Name: Yusuf Kurnia Romadhon
Student ID: 35425067
Assignment 2

1. Part A: Writing the Article

Here is my version of the report based on the journal article: "Application of a new methodology and R package reveals a high burden of healthcare-associated infections (HAI) in Germany compared to the average in the European Union/European Economic Area, 2011 to 2012" (Zacher et al., 2019):

1.1. Executive Summary

Healthcare-associated infections (HAIs) are a serious issue for hospitals, as they increase illness, deaths, and healthcare costs. A recent study applied a new statistical method and the R package of Burden of Healthcare-Associated Infections (BHAI) to estimate the burden of HAIs in Germany. Using 2011 – 2012 survey data, the study estimated almost 480,000 infection cases, around 16,000 deaths, and nearly 250,000 disability-adjusted life years (DALYs) in one year. Although Germany has a relatively low infection rate in hospitals, the overall health burden per population was higher than the average of the European Union.

The large number of hospital beds and admissions in Germany is likely the key reason for this outcome. These results underline the importance of improving infection control and reducing hospital stays that are not medically necessary.

1.2. Introduction

Healthcare-associated infections (HAIs) refer to infections that occur in patients during their stay in a hospital or another medical facility. These infections are associated with longer hospital stays, higher treatment costs, and avoidable deaths. They often arise from procedures such as catheter use, surgical operations, or mechanical ventilation.

In Germany, earlier studies suggested that 20 – 30% of HAIs could be prevented with better hygiene and care practices (Gastmeier et al., 2010). However, these estimates mainly relied on prevalence data and did not fully capture the overall health burden. To address this gap, Zacher et al. (2019) applied a new methodology using the Burden of Healthcare-Associated Infections (BHAI) R package to estimate the incidence, attributable deaths, and disability-adjusted life years (DALYs) caused by HAIs in Germany, and compared these findings with those from other European countries. This report summarises their methodology and results to highlight the scale of the problem and its implications for infection prevention.

1.3. Methodology

The methodology in this research involved three main steps, which are (Zacher et al., 2019):

1. **Using ECDC Survey Data.**
   This study used data from the European Centre for Disease Prevention and Control (ECDC) Point Prevalence Survey, conducted in 2011–2012. In total, 9,600 patients were surveyed, and 414 cases of HAIs were identified. These included Pneumonia (HAP), Surgical Site Infections (SSI), Bloodstream Infections (BSI), Urinary Tract Infections (UTI), and *Clostridioides Difficile* Infection (CDI). The distribution of these cases is presented in Table 1.

Table 1: The Number of HAIs observed in the German PPS sample (2011–2012)

Type of HAI	No. HAIs
HAP	88
SSI	111
BSI	23
UTI	155
CDI	37

According to Table 1, the counts provided the starting point for estimating national incidence, attributable deaths, and DALYs in Germany through the BHAI R package.

2. Applying the BHAI R Package.

The study applied the Burden of Healthcare-Associated Infections (BHAI) R package, which transformed the survey prevalence data into national estimates of incidence, deaths, and DALYs. The method projected the prevalence from the 9,600 patients to the whole hospital population in Germany, based on the hospital admission and bed numbers. It also adjusted for patient age, sex, and underlying health conditions to improve accuracy. To clarify the process, Figure 1 illustrates the burden estimation workflow from sampling to DALYs adjustment:

