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SAKTI: Development of an Integrated Health Analytics Dashboard to Support Data-Driven Decision-Making at the Sleman District Health Office

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ABSTRACT

Objective: *This study aimed to develop a web-based integrated health analytics dashboard prototype named SAKTI, an acronym for Sistem Analitik Kesehatan Terintegrasi (Integrated Health Analytics System), as a decision-support tool at the Sleman District Health Office.* ***Method:*** *The system was developed using the System Development Life Cycle (SDLC) approach with the Waterfall model, encompassing requirement analysis, system design, implementation, and initial testing. The initial dataset used in the prototype included three priority health indicators in Sleman Regency for the 2023–2025 period: dengue hemorrhagic fever (DHF) and measles in the Disease Prevention and Control Department, and stunting in the Public Health Department.* ***Results:*** *This study produced a web-based SAKTI dashboard prototype with a modular architecture designed to represent four main departments at the Sleman District Health Office: Disease Prevention and Control, Public Health, Health Services, and Health Resources. In the initial development stage, active data implementation focused on two modules – Disease Prevention and Control and Public Health – while the Health Services and Health Resources modules were prepared as integration-ready modules. The dashboard features two-factor authentication, trend charts, distribution maps, demographic visualizations, and cross-department summary tables. The resulting visualizations effectively illustrated differences in indicator dynamics, including a rise in dengue hemorrhagic fever cases, a decline in the measles positivity rate, and a decrease in stunting prevalence alongside inter-area disparities.* ***Novelty:*** *SAKTI serves as a proof-of-concept for an integrated health dashboard that provides an initial foundation for strengthening data-driven decision-making at the district health office level.*

INTRODUCTION

A district health office, as a regional government organization responsible for administering health affairs at the regency/municipal level, consists of several departments and working teams, including the Health Services Department, Public Health Department, Disease Prevention and Control Department (P2PL), and Health Resources Department (SDK). Each department executes distinct programs and activities, resulting in varied data requirements and reporting workflows. In practice, individual departments frequently develop or utilize separate information systems tailored to their specific program needs [1]. This condition leads to the fragmentation of health information systems, wherein health data are scattered across disconnected platforms [2].

From a leadership perspective, particularly for the Head of the Health Office, this fragmentation poses significant operational challenges. To monitor overall departmental performance, the Head of the Health Office must access each system or report separately, manually compare cross-departmental data, and synthesize a comprehensive picture from unintegrated sources. This process requires considerable time and effort and risks delaying strategic decision-making, especially when public health situations demand rapid responses [3].

A similar challenge occurs at the Sleman District Health Office. Preliminary observations indicate that each department and working team at the Sleman District Health Office maintains its own standalone dashboard or reporting system. Consequently, the Head of the Health Office cannot view a consolidated summary report across all departments within a single platform, leading to suboptimal performance monitoring and data-driven decision-making.

An integrated health dashboard offers a viable solution to this issue. A dashboard is a visual interface that consolidates information from multiple sources into a single, easily digestible view (at-a-glance), supporting efficient monitoring, analysis, and decision-making. Within health office management, an integrated dashboard enables leaders to gain a holistic overview of community health status across their jurisdiction without switching between disparate systems [3].

This study developed a dashboard prototype named SAKTI (*Sistem Analitik Kesehatan Terintegrasi*), designed as a decision-support tool for the Head of the Sleman District Health Office. SAKTI is engineered to integrate data from all departments into a single web-based platform. Given data access constraints during this initial development phase, active data implementation focused on two departments with available datasets: the Disease Prevention and Control Department (P2PL), covering Dengue Hemorrhagic Fever (DHF) and measles indicators, and the Public Health Department, covering stunting indicators. These indicators were selected due to their epidemiological relevance, as DHF, measles, and stunting are currently priority public health concerns in Sleman Regency. Meanwhile, the Health Services and Health Resources departments are displayed as ready-to-populate modules awaiting data access authorization.

Therefore, this study aimed to: (1) design and develop the web-based integrated SAKTI dashboard capable of visualizing data from all departments of the Sleman District Health Office on a single platform; (2) implement a two-factor authentication security system to safeguard sensitive health data; and (3) produce a scalable prototype that can be progressively expanded as datasets from other departments become available.

