

Injury Pattern of Motor Vehicle Accident Case Based on HDSS Sleman

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Abstract

Injuries from motor vehicle accidents are a major public health concern worldwide, with estimates predicting an increase in death due to increased vehicle ownership and usage. The confluence of an inter-provincial route and a high population density in Sleman Regency, add to traffic congestion, making road safety a concern. The study uses data from the Health and Demographic Surveillance System Sleman, using the 2019 dataset. This descriptive study used a cross-sectional observational design. Secondary data analysis was carried out to see the pattern of injury. The study focuses on motor vehicle accidents in Sleman in 2019, which included 368 individuals, with 79% being motorbike accidents, 221 (76.47%) was wearing a standardized helmet fastened. There are 206 males (56%) are more prone to frequent motor vehicle accidents. The most susceptible category consisted of 123 teenagers aged 12-25, while secondary school education was the most heavily impacted group, with 134 counts. The lower extremities were the most afflicted anatomical location, with 247 casualties. Only lower extremity injuries exhibit a significant correlation with gender ($p\text{-value } 0.03 < 0.05$). The two-tailed significance value was $0.182 > 0.05$, indicating no significant gender-based difference in motor vehicle accidents. The study examines injury patterns in Sleman during 2019, analyzing factors such as gender, age, education, injury type, and anatomical location. Motorcycle accidents were the most frequent, with helmets providing limited protection. Males and adolescents were particularly vulnerable, aligning with other studies linking risk behaviors and inexperience to higher accident rates. Individuals with secondary education were the most affected, likely due to increased exposure to driving risks. Lower extremities were the most frequently injured area, with bruises being the most common injury type. Permanent scars predominantly affected the upper extremities, highlighting the long-term cosmetic impact of accidents.

Keywords: Cross-sectional, HDSS 2019, Motor Vehicle Accidents, Sleman, Pattern of Injury

INTRODUCTION

The global trajectory of motor vehicle accident fatalities is anticipated to increase from 1.3 million in 2004 to 2.4 million in 2030, primarily driven by heightened

vehicle ownership and usage associated with economic growth in low- and middle-income countries (Mathers and WHO, 2008). According to the Global Status

Report on Road Safety 2018 by WHO, over half of these estimates involve motorcyclists, cyclists, and pedestrians, with a pronounced impact on developing nations (WHO, 2018). In the South-East Asia region, there are 18.5 fatalities per 100,000 people, with motorized 2-3 wheelers contributing to 30 percent of these deaths (Tharu and Shrestha, 2021). Indonesia, a middle-income country in South-East Asia, grapples with a significant challenge as it harbors over 128 million vehicles and a population of 261 million, reporting a total of 31,282 deaths to WHO. GRSF highlights that 76% of motor vehicle fatalities and injuries in Indonesia occur within economically productive age groups (15-64 years), with a notable vulnerability ratio of 3:1 for male to female fatalities (GRSF, 2023). Regional Police data for Yogyakarta in 2017 reveals 4,011 total accidents, 442 deaths, and 5,069 injuries, while 2018 sees an increase with over 5,000 road traffic incidents, 485 deaths, and 6,823 injuries (Bappeda Jogja, 2023). Further, BPS Sleman reported 1,020 accidents in Sleman Regency in 2016, resulting in 183 fatalities, 9 severe injuries, 1,240 minor injuries, and material losses exceeding 900 million Indonesian Rupiah (BPS Sleman, 2022).

Injuries are the leading cause of death and disability among children and adolescents across the world. Injuries can

be characterized as either unintentionally or intentionally injuries (Potter & Perry, 2005). The pattern of injury encompasses details regarding the method, force, and location of the injury on the patient's body, serving as a crucial concept for accurately classifying deaths or injuries as either resulting from homicide or accident (Fraizer, 2019). Traffic events that result in vehicle and/or object damage, minor injuries, and victims who die or are badly injured are referred to as motor vehicle accident injury cases. Many of the injuries are difficult to treat with simple medical care. Understanding the patterns of injury might help in assessing the likelihood that a significant injury has happened. The potential severity of the patient's injuries can be concluded from the intensity of the wound or damage. This may help an offender to be identified and/or a better understanding of the events surrounding an injury event. Injury prevention measures are required in order for a significant reduction to be felt, as prevention is better than treatment. A similar recurring injury pattern may also aid in improving initial emergency care and overall clinical survival.

