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### Review of Gender Related Trends Among People Hospitalized for Infections with Concurrent Substance Use

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**Review of Gender Related Trends Among People Hospitalized for Infections with  
Concurrent Substance Use**

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Honors Thesis

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### **Abstract**

**Background:** The opioid epidemic has been on the rise in the past decades, and with the rise of opioid use, infections related to substance use has also been on the rise. Infection trends in relation to gender currently have little evidence on how they affect each other.

**Methods:** Data was gathered from the New Hampshire Discharge Dataset on patients aged 18 to 85 who were admitted to any hospital with an infection diagnosis and concurrent substance use, from the years 2012 to 2019. This data was then graphed to analyze the trends.

**Results:** Infection rates had a consistent rise during the years 2012 to 2019. Males had higher rates than women, but there was a narrow gap depicted.

**Discussion:** There are currently few gender targeted interventions available for individuals seeking out treatment for substance use. Both genders may benefit from these interventions, yet women have experienced a more concerning increase, as it was believed that women utilize substance less than men. Implementing more targeted interventions for women can work to decrease the narrowing gap seen in the data. Increasing the availability of infection prevention methods will help to decrease the rise in infection rates seen throughout New Hampshire.

**Conclusion:** Increasing the availability of targeted interventions will work to decrease the prevalence of substance use, and infection rates related to substance use.

## **Review of Gender Related Trends Among People Hospitalized for Infections with Concurrent Substance Use**

### **Background**

The opioid epidemic has been on the rise within the United States for the past decade, creating an emergent public health crisis (Schwetz et al., 2019). Hospitals throughout the nation have been seeing increases in patients with opioid abuse, while simultaneously reporting increases in infections seen related to this abuse (McCarthy et al., 2020). Despite these alarming increases, there is currently little data examining the relationship gender has in relation to hospital admissions for infections related to substance misuse.

Overdose rates have increased, and hospitals have seen a marked increase in admissions of patients with substance use disorder (Hsu et al., 2017). This increase in admissions have revealed a plethora of infections and diagnoses related to opioid use that may have not been previously seen. Older hospitalization data related to patients with infections and substance use disorder was underreported, as drug abuse was often not recorded in diagnostic reports when patients were admitted with infections (Miller et al., 2018). The recent increase in the opioid epidemic has since spurred healthcare providers to document drug abuse in patients more consistently, which has created increasing data showing hospital admission and concurrent drug abuse (Miller et al., 2018).

This increase in documentation of substance abuse data showed a subsequent increase in infections. Infections related to substance use are wide in variety, as they can be anything from soft skin bacterial infection, cellulitis, to endocarditis. Infections are commonly seen with injection of substances. Substance users can improperly clean their skin, reuse needles, or share needles, which creates risk for infection once injected. The annual number rose between 105-

218% once previous unrecorded drug abuse was taken into consideration (Miller et al., 2018).

This has prompted researchers to examine the correlations between patients with drug abuse, the reason for their admission, and presenting diagnoses. There is a significant range of infections that occur in patients with drug abuse, occurring throughout in-patient hospitalizations and emergency department admissions (McCarthy et al, 2020).

### **Gender and Substance Use**

Examining the differences of substance use between the two genders is crucial to understanding the factors surrounding drug use. Substance use disorders progress differently for men and women (National Institute on Drug Abuse, 2020). A combination of genetics, epigenetics, sociocultural factors, and environmental conditions all affect the differences between substance use in males and females (Becker et al., 2017). These different factors contribute to an individual's chance of addiction, as well as their tolerance levels, risk of relapse, and mental health disorders (National Institute on Drug Abuse, 2020). Examining these differences allows for improvement regarding prevention and education, as interventions may be more effective for different genders.

For most age groups, men have a higher rate of use of illicit substances and alcohol, in comparison to women (National Institute on Drug Abuse, 2020). These numbers often affect the prevention and interventions seen, as research on substance use disorders and treatment is disproportionately focused on males (McHugh et al., 2017). Recent epidemiological studies have illustrated a narrowing in the gap of drug use between the genders, especially in younger age groups (Thibaut, 2018). Despite this narrowing in data, significant gaps in knowledge of opioid misuse between the genders remain (McHugh et al., 2020). This narrowed gap between the genders may also be translated to the infectious disease rates related to substance abuse.