RESEARCH METHODS

This study employed the System Development Life Cycle (SDLC) methodology using the Waterfall model as the technical framework for system development. The Waterfall SDLC model is a sequential software development process that flows systematically through distinct phases. The resulting product is a disease data visualization dashboard for Sleman Regency, Special Region of Yogyakarta, intended as an informational resource for executive leadership (Head of the Sleman District Health Office), the institution, cross-structural agencies, and the public. The Waterfall stages comprise requirement analysis, system design, implementation, testing, and maintenance. Each stage must be completed before proceeding to the next, ensuring a structured and well-documented development process [4], [5].

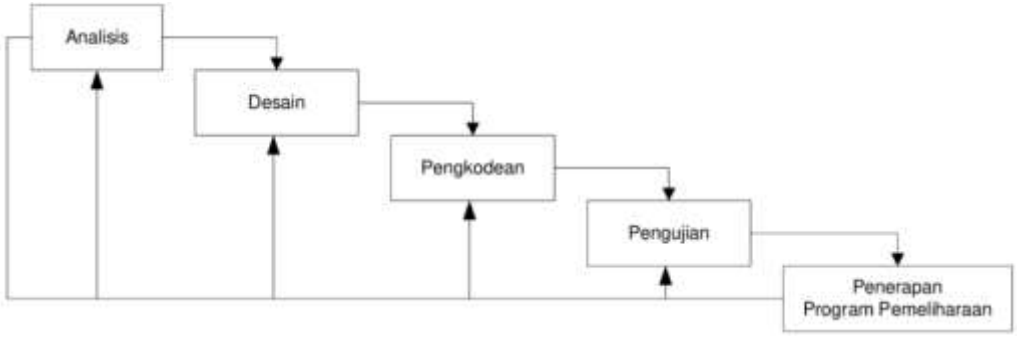


Figure 1. System development stages using the Waterfall method

In this study, SAKTI remains in the developmental prototype phase, focusing primarily on requirement analysis, system design, and dashboard data visualization development. Subsequent lifecycle stages have not yet been fully executed and are reserved for future research. According to Sommerville [6], the primary advantage of the Waterfall model lies in its clear process structure and comprehensive documentation, making it straightforward to understand and manage—particularly for development teams working on projects with clearly defined initial requirements and low risk of mid-project scope changes.

The study subjects were staff members of the Health Resources Development Working Team (PSDK) within the Health Resources Department (SDK) of the Sleman District Health Office. They served as aggregate disease data providers and key informants during the requirement analysis phase. Their involvement encompassed identifying priority indicators (DHF, stunting, and measles), clarifying available data formats, and providing initial input regarding executive visualization expectations. Thus, system requirements were validated directly by personnel who manage the data and understand regional health policy contexts. The research objects consisted of secondary data obtained from the Sleman District Health Office covering the 2023–2025 period across all community health centers (*Puskesmas*) in Sleman Regency. These datasets included DHF cases categorized by age groups (<1, 1–4, 5–9, 10–14, 15–19, 20–44, 45–59, and ≥60 years), stunting records (target toddlers, total monitored toddlers, and length/height-for-age z-scores [PB-TB/U]), and suspected and confirmed positive measles cases.

RESULTS AND DISCUSSION

Results

This study successfully produced a web-based dashboard prototype named SAKTI (*Sistem Analitik Kesehatan Terintegrasi*). Developed using a Python framework under the sequential Waterfall SDLC approach, the web-based architecture was chosen to ensure cross-device accessibility without requiring specialized software installation on the user's end—an essential feature for highly mobile health executives. All development phases, from requirement analysis to implementation, were executed sequentially [4].

SAKTI features a modular architecture comprising four main modules representing the four core departments of the Sleman District Health Office: Disease Prevention and Control (P2PL), Public Health (*Kesmas*), Health Services (*Yankes*), and Health Resources (SDK). Currently, the first two modules are populated with active data from the Sleman

District Health Office, while the *Yankes* and SDK modules function as technically ready placeholders prepared to ingest data once access permissions are granted. This modular design ensures incremental system sustainability without delaying deployment until all departmental datasets are fully available.

System security is enforced via a Two-Factor Authentication (2FA) mechanism to protect sensitive and confidential public health data against unauthorized access [1]. Furthermore, the user interface is built around the principle of at-a-glance information display, enabling the Head of the Health Office to review overall departmental performance on a single screen without switching systems [7].

