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Epidemiology

AN INTEGRATED HEALTH INFORMATION PLATFORM-DISTRICT-WISE CASE REPORTING DATA ANALYSIS STUDY IN MADHYA PRADESH AND HOW REPORTING VARIED IN DIFFERENT MONTHS CORRELATED IT WITH EXTERNAL FACTOR COVID 19

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ABSTRACT **Background:** In India disease burden is prevailing and central part of India precisely Madhya Pradesh characterized with high number of communicable and non communicable disease. Higher population and diversity pose continuous challenges in disease surveillance and monitoring. IHIP is a unique surveillance platform that leverages technology to map near-real-time data for multiple disease categories. In a densely populated country like India, accurate, trustworthy, and timely data allows policymakers to make informed decisions and implement targeted evidence-based initiatives. **Methods;** The Integrated Health Information Platform was used for data source and collection. In the present study, one-year disease reporting data was collected for all the districts of Madhya Pradesh. In the study data obtained from IHIP facility-wise cases reported by district staff in S, P, L Form in the period April 2021 to April 2022 was retrieved and analyzed. A specific comparison of data reporting by district varied in the different months and correlated it with external factors like COVID 19.**Results;** The data shows a decline among S, P, and L forms of reporting in the Sheopur, Panna, Sehore, Seoni, Barvani, Umaria, Rajgarh, Datia, Katni, Burhanur. Among these districts, the highest average disease reporting (%) was achieved in Sheopur, Panna, and Sehore. For the L form of disease reporting Sheopur, Panna, and Sehore disease reporting was 100%, 98%, and 95% respectively. However, S form of disease reporting showed the highest in Vidisha (96.89%) and Sheopur (95%). Similarly, the P form of disease reporting was highest in Sheopur (100%) and followed by Datia (96.25%). Conclusion; Results obtained in present study demonstrates that the IHIP platform serves as the foundation for the country's Integrated Disease Surveillance Programme (IDSP), which provides near-real-time data to government decision-makers at all levels.

KEYWORDS : COVID 19, nSARS-CoV2, Reporting and surveillance, Integrated Health Information Platform, S-Form (suspected cases) P-form, (presumptive cases), L-form (Lab confirmation cases).

Introduction

India is a second populous country and higher population density, a lack of affordable healthcare facilities posed a higher risk of various diseases including infectious diseases. [1] Central India especially Madhya Pradesh remain known as the centre of both communicable and non-communicable disease.[2] In December 2019, Wuhan, China reported unknown viral pneumonia in a small pocket of the city associated with acute respiratory distress. The causative agent for unknown viral pneumonia was reported as a new class of coronavirus.[3]The novel SARS-CoV-2 identified from clinical isolates in Wuhan China showed resemblance with the previous coronavirus SARS-CoV and MERS-CoV (2014 in the Middle East).[4] The first incidence was reported on January 3, 2020 in India, making it one of the most impacted countries in the globe. Till now, India is the world's second-most populous country and the third-worst hit by COVID-19**.** [5] As a result, it's important to look back at how the country has dealt with the pandemic since it began. In light of this, the purpose of this article is to evaluate the influence of government policy and technical initiatives on COVID-19 trends in India. Before the COVID-19 pandemic, India's different demographic characteristics are displayed, followed by the state of health and medical infrastructure. Second, the impact of the pandemic on India and the measures taken by the government in response are discussed. Third, the technological advances that catalyzed the overall recovery process are summarized. Finally, the economic impact of the pandemic is presented, followed by concluding observations concerning the impact of these measures their limitations, and the way forwards.[6]

COVID-19 data was often reported by state governments based on daily counts of confirmed, deceased, recovered, and active cases. [5] MoHFW, the Aarogya Setu Mobile application, news briefings, and the COVID-19 India website, which was built by a group of volunteers [7] provided an overview of the epidemic's growth rate during different phases of the mitigation tactics.[6] From the beginning, India's response against nSARS-CoV2 infections was promising where strict lockdown, surveillance, and tracking of the pandemic were done effectively. The Integrated Health Information Platform (IHIP) provides a comprehensive health profile of the population**.** [8] It integrates the Electronic Health Records (EHRs) of the citizens on a pan-India basis enabling better continuity of care, secure and confidential health data/records management, better diagnosis of diseases, reduction in patient re-visits, and even prevention of medical errors, better affordability, optimal information exchange to support better health outcome, better decision support system, and thus eventually facilitating improvement in the reforms of treatment and care of public health at National-Level.[9] It works by bringing together communicable disease programs like the NVBDCP, NLEP, NACO, RNTCP, AMR surveillance, and non-communicable disease programs like the National Program for Prevention and Control of Cancer [6], Diabetes, CVD, and Stroke, National Tobacco Control Program National Programme for Control of Blindness NPCB, NMHP, Injury, trauma with NADRS, Mo-EFCC, MoAFW, Ministry of Earth Sciences and Ministry of Electronics and Information Technology**.**[8]