One study examined has defined the numbers of infectious diseases correlating to opioid abuse in females and males, with a sample size of 34,404 people (Capizzi et al., 2020). Bacteremia in both males and females was the most frequently occurring infection, with 8,156 and 8,010 patients diagnosed respectively (Capizzi et al., 2020). However, there were more cases of endocarditis in females with 2,367 case reports, compared to 2,160 case reports in males (Capizzi et al., 2020). Females have a noticeably higher rate of this disease, but there is no current explanation as to why. This study also determined that overall males (54%) were more likely to be hospitalized for at least one injection drug use related serious bacterial infection (Capizzi et al., 2020). Since the beginning of the opioid epidemic, opioid use has been historically characterized by a significantly higher prevalence in men (McHugh et al., 2020).

This gap in knowledge of opioid misuse prevents proper treatment and prevention, which can then lead to further increases in individuals seen with infections. Creating prevention techniques and interventions specific to gender will help decrease these infection rates. A decrease in infection numbers will likely decrease healthcare cost related to infections. A study done in Oregon found that the cost of hospitalizations due to injection drug use related serious bacterial infections increased from \$16,305,129 in 2008 to \$150,879,327 in 2015 (Capizzi et al., 2020). The lack of proper prevention and public health intervention has caused these numbers to increase and will continue to allow them to increase. Understanding the factors that contribute to infection rates can influence prevention efforts and interventions target to these populations.

### **New Hampshire Context**

New Hampshire (NH) has one of the highest rates of overdose in the United States, which is largely due to opioids (NH DHHS, 2016). Approximately 12.5% of New Hampshire residents have utilized illicit substances, or are addicted to illicit substances, compared to the national

average of 8.82% (National Drug Court Institute and ONDCP, 2012). New Hampshire has an increasing rate of substance use, and related to this, infection rates are on the rise. However, there is little data examining these variables in NH, and their effect on the community.

Although the entire US has been affected by the opioid epidemic, NH has been disproportionately affected. Data from the New Hampshire Department of Health and Human Services shows that the drug overdose deaths per year/ per 100k population rose from 12.34 in 2012 to 36.34 in 2016 (New Hampshire Information and Analysis Center, 2020). This marked increase is likely the result of the ‘third wave’ of the opioid epidemic, as defined by the CDC. The ‘third wave’ began in 2013 and is centered around synthetic opioids, particularly fentanyl (CDC, 2021). The newer market of synthetic opioids has led to increasing overdose and infection rates, yet there is little data around what is causing these increases in individuals.

There are no current publications which describe infection due to injecting in New Hampshire. To address this gap, examining the relationship between gender and infection rates, can support understanding of the incidence. Drug use in each gender presents in differing ways and new research and interventions are necessary to decrease infection rates in both genders. This study aimed to analyze data from patients admitted with concurrent infections and drug use, to then determine possible trends. From the data gathered, recommendations for infection prevention and education that are population specific can be made. These will help decrease costs and overdose deaths, as patients will have education and resources available to them, that are specific to their population. This study was done under a harm reduction framework, with the hopes of increasing infection prevention methods.

## **Methods**

An analysis was conducted on hospital admission data gathered from mandated hospital discharge records from hospitals in New Hampshire. The dataset was received upon request from the NH Hospital Discharge Dataset (NH HDD). These data provided discharge data on every person admitted to the hospital for an infection and a diagnosis of substance use disorder from the years 2012 to 2019. It provided their ICD-9 or 10 diagnosis code for infection, such as cellulitis abscess, sepsis bacteremia, septic arthritis, osteomyelitis, endocarditis, general skin infections, and other infections. The patients were also coded with substance use related codes, which included opioid use/abuse/dependence, poisoning by opioid, and poisoning by opioid. The dataset did not provide case specific data but rather aggregated data to protect confidentiality. Aggregated sex, age, and region were also included. This sample includes males and females from ages 18 or greater. Variations between in-patient hospital admissions and emergency room visits with similar infections were examined. Data was placed in an excel sheet, and was separated by gender, age, and opioid use code. The age groups were defined as 18-19, 20-24, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, 75-79, 80-84, and 85+. For the year and age groups with less than five patients, the data was written as 1-4. This was changed to one, for the purpose of combining the rates. The rates from these groupings were combined for each gender, by year. The data was then placed into a graph, separated by year from the years 2012 to 2019. The trends by gender were examined, to understand gender-based risks for hospitalization related to infection and how this has trended over the past years. There are no risks to human subjects associated with this study, as a secondary analysis of pre-existing data was conducted.

