

# THE CHARACTERISTICS OF DISTRIBUTION OF TYPES OF *DENGUE* VIRUS SERUM AND LEVEL OF CONSENSUS RESULTS AGREEMENT ON DIAGNOSTIC TESTING FOR DENGUE HEMORRHAGIC FEVER IN PEOPLE WITH FEVER OF QUANG NINH PROVINCE IN 2024

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**Objectives:** Characteristics of the Dengue virus serotypes by Realtime PCR method in Dengue hemorrhagic fever patients and comparing the similarity between the results of the Dengue virus serotype testing using the Realtime PCR method with the NS1 rapid test technique on Dengue hemorrhagic fever patients in Quang Ninh Province from 2022 - 2023.

**Subjects and methods:** A retrospective study of the statistical reports on 300 patients suspected of having Dengue fever were collected at the Center for Disease Control in Quang Ninh Province from 2022 - 2023, cross-sectional study.

**Results:** Patients infected with DENV1; 2; 4 accounted for 59.1%, 39.1%, 1.7%, respectively. The distribution of DENV1 type by region, DENV1 in the central region (Ha Long, Cam Pha) (46%) and western region (Uong Bi, Dong Trieu, Quang Yen) (41%) predominates over the eastern region and island districts; DENV2 type is higher in the western region (39.1%) than the central region (33.7%). The distribution of DENV types by subjects ( $\leq 15$  years old,  $> 15$  years old, man and women) and by time, clinical grade, and occupational group did not differ. Overall sensitivity and specificity of the rapid test were 93.19% and 96.92% with 95% CI. Positive predictive value (PPV) is: 99.09%, negative predictive value (NPV) is: 79.74% with 95% CI. The positive rate of rapid test was found to be higher at cut-off period value  $\leq 25$ . The similarity calculated by Cohen's Kappa coefficient was 83.6%.

**Conclusions:** Three types of DENV were detected, of which DENV1 had the highest rate (59.1%) followed by DENV 2 (39.1%), DENV 4 accounted for a very low rate (1.7%). The NS1 rapid antigen test can be used as a very good screening test to identify Dengue virus infection status.

**Keywords:** Dengue virus, DENV serotypes, NS1 Rapid antigen detection, Realtime PCR typing.

## INTRODUCTION

Dengue hemorrhagic fever (DHF) is a very dangerous acute viral infectious disease, spread from sick to healthy people mainly through the female mosquitoes *Aedes*

*aegypti* and *Aedes albopictus* infected with the virus. The causative agent is the Dengue virus of the Flaviviridae family, which consists of 4 different serotypes: DEN-1, DEN-2, DEN-3, DEN-4. There is no specific treatment for the disease and there is no vaccine to prevent the disease, the current effective prevention and control measures are to prevent and control the vector as well as rely on diagnostic tests for Dengue fever<sup>1</sup>. DENV serotypes are distributed differently across geographic regions and have alternating pathogenic roles over time and by region. The clinical manifestations caused by the DENV types are relatively similar. However, the risk of severe Dengue hemorrhagic fever and secondary Dengue hemorrhagic fever is different between DENV types<sup>1</sup>.

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Dengue diagnostic tests help determine the presence of pathogenic viruses or antiviral antibodies in the blood. The tests commonly used to diagnose Dengue fever are rapid tests: NS1, IgM antibodies and IgG antibodies, ELISA tests, semi-nested RT-PCR tests, and Realtime RT-PCR type tests<sup>2</sup>. The real-time PCR test is considered the gold standard in the diagnosis of Dengue virus infection<sup>2</sup>. This test can detect 4 DENV tubes in a single run. The NS1 antigen rapid test has the advantage of being convenient to use, giving quick results within 30 minutes, and the cost is lower than the real-time PCR test. The NS1 rapid test result gives the best result < 5 days from the start date. However, rapid tests cannot distinguish between pathogenic serotypes, and detect antibodies against Dengue virus, so it is necessary to combine the NS1 rapid test with other tests such as Real-Time PCR and ELISA to accurately diagnose Dengue virus infection.

