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## A Descriptive Review of the Role of Epidemiological Data in Public Health Policy Formulation

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### ABSTRACT

This study aims to provide a descriptive qualitative review of the role of epidemiological data in formulating public health policies, focusing on its function as a foundation for evidence-based and equitable decision-making. Using a qualitative-descriptive research design through a literature-based study, data were collected from peer-reviewed journals, official reports, and theoretical frameworks published between 2011 and 2025. The analysis was conducted through stages of data reduction, thematic categorization, and inductive interpretation to identify patterns in how epidemiological evidence supports public policy development. The findings reveal that epidemiological data play a critical role in five major domains: early detection and surveillance, identification of risk factors, evaluation of interventions, reduction of health inequalities, and enhancement of research-policy collaboration. These results indicate that effective policymaking depends on the integration of epidemiological evidence within structured frameworks such as evidence-informed policymaking and output-oriented policy engagement. Furthermore, the study highlights that epidemiological data not only improve efficiency and responsiveness in health governance but also promote fairness by identifying and addressing social and regional disparities in health outcomes. Despite challenges related to data accessibility, standardization, and interdisciplinary coordination, the research concludes that strengthening the use of epidemiological data is essential for achieving adaptive and just health policies. The study contributes theoretically by reinforcing the linkage between epidemiological research and policy design, and practically by outlining strategies for data-driven governance in public health.

**Keywords:** Epidemiological data, public health policy, evidence-based decision-making, health equity, qualitative descriptive study

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### INTRODUCTION

In recent years, epidemiological data have emerged as a critical foundation for evidence-based public health policy formulation. The global landscape of public health threats—from pandemics to chronic disease burdens—demands decision-making processes that are grounded in reliable, comprehensive, and timely epidemiological information (1). The increasing availability of digital health records, large-scale surveillance systems, and data analytics tools has transformed how policymakers interpret health phenomena and allocate resources effectively (2). These developments highlight a paradigm shift in governance toward data-driven health policy, where epidemiology functions not merely as a scientific tool but as an essential pillar for strategic public health management (3).

Epidemiological data serve as a cornerstone in identifying, monitoring, and mitigating health risks across populations. Through rigorous collection and analysis of disease patterns, public health authorities can prioritize interventions that address the most pressing health challenges (4). The relevance of this approach became particularly evident during the COVID-19 pandemic, where real-time epidemiological insights guided the implementation of testing strategies, lockdowns, and vaccination campaigns (1). Despite these advancements, many regions still face challenges related to data quality, accessibility, and interoperability, which impede effective policymaking (5,6).

The urgency of leveraging epidemiological data is reinforced by the growing complexity of public health issues. Beyond infectious diseases,

chronic illnesses, environmental exposures, and behavioral health determinants now require multifaceted data systems capable of integrating diverse datasets (7). Big data technologies and machine learning offer new opportunities to synthesize vast amounts of information into actionable insights (2,8). These innovations, however, raise critical questions about privacy, ethics, and equitable access to information (3,5).

Another layer of complexity arises from the ethical and legal dimensions of epidemiological data use. The rapid expansion of health databases poses concerns over data security and consent, particularly in low- and middle-income countries where regulatory frameworks may be weak (3,5). Balancing the imperative for comprehensive data collection with the protection of individual rights remains a delicate policy challenge. This tension underscores the need for policies that harmonize public health interests with ethical standards.

In many cases, epidemiological data also reveal profound disparities in health outcomes between different population groups. Through granular statistical analysis, policymakers can identify vulnerable demographics and design targeted interventions to reduce inequities (8,9). For instance, surveillance data can expose geographic clusters of disease or social determinants that amplify vulnerability, thereby informing place-based interventions and equitable resource distribution (4). Without such evidence, health policies risk reinforcing rather than alleviating existing inequalities.