## Results

The trends of data are graphed in Figure 1 and Figure 2. Figure 1 illustrates trends in inpatient admissions for concurrent infection and substance use among males and females. Figure 2 illustrates trends in hospitalizations for emergency department admissions for concurrent infection and substance use among males and females. From the year 2012 to the year 2019, there were stark increases in the infection rates in both inpatient admissions and emergency department admissions for both genders. In 2012, there were 113 males who experienced inpatient hospital admissions for concurrent infection and substance use, while in 2019, there were 577 male cases. This indicates a net increase of 410% in infection rates within a seven-year time span. From 2012 to 2013, the infection rates increased 10.6% (Figure 3), yet as the years went on the percentage of increase grew each year. 2013 to 2014 saw a 39.2% increase, 2014 to 2015 saw a 91.9% increase, and 2015 to 2016 saw a 47.9%. After 2016, the increases dropped dramatically. From 2016 to 2017 there was a decrease in the infection rates, of 0.6%. The rates then increased again by 2018, with a 9.4% increase from 2018 to 2019.

Emergency department admissions saw a similar and sharp increase. In 2012, 186 males were admitted to the ED, and in 2019, 614 males were admitted. This illustrates a net 230% increase within the seven-year time frame. However, in 2016 the emergency department saw a stark increase in admissions related to infection. There were 713 males seen with infections throughout this year, which is a 75.2% increase from 2015 (Figure 4). This differs from previous years that only saw moderate increases, as from 2012 to 2013 there was a 9.1% increase, from 2013 to 2014 there was a 45.3% increase, and from 2014 to 2015 there was a 37.9% increase. Following 2016, a minor decrease in the infection rates was seen. From 2016 to 2017 there was a

7.0% decrease in the infection rates, a 4.5% decrease from 2017 to 2018, and a 3.0% decrease from 2018 to 2019.

Women experienced similar trends throughout the years 2012 to 2019 regarding the infection rates in the emergency department and in-patient. Inpatient admissions for women with an infection and concurrent substance use started at 82 patients in 2012, increasing to 466 by 2019. This indicates a 468% net increase across the seven-year time span. A stark increase was seen in 2016, similar to that observed in males. 470 females were admitted to the NH hospitals across the state in 2016, following these criteria. This was the highest number of patients seen within the study timeframe. Figure 3 illustrates these changes. From 2012 to 2013 a 45.1% increase was seen, and from 2013 to 2014 a 23.5% increase. From 2014 to 2015 there was a larger jump in the increases, a 87.1% was seen. This trend continued from 2015 to 2016, with a 70.9% increase. Following 2016, there was a drop in the percent changes, switching over to decreases. 2016 to 2017 saw a 2.6% decrease, and 2017 to 2018 had a 7.0% decrease. The final year examined in this study, from 2018 to 2019, saw a 11.2% increase overall.

Examining the emergency department infection rates in women, they followed similar trends to the inpatient rates. In 2012, there were 135 females seen within the emergency department with a form of infection and concurrent substance use. In 2019, 438 females were seen in the emergency department. These rates reflect a 224% net increase across the seven-year time span examined. Looking more closely at the yearly percent changes, the increases and decreases differed significantly from year to year. From 2012 to 2013 there was a 42.3% increase (Figure 4), from 2013 to 2014 there was a 32.3% increase, and 2014 to 2015 had a 9.1% increase. 2015 to 2016 had a sharp increase in the percent change, with a 103.2% increase. The

percentages then decreased for the final three years. 2016 to 2017 had a 4.8% decrease, 2017 to 2018 had a 17.0% decrease, and 2018 to 2019 had a 1.6% decrease.

### **Discussion**

This study demonstrates increasing infections rates seen throughout the state of New Hampshire with concurrent substance use. The results illustrate significant increases from the years 2012 to 2019 in both in-patient admissions and emergency department admissions. There was minimal difference noted between females and males, except that males consistently had a higher number of cases. This study examined the trends of the statewide data and found concerning increases in both genders. It is unclear if prevention interventions would be well served by gender-specific interventions and there are currently few gender-targeted interventions focused on treatment and infection prevention (Lynskey-Lake, 2018).

