ASSESSMENT OF HEALTH CARE WASTE MANAGEMENT IN LAO PDR

PROJECT NAME: LEARNING FROM CHINA'S EXPERIENCE TO IMPROVE THE ABILITY OF RESPONSE TO COVID-19 IN ASIA AND THE PACIFIC REGION

PREPARED BY: THONGDEUANE NANTHANVONE, NATIONAL CONSULTANT

NOVEMBER 2022

Tale of Contents

1. Introduction ... 3
2. Methodology ... 4
3. Objectives ... 6
4. Limitations of the study ... 6
5. Healthcare Waste Management Situational Analysis in Lao PDR ... 6
5.1 Policy and regulatory framework (national level) ... 6
5.2 Breakdown of healthcare facilities in the country ... 9
6. Waste generation rates ... 10
7. Waste management practices – step-by-step ... 13
8. Management of COVID-19 waste ... 17
9. Assessment of the HCWM system's maturity based on the GAVI HCWM maturity model) ... 19
10. Assessment for Disaster Risk Reduction in Health Care Facilities ... 22
Recommendations ... 27
Potential areas for future support ... 28
References ... 29

List of Tables:

Table 1: Compliance of national policy, regulatory framework with WHO international guidelines ... 6
Table 2: How compliance of national policy, regulatory framework with WHO international guidelines ... 8
Table 3: Number of healthcare facilities per province and district ... 9
Table 4: Estimated waste generation rates in key quarantine and isolation facilities in Vientiane Capital ... 11
Table 5: Health care facilities (HCFs) having the following HCWM practices ... 12
Table 6: Status of current waste management practices in healthcare facilities ... 13

List of Figures:

Figure 1: Decision Tree for the Treament of COVID-19 waste ... 18
Figure 2: Disasters in Lao PDR from 1990-2012 ... 22
Figure 3: DRR scoring against GAVI maturity model ... 26

1. Introduction

COVID-19, with its highly contagious and transmissible nature, has led to the exponential increase of healthcare waste generated in healthcare and quarantine facilities, medical laboratories and biomedical research facilities. Additionally, the increase in the amount of personal protective equipment (PPE) used during the COVID-19 pandemic, compared to normal circumstances, has further contributed towards the increase in healthcare solid waste. For example, recent research estimated that every minute 3 million facial masks are thrown away globally and in some cities in the Asia and the Pacific the volume of medical waste has been increased by 500% on average compared with before COVID-19 figures.

If not properly treated and managed, such large amount of waste will pose serious risks of disease transmission to waste pickers, waste workers, health workers, patients, and the community in general through exposure to infectious agents. In addition, unmanaged or poor-managed waste will also cause pollution and create new environmental risks.

COVID-19 has put significant additional burden on all phases of medical waste management systems, from segregation, collection, storage, transportation, treatment to final disposal. In light of the serious issue, international organizations such as WHO have developed a series of guidelines to support the countries manage healthcare waste resulting from the current pandemic. Many countries have also formulated policies, plans and SOPs on COVID-19 medical waste management at national and local levels. However, institutional and capacity gaps continue to persist, such as shortage of waste treatment equipment and facilities, lack of technologies for safe transportation and disposal, lack of professional workers and expertise for safe operations and the need for awareness-raising and behavioral changes towards better management of COVID medical waste etc.

In a recent study conducted in five Asian cities, COVID-19 pandemic has led to an increased the amount of hazardous medical waste by 3.4 kg/bed/day, which is about 10 times higher than the average amount of hazardous medical waste of 0.2-0.5 kg/bed/day (WHO, 2022a). In addition, due to the COVID-19 pandemic, Lao PDR, like other countries, faced a severe waste management problem. In particular, the increase in hazardous waste volume due to the pandemic response, including personal protective equipment (PPE) such as masks, was reported to have quadrupled from an average of 0.5 kg per person per day to 2 kg per person per day (WHO, 2022b). As a result, the COVID-19 crisis is putting tremendous pressure and potential risk on health care workers, health care facility cleaners and waste handlers, waste pickers at waste disposal sites (e.g. landfills), workers at medical waste disposal facilities, as well as creating new environmental risks.

Unfortunately, shortage of effective healthcare waste treatment equipment and facilities, lack of appropriate technologies and know-how for safe collection and transport, effective waste

segregation at sources, safe treatment and final disposal, as well as the need for improved technical capacity, awareness raising and attitudes changes towards better management of medical waste under COVID pandemic situation remain major challenges in Lao PDR.

2. Methodology

The study draws its findings from various data collection instrument including a desk review, key informant interview (KII), expert opinion survey and a national validation workshop. The desk review focused on available survey findings in the field of healthcare waste management, national laws, policies, guidelines, administrative data from the MOH records. KIIs were conducted with six experts from the government and development partner agencies. Expert opinion survey was administered via online survey from (using Kobo toolbox). They questionnaires were distributed to over 90 tentative respondents with 35 respondents returned to the questionnaire. The national validation workshop was held to discuss the finding from all the various instruments and consolidated and confirm the key findings and conclusions including the findings and recommendations from the regional study.

As in other participated countries, a framework of assessment was collectively developed and adopted to guide the analysis of collected information vis-à-vis international guidelines and best practices. The assessment framework includes the parameters as shown in the table below.

ASSESSMENT FRAMEWORK PARAMETERS	
▪ ***National policy and regulatory framework*** ▪ ***Breakdown of health care facilities country-wide*** ▪ ***Waste generation rate*** ▪ ***Basic waste management practices***	▪ *Steps in the waste management chain* ▪ *Management of COVID-19 waste* ▪ *Case studies*

The analysis draws on various data sources such as recently survey findings carried out by WHO, MOH and WB. The gaps were identified and addressed through expert opinion survey and KIIs.

The Gavi HCWM maturity model was used to benchmark HCWM system against international best practice. This is a qualitative method of assessment which looks at broad areas of waste management including people, processes, and technology. Six areas of assessment are assessed at levels 1 through 5, with 1 being the lowest level of assessment and 5 the highest. The study assessed the country's performance in each of the six areas of assessment based on the data and information collected through literature review and supplementary methods of collection.

The assessment of DRR in health care facilities relies on three methods including desk review, expert opinion survey and a national validation workshop. Desk review was carried out by reviewing relevant documents from MOH, MONRE, WHO, WB, UNDP, and other originations. The opinion survey was implemented by sending out the survey questionnaire to over 90 respondents. 35 respondents replied. The findings from the survey were then validated through a national workshop which 40 participants attended.

Table 1. Areas of assessment under the Gavi HCWM maturity model[1]

PEOPLE	1. **Awareness, training and supportive supervision:** Looks at the availability of training for health care workers and waste handlers on HCWM (both pre-service and in-service) and the level of integrated supervision that incorporates HCWM such as monitoring the availability and proper use of safety boxes for syringes; and tracks comprehension of best practices in HCWM. 2. **Adherence and compliance:** Assesses the level of adherence to best HCWM practices across the entire process, from point of generation to point of disposal. Monitoring and evaluation frameworks and key performance indicators in place and supported through supervision.
PROCESSES	3. **National policy/strategic plans:** Includes national policies and strategic plans for HCWM (including any immunisation specific policies or guidance); laws and regulations related to HCWM; and environmental impacts and policies on environmental sanitation and hygiene – to list a few. 4. **Budget and planning:** Reflects the country having developed an appropriate budget that is fully funded and supports realistic needs. Budgets should be linked to resources and tools needed across all steps of HCWM, such as colour-coded bags at the facility level, transport for waste, treatment and disposal sites, and maintenance for HCWM equipment. 5. **Practical guidance:** Looks at the hands-on tools such as standard operating procedures (SOPs), communication guidance, and job aids for health care workers and waste handlers directly involved in generating and managing waste.
TECHNOLOGY	6. **Technology and equipment availability and use:** Beyond equipment for treatment and disposal, this key area also incorporates all of the tools and supplies needed for HCWM. This begins with colour-coded collection technology at point of generation of waste, resources for occupational health and safety such as personal protective equipment, through the entire management process until disposal. This area should also consider maintenance for equipment to ensure functionality and overall sustainability.

