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Comparison of Data and Performance Indicators: Before and After the Transition of Thailand's National Disease Surveillance System, 2023–2024

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Abstract

In 2024, Thailand modernized its national disease surveillance system, transitioning from Report 506 (R506) to the Digital Disease Surveillance (DDS) system, replacing batch file reporting with an application programming interface (API). To compare the data characteristics and performance indicators between the DDS and R506 systems, a descriptive study was conducted using data from January to September 2023 for R506 and 2024 for DDS, obtained from the Department of Disease Control. The DDS system contained 1,567,885 records, while R506 had 980,934. The number of hospitals and health centers reporting to the DDS system was 3,402, while 5,319 reported to R506. Due to the ongoing transfer of health centers to the Ministry of Interior, fewer reports were sent from health centers to the DDS system (14,374) compared to R506 (44,298). Timeliness (median interval from diagnosis to report) was 1 days (interquartile range (IQR) 0–2 days) in R506 and 1 days (IQR 0–4 days) in DDS. The DDS system achieved 99.99% completeness for citizen identification numbers and 100% for diagnostic codes, while R506 achieved 49.75% and 41.59%, respectively. The DDS system had a larger contribution from Bangkok than R506 (25.45% vs 10.70%). In conclusion, the data characteristics of the DDS system remained similar to R506. However, the DDS system is less than one year old, and the ongoing transfer of health centers might affect the reporting coverage. Therefore, follow-up surveillance evaluation with an emphasis on qualitative attributes is recommended.

Keywords: digital disease surveillance system, DDS, R506, surveillance, epidemiology

Introduction

A disease outbreak is defined as an occurrence of more than the expected number of people with a disease. Outbreaks often occur suddenly and can severely cause damage to society and public health. Therefore, public health surveillance is often initiated, which involves the ongoing systematic collection, analysis, and timely dissemination of information for identifying, preventing, and controlling outbreaks.

In 1967, Thailand established a national disease surveillance system, called Report 506 (R506), to provide timely information for disease control action and remained the centerpiece of Thailand's public health and epidemiology for many years.[1] The system started as a paper-based mail reporting system and was modernized in 2006 into an electronic batch file system using Microsoft Access® database. Since then, R506 used an offline batch file system that required personnel to manually extract records of specific diagnoses, and process and submit the data in batches to the Division of Epidemiology (DOE), Department of Disease Control (DDC), to analyze and provide response and policy recommendations.[2]

However, with the emergence of new technology and social media platforms, which have changed the speed and nature of information flow, R506 could not keep up with the virtually real-time nature of the information flow of the current era. Moreover, the manual process was prone to human error and caused a burden on staff workloads.[3]

The DOE realized the challenges of the R506 system and initiated further enhancements in 2010 to improve the system from the manual batch-file process into an automated application programming interface (API) system. However, several initiatives, e.g., the Electronic Integrated Disease Surveillance System, were not successful at being able to address the changes in the need for the surveillance system in a

timely manner and did not achieve nationwide adoption.[4]

During the coronavirus disease 2019 (COVID-19) pandemic in 2020–2022, Thailand established a national vaccine registry platform called "MOHPROMPT". The system was successfully integrated into the electronic health records of most hospitals in Thailand through an API interface. The DOE recognized the opportunity to modernize the system and created the COVID-19 recovery certificate that incorporates laboratories and diagnosis as a module of the chatbot that functions as the national COVID-19 disease surveillance system, COVID-19 case report (CCR). The CCR became the proof-of-concept of the electronic surveillance system for the R506 modernization initiative. At the end of the COVID-19 pandemic in 2022, the DOE decided to incorporate the R506 surveillance system into the CCR and renamed it the Digital 506 (D506) and later to the Digital Disease Surveillance (DDS) system.

