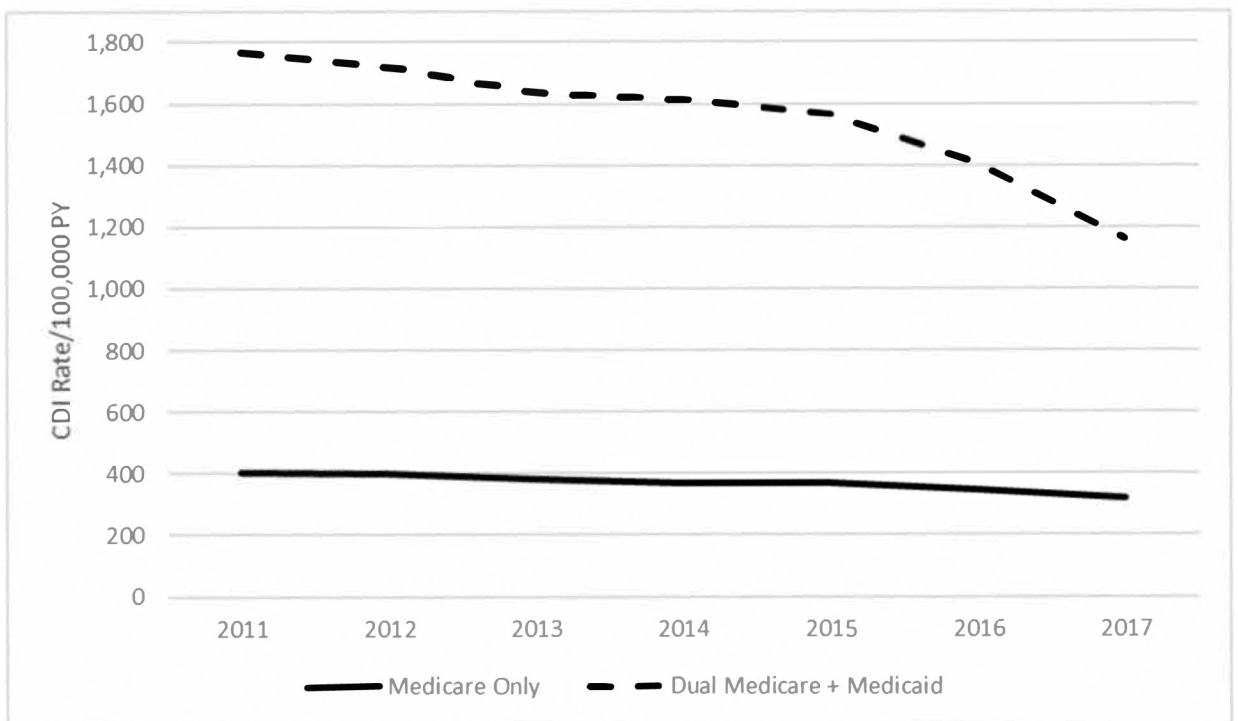
Key Points:

The incidence of *Clostridioides difficile* infection in US adults was significantly higher in persons insured by Medicaid compared to non-Medicaid plans. The incidence of healthcare facility associated CDI decreased from 2011–2017, particularly in persons insured by Medicaid.

