

Report of the Survey on Emergency Care Service in Hanoi

As a final product of the DrPH Practicum 2023

Nagasaki University
Interfaculty Initiative in Planetary Health
Doctor of Public Health Program

September 2023
Nagasaki, Japan



Executive summary

Introduction:

The survey is conducted as part of the first-year Doctor of Public Health program at Interfaculty Initiative of Planetary Health, Nagasaki University with the aim to assess the determinants and deterrents of emergency healthcare services within the city leading to low survival rates in Out-of-Hospital Cardiac Arrest (OHCA). In Hanoi, Vietnam, rising cases of Non-Communicable Diseases (NCDs) and road traffic injuries have led to an alarming increase in emergencies. While mortality rates at health facilities are admirably low, the OHCA survival rates remain critically low at 3.8%.¹ Responding to this urgent need, Bach Mai Hospital, a major tertiary healthcare center, had sought support from Japan International Cooperation Agency (JICA) to renovate its emergency department. While physical improvements and infrastructure are crucial, other challenges like first aid, cardiopulmonary resuscitation, delayed ambulances and skill gaps in bystanders and healthcare workers require a more comprehensive approach. JICA in collaboration with Nagasaki University aims to analyze the situation from a multisectoral approach to design effective public health interventions to increase the survival rates for emergency care services in Hanoi.

Objective

1. To conduct systematic and multisectoral analysis of the emergency services in Hanoi
2. To recommend effective and pragmatic public health interventions to improve the patient's survival rate.

Methodology

The team conducted in-depth interviews and focus group discussions with the stakeholders in Hanoi after the literature review and the secondary data collection. The team also held meetings to discuss the possible solutions based on the findings.

Key Findings and Insights:

The Hanoi residents show commendable awareness and utilization of "115" emergency medical service (EMS), resulting in a substantial number of monthly calls for example in OHCA to the 115 EMS center. Moreover, there is a concern about the use of alternative emergency services, both public and private, indicating a misuse and inefficiency of service. However, there is a pressing need to address gaps in First Aid, Cardiopulmonary Resuscitation (CPR), and safety survival skills, along with the level of knowledge and practical application among residents, including in school and workplace settings. Current practices reveal a tendency towards over-utilization of emergency care at the highest level, underscoring the necessity for targeted interventions. Addressing misuse of the emergency call number, as well as preventing abuse and assault of EMS boarding crew, are vital areas requiring immediate attention. Furthermore, improving access to Automated External Defibrillators (AEDs) for bystanders in Hanoi remains a critical aspect of enhancing emergency response capabilities.

The 115 EMS service benefits from a well-defined regulatory framework, and recent legal amendments solidify the prehospital care system. Efficient resource utilization is evident with impressive response times. Internal knowledge

exchange fosters a culture of continuous learning. Ongoing education programs and the presence of private ambulance services enhance emergency response capabilities. However, addressing communication gaps between prehospital and in-hospital care, establishing a reliable fee collection system, and allocating additional resources are crucial areas for improvement. Implementing routine training courses, creating a legal framework for private service providers, and enhancing multiplayer collaboration on emergency scenes will further strengthen the prehospital care system.

The emergency healthcare system in Hanoi exhibits notable strengths, including effective communication channels for patient referrals and transfers, robust Continuing Medical Education (CME) opportunities, and high-quality emergency services at key hospitals. However, areas for improvement include the need for enhanced communication platform authorization, optimizing the role of lower-level and private hospitals, strengthening inter-sectoral communication, and expanding emergency care training in surrounding provinces. Establishing additional stroke satellite centers in existing facilities and improving internal patient flow within Bach Mai Hospital (BMH) are crucial steps toward further enhancing the healthcare system's capabilities in Hanoi.

Recommendations:

The recommendations encompass a multifaceted approach to enhance emergency care services in Hanoi. A pivotal step is to establish a central coordination mechanism that is led by the Ministry of Health. This coordination mechanism should be in collaboration with relevant stakeholders to drive harmonized actions. These are not limited to the ministry, department, institutions and associations, for education, fire, police, private, non-profit, media. The vision is to create an ideal emergency care system, where well-prepared bystanders, coordinated response, and well-equipped facilities converge for optimal patient outcomes.

Firstly, strengthening bystander capabilities through targeted behavior change campaigns and integrating safety skills into education, workplaces, and community programs forms a cornerstone. Secondly, establishing a digitalized coordination mechanism for seamless communication among stakeholders is crucial, expanding the network of pre-hospital providers and serving as intermediary between out of hospital care at the scene and during transport as well as in hospital care. Thirdly, developing the capacity and capability of lower-level hospitals, including the consideration of expanding licenses for ICU licensed doctors and continuous training, is imperative. Additional measures involve financial policy amendments, augmenting EMS resources, standardizing training, and strategic placement of life-saving equipment.

Next Steps:

The immediate priority lies in the establishment of the central coordination mechanism, an essential step led by the Ministry of Health in close collaboration with relevant stakeholders spanning various administrative levels and sectors. This mechanism will serve as the linchpin for streamlined coordination, information sharing, and concerted action among key players in emergency care services. Its implementation will pave the way for a more cohesive and effective system, ensuring optimal patient outcomes and enhancing the overall emergency care scenario in Hanoi.

Conclusion:

The survey findings indicate both strengths and areas for improvement in emergency care services in Hanoi. Implementation of the recommended strategies will lead to a more efficient and effective emergency care system, ultimately benefiting the residents of Hanoi.

Table of contents

Executive summary	2
Abbreviation	8
I. Introduction	10
II. Survey objectives	10
III. Methodology	10
IV. The landscape of the health system in Vietnam	11
1. Demography	11
2. Health governance	11
3. Health finance.....	14
4. Human resources for health.....	15
5. Health infrastructure, equipment, and medicine	17
6. Health service delivery	18
7. Health Information	20
8. The trend of mortality and morbidity	21
V. Findings	24
1. Situation under the WHO Emergency Care System Framework	24
1-1. WHO Emergency Care System Framework	24
1-2. Scene	25
1-3. Transport.....	27
1-4. Facility	32
1-5. Multisectoral collaboration.....	39
2. Health-System Diagnostic Tree	41
3. Possible solutions (PS)	42

3-1. Bystander role, awareness and capacity strengthening (Possible solution 1: PS1).....	42
3-2. Interoperable digitalized coordination mechanism for the emergency system in Hanoi (Possible solution 2: PS2) 44	
3-3. The capacity development on emergency care at the lower level of hospitals (Possible solution 3: PS3)	47
3-4. Other possible solutions	48
4. Key steps.....	49
4-1. To establish the central coordination mechanism for emergency care services, under the leadership of the MOH 49	
4-2. To conduct further research, survey, in-depth assessment and needs assessment for identified gaps	49
4-3. To start the intervention on a small scale first in Hanoi	50
5. Ideal situation of emergency care services in Hanoi.....	50
5-1. Scene	50
5-2. Transport.....	51
5-3. Facility	51
VI. Limitation	51
VII. Conclusion	52
Reference	53

List of tables

Table 1. The trend of health financing in Vietnam	14
Table 2. Trends in the number of health personnel ²	16
Table 3. Trends in the number of health personnel per 10,000 population ²	16
Table 4: Trends in the number of facilities and beds ²	17
Table 5. Trends in health service delivery ²	18
Table 6. Category of public health facilities	19
Table 7. National trend in the distribution of morbidity and mortality by disease chapters ²	21
Table 8: Leading cause of death in 1990 and 2017 ¹⁶	22
Table 9. The price for pre-hospital emergency care services attached to Decision No. 45/2017/QĐ – UBND ²³	28

Table 10. Resources for EMS, adapted the study in 2021 ²⁴	30
Table 11. Comparison of the number of populations per ambulance of Hanoi situation and International Standard	30

List of graphs

Graph 1. Comparison of the population between urban and rural in Hanoi (thousands) ²	11
Graph 2. Trends of GDP, expenditure of state budget, and total state budget for health.....	15
Graph 3. Trends of the health budget in state budget expenditure and GDP	15
Graph 4. Trends in the number of beds per 10,000 population ²	17
Graph 5. Trends in the proportion of mortality	23
Graph 6. Trends in the proportion of morbidity	23
Graph 7. Emergency Department volume 2018-2023.....	33
Graph 8. Provenance of patients admitted in the ED of BMH.....	33
Graph 9. Bed occupancy rate in the ED of BMH 2018-2022	34
Graph 10. Length of Stay (hours) in the ED of BMH: overall patients versus half of them.....	35
Graph 11. ED boarding time	35
Graph 12. Trend of in-hospital mortality in the ED of BMH.....	36
Graph 13. Stroke patients received at the Stroke Center of BMH.....	37

List of Figures

Figure 1. Outline of Vietnam Health System ⁴	12
Figure 2: WHO Emergency Care System Framework	24
Figure 3: Health- System Diagnostic Tree for the low survival rate of OHCA in Hanoi.	41
Figure 4: Access users.....	45
Figure 5. Ideal situation of emergency care service in Hanoi	50

List of boxes

Box 1. Representative articles of the regulation on emergency treatment, intensive care and poison control..	13
Box 2. Finding in Scene	27
Box 3. Finding in “Transport”.....	31
Box 4. Finding in “Facility”	38

Abbreviation

A9	Emergency Department at Bach Mai Hospital
AED	Automated External Defibrillator
AMS	Altered Mental Status
BMH	Bach Mai Hospital
CHC	Commune Health Center
CME	Continuing Medical Education
CPA	Cardiopulmonary Arrest
CPR	Cardiopulmonary Resuscitation
CPV	The Communist Party of Viet Nam
CSO	Civil Society Organization
COVID-19	Coronavirus Disease 2019
CT	Computed Tomography
DDH	Dong Da Hospital
DoH	Department of Health
ECMO	Extracorporeal Membrane Oxygenation
ECS	Emergency Care System
ED	Emergency Department
EHR	Electronic Health Record
EMS	Emergency Medical Service
EMT	Emergency Medical Technician
FGD	Focus Group Discussion
GDP	Gross Domestic Product
GoV	Government of Vietnam
HNH	Hong Ngoc Hospital
IEC	Information, Education and Communication
ICU	Intensive Care Unit
IDI	In-Depth Interview
JICA	Japan International Cooperation Agency
LMIC	Low- and Middle-Income Country
MI	Myocardial Infarction
MoH	Ministry of Health
NCD	Non-Communicable Disease
NGO	Non-Governmental Organization
NPO	Non-Profit Organization

OHCA	Out-of-Hospital Cardiac Arrest
PS	Possible Solution
RTI	Road Traffic Injury
SPH	Saint Paul Hospital
TTH	Thanh Tri Hospital
VND	Vietnamese Dong
VOV	Voice of Vietnam
WHO	World Health Organization

I. Introduction

In Hanoi, Vietnam, non-communicable diseases (NCDs) and road traffic injuries (RTIs) are driving the rise in the number of emergency cases. Yet, the patients' survival rate of Out-of-Hospital Cardiac arrest (OHCA) in emergency services is considered unacceptably low (3.8%).¹ Facing this challenge, Bach Mai Hospital (BMH), one of the tertiary hospitals in Hanoi with 1,900 beds, which receives 900,000 out-patients and 100,000 in-patients annually, requested Japan International Cooperation Agency (JICA) to support the renovation of the hospital's emergency department.

BMH indeed needs improvement, shown by crowded waiting rooms, long distance between the emergency ward and operation rooms, outdated equipment, etc. Thus, JICA considers that such renovation of physical structure and equipment may improve performance of emergency services.

However, it appears that there are also issues that cannot be solved by only renovating the emergency department, such as late arrival of ambulances due to heavy traffic, lack of skills among health workforce and bystanders, etc. It is unclear what policy, plan, or strategy the Vietnamese government has for strengthening emergency services. In sum, in order to better understand the emergency care system in Hanoi as a whole, JICA needed to analyze the problem from public health perspectives and design effective interventions.

II. Survey objectives

1. To conduct systematic and multisectoral analysis of the emergency services in Hanoi
2. To recommend effective and pragmatic public health interventions to improve the patient's survival rate.

III. Methodology

First, the relevant literature was reviewed by the category of the World Health Organization (WHO) Emergency Care System Framework such as scene, transport, and facility. (The Framework will be explained at V1.1-1) Also, some official documents such as the Health Statistic Yearbook of Vietnam, strategies, and plans were reviewed. Moreover, some secondary data was collected from the stakeholders.

The team stayed for three weeks in September 2023 in Hanoi to collect the data, conduct in-depth interviews (IDIs) and focus group discussions (FGDs), and have discussions on possible solutions with stakeholders. The IDIs were held at the Department of Medical Service Administration in the Ministry of Health, Department of Health under the Hanoi People's Committee, Emergency Department (ED), Stroke Center and Intensive Care Unit (ICU) at the BMH, 115 Emergency Medical Service (EMS) headquarters and the satellite station, Saint Paul Hospital (city hospital), Dong Da Hospital (city hospital), Thanh Tri Hospital (city hospital located sub-urban area), and Hong Ngoc Hospital (private hospital). The FGDs took place at BMH targeting patients' families and nurses working at ED and at 115 EMS headquarters and the satellite station targeting the EMS boarding crew. After developing the

possible solutions based on the findings, two meetings were held at BMH and 115 EMS headquarters to discuss the effectiveness and feasibility of the possible solutions.

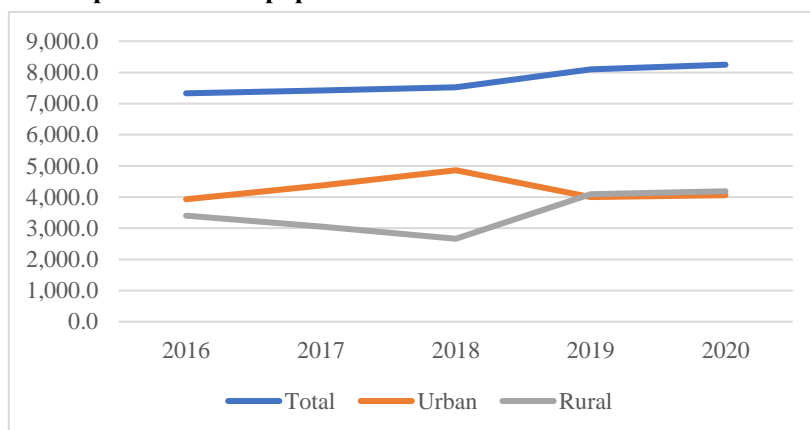
IV. The landscape of the health system in Vietnam

1. Demography

Urbanization has been progressing in Vietnam. The population growth rate was 1.15% in 2020, and the total population has been increasing; from 91,709,800 in 2015 to 97,582,700 in 2020.² The density also went up to 295 persons per km² in 2020. While the population growth rate in rural areas is less than 1 or even minus, that in urban areas achieved more than 6 in 2020. The population in urban areas increased by 36% in the past 10 years, and that in rural areas only by 2% in the same period. As a result, the ratio of urban to rural was 30.39% to 69.61% in 2010, and 36.82% to 63.18% in 2020.

Hanoi is capital city of Vietnam having the second-largest population of 8,246,500 and the second-highest density of 2,410 people per km² in the country.² Graph 1 shows the population in urban and rural area in Hanoi from 2016 to 2020. The urban population used to be higher than the rural one, but the rural population exceeded the urban one in 2019. 49.2% of the population lived in urban areas in 2020, which is higher than the national average of 36.8%.