Sleman, which is noted for its educational institutions, diversified population, and tourism historical and cultural sites, is not immune to traffic and transportation issues. The huge number of students and residents adds to traffic

congestion and raises the likelihood of motor vehicle accidents. Adding to that reason, Sleman Regency is intersected by an inter-provincial road that connects the Special Region of Yogyakarta with Central Java, running from Yogyakarta to Magelang. In this sought-after residential neighborhood, balancing urban convenience with natural beauty is important. To sustain Sleman's appearance of safe living, authorities must prioritize road safety and invest in transportation solutions.

The study makes use of data from HDSS (Health and Demographic Surveillance System) Sleman which is a surveillance system that gathers population transition statistics, health status, and social transition in Sleman Regency, Yogyakarta Special Administrative Region, Indonesia, within a certain period of time. Each HDSS Sleman cycle collects data from 5,147 households in 216 selected clusters in 80 villages in Sleman District. Of all these clusters, 184 clusters are in urban areas and 32 clusters are in rural areas. The study makes use of data from the fifth HDSS Sleman cycle, which spanned from March to May 2019 and included 4,890 households in 17 districts in Sleman Regency. The study chose to use a Health Demographic Surveillance System (HDSS) in Sleman, Yogyakarta, Indonesia, because Sleman offers a diverse population and unique

health challenges. The HDSS provides ongoing data on population trends, health behaviors, and disease prevalence, helping researchers track changes and assess interventions and Sleman's specific health issues make it an ideal location for the study to explore the relationship between demographics and health outcomes, aiming to contribute insights for targeted health interventions in the local community. The decision to use Health Demographic Surveillance System (HDSS) data from 2019 in this analysis is important for a variety of reasons. This decision is based on the use of the most recent and accessible dataset available at the start of the study, which provides current and complete insights on population dynamics and health trends. Importantly, the emphasis on the 2019 dataset highlights circumstances and patterns that existed before the COVID-19 pandemic. By focusing on the pre-pandemic period, the study hopes to build a solid baseline understanding of health dynamics, demographic variables, and prevalence that is without of the difficult consequences caused by the global health crisis. Formulation of the problem in this research what is the extent of motor vehicle accident-related injuries in Sleman, based on HDSS Sleman data from 2019, and how do these injuries impact victims?. The aim of this study the purpose of this study is to determine the pattern of injury and to learn

more about injury patterns based on HDSS Sleman data year 2019. The benefit of this research is a better understanding and expansion of knowledge about various injury patterns, in assessing the possibility of significant injury. Contribute to better injury prevention, both through lifestyle changes and improved public health services. Valuable insights for relevant agencies, such as the police, to improve crash response, prevention strategies and overall road safety measures. Support the development of evidence-based policies by providing comprehensive data on injury patterns and risk factors, guiding the implementation of effective measures to reduce the burden of traffic accidents on society. Increase public awareness of the importance of road safety, leading to increased compliance with traffic regulations, responsible driving behavior, and increased use of personal protective equipment among drivers and pedestrians.

RESEARCH METHOD

This descriptive study used a cross-sectional observational design and will be analyzed with a descriptive method. This study uses secondary data of motor vehicle accident cases that were recorded in HDSS data 2019. This study will be conducted after the proposal seminar and ethical clearance is issued by the ethics commission of Faculty of Medicine, Public

Health, and Nursing Universitas Gadjah Mada. This study will be conducted and the data will be analyzed for 8 to 12 weeks.

The target population of this study is incident cases of motor vehicle accident in Sleman Regency, Yogyakarta, Indonesia year 2019. The sample of this study is all cases recorded in the HDSS Sleman from the year 2019. In this study, all cases that already existed were included in the sample that meet the inclusion and exclusion criteria. This study used total sampling, which included all existing motor vehicle accident cases. Inclusion criteria includes every case that is documented in the HDSS Sleman mapping that answers the question “what causes the injury?” with motorbike transportation accident and other transportation accidents in the year 2019 period. Exclusion criteria are recorded subject data cases with ambiguous or unclear documentation regarding the cause of injury. Calculation of the Minimum Sample Size uses the Yamane Formula because the population is known to be 368 so the sample required is 196.

