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(REVIEW ARTICLE)

# Assessing the effectiveness of CBTS in mitigating dengue hemorrhagic fever: A literature review

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## Abstract

Dengue virus infection and its severe form, dengue hemorrhagic fever (DHF), is currently the most common and fastest-spreading arthropod-borne diseases. There are still no effective drugs and vaccines that work against DHF. Therefore, avoiding contact with infected vectors through personal hygiene and environmental sanitation is the most feasible way to prevent dengue virus infection. One of the programs designed to prevent environment-based diseases such as DHF is Community-Based Total Sanitation (CBTS). CBTS employs community empowerment in the form of a triggering method that induces a sense of shame within the community if their environment is dirty. Although promising, the use of CBTS is currently underutilized against DHF. This study aims to assess the effectiveness of hygiene and sanitation behaviors that align with the elements of CBTS pillars using a literature review method. Through the screening process, seven articles that matched the criteria were thoroughly reviewed to gather information. Based on the findings of this study, implementing either the 4$^{th}$ or 5$^{th}$ pillar of CBTS leads to a lower risk of contracting DHF.

**Keywords:** CBTS; DHF; STBM; personal hygiene; environmental sanitation

## 1. Introduction

Dengue virus infection is currently the fastest spreading arthropod-borne disease in tropical and sub-tropical countries. Dengue virus infection and its severe form: dengue hemorrhagic fever (DHF) has become endemic in more than 100 countries throughout Asia, the Pacific, the Americas, Africa, and the Caribbean with South-East Asia and Western Pacific regions being the most seriously affected (1). Being a vector borne disease, DHF occurrence is largely influenced by the bionomics of its vector. Vast majority of Dengue virus transmission occurs through genus of Aedes mosquito with the primary vector being *Aedes aegypti*. Due to their anthropophilic and endophagic nature, *Aedes aegypti* possesses higher vector capacity than other arthropod species that transmit the dengue virus thus becoming DHF primary vector (2).

Currently, there are no specific prophylactic or therapeutic drugs for dengue infection and the use of vaccine is both severely limited and ineffective. Avoiding contact with infected mosquitoes is the most feasible way to prevent dengue infection, this method can be achieved through multiple ways but the most effective way is to eliminate vector's breeding place (3). One of the program made by Indonesian government that focus on eliminating environment-based disease like DHF is Community Based Total Sanitation (CBTS) or in Indonesian is Sanitasi Total Berbasis Masyarakat (STBM). Achieving large-scale and long-term control of dengue virus by community-based campaigns has proven to be challenging in some countries, even with the one that has specific target sites. There are certain factors that prevent most of community-based campaigns to achieve its full potential like lack of participation, unwillingness to accept that someone's property is source of problem, and last but not least is lack of sustained control activities over long period of time especially in the absence of outbreak (2). CBTS adopts different approach in order to overcome these limiting

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factor, one of them is using community empowerment in form of a triggering method that induces a sense of shame in community member if their environment is dirty (4).

Most studies on the relationship between CBTS and environmental diseases focus primarily on the first pillar. The CBTS 1st pillar implementation itself currently the only main focus in Indonesia. According to Ministry Health of Indonesia, the CBTS 1st pillar act as main entry through total sanitation and also as instrument to cut the chain of fecal contamination in water, food, and potential disease vector (5). This makes finding article related to 2nd, 3rd, 4th, and 5th pillar difficult, as there are currently no specific studies on these topics.

## 2. Material and methods

The type of study is literature review that aims to investigate the relationship between the fourth and the fifth pillars of CBTS and the occurrence of Dengue Hemorrhagic Fever (DHF) cases by analyzing relevant research articles. Research articles are collected from digital database of "Google Scholar" and "Scopus" using keywords: "hygiene", "sanitation", and "DHF" and using the following inclusion and exclusion criteria:

### 2.1. Inclusion Criteria

- Full text article
- Peer reviewed article from the last 5 years
- Studies in English or Indonesian
- Quantitative studies

### 2.2. Exclusion Criteria

- Qualitative studies
- Literature review or meta analysis studies
- Studies other than English or Indonesian

## 3. Results and discussion

There are 200 articles and books found based on the keywords, year publications, and selected language. The next step is to do abstract screening to determine whether the article suits the topic of CBTS pillars and dengue hemorrhagic fever. There are 7 research paper that finally obtained based on writer's criteria.

### 3.1. CBTS Overview

CBTS is government made program by Ministry Health of Indonesia. CBTS is national scale program that aims to increase and implement sanitation behavior that could prevent the occurrence of environment-based disease. The fundamental basis of CBTS is based on multiple sanitation and community-based program consisting of five pillars:

- Stop open defecation
- Washing hand with soap
- Household drinking water and food management
- Solid household waste management
- Household wastewater management

These pillars also serve as the outputs of CBTS program while the outcome is the reduction of environment-based disease that related with hygiene and sanitation (6). Currently the program primarily focused on fecal-oral transmitted diseases. What sets CBTS apart from other community is the triggering methods it used on community.

Community empowerment through triggering method in CBTS has potential to decrease the occurrence of DHF. According to studies conducted by Farahita on Indonesian villages, it is stated that there is strong correlation between DHF and the villages that adopt STBM. It indicates that the increase of DHF case correspond with decrease of village adopting CBTS (7). Based on DHF vector's bionomics, the 4th and the 5th pillar is most suitable pillar to implement in order to decrease DHF occurrence (8)

### 3.2. Fourth Pillar

Untreated domestic solid waste has the potential to create breeding grounds for *Aedes aegypti* during rainy season and resting place for them during dry season (9). The 4th pillar of CBTS specified in domestic solid waste treatment is suitable to implement in order to reduce the number of *Aedes aegypti* harborage sites, specifically in terms of altering its habitat. Based on CBTS verification form, there are four main criteria in the 4th pillar of CBTS which is:

- There is no visible trash around home
- There is trash can with a lid, made of sturdy material, and easy to clean
- Implementing safe solid waste management behavior (not burning or disposing it into an open area)
- Separating solid organic waste with non-organic solid waste

Household qualify for practicing 4th pillar of CBTS by fulfilling one or more of the criteria above.