A



B



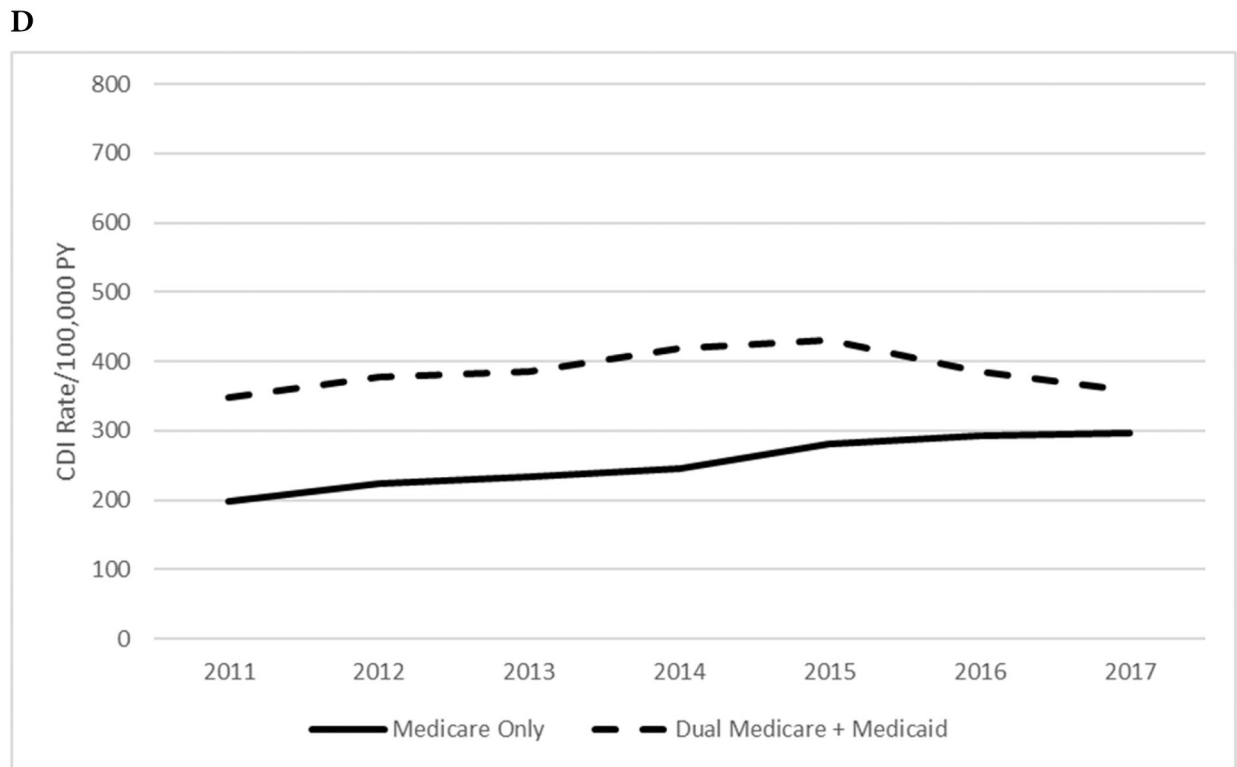
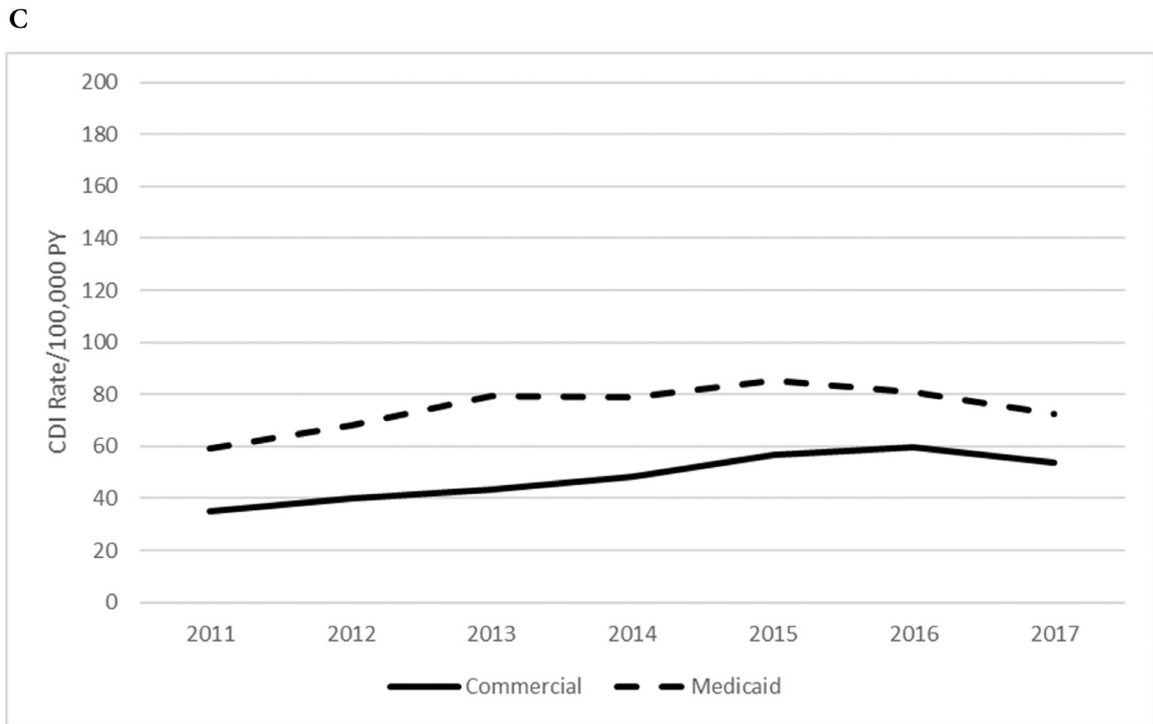