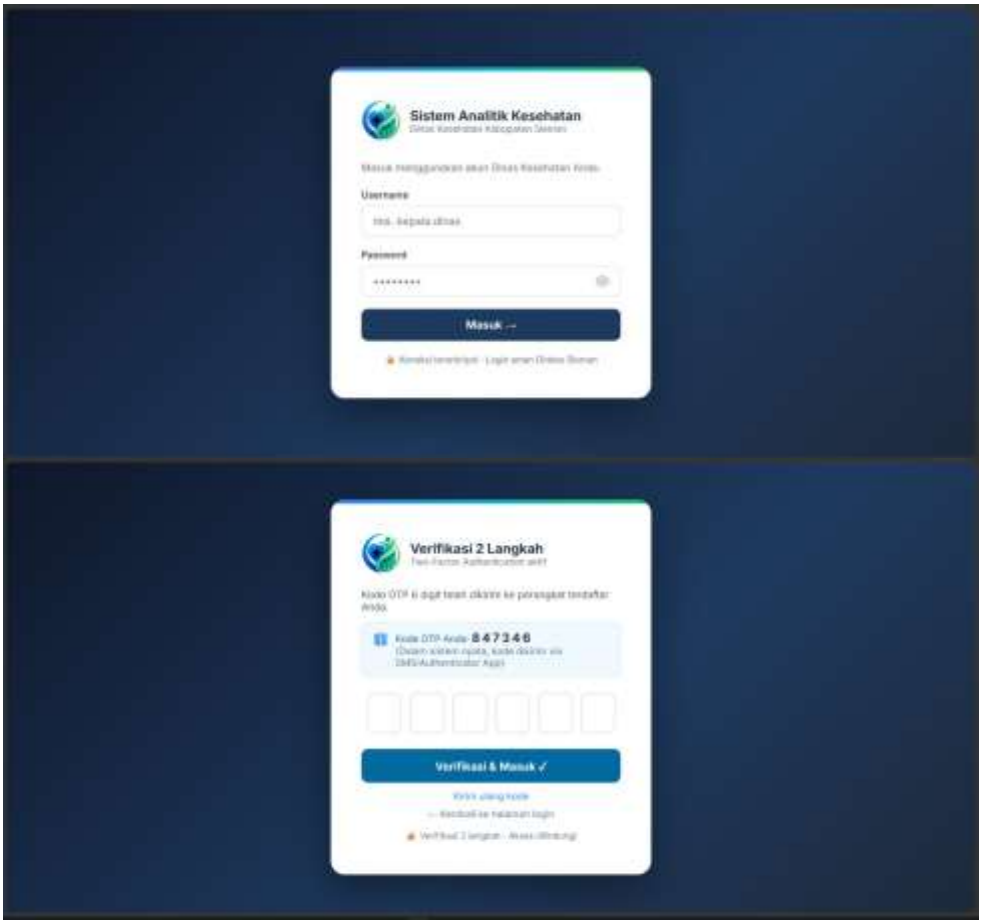


Figure 2. Two-Factor Authentication [2FA] interface

Active data implementation in SAKTI covers three priority health indicators in Sleman Regency from 2023 to 2025: Dengue Hemorrhagic Fever (DHF) and measles under P2PL, and stunting under Public Health.


Sistem Analitik Kesehatan Terintegrasi
Dashboard DBD — Kabupaten Sleman
139
303
420
SEYEGAN
Tren Kasus DBD per Tahun
Distribusi Kelompok Umur
Sebaran Puskesmas — Kasus DBD
Distribusi Gender — DBD
Proporsi Gender DBD (%)
Kasus per Kapanewon
Kelompok Umur per Tahun