Health is a “state” subject in India, managed and funded by state governments, with part-funding from the Center**.** [10] Between August 2013 and December 2016, India's MoHFW issued a series of suggestions for electronic health records that outlined vital components of a standardized health care information ecosystem, and a common language for the organization of medical terminology and data. The Ministry also instituted the National Digital Health Authority meant to “regulate, develop and deploy digital health along the continuum of care across India.” In December 2016, the government's Centre for Health Informatics released a Request for Proposals for the creation of an IHIP, where the exchange would be facilitated via a central storage repository. Madhya Pradesh, in the response to the COVID19 IHIP was launched and implemented in all the districts. [11] IHIP provides a piece of comprehensive information with real-time monitoring of ongoing surveillance programs. The public health surveillance attributes of person, place, and time are present in all data in IHIP, and the data is decoded for spatial reference. Here, in the present study, data collection and its interpretation were associated in three major classes including suspected cases (S), presumptive cases (P), and Laboratory confirmed cases (S)**.** [10] The complete information regarding the outbreak can be accessed at State and National levels on a real-time basis which helps in monitoring public health emergencies. The study aimed to investigate COVID 19 surveillance and monitoring in all the districts of Madhya Pradesh using IHIP based on daily, weekly and monthly cases under S-Form, P-form,, L-form**.**[8] The reporting of all the cases linked to the MoHFW uses data and results for policies making against disease outbreaks.

Methodology

Data Source

The IHIP platform was used for data source and collection. In the present study, one-year disease reporting data was collected for all the districts of Madhya Pradesh.

Data Collection

We compared IHIP data with facility-wise cases reported by district staff in S, P, L Form in the period April 2021 to April 2022. A specific comparison of data reporting by district varied in the different months and correlated it with external factors like COVID 19.

Study Design

Data were obtained from the Department of integrated Disease Surveillance program of the health and family welfare department of Madhya Pradesh. These data consisted of monthly records of suspected, presumptive, and laboratory-confirmed outpatient diagnosed by health staff in sub-centers, primary health centers, community health centers, and district hospitals across the Madhya Pradesh period (April 2021 - 2022). IHIP data included the total number of health facilities in the district and reporting made by the staff posted in the health facility during one year.

Objectives

The study aimed to analyze the coverage of reporting in the IHIP portal. Further study also aims to analyze facility-wise cases reported by district staff in S, P, L Form in the period April 2021 to March 2022. Another objective of the present study was designed to for comparison of data on how reporting by district varied in the different month and correlated it with external factors such as COVID 19. Finally, the study aims to discuss the challenges to improving IHIP data quality soon for better disease surveillance and monitoring.

Data Analysis

Data analysis was performed using Origin Pro version 2018. The disease reporting and distribution were analyzed in different districts and month-wise under suspected, presumptive and laboratory-confirmed cases. Geographical data analysis was also made in the present study under the IHIP using suspected, presumptive and laboratory-confirmed cases. A comparative analysis of average disease reporting (%) was carried out in the top ten districts of Madhya Pradesh.

Results

In the present study, disease reporting units and data from April 2021 to March 2022 was analyzed. The disease data available on the IHIP was retrieved and analyzed based on geographical, based on months, and district in Madhya Pradesh. IHIP record disease data for all major communicable and non-communicable disease under three major categories including suspected cases, presumptive cases, and laboratory-confirmed cases. As the results are shown in Figures 1,2 and 3 demonstrate S, P, and L forms of reporting number of entries in IHIP were significantly large in, presumptive and laboratory from of reporting in all the districts of Madhya Pradesh compared to suspected reporting. Further, comparing between S, P, and L forms of reporting the % average reporting units was higher in P and L form over S form. The higher disease reporting unit was done for suspected and presumptive and laboratory cases in Sheopur and laboratory-confirmed cases in Panna, Barwani, Seoni, Umaria, and Rajgarh, district of Madhya Pradesh. Among these higher disease reported districts in SPL Sheopur (98%) Panna (92%) and Barwani (89%) reported maximum disease reporting in suspected, presumptive and laboratory-confirmed cases.

