



Reaching the unreached through an integrated communicable disease dashboard

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Aiming to reach the unreached, we developed a Dashboard pipeline incorporated with ChatGPT engine to effectively monitoring various disease metrics and trends and to inform necessary response strategies. This WHO Digital Public Good provides a coordinated framework to monitor the estimated burden and reported cases of various communicable diseases across different WHO Regional Offices. We believe that this initiative is important to achieve universal health coverage.

In 2022, Member States of the World Health Organization (WHO) in the Western Pacific Region endorsed the WHO Regional Framework for Reaching the Unreached (RTU)¹. The “Unreached” refers to individuals who have no to limited access to effective, quality health services and experience poorer health outcomes than anticipated for their country. The RTU framework underscores the need to utilize innovative approaches to facilitate system-wide coordination, incorporating both national and global evidence while remaining adaptable to local contexts. This inclusive systems approach aims to achieve the overarching goal of providing essential health services to everyone, everywhere in the world². In recent years, digital technologies have proved incredibly valuable as public health tools³. Throughout the coronavirus disease 2019 (COVID-19) pandemic, we have witnessed many successful digital health innovations, including case dashboards^{4,5} that supported effective pandemic response and communication.

In the Western Pacific Region, an Integrated Communicable Disease (ICD) Dashboard⁶ utilizes disaggregated public health and epidemiological data to facilitate effective monitoring of unmet healthcare needs has been launched. Aiming to support data-driven decision making and to inform necessary response strategies in reaching the unreached populations in the Region, the dashboard exemplifies how digital innovations can be deployed to maximize the value of routinely collected surveillance and programmatic data, visualizing various disease metrics and trends. This dashboard is tailored for both general public and health professionals worldwide, with a primary focus on public health experts including government health officials. Nonetheless, professionals in clinical settings can also leverage its epidemiological data and programmatic information for their benefit. Currently, the dashboard provides a centralized digital platform to monitor

the estimated burden and/or reported cases of various communicable diseases, including tuberculosis, human immunodeficiency virus (HIV), malaria, neglected tropical diseases and viral hepatitis covering the 1.9 billion population across 37 countries and areas in the Region.

The development of the ICD dashboard was conceptualized in late 2022. After which, an extensive mapping of data sources was conducted and a data flow from diverse databases was established to consolidate varying data formats. This allowed for an automated update feature. To ensure that the presented indicators accurately reflect regional priority areas, a consultative review was held involving technical staff from the WHO Regional Office of the Western Pacific and WHO Country Offices together with external experts from the Technical Advisory Group for the Reaching the Unreached. After user testing and piloting phases conducted in early 2023, the ICD dashboard was officially launched in August 2023.

As shown in Fig. 1, the dashboard web application is highly functional, pooling multiple streams of data sources, including WHO Global Health Observatory, disease-specific global databases (WHO global tuberculosis database, WHO world malaria reports, and UNAIDS database), the Institute for Health Metrics and Evaluation (IHME), and published literature. The key indicators for the dashboard were presented based on essential monitoring indicators recommended by global disease control and elimination strategies and technical guidelines for various communicable diseases. The dashboard’s “Overview” tab provides a visual summary of the incidence and mortality of the six major communicable diseases in the Region.

The “Disease Burden” tab provides a quick display of corresponding disease burden estimates from the IHME in cross-disease and cross-country comparison panels. Visualization methods include line chart, area chart, bar chart, Treemap, and the raw data is downloadable from the app. By integrating the Generative Pre-trained Transformer (GPT) model via ChatGPT API, it incorporates a generative artificial intelligence (AI) chatbot function to assist digital users in demystifying diseases burden trends and patterns through bidirectional dialogues. The function features multiple shortcut buttons with predefined template questions crafted to guide digital users in prompting ChatGPT to provide descriptive analyses within the specific display page. For example, users could inquire about describing the trend of each disease, summarizing the major disease burdens in a concise paragraph, and identifying the disease with the highest burden for the selected country. Beyond these predefined queries, users can engage in open-ended conversations with ChatGPT within the same window, posting questions like “What could be the potential reasons for the high mortality of [disease] in [country]?”, “Please suggest five major strategies to address these issues.”, or even inquire about medical interventions for a particular disease. This approach enables users to delve deeper into displayed data, tapping into