Graph 1. Comparison of the population between urban and rural in Hanoi (thousands)²



2. Health governance

Vietnam's health system comprises four administrative levels of health establishments: central level, provincial level, district level, and commune level (Figure 1). At present, the public health care sector covers all levels from central to commune level. In terms of health service delivery, health facilities at district and commune level are categorized as primary level, those at province level as secondary level, and those under the central government as tertiary level.³

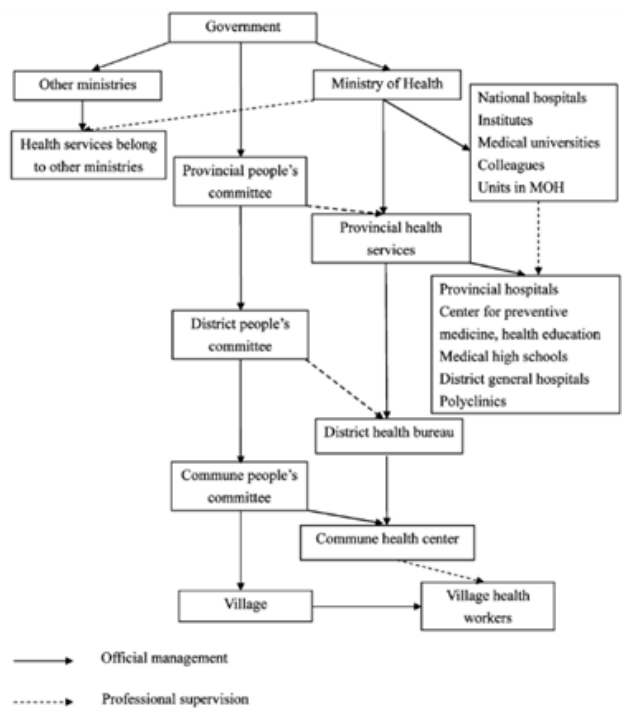
The Ministry of Health (MoH) of Vietnam, the governmental agency and the leading organization at the central level, is responsible for the care and protection of people's health including issuing law and other legal documents

for health care and protection. This organization also has duties in making long-term plans and strategies for the further development of the health sector.

Provincial, district, and commune health facilities are under the competence management of the MoH and responsible for the implementation and development of healthcare services in the corresponding level. In these levels, the people’s committee is responsible for allocating finance and human resources, while provincial or district health department is responsible for professional competence under the supervision by MoH. Provincial and district health departments also have duties in supporting people’s committee in corresponding level in terms of health care and protection for people.

Commune Health Centers (CHCs) provide a range of basic services, such as mother and child health care, family planning treatment for acute respiratory infections, immunization and treatment of common ailments. After the establishment of the health care system, an extensive network of CHCs has been structured throughout the country, based on population distribution and geographical condition.

Figure 1. Outline of Vietnam Health System⁴



According to the five-year socio-economic development plan 2015-2020, the Government of Vietnam (GoV) planned to achieve 9-10 doctors and more than 26.5 patient beds per 10,000 people and above 80% of health insurance coverage by 2020. Also, it set a primary objective of *sustainably develop culture, society, health care*

*base on close and harmonious connection between economic development and cultural development, strive for social. Advancement and equality and improve people's living standards.*⁵

As for the hierarchy of the authoritativeness of policy documents, constitution, legislation, law and decree are at the highest level of authority, rules and regulations at the middle level, and plans, strategies, guidelines, and standards at the lowest.⁶

In terms of emergency care services, the regulation on emergency treatment, intensive care, and poison control (Decision No. 01/2008/QD-BYT), defines the function, organization, facility, equipment, and human resources of extra-hospital emergency centers (115 EMS centers) and health facilities in the emergency system. Representative articles are shown in Box1.

Box 1. Representative articles of the regulation on emergency treatment, intensive care and poison control

Article 2.1. Emergency treatment, intensive care and poison control are extremely important missions that must be carried out by 1-1-5 emergency centers and healthcare facilities in any case.

Article 2.2 In any cases of emergency treatment, intensive care and poison control, health professionals shall expeditiously carry out the missions in order of priority. Causing difficulties in terms of administrative procedures and rejection of patients are forbidden.

Article 2.3. Healthcare facilities shall gather as much resources as possible in terms of human resources, equipment and facilities to provide emergency treatment, intensive care and poison control for patients.

Article 2.4. The emergency treatment, intensive care and poison control activities shall be maintained constantly 24 hours per day.

Article 3.1. 1-1-5 emergency centers shall be established in provinces and central-affiliated cities and are public service providers with revenues affiliated to the Departments of Health of provinces.

Article 4.1. 1-1-5 emergency centers provide extra-hospital emergency treatment for patients and transport the patients to the hospital for further treatment.

Article 4.4. In order to satisfy the needs of people, 1-1-5 emergency centers shall counsel the Ministry of Health and the Departments of Health of provinces to build and develop the extra-hospital emergency system.

Article 6.4. 1-1-5 emergency team transports the patient to the nearest medical facility that is suitable for his/her condition after contacting such facility for preparation.

Article 6.5.c) Medical examination and treatment facilities must not reject patients transferred by the 1-1-5 emergency team and are obliged to admit patients promptly.

Article 8.1.b) Emergency department conduct assessment and conduct triage and take appropriate emergency measures in the order of priority until the patient is no longer in critical condition; within 48 hours, the patient shall be transferred to the intensive care department or an appropriate specialty depending on his/her condition.

Article 8.1.dd) and e) Emergency department cooperates with the intensive care department in providing professional support for the emergency system in the specialties in hospital and also cooperates with 1-1-5 emergency centers in providing emergency care and emergency transport outside the hospital on request.

Article 8.1.g) Emergency department carry out scientific researche, hold consultations and provide propagation about emergency treatment for the community.

Article 12.1.1a) Departments in the same hospital shall cooperate together and stay prepared for receiving patients that are sent from the emergency department.

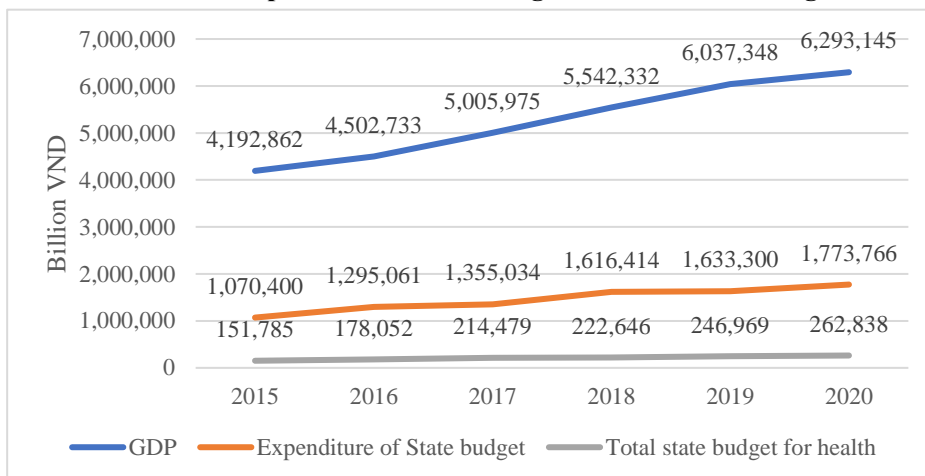
3. Health finance

According to the economic growth, the health budget has been steadily increasing in Vietnam. While Gross Domestic Product (GDP) increased by 50% in six years, from 4,192,862 billion Vietnamese Dong (VND) in 2015 to 6,293,145 billion VND in 2020, the expenditure of the state budget increased by 66% in the same period. The total state budget for health also increased from 151,785 billion in 2015 to 262,838 in 2020 by 73%. (Table 1 and Graph 2.) The proportion of the health budget in state budget expenditure fluctuated between 13.8% and 15.8% and the proportion of the health budget in GDP slightly increased from 3.62% to 4.18%. (Table 1. and Graph 3.) While GDP per capita increased by 41%, the health budget per capita increased by 37.8%. (Table 1)²

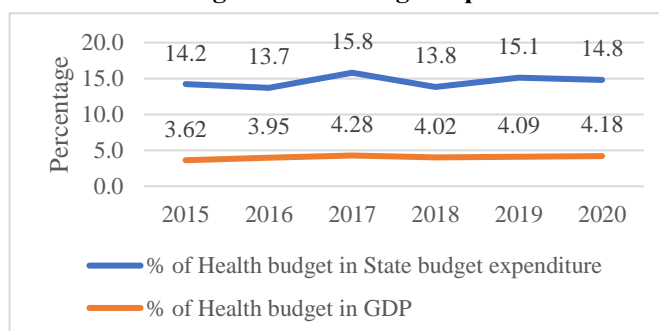
Table 1. The trend of health financing in Vietnam

	2015	2016	2017	2018	2019	2020
Population (1000)	91,709.8	92,695.1	93677.6	94666	96,484.0	97,582.7
GDP (Billion VND)	4,192,862	4,502,733	5,005,975	5,542,332	6,037,348	6,293,145
GDP per capita (1000VND)	45,719	48,576	53,442	58,546	62,574	64,490
GDP per capita (USD)	2,109	2,215	2,389	2,590	2,714	2,779
Expenditure of state budget (Billion VND)	1,070,400	1,295,061	1,355,034	1,616,414	1,633,300	1,773,766
Total state budget for health (Billion VND)	151,785	178,052	214,479	222,646	246,969	262,838
% of health budget in GDP	3.62%	3.95%	4.28%	4.02%	4.09%	4.18%
% of health budget in state budget expenditure	14.2%	13.7%	15.8%	13.8%	15.1%	14.8%
Health budget per capita (1000VND)	1655.0	1920.8	2289.5	2351.9	2223.0	2281.6

Graph 2. Trends of GDP, expenditure of state budget, and total state budget for health



Graph 3. Trends of the health budget in state budget expenditure and GDP



In 1992, the GoV shifted from a tax-based system to a social health insurance to cover some health services in public health facilities.⁷ More than 90 % of people participate in health insurance; showing a steady increase from 81.8% in 2016 to 90.85% in 2020.² Out-of-pocket payment for health is around 41% of total health expenditure in 2016. The tax revenues are used to subsidize vulnerable people such as the poor, ethnic minorities, children and the elderly.⁸

4. Human resources for health

The total number of medical doctors increased by 2% from 2016 to 2020, and that of pharmacists was stable. While graduates in public health significantly increased by 52%, the number of assistant doctors decreased by 16% (Table 2). The number of doctors per 10,000 population has been steadily increasing from 8.6 in 2016 to 9,8 in 2020, which achieved the government target in 2020 (9.0) and is approaching the target in 2025 (10.0). On the other hand,

the number of pharmacists per 10,000 population has been decreasing; from 2.96 in 2016 to 2.85 in 2020 although it has already achieved the 2025 target (2.8). (Table 3)

Although the number of doctors increased, this does not meet the WHO threshold. WHO defines the indicative SDG index threshold as 4.45 doctors, nurses, and midwives per 1,000 population.⁹ According to the World Health Statistics 2023, the density of medical doctors in Vietnam between 2013-2021 was 8.3 per 10,000 population and the density of nursing and midwifery personnel was 14.5 per 10,000 population.¹⁰

Table 2. Trends in the number of health personnel²

Categories	2016	2017	2018	2019	2020
Total	471,702	470,535	472,558	475,100	482,975
1. Medical doctors and higher	79,306	80,413	82,043	87,433	95,745
2. Pharmacists and higher	27,473	27,493	27,540	27,776	27,770
3. Bachelor of public health and higher	2,248	2,595	2,960	3,431	3,413
4. Assistant doctors	53,558	50,160	47,614	44,794	44,794
5. Hight degree nurses	12,467	14,771	16,963	16,963	16,963
6. Medical technicians	18,671	19,238	19,692	21,087	20,659
7. Assistant pharmacists & 2nd degree pharm. technicians	70,340	70,340	70,340	70,340	70,340
8. 2nd degree nurses	88,582	88,485	88,868	88,868	88,868
9. Bachelor & 2nd degree midwives	27,676	27,836	27,383	27,531	27,531
10. Elementary nurses	3,434	2,843	2,282	515	530
11. Elementary midwives	546	433	349	11,439	11,439
12. Traditional medicine practitioners	210	185	162	1,666	1,666
13. Elementary pharmacists	11,439	11,439	11,439	27,169	27,169
14. Other bachelor degrees and over	25,764	27,972	28,835	27,972	27,972
15. Other 2nd degree level	12,598	12,445	11,704	12,445	11,704
16. Others	37,390	33,887	34,384	33,887	34,384

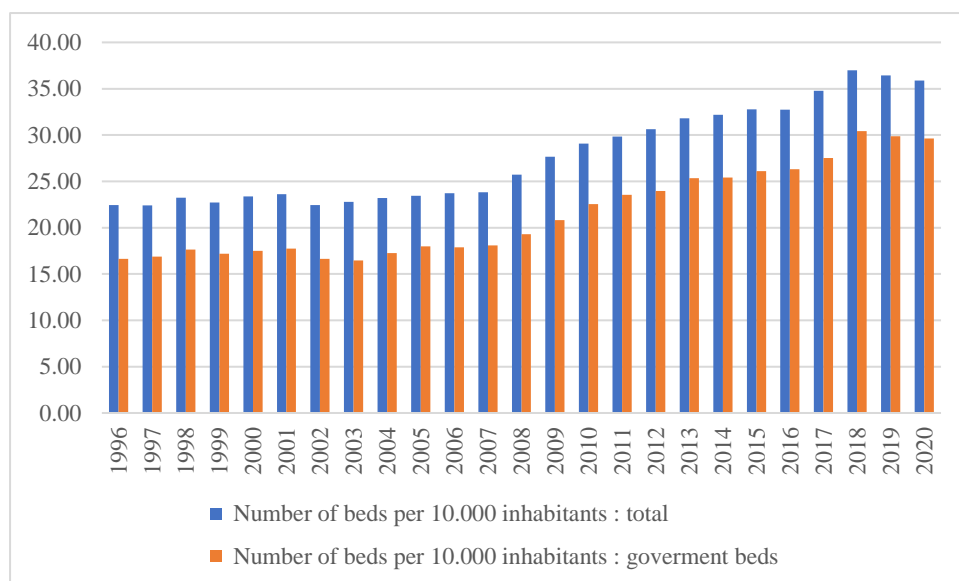
Table 3. Trends in the number of health personnel per 10,000 population²

	2016	2017	2018	2019	2020	Target to 2020	Target to 2025
1. Medical Doctors	8.56	8.58	8.70	9.06	9.81	9.00	10.00
2. Pharmacists	2.96	2.93	2.91	2.88	2.85	2.20	2.80
3. Nurses	11.30	11.32	11.42	11.02	10.89	-	-

5. Health infrastructure, equipment, and medicine

The number of beds drastically increased in Vietnam for the last quarter of a century. The number doubled; from 164,199 beds in 1996 to 350,068 beds in 2020. The number of beds per 10,000 population also went up by 60%. (Graph 4)

Graph 4. Trends in the number of beds per 10,000 population²



The number of health facilities both public and private decreased from 2016 to 2020. However, the number of beds in the public sector increased by 13% and that in private by 75%. (Table 4.)