Figure 1. Healthcare Associated and Community Associated CDI Rates/100,000 Person Years of Observation, 2011–2017

- A. MarketScan aged 25–64 years, Healthcare associated CDI
- B. Medicare aged 65 years and older, Healthcare associated CDI
- C. MarketScan aged 25–64 years, Community associated CDI
- D. Medicare aged 65 years and older, Community associated CDI

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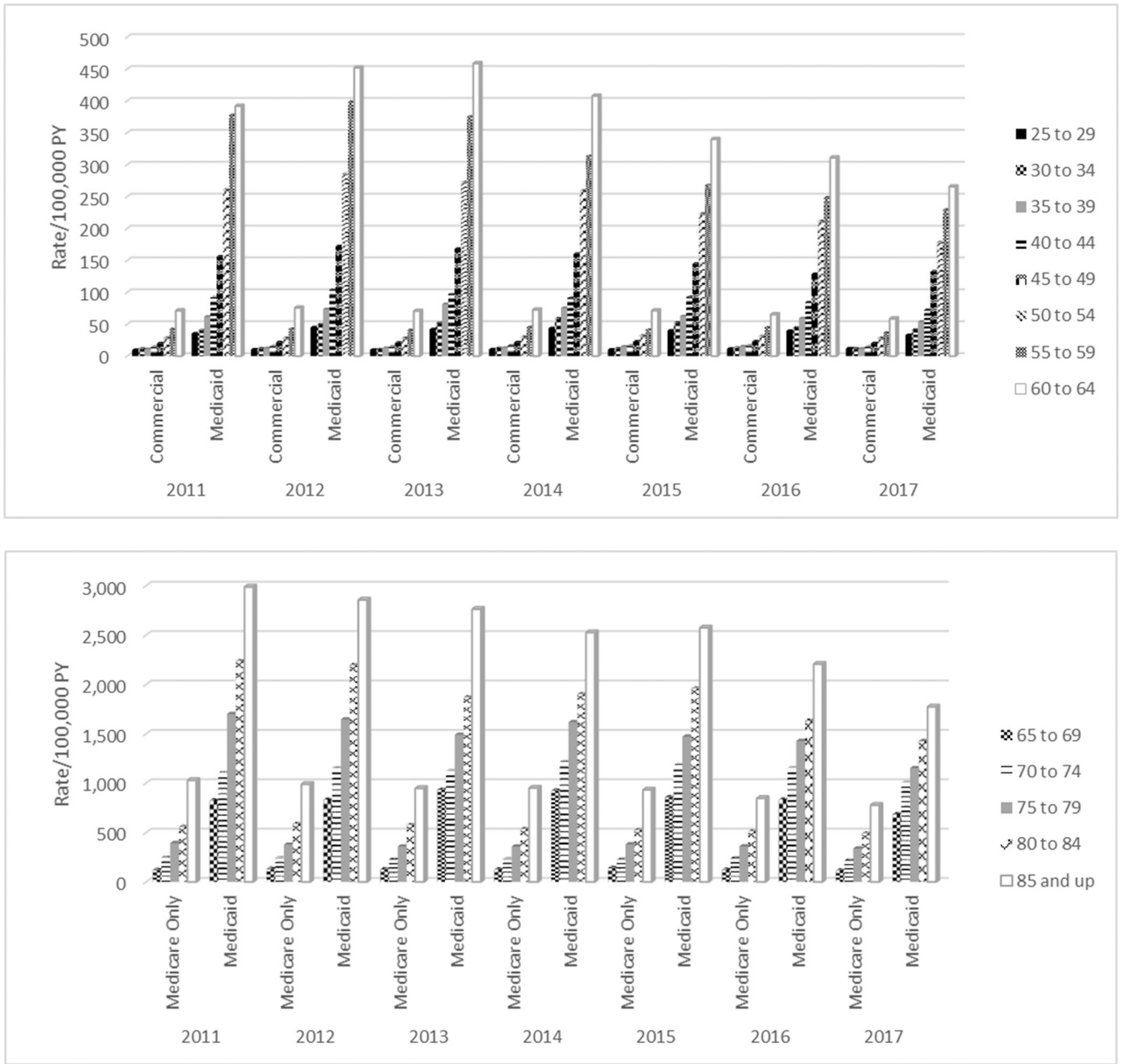


