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National Surveillance Analysis of Notifiable Infectious Diseases in Saudi Arabia, 2020-2024

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Abstract **Background:** Comprehensive surveillance is required to monitor the burden of infectious diseases, detect changes over time and guide prevention and control efforts. **Objective:** This study analyzed national patterns and temporal trends in reported cases and incidence rates of selected notifiable infectious diseases in Saudi Arabia. **Methods:** A repeated cross-sectional surveillance analysis used year-specific national data from the Saudi Open Data Platform for 2020-2024. Annual case counts and incidence rates per 100,000 population were summarized. Linear regression and Spearman's rank correlation were used to examine temporal trends for each disease and to assess the link between incidence rates and case numbers. **Results**: The data showed that dengue fever, hepatitis B, brucellosis, chickenpox, hepatitis C, salmonellosis and hepatitis A accounted for the highest disease burden. Linear trend analysis identified statistically significant increases in incidence rates for brucellosis (β = 0.413 per 100,000 population per year, 95% CI 0.053-0.773, p = 0.035), meningococcal meningitis (β = 0.0150, 95% CI 0.0009-0.0290, p = 0.043), pneumococcal meningitis (β = 0.0368, 95% CI 0.0061-0.0674, p = 0.032) and Haemophilus meningitis (β = 0.0136, 95% CI 0.0050-0.0222, p = 0.015), whereas trends for other diseases were not statistically significant. Reported case counts strongly correlated with incidence rates (ρ = 0.9997, p<0.001). **Conclusion:** National surveillance data reveal varied patterns in notifiable infectious diseases in Saudi Arabia and support routine trend analysis to inform evidence-based prevention, control and public health planning. However, findings should be interpreted cautiously, given the ecological nature of the analysis, reliance on aggregated secondary surveillance data and the potential influence of reporting practices and case detection variability on observed trends.

Key Words Notifiable Diseases, Infectious Disease Surveillance, Incidence, Trend Analysis, Saudi Arabia, Dengue Fever; Hepatitis B, Brucellosis

INTRODUCTION

Public health surveillance, a systematic and ongoing process of collecting, analyzing, interpreting and sharing health data, is essential for controlling infectious diseases and protecting public health. Surveillance systems allow early detection of outbreaks, track disease trends over time and evaluate the effectiveness of public health measures. This helps guide resource allocation and informs policymaking [1-3]. Despite significant progress in immunization, sanitation and disease control, notifiable infectious diseases remain major global health challenges. While many vaccine- preventable diseases, such as poliomyelitis and diphtheria, have been effectively eradicated or greatly reduced in many countries, others, like viral hepatitis, dengue fever and zoonotic infections, persist and, in some areas, re-emerge. The World Health Organization (WHO) has identified viral hepatitis as a leading cause of infectious disease-related illness and death worldwide, especially in low- and middle-income countries. At the same time, dengue fever is recognized as one of the fastest-spreading vector-borne diseases globally, driven by urbanization, climate change and increased population movement [4].

The Ministry of Health in Saudi Arabia mandates reporting of notifiable infectious diseases to ensure systematic documentation and management of cases vital to public health through national surveillance systems like the Health Electronic Surveillance Network (HESN). This network offers a unified platform for reporting communicable diseases and real-time surveillance within healthcare facilities, enhancing the speed and completeness of data used for public health actions [5]. The shift to digital, real-time national surveillance systems has improved data

completeness, timeliness and analytical value for tracking infectious disease trends and facilitating public health decision-making [6]. This approach has helped the country make significant progress in controlling and eradicating certain vaccine-preventable infectious diseases through sustained national vaccination efforts and comprehensive monitoring systems. Saudi Arabia has remained polio-free since the mid-1990s and cases of diphtheria, measles and neonatal tetanus have become very rare [7]. These achievements highlight the effectiveness of national prevention programs, mandatory vaccination laws and robust disease surveillance systems, such as the Health Electronic Surveillance Network (HESN). Despite these successes, other reportable infectious diseases- such as viral hepatitis, dengue fever and brucellosis-continue to pose major public health challenges, emphasizing the need for ongoing surveillance and detailed analysis.