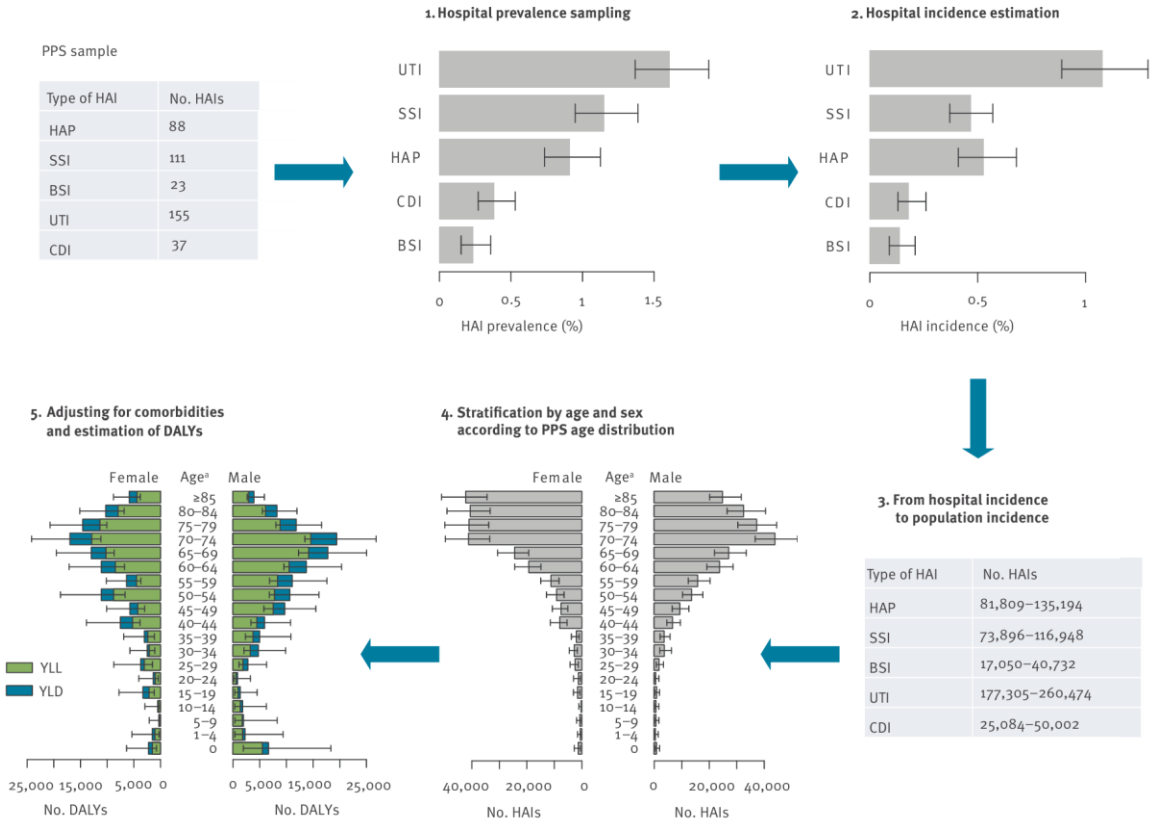

Figure 1: Workflow of the estimation of the burden of healthcare-associated infections implemented in the BHAI R package

3. Comparing Germany's Results with EU/EEA Averages:

Then, Germany's estimates were compared with averages from the European Union and European Economic Area (EU/EEA). This step allowed assessment of whether Germany's burden was higher or lower than the European average and helped identify the reasons for observed differences.

1.4. Results

Based on the survey data and national scaling through the BHAI R package, Germany recorded an estimated 478,222 HAIs in 2011. These were linked to approximately 16,245 deaths and nearly 248,920 disability-adjusted life years (DALYs). The following subsections present the burden of HAIs by infection type (1.4.1), the relationship between the frequency and severity of infection (1.4.2), and the comparison of Germany's results with EU/EEA average values (1.4.3).

1.4.1. Burden by Infection Type

Among the five infection types, urinary tract infections (UTIs) were the most frequent, with an estimated 214,150 cases, followed by pneumonia (106,586) and surgical site infections (93,222). However, the most severe outcomes were linked to pneumonia (HAP) and bloodstream infections (BSIs). Even though they were less frequent, pneumonia and bloodstream infections were responsible for almost half of the estimated HAI deaths (7,873) and DALYs (127,858).

Table 2 summarises these results, showing both the total numbers and the breakdown into years of life lost (YLL) and years lived with disability (YLD). UTIs dominate in case numbers, but pneumonia and BSIs represent the most significant share of deaths and DALYs.