3. Objectives

The main objective of the study is to better understand the most pressing issues on healthcare waste management in Lao PDR and develop recommendations to address them. The study involved key government counterpart such MOH who took ownership of the research process and will carry forward to the work around healthcare waste management. They study took the following approach the achieve the main objective.

- Understand the current situation regarding healthcare waste management
- Assess the current institutional and human resource capacity gaps regarding healthcare waste management
- Prioritize the pressing issues according to the urgency of the issues and develop recommendations to address them.

4. Limitations of the study

Due to the limited time frame available for the study, a comprehensive survey with sufficient sample size could not be done. Thus, the study relied heavily on the secondary data analysis, key informant interviews (KIIs) and expert opinions survey.

5. Healthcare Waste Management Situational Analysis in Lao PDR

5.1 Policy and regulatory framework (national level)

In Lao PDR, there is no basic law on waste management. However, waste management is basically stipulated in the Environmental Protection Law, which defines the types of waste into two types of waste including general waste and hazardous waste. Table 1 below shows review of the national policy and regulatory framework that focuses on the hazardous waste from the healthcare facilities.

Table 1: Compliance of national policy, regulatory framework with WHO international guidelines

Country: Lao PDR					
Laws, regulations, administrative orders, etc.	**National policy on HCW**	**National strategy on HCW**	**National action plan or Implementation plan**	**Technical guidelines**	**National HCWM coordination mechanism**
1. Law on Immunization 2018, Article 30: Destruction of Vaccines and Immunization Equipment. *2. Law on Prevention and Disease Control 2017, Article 17: Hygiene*	*National Policy for Health Laboratories 2012 (MoH)*	*National Pollution Control Strategy and Action Plan 2018-2025, with Vision to 2030 (Full draft #16), Chapter I.3.6: Hazardous Waste.*	*National Deployment and Vaccination Plan for COVID-19 Vaccines, Chapter 7.2: Biohazard and Immunization Waste Management (May 2021, MOH)*	*1. Guideline on Hygiene and Disinfection for COVID-19 Prevention 2021 (Department of Hygiene and Health Promotion, MOH).* *2. National Guideline for Domestic Specimen Packaging and*	*Not established yet*

and Environment Protection. 3. *Law on Health Care 2014, Article 23: Medical Materials and Equipment.* 4. *Ministerial Decision on Environmental and Hygiene at Health Facilities 2018.* 5. *Ministerial Instruction on Hazardous Waste Management 2015.* 6. *Regulation on National Biosafety 2019.* 7. *the Minister of Health's Decision on Health-care Waste Management*				*Transportation 2020 (National Center for Laboratories and Epidemiology, MOH).* 3. *Guideline on Sharps Waste Management 2019 (Department of Planning and Cooperation, MOH).* 4. *National Laboratory Quality Standard 2018 (National Center for Laboratories and Epidemiology, MOH).* 5. *Guidelines on National Biosafety 2016 (National Center for Laboratories and Epidemiology, MOH).* 6. *Guideline on Prevention and Infectious Control at Primary and Secondary Healthcare Facilities 2016 (Department of Healthcare and Rehabilitation, MOH)*	

Note: Lao PDR does not have the Law on Healthcare Waste Management in place yet

As shown in the Table 1, the policy and regulatory framework of the country is quite comprehensive with well-developed laws, regulations, administrative orders; national policy on healthcare waste, national strategy on healthcare waste, national action plan or implementation plan; and technical guidelines. Yet the country has no formal HCWM coordination mechanism. In the Law on Prevention and Disease Control 2017, the environmental prevention refers to hygiene practice and disposal of hazardous wastes or any waste that is potentially harmful to physical and mental health and society. Individuals, entities, and organizations need to appropriately dispose and treat the waste and sludges; protect the water source, ensure the cleanliness of the public road, cannel, toilet or latrine, public venue and other facilities that could spread the infectious diseases (Article 17). In the Law on Health Care 2014, Installation of medical materials and equipment in public and private health-care establishments at different levels shall comply with the standards of the Ministry of Health. Damaged materials or equipment, which cannot be repaired or whose period of use has expired, shall be removed in accordance with the regulations of the Ministry of Health (Article 23).

The country also developed the National Deployment and Vaccination Plan for COVID-19 Vaccines. The Plan has been prepared to support the effort of the Ministry of Health by providing COVID-19 vaccination to all people, starting with priory groups recommended by the WHO. The plan includes technical specifications for specific components of biohazard and immunization waste management. In the preparation of this guideline, consideration has also been given to the Lao PDR Ministry of Health's vaccination plan for routine immunization, as well as vaccine waste management. Furthermore, specific guidelines have also been developed for example, Guideline on Hygiene and Disinfection for COVID-19 Prevention 2021, and the National Guideline for Domestic Specimen Packaging and Transportation 2020 (see Table 1 for more detailed information).

As shown in the Table 2 below, Lao PDR comply with almost all the WHO international guidelines including a minimum approach to segregation, storage and transport, guidance for waste minimization, reuse and recycling, guidance for safely collecting HCW within health-care facilities. However, the country is only partially compliant with guidance for offsite transport of waste and non-compliance with guidance on collection and treatment of wastewater from health-care facilities.

Table 2: How compliance of national policy, regulatory framework with WHO international guidelines

Compliance to WHO international guidelines	**Section**	**Yes/Partially/No**
Definitions of HCW categories	2	Yes
- Minimum approach to segregation, storage and transport	7.8	Yes
- Guidance for waste minimization, reuse and recycling	6	Yes
- Guidance for safely collecting HCW within health-care facilities	7.3	Yes
- Guidance for interim storage within medical departments	7.4	No
- Guidance for onsite transport of waste	7.5	Yes
- Guidance for central storage within health-care facilities	7.6	Yes
- Guidance for offsite transport of waste	7.7	Partially
- Guidance on permissible waste treatment technologies for specific waste categories? o Sharps o Pathogenic o Chemical o Pharmaceutical o Cytotoxic o Waste containing heavy metals	8.11	Yes
- Guidance on minimum approach to treatment and disposal	8.13	Yes
- Guidance on collection and treatment of wastewater from health-care facilities	9	No

Lao PDR has followed WHO guidance on WASH and Waste Management for COVID-19. It follows key principles for safe management of the medical wastes: 1) reduction of unnecessary wastes; 2) separation of general waste from hazardous wastes, and waste treatment that reduces risks to health workers and community. Implementation of Waste Management for COVID-19 follows the system at national and health care facility levels which has begun development of national training program in health care waste management in 2015. National and provincial trainer guides were prepared in 2015-16. The country endorsed the environment health standards for health facility in 2017. Autoclave was introduced to the country with support from the Austria government at central hospitals. Assessment of the used of

autoclave recommend continuing expanding the application of autoclave in other hospitals at subnation level, while shredder is not recommended.

The regulation on vaccine lies with the Law on Immunization 2018. Article 30 of the Law addresses vaccine waste disposal. The Article stipulated that the Impotent vaccines and already used vaccine vials and/or ampules must be destroyed in accordance with the principles and international standards by burning in at least one-meter-deep hole then firmly fill up with soil. The destruction of immunization equipment such as syringes, and the impotent immunization needles and used needles must follow the principles and international standards by using specific incinerator with the heat over 800 degrees Celsius and other separate measures stipulated in other specific regulations. Ministry of Natural Resource and Environment's Ministerial Instructions on Hazardous Waste Management 2015. In addition, the MONRE also issued the Decision on the Management, Monitoring, and Inspection of the Treatment and Disposal of Contaminated and Hazardous Waste 2021. The Decision prescribes principles and measures regarding the management, monitoring, and inspection of the treatment and disposal of wastes contaminated with hazardous substances to ensure that the treatment and disposal comply with the procedures and techniques which minimize the impact on the health of humans and the environment.