The transition from R506 to DDS was initiated nationwide on 1 Oct 2023, and successfully upscaled nationwide on 1 Jan 2024. The DDS data was utilized as part of the routine surveillance system of R506 as of 2024. While a feasibility study of using the DDS as a replacement for R506 was conducted, there has been no operational comparison of data characteristics and performance indicators between the R506 and the DDS systems.[5] Therefore, we aim to compare the data characteristics and performance indicators between the DDS and R506 systems to guide the planning, and implementation of the DDS in the future.

Methods

Data Sources

The data flow of both R506 and DDS were presented and a descriptive study was conducted. For R506, we obtained all anonymized records available from 1 Jan to 30 Sep 2023 based on the date of reporting. For the DDS, all anonymized records from 1 Jan to 30 Sep 2024 based on the date of reporting were obtained.

The period from January to September (9 months) was used to compare the two systems instead of the full year because the transition period from R506 to DDS was initiated from 1 Oct to 31 Dec 2023.

Variables included in the analysis were demographic characteristics of the cases (age and gender), diagnosis, date of diagnosis, date of reporting, and reporting hospital. Timeliness was calculated from the case detection date to the reporting date. Completeness was defined separately for citizen ID (the number of records having a complete 13-digit citizen identification number divided by the total number of records) and for diagnosis (the number of records having a valid diagnosis code, based on the International Classification of Diseases, 10th revision (ICD-10), divided by the total number of records). The numbers of health facilities reporting to the R506 and DDS systems were used to represent the coverage of each system.

ICD-10 codes related to COVID-19 were excluded from both R506 and DDS as there were several other COVID-19 reports during and after the pandemic.

Statistics Analysis

A descriptive analysis was conducted to describe count and distribution of characteristics of the demographic data, diagnosis, and trend of the reporting and reporting hospital. Median with interquartile range (IQR), count and percentage were presented. A choropleth map was constructed to describe the distribution of case reports by province. Data management and analysis were conducted using Microsoft Excel 365® and Anaconda Packages version 2.6.3.[6,7]

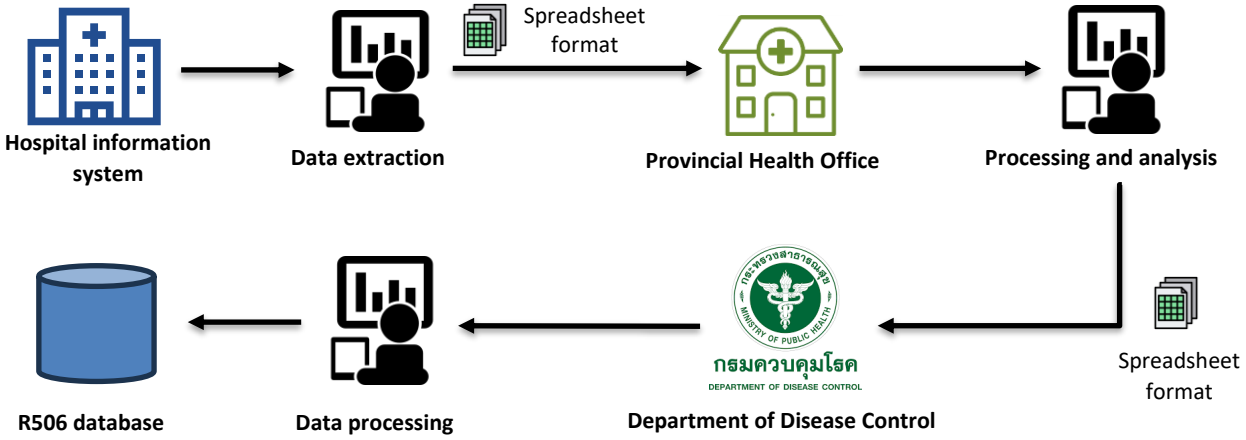
Results

System Description

Report 506 (R506)

The R506 system, established in 1967, was modeled after the U.S. Centers for Disease Control and Prevention's national surveillance system for priority diseases.[1] It was operated nationwide by the DOE, DDC, Ministry of Public Health, Thailand. In 2023, the system covered 57 priority disease groups, and more than one ICD-10 code was allowed for each disease group.[8] Briefly, hospital personnel would extract the database variables relevant to the requirement by Extract-Transform-Load process from their database and conduct the preliminary data cleansing and analysis. Data would then be submitted to the DOE in batches by e-mail or file-transfer protocol. For paper-based reports, DOE personnel manually keyed data into the R506 database.