Figure 2. Healthcare Associated CDI Rates, 2011–2017, by Age Group and Insurer
A. MarketScan Aged 25–64 Years B. Medicare Aged 65 Years and Older

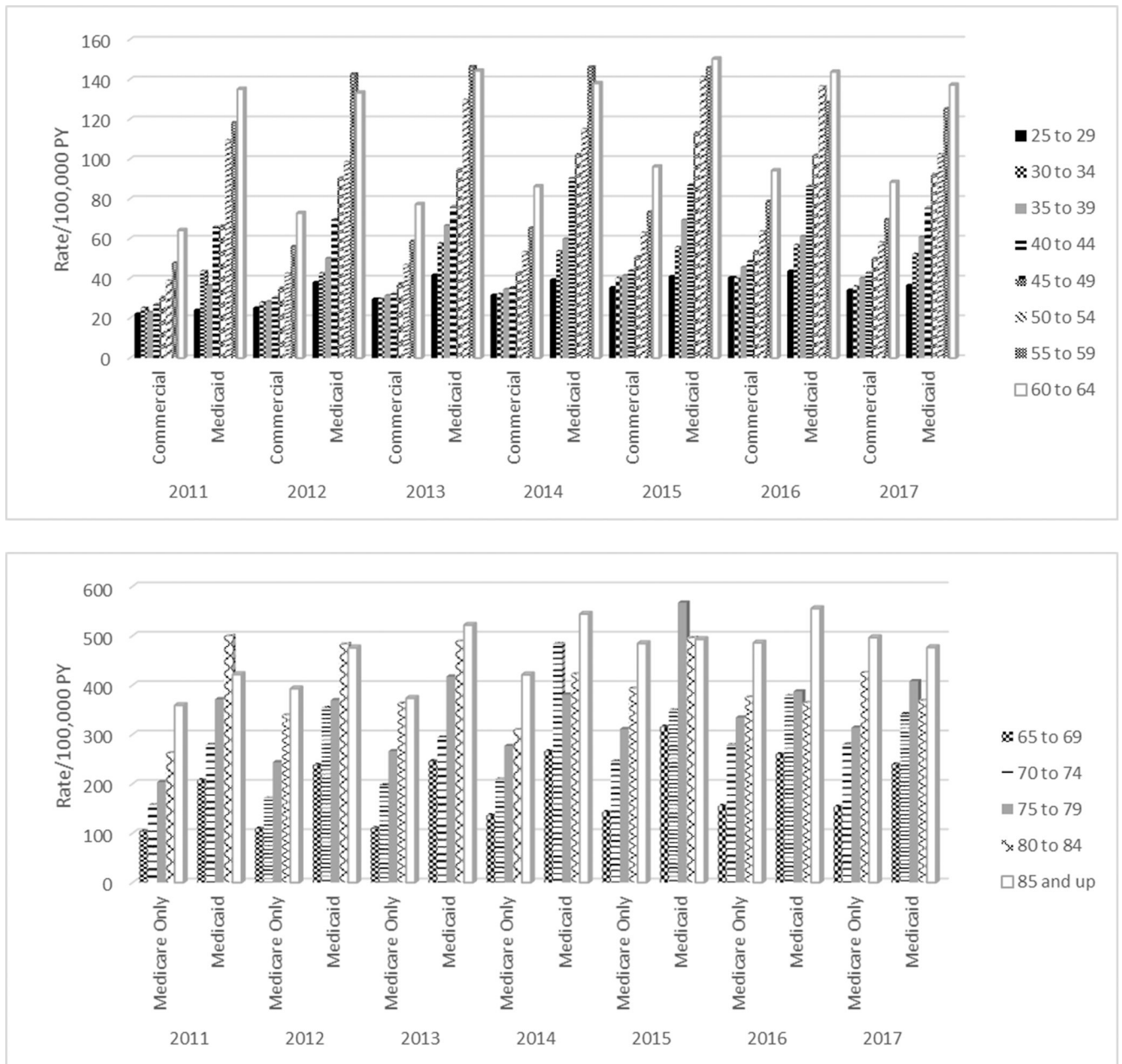


Figure 3. Community Associated CDI Rates, 2011–2017, by Age Group and Insurer
 A. MarketScan Aged 25–64 Years B. Medicare Aged 65 Years and Older