Table 2: The Estimated Infections, Attributable Deaths, and DALYs by Type of HAI in Germany, 2011

Type of HAI	Sample	Number of HAIs	Number of attributable deaths	Number of DALYs	Number of YLLs	Number of YLDs
		Point estimate[a] (95% UI)	Point estimate[a] (95% UI)	Point estimate[a] (95% UI)	Point estimate[a] (95% UI)	Point estimate[a] (95% UI)
HAP	German PPS	106,586 (83,618–137,476)	3,968 (1,107–8,164)	69,508 (34,042–117,232)	41,306 (11,475–84,483)	27,539 (16,528–42,824)
SSI	German PPS	93,222 (75,369–114,241)	2,328 (1,888–2,882)	28,842 (23,313–35,303)	28,376 (22,983–34,714)	452 (352–580)
BSI	German PPS	26,976 (16,520–42,252)	3,905 (2,004–6,987)	58,350 (30,940–104,227)	49,578 (25,499–90,816)	8,787 (4,463–16,609)
UTI	German PPS	214,150 (175,086–253,524)	3,664 (1,462–7,533)	66,701 (27,890–128,543)	44,871 (18,043–92,915)	20,243 (8,095–40,522)
CDI	German PPS	36,002 (25,108–49,934)	1,917 (112–4,547)	20,890 (2,023–49,443)	19,937 (1,166–47,973)	977 (172–2,125)
All	German PPS	478,222 (421,350–537,787)	16,245 (10,863–22,756)	248,920 (178,693–336,239)	190,245 (131,301–264,573)	59,076 (40,263–84,578)

1.4.2. Relationship Between Infections and Deaths

Table 2 also shows the relationship between infections and deaths. It can be seen that UTIs dominated in case numbers but contributed a smaller proportion of deaths. In contrast, pneumonia (HAP) and bloodstream infections (BSIs) made up less than one-third of all cases but were responsible for nearly half of the deaths and DALYs. This shows that the number of cases alone does not indicate the actual health impact of HAIs. This suggests that high case numbers do not necessarily equal a higher health burden.

1.4.3. Comparison with EU/EEA Averages

When compared with European Union/European Economic Area (EU/EEA) averages, Germany displayed a higher burden of HAIs at the population level, despite a lower prevalence of infections within hospitals. Specifically, when adjusted for population size, Germany reached 308 DALYs per 100,000 residents, which exceeded the EU/EEA average of 290. This difference is mainly due to Germany's large number of hospitalised patients and the high availability of hospital beds, which increases the overall burden. These results underline that even relatively low hospital prevalence can translate into a higher national burden when admission rates are high.

In summary, the results show that UTIs were the most common type of HAI in Germany. Still, HAP and BSIs contributed the most significant share of deaths and DALYs, as discussed in 1.4.1. The relationship between infection numbers and outcomes highlights that frequency alone does not capture severity, as discussed in 1.4.2. When compared with EU/EEA averages, Germany demonstrated a higher overall burden despite lower hospital prevalence, mainly due to its large hospital population and admission rates, as discussed in 1.4.3. Together, these findings provide a comprehensive picture of both the scale and impact of HAIs in Germany.

1.5. Conclusion

Healthcare-associated infections (HAIs) remain a significant challenge for patient safety in Germany. Using the ECDC Point Prevalence Survey (2011–2012) and the BHAI R package, the study estimated almost 480,000 infections, around 16,200 attributable deaths, and nearly 250,000 disability-adjusted life years (DALYs) for 2011. Urinary tract infections (UTIs) were the most frequent type, but pneumonia (HAP) and bloodstream infections (BSIs) caused the most significant share of deaths and overall health impact.

Compared with the European Union and European Economic Area (EU/EEA), Germany showed a higher burden per population despite lower hospital prevalence. This outcome is mainly linked to the country's large hospitalised population and greater bed availability. These findings underline the importance of strengthening infection prevention, improving hygiene practices, and reducing avoidable hospital admissions to lessen the preventable impact of HAIs on patients and the healthcare system.