Study Variables and Operational Definitions

1. Study Variables

a. Independent Variable

i. Age

Age in this study is aimed determine whether there are significant differences in the types, severity, or causes of injuries

among various age groups (e.g., children, adolescents, adults, elderly). According to the Ministry of Health of the Republic of Indonesia in 2009, age categories are divided into:

- Childhood aged 0-11 years
- Adolescent aged 12-25 years
- Early adulthood aged 26-35 years
- Late adulthood aged 36-45 years
- Elderly aged 46-55 years
- Seniors aged 65 and over

ii. Gender

Defined in the Indonesian dictionary, Gender in this study serves as a dependent variable for this study to help focus on disparities in injuries and investigate whether there are differences in the types, causes, or severity of injuries divided into male and female (Kemdikbud, 2016).

iii. Education

According to Article 14 of the Law of the Republic of Indonesia No. 20 of 2003 on the national education system, formal education levels include basic education (preschool and middle school), secondary education (high school), and higher education (bachelors, masters, and doctorate degree). The study uses provided education levels and also includes no/never gotten formal education level to assist explore patterns of injury in the highest education achieved.

b. Dependent Variable

i. Severity

As an analysis to reveal how the severity of injuries is associated with cosmetics severity of permanent scar as one of the outcome categories, it can help assess how the likelihood of death varies with injury severity (HDSS Sleman, 2019)

ii. Site of Injury Based on Anatomical Topography

As an analysis based on HDSS Sleman 2019, to reveal how the site of injury on the head, chest, back, stomach/internal organs, upper extremities, and lower extremities with is associated with different types of injuries, their severity, required treatments, recovery times, and the likelihood of complications.

iii. Types of Injury

The analysis to demonstrate distinct associations between the bruises, cut or laceration, fracture, severed limbs, eye injury, concussion types of injuries based on HDSS Sleman 2019, enabling a more informed prediction of potential outcomes based on the nature of the injury.

iv. Vehicle and Helmet Type

As an analysis to reveal how accidents involving motorcycles compare to accidents involving other types of vehicles in terms of injury severity and types of injuries. Accidents that involve motorcycle is also divisible into whether the rider is wearing standard helmet buttoned, standard

helmet unbuttoned, non-standard helmets, not wearing a helmet (HDSS Sleman, 2019).

2. Operational Definitions

a. Injury

Injury is physical damage that occurs when the human body suddenly experiences a decrease in energy in an amount that exceeds the physiological tolerance threshold or is the result of a lack of one or more essential elements such as oxygen that could cause minor injury, severe injury, or death (Vavilala, Curry and Ramaiah, 2011).

b. Motor Vehicle Accidents

Motor vehicle accident is defined as an occurrence that occurs on a route or street open to public traffic, resulting in one or more individual's being hurt or killed, and involving at least one moving vehicle (Mitra et al., 2018).

c. Pattern

Pattern or pattern of injury here is described in general terms as to how a single injury might have been caused and the individualization of a particular injury (Cordner, 2011). The study processes secondary data on injuries in 2019 derived from HDSS Sleman using the 25th version of SPSS Statistics and Microsoft Excel, and tested with Independent Sample T-Test and Chi-Square Test

This study is conducted after obtaining ethical clearance from the Faculty of Medicine, Public Health, and Nursing

Ethics Commission (FK-KMK) Universitas Gadjah Mada with Ref. No KE/FK/1730/EC/2023 and a validation number of 6549da0dafb6b from the ethics committee.

RESEARCH RESULT AND DISCUSSION

RESULT

In the context of the data collected from the HDSS Sleman 2019, it is evident that respondents have the capacity to report experiencing a diverse range of injuries. The input records are structured based on the anatomical topography of the injuries and severity, allowing for a detailed classification of the affected body parts. Respondents are provided with the opportunity to specify the site of injury, enabling a comprehensive understanding of the varied impact that motor vehicle accidents can have on individuals. Due to the complexity and diversity of accidents, a single respondent may encounter and report multiple kinds of injuries. Therefore, they can input records of multiple various injuries based on the circumstances of their involvement in the accident. The total number of motor vehicle accident victims in 2019 are 368 victims.