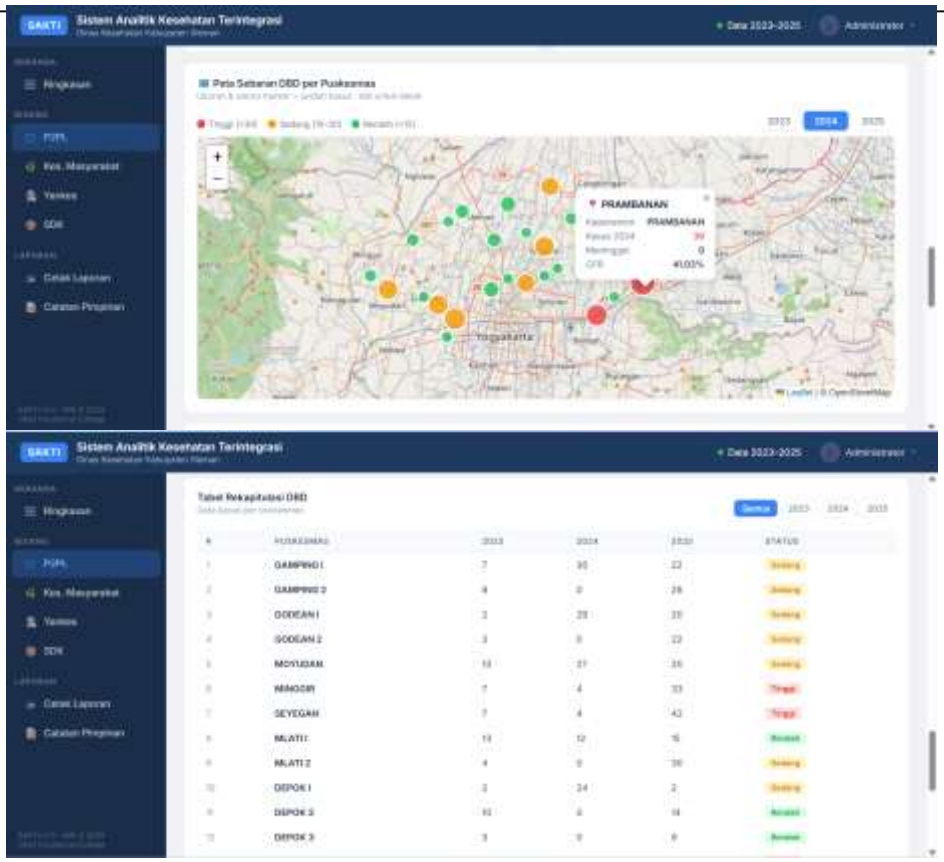


Figure 3. DHF Dashboard Visualization on SAKTI

DHF data in Sleman Regency reveal a significant upward trend over the past three years, rising from 139 cases in 2023 to 303 cases in 2024 (a 118% surge), and reaching 420 cases in 2025 (a further 39% increase). In 2025, the three *Puskesmas* jurisdictions with the highest caseloads were Seyegan (42 cases), Minggir (33 cases), and Ngaglik 1 (33 cases).

Age-group analysis in 2025 indicates that the productive age group (20–44 years) bore the highest burden, accounting for 174 cases (41.4%), followed by the 15–19 age group with 68 cases (16.2%) and the 45–59 age group with 49 cases (11.7%). The predominance of cases among productive-age adults carries notable socio-economic implications due to productivity losses. Gender-based analysis in 2023 showed higher incidence among males (83 cases, 59.7%) than females (63 cases, 45.3%). This male predominance aligns with epidemiological literature linking higher outdoor environmental exposure among working-age males to increased vector bite risks [8].

SAKTI presents DHF data through seven complementary visualization components spanning temporal, spatial, demographic, and summary dimensions:

1. A bar chart of total annual cases providing a macro overview of upward trends.
2. An age-group distribution bar chart highlighting high-burden population segments.
3. A gender distribution bar chart and (4) pie chart displaying absolute and proportional sex ratios simultaneously.
4. An annual age-group line chart illustrating demographic shifts over time.
5. A sub-district (*Kapanewon*) bar chart paired with a *Puskesmas*-level spatial distribution map enabling granular, facility-level intervention targeting.

6. A year-filterable recapitulation table allowing executive leadership to perform cross-period comparisons independently without manual compilation.

