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Using PEPFAR's Operational Analytics for Equity, Governance, and Real-Time Decision-Making: From HIV Monitoring Dashboards to Community Health Surveillance

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Abstract

The growing popularity of dashboards within the domain of the public health systems has not only changed the way global health is being tracked, but the example of the United States President Emergency Population Relief Program (PEPFAR) stands out as one of such prominent. PEPFAR successfully built high-frequency reporting, anomaly detection, and equity surveillance functions in the originally version of their real-time dashboards planned to manage HIV/AIDS. With the use of these tools, it is possible to respond quickly to the arisen health crisis, so the effective distribution of funds occurs. The experiences of PEPFAR in monitoring of the HIV program can also be an example in increasing the scope of surveillance activities to community related activities such as non-communicable diseases, material health, and disaster management in pandemics.

One of the most important transitions in this change is the adaptation of methods, such as Extraction, Transformation, and Loading (ETL) processes, Bayesian hierarchical modeling, and machine learning, to utilize variety of health data. Through such techniques, such health systems have an opportunity to enhance their decision-making processes by using real-time data analytics to make sure that indicators of health equity and social justice are handled as immediate as possible. Specifically, data disaggregation based on the factors like geography, gender, and socio-economic status enables the identification of health disparities, which could be further taken into action to enhance service provision in underserved populations.

Similar challenges remain such as threat of data overload, poor consistency in data quality and need to ensure a sustainable funding module to sustain such systems. Furthermore, the issue of privacy protection and openness and accountability in using data need to be critical. Nonetheless, there is a possibility of linking the PEPFAR dashboard model to larger community health surveillance in order to impact more positively health outcomes in the world since thoughtful, data-driven decision-making would become feasible.

Keywords: Analytics; Dashboard; Decision-Making; Equity; Governance

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1. Introduction

1.1. Dashboards Background in Worldwide Wellbeing

The entire process of global health has been transformed in the last 20 years by the digital revolution, dashboards, and operational analytics, which monitor, optimize, and improve community health programs. In today's world of digital information streams, mobile health, and electronic health records, data collecting is becoming a reality. However, the health system's issue is not with data collection, but rather with paying attention to data so that decisions may be made promptly (Lin et al., 2022). In the present world, dashboards—also referred to as integrated visual interfaces—that combine many information sources into actionable insights are crucial for both program execution and real-time surveillance (Gazzarata et al., 2024). One of the clearest instances of this kind of shift would have been the United States President Emergency Plan on AIDS Relief (PEPFAR).

In addition to raising and allocating billions of funds for the fight against HIV/AIDS, PEPFAR has taken the lead in developing data-driven governance mechanisms and program monitoring from its designation in 2003 (Mercadal-Orfila et al., 2024). These dashboards have been tremendously helpful in connecting the macro-level global health projects with the actual service delivery realities on the ground. In 2019, Haakenstad et al. In order to demonstrate how HIV monitoring dashboards could develop into the next generation of blueprints for cognitive frameworks of communal wellness, the article integrates policy, technical, and moral perspectives. By doing this, it highlights one of the main theories, which is that in order to address the complex public health concerns of today, real-time, equitable, and transparent data systems are necessary.

1.2. Importance of real-time analytics

PEPFAR dashboards also strongly depend on real-time analytics as they are the means to make it successful in the area of health. Timely flow of information incorporated in the decision making of health systems will provide the opportunity to transition to an active rather than a retrospective management system (Kaliel et al., 2023). The tools of anomaly detection, trend analysis, predictive modelling, among others, are what enable the identification of problems early and facilitate their resource distribution and accountability at all levels of the service delivery (Lin et al., 2022). This transformation of data collection to the dynamic use has restored the momentum of what is achievable with an effective program monitoring.

1.3. Why HIV Monitoring Dashboards → Community health

The second question is, do the experiences of the HIV monitoring dashboards in larger community health systems apply? New categories of infectious, chronic non-communicable, maternal and child health, and the social determinants of inequities are also on the global health agenda not just over HIV, but today (Mercadal-Orfila et al., 2024). One way in which health systems can strengthen county- and community-level surveillance lies in changing the methodologies underlying the dashboards to visualize HIV, which include, are not limited to: ETL pipelines, Bayesian modelling, equity-oriented analytics, and others (Gazzarata et al., 2024). This would help the completeness and timeliness of the reporting as well as advocate the marginalized population in the decision-making.