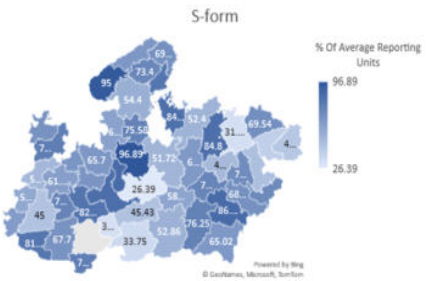

Figure 1; The figure demonstrates S form disease reporting in Madhya Pradesh

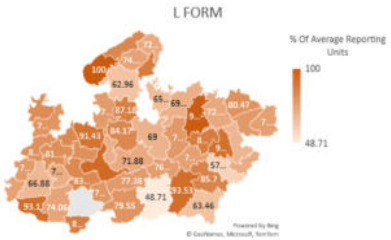

Figure 2; The figure demonstrates L form disease reporting in Madhya Pradesh

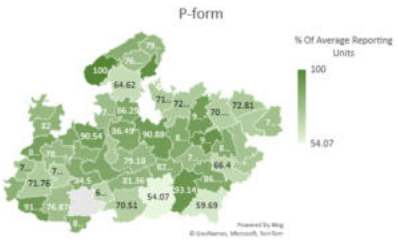

Figure 3; The figure demonstrates P form disease reporting in Madhya Pradesh

In the study, figure 3 demonstrates presumptive (P) disease reporting in different districts of Madhya Pradesh from April 2021 to 2022. As the result shown in figure 3, total disease reporting was maxima in the Sheopur district. Other districts that reported higher disease data on IHIP in Madhya Pradesh were Datia, Katni, and Barwani. The district reported the least number of disease cases in Madhya Pradesh districts including Chhindwara, Harda, Betul, and Shivpuri. A similar pattern was reported in the average number of reporting from the data retrieved from IHIP for disease reporting in Madhya Pradesh. Earlier in 2015, Jain et al. demonstrated disease burden and prevalence in Madhya Pradesh as part of central India [12]. Madhya Pradesh is known for its tribal community and diversity in the population of tribal in selected districts such as Jabalpur. Jabalpur and nearby districts frequently report mosquito-borne bacteria, protozoan, and viral diseases where the central disease reporting mechanism has shown a promising platform for policy-making and the fight against such diseases.[13] Malaria, influenza, and flu are key diseases prevailing in tribal areas such as Jabalpur. The four major non-communicable diseases (NCDs) are CVDs, diabetes, cancer, and chronic respiratory diseases. In the year 2020, more than three-quarters of NCD deaths happened in low and middle-income countries with almost 46% of deaths occurring in those below the age of 70 years.[14] In India, also the burden of these diseases is rising; in 1990, the deaths due to NCDs contributed to 53.6% whereas these have increased to 61.8% in 2020.

Figure 4 demonstrates presumptive (P) disease reporting in different districts of Madhya Pradesh from April 2021 to 2022 monthly. As the result shown in figure 4, higher disease reported was achieved in August 2021, September 2021, and March 2022. The highest number of disease cases in the month August 2021, September 2021, and March 2022 were reported in Devas District of Madhya Pradesh. The year 2021 remains critical for India as the second wave (April and May 2021) of COVID19 affected the entire healthcare system and disease reporting was also affected. In this study, a district-wise analysis was done and reported in the last two-year much emphasis was given to the COVID19 and reporting nSARS-CoV2 infection however other diseases remain prevailing in all all-major states and districts in India including Madhya Pradesh.

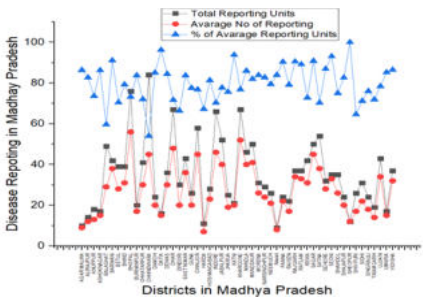

Figure 4; The figure demonstrates P form of disease reporting in Madhya Pradesh among all the districts.