5.2 Breakdown of healthcare facilities in the country

Table 3 provides a breakdown of the number of healthcare facilities (both public and private) in Lao PDR.

Table 3: Number of healthcare facilities per province and district

No.	Name of City/Province	Number of Public Referral Hospitals			Health Center	Army Hospital	Police Hospital
		Central	Provincial	District			
1	Vientiane Capital	8	0	9	33	2	1
2	Phongsaly	0	1	6	50	1	0
3	Luangnamtha	0	1	4	40	1	1
4	Oudomxay	0	1	6	53	2	0
5	Bokeo	0	1	5	40	1	0
6	Luangprabang	0	1	12	83	1	0
7	Huaphanh	0	1	9	75	1	0
8	Xayabury	0	1	10	77	3	0
9	Xiengkhuang	0	1	6	56	2	0
10	Vientiane Province	0	1	11	46	3	0
11	Borikhamxay	0	1	6	42	1	0
12	Khammuane	0	1	9	91	1	1
13	Savannakhet	0	1	15	158	2	1
14	Saravane	0	1	7	72	1	0
15	Sekong	0	1	3	30	1	0
16	Champasack	0	1	9	77	6	1
17	Attapeu	0	1	4	33	1	0
18	Xaysomboun	0	1	4	18	2	0

No.	Name of City/Province	Number of Public Referral Hospitals			Health Center	Army Hospital	Police Hospital
		Central	Provincial	District			
Total		**8**	**17**	**135[1]**	**1,074[2]**	**32**	**5**

Source: MoH, April 21, 202. http://hfml.la/hospital.html
**Number of private HCFs is not available for public access*

6. Waste generation rates

According to the Guideline on Prevention and Infectious Control at Primary and Secondary Healthcare Facilities 2016, prepared by Department of Healthcare and Rehabilitation, Ministry of Health, medical waste is defined as the waste (solid, liquid, gases) from health facilities and medical laboratories; and the waste from "a place" or "fragile areas" such as the waste from home treatment e.g., home dialysis, insulin injection for diabetes patient.

Based on the guideline, medical waste handling is classified into two types:

- Non-Hazardous Waste: General waste (e.g., office waste, household waste, non-infectious plastic etc.); the waste that does not contained poison or disease that is harmful to human and environment.
- Hazardous Waste: COVID-19 and infectious wastes (flesh, bandage, blood, etc.), sharp waste, immunization waste, pharmaceutical waste, chemical waste, radioactive wastes; wastes that have the following characteristic: explosive, oxidizing high flammable, irritant toxic, teratogenic, mutagenic, carcinogenic, ecotoxic, corrosive etc.

In April 2022, MOH commissioned a Rapid Assessment of Health Care Waste Management, Wastewater treatment facility and Sanitation of 12 Target Provincial Hospitals. The objective of the assessment is to assess urgent and basic needs of HCWM, wastewater management and IPC measures. Data collection methods include interviews with facility personnel and site observation. The findings show that health care facilities have limited waste management capacity and inadequate logistics and equipment required to effectively carry out health care waste management. There are no intermediate storage facilities at the Houayhong and km 27 stadium COVID-19 field treatment facilities. There is a lack of supplies for waste separation, collection, intermediate transport and on-site treatment. Wastewater treatment facilities are malfunctioning. A half of wastewater treatment facilities are not functional at Lanxang and Houyhong sport centers[3].

[1] Lao PDR has two type of district hospitals. Type A can delivery surgery services: type B doesn't have the service. Of 135 district hospitals, 102 is type B.
[2] There are two types of health center in Lao PDR. Type A can delivery both inpatient and outpatient services, type B can delivery only outpatient service. Of 1074 health center, 173 is type A which as 3-5 health professionals. Most of health center type B are located in rural and remote areas with 1-3 health professionals.
[3] Ministry of Health (2022). *Rapid assessment of health care waste management, wastewater treatment facility and sanitation of 12 target provincial hospitals*.

Table 4: Estimated waste generation rates in key quarantine and isolation facilities in Vientiane Capital

No.	Designated isolation and healthcare facilities	Total bed available	Number of patients	Accuracy rate	Average amount of waste generated	Infectious waste	Sharp waste	Assessment date
	Lanexay Sport Center – COVID-19 quarantine and isolation facility	300	55	18,3%	50 kg/day	50% (estimated), mostly PPEs	0	May 12, 2021
	Huayhong Sport Dormitory – COVID-19 quarantine and isolation facility	152	99	65%	400 kg/day	Up to 50%	0	May 12, 2021
	Km 27 Isolation and treatment facility	500	137	27.4%	800 kg/day	Up to 50%	0	May 12, 2021

Waste Generated at Mahosod Hospital and Children Hospital[4]

According to survey conducted by WHO and Water & Environment International, LL (2016), the Mahosot hospital is the tertiary level hospital and one of the biggest central hospitals in Lao PDR. It is a 450 bedded hospital established in 1903 with the support of Lao government. It provides all general health services to public, but is specialized in heart surgery and abdominal surgery. It also provides COVID-19 vaccination services. Follow the findings of the rapid assessment of health care waste management at the hospital between 28th November 2015 and 11th December 2015, conducted by Water & Environment International, with the support of WHO, the hospital generated 556.06 kg of waste per day during 58% occupancy out of which 50 percent was hazardous and 50 percent was general before separation of the waste. Nearly 37 percent of the waste generated can be sent for recycling. The waste generation is

[4] WHO and Water and Environment International, LLC, (2016)

projected to go up to 957.02 kg during 100 percent occupancy. The waste generation rate of the hospital is 2.21 kg per patient per day.

Children hospital is specialized hospital for diagnostic and treatment of children in Lao PDR. The hospital is 70 bedded established in November 2011. The hospital infrastructure construction was supported by KOIKA, Korean fund and the operation cost is supported by Lao government. According to the assessment conducted by the Water & Environment International, LLC in 2015, the hospital generated 90.14 kg of waste per day during 77 percent occupancy out of which 66 percent was hazardous and 34 percent was general before separation of the waste. Nearly 25 percent of the waste generated can be sent for recycling. The waste generation is projected to go up to 117 kg during 100 percent occupancy. The waste generation rate of the hospital is 1.88 kg per patient per day.

Basic management practices

Percent of health care facilities (HCFs) having the following practices:

Table 5: Health care facilities (HCFs) having the following HCWM practices

Name of country: Lao PDR				
Level of health service	**Level of HCWM in practice**			
	None	**Limited**	**Basic**	**Higher**
a) Central hospital			✓	✓
b) Provincial hospital			✓	✓
c) District hospital		✓	✓	
d) Health center		✓		
e) Army hospital			✓	
f) Police hospital			✓	

Note: Healthcare facilities in Lao PDR consist of four level, including central, provincial, district, and health center. It does not set up have a health post and nurse stations. Head nurses or assistant head nursed are commonly assigned to be a chief of ward to in-charge nursing care and nursing process toward patients directly at all levels of the health facilities, but they do not really have their specific stations to prepare their administrative tasks.

Legend

None – There are no separate bins for sharps or infectious waste, and sharps and/or infectious waste are not treated or disposed.

Limited – There is limited separation and/or treatment and disposal of sharps and infectious waste, but not all requirement for basic service are met.

Basic – Waste is safely segregated into at least three bins, and sharps and infectious waste are treated and disposed safely.