2. The PEPFAR Dashboard Model: Lessons from HIV Programs

2.1. History and evolution

At the time of launching the Emergency Plan of AIDS Relief (PEPFAR) in 2003 the U.S. President had to address the peak of an HIV epidemic. The health systems were disintegrated, underfunded, and in a deplorable condition and the Millions of people (especially in the sub-Saharan part of Africa) were not taking the life saving antiretroviral therapy (ART). PEPFAR was focused on the short-term development of HIV care and prevention programs involving the target at providing ART and testing as a way to reduce the crisis (Byrne et al., 2025). However, towards the end of the 2000s, the program encountered another setback of guaranteeing accountability and sustainability of the billions of dollars spent on HIV programs (Kaliel et al., 2023). It was also made evident that effective monitoring and evaluation systems were good additional resources and their main pillars of long-term success.

PEPFAR, in its turn, was the first program to implement the use of digital dashboards when running the program. Franchises such as the Data for Accountability, Transparency and Impact (DATIM) franchise, Site Improvement through Monitoring System (SIMS) and other systems depending on countries used these franchises to simplify disrupted data flows (Sarker et al., 2024). This dashboard reduced reporting lags and had the ability to provide real-time program outcomes on different national, regional, district, and facility levels (Lin et al., 2022). It is important to note that they were not designed as a passive information warehouse but rather as the active decision-support system (Gaayeb et al., 2023). PEPFAR dashboards were seen as a novel reporting framework which was not compliance based but data-driven proactive improvement that interconnects data to resources, program reviews and remedial action.

2.2. Key Indicators and Metrics

2.2.1. High-Frequency Reporting

Annual or bi-annual surveys formed the basis of traditional global health monitoring and led to very high time delays in program implementation and results. PEPFAR, in turn, was paying more attention to quarterly and even monthly reportages (Haakenstad et al., 2019). High-frequency reporting culture promoted near-real-time responsibility where managers detected a business problem like drug stock-outs or patient dropouts early enough to correct them.

2.2.2. Disaggregation and Equity Surveillance

Among the strong points was the systematic disaggregated information utilization that was included in PEPFAR dashboards. The information categorization based on age, sex, geography, and treatment status identified inequities in populations, after which policy makers could correct inequity (De Brito et al., 2021). One would be the use of dashboards to signal failures in treatment adherence with teenage female patients or low coverage in rural care.

2.2.3. Uniformity among geographies

PEPFAR introduced a standard reporting format and indicators in different national environments. This standard allowed benchmarking and intercountry comparisons to be done even though there was the flexibility to make local adaptations. According to Sarker et al. (2024), the standardization improved the transparency and accountability of the whole global program.

2.2.4. Early Anomaly Detection

HIV monitoring dashboards reflected sudden patterns (total ART retention or HIV cases upsurge) and were identified by inbuilt algorithms. These alarms assisted the program managers in determining the true crises or the healthcare problem which was the data quality issue and taken relevant investigation and measures.

2.3. Achievements and Restrictions

2.3.1. Achievements

- **It would be more accountable:** Governments, donors and implementing partners would find it easy to see whether resources were turning into results, based on trust and transparency.
- **More Timeliness:** The time between reporting became shorter, making health programs more like a reactive system, and not a proactive system.
- **Equity Focus:** PEPFAR had acknowledged marginal and local differences with inclusion of disaggregation to the statistics and presentation of these disparities in the confounding of the vast statistics.
- **Capacity Building:** The data use focus facilitated the countries invest in the monitoring and evaluation infrastructure and develop domestic data analysis capacity.
- **Set Policy:** Dashboards played an important role in the process of decision-making, such as the role it played in resources allocation, definition of poor-performing areas, and the creation of interventions based on local situation.

2.3.2. Restrictions

- **Information Overload:** with the number of indicators, the job overload on the overworked employees of the facility and district is charging fatigue. Usability and comprehensiveness are not quite easy to strike a balance.
- **Variable Data Quality:** The collection was not done consistently on sites and countries even though the anomaly detection tools were used to detect anomalies. The poor infrastructure and the poor training are the common cause of the data inconsistency and were all present.
- **Dynamics of donors:** It was criticized that the dashboards were largely meant to bring the donors to book as opposed to empowering the local governments and communities. The engagement of the issue of ownership and sustainability were brought up.
- **Sustainability Issues:** dashboards might be expensive to upkeep and entail technical support and political will. With regards to the reduced donor funding in eye, there is a concern as to whether such systems are sustainable.