Table 4: Trends in the number of facilities and beds²

	2016		2020	
	Facilities	Beds	Facilities	Beds
Total	13,638	303,515	13,544	350,068
Government section (a. + b. + c.)	13,407	291,447	13,316	328,946
a. Central level	47	31,436	47	31,436
General Hospitals	20	20,681	20	20,681
Special Hospitals	20	8,825	20	8,825
Traditional Medicine Hospitals	3	840	3	840
Leprosarium	3	800	3	800
Sanatoriums, Rehabilitation	1	290	1	290
b. Local level	12,605	253,781	12,514	288,455
<u>Provincial level</u>	471	122,361	462	143,437
General Hospitals	165	83,385	162	94,244

Special Hospitals	160	25,790	177	34,500
Traditional Medicine Hospital	54	7,960	57	9,605
Leprosarium	19	1,095	20	1,260
Sanatoriums, Rehabilitation	32	3,180	27	3,430
Special Clinics	41	951	19	398
<u>District level</u>	1,034	83,863	952	104,226
General Hospitals	679	79,644	712	99,766
Inter-Communal Polyclinics	351	4,184	236	4,440
Maternity Homes	4	35	4	20
<u>Communal level</u>	11,100	47,557	11,100	40,792
Communal Health Stations	11,100	47,557	11,100	40,792
c. Other branches	755	6,230	755	9,055
General Hospitals	22	3,320	22	4,090
Polyclinics	7	320	7	320
Sanatoriums	11	1,360	11	2,880
Health Centers	5	1,230	5	1,765
Health Stations of other branches	710		710	
Private hospital	231	12,068	228	21,122

6. Health service delivery

The numbers of consultation for inpatients and outpatients were fluctuating from 2016 to 2020. While the number of beds increased by 15%, the bed occupancy rate increased from 117.37% to 129.00%. The number of operations increased from 2016 to 2019 and dropped in 2020.² (Table 5)

Table 5. Trends in health service delivery²

	2016	2017	2018	2019	2020
1. Number of consultations	229,775,745	215,586,657	204,372,579	219,624,440	208,236,965
2. Number of inpatients	15,340,526	16,058,464	15,361,698	16,797,632	16,185,034
3. Number of outpatients	21,152,775	21,763,055	27,890,322	27,965,255	21,763,055
4. Total of inpatient days	102,622,325	107,658,762*	93,726,110	107,658,762*	107,658,762*
5. Bed occupancy rate (%)	117.37	6.70*	1.39*	125.17	129.00
6. Average bed day used by inpatient	6.69	116.42*	117.87*	6.41	6.65
7. Average consultation times per capita	2.48	2.30	2.16	2.28	2.13
8. Total number of operations	2,874,425	3,080,737	3,510,005	3,789,575	3,296,918
9. Average operations per inpatient	0.19	0.19	0.21	0.23	0.20

*Anomalies

The GoV categorize public health facilities as follows;

- i. Type – This is defined by the Article 81 of the Law on Medical Examination and Treatment 2009 and describes the nature of health facilities
- ii. Management level – Is the traditionally defined three supervisory organizations;
 - a. Ministry of Health, other ministries, and the Department of Health (DoH) of the People’s Committee of each province. While central hospitals are managed by MoH, provincial hospitals, district hospitals, and CHC by DoH.
- iii. Grade – This is used for quality improvement and is based on the evaluation scored by accrediting bodies according to various factors such as roles and duties, medical service provided, number of beds, number of medical staff, and available equipment. Health facilities with Grade S need to meet the criteria listed in Appendix 1.3 of Circular No.23/2005/BYT and are accredited by the Ministry of Internal Affairs. Those with Grade 1 or 2 need to meet the criteria of the conditions such as the nurses-inpatient rate listed in Appendix 1.b.4 of the same Circular and are accredited by MoH
- iv. Technical level – This is determined by both the management level and grade and divided into central level, provincial level, district level, and commune level, which is used for referral purposes including emergency cases. This is unique because provincial hospitals with different grades exist
- v. Financial autonomy level This is divided into four groups based on the self-burden rate for general expense and capital expenditure, which means how much the facilities cover their expense from their own revenue. Unlike other classifications, medical institutions can apply for the financial autonomy level by themselves. (Table 6).¹¹

Table 6. Category of public health facilities

Category	Classification	Levels
i. Type	Based on Article 81 of the Law on Medical Examination and Treatment 2009	<ul style="list-style-type: none"> - Hospital - Health checkup center - General clinic - Special clinic - Home doctor - Traditional medicine hospital - Health center - Maternity home - Sanatorium - Other
ii. Management level	Traditionally defined	<ul style="list-style-type: none"> - MoH (central level) - Other ministries - DoH (provincial level)

iii. Grade	Based on the evaluation scored by the function of the facility and availability of human resources and equipment	<ul style="list-style-type: none"> - Grade S - Grade 1 - Grade 2 - Grade 3 - Grade 4
iv. Technical level	Based on the level of management (ii) and facility grade (iii)	<ul style="list-style-type: none"> - Central - Provincial - District - CHC
v. Financial autonomy level	Based on the self-burden rate for general expense and capital expenditure.	<ul style="list-style-type: none"> - Level 1 - Level 2 - Level 3 - Level 4

Pre-hospital emergency care services

System 115 EMS Center is the unit in the public sector that has adequate functions to provide emergency transport as defined by WHO, which stated in the Decision on promulgation of regulation on emergency treatment, intensive care, and poison control No. 01/2009/QD-BYT “provide pre-hospital emergency care for patients and transport the patients to hospital for further treatment”. Most provinces set up 115 EMS centers but diverse and different types of organizational forms, some independent centers and some integrated 115 centers into the Provincial General Hospital. Several provinces have not yet established 115 centers, but there are private units providing pre-hospital care services.

7. Health Information

In 2020, the GoV announced the National Digital Transformation Programme by 2025 with a vision towards 2030 (Decision No.749/QD-TTg).¹² This programme includes online work records at all governmental administrative levels and an online national database including those for population, land, business registration, finance and insurance.

Digitalization has been progressing in the health sector. MoH has applied information technology to health administration and management for all 63 provinces and cities.¹³ The set-up of the Electronic Health Records (EHRs) system was discussed at the 6th meeting of the 12th Central Committee on the Enhancement of Citizens’ Health Protection, improvement, and care in new situation in 2017¹⁴, and EHRs have been introduced nationwide from July 2019.¹⁵ Moreover, the plan to promote the development and use of digital health platforms (Decision No.2955/QD-BYT) was approved in 2022.

8. The trend of mortality and morbidity

A steady increase has been seen in life expectancy at birth; 73.4 years in 2016 and 73.7 years in 2020.² Table 6 shows the national trend in the distribution of morbidity and mortality by disease chapter.

Table 7. National trend in the distribution of morbidity and mortality by disease chapters²

Disease chapters	Cases					Deaths				
	2016	2017	2018	2019	2020	2016	2017	2018	2019	2020
1. Certain infectious and parasitic diseases	9.02	8.12	7.89	9.25	6.60	0.02*	8.37	7.71	16.59	11.37
2. Neoplasm	3.76	4.13	3.80	3.05	3.60	0.00*	3.22	3.96	0.73	0.90
3. Diseases of blood and blood-forming organ and disorders involving the immune mechanism	0.62	0.63	0.72	0.72	0.69	0.00*	0.35	0.60	0.58	0.89
4. Endocrine, nutritional and metabolic diseases	2.44	1.91	2.12	1.82	2.81	0.00*	1.59	2.99	0.29	0.66
5. Mental and behavioral disorders	0.81	0.74	0.95	0.98	1.42	0.00*	0.38	0.74	0.37	0.09
6. Diseases of the nervous system	2.43	2.24	2.42	2.32	2.93	0.00*	1.08	4.94	4.55	1.08
7. Diseases of the eye and adnexa	2.85	2.83	3.28	2.24	2.28	0.00*	0.05	0.07	0.08	0.83
8. Diseases of the ear and mastoid process	1.94	1.90	2.19	2.58	2.56	0.00*	0.02	2.87	0.71	0.96
9. Diseases of the circulatory system	10.13	9.14	9.60	9.14	10.32	0.03*	22.64	22.32	8.38*	7.89*
10. Diseases of the respiratory system	17.3	16.26	16.35	17.57	14.57	0.02*	11.97	11.01	23.34*	32.94*
11. Diseases of the digestive system	9.47	15.74	10.04	9.93	10.29	0.00*	3.51	6.03	4.68	13.37
12. Diseases of skin and subcutaneous tissue	1.41	1.29	1.54	1.67	1.72	0.00*	0.38	0.06	0.68	2.16
13. Diseases of the muscular system and connective tissue	4.56	4.23	5.41	5.62	6.38	0.00*	0.87	4.27	11.62	3.10
14. Diseases of the genitourinary system	4.36	4.14	5.94	4.93	5.84	0.00*	1.80	0.80	0.84	4.43
15. Pregnancy, childbirth and the puerperium	11.05	10.27	10.25	9.23	7.81	0.00*	7.79	0.41	1.42	0.88
16. Certain conditions originating in the perinatal period	1.66	1.61	2.16	1.63	1.98	0.01*	9.73	9.22	3.17	2.71

17. Congenital malformations, deformation and chromosomal abnormalities	0.45	0.39	0.57	0.43	0.88	0.00*	2.33	2.01	0.36	0.88
18. Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	2.5	2.30	2.65	3.79	3.60	0.01*	6.87	8.33	10.06	4.53
19. Injury, poisoning and certain other consequences of external causes	8.24	8.98	8.65	9.19	9.98	0.03*	13.65	9.30	9.76	7.43
20. External causes of morbidity and mortality	1.51	1.17	1.11	0.98	1.30	0.01*	1.75	2.15	1.52	1.40
21. Person encountering health services for examination and investigation	3.48	1.96	2.37	2.91	2.44	0.00*	1.67	0.22	0.26	1.49

* Anomalies

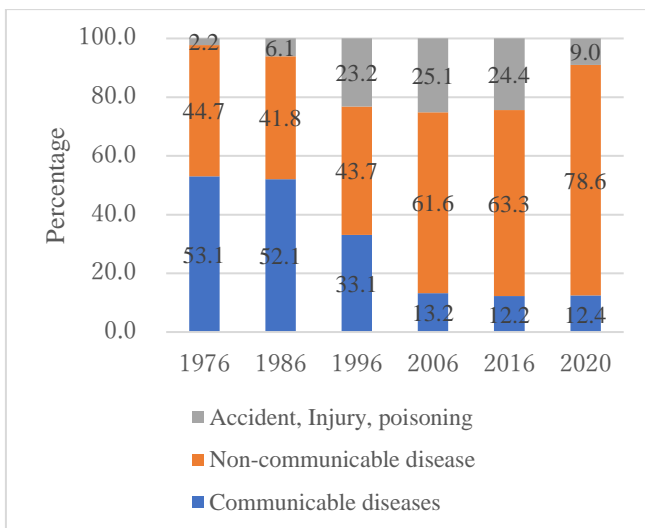
In the 1990s, while Vietnam was experiencing an epidemiological transition, the top causes of death included the communicable diseases, such as lower respiratory infections, childhood diseases preventable by vaccine, tuberculosis, and the non-communicable diseases (NCDs), like hemorrhagic and other non-ischemic diseases. In 2017, NCDs became preponderant among the top ten causes of mortality. This included stroke, ischemic heart disease, lung cancer, diabetes. Road injuries also became a leading causes of death in 2017.¹⁶ (Table 7)

Table 8: Leading cause of death in 1990 and 2017¹⁶

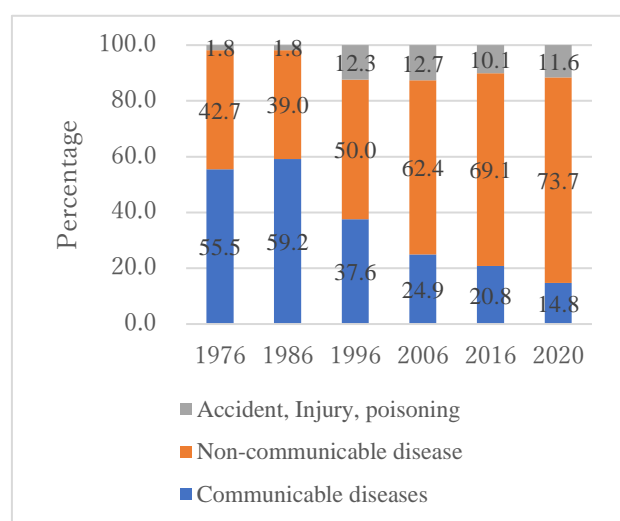
1990	2017
Lower respiratory infection	Stroke
Haemorrhagic and other non-ischaemic disease	Ischaemic heart disease
Preterm birth complications	Lung cancer
Congenital anomalies	Chronic obstructive pulmonary disease
Childhood diseases preventable by vaccine (Diphtheria, Pertussis, and Tetanus, measles, chicken pox)	Alzheimer's disease
Tuberculosis	Diabetes
Diarrhea	Liver cirrhosis
Drowning	Road injuries
Iron-deficiency anaemia	Lower respiratory infections
Unipolar depressive disorders	Tuberculosis

The trend in the proportion of morbidity and mortality showed an increasing proportion of NCDs over more than three decades in Vietnam, compared to a stable proportion of accidents, injury, and poisoning and a decreasing proportion of communicable diseases.² (Graph 5 and Graph 6)

Graph 5. Trends in the proportion of mortality



Graph 6. Trends in the proportion of morbidity



A multicenter retrospective study on admitted patients to critical care units in primary and secondary hospitals in Vietnam in 2018 found that the in-hospital mortality rate increased with age, from 2.8% in the under five years old age group to 23.1% in the over 90-year age group.¹⁷ The diseases of the respiratory system were the leading causes of death (21.8% of all deaths) and the diagnosis of sepsis was associated with the highest in-hospital mortality (36.8%).¹⁷ The National Health Statistics showed that the leading causes of death in 2020 were the respiratory system diseases, mainly pneumonia with the COVID-19 pandemic, the digestive system diseases (including infectious diseases), conduction disorders and cardiac arrhythmias, other viral diseases, dorsopathies, glomerular diseases, acute myocardial infarction.²

One of the critical reasons for death is OHCA. A multi-center observational study of patients presenting with OHCA to one of five tertiary care hospital emergency departments in Hanoi from 2017 to 2019 found a low survival rate after OHCA, with 3.8% of patients surviving hospital discharge.¹ This OHCA survivability was significantly affected by bystander care at the scene and the emergency medical services providing prehospital care and transport.