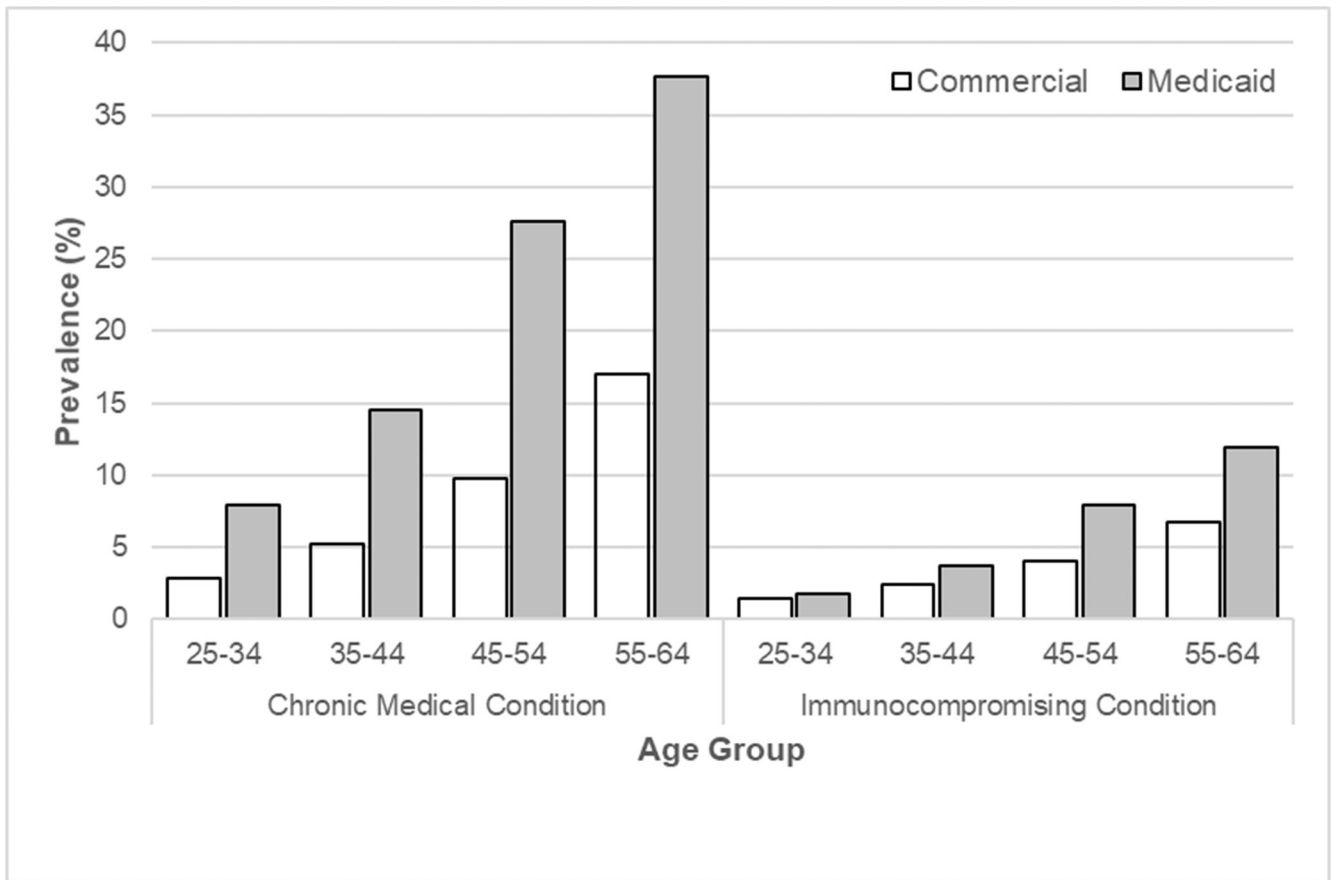


Figure 4. Prevalence of Chronic Medical and Immunocompromising Conditions with Age, MarketScan Aged 25–64 Years