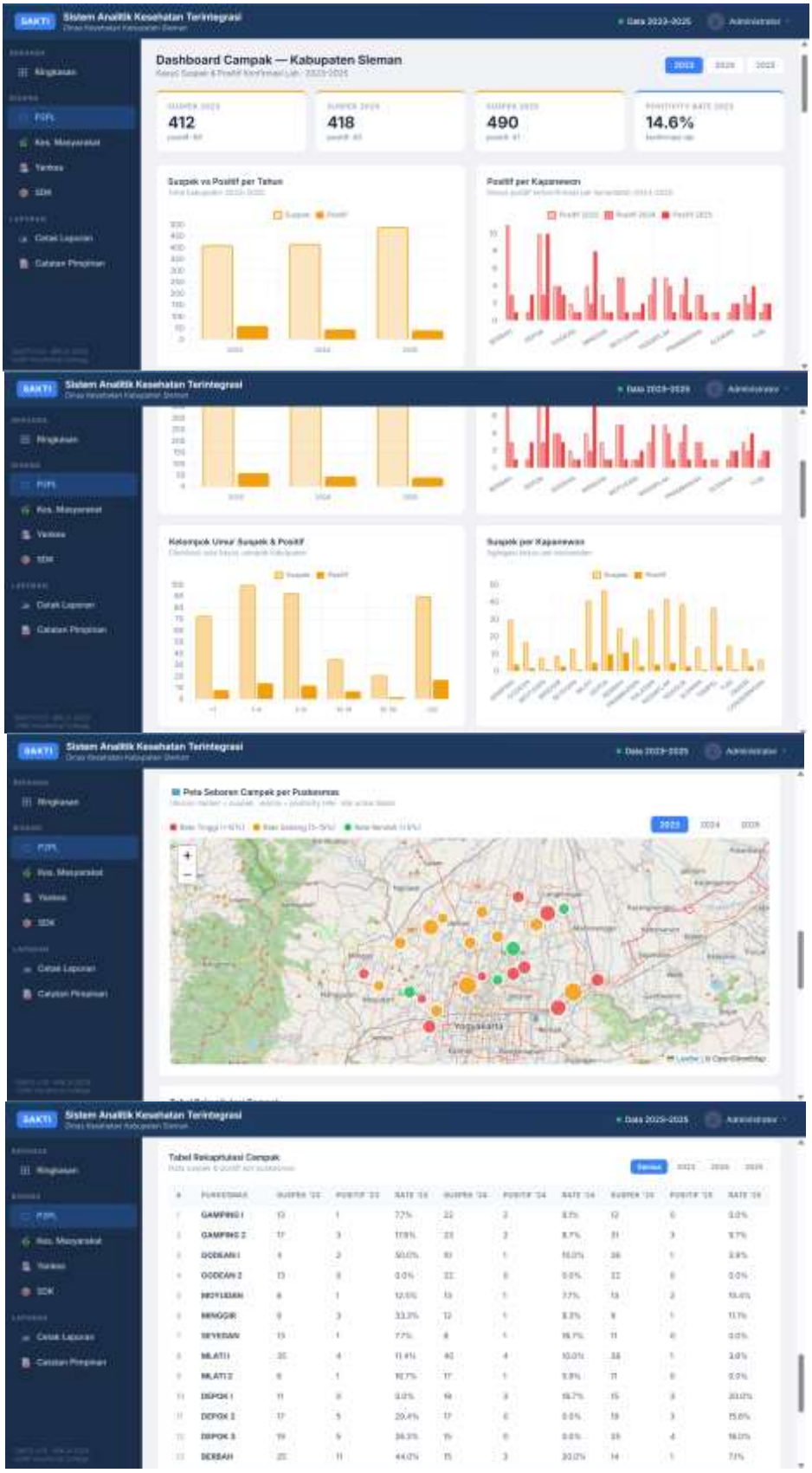
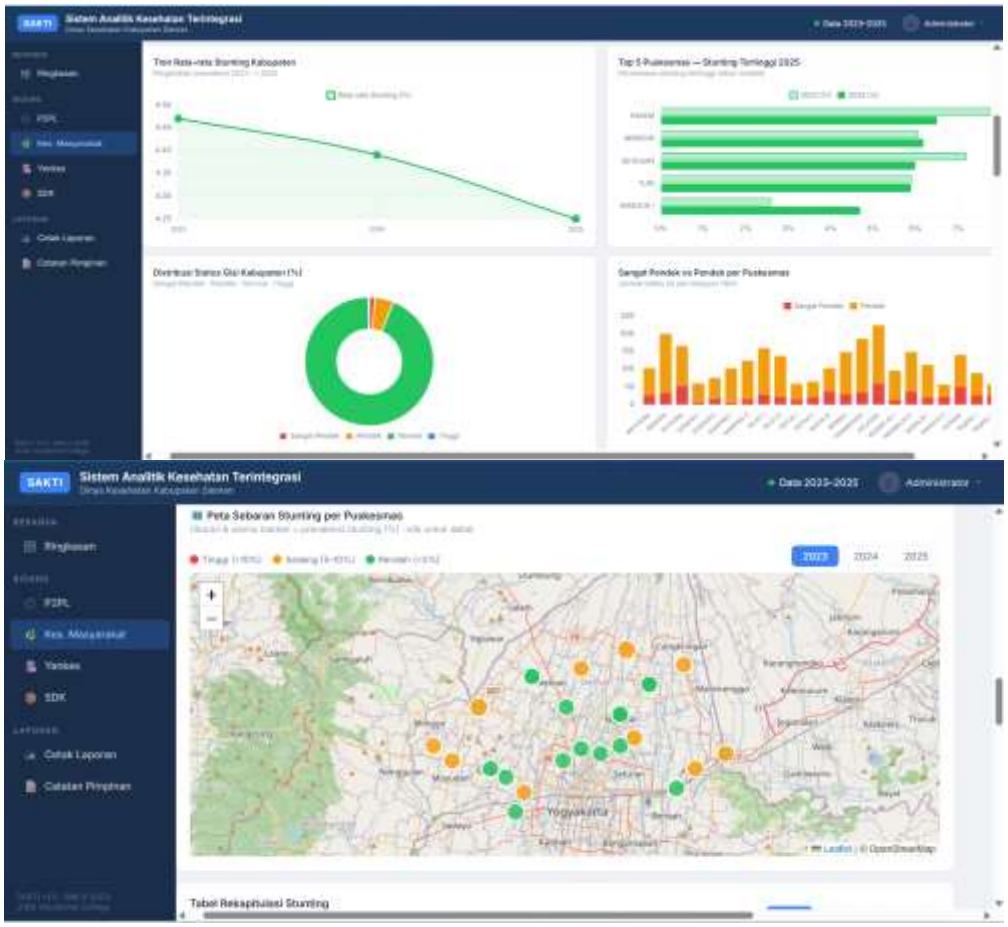