These results are based on survey and modelling methods, and should therefore be interpreted with awareness of the assumptions and limitations discussed in Zacher et al.'s article.

1.6. References

Gastmeier, P., Brunkhorst, F., Schrappe, M., Kern, W., & Geffers, C. (2010). How many nosocomial infections are avoidable? *Deutsche Medizinische Wochenschrift*, *135*(3), 91–93. https://doi.org/10.1055/s-0029-1244823

Zacher, B., Haller, S., Willrich, N., Walter, J., Abu Sin, M., Cassini, A., Plachouras, D., Suetens, C., Behnke, M., Gastmeier, P., Wieler, L. H., & Eckmanns, T. (2019). Application of a new methodology and R package reveals a high burden of healthcare-associated infections (HAI) in Germany compared to the average in the European Union/European Economic Area, 2011 to 2012. *Eurosurveillance*, *24*(46). https://doi.org/10.2807/1560-7917.ES.2019.24.46.1900135

2. Part B: Article Analysis

The analysis for the comparison and the reasons for the differences will be done for each section. Here are the details:

2.1. Executive Summary

The original article had an abstract written for a scientific audience, with detailed terms and statistical references. In contrast, my report presented a short executive summary in clear language, focusing on the estimated number of infections, deaths, and DALYs. To make the summary more suitable for a managerial audience, I avoided using exact numbers. Instead, I reported rounded estimates (e.g., 478,222 was presented as about 480,000), so the results could be understood more easily. While the abstract in the article was designed to situate the study within the academic field, my summary was written to provide a concise and accessible overview of the main results so that managers could quickly grasp the key points and implications of the findings.

2.2. Introduction

The original article began with a broad explanation of the European perspective, reviewing several studies and methodological challenges before focusing on Germany. In contrast, my introduction was shorter and more direct. It explained the definition of HAIs, outlining their consequences, and including prevention estimates from Gastmeier et al. (2010), before moving straight to the study by Zacher et al. (2019). The changes in the report were made to provide a focused introduction that explains the German context clearly, rather than presenting an extended literature review. The aim was to ensure that my manager could quickly understand the problem without needing to read through background details that were more relevant to an academic audience.

2.3. Methodology

The original article described the statistical modelling process in detail, including estimating incidence from prevalence data, uncertainty intervals, and complex calculations for DALY estimates. In contrast, my methodology section simplified and grouped the detailed steps into three main steps: using the PPS survey data, applying the BHAI R package, and comparing Germany with EU/EEA averages. I also included one descriptive table and one workflow figure to illustrate the process. This change was made because my report needed to highlight the data source and the key steps of work done, rather than provide a complete technical explanation that would not be practical for my manager. Also, by using visual support, the methods could be communicated more clearly and interpreted more easily by my manager.

2.4. Results

The original article presented results with exact numbers, statistical ranges, and confidence intervals. In contrast, my report used the point estimates only and organised the results into subsections: burden by type, relationship between cases and deaths, and comparison with EU/EEA averages. I also included a final summary paragraph to connect the findings. This adjustment was made to ensure that the results could be understood more easily by my manager. In my report, I did not include confidence intervals, but I kept the exact national estimates. This made the results clearer for managers while still showing the main findings accurately.

2.5. Conclusion

The original article concluded with a detailed discussion of methodology, results, and study limitations, but it did not provide a short, stand-alone conclusion. In contrast, my report closed with a concise conclusion. It summarised the national figures, compared common infections such as urinary tract infections with more severe ones like pneumonia and bloodstream infections, and underlined Germany's higher burden relative to the EU/EEA average. I also included practical recommendations

on infection prevention, improved hygiene, and reducing unnecessary hospital admissions. This change made the findings easier for my manager to understand by providing a clear conclusion, and it ensured that the report offered direct implications for managers rather than focusing only on academic discussion.