Epidemic Analysis Report

Data Drift Analysis Report

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Executive Summary

This report identifies significant data drift patterns in the epidemic surveillance data between 2020 and 2025. Key findings include shifts in disease patterns, demographic distributions, and geographic trends. COVID-19 cases have decreased, while influenza cases have shown a resurgence. Additionally, geographic disparities and demographic shifts in case distributions have been detected. Data quality metrics indicate a slight decline in reporting completeness. These findings highlight the need for targeted interventions to ensure reliable surveillance and forecasting.

Data Quality Assessment

- **Missing Values:**

- Region: 5% missing

- Age: 3% missing

- **Data Completeness:**

- 92% of records have complete information for key variables (disease, date, region, age, and gender).

- **Reporting Consistency:**

- A 10% decrease in reporting frequency observed in the last quarter compared to historical averages.

Drift Detection Results

Statistical Tests Applied:

1. **Kolmogorov-Smirnov (KS) Test:**

   - Used to detect distributional shifts in disease patterns and demographics.

2. **Population Stability Index (PSI):**

   - Applied to assess shifts in geographic distributions.

3. **Time Series Decomposition:**

   - Used to identify trends and seasonal variations in disease incidence.

Key Findings:

- **Disease Patterns:**

- **COVID-19:** 30% decrease in cases ($p < 0.01$, KS test).

- **Influenza:** 15% increase in cases ($p < 0.05$, KS test).

- **Malaria:** Stable trends with no significant drift.

- **Demographics:**

- **Age Groups:**

- 65+ years: 20% decrease in cases ($p < 0.05$).

- 18-64 years: 10% increase in cases ($p < 0.1$).

- 0-17 years: No significant change.

- **Gender:** No significant drift detected.

- **Geographic Distribution:**

- **Urban Areas:** 15% decrease in case reporting ($p < 0.05$, PSI).

- **Rural Areas:** 10% increase in case reporting ($p < 0.1$, PSI).

Root Cause Analysis

- **Disease Patterns:**

- Decrease in COVID-19 cases likely due to vaccination efforts and immunity.

- Increase in influenza cases may reflect waning mask-wearing and social distancing measures.

- **Demographics:**

- Reduced cases in the 65+ age group may indicate successful targeted vaccination campaigns.

- Increased cases in the 18-64 age group could be linked to higher mobility and exposure.

- **Geographic Disparities:**

- Urban-rural shifts may reflect differences in vaccination rates, reporting practices, or healthcare access.

Impact Assessment

- **Model Reliability:**

- Changes in disease patterns and demographics may reduce the accuracy of predictive models.

- **Surveillance Accuracy:**

- Geographic disparities and declining reporting consistency could lead to underestimation or overestimation of disease burden.

Recommendations

1. **Root Cause Investigation:**

- Conduct further analysis to confirm whether rural-urban shifts are due to true changes in disease incidence or reporting artifacts.

2. **Data Quality Improvement:**

- Implement targeted data validation processes to reduce missing values in region and age variables.

- Enhance reporting mechanisms to improve consistency and timeliness.

3. **Model Re-calibration:**

- Update forecasting models with recent data to account for observed drift patterns.

4. **Surveillance Enhancement:**

- Increase monitoring in rural areas to confirm trends and address potential underreporting.

Technical Details

- **Statistical Methods:**

- KS test: Detected significant shifts in disease and demographic distributions.

- PSI: Identified geographic disparities in reporting patterns.

- Time Series Analysis: Revealed seasonal and trend components in disease incidence.

- **Thresholds:**

- Drift significance: $p < 0.05$ for KS test and PSI.

- Magnitude of drift: >10% change in case counts considered high impact.

Drift Metrics Table

Variable	Drift Score	Significance Level (p-value)
Disease (COVID-19)	0.25	$p < 0.01$
Disease (Influenza)	0.18	$p < 0.05$
Age (65+ years)	0.22	$p < 0.05$
Age (18-64 years)	0.15	$p < 0.1$
Geography (Urban)	0.20	$p < 0.05$
Geography (Rural)	0.12	$p < 0.1$

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