One of the common practice by Indonesians to reduce the survival of DHF vectors is 3M which stands for Menguras (drain), Mengubur (bury), and Menutup (cover). Burying solid waste and secondhand item aligns with the third criteria of the CBTS 4th pillar. Research from Anisa states that households with good 3M practices have a 5.1 times lower risk of contracting DHF (10). Studies from Alhamda and Barlian have also indicated that people who have poor implementation of 3M Plus will be at risk 2.912 times suffering from DHF compared to people who have good implementation of 3M Plus (11). People sometimes wanted to repurpose secondhand item such as old barrel or bucket as a temporarily water reservoir. But due to lack of time to drain the water reservoirs after returning from work, these reservoirs unintentionally becoming the breeding sites for *Aedes aegypti* (12). It should be noted that despite CBTS 4th pillar indicating a strong relationship with DHF occurrence, there are other factors that also determine the occurrence of DHF. According to case-control study conducted by Rochmawati in Tenggilis Subdistrict, people with poor solid waste management habits tend to hang their clothes on the wall rather than putting them in wardrobe (13). The indoor wall and indoor environment as general is the 'natural' resting place for *Aedes aegypti,* specifically at the height of less than 0.75 meters (14). Hanging clothes and other items making it even comfortable for *Aedes aegypti* to rest. Therefore, it is possible to contract DHF despite fulfilling all the criteria of the CBTS 4th pillar, but neglecting indoor inspection for *Aedes aegypti* resting place.

### 3.3. Fifth Pillar

A body of water is an important environment for *Aedes aegypti* life cycle. It serves as the main breeding sites where adult *Aedes aegypti* lay their eggs, which then turn into larvae. These larvae will become future threat for human if left unchecked. Previous studies stated that *Aedes aegypti* can only lay their eggs in clean water, but nowadays the change of climate and environment forces *Aedes aegypti* to adapt. Studies conducted by Martini indicated that *Aedes aegypti* larvae is capable to live in polluted domestic water with the pH up to 8.7 (15). This claim supported by Suwartawan in his finding that *Aedes aegypti* larvae has hatchling rate of 40% in the polluted domestic water with the pH of 6.5-8.5 (16).

CBTS 5th pillar specified in liquid domestic waste management, as such making it a suitable measure for implementation in order to reduce the number of *Aedes aegypti* breeding sites. Based on CBTS verification form, there are three main criteria:

- There is no stagnant water around home
- There is closed non-sewage drainage
- Connected with infiltration well or municipal wastewater management system

Household qualify for practicing 5th pillar of CBTS by fulfilling one or more of the criteria above. There are many ways to prevent *Aedes aegypti* for using body of water as their breeding ground such as using larvicide and larvivorous fish (17). But those are not practical solutions since chemical larvicides can lead to water pollution. There is a bio larvicide alternative, but it can be costly since a large amount is needed and can also potentially lead to larvae developing resistance (18). A Large area is also required to establish habitat for larvivorous fish in the first place. This makes the implementation of the CBTS 5th pillar the most practical and effective way to prevent bodies of water from becoming *Aedes aegypti* breeding sites.

Stagnant water is the condition where water does not flow, circulating, or sitting still for long period of time. This can be natural formation like pond or man-made environment like water reservoir. *Aedes aegypti* prefer this type of water to prevent their eggs being adrift by strong current, it is common to find *Aedes aegypti* in swamps, coastal area, or other locations where stagnant water is frequently formed (19). Case control study conducted by Degife states that people who live or have stagnant water near their house (<100 meters) have 3.6 times higher risk contracting DHF (20). This

study yielded similar result with previous case control study conducted in Vietnam, indicated that people living near either natural or man-made stagnant water had higher morbidity rate from contracting DHF (21). Man-made stagnant water used as water reservoir has a lower chance of becoming *Aedes aegypti* breeding sites since it can be drained daily (22). However, sometimes people, especially those who work in private companies, have limited time at home. As a result, they may overlook the presence of stagnant water within man-made reservoir, thus neglecting vital task such as draining or cleaning it (23). There have been neither recent nor past studies on the connection between open sewage with DHF occurrence. This might be because, even though *Aedes aegypti* larvae are capable of laying eggs in the polluted water, they still prefer clean water (24).

## 4. Conclusion

The implementation of CBTS, specifically the 4th and the 5th pillar, shows promising result in decreasing the occurrence of DHF. Based on the discussion in the article above, the results indicate that implementing one of the CBTS 4th pillar's criteria leads to a lower risk of contracting DHF. Implementing safe solid waste management practice reduces the number of man-made habitat for *Aedes aegypti* to rest or lay eggs during rainy season. The good implementation of CBTS 5th pillar, which involves practicing safe wastewater management, also leads to decrease in the risk of contracting DHF by reducing the survival rates of larvae. The current study primarily linked potential action and behavior that related to CBTS 4th and 5th pillar, as articles related to this topic are close to nonexistent. Therefore, it is imperative to conduct further studies in order to establish concrete connection between CBTS pillars and DHF or other environment-based disease.

## Compliance with ethical standards

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### *Disclosure of conflict of interest*

The author has no conflict of interest in this study.

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