V. Findings

1. Situation under the WHO Emergency Care System Framework

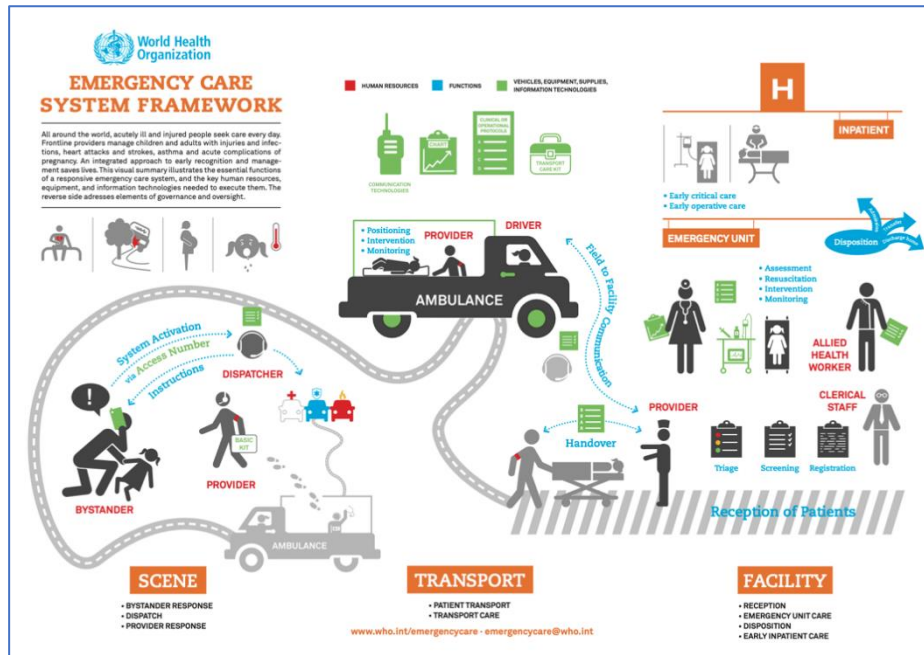
1-1. WHO Emergency Care System Framework

WHO Emergency Care System Framework is designed for policymakers to assess national emergency care systems. (Figure 2) The Framework shows essential emergency care functions at the scene of injury or illness, during transport, and through to emergency unit and early inpatient care at facility.¹⁸ “Scene” refers to the location where an emergency has occurred. This could be a variety of places, such as home, a public area, a workplace, or a roadway. It's the environment in which first responders, that are bystanders and emergency care providers operate to assess and treat patients. “Transport” refers to the basic transfer of emergency patients from the scene to a hospital-based care and first aid, initial resuscitation, and care of the patients by health professionals at the scene and throughout the transport process. “Facility” refers to the place where emergency patients are received for the treatments. The facilities provide assessment, resuscitation, intervention, and monitoring for emergency patients.

In Figure 2 below is the continuum of emergency care. It starts from the scene as provided by bystander (bystander care). A bystander communicates with the dispatch team. EMS boarding crew, who receive information from dispatch team, provides care during transport, and communicates with facility (hospital-based emergency department care). The care will be continued at ICU and/or general wards, outpatient, and at home afterward. Varied resources and personnel play an early and critical role within the continuum of emergency care.

Through the analysis, multisectoral collaboration is realized the indispensable part of emergency care system, as described in the section 1-5.

Figure 2: WHO Emergency Care System Framework



1-2. Scene

Growing congestion on Vietnam’s roads poses challenge to emergency service activities, especially in big cities such as Ho Chi Minh City and Hanoi where traffic congestion is a major hindrance to a swift response to incidents. The exponential growing number of motorcycles, especially scooters (1.5 million), bicycles, buses, trucks and cars amidst discrepancy in adherence to road rules, contribute to the road congestion and traffic.¹⁹ Hanoi is a mono centric fast-growing metropolis with a population density of 2,300 people per square kilometer.²⁰ Some homes are in obscure locations with alleys that are difficult to access and identify, posing a challenge for bystanders to describe as well as for dispatchers and EMS staff to locate. Often some scenes threaten the EMS boarding crew as there have been reports of mob action and attacks on them. A key informant during interview stated, “There is no installation of AED at designated areas in Hanoi accessible to the public, only those with EMS”.

At the scene the people other than the emergency medical team that observe or witness the emergency but are not necessarily involved in it are referred to as bystanders. In Hanoi, there is popularity of the emergency numbers 111 (child support), 112 (emergency rescue), 113 (police), 114 (fire) and 115 (ambulance). A key informant said that *“For 115 specifically, about 150 - 200 calls for Out of Hospital Cardiac Arrest (OHCA)/month were received”*. The 115 is managed by the Hanoi People’s Committee Department of Health and is established as a prehospital service. Currently, developing the pre-hospital care system is the government’s concern and future investment direction. By 2023, priority investment in the pre-hospital emergency system has been mentioned in the amendment of the Law on Medical Examination and Treatment No. 15/2023/QH15 dated 9th January 2023. Apart from 115 EMS Center, there are more than 10 private ambulance service providers with nearly 300 ambulances in Hanoi. This is also considered a foundational element in addition to 115 EMS Center to develop a pre-hospital emergency care system in Hanoi. Although the guideline that provides a legal framework for the pre-hospital care system has been establishing, it prescribes care at the scene and during transport, defines the roles of the Emergency Medical Team (see box 3 below) but the role of the bystander is not clearly defined in the draft of guideline.

While there are guidelines for First aid training of **staff at workplace** at recruitment and retraining every year, knowledge and skills on fire prevention, firefighting and rescue for **students in educational institutions**, and **teachers** on common injury in children and adults. Utilization of the emergency care service shows gap as follows.

Bystanders call for multiple emergency services including those from commercial vehicles, motorbikes as well as alternative medical service providers from private and public facilities (health and ambulance) most of which offer transport service with or without prehospital care service (during transport care). There are reports on abuse of the service; prank calls, assault staff, not paying for service. Also, there are several learning and training opportunities for the public at school, workplace to community and teachers, provided by public, private and Non-Governmental Organization (NGO)/ Civil Society Organization (CSO)/ Non-Profit Organization (NPO). According to key informant interviews and focused group discussions, *“There were reports of first responders not providing first aid or when provided it was poorly done and often caused more harm to the patient in need of emergency care”*. This supports the finding of a systematic review on OHCA reporting low CPR given by bystander (8.4%)¹ and RTI study with less than half of the patients receiving first aid (48.1%).²¹ Bystanders often prefer the highest level of care given that perception of bystanders and trust in the quality of care at lower level of care is very low. This affects their health seeking behavior especially with regards to where care is sought resulting in overcrowding at higher level of care, even when they are far from scene and underutilization of lower level of care contributing to lesser survival rate.

In addition, the emergency system needs inter-sectoral coordination because at the scene, close coordination with the fire and police forces is essential to help reduce emergency response time in some special situations such as disaster emergencies or not being able to reach patients while they are alone. In addition, strengthening

interdisciplinary coordination also ensures the safety of EMS boarding crews when performing tasks at the scene with aggressive family members having violent behaviors. According to EMS boarding crew members of the 115 Center, *"sometimes performing tasks in the middle of the night is very dangerous for female EMS workers as well as sometimes encountering situations where patients' families lose their temper and have violent behaviours"* (FDG with 115 EMS boarding crews)

Box 2. Finding in Scene

Success	Opportunity for improvement
<ul style="list-style-type: none"> • Bystanders aware of and utilize “115” services: 150-200 calls for OHCA/month to the 115 center • Utilize alternative emergency services (Public and Private) • Aware of stroke risk, how and where to access care • Existing first aid training provided by NGO, public and private organizations to the public • Regulation: for example <ul style="list-style-type: none"> ○ Responsibility of the individual, agency or organization when the accident occurs. Law 23/2008/qh12 ○ First Aid Training for staff at workplace Circular (2016) 19/2016/TT-BYT ○ Knowledge and skills on fire prevention, firefighting and rescue for students in educational institutions Circular (2022) 06/2022/TT-BGDDT ○ Teachers to common injury in children and adults Decision (2023) 966/QD-BGDDT 	<ul style="list-style-type: none"> • Necessity for addressing gaps in First aid, CPR & safety survival skills and level of knowledge and practice of residents including school settings and workplace: acquired skills are not always practiced in emergency settings, and no guidelines for the responsibilities of bystanders • Need to address bystander preference leading to over-utilization of emergency care at the highest level • Need to address misuse or abuse of emergency call number • Need to stop abuse and assault of EMS boarding crew • Poor access and unavailability of AEDs to bystanders in Hanoi

1-3. Transport

Overview of 115 EMS Service in Hanoi

According to the IDI and FGD, the Hanoi 115 Emergency Medical Service Center (115 EMS Center) is under the supervision of the Hanoi Department of Health. It was established in 1975 and provides emergency services to the entire city, following the French ambulance service model that is manned by doctors and nurses. When receiving an emergency case, the 115-call center will dispatch ambulances and an EMS boarding crew including one driver, one doctor, and one nurse from one of the main center and seven satellite stations which are nearest the scene. The EMS physicians and nurses solely give care in ambulances and do not work for hospitals; the center and dispatch centers are also independent of hospitals.

The 115 Hanoi EMS Center has the dispatching coordination department with nine staff divided into three swift-work groups, 15 active ambulances with EMS boarding crew including 46 physicians/ physician assistants, 44 nurses and 45 drivers to provide pre-hospital care for more than 8 million citizens in Hanoi. Despite many resource limitations, 115 EMS center has allocated resources very effectively. According to the IDI, the average response time of an emergency case is 10 minutes from emergency need notification to the scene and 27 minutes to the hospital. It is not too long in comparison to close-by countries (the average time to the scene: 11.8 minutes in Bangkok, Thailand; 22.5 minutes in Kuala Lumpur, Malaysia), and even shorter than the total time of transportation of the emergency care system in Japan (42.8 minutes).²²

Having the above success is because 115 EMS staff are relatively well-trained despite being limited in number. They have the opportunity to access Continuous Medical Education (CME) on emergency medicine organized by national hospitals. In addition, 115 EMS center also focuses on regular professional exchange activities to proactively update information and knowledge in the emergency care field for its staff.

In the future, the human resource of 115 EMS Center will be strengthened, when in 2023, the University of Medicine and Pharmacy, Hanoi National University established the faculty of pre-hospital care and is in the process of development of Emergency Medical Technician (EMT) education program. The program is expected to be provided for pre-hospital care units with specially trained human resources for the out-of-hospital emergency system, ensuring the maintenance of stable pre-hospital care workforce.

Besides successes, the pre-hospital emergency system for patient transportation still has gaps and opportunities for improvement. Through the findings of group discussions and interviews with doctors and nurses working at ED off hospitals and 115 EMS boarding crews, the lack of close cooperation between the pre- and in-hospital emergency care systems needs to be thoroughly resolved. Doctors and nurses at EDs pointed out they did not receive any prior notice from the 115 EMS center when transporting patients to them, leading to a shortage in preparation including hospital beds, medicine, and equipment. It also causes overcrowding situation in receiving hospitals when these run out of beds, while they cannot refuse patients according to the Law on Examination and Treatment (No.40/2009/QH12). In contrast, the 115 EMS center reported that they used to make notifications before transferring patients, but most hospitals did not receive calls because medical staff were too busy with professional activities and did not have specialized staff for this duty. Another reason they do not notify in advance is that they have ever received refusals from hospitals in case of prior notice and it takes a lot of time to seek a receiving hospital. To overcome this, it is necessary to establish an effective communication channel between the pre- and in-hospital emergency units so that patient care can be transferred seamlessly between relevant parties.

Table 9. The price for pre-hospital emergency care services attached to Decision No. 45/2017/QĐ – UBND²³

No.	Content	Price (VND)		
		2018	2019	2020

1	Distance ≤ 5 km			
	On-site emergency care and do not transfer to hospital	192,500	288,750	469,000
	On-site emergency care and transport of patients to the hospital	275,000	412,500	670,000
2	Distance from: >5 – 10km			
	On-site emergency care and do not transfer to hospital	213,500	320,250	504,000
	On-site emergency care and transport of patients to the hospital	305,000	457,500	720,000
3	Distance from: 11 – 20 km			
	On-site emergency care and do not transfer to hospital	248,500	372,750	581,000
	On-site emergency care and transport of patients to the hospital	355,000	532,500	830,000
4	Distance from: 21 – 30 km			
	On-site emergency care and do not transfer to hospital	294,000	441,000	665,000
	On-site emergency care and transport of patients to the hospital	420,000	630,000	950,000
5	Distance from: 31- 50km			
	On-site emergency care and do not transfer to hospital	360,500	540,750	805,000
	On-site emergency care and transport of patients to the hospital	515,000	772,500	1,150,000
6	Distance from: 51 - 100km			
	On-site emergency care and do not transfer to hospital	525,000	787,500	1,120,000
	On-site emergency care and transport of patients to the hospital	750,000	1,125,000	1,600,000

Another issue that needs to be addressed is the fee collection mechanism for pre-hospital emergency services. The 115 EMS center is a medical service unit having revenue and price lists for pre-hospital emergency services as stated by Decision No. 45/2017/QĐ – UBND of the Hanoi People’s Committee (Table 8).²³ Currently, pre-hospital care services are not covered by health insurance, nor are they subsidized by the state budget. This raises many problems. Firstly, on the patient side, especially for poor or low-income households, the fee mentioned in Table 9 is beyond their affordability and the family's personal means of transportation would be a reasonable substitution or a less expensive means of transportation is a taxi with an average fee of 7,500 - 9,500 VND/km. This greatly affects the patient's health condition when not initially treated and given emergency care at the scene as well as during transportation by health professionals. Secondly, on the service provider side, the lack of a payment support mechanism leads to difficulties in collecting fees for some cases such as patients are unable to pay, patient has already died or are transferred by other means. This case accounts for 33% of emergency visits according to the report from Thanh Tri satellite station. This leads to a financial shortage to operate the center as well as to invest in infrastructure improvement. Thus, it is necessary to establish an appropriate financial mechanism for the pre-hospital emergency care service to further develop as well as ensure social security.

Although the Hanoi 115 EMS center is a standard pre-hospital care unit in the emergency medical system in Hanoi, the capacity to meet emergency needs in Hanoi only reaches 10% according to the director. The main reason is because of limited resources. The shortage in the number of specialized vehicles qualified to perform pre-hospital

care functions and emergency medical workers at Hanoi 115 EMS center directly affects the operation and quality of pre-hospital emergency care services.

Table 10. Resources for EMS, adapted the study in 2021²⁴

Year	2013	2014	2015	2016	2017	2018	2022
Population in Hanoi	7,164,200	7,265,600	7,390,900	7,522,600	7,739,400	7,832,200	8,435,650
Number of EMS stations	5	5	5	5	5	5	8
Number of ambulances	23	23	22	22	19	19	30
Number of EMS physicians	52	49	44	52	48	43	46
Number of EMS nurses	68	67	66	64	61	65	53
Ambulances/100,000 inhabitants	0.32	0.32	0.3	0.29	0.25	0.24	0.36
Transported patients/100,000 population	256.9	280.4	281.8	293.9	336.0	342.3	426.8

In the period from 2013 to 2022, the availability of EMS resources in Hanoi evolved, as indicated by data from a 2021²⁴ study and the 115 EMS center (Table 9). Notably, the number of ambulances increased from 23 to 30, while the number of physicians decreased from 52 to 46, and the number of nurses declined from 68 to 53. Over the same period, Hanoi's population grew by approximately 17.7%, from 7.2 million to 8.4 million. Consequently, the ambulance-to-population ratio increased by 12.5%, from 0.32 to 0.36 per 100,000 people. However, the demand for EMS services also rose, with the number of transported patients per 100,000 people increasing by 66.1%, from 257 to 427.