DOE personnel retrieved the data and regularly conducted data cleansing and routine analysis. Due to the nature of the batch file approach, data summaries were only available weekly at best. The database was stored in a conventional relational database system at the DOE (Figure 1).[2]

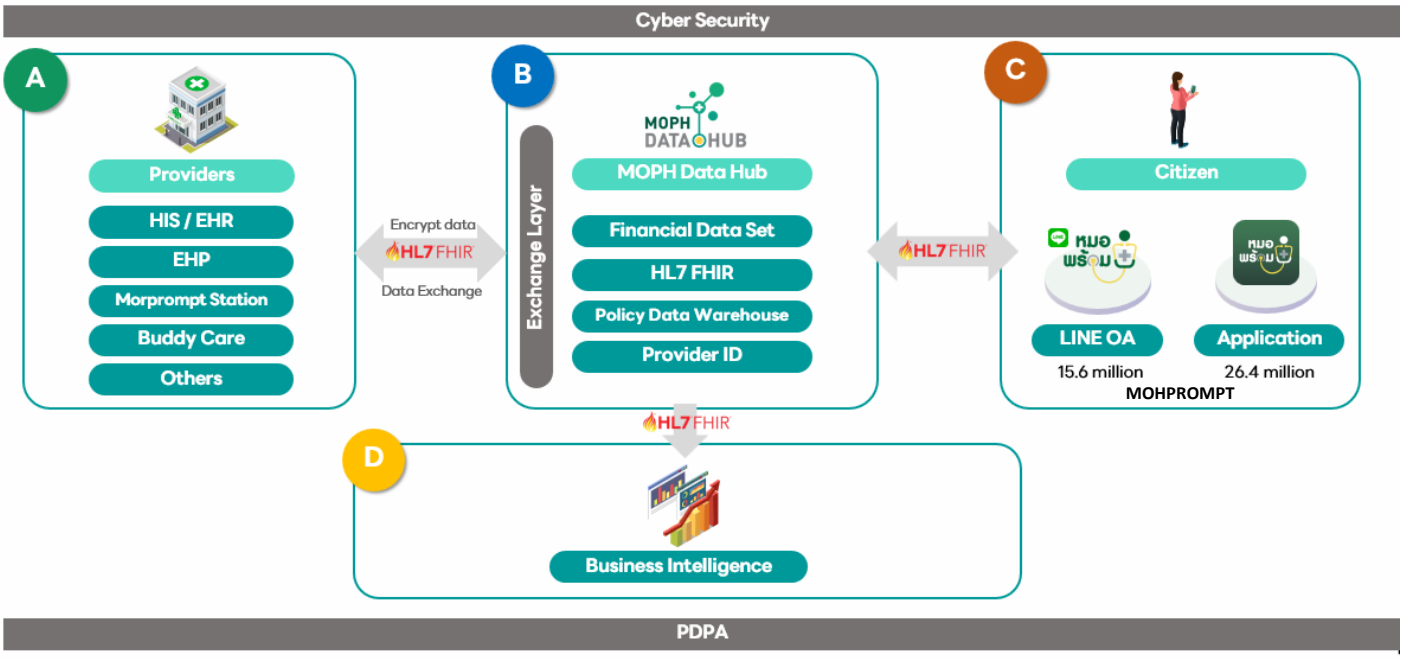


Hospital personnel extract data from the hospital information system (HIS) into a spreadsheet file format and then transfer it manually to the Provincial Health Office (PHO). PHO personnel process the data and then submit the processed data to the Department of Disease Control (DDC) in a spreadsheet format, which is then processed by the DDC personnel and then integrated into the R506 database.