There is limited research on overall national patterns of infectious disease cases and incidence rates in Saudi Arabia, despite the availability of national surveillance data. In dynamic epidemiological settings, analyzing surveillance data trends over many years is essential for identifying shifts in disease burden, evaluating the effectiveness of control measures and predicting emerging threats. Several studies have used multi-year surveillance data from Saudi Arabia to demonstrate that trend analysis enhances understanding of the epidemiology of bacterial and viral infectious diseases [1,8,9]. Unlike previous national surveillance reports that focused primarily on specific disease groups or individual infections, this study provides an integrated analysis of multiple nationally notifiable infectious diseases using a consistent analytical framework, allowing direct comparison of disease burden and temporal trends across conditions. Therefore, given the lack of comprehensive trend analysis of national surveillance data and the importance of evidence-based public health planning, this study aims to examine the reported cases and incidence rates of specific notifiable infectious diseases over a five-year period. The findings will assist health planners, surveillance units and policymakers in Saudi Arabia in improving their policies for preventing and controlling infectious diseases by providing an updated epidemiological overview. Based on previous national surveillance reports, it was anticipated that disease patterns would vary across infectious diseases, with persistent burdens from viral hepatitis, dengue fever and brucellosis. In contrast, vaccine-preventable diseases would remain stable or occur at very low levels.

METHODS

Study Design and Data Source

Using secondary national surveillance data, this study analyzed the reported cases and incidence rates of selected notifiable infectious diseases in Saudi Arabia over five years (2020-2024) through a repeated cross-sectional trend analysis. Data were sourced from the Saudi Open Data Platform (Ministry of Health) and included annual reported case counts and the corresponding incidence rates per 100,000 population for each disease from 2020 to 2024. The research focused on commonly notifiable infectious diseases included in the national monitoring system during this time. COVID-19 was excluded because it is tracked through a separate monitoring and reporting system. Conditions such as tuberculosis and other diseases covered by specific national programs were also excluded to maintain consistency in case definitions and reporting methods throughout the study period. National notifiable disease surveillance systems are mainly aimed at tracking temporal trends and identifying changes over time, rather than assessing exact individual-level risk; therefore being suitable for longitudinal trend analysis [10]. Using a national surveillance database provides broad population coverage and standardized reporting across healthcare sectors; however, surveillance data may be influenced by variations in reporting completeness, diagnostic practices, healthcare-seeking behavior and disease-specific case detection sensitivity. While the Health Electronic Surveillance Network (HESN) has strengthened the timeliness and consistency of disease reporting in Saudi Arabia, the completeness of reporting may vary across diseases and over time. Therefore, surveillance-based estimates should be interpreted as indicators of population-level disease patterns and trends rather than precise measures of disease occurrence. As the analysis used publicly available, secondary data without personal identifiers, ethical approval was not required.

Data Analysis

Descriptive statistics were used to summarize reported cases and incidence rates by disease and year. For interpretive purposes, diseases were conceptually classified into broad epidemiological categories (e.g., vaccine-preventable, vector-borne, zoonotic, foodborne and other infections) to support structured interpretation of national surveillance trends, without altering disease-specific analyses [11]. Linear trend analysis (ordinary least squares regression) was performed for each disease to estimate temporal trends from 2020 to 2024 for (i) Reported cases and (ii) Incidence rates per 100,000 population; results are reported as β (slope per year), Standard Error (SE), R^2 and p-value. Full trend outputs and year-by-year values for all diseases are provided in the Supplementary Materials. Analyses were conducted using JASP (version 0.18.3), with statistical significance set at $p<0.05$. As a check for consistency, the relationship between reported case counts and incidence rates across disease-year observations was assessed using Spearman's rank correlation.

RESULTS

Distribution of Reported Cases

The distribution of reported cases of selected notifiable infectious diseases varied significantly across different disease categories (Figure 1). The highest number of reported cases was for hepatitis B (5,714), followed by dengue fever (4,413), brucellosis (2,372), hepatitis C