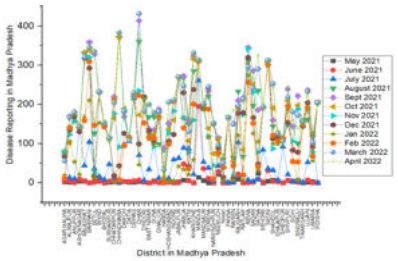

Figure 5; The figure demonstrates S form of disease reporting in Madhya Pradesh month wise among all the districts.

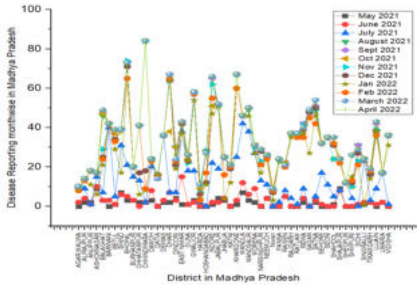

Figure 6; The figure demonstrates the consolidated L form of disease reporting in Madhya Pradesh.

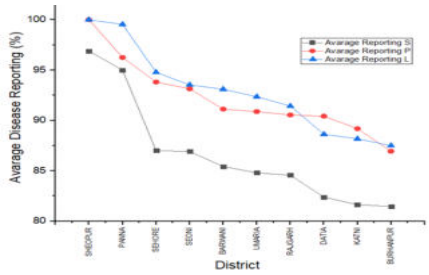

Figure 7; The figure demonstrates the percentage average reporting of SPL % in the top 10 districts of Madhya Pradesh.

Figure 5 demonstrates disease reporting (S form) in the different districts of Madhya Pradesh in the last year of the planned study. As the data shows, S form disease reporting finds a similar pattern as in the case of P form in the different districts and month-wise as well. In the S form of disease reporting major districts that showed data on IHIP were Chhatarpur, Bhind, Jabalpur, and Mandla. S and P form disease reporting find many similarities however the number of disease reporting units declines in L form in all major districts of Madhya Pradesh month-wise. Additionally, the disease reporting variations can be also seen in the different seasons. [15] As the data shown in figure 5 higher disease reporting on IHIP was achieved in the last quarter of 2021 and early 2022 which clearly shows after the second wave of COVID19. It is evident that the pandemic has not only affected disease reporting but also lacks data. In the study, ten major districts were compared for average disease reporting (Figure 6). The data shows a similar pattern i.e. decline among S, P, and L forms of reporting in the Sheopur, Panna, Sehore, Seoni, Barvani, Umaria, Rajgarh, Datia, Katni, Burhanur. Among these districts, the highest average disease reporting (%) was achieved in Sheopur, Panna, and Sehore. For the L form of disease reporting Sheopur, Panna, and Sehore disease reporting was 100%, 98%, and 95% respectively. However, S form of disease reporting showed the highest in Vidisha (96.89%) and Sheopur (95%) (Figure 7). Similarly, the P form of disease reporting was highest in Sheopur (100%) and followed by Datia (96.25%).

DISCUSSION

Spatiotemporal and machine learning approaches are increasingly used to understand the epidemiology of infectious diseases. The epidemiological understanding gained using these approaches has been instrumental in developing decision support tools, early warning systems, aberration detection algorithms, disease forecasting models, and evidence-informed public health decision-making. [16] Implementation of the Integrated Health Information Portal, deregulation of geospatial data by the Department of Science and Technology, National Digital Health Mission, and other digital health initiatives will generate high-resolution geocoded big data on health-related events in India in the coming years. Existing routine datasets have also been used to understand micro-climatic determinants using algorithms that can extract spatiotemporal parameters associated with disease occurrence. [17] The present study offers a data analysis available on IHIP for disease reporting in Madhya Pradesh districts. The IHIP application is a good example of IT-based disease surveillance, which allowed precision and integrity. The IHIP platform was successfully implemented by the Government of India for disease surveillance and monitoring where Madhya Pradesh's response was promising. [18] Madhya Pradesh prevails against both communicable and non-communicable diseases hence such platforms improved the health sector by not providing management but prevention precisely. These features made IHIP and similar technologies the new gold standard in disease surveillance and health care management. [19] The framework is customizable and has the potential to be scaled up in the entire state and country.