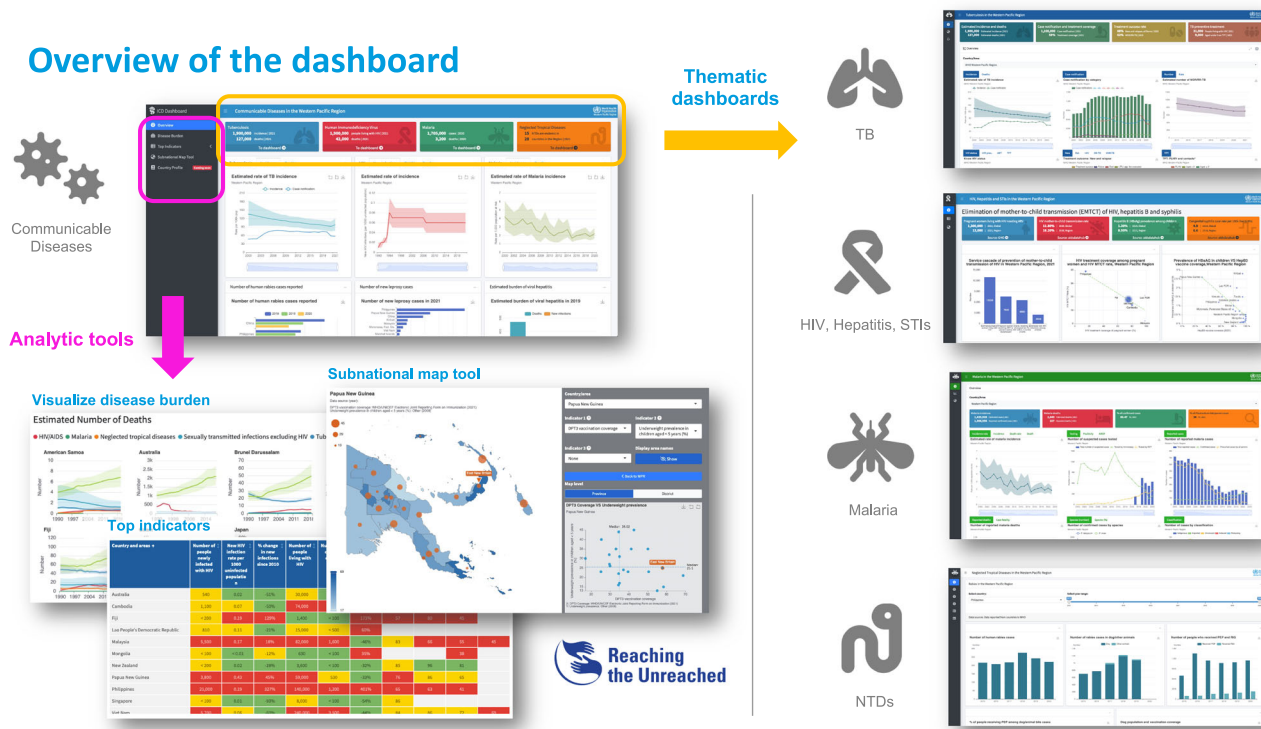


Fig. 1 | The ICD Dashboard from the WHO Regional Office for the Western Pacific. Aimed at reaching the unreached, the ICD Dashboard provides an overview of diseases on digital platform. It includes built-in disease analytics tools, enabling effective visualization of various disease burdens through interactive plots,

heatmaps, and subnational maps. Thematic dashboards cover tuberculosis, human immunodeficiency virus (HIV), viral hepatitis, sexually transmitted infections (STIs), malaria, and neglected tropical diseases (NTDs).

both ChatGPT’s derived general knowledge and its ability to generate contextually relevant responses. However it is important to recognize that ChatGPT operates as a pre-trained language model, and its output should be interpreted with caution. As such, the dashboard includes a disclaimer to remind users to exercise discretion when relying on generative AI information, as it may not always be accurate, complete, or reliable.