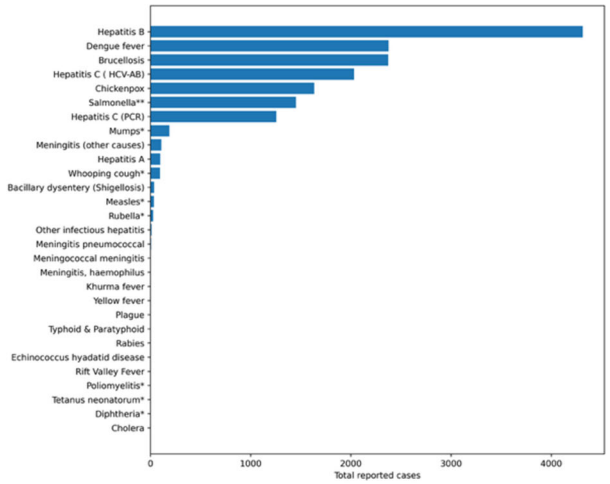

Figure 1: Total Reported Cases of Selected Notifiable Infectious Diseases in Saudi Arabia (2020-2024)

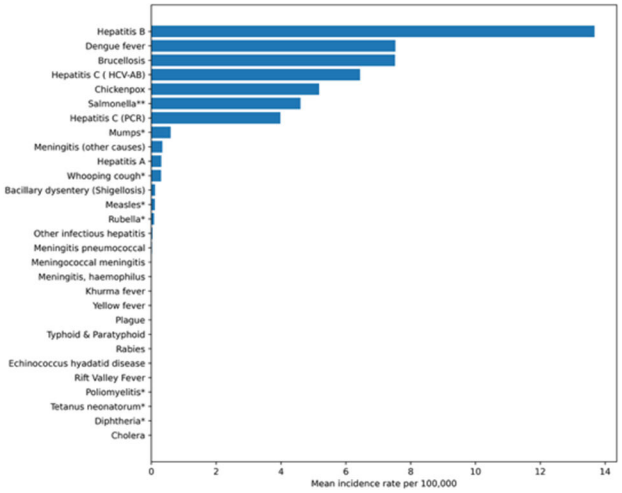

Figure 2: Mean Incidence Rates of Selected Notifiable Infectious Diseases in Saudi Arabia (2020-2024)

(HCV-Ab) (2,055), salmonellosis (1,680) and chickenpox (1,633). Moderate case numbers were reported for mumps (188 cases), meningitis (other causes) (107 cases) and hepatitis A (97 cases). Several notifiable infectious diseases, including cholera, diphtheria, poliomyelitis, rabies, Rift Valley fever, yellow fever, plague and Khurma fever, reported zero cases during the surveillance period. However, comparisons of absolute case counts across diseases should be interpreted cautiously, as differences may partly reflect variations in disease-specific reporting requirements, diagnostic practices, surveillance sensitivity and case ascertainment processes rather than true differences in disease burden alone.

Incidence Rates of Notifiable Infectious Diseases

Incidence rates per 100,000 people generally aligned with reported case counts (Figure 2). The highest incidence was for hepatitis B (23.58 per 100,000), followed by dengue

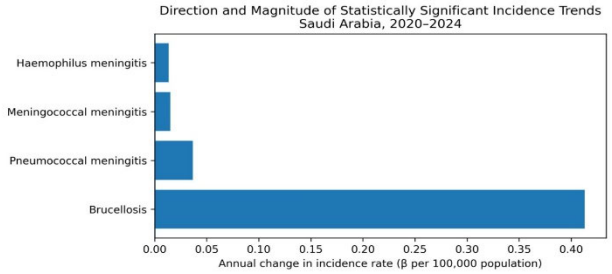

Figure 3: Direction and Magnitude of Statistically Significant Incidence Trends for Selected Notifiable Infectious Diseases in Saudi Arabia, 2020-2024

fever (17.01 per 100,000), chickenpox (10.27 per 100,000), brucellosis (8.91 per 100,000) and hepatitis C (HCV-Ab) (8.46 per 100,000). Lower rates were observed with whooping cough (3.09 per 100,000), measles (3.57 per 100,000) and hepatitis C (PCR) (3.39 per 100,000). Several vaccine-preventable and rare infectious diseases had incidence rates close to zero, indicating either effective control or low circulation during the study period.