Historically, men are more likely to use illicit substances than women (National Institute on Drug Abuse, 2020). Research on substance use has disproportionately been targeted towards males (McHugh et al, 2017). Despite there being little research on how substance abuse affects females, evidence has shown a narrowing gap between males and female with a substance use disorder (McHugh et al, 2017). This is reflected in the analysis from this study, in relation to infection rates. The narrowed gap between the genders could be related to a lower prevalence of traditional gender roles throughout society, such as an increase in women's representation in workplaces (McHugh et al, 2017). It is more likely attributed to changes in sociocultural patterns, as opposed to biological reasons (Thibaut, 2018).

With the narrowed gap in drug use there is an increased need for accessible treatment targeted for women, as men are more likely than women to seek out treatment (National Institute on Drug Abuse, 2020). In 2015, of the estimated 7.9 million women who needed treatment

regarding alcohol and substance abuse, only 10.4% received treatment, compared to the 11.1% of men that received treatment in the same year (McHugh et al., 2018). Women are more likely to face barriers when seeking out treatment, such as economic barriers, family responsibilities, and comorbid psychiatric disorders, especially depression and post-traumatic stress disorder (Thibaut, 2018; Fonesca et al, 2021). There is a higher prevalence of stigma toward women using substances, which leads to decreased chance of seeking out treatment (Fonesca et al, 2021). External factors such as pregnancy, mental health disorders, high prevalence of intimate partner violence, and increased stigma are all contributors to the increased risk of females utilizing substances. Although men are more likely to start utilizing substances (National Institute on Drug Abuse, 2020), once women do start utilizing substances they experience more cravings in comparison to men, while also having a higher risk of reoccurrence (Fonesca et al, 2021). With these increased risks and factors affecting women regarding substance use, females are continuously underrepresented in treatment facilities and may struggle to find specialized treatment for addiction (Thibaut, 2018). Gender specific treatments that are targeted towards women and consider their unique risks for medical, psychiatric, and psychosocial consequences are necessary (Fonesca et al, 2021). Providing treatment that factors in these aspects can increase the accessibility of treatment for women, while also providing treatment that is customized to specific needs, improving the success of treatment in general.

There are few gender specific interventions available, nationwide and in the state of New Hampshire more specifically. Introduction of separate treatment programs for men and women began in the 1980's, particularly centered on pregnant women and women with children (McHugh et al., 2018). In the 1990's "gender-responsive" treatment, which is treatment that factors in the risks that specifically affect women, such as exposure to trauma, psychiatric

disorders, and relationships with partners and children (McHugh et al., 2018). Women in women-only treatment programs experience better treatment outcomes as compared to women in mixed-gender treatment programs (McHugh et al., 2018). Women also report increased comfort and satisfaction in these programs (McHugh et al., 2018). Gender specific treatment is crucial to improving the rates of successful treatment and decreasing the rates of substance use in general.

Within treatment programs, women have specific needs that will help improve their success rates. Understanding the connection of relationships, past trauma, and experiences that are factors to women's development of substance abuse are all crucial to giving women the space they need to receive proper treatment for their substance abuse (Substance Abuse and Mental Health Services Administration, 2015). Considering an individual's family status, such as their parenting roles and needs, trauma background, mental illness, and physical illness while providing treatment allows for formation of tailored interventions (Substance Abuse and Mental Health Services Administration, 2009). Developing a relational approach to treatment, such as placing a focus on creating a support system and trusting relationships, can benefit women and should be a focus in treatment planning (Substance Abuse and Mental Health Services Administration, 2021). These approaches to treatment can aid women in finding success in their treatment and preventing reoccurrence. Despite there being specific interventions that can be provided to women within treatment, there are few interventions targeted towards women outside of treatment programs.

Upon examination of the literature, there is little evidence on the effectiveness of gender specific substance use prevention programs. One study examined the effectiveness of gender specific prevention programs for adolescent girls. This study found that there were four gender specific prevention programs that focused on providing education and prevention methods for

mothers and daughters of adolescent age (United Nations Office on Drugs and Crime, 2016).

Despite the success of these prevention programs, they were each implemented only for specific studies and are no longer available (United Nations Office on Drugs and Crime, 2016). Evidence has shown that family-based strategies are effective in helping prevent substance abuse in girls, yet community and school-based programs rarely provide them with these strategies (United Nations Office on Drugs and Crime, 2016). Screening adolescent girls for risks for developing substance use disorders, such as psychiatric disorders, family risk, and environmental factors can influence individual's need for prevention interventions (United Nations Office on Drugs and Crime, 2016).