Higher – Health care waste management practices that exceed basic. This may include, for example, safe management of other waste categories (pathological, chemical, pharmaceutical,

cytotoxic, and radioactive) that comply fully or at least partially with international guidelines and national regulations.

7. Waste management practices – step-by-step

Due to the COVID-19 pandemic, Lao PDR, like other countries, faced a severe waste management problem. In particular, the increase in hazardous waste volume due to the pandemic response, including personal protective equipment (PPE) such as masks, was reported to have quadrupled from an average of 0.5 kg per person per day to 2 kg per person per day (MOH, 2022). This section presents status of waste management practice healthcare facilities across the country. The findings are drawn from two survey i) a rapid survey of 12 central and provincial hospitals carried out by MOH (2022) with WB support and ii) the WASH FIT survey on 14 district and communities' health facilities in central and norther parts of the country carried out UNDP (2022).

As show in Table 6 below, waste segregation at source remains a big concern, only 62 percent of the surveyed facilities performed well. All facilities had performed better with color coded rubbish bins at 77%. Only about 38 percent had dedicated area for waste storage before treatment. Only about 46 percent had a proper infectious waste storage system. however, all had reported they treated hazardous waste before final disposal (see table 6 below for more details).

Table 6: Status of current waste management practices in healthcare facilities

Name of country: Lao PDR		
Classification and segregation	**Frequency** **26**	**Percentage** **100**
Wastes segregated at source		
Perform well	16	62%
Perform partially well	3	12%
Perform poorly	1	4%
Data not available	6	23%
Color coded containers with labels for different categories of waste		
Perform well	20	77%
Perform partially well	4	15%
Perform poorly	2	8%
Data not available		
Enough color-coded and labeled buckets available		

Perform well		
Perform partially well		
Perform poorly		

Name of country: Lao PDR		
Waste collection and handling	**Frequency 26**	**Percentage 100**
Waste collection system		
More than once per day	26	100
Once per day		
Less than once per day		

Name of country: Lao PDR		
Waste storage	**Frequency 26**	**Percentage 100**
Dedicated area for waste storage before treatment		
Yes, protected	10	38.46
Yes, protected but not adequate	4	15.38
Yes, not protected	12	46.53
No		
Storage area needs to be expanded		
Yes	4	33.33
No	8	66.66
Don't know		
Infectious waste stored as per regulations/guidelines		
Yes	12	46.53%
No		
Don't know		
Infectious Waste Management performance	26	100
Perform well	8	29
Perform partially well	1	4.91
Perform poorly	4	16.08
Data not available	13	50

Name of country:		
Waste treatment and disposal	**Frequency 26**	**Percentage 100**

Treatment of infectious waste before final disposal		
Yes, always or almost always	26	100
Yes, sometimes		
No, never or almost never		
Treatment of infectious waste		
Offsite	16	61.54
Onsite	10	38.46
Both off site and on site		
Untreated or don't know		

Name of country: Lao PDR		
Methods of treatment and disposal	**Frequency 26**	**Percentage 100**
Treatment of infectious waste		
Autoclave	Yes	
Microwave	No	
Incineration	yes	
Offsite HCWM treatment		
Treatment and disposal of sharp waste		
Autoclave		
Incineration	20	76.92
Offsite HCWM treatment		
Open burn pit		
Onsite fenced burial		
Onsite open pit		
Encapsulation		
Septic concrete vault		
Sharp pit	6	23.08
Treatment and disposal of pharmaceutical/chemical/cytotoxic waste		
Incineration	6	23.08
Chemical degradation and neutralization		
Offsite HCWM treatment		
Open burn pit	20	76.92
Onsite fenced burial		
Onsite open pit		
Encapsulation		
Septic concrete vault		
Return to supplier		

Name of country: Lao PDR		
Wastewater treatment and disposal	**Frequency 26**	**Percentage 100**
Wastewater treatment plant onsite		
Yes, fully functional and sufficient capacity	14	53.84
Yes, partially functional and/or insufficient capacity	12	46.16
No, not present or present but not functional		

Name of country: Lao PDR		
Vaccination waste	**Frequency**	**Percentage**
Provide regular vaccinations through national immunization programme	12	46.15
Provide COVID-19 vaccinations	26	100
Correctly collect and segregate general vaccination waste		
Correctly collect and segregate COVID-19 vaccination waste		
Syringes destroyed using needle cutter/destroyer		
Syringes disposed in safety boxes/sharp containers	26	100
Vaccination waste treated with autoclave or microwave	26	100
Receive vaccination waste including safety boxes from other centers	12	46.16
Has adequate quantities of safety boxes/sharp containers		
Management of safety boxes filled with vaccine sharp waste		
Autoclave		
Incineration	26	100
Chemical disinfection		
Offsite HCWM center		
Onsite fenced burial pit		
Onsite open pit		
Open burn pit		
Septic concrete vault		
Transferred vaccination waste to another HCF		

Transport sharp waste to treat at the OD		
Covid-19 vaccine service waste management and disposal	Frequency 26	Percentage 100
Perform well	13	50.83
Perform partially well	1	3.33
Perform poorly	5	20.83
Data not available	7	25.01