Trend Analysis

Linear trend analysis of annual incidence rates from 2020 to 2024 identified statistically significant upward trends for four diseases: Brucellosis ($\beta = 0.413$ per 100,000 per year, 95% CI 0.053-0.773, $p = 0.035$), Meningococcal meningitis ($\beta = 0.0150$, 95% CI 0.0009-0.0290, $p = 0.043$), Pneumococcal meningitis ($\beta = 0.0368$, 95% CI 0.0061-0.0674, $p = 0.032$) and Haemophilus meningitis ($\beta = 0.0136$, 95% CI 0.0050-0.0222, $p = 0.015$). Trends for the other diseases over 2020-2024 were not statistically significant (Supplementary Material). Case count trends matched incidence rate trends, with the same four diseases showing statistically significant increases in cases over time (Supplementary Material). Although these trends were statistically significant, the magnitude of the annual increases was relatively modest and should be interpreted with caution. Figure 3 represents the annual regression slope (β) of incidence rates per 100,000 population derived from linear trend analysis. Only diseases with statistically significant trends ($p<0.05$) are shown.

Consistency Between Cases and Incidence Rates

As expected, reported case counts were strongly correlated with incidence rates (Spearman's $\rho = 0.9997$, $p<0.001$), reflecting the mathematical relationship between absolute case counts and population-adjusted measures.

DISCUSSION

This research offers a nationwide evaluation of the burden of several notifiable infectious diseases in Saudi Arabia, based on annual surveillance data collected over five years. The findings show that hepatitis B, dengue fever, brucellosis, chickenpox and hepatitis C had the highest reported case

numbers and incidence rates, highlighting their ongoing public health significance. These findings are consistent with previous national surveillance studies that identified viral hepatitis and brucellosis as major contributors to the infectious disease burden in Saudi Arabia over the past two decades [1,8]. Earlier studies reported significantly higher incidence rates of hepatitis B and hepatitis C in the early 2000s, followed by steady declines due to increased vaccine coverage, enhanced blood safety procedures and improved infection control measures [9]. However, the continued presence of these infections during the current research period indicates that viral hepatitis remains a public health challenge rather than a completely resolved issue. In contrast, several vaccine-preventable and rare infectious diseases, such as poliomyelitis, diphtheria, rabies and plague, recorded no cases throughout the study period, reflecting ongoing control efforts and effective monitoring. Such findings are consistent with the expected performance of a national surveillance system for monitoring population-level disease burden and temporal trends [6].

The observed disease patterns during the study period closely match those reported in previous national and international research. Previous studies from Saudi Arabia have identified viral hepatitis, dengue fever and brucellosis as important contributors to the national infectious disease burden, reflecting ongoing challenges related to vector transmission, zoonotic exposure and chronic viral infections [1,8]. The World Health Organization's reports and global surveillance studies identify viral hepatitis and dengue fever as major contributors to infectious disease morbidity in both endemic and emerging regions, especially in areas undergoing rapid urbanization and population movement [3,4]. The low or nonexistent incidence of illnesses such as poliomyelitis and diphtheria reflects global progress in vaccination coverage and disease eradication efforts. Examining trends in national surveillance data can support health promotion planning by identifying priority illnesses, evaluating the success of preventive measures over time and guiding resource allocation toward high-burden and developing diseases. International surveillance studies similarly demonstrate that disease-specific interpretation is essential, as temporal patterns often vary substantially across infectious diseases despite comprehensive surveillance coverage [11].

Although disease patterns remain consistent with earlier findings, the current study revealed a statistically significant increase in the incidence of brucellosis from 2020 to 2024. This finding should be interpreted with caution and within the context of prolonged national epidemiological patterns. Previous national assessments of Ministry of Health monitoring data have shown a steady decline in brucellosis incidence in Saudi Arabia over the past ten years, mainly due to improved veterinary control measures, food safety regulations and public awareness campaigns [12,13]. The slight rise observed in this study may therefore reflect short-term variations, isolated outbreaks, enhanced case detection or increased reporting accuracy rather than a long-term nationwide resurgence. These findings highlight the importance of ongoing, long-term surveillance to differentiate temporary fluctuations from meaningful epidemiological shifts.

While several diseases exhibited statistically significant increasing trends, the observed annual changes were generally small in magnitude. Therefore, statistical significance should not be interpreted as evidence of substantial public health impact. The practical significance of these trends should be considered alongside disease burden, transmission dynamics, surveillance practices and reporting characteristics. Consequently, although the identified trends warrant continued monitoring, they do not necessarily indicate major epidemiological shifts during the study period.

The study period overlapped with the COVID-19 pandemic, during which extraordinary public health measures-such as travel restrictions, bans on large gatherings, social distancing and enhanced infection control-were implemented worldwide. These measures may have influenced the transmission dynamics and reporting patterns of various infectious diseases, possibly causing temporary declines or delays in diagnosing specific illnesses throughout 2020-2021 [14]. The stability or reemergence of some diseases in later years may partly reflect the gradual return to normal healthcare use and monitoring efforts after the pandemic.