Figure 4. Measles Dashboard Visualization on SAKTI

Conversely, measles data in Sleman Regency exhibited a downward trend in confirmed positivity. Laboratory-confirmed positive cases declined steadily from 60 cases in 2023 (14.6% positivity rate) to 45 cases in 2024 (10.8%), and 41 cases in 2025 (8.4%). This consistent decline in positivity rate suggests effective measles control and immunization coverage, even as suspected cases rose from 412 in 2023 to 490 in 2025—reflecting heightened surveillance sensitivity and screening capacity rather than epidemiological deterioration.

In 2025, *Puskesmas* Kalasan recorded the highest number of confirmed cases (8 cases, 18.6% positivity rate), followed by Depok 3 (4 cases, 16.0%). Notably, Depok I and Cangkringan each recorded 3 positive cases with a 20.0% positivity rate, surpassing Depok 3 proportionally despite lower absolute counts. Such regional variations alert leadership to areas requiring targeted immunization coverage evaluations. Age analysis further revealed that positive cases were concentrated among children under five; in 2024, infants (<1 year) and toddlers (1–4 years) accounted for 55.6% of all positive cases, underscoring the critical role of early childhood immunization [9].



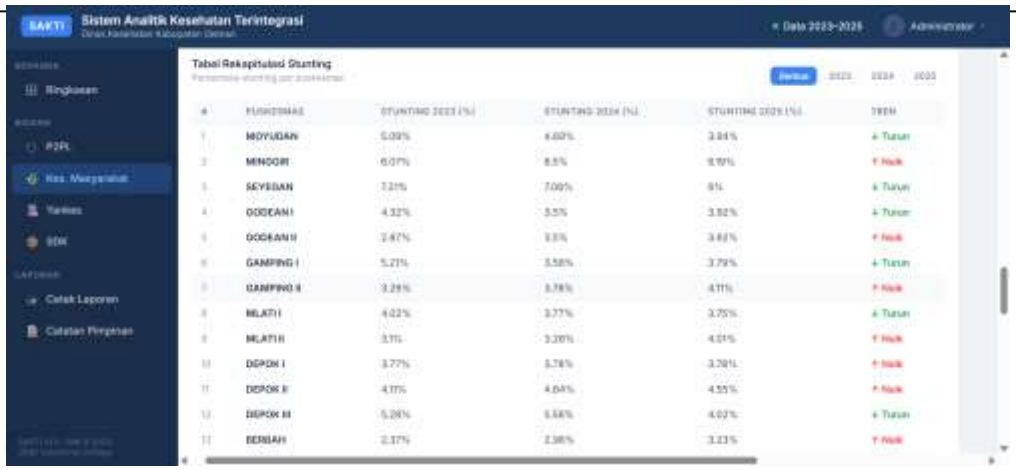


Figure 5. Stunting Dashboard Visualization on SAKTI

Stunting prevalence in Sleman Regency demonstrated a consistent downward trajectory, decreasing from 4.42% in 2023 to 4.29% in 2024, and 4.27% in 2025. All three figures sit well below the national stunting reduction target of 14% set in the 2020–2024 National Medium-Term Development Plan (RPJMN), reflecting strong aggregate nutritional program performance.