Figure 1. R506 Dataflow diagram, 2023

Digital Disease Surveillance (DDS)

The DDS system was established as a central API and was connected to the electronic health record from each hospital. To reduce the cost of implementation, the DDS utilized existing authentication and authorization from the MOHPROMPT chatbot. Developers and electronic health record vendors can leverage the existing connection application already utilized for the MOHPROMPT system as described in Figure 2. This approach reduces the cost and simplifies the implementation of the system.



There are four components available for utilization by other systems: A) The hospital database, electronic health record, B) The central database overseen by the Ministry of Public Health (MOPH). All data transferred between the hospitals travel through this component. Several services on the database including authentication and authorization are available, C) The point of contact to Thai citizens including the LINE application and smartphone application, D) The dashboard displaying data to the stakeholders as needed. HL7 FHIR: Health Level 7 Fast Healthcare Interoperability Resources. EHR: Electronic Health Record. EHP: Excellent Health Platform.

Figure 2. Ministry of Public Health Digital Health Platform (MOHPROMPT), 2021–2024

The DDS system adapted the R506 variables into the JavaScript Object Notation format, a well-known data structure for many API services. The database utilized the "not only structured query language" (no-SQL) concept to allow the flexible nature of the surveillance system where specific variables are required in some circumstances while allowing better timeliness of data reporting than the batch-file approach. The overall process is described in Figure 3. The database is hosted centrally.

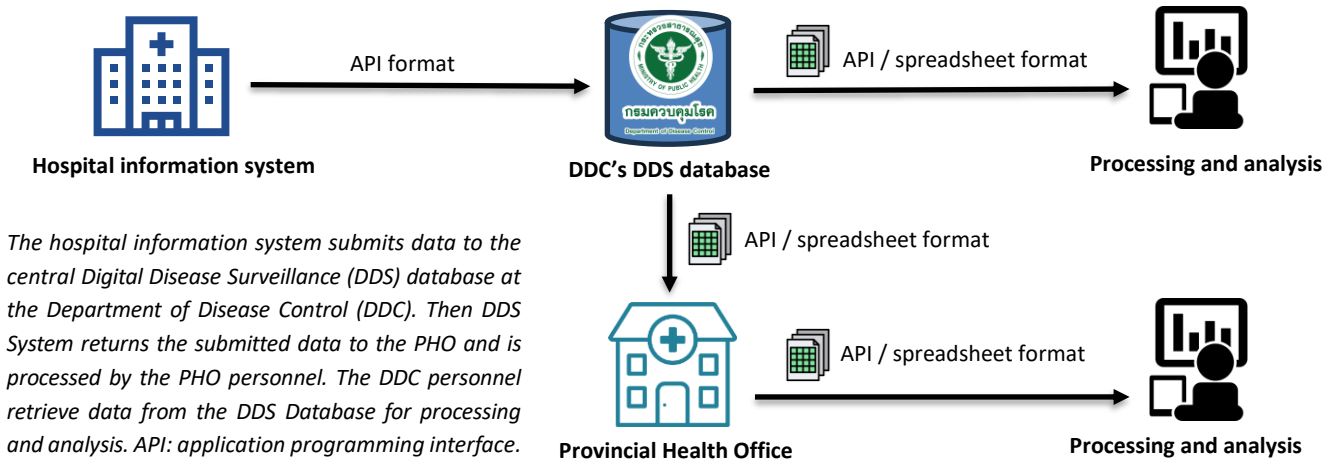


Figure 3. Digital Disease Surveillance system diagram, 2024

Four disease groups: Legionnaires' disease, filariasis, leishmaniasis, and leprosy, were added to the DDS while seven disease groups: influenza-like illness, viral exanthema, fever of unknown origin, adverse events following immunization, acute flaccid paralysis, viral conjunctivitis and acute diarrhea, were removed per the Communicable Diseases Act B.E. 2558 (2015), updated in 2024.[9] Therefore, the system covers 54 priority diseases. Provincial Health Office personnel can retrieve the data from the database in batch spreadsheet format.