3. Method Transfer to Community Health Surveillance

3.1. Why Transfer Matters

The health environment in the world today is quite different than it was in the early period of the U.S. Presidential Emergency Plan for AIDS Relief (PEPFAR). It is important to note that despite being an immediate issue in the past, the list of threats to community health systems has become very broad nowadays: new infectious diseases such as COVID-19, Ebola and Zika; the spread of the burden of non-communicable diseases (NCDs) such as diabetes, high blood pressure and cancers; sustained maternal and child mortality; malnutrition and the growing effects of climate change on health (Skjefte et al., 2024). Unlike a vertical program where a single disease is the target population health is observed through community health surveillance where an attempt is made to capture a portrait or comprehensive picture of the population. Nonetheless, surveillance data may be disjointed, slow, innate, and therefore unhelpful when making decisions in a limited period (Ali et al., 2024). By altering the methods initially presented in HIV monitoring dashboards health systems can move towards equity based, real time and integrated surveillance of different health indicators.

3.2. Extraction, Transformation and Loading (ETL)

- **Extract:** Automated collection of data should integrate diverse data categories, including electronic health records (EHRs) and other laboratory information platforms, civil registration and vital statistics, mobile health tools that community health workers use, and sentinel disease surveillance sites. Liu and Hsiao (2025) confirm that, with such automation, there is no need to make such entries manually and this results in reduction of errors and delays.
- **Change:** The non-homogeneous inputs must be homogenized into inter operable data. It involves checking data, removing data duplication, standardization of names and units of the variables and imputation of missing data (Ali et al., 2024). Transformation also makes use of business rules to ensure consistency e.g. the use of international diagnosis codes, such as the ICD-10.
- **Loading**: Structured data sets (when changed) must be either stored centrally (in a centralized repository, such as nationwide data warehouses) or federated to allow centralized data control and combined analytics (Skjefte et al., 2024). Remarkably, the data governance policies and the compliance with privacy frameworks at a local level should be followed in the course of the loading process.

3.3. Bayesian and Machine Learning

3.3.1. Bayesian Hierarchical Modelling

- **Quantifying uncertainty:** Bayesian models directly measure uncertainty in parameter estimates, which is important when making high-stakes policy decisions with incomplete information, as discussed by Wang et al. (2025).
- **Smoothing information across groups:** Bayesian models can provide information that is smoothed across groups, so that count-level information in small counties is smoothed with that of related populations, as stated by Sahin (2025).
- **Dynamic updating:** Bayesian updating enables the model to continuously use new data to refine predictions, an important feature of outbreak detection and epidemic forecasting.

3.3.2. Machine Learning Core Elements of Method Transfer

Integrated Data ETL Pipelines

Pipelines automated these data consolidation transformations in PEPFAR, Extract, Transform, Load (ETL). All of these systems can be extended to community health using electronic medical records and based on open-source medical record systems (like DHIS2 and OpenMRS), community health worker (CHW) mobile applications, disease surveillance reports, and civil registration and vital statistics (Sritharan et al., 2025). Fragmented datasets are automatically cleaned, transformed, and standardized to ensure that a coherent dashboard of data runs in near real-time, improving turnaround and completeness.

High-Frequency Analytics

Responsive community health action requires annual or biannual surveys, which are too slow. Instead, dashboards need to include weekly or monthly updates. Some examples are weekly cases of malaria per village, stock levels of vital medicines, and monthly rates of antenatal care attendance. Sarker et al. (2024) assertassert that greater data frequency is helpful to respond more quickly, e.g., delivering new stock to the clinic before it runs out or organizing vaccination in response to the outbreak.

The Lens of Disaggregation and Equity

PEPFAR also prioritized disaggregating by age, sex, and geography, and this imperative is even greater in community health (Liu & Hsiao, 2025). This equity prism does not mask disparities in aggregate results to ensure marginalized groups are visible in program development and review.

Local Decision Feedback Loops

The best dashboards ought to support bi-directional information. The data needs to be transferred to national governments and donors to support frontline providers and communities (De Brito et al., 2021). This type of loop increases ownership, responsibility and real-time corrective response.

Clustering Anomaly Detection Algorithms

Three statistical tools that can be borrowed by community health systems and used to identify abnormalities include control charts, z-scores, and Bayesian change-point detection. According to Sahin (2025), all of these indicators could be temporary or planned reduction of immunization rates, which would mean a lack of vaccines, and unexpected growth of cases of diarrhea, which may be an indicator of water pollution (Byrne et al., 2025).