In the face of the complicated situation of Dengue fever in Quang Ninh province, rapid diagnostic tests for patients with Dengue fever and identification of pathogenic serotypes play several important roles in the prognosis and monitoring and treatment of patients with Dengue hemorrhagic fever. Currently, the Quang Ninh Provincial Center for Disease Control is simultaneously implementing 2 diagnostic techniques for Dengue Fever, namely the NS1 rapid test and the Realtime PCR test. The survey of Dengue hemorrhagic strains circulating in Quang Ninh province along with the evaluation of the similarity of test results between the above 2 methods is necessary to make clinical recommendations on the practice as well as the use of the results in the most accurate and effective way, thereby strengthening disease prevention and control in the locality. In Quang Ninh, there are many studies on Dengue Hemorrhagic Fever but mainly learn about the disease and the virus that transmits the disease, there is little research on the serotype and compare the similarity of test results between the 2 diagnostic test methods for Dengue Hemorrhagic Fever. Therefore, in order to improve the quality of Dengue virus diagnosis quickly and accurately, we conducted this study with two objectives: Characteristics of serotype distribution and consensus level of Dengue virus diagnostic test results in Dengue hemorrhagic fever patients in Quang Ninh province in 2024.

## SUBJECTS AND METHOD

**Subjects:** Patients suspected of having Dengue fever are preliminarily diagnosed with Dengue fever in the community, hospitalized and treated at district hospitals and health centers in Quang Ninh province.

**Time:** From 01/1/2022 to 31/12/2023.

**Research location:** Department of Microbiology and Hematology Laboratory, Quang Ninh Provincial Center for Disease Control.

### Methods

**Study design:** Cross-sectional retrospective study.

**Sample size and sample selection method:** All patients were assigned to do both the DENV real-time PCR test and the NS1 rapid test at the same time, specifically 300 samples that met the standards.

**Select the entire template:** All suspected Dengue cases monitored and treated have a permanent address in Quang Ninh province, with the onset of the disease from January 1, 2022 to December 31, 2023 and are designated as both NS1 and Realtime PCR rapid test techniques. Proceed to select all dossiers on the software of Circular 54/2015/TT-BYT dated 28/12/2015 of the Ministry of Health<sup>3</sup> and patient information on the book of disease test results at the Department of Microbiology and Hematology Laboratory, Quang Ninh Provincial Center for Disease Control.

**Research material:** Patient statistical report, collected at the Center for Disease Control of Quang Ninh province. 300 patients suspected of having Dengue hemorrhagic fever were sampled and tested for DENV serotype by realtime PCR method and NS1 rapid test at the Center for Disease Control of Quang Ninh province.

**Data management and analysis:** According to the biomedical statistical method using SPSS 25 software, excel 2019. Using the Chi squared test algorithm ( $\chi^2$ ), the difference was statistically significant when  $p < 0.05$ . The Kappa test was used to compare the similarity of test results using the realtime PCR tube method and the NS1 rapid test.

**Ethics considerations:** This study is based on the medical records of patients suspected of Dengue Fever, samples are taken to serve the correct diagnosis of Dengue Fever and treatment of the disease in accordance with the hospital's procedures. The study did not harm the patient and

the patient's family. The study was submitted to the Ethics Committee of the University of Public Health for review and approval. Decision No. 67/2024/YTCC-HD3 dated April 11, 2024, approving ethical issues Biomedical research. Objective and honest in evaluating and processing data.

## RESULTS

### Characteristics of serotype distribution of Dengue virus

**Table 1.** Dengue virus isolation results

Time DENV type	Year 2022		Year 2023		Total		P
	Quantity	Ratio %	Quantity	Ratio %	Quantity	Ratio %	
DENV1	64	56.6	75	61.5	139	59.1	0.752
DENV2	47	41.6	45	36.9	92	39.1	
DENV3	0	0.0	0	0.0	0		
DENV4	2	1.8	2	1.6	4	1.7	
<b>Total</b>	<b>113</b>	<b>100</b>	<b>122</b>	<b>100</b>	<b>235</b>	<b>100</b>	

**Comments:** In 2 years, there were 300 cases of the disease whose blood samples were taken as tests to determine the serum type of Dengue virus. The results show that there are 3 types of Dengue virus, namely DENV1, DENV2, DENV4 circulating in Quang Ninh province. In which, DENV1 accounted for the highest rate (59.1%), the lowest was DENV4 with a rate (1.7%).

In 2023, the circulation of type DENV1 (61.5%) is higher than in 2022 (56.6%). Type DENV2 in 2022 (41.6%) is higher than in 2023 (36.9%). However, the prevalence of the DENV type over time was not statistically significant with  $p > 0.05$ .