Descriptive Study

From 1 Jan–30 Sep 2024 the DDS system contained 1,567,785 records, and from 1 Jan–30 Sep 2023 R506 contained 980,934 records. The number of hospitals and health centers reported to the DDS (3,402) was less than those reporting to R506 (5,319). This was reflected in the reports from health centers of both systems. There were 14,374 records from health centers sent to the DDS system compared to 44,298 for R506.

The 10 most common diagnoses from both systems are shown in Table 1. The top five highest diagnoses in the R506 were: fever, unspecified; pneumonia, unspecified organism; influenza with other respiratory manifestations; dengue fever (classical dengue); and influenza with other manifestations, virus not identified. The top five highest diagnoses in the DDS system were pneumonia, unspecified organism; influenza with other respiratory manifestations, seasonal influenza virus identified; influenza due to other identified influenza virus with other manifestations, influenza with other respiratory manifestations, virus not identified; and bacterial foodborne intoxication, unspecified.

Table 1. Top 10 ICD-10 diagnosis codes by frequency in R506 (January–September 2023) and DDS (January–September 2024)

	R506			DDS	
	ICD-10 code	n		ICD-10 code	n
1.	**R509** Fever, unspecified	103,815	**J189**	Pneumonia, unspecified organism	239,579
2.	**J189** Pneumonia, unspecified organism	45,446	**J101**	Influenza with other respiratory manifestations, seasonal influenza virus identified	173,524
3.	**J111** Influenza with other respiratory manifestations	26,642	**J108**	Influenza due to other identified influenza virus with other manifestations	161,114
4.	**A90** Dengue fever (classical dengue)	20,678	**J111**	Influenza with other respiratory manifestations, virus not identified	99,559
5.	**J118** Influenza with other manifestations, virus not identified	20,532	**A059**	Bacterial foodborne intoxication, unspecified	83,619
6.	**A059** Bacterial foodborne intoxication, unspecified	20,421	**J118**	Influenza with other manifestations, virus not identified	70,036
7.	**J101** Influenza with other respiratory manifestations, seasonal influenza virus identified	15,722	**J159**	Bacterial pneumonia, unspecified	69,376
8.	**J108** Influenza due to other identified influenza virus with other manifestations	11,558	**J10**	Influenza due to identified seasonal influenza virus	54,013
9.	**B084** Enteroviral vesicular stomatitis with exanthem	10,819	**J11**	Influenza due to unidentified influenza virus with pneumonia	53,504
10.	**H109** Unspecified conjunctivitis	9,399	**B084**	Enteroviral vesicular stomatitis with exanthem	51,452

R506: Report 506. DDS: Digital Disease Surveillance. ICD-10: the international classification of diseases, 10th revision.

Although the ranks by frequency of diagnoses differed, most of the diagnoses in the top ten were similar between the two systems, except for "fever, unspecified," which was removed from the DDS system as it was not listed in the Communicable Diseases Act B.E. 2558 (2015), updated in 2024.[9]

Table 2 compares the distributions of age group and gender between the two systems. The 1–6 year age group had the highest proportion in both systems (24.78% for R506 and 27.58% for DDS). The proportion of males was 51.66% for R506 and 50.19% for DDS.

Table 2. Demographic characteristics of cases reported in R506 (January–September 2023) and DDS (January–September 2024)

Characteristics	R506 (%) (n=980,934)	DDS (%) (n=1,567,785)
Gender		
Male	506,752 (51.66)	786,892 (50.19)
Female	474,182 (48.34)	780,893 (49.81)
Age group (years)		
<1	37,108 (3.78)	50,948 (3.25)
1–6	243,055 (24.78)	432,375 (27.58)
7–9	81,160 (8.27)	31,216 (1.99)
10–14	98,495 (10.04)	137,030 (8.74)
15–24	102,585 (10.46)	131,638 (8.40)
25–34	81,432 (8.30)	157,746 (10.06)
35–44	67,600 (6.89)	125,754 (8.02)
45–64	137,922 (14.06)	242,206 (15.45)
≥65	131,577 (13.41)	258,527 (16.49)

R506: Report 506. DDS: Digital Disease Surveillance.