3.3.3. Examples of Method Transfer

- **Mother and Newborn Health:** Dashboards can monitor prenatal care, skilled births and post-deliveries. The significant decline in antenatal attendance can become the beginning of outreach activities.
- **Vaccination Programs:** Weekly Vaccination Data will help identify low-recovery areas and conduct specific campaigns in low-performing districts.
- **Chronic Disease Management:** Just like ART adherence tracking, dashboards could be used to track insulin or hypertension medication adherence to identify patients at risk.
- **Outbreak Detection:** Rapid outbreak investigation may be prompted by aberrant fever or respiratory disease cases.

3.4. Community Health Indicators for Real-Time Equity Monitoring

3.4.1. Defining Community Health Indicators

- **Maternal and Child Health:** coverage of antenatal care, skilled birth care, postnatal care, and immunization coverage.
- **Communicable Diseases:** malaria, tuberculosis and diarrheal diseases incidence; HIV testing and treatment commencing; and level of essential medicine stocks.
- **Non-Communicable Diseases:** hypertension and diabetes detection, treatment compliance and cancer screening rates.
- **Environmental and Social Determinants:** quality water, food availability, and housing.
- **Health System Performance:** human resource coverage, timeliness and completeness of reporting.

3.4.2. Importance of Timeliness

Timeliness of reporting is one of the most important indicators. Delays reduce the importance of data in taking immediate action. Ali et al. (2024). The metrics that dashboards should monitor include a percentage of facilities that report data during reporting periods and the number of days (on average) it takes for the facility to deliver services and update its dashboard.

3.4.3. Detecting Abnormalities in Indicators

Using HIV experience, a sudden decrease in the number of antenatal care visits could indicate facility closures, and a sudden increase in diarrheal disease may indicate contaminated water. Lin et al. (2022) advocate that abrupt shifts in mortality rates could demonstrate flaws in reporting or a crisis and should be investigated promptly.

3.4.4. Indicators of Equity and Social Justice

In addition to the disaggregation, equity will require overt attention to inequities. Examples include immunization disparities between rural and urban settings, maternal mortality disparities based on the wealth quintile, and refugee versus host coverage of services (Kaliel et al., 2023). When inequities are brought into visibility, policymakers are motivated to adopt more inclusive concerns.

4. Case Applications: PEFAR Lessons Translation

The best way to translate the methodologies used in HIV monitoring dashboards into community health surveillance is by example. County health systems can develop responsive systems to various health issues, using PEPFAR's focus on high-frequency reporting, anomaly detection, and equity-driven monitoring.

4.1. Example 1: Maternal and Child Health Surveillance

Rapid responses were achieved through displaying real-time on the PEPFAR dashboards showing treatment compliance and the rate of viral load suppression. The same could also work in motherly and child health programs.

Real-time visualization of immunization would also be easy to use to allow the health managers to visualize geographical regions with poor coverage.

Computer programs used to detect anomalies would be notified of a sharp drop in ANC visits to the facility or deliveries. These are often among the initial indications of community disruption, such as an outbreak of infectious disease or transportation issues.

Allowing discrepancies to remain transparent, as oppose to clustering data on a rural versus urban, socioeconomic quintile, marginalized groups, etc. The advantages of this data solution are that the interventions (maternal and child health) will be provided to the susceptible groups on time and fairly.

4.2. Example 2: Non-Communicable Disease surveillance.

Chronic diseases such as diabetes and hypertension pose more and more challenges to the community health systems, yet these diseases are not equally treated. PEPFAR data about completeness and timeliness can be reused to improve the NCD surveillance.

The counties could monitor dashboards:

- Percentages of those patients that have had their blood pressure or glucose read at least once.
- UTF -Early notification about the facility-wide stock-outs of medications should serve to indicate derailment of treatment.
- Scheduling of follow-up appointments (time-sensitive measurements of promptness according to the clinical guidelines) is undertaken to identify a discrepancy in continuity of care.

Bayesian forecasting could also be applied to the system to increase its responsiveness. Dashboards can alert the facilities which are in danger of shortages because they predict the future demand of medication based on the past patterns and seasonal changes (Sritharan et al., 2025). Such preventive surveillance indicates the resource allocation processes of PEPFAR that can be seen through the lens of chronic disease conditions (Omrany et al., 2025). These dashboards would ultimately place the NCD care into proactive care and not reactive care.