However, inter-*Puskesmas* disparities warrant close attention. In 2025, *Puskesmas* Pakem recorded the highest stunting prevalence at 6.51%, followed by Minggir (6.19%) and Seyegan (6.00%), whereas Ngaglik II recorded the lowest at 2.52%, followed by Berbah (3.23%) and Tempel I (3.37%). This more than 2.5-fold gap demonstrates that low district-wide averages can mask localized pockets of vulnerability. Longitudinal tracking further highlights sharp local fluctuations: *Puskesmas* Minggir experienced a spike from 6.07% in 2023 to 8.50% in 2024 before declining to 6.19% in 2025. Identifying such localized anomalies is a core strength of SAKTI's cross-facility comparative interface.

Finally, SAKTI provides a cross-departmental summary table consolidating key indicators across modules into a unified view. Comparing these three distinct trajectories simultaneously—rising DHF requiring urgent vector control, declining measles confirming program efficacy, and low-average stunting requiring targeted disparity reduction—eliminates the manual synthesis bottlenecks inherent in fragmented reporting systems.

Discussion

The development of SAKTI directly addresses health information system fragmentation at the Sleman District Health Office, where departmental reporting silos impede cohesive governance. This aligns with broader health informatics literature identifying cross-unit data fragmentation as a primary structural barrier to data-driven executive decision-making [10], [11].

Applying Dowding et al.'s [7] principles of at-a-glance visual display, SAKTI contextualizes single-platform integration for a multi-departmental district health office. Viewing divergent epidemiological trends concurrently—such as escalating DHF cases among working-age adults alongside localized stunting disparities—enables leadership to allocate resources proportionately based on programmatic urgency, a core function of decision-oriented health information systems [12].

While previous studies have documented integrated dashboards primarily within hospitals and primary care clinics [7], [12], few have addressed multi-departmental

district health offices in Indonesia. SAKTI bridges this gap through three key innovations: (1) a modular architecture enabling phased rollout despite uneven departmental data readiness; (2) embedded 2FA security as a foundational design requirement rather than an afterthought; and (3) a replicable blueprint tailored to regional health governance structures. Methodologically, utilizing the Waterfall model was well-suited given the clearly defined initial requirements, fixed timeline, and low volatility of core specifications [4], [6].

Nevertheless, three limitations must be acknowledged. First, active data implementation currently covers only two of the four departments due to initial data access restrictions; integrating the Health Services and Health Resources modules remains a top priority. Second, the prototype has not yet undergone formal functionality or usability testing with end-users (specifically the Head of the Health Office); future work must incorporate validated instruments such as the System Usability Scale (SUS). Third, the current prototype relies on manually entered secondary data; establishing automated, real-time interoperability with source databases is essential for operational deployment. Accordingly, SAKTI currently serves as a foundational proof-of-concept rather than a fully deployed production system.

CONCLUSION

Fundamental Finding: The web-based SAKTI (Sistem Analitik Kesehatan Terintegrasi) dashboard prototype was successfully developed to address health information system fragmentation at the Sleman District Health Office. Built using the Waterfall SDLC methodology, its modular architecture encompasses four core departments: Disease Prevention and Control (P2PL), Public Health, Health Services, and Health Resources. Active data visualizations for DHF, measles, and stunting—comprising trend charts, spatial maps, and cross-departmental summary tables—are safeguarded by Two-Factor Authentication (2FA). **Implication:** By providing an at-a-glance consolidated interface, SAKTI empowers the Head of the Health Office to monitor cross-program performance and make timely, data-driven strategic decisions. **Limitation:** To advance SAKTI from a proof-of-concept to a fully operational system, future development should focus on completing full-scale data integration by populating the Health Services and Health Resources modules. **Future Research:** Conducting formal functionality and usability testing with health office leadership and staff using validated metrics such as the System Usability Scale (SUS). Establishing automated system interoperability (e.g., via Application Programming Interfaces [APIs]) with existing departmental databases to enable real-time data synchronization.

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