Silvia Runge-Ranzinger

Dr.med.

Is dengue disease surveillance able to predict or detect outbreaks and initiate timely response? Assessment of National Dengue Control Programmes in Thailand and Cambodia

Promotionsfach: Institute of Public Health

Doktorvater: Priv.-Doz. Dr. med. M. Marx

Dengue is the most rapidly spreading arboviral disease in the world. Over 2.5 billion people live in areas where dengue viruses can be transmitted and an estimated 50-100 million infections occur annually, with 500 000 cases requiring hospitalisation. The reported average annual incidence of dengue infection has increased 30-fold over the past 50 years. Compared to nine reporting countries in the 1950s, today the geographic distribution includes more than 100 countries worldwide.

The increase of dengue cases worldwide is related to different factors as the demographic trends, rural-urban migration, and inadequacy of basic urban infrastructure, unreliable water supply and unprotected water storage. Increasingly solid waste and discarded plastic containers provide new larval habitats. Overburdened health services and a shift from vertical vector control programmes towards integrated programmes resulting in lack of accountability and organisation. Globalisation has facilitated geographic expansion of the virus and vector distribution. Climatic factors, especially temperature and environmental factors play an additional role.

There are no drugs or vaccines available yet. So far the most important intervention to prevent dengue is vector control focusing on source reduction, which is resource intensive and difficult to maintain. An appropriate, feasible and accurate surveillance system will help decision makers to a) allocate resources and plan routine vector control, b) initiate timely emergency vector control and c) upscale the health services in case of an impending epidemic.

Due to its public health importance in 1999 dengue was incorporated into the portfolio of the UNICEF, UNDP, World Bank, WHO Special Programme for Research and Training in Tropical Diseases (TDR). The 2002 World Health Assembly Resolution urged greater commitment to dengue among Member States and WHO; of particular significance is the 2005 Revision of the International Health Regulations which includes dengue as an example of a disease that may constitute a public health emergency of international concern.

Against this background a Dengue Scientific Working Group of 60 experts reviewed existing knowledge on dengue and established priorities for future dengue research to

provide evidence and information for policy-makers and control programmes. Some of those recommended areas were the a) development and utilization of early warning and response systems, b) triggers that will allow effective response to incipient epidemics, c) factors leading to success or failure of national programmes and d) decision-making that results in declaration of state of emergency.

This study was designed to look into the development and utilisation of early warning and response systems which partly includes and overlaps with the triggers allowing effective response.

As analysing in the context of dengue surveillance and outbreak management is a particularly difficult research area and outside the mainstream of biological research, TDR supported this study in order to get a clearer picture for larger multi-country studies.

The main research question applied was “How effective is dengue disease surveillance to trigger epidemic response as applied in Thailand and Cambodia and how can it be improved?” The objectives were to a) identify factors for programme failure or success and formulate programme specific recommendations for both countries, b) identify and analyse different components and processes of dengue disease surveillance focusing on outbreak prediction/detection, c) formulate research recommendations, d) develop a framework for the assessment of dengue disease surveillance and its linkage to response, allowing for inter-country comparison.

First a systematic literature review was conducted in order to identify knowledge gaps. A conceptual case study was designed by the author in order to explore some of those gaps and to develop a tool to be used for further comparative evaluations. The framework of this study was then successfully applied in 2009 and 2010 by master students of the University of Heidelberg to assess the dengue surveillance system in Bolivia, Goiás state Brazil and Indonesia.

The methods used were individual in-depth interviews of key informants, documentary analysis and non-participatory observation focusing on dengue disease surveillance, epidemic preparedness and response. Individual key informant interviews were performed in Thailand and Cambodia in 2007. Confidentiality is considered to be of high importance in this study. Data analysis was performed using the Framework Approach especially looking into 1) components of the surveillance system, 2) sensitivity of case/ outbreak detection, 3) accuracy of case/ outbreak detection and classification, 4) timeliness of reporting and response, 5) usefulness, 6) trigger for and linkage to response, 7) epidemic preparedness and 8) epidemic response.