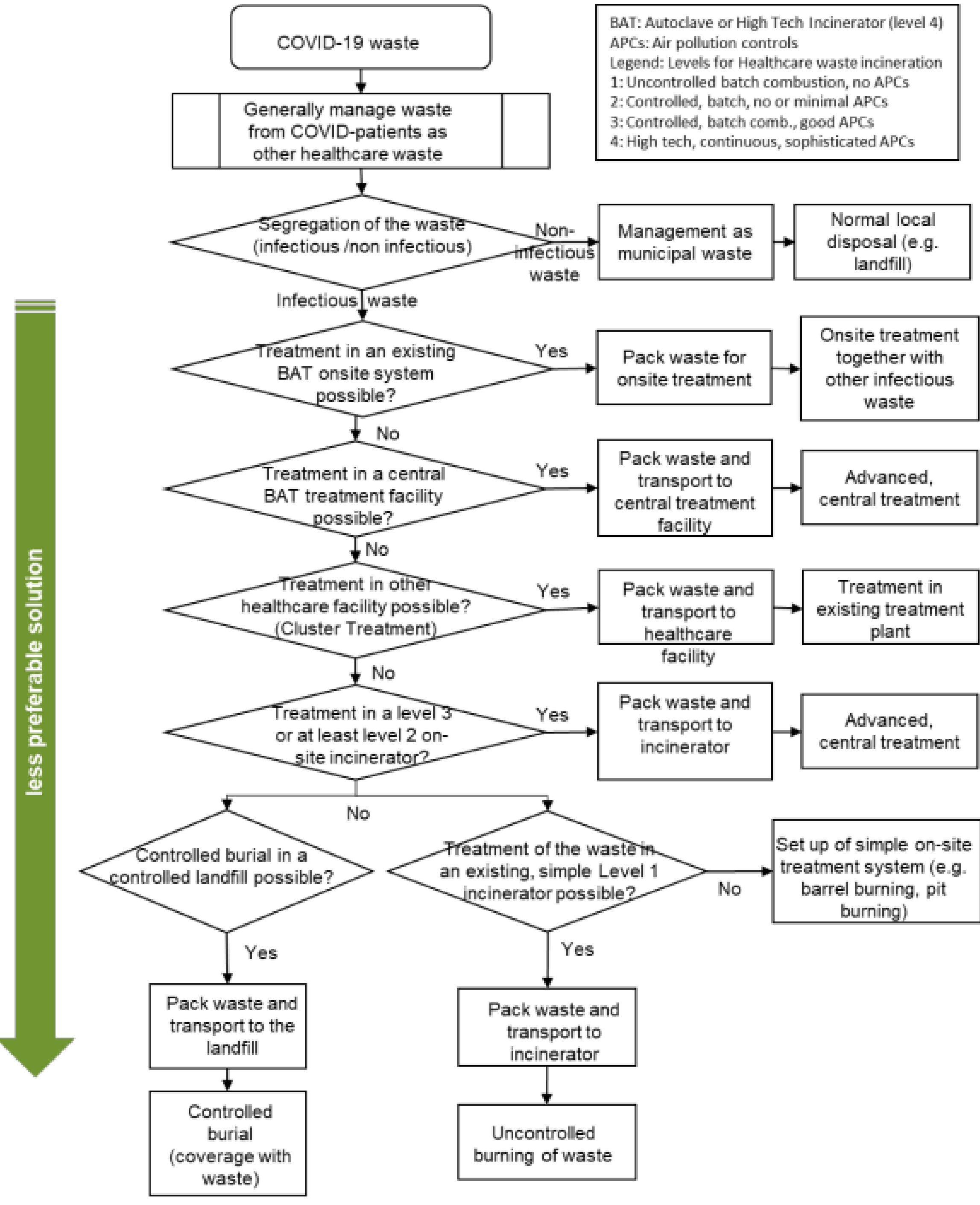
8. Management of COVID-19 waste

During the Covid-19 pandemic, Covid-19 vaccination sites were set up in each province and vaccination campaigns are implemented at provincial hospitals, provincial maternal and child health sector and district health offices at all districts across the country.

Lao PDR has national guidelines for management of COVID-19 waste called, "National Deployment and Vaccination Plan for COVID-19 Vaccines" (NDVP) (May 2021). The Department of Hygiene and Health Promotion (DHHP) from the Ministry of Health (MoH) in Lao PDR has developed this NDVP in collaboration with World Health Organization (WHO). The National Deployment and Vaccination Plan (NDVP) for COVID-19 vaccines defines the processes and structures required for deployment of COVID-19 vaccines and related supplies and subsequent rapid vaccination of target population.

The national guidelines for management of COVID-19 vaccines comply with the international guidelines of WHO. Consistent with WHO guideline, the capacities and requirement for storage and transport of vaccine and required equipment were assessed. Waste management capacity was also assessed and laid out the strategies and methods for waste collection, transport, treatment, and disposal of hazardous waste materials generated from immunization sessions. Sufficient workforce adequately trained will ensure efficient deployment and vaccination. Similar to WHO guidelines, all hazardous waste material (syringes, needles, vaccine vials, and PPE) generated from the immunization sessions will be collected and transported by road to the nearest waste treatment and disposal facility. Vaccine vials will be safely buried at the designated landfill area, while safety boxes containing sharps will be sealed and transported to the district and then to the province for incineration or to be treated by autoclave. Collection and transport of all hazardous waste material will be collected by trained personnel and properly equipped with protection materials. The frequency of collection routes, and destinations of all medical waste generated by the immunization activities will be clearly defined by the Focal Point for Logistics with the provincial and district National Immunization Program (NIP) staff.

Figure 1: Decision Tree for the Treament of COVID-19 waste



9. Assessment of the HCWM system's maturity based on the GAVI HCWM maturity model

The Gavi HCWM maturity model is adopted for this assessment and consistent with other participated countries. It is not a full-scale assessment as the assessment is based on the representative sample instead of a census. The model consists of six HCWM related areas and arranged into five levels maturities from lowest of one to highest of five. The results show that the higher in the scale the better is the system. See Figure 13 below for the full model.

Table 13. Areas and Levels of GAVI Maturity Model

	AREA	LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4	LEVEL 5
PEOPLE	**Awareness, training and supportive supervision**	Low level of awareness of risk associated with HCW (less than 40%)	Moderate awareness of risk associated with HCW; curriculum developed but not fully rolled out (implemented in 41%–50% of facilities)	A significant proportion of health workers and waste handlers (51%–75%) are trained on the risks associated with HCW and clear guidance on HCWM is available at most facilities	High level of awareness of HCW risk. 76%–85% health care workers and waste handlers have undergone training and have access to on-going training	More than 85% of health workers and waste handlers are trained and are aware of risks associated with HCW and demonstrate BEP. HCWM is included in supportive supervision activities
PEOPLE	**Adherence and compliance**	Little insight into adherence of best practices for HCWM	Have insight and best practice of HCWM available (SOPs and job aids) but not practiced (less than 50% of facilities adhere and comply)	Best practices of HCWM being adhered to in at least half of the facilities; minimal M&E in place.	Significant compliance to the best HCWM practices. M&E framework in place with some tracking of adherence	Country fully adheres to the best practices; M&E framework tracks adherence to policies and guidance
PROCESSES	**National policy/ strategic plans**	Policy is needed or currently being developed. No recent HCWM assessment carried out (within the last 5 years)	Policy developed and/or reviewed within the last 5 years. HCWM assessment carried out within the last 5 years	Policies and guidelines are disseminated and partially adopted	Country can show that the policies and guidelines are fully implemented at all levels of the system	Policies widely adopted across the country. Evidence that WM performance gaps are addressed in strategic planning and financing mechanisms at national and sub-national levels.
PROCESSES	**Budget and planning**	HCWM is not planned and budgeted	Budgeted but not directly linked to realistic needs or assessment findings	At least half of facilities develop a HCWM budget and implement specific plans	Budgets are available, funded and tracked at 75% of system levels	HCWM is 100% budgeted at national and sub-national levels.
PROCESSES	**Practical guidance**	Need, or currently being developed	Guidance developed but not fully in use (used in less than 50% of the facilities)	Guidance is developed and in use in 50%–65% of the facilities within the country	Guidance is available and being implemented at most (65%–85%) system levels	Guidance is available and in use at more than 85% of facilities within the country
TECHNOLOGY	**Technology and equipment availability and use**	Not aware of BAT and BEP. Out-of-date, inefficient, non-environmentally friendly options for treatment and disposal	Awareness of the recommended BAT and BEP options but still using out-of-date equipment and technology	Some BAT equipment available at 50% of facilities (or 50% accessing services) and/or at least 50% of the waste being generated is treated and disposed using globally accepted technologies	Globally accepted equipment is widely (more than 51%) available; most facilities are clustered and mapped to an acceptable treatment technology	Only efficient and BAT used to manage HCW. Environmental monitoring of waste treatment and disposal done in compliance with national and/or global standards

---

The findings for Lao PDR draw on the KIIs, expert opinion survey and national validation workshop. Lao has followed the WHO's guidance on WASH and Waste Management for COVID-19. Healthcare waste management has become part of WASH Facility Improvement tool (WASH FIT) developed by the WHO. Survey results show that 55% respondents reported well aware of risks associated with health care waste. The WASH FIT was developed into a national training program including health care waste management in 2015, there is limited financial capacity to roll out the training nationwide. The guidelines and operating procedures (SOP) of the Infection Prevention and Control (IPC) are in place but less than 50% performed well on compliance. MOH, with support of WHO, has developed HCWM policy and plans and has been rolling out an Infection Prevention and Control program with finance from the World Bank. The program provides support for COVID-19 waste management. HCWM is the least prioritized in budgeting process. All respondents reported insufficient budget for HCWM in participated provincial hospitals and Covid-19

treatment centers. Most provincial hospitals have contracted with a private sanitation company to provide sanitation/cleaning services at the hospital, where the company dispatched sanitation staff to clean for health screening and treatment services units at all buildings facilities, including waste transport to the hospital waste collection area and waste transportation from hospital to landfill. The guidelines of IPC, especially the waste at the COVID-19 treatment center was distributed to most facilities which suggest all infected waste and all types of waste are incinerated or sterilized by autoclave then transported to the provincial management units then to the landfills. All types of waste are incinerated or sterilized by autoclave which is not a non-burn technology. Table 14 below shows the result for Lao PDR.