With the limited amount of prevention methods in place, increased women specific screening should be implemented by providers and especially at women's health clinics. Screenings tailored towards women are necessary to understand an individual's risk and their need for increased prevention methods. Prenatal screenings should be implemented for women (Substance Abuse and Mental Health Services Administration, 2021). Screening women for mood disorders, post-traumatic stress disorders, trauma, violence, and other health issues is necessary to understanding a women's risk and the possible implications that can increase their chance of utilizing substances (Substance Abuse and Mental Health Services Administration, 2021).

Beginning proper prevention methods and screening in adolescence can help to decrease the prevalence of substance abuse in women. Historically, substance misuse has been treated as a social and criminal problem (US Department of Health and Human Services, 2016). Due to this, preventative services have not been integrated into the healthcare system. This limits the number of preventative services available, as there is limited funding and accessibility to services outside

of the healthcare system (US Department of Health and Human Services, 2016). There are also limited gender specific interventions available, yet both women and men will benefit from these interventions, due to the differences that occur in their path to substance abuse (Lynskey-Lake, 2018). Understanding the need, and the prevalence of women utilizing substances can influence future prevention and treatment methods that are targeted towards women in specific.

Historically, research regarding substance abuse is typically targeted and focused on males, as it was believed that women are more biologically complicated than men (National Institute on Drug Abuse, 2020). Therefore, there are more treatments and interventions targeted for men. Males face less barriers to accessing care as well (Thibaut, 2018). Treatment and interventions accessibility is a nationwide problem, however males have a slightly improved ability to access this care. One specific intervention targeted towards males is the Time Out! For Men, which is a group intervention for males in substance abuse programs that allows males to reexamine gender stereotypes and social pressures to aid them in their path to recovery (Substance Abuse and Mental Health Services Administration, 2013). Motivational interviewing has becoming increasingly more common among males, as this allows men to discuss their emotions regarding their substance use and their feelings on beginning treatment (Substance Abuse and Mental Health Services Administration, 2013). Mutual help groups have also assisted men in connecting with individuals experiencing similar substance abuse disorders (Substance Abuse and Mental Health Services Administration, 2013). There is a limited amount of gender specific interventions targeted for men, yet there are fewer interventions for women. With these limited services available, and the clear increases in data, more targeted services are needed to aid individuals with substance abuse.

Examining the differences between inpatient data and emergency department data shows that there is a higher rate of infections seen in the emergency department. This can be attributed to the nature of the emergency department, as a significant portion of patients are treated and then sent home, as an average of 12% of patients seen in the emergency department are then admitted to an in-patient unit (Center for Disease Control and Prevention, 2022).

Infection prevention methods are also needed to reduce the increasing infection rates examined in this study. Infection rates saw a general increase in 2016, as a consequence of the introduction of synthetic opioids (Harvey et al., 2022). Fentanyl use is correlated with a higher injection frequency, as well as increased rate of needle and syringe sharing (Harvey et al., 2022). Increased injection rate leads to increased risk to infection, as each injection places the individual at risk for developing an infection at the injection site or a widespread infection. To decrease these rates of infection, syringe service programs can be implemented. These programs provide locations for dropping off used needles, as well as acquiring clean needles for injection (Harvey et al., 2022). Syringe services programs have become more available since the increase of synthetic opioids in 2016, yet there is still limited access to these services in rural areas (Rural Health Information Hub, 2022). There is significant evidence that illustrates the effectiveness of these programs (Harvey et al., 2022). Skin cleaning and safe injection education can also help to reduce the risk of infection, as this can work to decrease the risk of injection of bacteria into the system (Harvey et al., 2022). Increasing education to substance users on when infection risk is highest, and ways to decrease that is helpful in the prevention. The “Six Moments of Infection Prevention in Injection Drug Use” is a model created to educate individuals on potential sources of infection, how infection can occur at each step, and specific interventions at each step that can work to reduce transmission (Harvey et al., 2022). Increasing the knowledge of this model can

aid in decreasing the infection rates seen. Creating more widespread general infection prevention will work to decrease the rate of infections across the nation.

### **Limitations**

There are several limitations present in the analysis of this data. Female and male were the only two genders examined, there was no data regarding transgender and non-binary individuals. In collection of the data from hospital discharge data, the codes utilized for criteria in the data set were opioid use/abuse/dependence, poisoning by opioids, and adverse effects of opioids. This creates limited exclusion criteria, that prevents inclusion of other substances.