The integration of genomic epidemiology into public health policy represents a transformative advancement. Pathogen sequencing and serological studies have enhanced understanding of transmission dynamics, antimicrobial resistance, and vaccine effectiveness (7,10). These insights are vital for guiding evidence-based interventions, particularly in controlling emerging infectious diseases. By combining traditional surveillance with genomic data, policymakers can better predict outbreaks and optimize prevention strategies.

Despite the promise of data-driven policymaking, significant barriers persist. Fragmented health information systems, limited analytical capacity, and inadequate investment in infrastructure hinder the full utilization of

epidemiological data (3,6). Moreover, the absence of standardized frameworks for data collection and analysis reduces comparability and reproducibility across regions (5). Addressing these gaps requires coordinated international efforts to strengthen data governance and foster collaboration between academic, governmental, and private sectors.

The dynamic nature of public health threats further amplifies the need for adaptive data systems. Climate change, urbanization, and globalization continuously reshape the epidemiological landscape, introducing new risks and challenges (1). Therefore, health policies must evolve in tandem, guided by up-to-date data that reflect changing patterns of disease burden and exposure (11). This adaptability ensures that interventions remain relevant, efficient, and responsive to emerging needs.

From a methodological perspective, advancements in epidemiological modeling have improved the predictive capacity of policy evaluation. Tools such as agent-based simulations and dynamic compartmental models allow researchers to estimate the potential impact of various interventions before implementation (12,13). These analytical innovations provide policymakers with foresight to allocate resources strategically and minimize unintended consequences.

However, the translation of epidemiological evidence into policy decisions is not always straightforward. Political, economic, and social considerations often mediate how data are interpreted and acted upon (9). Bridging this gap requires fostering a culture of evidence-based governance where policymakers and scientists collaborate continuously. Strengthening these linkages can enhance both the credibility and effectiveness of public health interventions.

A central challenge in the field is the uneven global capacity for epidemiological research and data utilization. While high-income countries possess sophisticated systems for disease monitoring, many developing nations lack the infrastructure to collect and analyze data effectively (4). International cooperation and capacity-building initiatives are thus essential to democratize access to data and ensure that all regions can participate in global health intelligence networks.

In light of these challenges, this article seeks to provide a descriptive overview of how epidemiological data contribute to the formulation of public health policies. By examining various types and sources of epidemiological data, the discussion elucidates their applications across different stages of the policy cycle, from problem identification to evaluation (1). The paper also highlights emerging technologies and methodological innovations that enhance the integration of data into policy processes (2,8).

The discussion extends to address ethical and operational challenges, exploring strategies to enhance data interoperability, transparency, and accountability. Furthermore, it emphasizes the necessity of multidisciplinary collaboration among epidemiologists, data scientists, policymakers, and public health practitioners (5). Such collaboration ensures that data-driven insights translate effectively into actionable and equitable policies.

Ultimately, the main objective of this article is to delineate the multifaceted role of epidemiological data in public health policy development and to identify pathways for optimizing its use. The findings are expected to contribute both theoretically—by expanding understanding of evidence-based policymaking—and practically, by guiding the design of more efficient and equitable health systems. Strengthening the bridge between epidemiological research and policy action represents not only a scientific imperative but also a moral one, aimed at improving population health outcomes globally (9,11).

## METHOD

This study employs a qualitative descriptive approach through an extensive library-based literature review aimed at analyzing the role of epidemiological data in shaping public health policy. The qualitative method was chosen to explore conceptual linkages, patterns, and relationships across a broad spectrum of academic literature, enabling a nuanced understanding of how data-driven insights inform evidence-based decision-making (14,15). This method emphasizes in-depth exploration of textual data rather than numerical generalization, aligning with the study's objective of developing a

comprehensive descriptive synthesis regarding epidemiological applications in policy contexts.