Table 11. Comparison of the number of populations per ambulance of Hanoi situation and International Standard

Comparison	Number of populations per ambulance
Hanoi's formal EMS resource ^(*)	1/562,376
World Bank standard ^(†)	1/50,000

(*) EMS resource situation in 2023

(†) International Standard of World Bank in 2012²⁵

Compared to the standard on the number of populations per ambulance, the Hanoi 115 EMS center s 15 activated ambulances out of 30 to meet the needs of around 8 million people, about more than 65 vehicles short of the recommended number (Table 10). In addition, a rather important problem is that the information technology

infrastructure does not ensure reception of calls. Accordingly, with the number of emergency calls increasing, the center currently only has one reception and coordination switchboard system with 8 transmission lines, one backup system for emergency coordination at the central dispatching room only and uses rudimentary technology at emergency station level. Most satellite stations do not have their own land and temporarily borrow the area of a general hospital, so there is a lack of stability and area for training activities, gathering and maintaining ambulances.

These are some reasons why the response capacity and response time of the emergency system in Hanoi do not meet standards, leading to missing the golden period to rescue patients from the most critical stage. Some serious emergencies such as stroke, traumatic brain injury due to traffic accidents... late emergency treatment time is one of the main factors leading to fatal outcome.

Although the EMS workers of the 115 EMS center had chances to access CME courses from central hospitals. However, according to the EMS boarding crews, *"the training courses focus more on emergency treatment and clinical care rather than on pre-hospital emergency care"* (FDG with the Hanoi 115 EMS teams). Professional work with a large workload does not allow EMS workers to have much time to attend training courses, so training courses need to be designed in a concise way with an in-depth focus on initial resuscitations, problem-solving skills at the scene as well as updating new knowledge about pre-hospital emergency care.

As mentioned above, the availability of private emergency transport units is the foundation for the expansion of the pre-hospital emergency system but also serves as a solution to increase the response capacity of the system. However, until now there is no legal framework regulating standards for a private outpatient emergency unit as well as a quality management system.

Box 3. Finding in “Transport”

Success	Opportunity for improvement
<ul style="list-style-type: none"> • 115 EMS is defined at the Decision on promulgation of regulation on emergency treatment, intensive care and poison control (No. 01/2009/QĐ-BYT) • The prehospital care system is stated in the amendment of the Law on Medical Examination and Treatment (No.15/2023/QH15) • 115 EMS is making the best use of the limited resources available: the average time to the scene is 10 minutes, and to the facility is 27 minutes. • Good internal knowledge exchange 	<ul style="list-style-type: none"> • Necessity of appropriate communication between the prehospital service and the in-hospital care service • Necessity of the prehospital care fee collection system: it is difficult to collect the service fee appropriately from patients who died on site, didn't exist, cannot be moved, and cannot afford. • In need of allocating more resources (current situation: 7 EMS hubs, 15 active ambulances out of 30, 45 EMS teams, dispatching units with fixed line only) • Necessity of routine in-service training courses focus on pre-hospital care

<ul style="list-style-type: none"> • The current EMS workers had chances to attend different in-service training courses on emergency care in hospital • Ongoing establishment of the EMT education program • Nearly 300 private ambulance services are available 	<ul style="list-style-type: none"> • Necessity of legal framework to manage the quality of private pre-hospital care providers • Lack of multiplayer collaboration on the scene: police, firefighter
--	--

1-4. Facility

There are 660 health facilities in Hanoi²⁶; 22 health facilities at the central level, 27 provincial level, 12 district level, 584 commune health centers (CHCs), and 228 private hospitals.² In public hospitals, central hospitals and some provincial hospitals, depends on the size, have independent Emergency Department (ED), but for rest of the provincial hospitals ED are covered under Intensive Care Unit (ICU). District hospitals have ED together with ICU either separately or in a combined way.

For referral, basically, patients are transferred to upper hospitals when lower-level hospitals are incapable treating emergency patients. However, if a hospital does not have specific department for emergency cases, such as cases including obstetrician and gynecologist, complex/ severe trauma, and with malignant neoplasms, the patients are transferred to the same level hospitals with the specialized units. Health facilities are not allowed to refuse emergency cases based on act 2.2 of the regulation on emergency treatment, intensive care and poison control.

Communication among doctors at ED of facilities is conducted through unofficial messaging applications including Zalo and Viber to transfer patients smoothly by sharing the patients' condition, the bed availabilities, etc.

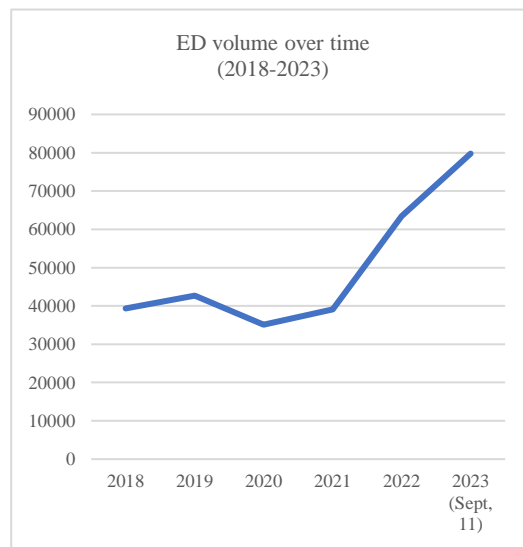
Central level

Bach Mai Hospital, the top-level national hospital in Hanoi with 3200 beds, had reunified its medical and surgical ED in one, and separate a Stroke Center in November 2020 (currently with 50 beds), after the enlargement of its building in 2020-2021. The hospital has three ICUs: medical ICU, surgical ICU, and ED-ICU. In 2022, the administratively registered number of beds in ED was 195 beds. "In reality, almost all beds in our ED are stretchers, the exact number is not fixed", as indicated by the ED manager. The ED was equipped with 32 ventilators in use, representing one for six beds in 2022. In the same year, the availability of ED staff was as follows: 29 physicians, 29 specialists in emergency care, 130 nurses, 4 nursing assistants, 5 points of care laboratory staff, and 6 medical secretaries. Staff demonstrate remarkable self-confidence in what they do. BMH provides a range of training to other facilities.

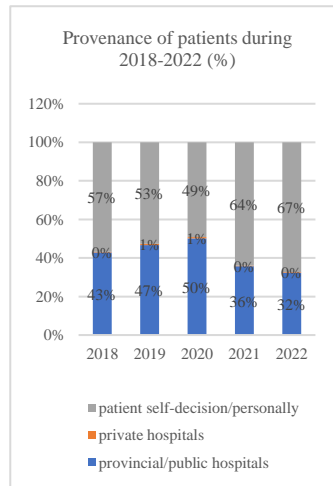
Data collected from 2018 shows that the ED of BMH faces a rise in input of patients, with a high number of admitted patients in the ED. In 2023, between January-September 11th, the number of patients in the ED (300 patients/day) exceeded double that of those received in 2018 (Graph 8). Patients prefer to go to BMH, instead of going to lower-

level hospitals. “We trust in the ED of BMH because there are good staff and top equipment to take care of us, compared to the lower-level hospitals” said patients in the FGD. The top ten frequencies of reasons for 2022 admission in ED include abdominal pain, dyspnea, chest pain, headache, fatigue, fever, melena, altered mental status (AMS), hematemesis, and vertigo.

Graph 7. Emergency Department volume 2018-2023

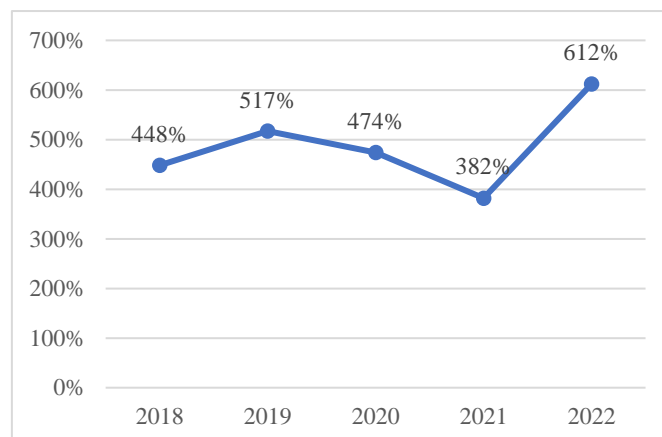


Graph 8. Provenance of patients admitted in the ED of BMH



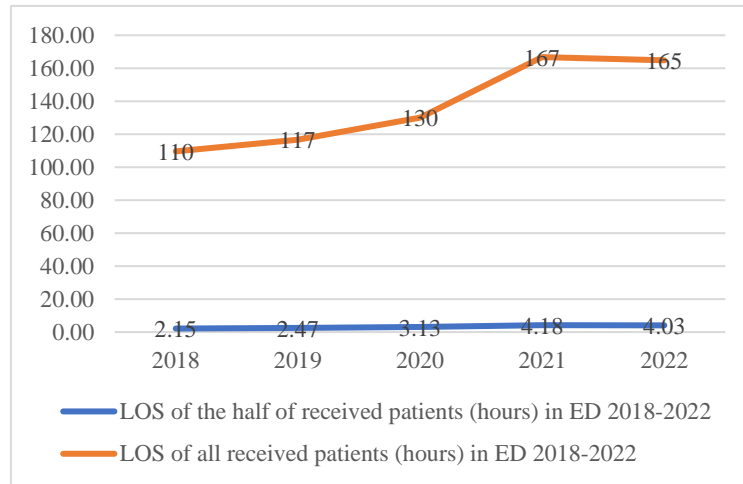
Most patients come by themselves (67% in 2022), others transferred from the provincial (32% in 2022) and private hospitals (less than 1% in 2022) (Graph 8). The trend of the proportion of transferred patients from hospitals showed a decrease in 2021 and 2022. The ED manager explained: “after the COVID-19 pandemic, the healthcare system of provincial hospitals has been significantly upgraded, especially in the areas of critical care and emergency medicine. As a result, the proportion of seriously ill patients in the group transferred from provincial hospitals to Bach Mai Hospital has decreased (because they can receive ventilator support and blood filtration at provincial facilities), contributing to a reduction in the mortality rate.” Yet, use of the lower levels remains low.

Graph 9. Bed occupancy rate in the ED of BMH 2018-2022



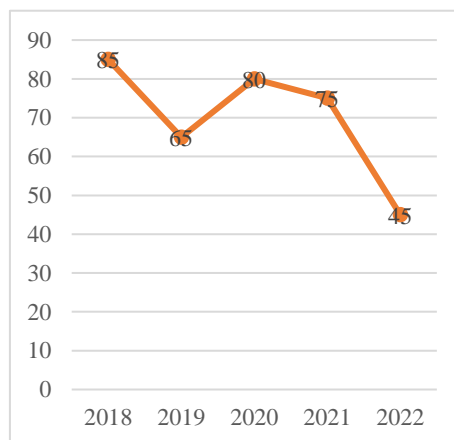
The overcrowding at the input of the ED explains its high bed occupancy the last five years, reaching 612% in 2022 (Graph 9).

Graph 10. Length of Stay (hours) in the ED of BMH: overall patients versus half of them



Regarding the time process and treatment, the ED tried to respect the “four-hour rule” for half of the patients from 2018 to 2022, meaning that these patients spent at most four hours on average at the ED. The overall of the patients stayed less than 7 days on average, with an impressive turnover of beds (Graph 10). The length of stay in 2023 (until September 11th) showed that half of the ED patients spent 3-4 hours on average.

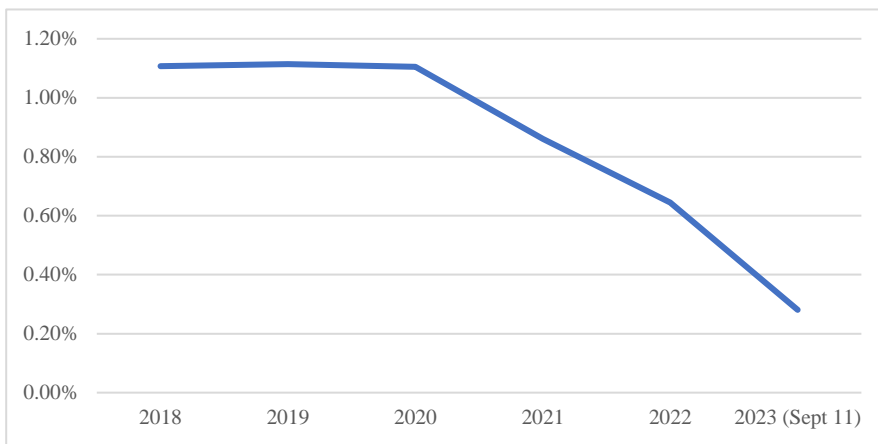
Graph 11. ED boarding time



The waiting time to leave the ED was reduced in 2022 (Graph 11). The ED manager attributes this performance to three factors: the building enlargement during 2020 and 2021, the management, and the availability of human resources. “We reorganized the triage after building enlargement, physician was added in the triage, with an updated triage protocol applied from March 2022.”

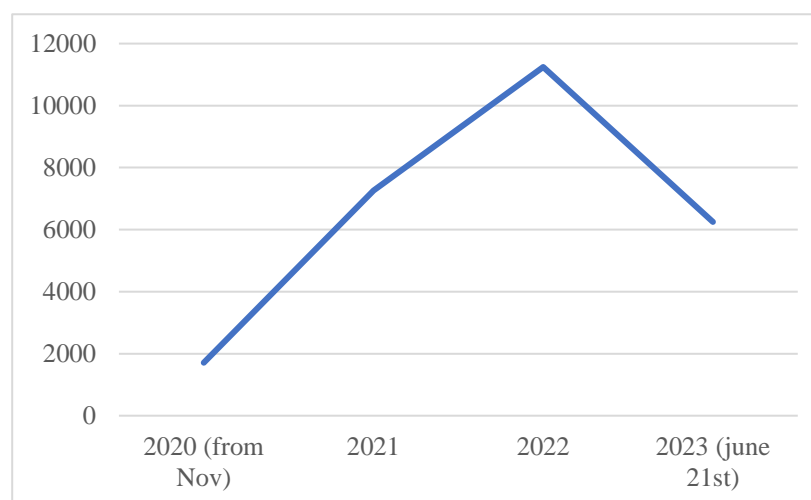
The management at the throughput and output stages of the ED effectively balances the high volume of received patient at the input. The efficient utilization of bed with intense patient turnover within time frames (time process and treatment and waiting time to leave the ED) is one of noticeable success of the ED. However, the separation of the ED building from the general ward does not allow efficient and comfortable transfer of patients exposed to the rain during their movement. This stage of the patient flow deserves improvement.

Graph 12. Trend of in-hospital mortality in the ED of BMH



The trend of (short-) mortality rate (within 7 days) shows a decrease (Graph 12). However, the unavailable data from the separate stroke center were not included from 2021 to 2023. Nevertheless, the ED manager assumes: “the number of patient deaths at the stroke center is not excessively high. Simultaneously, during the COVID-19 pandemic, the mortality rate in the group of patients with chronic and severe conditions such as COPD (Chronic Obstructive Pulmonary Disease), end-stage liver disease, cancer, malignant blood diseases, etc., was higher than in the healthier patient group. Therefore, after the pandemic, the number of patients in this group has decreased significantly, altering the patient population and affecting the overall mortality rate.” In 2023 (Jan 1-Sep 11), if we include any returned home case due to terminal illness (usually requested for patient with fatal prognosis and based on traditional belief), this mortality rate can be overestimated to 1.25%. The top reasons for in-hospital mortality in 2022 were OHCA, Myocardial infarction (MI), Septic shock, Gastrointestinal bleeding, Pneumonia. The top cause of death in the ED of BMH in 2022 was OHCA. Given its low survival rate after discharge from the hospital, only 3.8% in Hanoi¹, compared to 12% in the countries with more developed EMS such as Australia and New Zealand²⁷, OHCA is a major challenging issue for the ED of BMH. The BMH registry showed 150 - 200 OHCA cases calling to the 115 EMS center each month.