**Table 2.** Distribution of DENV types according to study subjects

DENV type Characteristic		DENV1		DENV2		Other DENV		P
		Quantity	Ratio %	Quantity	Ratio %	Quantity	Ratio %	
Age group	≤ 15 age	12	54.5	10	45.5	0	0.0	0.688
	>15 age	127	59.6	82	38.		1.9	
Sex	Male	76	54.7	61	43.9	2	1.4	0.198
	Female	63	65.6	31	32.3	2	2.1	
<b>Total</b>		<b>139</b>		<b>92</b>				

**Comments:** The prevalence of DENV1 infection in children ( $\leq 15$  years) was 54.5%, lower than in people  $> 15$  years (59.6%). The prevalence of DENV2 infection in children was 45.5%, higher than in people  $> 15$  years of age (38.5%), but the difference was not significant with  $p > 0.05$ . The prevalence of DENV1 infection in females (65.6%) was higher than in males (54.7%). But the prevalence of DENV2 infection in men (43.9%) was higher than in women (32.3%), a statistically significant difference of  $p > 0.05$ .

**Table 3.** Distribution of patients according to AST

DENV type Location	Year 2022		Year 2023		Total		P
	Quantity	Ratio %	Quantity	Ratio %	Quantity	Ratio %	
Central Region	64	46.0	31	33.7	2	50.	0.003
Western Region	58	41.7	36	39.1	1	25.0	
Eastern Region	16	11.5	22	23.9	0	0.0	
Islands Districts	1	0.7	3	3.3	1	25.0	
<b>Total</b>	<b>139</b>		<b>92</b>		<b>4</b>		

*Notes*

*Eastern Region: Mong Cai City, Binh Lieu District, Hai Ha District, Dam Ha District, Tien Yen District, Ba Che District.*

*Central Region: Ha Long City, Cam Pha City.*

*Western Region: Uong Bi City, Dong Trieu Town, Quang Yen Town.*

*Island districts: Van Don District, Co To District.*

**Comments:** The distribution of DENV1 type in the central region accounted for the highest proportion (46.0%), to the western region (41.7%), and the lowest was in the island district area (0.7%). In contrast, the distribution of DENV2 type in the Western region accounted for the highest proportion (39.1%), the central region accounted for (33.7%), then the Eastern region accounted for (23.9%), and the lowest was the island district area (3.3%). The difference was statistically significant ( $p < 0.05$ ).

**Similarity of serum tube test results by PCR and NS1 methods****Table 4.** Dengue virus positivity rate by rapid test and real-time PCR

Results	Quick test NS1		Realtime PCR	
	n	%	n	%
<b>Negative</b>	79	26.3	65	21.7
<b>Positive</b>	221	73.7	235	78.3
<b>Total</b>	<b>300</b>	<b>100</b>	<b>300</b>	<b>100</b>

**Comments:** The positive rate of Dengue virus by rapid test method on 300 study subjects showed that the number of samples with positive results was 221 samples (73.7%), the number of samples with negative results was 79 samples (26.3%).

The positive rate of Dengue virus by Real-Time PCR test method on 300 study subjects showed that the number of samples with positive results was 235 samples accounting for (78.3%), the number of samples with negative results was 65 samples accounting for (21.7%).

**Table 5.** Dengue virus positivity rate by rapid test and real-time PCR

Quick test NS1	Realtime PCR		
	Positive	Negative	Total
<b>Negative</b>	219	2	221
<b>Positive</b>	16	63	79
<b>Total</b>	<b>235</b>	<b>65</b>	<b>300</b>

**Comments:** The sensitivity of the NS1 antigen rapid test compared to the real-time PCR test was 93.19%, the specificity was 96.92%, the positive predictive value (PPV) was: 99.09%, the negative predictive value (NPV) was: 79.74%. The KAPPA coefficient = 0.836 shows that the NS1 antigen rapid test and the real-time PCR for Dengue virus serotyping have a very high similarity.

**Table 6.** The positive rate by antigen rapid test compared to the CT value determined by the RT-PCR technique

CT value \ Quick test NS1	Negative		Positive		Total	
	n	%	n	%	n	%
< 20	0	0.0	43	100	43	100
20 - 25	0	0.0	96	100	96	100
25.1 - 30	1	2.0	50	98.0	51	100
30.1 - 35	6	18.8	26	81.3	32	100
> 35	9	69.2	4	30.8	13	100
<b>Total</b>	<b>16</b>		<b>219</b>		<b>235</b>	

**Comments:** With a CT value  $\leq 25$ , the NS1 antigen rapid test detects 100%, with a CT value of 25.1-30.0 the detection rate is 98.0%. The detection rate decreased with samples with higher CT values, namely 81.3% and 30.8%, respectively, the detection rate of Dengue virus on samples with CT values of  $30 < CT \leq 35$  and  $CT > 35$ . If we consider samples with CT values  $\leq 30$ , there are 2% of false-negative cases with antigen rapid tests.