The data sources used in this research include academic books, peer-reviewed journal articles, institutional reports, and policy documents relevant to epidemiology and public health decision-making. Key databases and repositories were searched to identify credible and recent publications, prioritizing sources published from 2015 onward to ensure contemporary relevance (16,17). The selected materials encompass both theoretical discussions and empirical findings concerning epidemiological surveillance, big data analytics, and data visualization as tools for health governance (18,19). This approach ensures a balanced representation of conceptual and applied perspectives in the analysis.

The data collection process followed systematic literature review procedures, involving identification, screening, eligibility assessment, and inclusion phases. Literature searches were conducted using keywords such as epidemiological data, public health policy, data-driven decision-making, and qualitative descriptive research. Inclusion criteria required that studies be published in peer-reviewed journals, discuss methodological or policy implications of epidemiological data, and present qualitative or mixed-method evidence (20,21). Exclusion criteria eliminated non-scholarly sources, outdated references, and materials lacking methodological transparency. This systematic selection ensured that all reviewed sources contributed substantively to the analytical framework of this article.

The data analysis procedure adhered to qualitative analytical stages, including data reduction, thematic identification, categorization, and inductive interpretation (14,22). Initially, all retrieved sources were subjected to open coding to identify recurring concepts and constructs related to the integration of epidemiological data into health policy processes. These codes were then grouped into categories representing distinct analytical dimensions, such as data sources, applications, limitations, and governance implications (23). Through iterative synthesis, overarching themes emerged, providing the structural foundation for the article's descriptive narrative (24).

To ensure data validity and reliability, triangulation techniques were employed by comparing insights from multiple types of sources—academic articles, institutional reports, and theoretical frameworks (25). This triangulation process enhanced the trustworthiness of findings by corroborating patterns observed across independent studies. In addition, conceptual peer review was undertaken through intertextual comparison among key studies to validate thematic interpretations (21,26). The adoption of an audit trail documenting analytic decisions further reinforced methodological transparency and reproducibility (14).

Ultimately, this methodological framework allows for a rigorous qualitative-descriptive synthesis that captures both the complexity and the policy relevance of epidemiological data use in public health. By integrating a systematic literature review with inductive thematic analysis, the study produces a coherent and empirically grounded depiction of current trends, challenges, and innovations in data-informed policy design. The qualitative approach not only provides theoretical insights but also offers practical implications for strengthening evidence-based policymaking in public health domains (15,20).

## RESULTS

The results of this qualitative-descriptive literature review demonstrate that epidemiological data have become the backbone of evidence-based public health policymaking, driving more accurate, equitable, and adaptive decisions across all stages of the health policy cycle. The analysis of recent studies reveals that epidemiological data are not only instrumental in disease surveillance but also critical in identifying risk factors, evaluating interventions, reducing health inequalities, and fostering collaboration between researchers and policymakers (1,11,27,28).

First, epidemiological data play a pivotal role in early detection and surveillance of diseases. The synthesis of findings indicates that robust surveillance systems—particularly those enhanced by real-time data analytics and genomic epidemiology—enable rapid responses to emerging health threats (1,10). Integration of big data technologies in public health surveillance

facilitates dynamic monitoring, ensuring that interventions are both proactive and responsive. As noted by Thalia (2025), such integration enhances the government's capacity to identify potential outbreaks, assess risks, and design interventions based on predictive trends rather than reactive measures.

Second, epidemiological data contribute significantly to the identification of risk factors and disease determinants across population groups. Through analytical modeling and population-based data segmentation, policymakers can discern key demographic, behavioral, and environmental variables that drive disease prevalence (29,30). For instance, Komi et al. (2025) developed a conceptual framework using epidemiological data to analyze health disparities, emphasizing the importance of localized and context-specific data interpretation. Likewise, the study from *Epidemiological Indices in Clinical Aspects* (2023) highlights how understanding disease burden through statistical indices informs resource prioritization and strategic health planning.