Table 14. Assessment of the Lao PDR HCWM system's maturity

Country:			
Area		**Level Ranking**	**Basis for ranking**
People	Awareness, Training and Supportive Supervision	3	Awareness about HCW remains low. There is training, but that training does not cover all health personnel. When there is training or awareness activities the dissemination have not yet reached the actual practitioners. Motivational measures and various media are not developed and utilized enough. There is no serious monitoring of how the training in theory is put into practical use. In conclusion, training alone is not the best option to lead to practical implementation.
	Adherence and compliance	3	Lao has followed the WHO guidance on WASH and waste management for COVID-19 and HCWM has been integrated in the WASH FIT framework which was developed into a national training program in 2015. However, there is limited financial capacity to roll out the training nationwide. The guidelines and SOP of the IPC are in place but less than 50 percent performed well on compliance. In general waste segregation between infectious, sharp and common waste remain poorly performed, so that there is a high level of infectious waste, thus it is not possible to treat all the infected waste before removing it to the municipal land field. Management of medical waste in service facilities is a priority so that hospitals do not become a source of infection, there are actually policy and practices such as segregation, disinfecting of waste before disposal, but that does not mean that all service facilities do so. At the same time, on the social side, there is no measure by the

			public sector to enforce the disposal of contaminated waste. There are regulations but no strict enforcement and penalties for non-compliance.
Processes	National Policy and Strategic Plans	3	The MOH, with the support of WHO, has developed HCWM policy and plans and has been rolling out an IPC program with finance from the World Bank. The program also provides support for COVID-19 waste management. There is enough policy but implementation and turning policy into action is inadequate. Coverage of such programs is limited to some areas only and targeting of these program is not based on a systematic method due to lack of data. Dissemination of the policy can only be done with some facilities, in communities even more limited
	Budget and Planning	2	HCWM is the least prioritized in budgeting process. All respondents reported insufficient budget for HCWM in participated provincial hospitals and COVID-19 treatment centers. Until now, the budget for training, promotion and follow-up is still very small, and the supply of equipment for waste management is not enough.
	Practical Guidance (HCWM)	2	Most provincial hospitals have contracted private sanitation companies to provide sanitation and cleaning services. The services cover cleaning of health screening and treatment services units at all buildings facilities, including waste transport to the hospital waste collection area, and waste transportation from hospital to landfill.
Technology	Technology and Equipment Availability and Use	2	The guidelines of IPC specifies that wastes from COVID-19 treatment centers are considered infected waste and all types of waste are incinerated or sterilized by autoclave, and which are then transported to the provincial management units and eventually to landfills. The distribution of waste treatment equipment has not reached the need and is not enough to deal with the waste generated on a daily basis.
	Total	15	
	Number of Areas	/6	

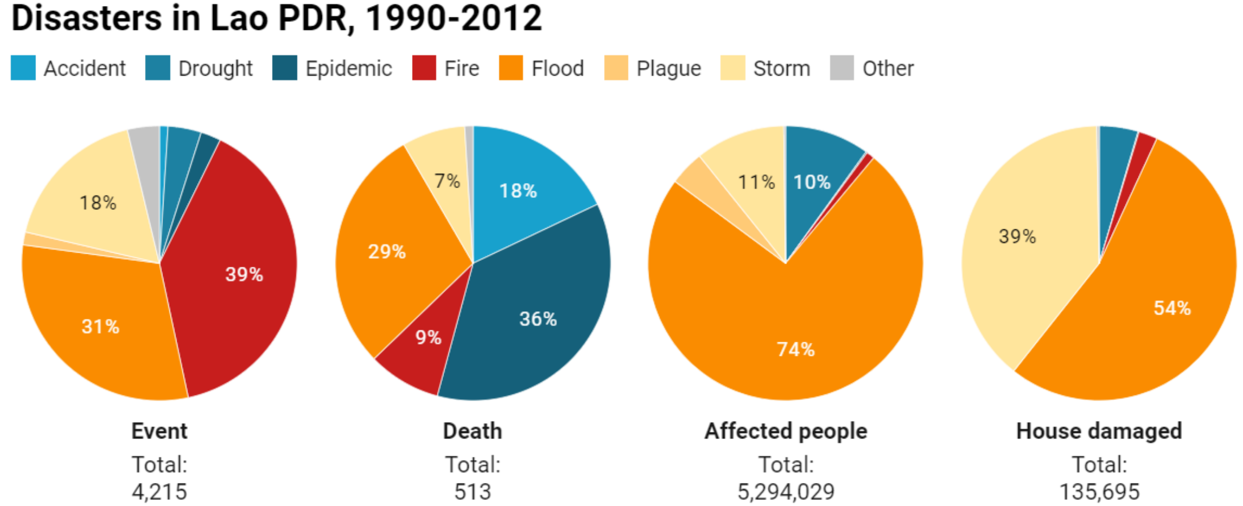
	Overall Score	2.5	

10. Assessment for Disaster Risk Reduction in Health Care Facilities

Laos is vulnerable to several types of disasters. Floods and landslides are prevalent, while droughts also occur in some years in different regions. Additionally, pests and disease are likely surging under the changing climate and environment.

Figure 2 below show records of disasters happened from 1990 to 2012. Flooding, fire, and storms are the most prevalent. The flooding affected more wider than other type of disasters. Likely, floodings could infringe damages to health facilities and their waste management system. Therefore, DRR in health care waste management system is relevant and become more so as it is realized that HCWM has also contributed to the occurrence of the extreme weather events.

Figure 2: Disasters in Lao PDR from 1990-2012



Source: Open development Laos 2019.

Lao PDR is exposed to high climate and disaster risks, including floods, landslides, droughts, and tropical storms and cyclones. Vast stretches of land are also heavily contaminated by unexploded ordinance (UXO). From 1990 to 2012, 33 natural hazard events (mostly floods and droughts) were registered, affecting almost 9 million people causing economic damage of more than US$400 million. Flooding is the major natural hazard in Lao PDR, with the Mekong River as its primary source. The river basin hydrology leads to extreme flooding in one portion of the basin, with average or below-average water levels prevailing elsewhere.

The development of hydroelectric dams has led to the hydrology of the Mekong River being increasingly affected by the regulation of releases from them. High vulnerability and substantial capacity gaps exacerbate the frequency, intensity, and impacts of disasters in Lao PDR. Some 70 percent of the country's population work in the agriculture sector, which is heavily affected by climate-related events. The country's reliance on extractive uses of natural resources also increases climate and disaster risks while causing environmental degradation. Resilience at the community level is low due to the prevalence of monoculture, lack of diversity in livelihoods, and limited infrastructure. Increased variability in precipitation and temperatures associated with climate change is projected to have severe impacts on crops, livestock, fisheries, and human health. The poor and vulnerable will be most affected, as they have fewest options to mitigate risks.

In 2018, the Ministry of Health (MOH) reported 37 public health facilities (35 health centers and 2 district hospitals) affected by the floods across 10 provinces, out of a total of 688 health facilities (615 health centers and 73 district hospitals). The post-disaster needs assessment (PDNA) only covered 23 health facilities in six provinces (Attapeu, Champasack, Savannakhet, Khammuane, Xiengkhuang, and Huaphanh), however the selection of which was based on the severity of flooding. Of these, 3 facilities were completely destroyed and 20 damaged (PDNA, 2018)[5]. The PDNA does not take into account damage to the waste management system. There is clearly a need to understand more about the DRR in HCWM in the country.