## DISCUSSIONS

The distribution of the Dengue virus serotype varies from year to year, from region to region<sup>1</sup>. The results in table 1 show that in 2 years from 2022 and 2023 in Quang Ninh province, there is a circulation of 3 serotypes: DENV1, DENV2, DENV4.

Of the 3 serotypes circulating at the study site, DENV1 accounted for the main proportion (59.1%), followed by DENV2 (39.1%), and DENV4 accounted for a very low proportion (1.7%). Virological surveillance results in the last nearly 2 decades have also recorded that DENV1 and DENV2 are still the 2 dominant pathogenic serotypes in the entire territory of Vietnam. Our results are consistent with the publication of Nguyen Manh Hung et al. (2018) in Hanoi, which studied 1863 cases, identifying 972 (52.2%) cases of Dengue virus infection. In which, mainly DENV-1 (60.3%), DENV-2 (39%), DENV-4 (0.7%), DENV-34 were not detected. According to the author, Nguyen Thi Van and colleagues in some districts of Hanoi (2017 - 2019) showed the results of the rate of patients infected with DENV1; 2; 4 are 60%,

38.5%, 1.5% respectively<sup>5</sup>. However, according to another study by Nguyen Thi Tuyet Van et al. (2022) in the Central Highlands region in the period from 2003 to 2020, the results show that in the Central Highlands, there are all 4 types of DENV, of which DENV-2 accounts for the highest proportion (47.48%), followed by DENV-1 (38.15%); DENV-4 (12.97%) is the lowest is DENV-3 (1.40%)<sup>6</sup>.

Other studies in Asia have also shown that the circulation of Dengue virus serotypes varies from region to region. A study in Indonesia in the city of Makassar, South Sulawesi, from 2007 to 2010, found that DENV-1 was the most common form (41%), followed by DENV-2 (31%), DENV-3 (20%) and DENV-4 (7%)<sup>7</sup>. However, another study in Sri Lanka by Dinuka Ariyaratne et al. (2022) showed that DENV-1 (15.2%), DENV-2 (68.9%) and DENV-3 types were (15.8%), and no cases of DENV-4 infection were recorded<sup>8</sup>. The reason for this difference is that the serotypes of the Dengue virus circulate in different years<sup>1</sup>.

In this study, the results in Table 2 show that subjects  $\leq 15$  years old have a lower rate of DENV1



infection (54.5%) than the group over 15 years old (59.6%), but the rate of DENV2 infection in the group  $\leq 15$  years old (45.5%) is higher than the group over 15 years old (38.5%). Our results are different from the announcement of Nguyen Thi Van, the results of the rate of patients infected with DENV1 in the group  $\leq 15$  years old is (80%), the group over 15 years old is (58%); in the DENV2 type, the rate (42%) is higher than that of  $\leq 15$ -year-old group (20%)<sup>5</sup>. According to the author Ha Quoc Viet et al (2020) at Can Tho Children's Hospital from 3/2019 to 3/2020, the rate of DENV-1, DENV-2, DENV-3 and DENV-4 types is 55.4%, respectively; 44.6%; 0% and 4.6%, DENV-1 and DENV-2 types are dominant<sup>9</sup>.

The results in Table 3 show that there is a difference in the circulation of DENV type between regions in Quang Ninh province. The rate of DENV1 infection in the central region including Ha Long city and Cam Pha city accounted for the highest rate (46.0%). Next is the Western region including Uong Bi city, Dong Trieu town and Quang Yen town accounting for the proportion (41.7%). The lowest is Van Don and Co To island districts (0.7%). The rate of DENV2 infection in the Western region is (39.1%) higher than in the central region (33.7%), the lowest is in Van Don and Co To island districts (3.3%).

Our results are different from those published by Nguyen Thi Van, there is no difference in the infection structure of DENV serotypes between ecological regions (rural and urban)<sup>5</sup>.