The Government of India uses the integrated Health Information Platform (IHIP) to analyze the national health data collected from various districts. The challenge of poor data quality is faced at the national level. The key contributing factor would be gaps at the level of data collection (paper-based system) and the capacity to analyze and correct the data at the district level. IHIP plugs this gap by ground-level reporting into the system with capabilities using its pre-loaded population database in the software and auto-generated reports for the district-level administration. In this study, data from April 2021 to April 2022 was collected and analyzed. Three data sets of suspected, presumptive, and laboratory-confirmed disease reporting were analyzed where the top ten districts were identified with higher reporting including Sheopur, Panna, Sehore, Seoni, Barwani, Umaria, Rajgarh, Datia, Katni, and Burhanur. In the one year of data analysis for disease reporting in Madhya Pradesh conclude two major findings; one robustness of IHIP and the second prevalence of disease in the community. The district with higher disease reporting not only provides a preliminary alert for disease management but also policy-making for large-scale surveillance and monitoring. Madhya Pradesh is known for tribal communities and a higher prevalence of diseases both communicable and non-communicable. In our study, we found that May to July 2021 unanimously reported the least disease reporting which demonstrates the number of diseases was in the community but reporting was minimal. Earlier in 2020, Chang et al. reviewed the impact of COVID19 on non-communicable disease reporting across the globe.[20] Crane et al. 2020 analyzed and concluded reporting of infectious diseases other than COVID-19 has been greatly decreased throughout the COVID-19 pandemic.[21] Imad et al. 2021 analyzed the impact of COVID19 on society precisely health.[22]

IHIP serves as a database and based on data analysis using various variables the disease prevalence is easily achieved. The overriding goal of IHIP is to collect disease data from the different regions across the country and in the present study Districts in Madhya Pradesh. In December 2016, the government's Centre for Health Informatics released a Request for Proposals for the creation of an integrated health information platform (IHIP), where the exchange would be facilitated via a central storage repository. [23] On the contrary, COVID19 affected global disease reporting and Madhya Pradesh as well. IHIP has another advantage, especially in India where healthcare is poor and affordable health facilities are limited. Indian public health programs are still evolving and IHIP is a promising platform and initiative by the Government of India. Robust data allowed the project to curate its strategies to meet the specific objectives. [24] IHIP also provides data analysis and early predictions of disease prevalence. A wide range of acceptance of such platforms like IHIP promotes e-health systems. To ensure the development and promotion of the e-Health ecosystem in India for enhancing or enabling the organization, management, and provision of effective people-centered health services to all in an efficient, cost-effective, and transparent manner the National e-Health Authority (NeHA) was proposed to be set up by the GOI. [25]

CONCLUSION

The present study demonstrates robust uses of IHIP in disease surveillance and mentoring. The study provides comprehensive details on disease reporting in all the districts of Madhya Pradesh where data

was collected, retrieved, and analyzed based on suspected (S), presumptive (P), and laboratory-confirmed (L) forms. The disease reporting data was analyzed and compared month-wise, district-wise, and season-wise. Three districts of Madhya Pradesh Sheopur, Panna, and Sehore reported the highest disease data in the last one-year April 2021-2022. The COVID19 pandemic has affected disease reporting and is seen in the data presented in the above study. The last five years since the implementation of IHIP gained visibility in the disease surveillance including COVID19. The wider range of IHIP can be achieved with additional modifications such as the integration of statistical tools and user-friendly applications.

Study limitations; The major limitation of the study is poor collaboration between healthcares professionals can result in mistakes/errors, and therefore collaboration ideally should be rated high. Another limitation of IHIP is the static nature of the platform and the lack of multivariate analysis.

Recommendation; Electronic health record in the Indian scenario is in their budding stages. A clear and precise guideline that can enlighten the patient and the healthcare workers is the need of the hour. The concerns of the EHRs and the online storage of data need to be alleviated and privacy concerns need to be addressed.

Abbreviations; Severe Acute Respiratory Syndrome (SARS); Coronavirus (CoV), Coronavirus Disease 2019 (COVID 19), Novel Severe Acute Respiratory Syndrome Coronavirus 2 (nSARS-CoV2), Acute Respiratory Distress Syndrome (ARDS), S-Form (suspected cases) P-form, (presumptive cases), L-form (Lab confirmation cases).

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Author Contribution; AD and SK conceptualize the study, AD collected data and analyzed, SK and YSK interpreted the results and wrote the manuscript, AD and YSK edited the manuscript; SK reviewed and revised the draft.

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