Table 15. Level of assessment of DRR for health care facilities

	AREA	LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4	LEVEL 5
PEOPLE	Awareness, training & supportive supervision	Low level of awareness of disaster risks associated with health care facilities & reduction measures (<40%)	Moderate awareness of disaster risks associated with health care facilities & reduction measures. Curriculum developed but not fully rolled out. (Implemented in 41-50%)	A significant number of health workers & waste handlers (51-75%) are trained on DRR for health care facilities and clear guidance on DRR is available at most facilities.	High level of awareness on DRR for health care facilities. 75-85% of health workers and waste handlers have undergone training and have access to on-going training.	More than 85% of health workers and waste handlers are aware of DRR for health care facilities and demonstrate best practices. DRR is included in supportive supervision activities.
PEOPLE	Adherence & compliance	Little insight into adherence of best practices for DRR for health care facilities.	Have insight and best practice of DRR for health care facilities are available (SOPs & job aids) but not practiced (<50% of facilities adhere and comply).	Best practices of DRR for health care facilities are adhered to in at least half of the facilities. Minimal M&E in place.	Significant compliance to the best practices for DRR in health care facilities. M&E framework in place with some tracking of adherence.	Country fully adheres to best practices for DRR in health care facilities. M&E framework tracks adherence to policies and guidance.
PROCESSES	National policy/ Strategic plans	Policy is needed or currently being developed. No recent assessment of DRR for health care facilities carried out (within the last 5 years).	Policy developed and/or reviewed with the last 5 years. Assessment of DRR for health care facilities carried out within the last 5 years.	Policies and guidelines are disseminated and partially adopted.	Country can show that the policies and guidelines are fully implemented at all levels of the system.	Policies widely adopted across the country. Evidence that gaps in DRR for health care facilities are addressed in strategic planning and financing mechanisms at national and sub-national level.
PROCESSES	Budget & planning	DRR for health care facilities are not planned and budgeted.	DRR for health care facilities are budgeted but budget is not linked to realistic needs or assessment findings.	At least half of facilities develop a budget for DRR for health care facilities and implement specific plans.	Budgets are available, funded and tracked at 75% of system levels.	DRR for health care facilities are 100% budgeted at national and sub-national levels.
PROCESSES	Practical guidance	Needed or currently being developed.	Guidance developed but not fully in use (used in <50% of facilities).	Guidance is developed and in use in 50-65% of the facilities within the country.	Guidance is available and being implemented at most (65-85%) systems levels.	Guidance is available and in use at more than 85% of facilities within the country.
TECHNOLOGY	Technology & equipment availability and use	Not aware of best practices for DRR for health care facilities. Technologies & equipment for DRR in health care facilities are out-of-date, inefficient, etc.	Awareness of best practices for DRR for health care facilities exists, but technologies & equipment for DRR are still out-of-date, inefficient, etc.	Some best available technology & equipment for DRR in health care facilities is available in 50%.	Globally accepted equipment is widely available (more than 51% of facilities).	Only efficient and best available technology for DRR in health care facilities is in use.

[5] Government of Lao People's Democratic Republic, 2018, *the Post-Disaster Needs Assessment*

Table 16. Area of assessment on DRR for Health Care Facilities

AREA		
PEOPLE	Awareness, training & supportive supervision	Awareness is the awareness of the risk of disaster from all hazards (including natural disasters, man-made disasters, and pandemics, epidemics, and disease outbreaks) for health care facilities. Training is the training given on DRR for health care facilities. Supportive supervision is the process of helping staff to improve their own work performance on DRR for health care facilities.
	Adherence & compliance	The extent to which the health care facility staff act in accordance with the guidelines and trainings on DRR.
PROCESSES	National policy/ Strategic plans	National policy and/or strategic plans regarding DRR for health care facility.
	Budget & planning	The existence of dedicated budget and plans of DRR for health care facilities.
	Practical guidance	Guidelines or SOP regarding DRR for health facility which include HCWM or HCWM guidelines or SOP which include disaster risk reduction portion.
TECHNOLOGY	Technology & equipment availability and use	The existence of and usage of best available technology and equipment for DRR for HCWM.

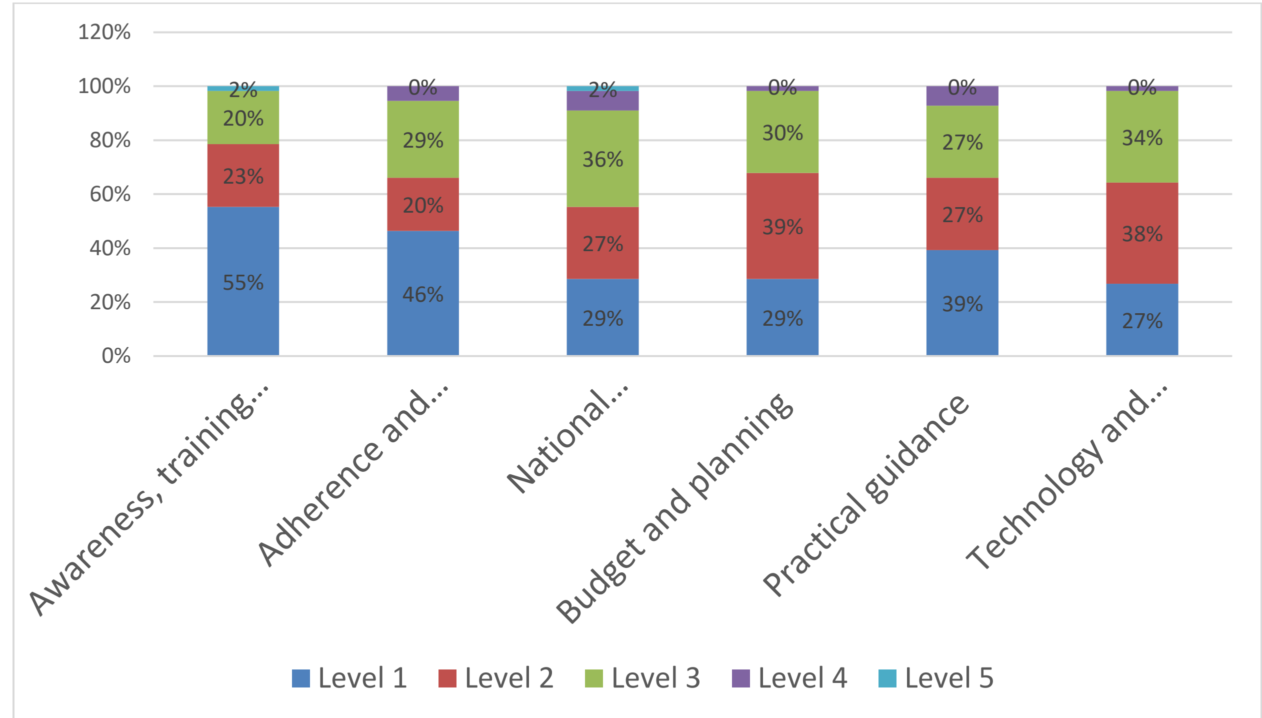
Table 17. Assessment of DRR for Lao PDR's HCWM (based on the GAVI HCWM maturity model)

AREA	LEVEL	REMARK
Awareness, training & supportive supervision	Level 1: low level of awareness of DRR associated with health care facilities and reduction measures (<40%)	KIIs, opinion survey and validation workshop confirmed strongly that awareness is low and related to other areas such as budgeting in general and specific. Low level of social spending has impacted on limited budget for HCWM, particularly DRR.
Adherence & compliance	Level 1: little insight into adherence of best practices for DRR for health care facilities	Lack of budget and enforcement of the regulations lead to this low result. The health staff and general public's awareness is low therefore, even when best practices are

		available, people don't fully compliant
National policy/ Strategic plans	Level 3: Policies and guidelines are disseminated and partially adopted	Significant level of support from donors and development partners in the area of policies and plan. however, financing the plan remain a big challenge and will remain so given the difficult fiscal space for further investment in this area.
Budget & planning	Level 2: DRR for health care facilities are budgeted but budget is not linked to realistic needs or assessment findings	Budget and planning is seen as insufficient which is consistent with situation in other areas. the budget for DRR is integrated in procurement policy of the donors therefore, it is assessed for level 2. But, there is a hug gap remains to be filled.
Practical guidance	Level 1: needed or currently being developed	Practical guidelines have been developed but not sufficiently comprehensive. There is a need to review and revise them to be consistent with international and regional standards
Technology & equipment availability and use	Level 2: awareness of best practices for DRR but technologies and equipment for DRR are still out of date, insufficient, etc.	Some up to date technologies are used, but not sufficient and lack maintenance system for sustainable use.