4.3. Example 3: Pandemic Preparedness and response to the outbreak.

COVID-19 has highlighted the importance of real-time dynamic monitoring. The anomaly detection mechanisms embraced as part of PEPFAR which have been designed initially to identify the discrepancies in reporting HIV can be modified so that they could be used to strengthen the response to an outbreak.

The counties could have dashboards that monitor:

As a form of early-warning system, cluster detection tools can identify abnormal surges in respiratory infections in a community or facility.

Scanning of the supply chain can be useful to indicate delays in laboratory findings and checks with testing capacity or availability of reagents.

Bayesian modelling is able to issue probabilistic projections that may generate increasing case scenario cases, provide informative county-level surge planning on hospital beds, oxygen or vaccines.

The introduction of this kind of analytics into county dashboards can help local health systems transition to preparedness instead of crisis response. In this framework, Gazzarata et al. (2024) affirm that the pandemic resistance is boosted, along with the detection and control of endemic diseases like malaria or seasonal influenza.

5. Ethics, Laws and Governance

5.1. Data Governance

Good governance will also mean that data systems are trusted and valuable not technical. Lastly, the accountability at the various levels of response to HIV was defined in terms of quality and timeliness of information and no ability was left to decide what to do in this area. To turn this into community health, the following is required:

- **Summary/ apparent rules:** Circulating facilities and counties are required to appoint data integrity stewards and data accountability should be developed on the data entry tier and not on the higher tier only. This makes the locals feel that they have ownership and improves the credibility of the information collected.
- **Standardized Protocols:** These may help avoid certain inter-jurisdictional differences by standardizing definitions of indicators and approving validation rules and reporting schedules. The comparison between counties may be meaningful in case of the use of standards because benching and fair performance can be evaluated.
- **Transparency and Feedback:** In terms of governance, the users and providers of such data are the facilities. Since a sense of ownership is introduced, offering them direct access to their own dashboards will enable to improve it and create a culture of improving their learning.

5.2. Privacy/Confidentiality

Introduction to community health surveillance extends the boundaries of sensitive information processing to a great extent. Despite the high level of confidentiality of HIV data, community health records might contain the history of reproductive health, mental health, substance abuse or/and drug addiction, or hereditary predisposition (Nugroho et al., 2025). This can have dire societal and economic implications on the individuals and communities as a result of such data breaches. Privacy protection is thus not possible.

Some of the key mechanisms are:

- **De-identification and aggregation:** Before personal identifiable information is shared among the systems, it must be de-identified/Aggregated. An example of this is a trended to risk in which records are being reported on a case by case basis would be less risky than a facility or a district being reported.
- **Role- depended access controls:** This should be highly hierarchical in terms of access to sensitive data sets where only authorized personnel should access the information. Only the national planner can observe aggregate knowledge, whereas the operational data needed by a community health worker to engage in care are shared.
- **Privacy-conscious analytics:** furthermore, analytics such as differentially private analysis and secure multiparty computation provide the promise of analyzing sensitive data in an efficient way, without any of the data entries being disclosed. Such methods are the ones that allow value analytics, which includes privacy-essential methods, and are becoming mandatory in digital health ecosystems.

5.3. Ethical Equity Lens

This irrational support of bad faith can be considered the most obvious operational analytics risk in the case in question (Omrany et al., 2025). Equity lens is a major key to governance.

Three safeguards stand out:

- **PAR 3 4.** Vital disaggregation: Each of the dashboards should be developed to be creatively directed on all the significant dimensions as age, gender, geography, socioeconomic status, marginalized and so on. This will ensure that no gap in aggregated average will be present.
- **Community representation:** Board Governance should meet the representatives of a group of people whose influences come to the fore to establish the supervision, background and responsibility. The participativity approach connects the governance of data and the situations, where it is enclosed.
- **Determination of equity effect:** The risk of allowing inequities to emerge or evading in the future must be determined without any issue before releasing new indicators in the market. That is, it can only be introduced the new performance measure due to the fact that it will be negative to the rural clinics or it might not indicate the vulnerable patients.

6. Bringing Bayesian Modelling to Community Health Dashboards

The Bayesian modelling, in combination with its adaptability has benefits to county health systems with sparse, delayed and piecemeal data streams. Under the dashboards, the presence of Bayesian techniques enables the health officials to produce more accurate estimates, produce timely forecasts, and provide the uncertainty directly to support the decision-making process.