The weekly case report count is shown in Figure 4. For each week, the DDS count was slightly higher than R506, except for two spikes in weeks 29 and 34 for the DDS.

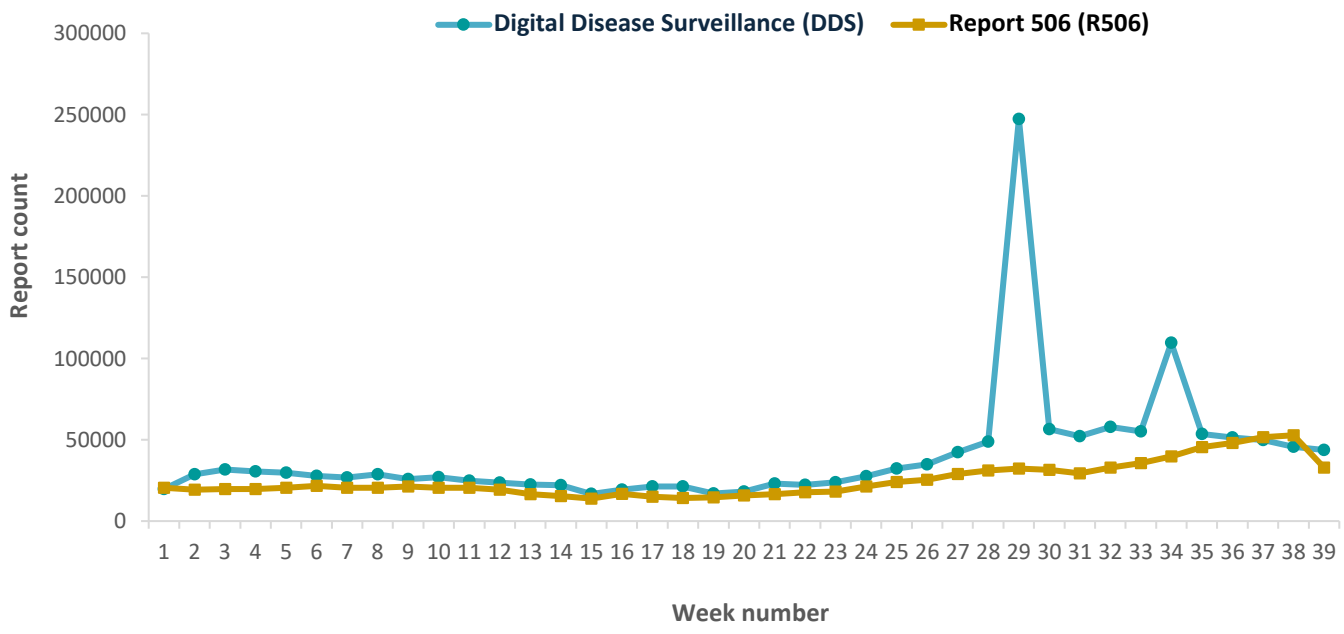
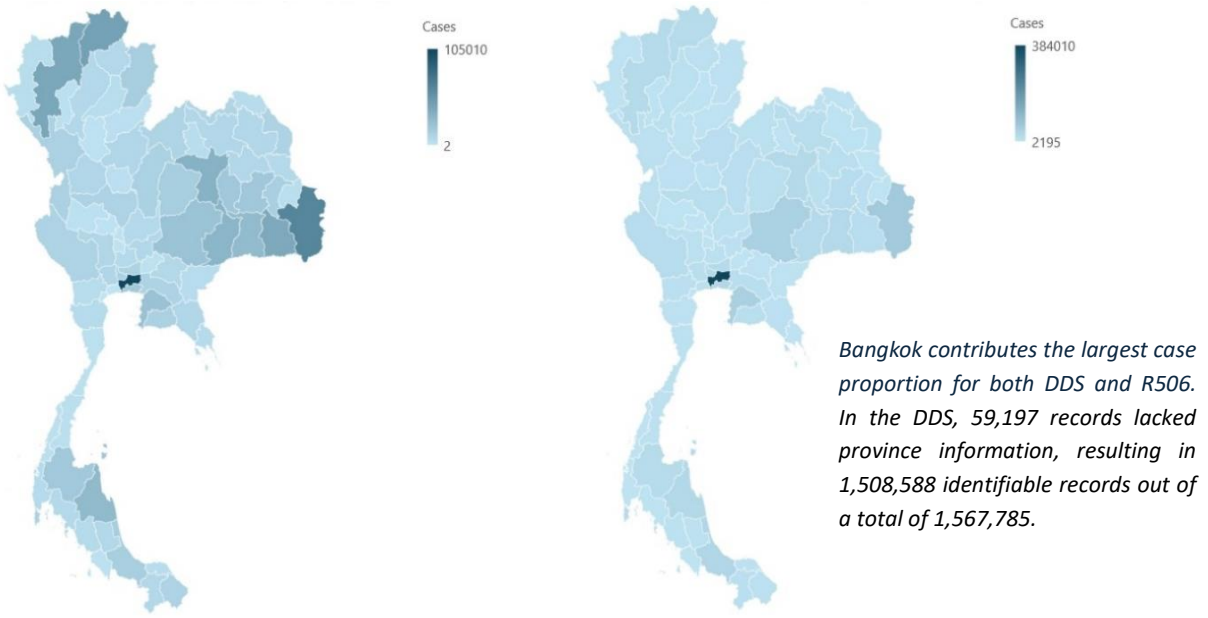