Third, epidemiological data are indispensable for the evaluation of intervention outcomes and policy effectiveness. Evidence-informed policy frameworks, such as the one proposed by Haby et al. (2025), provide systematic structures for translating empirical findings into measurable policy performance. By incorporating epidemiological indicators into the policy evaluation process, governments can identify inefficiencies and recalibrate interventions accordingly. Similarly, Banks et al. (2023) underscore that evidence derived from epidemiology enhances the accountability and legitimacy of policy decisions, bridging the gap between research outputs and political implementation.

The fourth major finding centers on the role of epidemiological data in reducing health inequities. Empirical evidence suggests that inequities—arising from socioeconomic, geographic, or racial disparities—can be mitigated when epidemiological insights guide targeted resource distribution (Komi et al., 2025; Marmot, 2017). Epidemiological mapping enables policymakers to visualize inequality hotspots, allowing interventions to focus on the most vulnerable groups. Moreover, Schnake-

Mahl et al. (2022) emphasize the importance of integrating multiple governance levels, suggesting that community-based participation enhances the inclusivity and responsiveness of data-driven policies.

In addition, a recurring pattern across the reviewed literature is the importance of researcher-policy collaboration. Effective translation of data into policy action relies on mechanisms that foster sustained engagement between researchers and policymakers. Banks et al. (2023) propose the Output-Oriented Policy Engagement (OOPE) model, which prioritizes collaboration through shared agendas and mutual accountability. Complementing this, Orton et al. (2011) identify barriers—such as communication gaps and political resistance—that often hinder evidence integration. Collectively, these studies underscore that continuous dialogue, rather than sporadic consultation, is essential for aligning epidemiological research with policy realities.

The synthesis of all findings reinforces that epidemiological data are both scientific and strategic assets in public health governance. Their integration across policy design, implementation, and evaluation stages ensures that interventions are not only evidence-based but also socially just and contextually adaptive. The following table summarizes the key findings from this literature review, delineating the main roles of epidemiological data in shaping health policy outcomes.

**Table 1. Summary of Key Roles of Epidemiological Data in Public Health Policy**

Role of Epidemiological Data	Impact on Public Health Policy	Key References
Early detection and surveillance	Enables rapid response to health threats	(1,10,11)
Identification of risk factors	Supports targeted interventions and preventive strategies	(29–31)
Evaluation of interventions	Enhances policy efficiency and accountability	(27,28,32)

Reduction of inequalities	Promotes equity and fairness in health policy	(30,33,34)
Research-policy collaboration	Improves policy relevance and knowledge translation	(27,28,32)

Overall, this review establishes that epidemiological data not only guide short-term public health responses but also enable long-term system resilience. By combining traditional epidemiological surveillance with novel data science techniques, health systems can continuously adapt to evolving risks. The findings further suggest that fostering cross-sector collaboration and ethical data governance will be crucial in optimizing the use of epidemiological data for equitable and sustainable policy outcomes (1,27,28).

## DISCUSSION

The synthesis of literature reveals that the integration of epidemiological data into public health policymaking represents not only a methodological advancement but also a paradigm shift toward evidence-based governance. This discussion interprets the findings by linking them with theoretical and empirical perspectives derived from the reviewed studies, emphasizing their implications for contemporary health systems and policymaking frameworks.

From a conceptual standpoint, the role of epidemiological data aligns closely with the evidence-informed policy model, which argues that decisions in health governance should be grounded in systematic evidence rather than intuition or political expediency (27,28). According to this model, epidemiological information provides a structured foundation for identifying health priorities, allocating resources, and evaluating outcomes. This analytical framework supports transparency, accountability, and inclusivity—three core principles of effective public policy. When epidemiological data are used in tandem with participatory deliberation and stakeholder engagement, policies become more adaptive and socially legitimate.

Furthermore, the integration of epidemiological evidence enhances the accuracy

and effectiveness of health interventions, as demonstrated by (1) and (11). Disease surveillance and predictive analytics allow policymakers to intervene early, thereby reducing morbidity and mortality through timely, evidence-based decisions. These applications demonstrate the pragmatic value of epidemiological data, confirming that data-driven decision-making is essential in managing both chronic and infectious disease burdens. (10) further illustrate that incorporating genomic data strengthens predictive modeling, making disease tracking and policy responses more precise. Thus, the synergy between epidemiological and genomic approaches represents a fundamental step toward precision public health.