### **Conclusion**

This study examined the infection rates occurring simultaneously with substance abuse across the state of New Hampshire, examining female and male rates, as well as inpatient and emergency department admission from the years 2012 to 2019. Based on the narrowing gap between males and females, and the increases in infections seen, there is a significant need for interventions targeted for these specific populations. Gender specific interventions, specifically targeted for women, are needed to decrease the gap in the treatment currently available for women. Improving the prevention methods in adolescent girls, young adult women, and women in general can increase the knowledge of risks specific to women that place them at risk for developing a substance use disorder. In addition to this, increased access to infection prevention methods can decrease the infection rates currently seen. This study recommends the improvement of these interventions, and the introduction of specific treatment and intervention plans.

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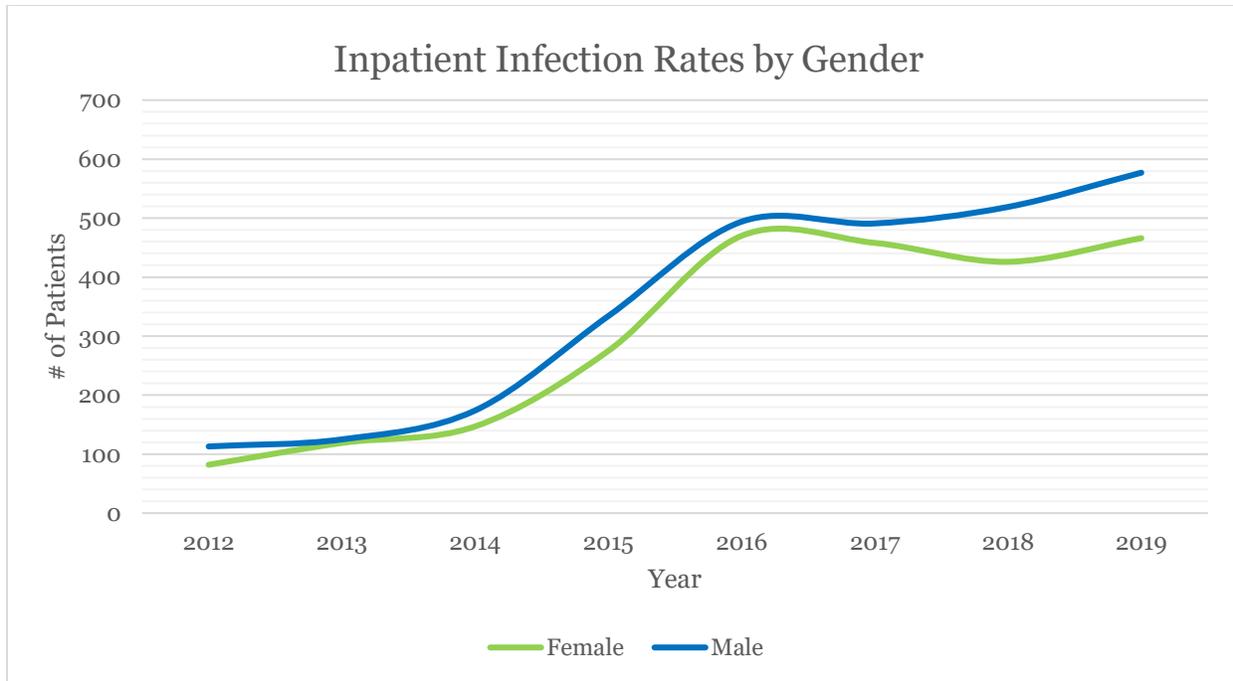


Figure 1. Graph of infection rates occurring simultaneously with substance use disorder among males and females in inpatient admissions across the state of New Hampshire from 2012 to 2019.