The positive rate of Dengue virus by the NS1 rapid test method in table 4 shows that out of a total of 300 samples tested, the total number of positive samples is 221 samples, accounting for 73.7%, and negative samples are 79 samples, accounting for 26.3%. Our results are also similar to those published by Shashi Sharma et al. (2018) in India, which showed that the NS1 rapid test results had a positive rate of 69% and a negative rate of 31%<sup>10</sup>. Also according to the author Do Nhu

Binh (2024), the test results by rapid test are 114 positive samples (54.3%) and 96 negative samples (45.7%)<sup>11</sup>. According to Nguyen Minh Ha (2023), the NS1 rapid test results have a positive rate of 75.8%, a negative rate of 24.2% (12), similar to the results of our study.

To date, realtime PCR has been recognized as the gold standard in the diagnosis and determination of DENV types, but the method still has some drawbacks, including false negatives and false positives<sup>13</sup>. In the medical literature, the rate of false positive NS1 tests is only allowed in the range of 0.5 - 2.0%<sup>7</sup>.

The positive rate of Dengue virus by realtime PCR method of serotyping in table 4 shows that out of a total of 300 samples tested, the total number of positive samples is 235 samples, accounting for 78.3%, negative samples have 65 samples, accounting for 21.7%, the cut-off threshold (Ct value) of the realtime PCR method at cycle 37. According to the author, the results of the Real-Time PCR test showed 121 positive samples (57.6%) and 89 negative samples (42.4%)<sup>11</sup>. In contrast, according to Nguyen Minh Ha's announcement, the Real-Time PCR test results showed a positive rate of 30.5%, a negative rate of 69.5%<sup>12</sup>. There is a difference between the author's announcement and ours, our positive and negative rates are 78.3% and 21.7%, respectively.

In our study, with a Ct  $\leq$  cycle of 25.0 the positivity rate with the NS1 rapid test was 100%, Ct from 25.1 to 30 the positivity rate was 98%, Ct from 30.1 to 35 the positivity rate decreased to 81.3%, Ct  $> 35$  had a positivity rate with the NS1 rapid test was 30.8% (table 6). The explanation for this difference is that with the Ct  $\leq$  cycle of 25.0 the percentage of viruses in PCR-positive samples is very high, there are millions of copies of the RNA of the Dengue virus, so the detectability of the NS1 rapid test is 100%. With a Ct of 25.1-30.0 the positivity rate is very high with 98%. Ct  $> 35.0$  the concentration of

virus in the sample is still very low, so the detection rate of the rapid test has decreased to 30.8%.

According to our results in table 5, a comparison of the similarity of test results between the two methods of NS1 rapid test and realtime PCR with 95% confidence shows that the sensitivity of the NS1 antigen rapid test compared to the realtime PCR test is 93.19%, the specificity is 96.92%, the positive predictive value (PPV) is: 99.09%, the negative predictive value (NPV) is: 79.74%, the Kappa coefficient = 0.83, so the consensus between these two methods is very high. This result shows that the sensitivity and consistency of the NS1 rapid test in our study is very high. According to the publication of Zhuo Lin Chong (2020) in Malaysia, the sensitivity and specificity, PPV, and NPV of the NS1 rapid test compared to real-time PCR were 52.4%, 97.7%, 95.2%, and 70.3%, respectively<sup>13</sup>. The sensitivity and negative predictive value of NPV in our study were much higher than those published by author Zhuo Lin Chong. According to Vu Ty Hang's announcement, the sensitivity of the NS1-LFRT test is 79%, the specificity is 100%, the PPV is 100%, and the NPV is 27.6%. In addition, it was found that NS1 was significantly reduced in patients infected with DENV-2 (55%) compared to DENV-1 (98%;  $p < 0.001$ ) or DENV-3 (96%;  $p = 0.004$ ). The NS1 rapid test is a strong diagnostic test in DENV-1 and DENV-3 infections, but less sensitive in DENV-2 infections<sup>14</sup>. The sensitivity in this study was lower than ours, especially the negative predictive value (NPV) was very low at 27.6% compared to 79.74%. According to Nguyen Minh Ha's announcement, the results of the NS1 rapid test have sensitivity, specificity, PPV, NPV of 51.2%, 92.9%, 75.9% and 81.3%, respectively, the highest on the 4th (22nd). The sensitivity in this study was much lower than our publication of 51.2% compared to 93.19%. This difference may be due to differences between Dengue virus types: Types 2 and 4 are less sensitive due to the poorer ability of these types to secrete NS1 in the

blood than other types<sup>7,8</sup>. Primary and secondary immune responses: In secondary infections, the body's antibody production response is faster and stronger, leading to early inhibition of viral activity than primary infection, so the sensitivity of the NS1 rapid test is lower than that of primary infection<sup>7,8</sup>.