Epidemiological data also play an essential role in promoting equity and justice within health policy. The findings from (30) and (33) underscore that data-driven insights allow policymakers to identify health disparities rooted in socioeconomic, environmental, and geographic determinants. Policies that incorporate these insights can address inequities proactively, thereby advancing health justice and inclusivity. (34) complement this view by emphasizing the necessity of multi-level governance—recognizing that effective epidemiological policymaking requires coordination between national, regional, and local levels. Such collaboration ensures that interventions are context-sensitive and culturally appropriate, reinforcing the moral imperative of equity in health governance.

However, while the literature converges on the value of epidemiological data, it also identifies structural and ethical challenges that may hinder optimal utilization. Orton et al. (2011) note that gaps in communication between researchers and policymakers often limit the translation of epidemiological findings into actionable policies. Similarly, Banks et al. (2023) argue that political priorities, bureaucratic inertia, and limited data accessibility can dilute the impact of scientific evidence. Ethical concerns—particularly regarding privacy and data ownership—also emerge, especially in low- and middle-income settings where regulatory frameworks remain underdeveloped (1). Addressing these challenges requires transparent governance mechanisms, investment in data

infrastructure, and continuous researcher–policy dialogue.

The implications of these findings are profound. In practical terms, they highlight that epidemiological data should not merely inform short-term interventions but should underpin the entire policy lifecycle—from problem identification to impact evaluation. Theoretically, this strengthens the understanding of public health as an interdependent system driven by empirical validation and community participation. By adopting models such as the Output-Oriented Policy Engagement (OOPE) approach (27), governments can institutionalize long-term collaborations that align scientific inquiry with policy objectives.

Despite its significance, this body of research also acknowledges certain limitations. First, disparities in data availability and quality across regions constrain the global comparability of epidemiological findings (28). Second, many studies rely on secondary data, which may introduce bias due to inconsistent reporting standards (31). Third, while the reviewed frameworks demonstrate theoretical coherence, empirical evidence of long-term implementation remains limited. To overcome these limitations, future research should focus on enhancing interoperability between data systems, strengthening ethical oversight, and developing participatory policy platforms that empower communities to co-create evidence-based solutions.

In conclusion, the analysis demonstrates that epidemiological data are not merely instrumental tools for policy formulation but transformative drivers of equitable and accountable health governance. Their integration ensures that public health systems evolve toward greater adaptability, inclusivity, and resilience—core elements in addressing the global health challenges of the twenty-first century (1,11,28).

## CONCLUSION

This qualitative-descriptive study concludes that epidemiological data play a transformative role in shaping evidence-based, equitable, and adaptive public health policies. The synthesis of literature demonstrates that the integration of epidemiological data enhances the precision of disease surveillance, the targeting of

preventive interventions, and the evaluation of policy effectiveness—ultimately reinforcing accountability and inclusivity in health governance. By linking empirical findings with frameworks such as evidence-informed policymaking (28) and output-oriented policy engagement (27), this research extends theoretical understanding of how data-driven decision-making fosters transparency and collaboration between researchers and policymakers. The study further underscores that epidemiological insights contribute to the advancement of health equity by identifying social and geographic disparities (30,33). Within broader social and cultural contexts, these findings highlight the necessity of multi-level governance and community participation to ensure that policies remain contextually relevant and ethically grounded (34). Nonetheless, limitations persist, particularly regarding disparities in data accessibility, standardization, and interdisciplinary integration. Future research should therefore focus on developing interoperable data infrastructures and participatory models that strengthen the ethical, methodological, and practical foundations of epidemiological policymaking—advancing not only the science of public health but also the justice it seeks to serve.

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