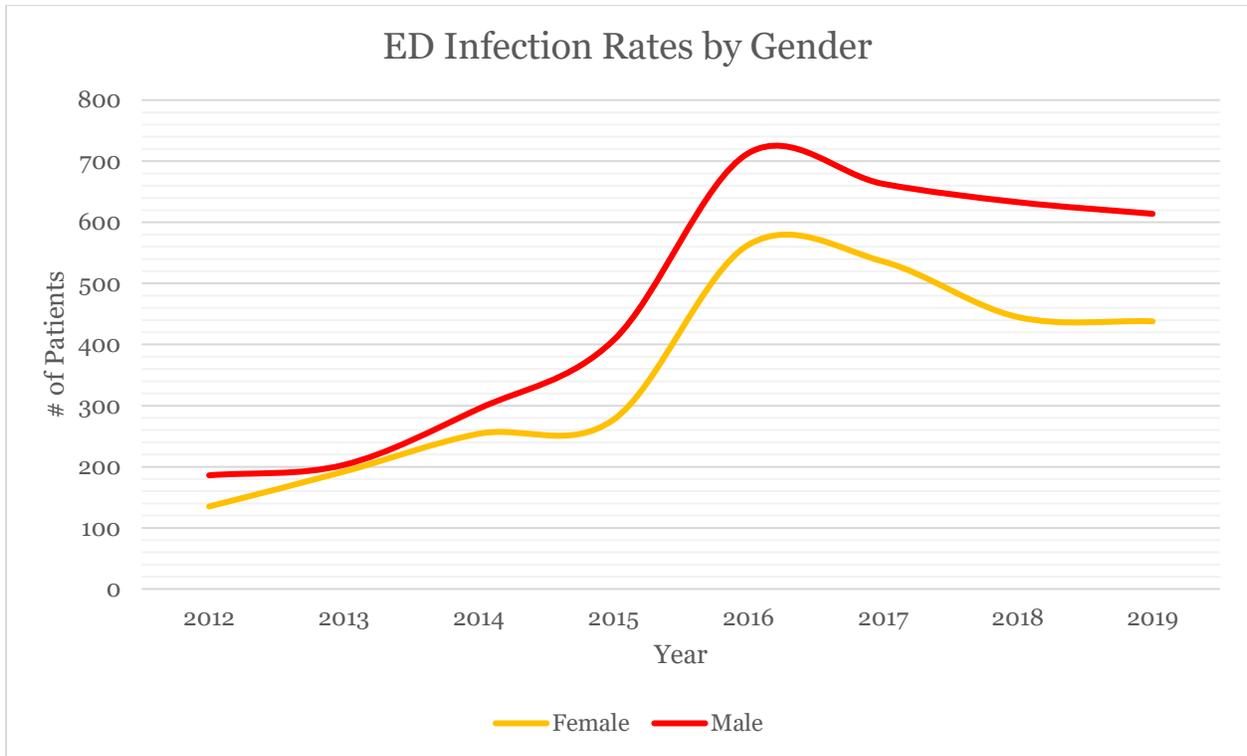


Figure 2. Graph of infection rates occurring simultaneously with substance use disorder among males and females in emergency departments across the state of New Hampshire from 2012 to 2019.