Graph 13. Stroke patients received at the Stroke Center of BMH



Separated from ED in November 2020 and currently equipped with 50 beds (200 beds are expected in the plan and the budget already secured), the Stroke Center is staffed by 13 doctors and 12 nurses in the daytime, and 6 nurses in the nighttime. Patients coming to the stroke center at BMH are brought directly by their family member (45 - 50 %), by ambulance (10%), or transferred from other hospitals (30%).

Stroke is one of major public health issue in Vietnam. There are hotlines for stroke care medical facilities (around 100 hospitals can treat stroke) and advertisements on TV and in newspapers about what to do if a case of stroke is suspected and the path for an ambulance. They also advise people to go to the nearest hospital if they fear a stroke.

Medical staff have established a Zalo/Facebook network, with around 1500 doctors from hospitals across the northern region to connect and transfer the patient to the stroke center or between facilities. Zalo/Facebook network is a personal initiative from physicians which is not formalized at the top level of the MOH.

The mortality rate at the Stroke Center of BMH was not available. According to the Stroke Center manager, stroke is the first cause of death and the first cause of disability. The mortality rate of stroke in his research data at stroke centers in Vietnam is 10% during a follow-up within 90 days. Stroke morbidity includes 73% ischemic stroke, 23% hemorrhagic stroke (including subarachnoid hemorrhage due to hypertension), 3% Transient Ischemic Attack (TIA), 1% cerebral venous thrombosis (CVT).

BMH also has a poison control center which is networked with other centers. In fact, the mortality rate from unintentional poisoning in 2016 was 0.9 per 100 000 population in Vietnam.²⁸ The same corresponding rate was estimated in 2019.¹⁰ The poison control center, as a response to this public health issue, is a specialized center which works closely with the ED and provides emergency care, information, and advice for poison prevention. A solving system was developed around the poison control center that collects information and shares with North and South

regions. Patients come from everywhere, including other provinces. The poison control center helps decrease the effects of the input overcrowding at the ED of BMH, as well as the Stroke center.

Provincial level

The survey team visited three provincial hospitals and one private hospital: Saint Paul Hospital, Dong Da Hospital, Thanh Tri Hospital and Hong Ngoc Hospital. Saint Paul Hospital (SPH) is a Grade 1 provincial hospital located in urban areas. Both Dong Da Hospital (DDH) and Thanh Tri Hospital (TTH) are Grade 2 provincial hospitals and Thanh Tri hospital is located in sub-urban. Hong Ngoc – Phuc Truong Minh Hospital (HNN) is a Grade 3 private hospital which opened in 2020.

Among the provincial hospitals, significant differences in the number of patients and bed occupancy rate were seen. While SPH admits 150-200 patients per day and DDH 50-100 patients per day, TTH receives only 20 patients per day on average. The bed occupancy rate of SPH is 100-150%, and that of TTH is around 60-70%. HNN also has rather low bed occupancy. According to the doctor of TTH, 115 EMS do not send patients to the hospital because the TTH does not have enough equipment to diagnose emergency patients.

Regarding the equipment for emergency care, the availability varies. SPH is well-equipped and can provide high-quality service, DDH has equipment but does not have ECMO and electro-dialyzer, TTH is currently unavailable to use CT scan, also no MRI and Angiography. SPH is well-equipped and can provide high-quality service, DDH has equipment but does not have ECMO and electro-dialyzer, TTH is currently unavailable to use CT scan, also no MRI and Angiography. At HNN, most of the resources to meet demands are already prepared, but not all high-tech equipment is available like the BMH. At HNN, most of the resources to meet demands are already prepared, but not all high-tech equipment is available as the BMH has.

As for training, a SPH doctor described that there is a lack of specialized training for emergency care. The ICU doctors are practicing emergency care. DDH is a training hospital where student doctors and interns receive the necessary training. DDH also described that there is also online training available. TTH doctors described that there are many training courses available. The newly graduated doctor this year will attend a 6-month training. A HNN doctor said that they participate in national and international conferences. They said that onsite training is needed.

All hospitals do not receive pre-notification from 115 EMS staff in the ambulance.

Box 4. Finding in “Facility”

Success	Opportunity for improvement
<ul style="list-style-type: none"> • Smooth communication among doctors in different health facilities is available for patient referral 	<ul style="list-style-type: none"> • Necessity of authorization of the communication platform for communication (more data volume, information protection)

<ul style="list-style-type: none"> • Smooth communication in-hospital is available for the patient transfer • Necessary CME is available; A variety of training opportunities is available in Hanoi. • BMH provides training to other health facilities. • Hospitals provide good quality emergency service <ul style="list-style-type: none"> ○ Mortality rate around 1% at BMH and SPH ○ 300 patients/day, 3-4 hours of the stay at the waiting room at A9 of BMH in 2023, which is consistent with the statistical results of A9 ○ Doctors are confident in their work • Available Red Alarm system in the case of CPA • Stroke center at BMH: <ul style="list-style-type: none"> ○ Hotline exists among other stroke care medical facilities. ○ Successful community campaign to raise awareness on stroke. Number of patients increased (40-50 patients/ day) • Poison control centers and hubs exist. 	<ul style="list-style-type: none"> • Low utilization of the lower-level hospitals located sub-urban and private hospitals • Necessity of appropriate communication between the prehospital service and the in-hospital care system • Necessity to strengthen the regular Emergency care training for health facilities in other provinces • Need for the establishment of more Stroke Satellite centers in the existing hospitals of Northern region • Need to improve the access of transferred patients from A9 to other departments in the main building of BMH
--	---

1-5. Multisectoral collaboration

The effective provision of emergency care services hinges upon a synchronized effort across various sectors within the community.²⁴ In Hanoi, as in any thriving urban center, the demand for emergency services extends beyond the scope of healthcare institutions alone. It encompasses a wide spectrum of sectors, each playing a pivotal role in ensuring timely and efficient responses to emergencies. This section will delve into the critical importance of multisectoral collaboration in augmenting emergency care services within the city.

113 – Police unit

The Police Force in Hanoi stands as the first line of defense in ensuring public safety and order. Their role in emergency care services is paramount, as they often serve as initial respondents to incidents that require medical attention. Through targeted training and joint exercises with emergency medical personnel, the Police Force contributes significantly to the seamless coordination of emergency response efforts. Moreover, their expertise in crowd control and traffic management during emergencies is invaluable in facilitating the rapid arrival of medical assistance to critical scenes.

114 – Fire unit

The Fire unit in Hanoi plays a dual role in emergency care services. Beyond their primary function of fire suppression, firefighters are trained to provide critical medical support in emergencies. Their proficiency in extracting individuals from hazardous environments, coupled with their knowledge of basic life support techniques, renders them indispensable partners in the continuum of care. Multisectoral collaboration ensures that the Fire Department's capabilities are seamlessly integrated into the broader emergency care framework.

Ministry of Education

Educational institutions hold a unique position in the promotion of emergency care awareness and preparedness. By incorporating safety and first aid training into curricula, schools contribute to a generation of citizens equipped with life-saving skills. Furthermore, educational campaigns within schools can extend to families, reinforcing the importance of responsible use of emergency services and imparting essential safety survival techniques.

Multisectoral collaboration in emergency care services extends beyond the aforementioned sectors. Entities such as Ministry of Information & Communication, Voice of Vietnam (VOV), Ministry of Transport, Ministry of Planning and Investment, the private sector entities, Civil Society Organizations (CSOs), Non-Governmental Organizations (NGOs), and Non-Profit Organizations (NPOs) all play indispensable roles in this endeavor as well as transportation authorities, municipal planning departments, and public health agencies all contribute unique expertise and resources to the collective effort. CSOs, NGOs, and NPOs bring specialized skills and knowledge to the table. They can facilitate training programs, workshops, and skill-building sessions for both professionals and community members. By harnessing their expertise, these organizations contribute to a more informed and skilled populace, capable of providing critical support during emergencies. Transportation agencies, for instance, facilitate the swift movement of emergency vehicles, while municipal planners ensure that urban infrastructure supports efficient emergency response.

The most crucial problem leading to the ineffective operation of the emergency medical system in Hanoi is the lack of coordination among stakeholders involved in the emergency system including the patients, pre- and in-hospital emergency care providers, and inter-sectoral parties mentioned above. People in emergency situations are confused in seeking another pre-hospital care unit in case the 115 EMS center cannot respond promptly due to running out of ambulances. Currently, 115 EMS center can only meet 10% of the emergency needs of Hanoi citizens. At the scene, during the process of dealing with disaster emergencies or emergencies in the middle of the night, pre-hospital care providers lack the coordination and support of the police and fire forces, leading to difficulties for EMS forces themselves, such as not being able to enter patients' houses to deliver emergency care due to locked doors, fires or even acts of violence, assault, or harassment that the EMS teams encountered. In addition, lack of coordination also leads to overlapping supplies between pre-hospital providers or a situation where the EMS team arrives at the scene but cannot pick up the patient because the patient was taken in another way. According to Thanh Tri satellite emergency station, 33% of emergency trips fail to meet patients, wasting resources. On the other hand,

pre- and in-hospital emergency care units do not have close coordination when 100% of emergency cases are transported to EDs of hospitals without prior notice, which leads to designated hospitals are overloaded and unprepared to receive patients. It is the lack of coordination mechanism between relevant parties that causes the quality of the emergency system to be degraded, response times to be prolonged, care to be delayed, and treatment effectiveness to be reduced.

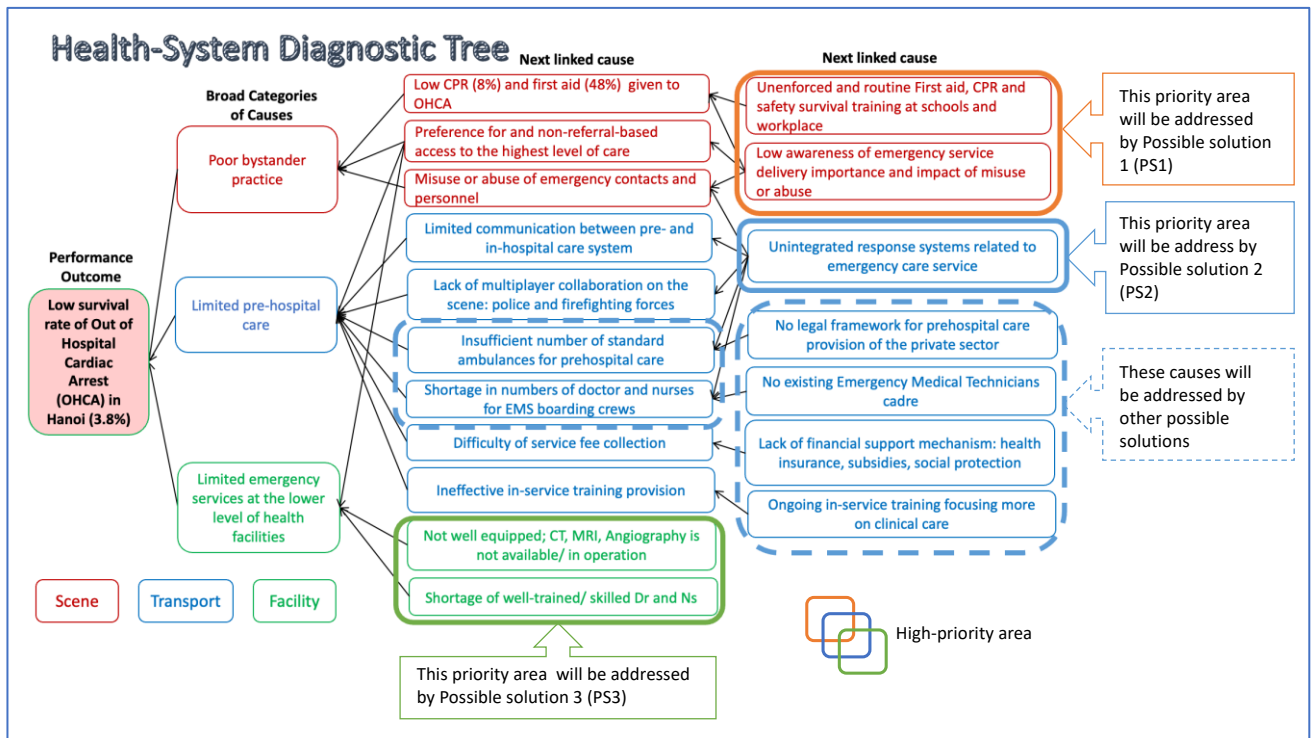
Effective multisectoral collaboration necessitates robust coordination mechanisms. Regular inter-sectoral meetings, joint training exercises, and the establishment of shared communication platforms are essential elements. Clear protocols for information sharing and resource allocation ensure that each sector can seamlessly integrate its efforts within the broader emergency care framework.²⁹

2. Health-System Diagnostic Tree

In this survey, the low survival rate of OHCA in Hanoi is the target health performance problem. Starting from this problem, the health-system diagnostic tree was developed to find causes to address. (Figure 2) The health-system diagnostic tree is an analytical tool of working backwards from identified performance problems to their causes and the causes of causes.³⁰ The first step is to think about broad categories of causes and poor bystander practice, limited pre-hospital care, and limited emergency services at the lower level of facilities were set using WHO framework. Linked causes were connected to broad categories and the next linked causes were connected to the prior linked causes based on the findings mentioned above.

Successful reform often needs “*a set of interdependent and mutually supporting interventions*” so that all the causes identified can be addressed.³⁰ Therefore, after listing all the linked causes, the last causes that connect more prior causes and more stakeholders mentioned and emphasized in the interviews were selected in the high-priority area. And then, possible solutions were developed for each high-priority area; possible solution 1 (PS1), possible solution 2 (PS2) and possible solution 3 (PS3). Furthermore, other possible solutions were developed for other important linked causes.

Figure 3: Health- System Diagnostic Tree for the low survival rate of OHCA in Hanoi.



3. Possible solutions (PS)

3-1. Bystander role, awareness and capacity strengthening (Possible solution 1: PS1)

Goal: Hanoi residents (bystanders) are well-prepared and ready to act with basic first aid, CPR, safety skills and responsibilities

- To ensure Hanoi residents use EMS appropriately.
- To strengthen routine community members' first aid, basic CPR, and safety skills before and during an emergency.

PS1a This comprehensive approach seeks to create a paradigm shift in the way our community members engage with EMS services. By fostering responsible behavior and imparting crucial safety skills, we aim to ensure the sanctity of the EMS system, safeguard the well-being of the citizens, and celebrate the unwavering dedication of EMS personnel. Through sustained efforts, we envision a safer and more informed community, where every individual plays a role in preserving the integrity of our emergency services.