1. Univariate Analysis

Based on the motor vehicle accident data of HDSS Sleman 2019, the dataset can be interpreted as categories of male and

female gender, age group consisting of childhood, adolescent, early adulthood, late adulthood, elderly, and seniors, as well as the victims highest education reached comprising of no/never, basic education, secondary education, and higher education.

Table 1. Study Characteristics

Study Characteristics		Total	
		n	%
Gender	Male	206	56
	Female	162	44
Age Categories	Childhood	35	10
	Adolescent	123	33
	Early Adulthood	40	11
	Late Adulthood	48	13
	Elderly	89	24
	Seniors	33	9
	Highest Education	42	11
Education	Secondary	127	35
	Tertiary	134	36
	None	65	18

The distribution of men and women in motor vehicle accidents, as shown in the table, reveals a significant gender contrast, showing that males are more likely to be involved in motor vehicle accidents in Sleman than females. The statistics show a notable susceptibility among adolescents age groups that suffer injuries from these kinds of incidents. Adolescents have a higher injury rate than other age groups, indicating a particular vulnerability. Next, surprising relationships are found between educational levels and their contributions to motor vehicle accidents. Interestingly, individuals who finished secondary school appeared as the most notably impacted

group, indicating a possible link between the age group associated with secondary education and a higher vulnerability to such incidents. Based on the motor vehicle accident data from HDSS Sleman in 2019, there were several sites of injury based on anatomical topography that were injured, including the head, chest, back, stomach/internal organ, upper extremities and lower extremities.

Table 2. Site of Injury

Site of injury	Total	
	n	%
Head	72	14
Chest	10	2
Back	20	4
Stomach/Internal Organ	6	1
Upper Extremity	170	32
Lower Extremity	247	47

The interpretation into anatomical topography table, indicates a specific susceptibility in upper and lower limb injuries among victims. Notably, the lower extremities are the most commonly affected anatomical topographical region. Based on the data of motor vehicle accidents obtained from HDSS Sleman 2019, there are several types of injuries that are defined in the dataset, bruise, cut/laceration, fracture, sprained/tensed, severed limb, and concussion.

Table 3. Type of Injury

Type of injury	Total	
	n	%
Bruises	271	58
Cut/Lacerations	88	19
Fracture	58	12
Sprained/Tensed	40	9
Severed Limb	3	1
Concussion	6	1

In particular, bruises appeared as the most prevalent injury in motor vehicle accidents, indicating their prevalence across a variety of motor vehicle accidents incidents. Following the bruises were cut/laceration injuries, indicating a high frequency of cuts or incisions. In contrast, severed limb injuries were the least common.

2. Bivariate Analysis

Based on the motor vehicle accident data of HDSS Sleman 2019, the dataset was tested for the correlation between site of injury, type of injury compared to gender.

Table 4. Analysis Correlation Result between Site of Injury and Gender

Site of Injury	p-value
Head	0,255
Chest	0,795
Back	0,139
Stomach/Internal Organ	0,174
Upper Extremity	0,308
Lower Extremity	0,030

The data on incidences of lower extremity injuries is associated with gender to see if there is a relationship between these two variables using the Chi-Square Test.

The p-value were under 0.05, with a value of 0.03 showing a significant association between the prevalence of lower extremity injuries and gender based on HDSS Sleman data for 2019. When there is a statistical significance between the occurrence of lower extremity injuries in motor vehicle accidents and gender, it indicates that the likelihood of experiencing lower extremity injuries differs between males and females in a way that cannot be reliably explained by random chance. The p-value for the other injury sites exceeds than 0.05, demonstrating that there is no statistically significant association between the occurrence of those injury sites and gender based on HDSS Sleman data for 2019.

Table 5. Analysis Correlation Result between Type of Injury and Gender

Type of Injury	p-value
Bruises	0,432
Cut/Laceration	0,422
Fracture	0,465
Sprained/Tensed	0,069
Severed Limb	0,708
Concussion	0,767

The Chi-Square Test was used to determine the p-value of type of injury and gender, and all p-values of type of injury above the 0.05 level. This means that, based on HDSS Sleman data for 2019, there is not a statistically significant association between the occurrence of any type of injury defined in the study and gender.

DISCUSSION

The study shows how the different types of recorded injured cases in Sleman during 2019 present with a variety of background and determinants such as genders, age groups, and highest education reached along with injury types and site of anatomical topography affected.