Figure 3 below show the level of maturity for each category. The percentages derived from a survey of 35 respondents where they were asked to rate a level at which each category is according to their opinion. The scoring was then validated through a national workshop where development partner experts and relevant government officials (40 in total) participated. The findings show clearly that awareness about the DRR in HCWM is low. Adherence and compliance to best practices for DRR for health care facilities also remains low (see figure 5 below).

Figure 3: DRR scoring against GAVI maturity model



Conclusions

Provincial Hospital Health Care Waste Management Committee:

The committee does not have an annual work plan for Health Care Waste Management in the provincial hospital. There is no regular assessment of health care waste management. The Infection Prevention and Control (IPC) committee does not have a health care waste management function. Many of the IPC technical committee members in the provincial hospitals have not been trained in HCWM and WASHFIT. In some provinces, the IPC structure and committee members have not been updated.

Guidelines and standard operating procedures (SOP) for waste management:

Only a few provincial hospitals have guidelines and standard operating procedures (SOPs) on HCWM. Many provincial hospitals were not able to show the paper of waste management and disposal guidelines, SOPs, and posters on the wall where the bins/waste container packaging are located.

Waste Separate and Waste storage site:

Waste separation, collection, and storage facilities exist in all provincial hospitals, but high rate of "did not perform well". Waste containers (bins/bags) are not implemented in full regarding the color coding according to the guidelines and SOP. Only some health care wards of the provincial hospitals used plastic bins or plastic bags for infectious waste collection. Safe packaging and adequate labeling of waste were not being practiced and a lot of bins, trash did not have completed cover. There is no waste scale for

weighing each type of waste before transporting it to a waste storage facility. Wheeled/ trolleys for transporting waste from each health care ward to the waste storage facility are not color-coded. Therefore, separation of general and infectious waste and insufficient. Small waste storage facility and cannot accommodate large amounts of the wastes.

Waste management and disposal records:

Each health care ward in every provincial hospital does not record the amount or volume of each type of waste on a daily basis before transporting the waste to the waste storage site. There is no regular supervision and monitoring for the implementation of health care waste management and disposal in each unit of the provincial hospital.

Waste disposal and treatment:

Infectious waste, including sharp waste, pathological waste and chemical waste management and disposed are not yet available or not performed well, the rate is still high (16,8%). Many provincial hospitals do not record the amount of waste that is sterilized by the Autoclave oven daily. Staff in charge of the Autoclave are not trained to use the Autoclave for waste disinfection. No specific technical staff responsible for incinerator. In some provincial hospitals, the personal protective equipment (PPE) was limited. Insufficient budget for health care waste management for all provincial hospitals and Covid-19 treatment centers.

Waste Management and Disposal at COVID-19 Treatment Centers and quarantine Centers:

There is no waste management planned, insufficient maternal and child health staff. There is no health education on waste management and disposal for patients and quarantine people regularly
Covid-19 center. In some provinces, large amounts of waste were not disposed on a daily basis.

Waste Management, disposal of COVID-19 vaccination facility:

Overall performance rate of the “non-performed” is high over 20 per cent. The needles contained in the safety box and syringes at each Covid-19 vaccination service point were delivered to the Provincial maternal and child health units for disinfection and disposal by incinerator and they were not incinerated on a daily basis. Used vaccine vails were not sprayed with 0.5% chlorine solution before buried.

Recommendations

RECOMMENDATIONS: PEOPLE

- Provide training on waste management and disposal to the IPC, health staff, and cleaners in all HCFs.
- Develop a facility specific annual plan for health care waste management and disposal including monitoring and evaluation system

RECOMMENDATIONS: PROCESSES

- Develop and update guidelines, SOPs, and communication materials of HCWM, covering a whole process of HCWM

RECOMMENDATIONS: TECHNOLOGY

- Provide autoclave to all HCFs that do not have one yet, including training of use and maintenance
- Help build a wastewater treatment model that can be scaled up

RECOMMENDATIONS: DRR

- Develop and deliver DRR awareness raising trainings to public health staff and public
- Carry out a need assessment for environmentally friendly equipment in HCWM
- Review and harmonized procurement policy for HCWM system with international and regional standards

Potential areas for future support

- Support on logistics management including reverse logistics, warehouse management and distribution,
- Procurement of autoclave,
- Help develop a wastewater treatment system,
- Promote the use and maintenance of appropriate technologies for HCW treatment and disposal, and
- Support countries in the development of strategies and tools to educate health workers, waste handlers, and the public

References

Asian Development Bank (April 2020). Managing infectious medical waste during the COVID-19 pandemic. Available at https://www.adb.org/publications/managing-medical-waste-covid19

Health Care Without Harm (24 March 2020). Health care waste management: Coronavirus update. Available at https://noharm-global.org/documents/health-care-waste-management-coronavirus-update

Gavi, the Vaccine Alliance (May 2020). *Health care waste management maturity model*. Available at https://www.gavi.org/sites/default/files/programmes-impact/support/HCWM-Maturity-Model-May-2020.pdf

Ministry of Health (2022). *Rapid assessment of health care waste management, wastewater treatment facility and sanitation of 12 target provincial hospitals*.

WHO (2020). Water, sanitation, hygiene, and waste management for the COVID-19 virus: interim guidance, 19 March 2020. Available at https://apps.who.int/iris/handle/10665/331499

Prüss, Annette, Emmanuel, Jorge, Stringer, Ruth, Pieper, Ute, Townend, William. et al. (2014). Safe management of wastes from health-care activities / edited by A. Prüss …[et al], 2nd ed.. World Health Organization. Available at https://apps.who.int/iris/handle/10665/85349

United Nations Environment Programme (UNEP) and Institute for Global Environmental Strategies (IGES) (2020). *Waste management during the COVID-19 pandemic: from response to recovery*. Available at https://www.unep.org/resources/report/waste-management-during-covid-19-pandemic-response-recovery

UNEP (19 June 2020). *COVID-19 Waste management factsheets*. Available at https://www.unep.org/resources/factsheet/covid-19-waste-management-factsheets

WHO (2015). Immunization in practice: a practical guide for health staff. Available at https://apps.who.int/iris/handle/10665/193412

WHO (2006). Management of waste from injection activities at the district level: guidelines for district health managers. Available at https://apps.who.int/iris/handle/10665/43476

WHO and United Nations Children's Fund (UNICEF) (2021). Guidance on developing a national deployment and vaccination plan for COVID-19 vaccines: interim guidance, 1 June 2021. Available at https://apps.who.int/iris/handle/10665/341564

Ruth Stringer (2021). COVID-19 Vaccination and municipal waste management: technical brief. Global Platform for Sustainable Cities (GPSC)/World Bank. Available at https://www.thegpsc.org/knowledge-products/solid-waste-management/covid-19-vaccination-and-municipal-waste-management

WHO (2015). Status of health-care waste management in selected countries of the Western Pacific Region. Available at https://apps.who.int/iris/handle/10665/208230

WHO (2017). Report on health-care waste management status in Countries of the South-East Asia Region. Available at https://apps.who.int/iris/handle/10665/258761

WHO And MOH (2021), *WASH FIT survey of 1,225 health care facilities across the country*

WHO and Water and Environment International, LLC, (2016)