Figure 4. Number of reported cases in R506 (January–September 2023) and DDS (January–September 2024)

Figure 5 compares the distribution of case reports by province. Reports were concentrated in Bangkok for both systems (10.70% for R506 and 25.45% for DDS). However, the proportion of reports from provinces outside Bangkok, especially Ubon Ratchathani Province, in R506 was higher compared to DDS.



(a) Report 506 (R506) (n=980,934) **(b) Digital Disease Surveillance (DDS) (n=1,508,588)**

Figure 5. Distribution of case counts by province in R506 (January–September 2023) and DDS (January–September 2024)

Timeliness and Completeness

R506 had a median timeliness of 1 day (IQR 0–2 days) and there were no changes with the removal of fever, unspecified, while the DDS also had a median timeliness of 1 day (IQR 0–4 days).

DDS achieved 99.99% completeness for the citizen ID with only one record missing and achieved 100% completeness for ICD-10 codes. For R506, completeness for citizen ID was 49.75% and 41.59% for ICD-10 codes.

Discussion

The implementation of the DDS system has led to a 59.83% increase in case reports by the DDC, with minimal change in demographic characteristics. This increase cannot be primarily attributed to the inclusion of additional disease groups, as these accounted for only an extra 186 cases (<0.01%). A key achievement of the DDS system was the significant improvement in data quality, particularly the completeness of reports compared to the previous R506 system. This enhancement is likely due to the shift to an API-based reporting mechanism, which automates data extraction and direct submission to the Ministry of Public Health, thereby reducing manual data entry, workload, and human error at the facility level.

Despite the DDS system having fewer reporting health centers than R506, the number of reported facilities remains high. This reduction is primarily due to the transfer of 3,263 health centers to the Ministry of Interior.[10] These facilities are unable to participate in the DDS system because of differences in governance, policies, and regulations within their new organizational structure. This transition is an ongoing annual process that will continue to affect system coverage. Addressing this challenge will require a formal agreement between the Ministry of Public Health and the Ministry of Interior. The continued high number of reporting facilities, even with the one-time switching cost associated with the API approach for hospitals, is attributed to the DDS offering a dedicated portal as an alternative solution to minimize this cost.[11] This approach, developed with stakeholder feedback, has successfully facilitated the transition for hospitals from R506 to the DDS system.