The primary objective of this initiative is to effect behavior change by promoting responsible use of emergency care services. This encompasses four key components:

- Define the role of bystanders: *Regulation review* – A clearly defined role and responsibilities of bystander included in the existing guideline that defines prehospital care No.15/2023/QH15 and development of guidelines for training of residents' mobilization and advocacy
- Mitigating Misuse of Emergency Call Numbers: *Behavior Change Message* – A robust

communication campaign will be launched to educate and encourage community members to utilize the emergency number exclusively for genuine emergencies. This will involve utilizing diverse media channels, including public announcers, mass media (TV, radio), and social media platforms.

- III. Disseminating Safety Survival Skills: *Educational Curriculum* - An enforced and monitored comprehensive curriculum should be integrated into school (elementary to high school), workplaces, and community events. This curriculum will focus on imparting essential safety skills, such as using wet towels during fire emergencies. Additionally, company orientation programs will incorporate these life-saving techniques.
- IV. Addressing Abuse and Assault of EMS Officers: *Media Engagement* - A proactive media engagement strategy should be implemented to highlight the invaluable contributions of EMS officers as *heroes*. Through various channels, including public announcers, mass media, and social media, the community will be encouraged to express their gratitude and support for these dedicated professionals.

Implementation Strategies:

Media Outreach: Utilize public announcers, TV, radio (VOV channel), and popular social media platforms (Zalo, Facebook, Instagram) to disseminate tailored messages regarding responsible EMS usage and safety survival skills.

Information, Education, and Communication (IEC) Materials: Develop and distribute pamphlets, posters, and brochures containing essential information about EMS services, emergency call protocols, and safety measures.

School Curriculum Integration: Collaborate with the ministry of education and other relevant educational institutions to incorporate the safety survival curriculum into their teaching modules, ensuring that students are equipped with life-saving skills from a young age.

Company Orientations: Partner with local businesses and organizations to integrate safety survival training into their onboarding and orientation processes, enhancing the preparedness of employees.

Community Events: Organize workshops, seminars, and demonstrations at community events to engage directly with residents, reinforcing the importance of responsible EMS use.

PS1b In order to fortify the responsiveness of Hanoi residents in emergencies, a crucial step forward lies in ensuring that every resident possesses fundamental first aid, basic CPR, and safety skills. This section outlines the second pivotal part of the EMS campaign solution, aiming to integrate this knowledge seamlessly into the fabric of society. This section outlines the second pivotal part of the EMS campaign solution, aiming to integrate this knowledge seamlessly into the fabric of society.

By embedding first aid, basic CPR, and safety skills into the education curriculum, workplace onboarding processes, and programs led by CSOs, NGOs, and NPOs, a develop the capability and capacity of a community capable of rapid and effective response in emergencies. This strategic integration not only bolsters collective resilience but

also empowers individuals with the knowledge and skills to be difference-makers when every second counts. Through this concerted effort, we lay the foundation for a safer, more prepared community, fortified by the strength of its own members.

Education

The foundation of a resilient community begins in the classroom. By embedding first aid, basic CPR, and safety skills within the formal education curriculum, we empower our youth to become the first line of defense in emergencies. This initiative will be structured to align with age-appropriate learning, progressing from elementary concepts to more advanced techniques in higher grades. By equipping our students with these life-saving skills, we instill a culture of preparedness and responsibility that will serve them and our community well in the years to come.

Workplace

The workplace serves as an optimal environment for disseminating crucial first aid and CPR knowledge. Reviewing, updating, enforcing and monitoring already incorporated comprehensive mandatory training as a component of onboarding not only heightens the safety consciousness of employees but also ensures that every workplace is equipped to respond effectively in the event of an emergency. By fostering a culture of preparedness within our workforce, we not only safeguard our colleagues but also contribute to a more resilient and proactive community at large.

Private and not for profit organizations

Civil Society Organizations (CSOs), Non-Governmental Organizations (NGOs), and Non-Profit Organizations (NPOs) play a pivotal role in disseminating life-saving skills. Since most already provide emergency care service-related training through their specialized programs and workshops, these entities can reach diverse segments of Hanoi community, providing tailored training sessions on first aid, CPR, and essential safety protocols. By leveraging their expertise, CSOs, NGOs, and NPOs amplify the impact of this initiative, ensuring that a wide spectrum of community members gain access to vital life-saving knowledge.

Monitoring and evaluation

An ongoing system of monitoring and evaluation would need to be implemented to gauge the effectiveness of these training programs. Feedback loops will be established to continuously refine the content and delivery methods, ensuring that community members are equipped with the most relevant and impactful skills.

3-2. Interoperable digitalized coordination mechanism for the emergency system in Hanoi (Possible solution 2: PS2)

A coordination mechanism between relevant parties in the emergency medical system in Hanoi, PS2 is extremely

necessary, especially in low-resource settings. This mechanism will expand the network of pre-hospital providers with the engagement of the private sector, increasing the response capacity of the emergency care system. Through this coordination mechanism, parties can monitor each other's activities as well as notify or request support simply to be able to coordinate smoothly and transition efficiently among stages from bystander care to pre- and in-hospital care ensures that patients are treated fastest and most properly at the scene, transferred to the hospital as soon as possible, and prepared for the most thorough and intensive treatment at the receiving hospital.

Goal: A streamlined coordination system is effectively utilized by all parties involved in the emergency medical system for smooth operation.

The platform is adapted by e-Emergency System of Cyprus in 2020, the main purpose of this model is to provide the support of prehospital and emergency call handling. During the last 25 months, this system has handled 112,414 cases including the transfer of patients from their house to the reference hospital, the transfer of critical patients from the reference hospital to another hospital with an intensive care unit.³¹



Figure 4: Access users

Access users

Access users of this platform including 3 groups: emergency patients/patients' family members/bystanders, pre-hospital care providers, Emergency Department (ED) of hospitals (Figure 4)

- Emergency patients/patients' family members/bystanders: People in need of emergency care or people who witness and beside the emergency patients have a smartphone installed the application.
- Pre-hospital care providers: 115 EMS center, hospitals providing pre-hospital care, private EMS facilities in Hanoi that meet the standards of pre-hospital care (qualified ambulances, medicines & equipment, trained paramedics), and complete registration to use the application. The expansion of the pre-hospital care provider network will promote the development of the legal framework for the private sector involving the pre-hospital care provision.
- ED of Hospitals: ED of Hospitals in Hanoi registered to participate in the system and have open access bed occupancy information system.

Main functions

The function of connecting emergency needs with available out-of-hospital emergency units includes the public and private sectors

Through the digital platform, the smart application will help patients in an emergency/patient's family/passersby easily and quickly seek the most appropriate pre-hospital emergency care services through utilities for the patient and service provider sites as follow:

- **Advantages for the patient site**
 - Connect to the pre-hospital care providers in the fastest way
 - Choose the most appropriate pre-hospital care providers based on the estimated arrival time and price
 - Keep track of the navigation of ambulances
 - Free two-way communication between the patients and service providers
 - Enable to request advice from the prehospital provider to deliver first aid at the scene if needed
 - Fast and transparent payment mechanism integrating with the health insurance system
 - Enable to evaluate the quality of service
- **Advantages for the pre-hospital care provider site**
 - Receive the patient information actively and quickly
 - AI support for initial triage and preparation
 - Have navigation support to reach out to the patient
 - Update patient's condition frequently by free two-way communication

The function of enhancing cooperation between pre- and in-hospital emergency care units (high priority for interventions)

The platform allows pre-hospital emergency care units, after accessing and classifying the patient's condition at the scene, to select the receiving hospital appropriate to the classification and response capacity at that time (bed vacancy). After selecting the receiving unit, the platform will establish a 2-way communication channel and automatically send essential information. Specific features are as follows:

- **Advantages for the pre-hospital care provider site**
 - AI support for final triage and list of appropriate hospitals with bed availability status.
 - Select the most appropriate hospital and send patient info and notification to the receiving hospital automatically
 - Enable to request advice from ED doctors/nurses of receiving hospital for on-site treatment or during transportation.
- **Advantages for the ED of hospitals (In-hospital care provider site)**
 - Receive patient information and notifications from pre-hospital providers actively and quickly
 - Well-prepared to receive patients
 - Enable to guide pre-hospital providers on the most appropriate initial treatment on-site and easily perform follow-up intensive care.
 - ED doctors/nurses of receiving hospital for on-site treatment or during transportation.

The function of strengthening collaboration between lower and higher-level health facilities

This function will help replace the spontaneous communication platform between emergency departments at different levels while ensuring smooth, continuous connection and ability of comprehensive uploading the patient's

electronic medical records with high confidentiality.

- **Advantages for the ED of hospital at lower level**

- Send the patient's medical record easily and quickly in a confidential way
- Create electronic referral letter to reduce the paper works
- Provide bed occupancy status of hospitals for the referrers to select the most appropriate hospital
- Receive necessary technical assistance from specialized doctors of the national hospitals

- **Advantages for the ED of hospital at higher level**

- Receive patient information and notifications from pre-hospital providers actively and quickly
- Receive the patient's medical record and electronic referral letter actively and quickly
- Keep track of the progress of patient transportation for the best preparation of receiving
- Provide needed emergency medical consultation for EDs at lower level

A comprehensive digital platform for the emergency medical system in Hanoi as above is vital for smooth coordination between relevant parties. However, building and operating such a platform requires a functional institution governed by a central coordination mechanism that includes high-central level direction as well as the participation of relevant ministries and departments such as the Ministry of Information and Communications, Ministry of Public Security for issues of cybersecurity, information security. These are also lessons learned from previous unsuccessful digital platforms. In addition, building a comprehensive platform requires a lot of time, effort and budget from design, setup, testing, operation, and maintenance. Therefore, the digital platform needs to gradually develop each module, however, the immediate priority that needs to be established is digitalization for the function of improving cooperation between the pre- and in-hospital emergency services to overcome current backlogs that cause the emergency system to operate ineffectively

3-3. The capacity development on emergency care at the lower level of hospitals (Possible solution 3: PS3)

Goal: All the facilities which have emergency departments are appropriately equipped with necessary medical devices with routinely trained emergency care staff.

Comprehensive capacity assessments for the emergency care at each health facility are needed before application of the solutions. The assessments include the role of the facility based on the demography of the residents, reason for the admission to the health facility, necessary medical equipment and optimal number of human resources. If data is already available, assessment can be carried out by using them. Also, regular assessments are required.

Human resource:

- To scale-up of the scope of the license for doctors in the emergency department and ICU. The current system does not allow ICU doctors to practice internal medicine, which made them unable to open their clinic. In order to allow more doctors to be involved in emergency treatment, it would be encouraging for the doctors with ICU license to be able to practice internal medicine.

- To strengthen continuous training for doctors in lower-level facilities as well as for doctors in other provinces: in-person, on-line, on-the-job training based on the comprehensive capacity assessments. It would be also necessary to have concrete mechanisms to evaluate if all the staff have an equal opportunity to receive appropriate training with adequate frequency and amend if necessary.
- To strengthen technical coaching and mentoring from the higher-level health facility. If there is a system in place for doctors in lower-level facilities to receive appropriate advice from doctors in higher-level, when necessary, doctors in lower-level facilities will be able to accept and respond to emergency patients without any hesitancy.

The responsibility for the human resource capacity development is on each hospital, training center of BMH, and university where they give a training and the license.

Medical equipment for emergency care:

- To procure, allocate and install necessary medical equipment to diagnose and to treat emergency patients, including; ventilator, X-ray, bed-side monitor, ultrasound, CT scanner, based on the result of the comprehensive capacity assessments. This allows lower-level hospitals to receive and to treat severe emergency patients. The responsibilities for capacity development by the medical equipment are on each hospital and DoH.

3-4. Other possible solutions

- To amend the financial policy to cover Pre-hospital care services, by health insurance, subsidy, or other social protection scheme. Even though there are standard rates for the usage of the ambulance by the distance, which is partially subsidized, currently there are no compensation mechanisms, especially for indigent people, to cover the pre-hospital care service fee. Additionally, almost half of the 115-ambulance dispatch cannot collect the fee because the person is already dead at the site, already moved, or unable to afford. This year, 2023, the amendment of the health insurance Law was on the table of the 15th Vietnam National Assembly.³² Pre-hospital care can be included in future consideration.
- To increase the number of EMS boarding crews with standard ambulances. A sufficient number of crews will provide appropriate treatments for patients. 115 EMS has a plan to increase the number of ambulances. Existing private ambulance can be utilized to increase the number of ambulances, while EMS boarding new crews will be graduated from the newly established school for EMS in few years.
- To increase the number of satellite EMS hubs and allocate them according to population density. This will correct the uneven distribution of EMS and shorten the time to reach patients. 115 EMS center has a plan to increase the number of satellites. Based on the existing data available, 115 EMS center is able to allocate the satellite strategically.
- To standardize and implement a regular in-service training scheme on pre-hospital care for EMS boarding crews. Standardized regular training allows EMS boarding crews to have equal knowledge and skills not only for in-hospital care, but also, pre-hospital care.
- To allocate Automated External Defibrillators (AED) at designated areas such as office and residential buildings

in Hanoi. AED usage in timely manner reduces OHCA death. Hanoi City Health Plan can include the AED allocation plan. Regular maintenance is also required.

- To improve the access between A9 and the main building in BMH.
- To increase the number of Stroke satellite centers in the existing facilities. BMH provides training for the lower-level health facilities so that patients reach out to the nearby health facilities with appropriately trained health staff in a shorter time. Increasing the number of stroke satellite centers helps to expand the training program.

4. Key steps

4-1. To establish the central coordination mechanism for emergency care services, under the leadership of the MOH

The central coordination mechanism is a formal functional structure for concertation and supporting the leadership and coordination of the MoH and involving key stakeholders, especially in the Emergency Care System (ECS). As a frame of dialogue and consultation, this platform will regularly help to mutually exchange information between stakeholders, make common decisions, and carry out joint and harmonized actions in the improvement of the ECS. Some interventions might be beyond the scope of authority of each key stakeholder of the MoH. So, it is crucial to involve other relevant and effective stakeholders in the open discussion, decision making and action in support of the ECS. This organized multisectoral framework of meetings is conducive to collaborative actions and the achievement of objectives.

The members can be representatives from MoH, DoH, 115 EMS, BMH, other health facilities, medical association, academics, development partners, private sector and CSO representatives, and any other relevant stakeholders, such as the Ministry of Education, Ministry of Public Security (police and fire forces), Ministry of Transportation (including the driving school's representatives), Ministry of Planning and Investment etc. The role of the mechanism would be to generate evidence and drive informed policy dialogue and action on specific ECS issues (in terms of laws, strategies, procedures, guidelines, actions), while mobilizing financial and technological resources for effective implementation. The terms of reference will be specifically defined, as well as the key stakeholders, the frequency of meetings with a clear action plan and follow-up of recommendations, the expected products. The working group will discuss some specific issues of the ECS.

4-2. To conduct further research, survey, in-depth assessment and needs assessment for identified gaps

Further evidence-based information is necessary to better develop prehospital care. This implies all stakeholders' responsibilities. Among additional assessment to inform policy, following examples could be considered:

- Research to set necessary indicators to assess the prehospital services: to address the prehospital care issues, it is primordial to fill the gap of information to plan any appropriate intervention, and to monitor the performance of the EMC system from the scene with the bystander capacities to the interface with the hospital, through the transport with 115 EMS.
- An assessment on the current situation of first aid and CPR training for the residents in Hanoi: it is important

to make an inventory of existing opportunities of training, as well as their beneficiaries, with a mapping of actors implementing training and the identified needs of training, including their frequency and effectiveness. Clarifying the variety of provided training on first aid and CPR will help fill gaps in capacities building.