From a public health perspective, these results highlight the importance of implementing control and prevention programs for high-burden, notifiable infectious diseases, particularly dengue fever and hepatitis B. To effectively prevent these diseases, increasing vaccination coverage, improving vector-control efforts and maintaining robust surveillance systems are essential. National surveillance data are crucial for evidence-based public health strategies because they help prioritize illnesses, assess intervention effectiveness and enable early detection of emerging threats. Additionally, strengthening health promotion campaigns that focus on adult screening, infection prevention and vaccine acceptance is vital, especially considering the ongoing impact of hepatitis B. The continued presence of dengue fever further emphasizes the need for public education, environmental sanitation and community-based vector control initiatives. The observed patterns of brucellosis highlight the importance of educating people about safe animal handling, food safety and occupational risk awareness. Adopting a One Health approach that combines human health promotion, veterinary surveillance, food safety regulations and occupational health education is also critical, particularly for high-risk groups involved in livestock trade and animal handling [15]. Routine analysis of national surveillance trends is essential for preparedness planning, priority setting and early detection of emerging infectious threats, as demonstrated in large-scale national surveillance studies [11].

This research has several strengths. It used official, representative national surveillance data, ensuring broad coverage and high external validity. Using population-adjusted incidence rates enables meaningful comparisons across diseases and the analytical methods were appropriate given the longitudinal nature of the surveillance data. Consistent with national surveillance profiles described in

South Korea, the primary strength of Saudi Arabia's notifiable disease surveillance lies in its ability to monitor temporal patterns and detect changes over time rather than to estimate individual-level risk. The Korean experience highlights that passive reporting systems are optimally interpreted through trend analysis and pattern recognition, an approach directly reflected in our use of longitudinal incidence trends [10].

However, several limitations should be acknowledged. The use of secondary surveillance data prevented individual-level analyses and assessment of demographic or clinical risk factors. In addition, underreporting, reporting inconsistencies, disease-specific reporting sensitivity and variations in healthcare-seeking behavior may have influenced the observed trends, particularly for mild or asymptomatic diseases. Regional differences in healthcare access, diagnostic capacity and reporting practices may also have affected case detection and notification rates. Furthermore, the study period was limited to five annual observations, which restricts the statistical power and robustness of the trend analyses. Consequently, short-term fluctuations may have substantially influenced estimated trends and statistically significant findings should be interpreted cautiously. Longer surveillance periods are needed to determine whether the observed patterns represent sustained epidemiological changes. The study period also overlapped with the COVID-19 pandemic, during which changes in healthcare utilization, testing priorities and surveillance activities may have affected the reporting of certain infectious diseases. Despite these limitations, national surveillance data remain indispensable for identifying temporal patterns and informing public health responses when interpreted at the population level and the present study provides valuable insights into the national infectious disease landscape and the ongoing value of routinely collected surveillance data for evidence-based public health planning [10].

Taken together, comparisons with international national surveillance studies indicate that Saudi Arabia's notifiable disease trends are consistent with global patterns observed in mature surveillance systems, where most diseases remain stable while only a limited number of diseases exhibit significant epidemiological shifts requiring targeted public health attention.

CONCLUSIONS

The largest share of reported cases and incidence rates is due to hepatitis B, dengue fever, brucellosis, chickenpox and hepatitis C, according to this nationwide surveillance-based research that shows a diverse burden of notifiable infectious diseases in Saudi Arabia. Continuous efforts to control and eliminate rare infectious diseases have led to their near absence or very low prevalence. To improve evidence-based public health planning and preparedness in Saudi Arabia, our findings highlight the importance of robust surveillance systems, prioritizing high-burden disease prevention initiatives and regularly analyzing surveillance data. Along with surveillance, our results emphasize the strategic value of national data in guiding health promotion and disease prevention, supporting more targeted and evidence-based public health actions.

Acknowledgement

The Ministry of Health is acknowledged for providing open-access surveillance data through the Saudi Open Data Platform.

Ethical Approval and Consent to Participate

Not applicable. This study used publicly available, aggregated secondary data with no individual-level identifiers.

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