The sensitivity of the results of the NS1 rapid test method compared to the realtime PCR method of determining the serum type is lower than the manufacturer's announcement of 93.2% compared to 100% and the specificity equivalent to the manufacturer is 96.92% compared to 98.75%. The consensus of the 2 methods is almost completely consistent. The NS1 rapid test is a powerful diagnostic test in Dengue virus infection with simple technique, short return time, low cost, high sensitivity and specificity, and is valuable for detecting Dengue virus at an early  $< 5$  days when infected. However, the amount of NS1 antigen gradually decreases after 4 to 5 days and antibodies begin to appear, affecting the diagnostic value of the NS1 rapid test<sup>7</sup>. Therefore, it is necessary to combine both real-time PCR testing methods and NS1 or ELISA with NS1 to increase the ability to detect Dengue virus early: According to the author Huhtamo, if PCR is combined with ELISA, the diagnosis rate is 99%; combined PCR with NS1 has a diagnosis rate of 95.9%<sup>15</sup>.

## CONCLUSIONS

3 blood types of Dengue virus causing endemic diseases were detected in Quang Ninh province in 2 years 2022 and 2023, of which DENV1 type had the highest rate (59.1%), followed by DENV2 (39.1), DENV4 accounted for a very low rate (1.7%).

The distribution of DENV types by region is different, the rate of DENV1 in the central region including Ha Long city and Cam Pha city accounts for the highest rate (46%), followed by the western region including Uong Bi city, Dong Trieu town, Quang Yen town accounts for the rate (41.7%), the Eastern region accounted for 11.5%, the lowest



was the island district area (0.7%). The rate of DENV2 type in the Western region accounted for the highest with 39.1%, followed by the central region (33.7%), the lowest were the two island districts of Van Don and Co To (3.3%).

There was no difference in the distribution of DENV types by subjects ( $\leq 15$  age,  $> 15$  age, male, female) and by time, clinical classification, and occupational group.

The sensitivity of the NS1 antigen rapid test compared to the real-time PCR test was 93.19%, the specificity was 96.92%, the positive predictive value (PPV) was: 99.09%, the negative predictive value (NPV) was: 79.74%. The similarity of the results of the NS1 rapid test with the realtime PCR test in the diagnosis of Dengue virus infection according to the Cohen's Kappa coefficient of 0.836 shows that the NS1 antigen rapid test and the realtime PCR for Dengue virus serotype have a very high similarity.

## RECOMMENDATIONS

It is necessary to carry out DENV type testing from the beginning of the epidemic season on a large scale to contribute to the expected epidemic level of the year in the whole province. In addition, it is necessary to continue to monitor the circulation of the DENV type to come up with plans to prevent and control Dengue fever epidemics in the future.

- Patients with hematocrit index 35 - 45% account for the highest rate of 21/43 (48.8%); Next, hematocrit  $> 45\%$  accounted for 20/43 (46.6%).

- Patients with a reduced platelet index of 5 -  $< 50$  accounted for the highest proportion, 22/43 (51.2%), followed by 20/43 (46.5%) of patients with a reduced platelet index of 50 -  $< 150$  G/L; No patient had platelets  $< 5$  G/L.

- Patients with AST index 40 -  $< 400$  (U/L) accounted for the highest proportion in the study: 35/43 (81.4%), 2/43 (4.6%) patients had AST  $\geq 1000$  (U/L). Patients with ALT index 40 -  $< 400$  (U/L) accounted for the highest proportion in the

study, 30/43 (69.8%), 1/43 (2.3%) patients had AST  $\geq 1000$  (U/L/l).

- 100% of patients in the study were cured and discharged from the hospital, with no deaths, of which: Patients with DHF and DHF with warning signs accounted for the highest rate of 46.6%. There were 3 cases of severe dengue fever, accounting for 6.8%.

## RECOMMENDATION

Clinicians in Thai Nguyen province, Vietnam need to consider dengue fever and screen patients with acute fever symptoms, even if the patient did not travel out of the province before the illness. People living in the province, when they have a fever, need to immediately go to medical facilities to be screened for DHF.

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