1. Motor Vehicle Types Involved in Accidents

In Sleman, motorcycle accidents occurred frequently compared to other vehicles accidents. These results agree with those found in another study (Setya, 2022) in which vehicle type accident was analysed in Gunungkidul, near the location of this study, and it was seen that motorcycle was the vehicles with most accidents. This demonstrates that motor vehicle accidents were responsible for the vast majority of injuries in Sleman throughout that time period, with motorcycles playing an especially important role.

Looking at the helmet usage result diagram, a study conducted in the United States (Brockhus et al., 2023) investigates the injury patterns and outcomes in motorcycle crashes with the effect of helmet use states that the majority of injuries in crashes were wearing a helmet (66%) while the rest were not wearing any helmet (34%). The numbers were matching with this study with a total of 289 recorded victims in a motorcycle, where 76.47% was wearing a

standardized helmet fastened and 20.76% were not wearing any helmet. The remainder of the count was contributed where 2.08% of victims were wearing a standardized helmet unfastened and 0.69% were wearing a non-standardized helmet. Differently, another study (Ngunde et al., 2019) reported that in their results, there were only 12.28% of victims wearing a helmet. focusing on the impact of helmet use, indicates that a significant proportion of individuals involved in crashes were wearing helmets at the time of the incident. This finding suggests that despite helmet usage, motorcyclists still experience injuries in crashes, raising questions about the efficacy of helmets alone in preventing injuries, despite wearing a helmet, motorcyclists are still vulnerable to sustaining injuries in crashes.

2. Gender

Another study that utilizes visum et repertum of motorcycle traffic accidents admitted into a hospital forensic unit (Zahra, 2017) mentioned that the majority of the victims of the motorcycle accident were male which was in line with this current study that male is more likely than females to be involved in motor vehicle accidents in the region with driving behaviors, risk perceptions, and exposure to specific road conditions may all contribute to the observed differences in gender. A similar study conducted in 2021 (Pellondo'u

P, Wijoyo and Napitupulu, 2021) also has similar result where 80.8% of victims who died due to traffic accidents are in the male sex group.

3. Age Group

This study reveals a vulnerability among the adolescent age group, between 12-25 years old, with 123 respondents experiencing injuries from motor vehicle accidents. This observation prompts a closer examination of factors influencing this vulnerability, such as inexperience, prone for risk-taking behaviors, or other contributing factors. Based on the output table, it is known that the number of motor vehicle accidents are majorly contributed by males with 206 people and peaked of being in the adolescent age group. A result from a study conducted (Saxena et al., 2022) agree that the majority of road traffic accident victims were males and belonged to the age group of 21 to 30 years, so did another study (Pellondo'u P, Wijoyo and Napitupulu, 2021) that also mentioned that of the victims reported, the highest frequency with 24% count were in the age range of 15-24 years old.

Independent Sample T-Test of Age Group Based on Gender was analyzed with a result that the data variance between the number of motor vehicle accidents for male and female is homogeneous or equal and there was no significant difference between the two genders involved in motor vehicle

accidents in Sleman (Sig. (2-tailed) is 0.182 > 0.05). Increases in risk-taking behavior throughout adolescence are thought to explain the disproportionate incidence of transportation injury among young people, including non-use of restraints, speeding, insufficient driving education, and inadequate on-road experience (Cullen et al., 2021).

4. Highest Education Reached

Individuals who completed secondary school emerged as the most prominently affected group, suggests a potential intersection between the age group associated with secondary education and a heightened susceptibility to such accidents. This result of the study was in line with another study conducted in Jakarta (Pellondo'u P, Wijoyo and Napitupulu, 2021) that states those who finished high school was the most vulnerable education group. Secondary school completion may coincide with the legal age for obtaining a driver's license in many places, leading to increased exposure to driving-related risks.

5. Site of Injury

A study from Cameroon (Ngunde et al., 2019) found a prevalence of lower extremity injuries in road traffic crashes of 47.93%. That high prevalence is similar with this study where the lower extremities are the most frequent suffering anatomical topography area with a total of 247 victims suffering 206 bruise injuries, 62

cut/laceration injuries, and 26 sprained/tensed injuries. This pattern emphasizes the lower extremities' prone to numerous forms of injuries in motor vehicle accidents. Using the Chi-Square Test to examine the correlation of sites of injury with gender, out of all data of site of injury incidents, all but one site has a significant relationship between the two variables. Lower extremities injuries Asymptotic Significance Result (2-sided) exceeds 0.05, with a number of 0.03. the likelihood of experiencing lower extremities injuries is different between males and females in a way that is not likely due to random chance. Additional analysis and interpretation are essential to find the specific nature of this association between genders that may contribute to the observed differences in lower extremities injuries.