6.1. The Bayesian Hierarchy Model

Community health surveillance can be arranged at more manageable administrative levels, e.g. sub-counties or districts where pure measures cannot be obtained due to small samples (Nugroho et al., 2025). Bayesian hierarchical models can be a solution because counties can exchange so-called information borrowing among similar geographic or demographic backgrounds.

In a single HIV program: With the need to include in the prevalence estimates sparsely populated counties, the prevalence of these purely sparsely populated counties may be stabilized with trends in areas with comparable demographics.

Just as in the case of maternal mortality, which is notoriously brutal to gauge in real-time, it is possible to correlate data in similar countries to obtain more up-to-date and plausible estimates, based on raw counts alone.

⍰Equity-oriented dashboards have as a foundation, hierarchical modelling, which is effective in reducing noise with local specificity.

6.2. Dynamic Bayesian Updating

The classical statistical models are slow to make decisions as new data tends to make the complete re-estimation of the models to be done. On the other hand, Bayesian models cause dynamic updating: any new piece of evidence can be simply included in the analysis that has already been conducted, and the one that has been conducted is not rejected (Khatter, 2025). This is very crucial in the rushed situations such as the outbreak of epidemic diseases or happenings in the supply chain.

Some examples: To illustrate: In the event of an outbreak of malaria or influenza, case notification reports received on a daily or weekly basis may be fed into Bayesian model to provide near real-time forecasts of transmission dynamics. Similarly, the supply chain demand may at other times require vital medicine and hence the ongoing refresh of the supply chain may exist as much as the dispensing information flows in the system.

Sharp change of health service utilization may also be captured in the case of an emergency, especially due to a flood, as a sudden shift in the frequency of usage of a product (as in the case with Aztec Healthcare) can be recorded using Bayesian updating.

Bayesian updating enables the county officials to anticipate a surge of demand because of the necessity of additional maternal services, additional utilization of the trauma services or additional vaccines.

6.3. Communicating Uncertainty

The first such feature is that Bayesian modelling allows the presentation of results in terms of probability, rather than absolute. Instead of acting in certainties, policymakers have to make choices by sacrificing some and taking some risks in the face of uncertainty (Byrne et al., 2025). On the basis of this fact, Bayesian procedures are the rational choice because the findings can be represented in the form of probabilities and a credible interval.

An example of a community health dashboard is given below:

IFI It is very possible (75 per cent) that cases of malaria in this county will increase the following month. These types of framing are useful in assisting decision-makers to find some balance between alternatives in mobilizing resources to prevent, as opposed to trying to mobilize more resources to treat or be prepared to treat based on some quantified likelihoods as opposed to binary prognostications.

Likewise, adherence after uncertainty interval of estimates of health of the maternal level would also be put on the proportion who adopts a certain intervention. Both of them would respond unrealistically and underreact to general rule.

7. Discussion: Implications and Problems

7.1. Equity and resiliency implications

Democratizing health data, the best use of real-time analytics is to offer insights to the executives of a country, as well as county and frontline workers, to enhance their capacity to improve national policy. This will allow local decision-makers to identify an imbalance, like poorer immunization rates in rural communities and deliver specific targeted interventions (Khatter, 2025). Nevertheless, danger arises when these marginalized groups are not represented sufficiently in the data. This can result in population groups like refugees, residents in informal settlements, or people not within formal health systems, creating Blind Spots that contribute to inequities as stated by Byrne et al. (2025).

7.2. Barriers of a technical and resource nature

Low-resource settings significantly hinder high-frequency community health dashboards because of the technical requirements involved. There might be no trustworthy access to the internet, adequate hardware or secured databases in the counties. In addition, in places where systems are available, local health workers are frequently required to train in data literacy to understand dashboards and convert insights into action. Another issue is sustainability: donor-funded structures will collapse unless funding and financing schemes are obtained over the long term.

7.3. Governance and Trust

Technology is not the most significant challenge, but governance is. Health-related data are highly sensitive, and societies should be confident that surveillance systems will preserve privacy and benefit society (Nugroho et al., 2025). Open administration systems, robust privacy policies, and fair use of data are essential to building trust and ensuring that data dashboards are built not to harm the resilience of communities.

8. Conclusion

Developing HIV monitoring dashboards for county-level health surveillance by adjusting their designs under PEPFAR is a roadmap to equal and real-time decision-making. Counties can gain a timely and comprehensive understanding of their population health using ETL pipelines, equity indicators, classification to anomaly detection algorithms, and Bayesian modelling. Nevertheless, the translation should be based on protecting the government, protection, and equity.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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