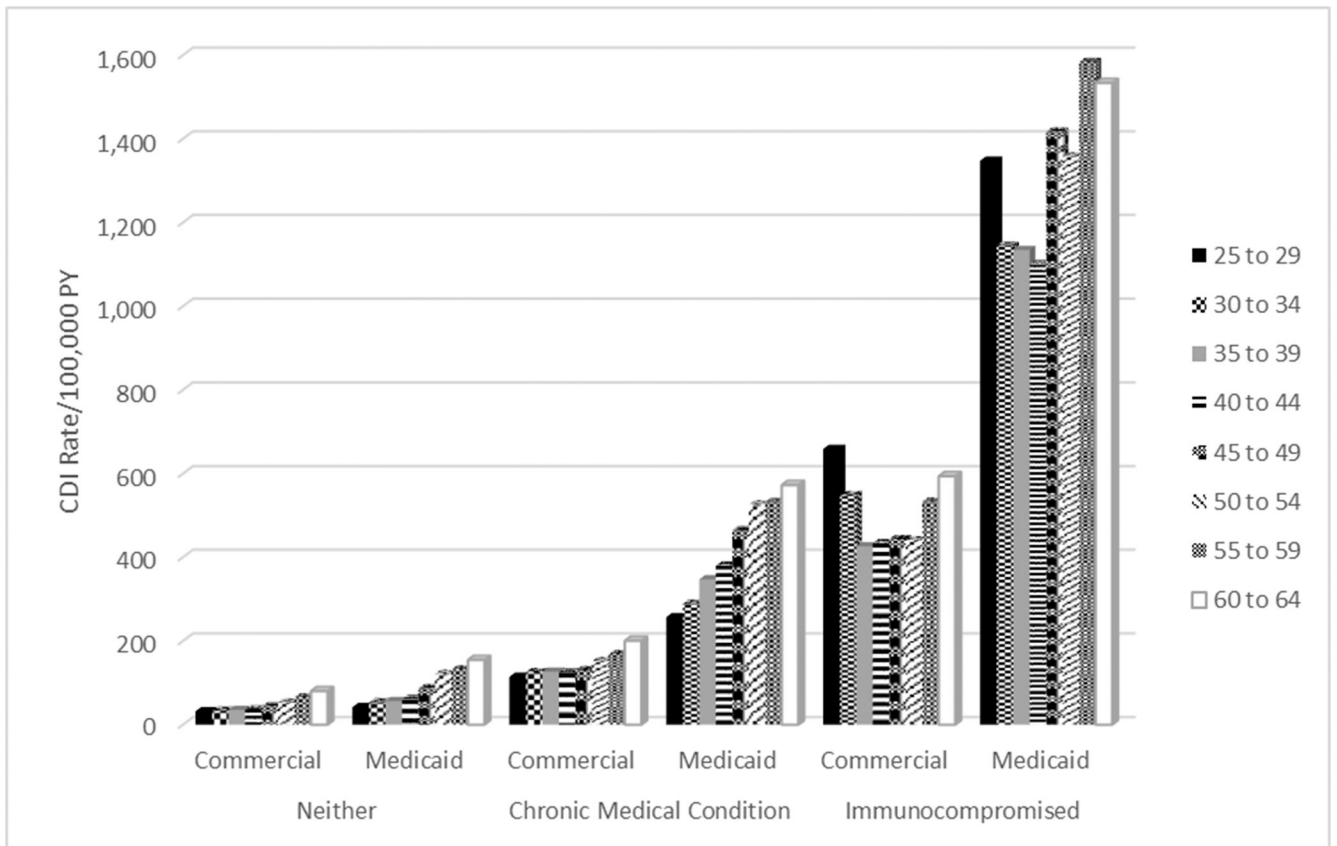


Figure 5. One-Year Incidence of CDI/100,000 Person Years from 2012 to 2017 Based on Prevalence of Chronic Medical Conditions, Immunocompromised Conditions, and Neither Conditions in the MarketScan Commercial and Medicaid Populations by Age Group

Table 1.