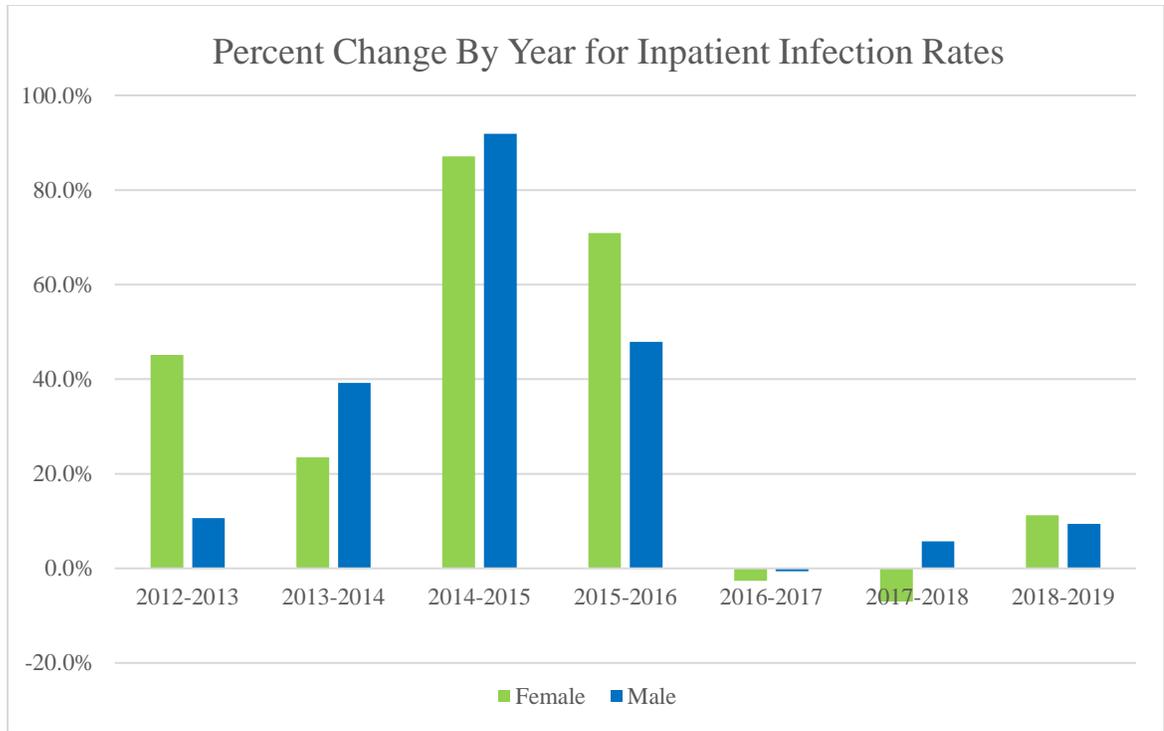


Figure 3. Bar graph of yearly percent changes in infection rates occurring simultaneously with substance use disorder for males and females, within inpatient admissions from the years 2012 to 2019.

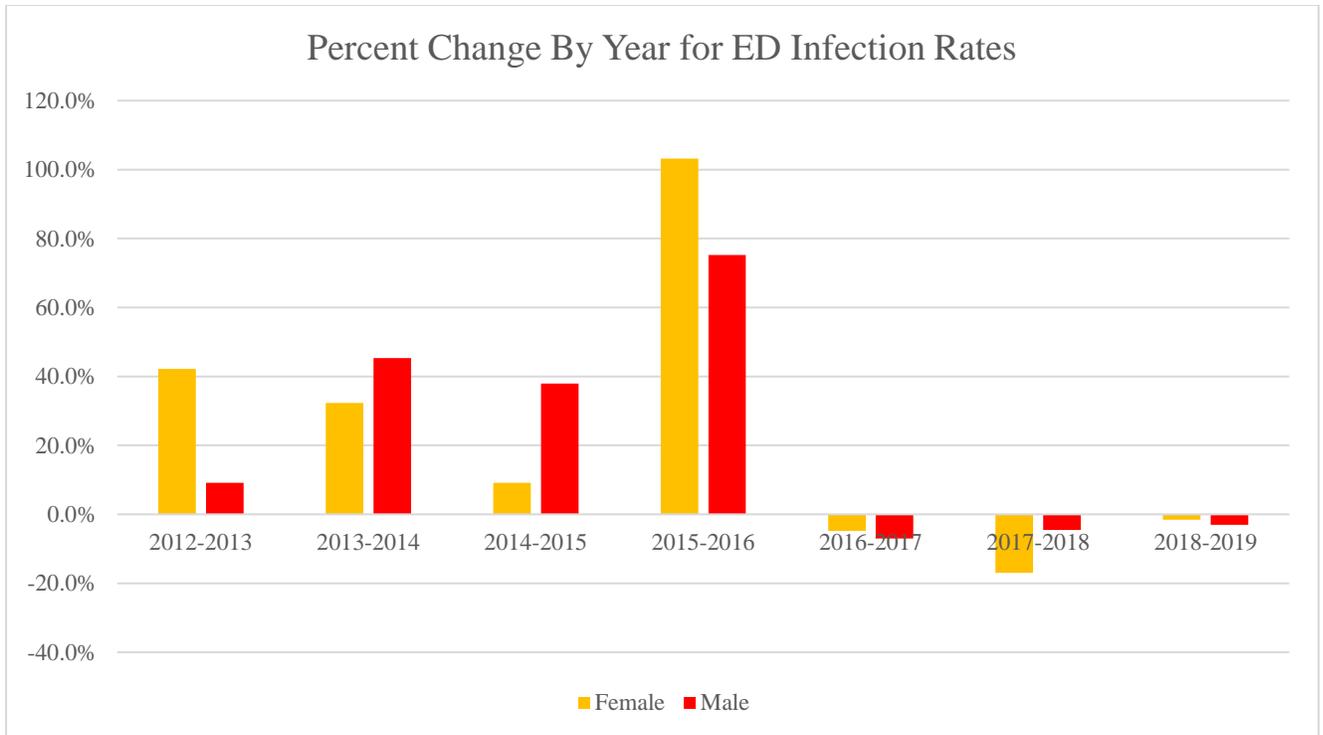


Figure 4. Bar graph of yearly percent changes in males and females seen with infection occurring simultaneously with substance use disorder within emergency department admissions from the years 2012 to 2019.