- A comprehensive capacity assessment of the emergency care at hospital (See PS3)

4-3. To start the intervention on a small scale first in Hanoi

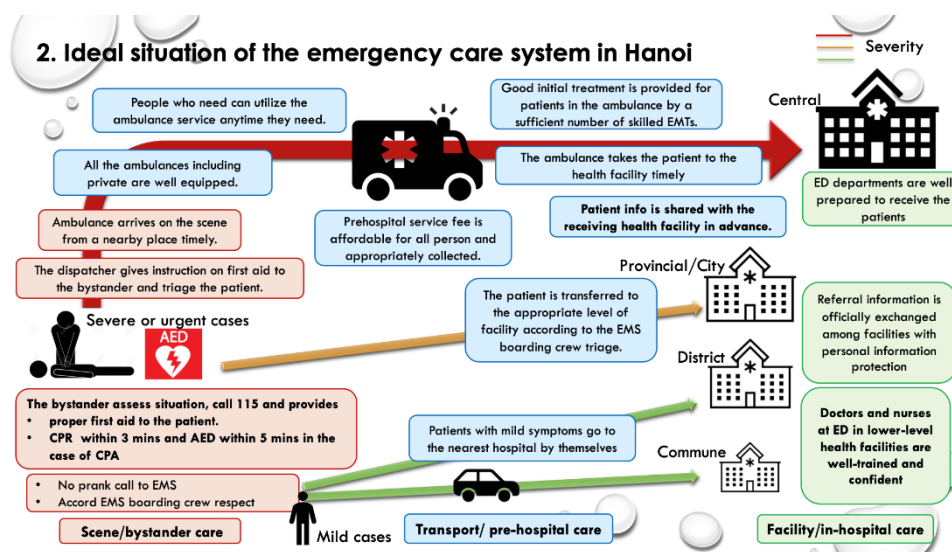
The following principles could be applied in practice:

- Starting the intervention on a small scale first in Hanoi (based on the possible solutions) and scaling up: this takes advantage of the availability of resources and the existing good practices generated in Hanoi.
- Leveraging on the results of prehospital service survey, conducted in 2022 by MoH, to design purposive intervention
- Some districts in Hanoi could be the target sites of the intervention.

5. Ideal situation of emergency care services in Hanoi

Figure 5 shows the ideal situation of emergency care services in Hanoi.

Figure 5. Ideal situation of emergency care service in Hanoi



5-1. Scene

A bystander can take proper action when they face an emergency such as a fallen person by stroke or heart attack or an injured person by a traffic accident. The bystander assesses the situation, calls 115 and provides first aid and/or CPR and/or AED within 3-5 minutes, as 75% of patients can be saved by starting CPR within 3 minutes after the OHCA, and the brain damage will be minimized by using AED within 5 minutes. During the call to 115, the bystander can receive necessary instruction on first aid and CPR and a decision on whether the case needs an ambulance or not from the EMS application and/or a dispatcher of the 115 EMS. Under the good navigation system, the ambulance arrives on the scene from a nearby place timely.

As the bystanders understand the importance of the emergency care services, they call 115 on the necessary occasion only and work together with the 115-boarding crew on site. In accident and disaster settings, all the stakeholders such as policemen, fire forces, and 115 boarding crew work together in a collaborative way so that many patients can be saved.

5-2. Transport

There are an optimal number of standard ambulances available in Hanoi including both public and private. People trust the ambulance services and call 115 anytime they need. The patient receives good initial treatment in the ambulance by the EMS boarding crew. The EMS boarding crew decides the level of hospital to send the patient according to the severity. Through the application, the crew easily finds a suitable hospital with available beds and sends the patient information to the receiving hospital after the confirmation of the acceptance.

The prehospital service fee is covered by financial systems such as health insurance, subsidies or social protection schemes so that EMS smoothly collects the fee, and the fee is affordable for patients.

5-3. Facility

All the emergency departments of the health facilities provide good quality of care and people acknowledge it. The emergency departments have enough doctors and nurses and optimal equipment. As the doctors and nurses are well trained by the standardized training system, they are confident with their knowledge and skills for emergency care.

Doctors of the health facilities decide whether the emergency department receives a new emergency patient, according to the severity of the patient, the number of available resources such as beds, equipment, and human resources, and other conditions through the application. The emergency patient information is shared by the EMS crew in advance so that the hospital can be prepared when the patient arrives at the hospital.

When a patient with a serious condition needs advanced medical care at a lower-level facility, the doctor smoothly communicates with a doctor at a higher-level facility to ask for the appropriate action and confirm the acceptance of the referral. The standard ambulance is also used for referral. The referral patient information is smoothly shared with the doctor at the receiving hospital. The receiving hospital is prepared when the patient arrives at the hospital.

VI. Limitation

Despite the results obtained, there are a few encountered limitations worth mentioning:

- The reality on the field constrained us to apply a more qualitative methodology, such as interviews, focus group discussions, or content analysis, as opposed to the initially planned mixed-method approach including a quantitative survey and statistical analysis. Among the inherent limitations, the following can be noticed:
 - Subjectivity and difficulty in quantification: the qualitative data collection and analysis might be influenced by the perspectives and interpretations of the participants, with a risk of introducing bias into

the results.

- Small number of participants and underrepresentation of certain groups in the focus group discussion or because of the limitation of the communication channel used to administer the survey. This can limit the depth and breadth of our findings, and make also challenging to reach data saturation, where new information or themes stop emerging.
- Language and cultural barriers: the effect of the cultural norms affecting how questions were interpreted might lead to misunderstandings and biased responses. Some possible translation errors might introduce confusion and inaccuracies, as we did not pre-test the questionnaire.
- Time constraints in the data collection and analysis might lead to some omissions.
- External event: During the on-site visit, Hanoi faced a fire disaster that not only mobilized most of key informants and organizations to respond, but also made some key actors unavailable for IDI and FGD.

VII. Conclusion

Through the survey, it was found that emergency care is very well-functioned in many settings. Central, urban provincial, and private hospitals are well-equipped with trained doctors and nurses. A variety of training courses is available on an in-person and online basis. Despite shortages in ambulances, personnel, equipment, and outdated systems and technology, the 115 EMS performed exceptionally well under these conditions, successfully increasing the number of patients transported per population.

From the findings, it was found out that the reason for the low survival rate mostly lies in the delays in care, because the appropriate treatment in a timely manner is crucial. Especially for cardiac arrest, proper CPR in the first few minutes divides life and death. The stroke case and severe RTI also needed to be treated swiftly in an appropriate hospital with skilled medical personnel and adequate medical equipment.

In order to increase the survival rate, we pointed out the bystander's role. Bystanders with knowledge of CPR and first aid training (PS1) and installation of AED increase the survival rate, especially for OHCA. Smooth communication between stakeholders is also crucial for patients to receive appropriate treatment in a hospital in a timely manner. Inter-operable digitalized coordination mechanism for the emergency system (PS2) will allow EMS crews (including private ambulance if appropriately equipped) and bystanders to share the location and the condition of a patient, EMS crews and hospitals to share patients' information and receive bed availabilities and advices for the treatment if necessary, which allows patients to be transferred to the prepared hospital with the stable condition in a timely manner. Strengthening the capacity development on emergency care at lower-level hospitals (PS3) also shortens the time for patients to receive appropriate emergency care, that, there will be more hospitals available near to the scene where severe emergency cases can be treated. Other possible solutions include the amendment of the financial mechanism and the strengthening of the capacity of 115 EMS will allow patients to reach prompt pre-hospital care which increases the patients' survival rate.

Not all solutions that are proposed cover every problem and the feasibilities vary, which need further study, however, it is believed that these possible solutions will not only improve the determined situation but improve the entire emergency care system as a whole. With the improved emergency care system, patients' satisfaction will increase, people trust the emergency care system more, utilize health services appropriately and eventually, the health indicators will be improved. It is a hope that the possible solutions will be adopted, implemented and will lead to the improvement of health status not only in Hanoi residents but also in entire Vietnam.

Reference

1. Hoang BH, Do NS, Vu DH, et al. Outcomes for out-of-hospital cardiac arrest transported to emergency departments in Hanoi, Vietnam: A multi-centre observational study. *Emerg Medicine Australasia*. 2021;33(3):541-546. doi:10.1111/1742-6723.13750
2. Ministry of Health, Vietnam. Health statistics Yearbook. Accessed October 19, 2023. <https://moh.gov.vn/thong-ke-y-te>
3. WHO. Health systems governance in Viet Nam. Accessed October 19, 2023. <https://www.who.int/vietnam/health-topics/health-systems-governance>
4. Le DC, Kubo T, Fujino Y, Pham TM, Matsuda S. Health Care System in Vietnam: Current Situation and Challenges. *Asian Pacific Journal of Disease Management*. 2010;4(2):23-30. doi:10.7223/apjdm.4.23
5. Socialist Republic of Vietnam. The five-year Socio-economic Development Plan 2016-2020. <https://pubdocs.worldbank.org/en/839361477533488479/Vietnam-SEDP-2016-2020.pdf>
6. Buse K, Aftab W, Akhter S, et al. The state of diet-related NCD policies in Afghanistan, Bangladesh, Nepal, Pakistan, Tunisia and Vietnam: a comparative assessment that introduces a 'policy cube' approach. *Health Policy and Planning*. 2020;35(5):503-521. doi:10.1093/heapol/czz175
7. Tran Van Tien, Hoang Thi Phuong, Inke Mathauer, Nguyen Thi Kim Phuong. A health financing review of Viet Nam with a focus on social health insurance. Published online August 2011. Accessed October 19, 2023. <https://iris.who.int/bitstream/handle/10665/341160/WHO-HSS-HSF-2011.02-eng.pdf?sequence=1&isAllowed=y>
8. WHO. Health financing in Viet Nam. Accessed October 19, 2023. <https://www.who.int/vietnam/health-topics/health-financing>
9. World Health Organization. *Global Strategy on Human Resources for Health: Workforce 2030*. World Health Organization; 2016. Accessed October 19, 2023. <https://iris.who.int/handle/10665/250368>
10. WHO. World health statistics 2023 – Monitoring health for the SDGs. Published online 2023. <https://www.who.int/publications/i/item/9789240074323>
11. Ministry of Economy, Trade and Industry, Japan. Survey on the Healthcare Market Environment in emerging country; Vietnam. Presented at: March 2016. https://www.meti.go.jp/policy/mono_info_service/healthcare/iryout/outbound/activity/healthcare.html
12. The socialist republic of Vietnam. *Approving the National Digital Transformation Program through 2025, with Orientations toward 2030*. <https://english.luatvietnam.vn/decision-no-749-qd-ttg-on-approving-the-national-digital-transformation-program-until-2025-with-a-vision-184241-doc1.html>

13. Ministry of Health, Vietnam. For people's health protection, care and promotion 2016-2020. Published online March 2016.
https://extranet.who.int/countryplanningcycles/sites/default/files/planning_cycle_repository/viet_nam/vietnam_plan_2016-2020.pdf
14. The communist party of Vietnam. The 6th meeting of the 12th central committee on enhancement of citizens' health protection, improvement, and care in new situation. Published online October 25, 2017.
<https://thuvienphapluat.vn/van-ban/The-thao-Y-te/Resolution-20-NQ-TW-enhancement-of-citizens-health-protection-improvement-care-in-new-situation-369858.aspx?tab=1>
15. Dean Koh. Vietnam to deploy EHR nationwide in July. Published online June 2019. Accessed October 19, 2023. <https://www.healthcareitnews.com/news/asia/vietnam-deploy-ehr-nationwide-july>
16. Nguyen TT, Trevisan M. Vietnam a country in transition: health challenges. *BMJNPH*. 2020;3(1):60-66. doi:10.1136/bmjnph-2020-000069
17. Dat VQ, Linh BTK, Kim GB. Causes of admissions and in-hospital mortality among patients admitted to critical care units in primary and secondary hospitals in Vietnam in 2018: a multicentre retrospective study. *BMJ Open*. 2022;12(6):e061638. doi:10.1136/bmjopen-2022-061638
18. WHO. Emergency care system framework. Published online May 2, 2018.
19. World Bank. An Expressway Development Strategy for Vietnam.
<https://documents1.worldbank.org/curated/zh/199241468329682265/pdf/694780ESW0P0960Vietnam0201090final.pdf>
20. World Bank. Vietnam Urbanization Review: Technical Assistance Report. Published online November 2011.
<https://documents1.worldbank.org/curated/en/225041468177548577/pdf/669160ESW0P1130Review000Full0report.pdf>
21. Mai HT, Vu HM, Ngo TT, et al. The Status of First Aid and Its Associations with Health Outcomes among Patients with Traffic Accidents in Urban Areas of Vietnam. *IJERPH*. 2020;17(12):4600. doi:10.3390/ijerph17124600
22. statista. Average waiting time between an emergency call and the arrival of an ambulance in Japan in 2012 to 2021. Accessed October 19, 2023. <https://www.statista.com/statistics/1057337/japan-time-between-emergency-call-ambulance-arrival/#:~:text=In%202021%2C%20the%20average%20waiting,minute%20longer%20than%20in%202012.>
23. *Price Issuance for Pre-Hospital Emergency Transportation Services for the 115 EMS Center in Hanoi.*; 2017.
24. Unmet Need for Emergency Medical Services in Hanoi, Vietnam. *JMA J*. 2021;4(3):277-280. doi:10.31662/jmaj.2020-0110
25. *Essential Surgery*. 3rd ed. World bank group; 2015.
26. Ministry of Health, Vietnam. *Registration and Treatment under Health Insurance.*; 2022.
27. Beck B, Bray J, Cameron P, et al. Regional variation in the characteristics, incidence and outcomes of out-of-hospital cardiac arrest in Australia and New Zealand: Results from the Aus-ROC Epistry. *Resuscitation*. 2018;126:49-57. doi:10.1016/j.resuscitation.2018.02.029
28. *World Health Statistics 2020: Monitoring Health for the SDGs : Sustainable Development Goals*. World Health Organization; 2020. <https://www.who.int/publications/i/item/9789240005105>
29. Alderwick H, Hutchings A, Briggs A, Mays N. The impacts of collaboration between local health care and non-health care organizations and factors shaping how they work: a systematic review of reviews. *BMC Public Health*.

2021;21(1):753. doi:10.1186/s12889-021-10630-1

30. Mark J. Roberts, William Hsiao, Peter Berman, Michael R. Reich. Getting Health Reform Right: A guide to improving performance and equity. Published online 2008.

31. Kyriacou E, Antoniou Z, Hadjichristofi G, et al. Operating an eHealth System for Prehospital and Emergency Health Care Support in Light of Covid-19. *Front Digit Health*. 2021;3:654234. doi:10.3389/fdgth.2021.654234

32. National Assembly of the Socialist Republic of Vietnam. Amending the health insurance law to quickly resolve voters' petitions. <https://quochoi.vn/tintuc/Pages/tin-hoat-dong-cua-quoc-hoi.aspx?ItemID=76290>. Published May 26, 2023.