A study conducted in a mortuary department of forensic department recorded majority of the patients had injury to head neck and face constituting 53.61%, similar to another study conducted in forensic installation of a hospital from 2014 to 2016 (Pellondo'u P, Wijoyo and Napitupulu, 2021) found that the most injured location of the respondents were the head followed by upper extremities. This was different in what was found in this HDSS study. The same study also reported that in the lower extremity injuries, the most common type of injury was abrasions/bruises/superficial

wounds, same reported number in this study.

The reason why lower extremities injuries remain high despite riders wearing helmets can be attributed to several factors. One of them is that wearing a helmet does not provide direct protection to those body parts. While helmets effectively protect the head and upper body from direct injuries, the lower body remains vulnerable to impacts, especially in accidents involving motorcycles. Additionally, wearing a helmet may give riders a false sense of confidence, leading them to overlook the use of other protective gear such as knee pads or boots that can help protect the lower extremities. Other factors that may play a role include the type of accidents that occur and road conditions that may influence injury patterns in motorcyclists.

6. Type of Injury

Although this study reveals that bruises was the most commonly occurring type of injury in all injury locations with 271 cases recorded, this was not the same findings in another study (Pellondo'u P, Wijoyo and Napitupulu, 2021) where majority of type of injury was blisters. Differently, a study (Saxena et al., 2022) mentioned that abrasions/bruises were seen mostly in their study results, in line with this HDSS study. Bruises often result from blunt force trauma or impact, which are common occurrences in motor vehicle accidents,

particularly those involving collisions or sudden stops. Additionally, the distribution of bruises across different anatomical areas might indicate that certain body parts are more vulnerable to impact during accidents. In the type of injury category, there was no relationship between type of injury and gender as all data was tested using the Chi-Square test and all of them exceeded 0.05 which was the threshold used for significance level in this study.

7. Permanent Scar

Among the various anatomical locations, the upper extremities stand out as the primary site for such concerns. Specifically, the analysis identified a total of 15 respondents who sustained permanent scars in this region as a result of their involvement in motor vehicle accidents. This finding underscores the significance of understanding the long-term impacts of such incidents, particularly in terms of cosmetic outcomes. Upper extremities are often exposed and vulnerable during collisions or sudden stops, making them more susceptible to abrasions, cuts, and subsequent scarring. Additionally, the protective instinct of individuals to shield their upper body during accidents could lead to injuries concentrated in this area.

CONCLUSION

Based on the analysis conducted from the Health and Demographic

Surveillance System (HDSS) Sleman data for the year 2019, motor vehicle accidents mainly motorcycle were responsible for the vast majority of injuries in Sleman throughout 2019 with the most common injuries occurred in the lower extremities, affecting 247 individuals, with bruises being the predominant type of injury. Majority of the victims of the motorcycle accident were male. Those who finished high school education group and the adolescent age group, between 12-25 years old was the most vulnerable. Among all the traffic accident victims recorded in HDSS Sleman 2019, bruises emerged as the most frequently occurring injury in motor vehicle accidents with 271 individuals affected. From the Chi-Square analysis, there is a statistically significant correlation between lower extremities injury and gender with p-value 0,03. There was no significant relationship is found between the type of injury and gender.

RECOMMENDATION

Based on the findings from the HDSS Sleman 2019 data on injury patterns resulting from motor vehicle accidents, several recommendations can be made to inform future studies. Conducting additional subgroup analyses can help identify specific risk factors within these categories. Combining a quantitative data with qualitative research methods, such as

interviews, can uncover nuances that quantitative data alone may not reveal. Increasing the sample size and incorporating data from a broader range of demographics and geographical locations can offer a more comprehensive picture of injury trends. Addressing the issue of data completeness is also crucial. Finally, distinguishing between the driver and the passenger rider in motor vehicle accident data can provide insights into the different risk profiles and injury patterns associated with each role.

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