As the R506 system was completely phased out in 2024 and replaced by the DDS system, the representativeness of R506 data, obtained from 2023, may not fully reflect the situation in 2024, from which DDS system data sources were obtained. A significant difference between the two systems lies in their hospital coding: R506 used the Health Service Code system, maintained by the DOE, DDC, specifically for its purposes, while the DDS system utilizes the standard hospital code system, maintained by the Office of the Permanent Secretary, Ministry of Public Health. The lack of a maintained mapping table between these two coding systems could lead to mismatches in identifying several hospitals, making a direct head-to-head comparison between the two systems at the hospital level unfeasible. These findings underscore the DDS system's more standardized approach, which, by using the widely adopted hospital code, potentially enhances system utilization and interoperability, allowing for integration with various electronic health records.

Despite the change from batch reporting to an API-based process, which was expected to improve reporting timeliness, the time from diagnosis to report remained consistent between the two systems. A plausible explanation is that hospital personnel may delay data submission to the DDS system until their local data analysis is complete, as the DDS system does not alter existing hospital workflows.

Furthermore, the timeliness indicator does not fully capture the benefit of reduced data processing time at the Provincial Health Office and the central unit, the Division of Epidemiology. The API approach enables a more efficient data analysis process at these levels, a benefit that could not be quantified in this study. Future comprehensive surveillance evaluations are needed to explore this aspect. This limitation arises because data processing for analysis, such as addressing policy concerns regarding outbreaks, is conducted externally after retrieving data from either the R506 or the DDS databases. Additionally, we could not assess man-hour savings or other timeliness benefits related to data processing when using the DDS system compared to R506 as this would require a more intensive qualitative study as part of a complete surveillance evaluation.

At the time of this study, the DDS system was less than one year old, meaning the available data may not fully represent its long-term success. We focused on coverage, completeness, and timeliness, but did not compare other surveillance evaluation attributes such as validity, accuracy, or sensitivity. In summary, the DDS system has demonstrated its ability to maintain data volume comparable to the previous reporting system, despite the complexities involved in a large-scale transition process. These findings align with previous study that suggested the DDS system could effectively replace R506.[5] While earlier research focused solely on COVID-19 comparisons, this study encompassed all diseases within the reporting system, supporting the potential for leveraging the success of the DDS system to enhance overall national disease surveillance.[5]

Recommendations

A comprehensive surveillance evaluation, encompassing both qualitative and quantitative attributes, should be conducted. This evaluation should involve both hospital staff and the central unit at the Department of Disease Control to thoroughly assess the impact of the Digital Disease Surveillance system. Future studies should consider the impact of health centers transferring to the Ministry of Interior on the reporting system and propose solutions to maintain the report coverage in these facilities.

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Author Contributions

Supharerk Thawillarp: Conceptualization, methodology, data curation, formal analysis, writing—original draft, writing—review & editing, and visualization.

Ethical Approval

This study used anonymized secondary surveillance data collected routinely by the Department of Disease Control, Ministry of Public Health, Thailand. Ethical approval was not required, as the study did not involve identifiable human subjects or direct contact with individuals.

Informed Consent

Informed consent was not required because the study used de-identified data collected for routine public health purposes, with no direct interaction with individuals.

Data Availability

The datasets used in this study are not publicly available due to legal and privacy restrictions. Data access may be granted upon reasonable request and with permission from the Department of Disease Control, Ministry of Public Health, Thailand.

Conflicts of Interest

The author declares no conflicts of interest.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

During the preparation of this work, the author used Gemini® to enhance clarity of the manuscript. The content produced by this tool was reviewed and edited by the author, who accept full responsibility for the final text.

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