Characteristics of Patients with CDI, 2011–2017, by Medicaid Status

Characteristic	Commercial 25–64 Years N = 90,587 n (%)	Medicaid 25–64 Years N = 24,098 n (%)	Elderly 65+ Years, Medicare Only N = 47,964 n (%)	Elderly 65+ Years, Medicare + Medicaid N = 23,704 n (%)
Age, mean (SD)	50.2 (10.8)	47.4 (11.2)	80.0 (8.2)	80.2 (8.8)
Female Sex	56,277 (62.1)	15,171 (63.0)	30,822 (64.3)	17,185 (72.5)
Race				
White	N/A	13,909 (57.7)	44,725 (93.2)	18,273 (77.1)
Black	N/A	6,104 (25.3)	2,140 (4.5)	3,351 (14.1)
Other/Hispanic/Missing	N/A	4,085 (17.0)	1,099 (2.3)	2,080 (8.8)
No. CDI Episodes	102,240	28,024	52,242	25,924
Healthcare associated ^a	30,923	14,341	25,922	18,582
Community associated	64,553	11,060	21,216	5,129
Indeterminate ^b	6,764	2,623	5,104	2,213

^aHealthcare associated CDI using the strict definition of HCA (health care facility-onset CDI or community-onset CDI with patient discharged from a healthcare facility in the prior 4 weeks).

^bIndeterminate CDI was defined as community-onset CDI and patient was discharged from a healthcare facility within the prior 4–12 weeks.

Table 2.

One-Year Incidence of CDI/100,000 Person-Years from 2012–2017 in Persons with Commercial or Medicaid Health Insurance By Coding for Immunocompetent and Immunocompromising Conditions During their First Year of Enrollment^a

Conditions	Commercially Insured			Medicaid Insured			IRR (Medicaid: Commercial)	P
	PY	# of Episodes	Incidence (Episodes/100,000 PY)	PY	# of Episodes	Incidence (Episodes/100,000 PY)		
Chronic Medical Conditions								
Any chronic medical condition	2813966.0	4393	156.1	535050.6	2315	432.7	2.8	<0.001
Chronic lung disease	723646.3	1562	215.9	239638.8	1099	458.6	2.1	<0.001
Diabetes	1619289.6	2164	133.6	223661.9	1034	462.3	3.5	<0.001
Heart disease	542857.3	1212	223.3	95301.6	615	645.3	2.9	<0.001
Alcohol abuse	98399.1	373	379.1	87704.3	547	623.7	1.6	<0.001
Liver disease	93867.8	475	506.0	32572.0	364	1117.5	2.2	<0.001
Cystic fibrosis	47305.4	88	186.0	3752.4	20	533.0	2.9	<0.001
Immunocompromising conditions								
Any immunocompromising condition	1313330.8	6619	504.0	166340.4	2262	1359.9	2.7	<0.001
AIDs	48893.3	145	296.6	16338.4	187	1144.5	3.9	<0.001
Chronic kidney disease	95622.1	918	960.0	24917.1	483	1938.4	2.0	<0.001
End stage renal disease	28686.1	786	2740.0	6980.9	268	3839.1	1.4	<0.001
Nephrotic disease	2397.9	15	625.5	353.1	8	2265.6	3.6	0.002
Inflammatory bowel disease	111345.6	1356	1217.8	10235.6	348	3399.9	2.8	<0.001
Rheumatoid arthritis/connective tissue disease	492888.8	1291	261.9	51962.7	352	677.4	2.6	<0.001
Bone marrow/stem cell transplant	5108.0	184	3602.2	644.6	35	5429.5	1.5	0.025
Solid organ transplant	28019.6	438	1563.2	1564.1	40	2557.4	1.6	0.003
Immunodeficiency	51754.8	1020	1970.8	17331.9	584	3369.5	1.7	<0.001
Leukemia	19413.8	307	1581.3	2039.9	63	3088.4	2.0	<0.001
Lymphoma	47858.5	539	1126.2	4721.4	92	1948.6	1.7	<0.001
Solid tumor	469804.1	1791	381.2	49455.2	579	1170.8	3.1	<0.001
Metastatic cancer	55728.0	693	1243.5	14074.1	247	1755.0	1.4	<0.001

Conditions	Commercially Insured			Medicaid Insured			IRR (Medicaid: Commercial)	P
	PY	# of Episodes	Incidence (Episodes/100,000 PY)	PY	# of Episodes	Incidence (Episodes/100,000 PY)		
Radiotherapy	74112.7	572	771.8	17617.8	224	1271.4	1.6	<0.001
No Chronic Medical Conditions And No Immunocompromised Conditions	32662276.6	14904	45.6	3006447.5	2033	67.6	1.5	<0.001

^aThe first year of enrollment in the Commercial or Medicaid Database, 2011–2017.

All comparisons of incidence rates between Commercially- and Medicaid-insured persons were significant with $p < 0.001$, except cystic fibrosis ($p = 0.0253$) and nephrotic syndrome ($p = 0.0016$).