The key results of the study could be summarized as follow: Secondary prevention has proven to be a successful strategy to decrease the Case Fatality Rate by 1) improved case management, 2) seasonal courses in case management, 3) death case conferences, 4) rotations during training and 5) improved accessibility of ICU facilities. Vector control is still mainly based on chemical control, either mass-laviciding or larviciding and adulticiding by a case based approach. Evidence based strategies and disease based indices for their development are missing. Vector surveillance is mainly used for programme monitoring not for risk assessment, main larval habitat and key containers are known. Community participation is of high priority but not implemented yet to a sufficient extent; strategies on sustainable behaviour change are missing. Lack of successful communication and cooperation and insufficient capacity building were identified as major additional barriers.

Strengthening of the Health System would be beneficial to the programmes. Political awareness was general there, however commitment was limited, as either financial and human resources were not sufficient, or dengue was not handled as priority disease. Special strategies for vulnerable groups were missing.

Dengue disease surveillance was generally passive with mandatory reporting for the public sector. Cambodia developed a sentinel component for reporting, as well as sero/virological confirmation. There was no common understanding and consensus of all stakeholders on the purpose and objectives of the surveillance system, so key attributes could not easily be identified and rooms for improvement were not exploited.

Both countries are relying almost exclusively on clinical case confirmation leading to inaccuracy in diagnosis. Case definitions were not standardized in Cambodia; difficulties with insensitivity of the case classification, missing Gold Standard for sensitivity and specificity of the surveillance system are major barriers. Specifically factors limiting sensitivity are 1) low user rates, 2) misdiagnosis based on clinical assessment only, 3) reporting limited to public sector, certain age groups or in-patients only, 4) limited acceptability of the surveillance system at all levels and 5) an insensitive case-classification. Sensitivity for outbreaks detection could be increased if threshold for excess reporting could be lowered and cluster definitions for sub-district/village level were added. Accuracy of clinical case detection remained unclear in both settings, timeliness for reporting was not sufficient with a delay of 4-6 weeks. Timelines could be improved by 1) reporting suspected instead of confirmed cases 2) avoid double reporting and compiling of data 3) the use of prompt to fill forms, 3) data analysis at all levels, including district, 4) data entry already at district level. Additional telephone alert to response teams are beneficial. Acceptability could be improved by 1) provision of information and training on the system, 2) reduced workload, 3) regular feedback, 4) timely outbreak investigation and 5) prompt and effective response to alerts. Mandatory reporting should include the private sector.

In general dengue disease surveillance showed to be useful for disease monitoring and national planning, but not for timely outbreak alert.

Surveillance data should clearly be linked to triggers for response. Mostly these are thresholds using excess reporting. Thailand had positive experience with lowered thresholds (80% of the mean over 5 years) to compensate for low timeliness. Excess reporting during low transmission times showed to have predictive capacity for the next season. Serotype shift and increased virus positivity rate in laboratory confirmed sub-samples were not used as additional indicators for an impending epidemic. Data on seasonality, spatial temporal distribution or events with mass movement of population were know, but not always used to modify the programme. How these data could be used for an early warning system needs to be further investigated.

Surveillance Rapid Response Teams were implemented in Thailand resulting in increase reporting timeliness and improved communication and collaboration during outbreaks. Proper contingency planning, risk and emergency communication based on evidence based emergency vector control strategies are lacking.

In conclusion with a view on the improvement of dengue prevention and control ministries need generally to focus on the 1) strengthening of the health system, 2) improvement of communication, including strategies on risk and emergency communication, 3) establishment of inter-sectoral, inter-agency, inter-programme and inter-country

cooperation and 4) improved capacity building.

For Dengue Prevention and Control Programmes in cooperation with the International Research Community it is recommended to 1) gain reliable data on burden of disease for advocacy tools, 2) to formulate evidence based vector control strategies and 3) promote operational research on distinct programme components to facilitate the identification of factors for success and failures and calculate cost-effectiveness.

To improve dengue disease surveillance and timely outbreak response it is recommended to 1) establish a common understanding and consensus of all stakeholders on the surveillance purpose and objectives, 2) assess rooms for improvement especially of identified priority attributes as sensitivity and accuracy of the system, timeliness and acceptability, 3) ensure a close linkage of analysed surveillance data to evidence based response, bedded in proper contingency planning, 4) increase additional active components based on a clear rational and linked to response. Further research on appropriate thresholds/alert indicators or risk assessment tools is needed.