Under the “Top Indicators” tab for different diseases, it provides a heatmap that visually displays the key monitoring indicators across countries and areas, indicating the level of achievements with respect to the recommended global and regional targets. The “Subnational Map Tool” tab provides an interactive map tool that allows users to analyze disparities in population health access and vulnerability across various geographical areas using proxy indicators. This function enables the identification of underserved populations, a critical step in delivering integrated services and targeted interventions. It will also facilitate the strategic allocation of resources to priority areas, supporting individuals in need at the primary healthcare level.

All estimates published by the WHO are approved by the respective countries and areas. Although WHO has multi-layer data validation procedures to verify reported cases, data quality may vary due to differences in collection mechanisms and reporting practices across countries. The Dashboard currently presents data primarily at the national level. However, subnational maps include Administrative Level 1 and Level 2 data, reaching the levels of provinces to districts. We plan to incorporate more subnational data to enhance monitoring and guide disease elimination efforts. Data are typically updated annually or biannually. However, there may be variations depending on the programme-specific reporting schedules.

The dashboard is written using the R Shiny interactive dashboard framework. The pipeline of solutions has been made available as a WHO Digital Public Good, which allows for adaptability by other WHO regional offices⁷, upon request. At present, the WHO Regional Office for South-East Asia has also adopted a development pipeline to build an integrated communicable disease dashboard for its region. Meanwhile, we will continuously update the pooled data and upgrade the dashboard functions based on country needs and user actions/feedback. Plans are underway to further expand the scope of coverage to include vaccine-preventable diseases and non-communicable diseases as well as to integrate more subnational data to guide local action and decision-making.

The utility of the dashboard is multifaceted and contextually adaptable. For example, the hepatitis dashboard effectively facilitated discussions among Ministry of Health officials on the challenges and priorities in countries, including Cambodia, Lao People’s Democratic Republic and Viet Nam. Synergizing regional surveillance, analysis, and strategic planning, this dashboard enables policy decision makers to make informed decisions to advance universal health coverage. Furthermore, it provides national programmes with an overview of their progress and gaps in programme implementation, facilitating the design of targeted interventions where significant gaps exist and strengthening advocacy and resource mobilization efforts. Epidemiologists from national disease control programmes can monitor the annual trend of disease epidemic, while donors can gain insights into country-specific disease conditions to effectively adjust their support priorities. Technical partners can align their assistance strategies to provide focused support to the countries. Researchers can conduct various secondary data analysis, combining other national data sources. The

dashboard contributes to the field of clinical medicine by improving both intra- and inter-country surveillance in both temporal and spatial dimensions. It facilitates the strategic allocation of medical resources to priority areas and individuals in need, ultimately resulting in improved population health outcomes.

Together with digital technology and academic partners, WHO aims to incorporate advanced data analytics and broaden the range of health indicators as part of the dashboard while keeping the interface user-friendly. This effort will allow WHO and its Member States to advance RTU through cross-programmatic and secondary data analysis, while fostering public health research within the purview of priority health programmes. Further enhancements and investments in digital innovations, including a more precise and strategic identification of the “unreached”² would enable us to better reach the underserved populations.

Data availability

No datasets were generated or analysed during the current study.

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Author contributions

The study was conceived by F.M., R.P.Y. and Z.W.; F.M., J.K., K.I., K.R., K.H.S., K.H.O., Z.W., R.P.Y. and T.T.G.H. contributed to the study design and implementation. Data retrieval and dashboard development were carried out by W.S. and F.M., with inputs from the other authors. Z.W. and F.M. led the writing of the paper, and all authors reviewed and approved the manuscript.

Competing interests

Z.W. is affiliated with npj Digital Medicine as an Associate Editor and Guest Editor of the Collection on Natural Language Processing in Clinical Medicine. F.M., J.K., K.I., K.R., K.H.S., K.H.O., R.P.Y. and T.T.G.H. are staff members of WHO. The authors alone are responsible for the views expressed in this publication and they do not necessarily represent the decisions or policies of WHO.

Additional information

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