

# National Needs Assessment of Health Information System to Address Cardiovascular Diseases in Nepal: A Mixed Method Study

Karmacharya RM,<sup>1,2</sup> Shrestha AP,<sup>2,3</sup> Shrestha A,<sup>4-7</sup> Bajracharya S,<sup>4</sup> Maharjan R,<sup>2,4,8</sup> Shrestha S,<sup>4</sup> Jha N,<sup>4</sup> Pyakurel P<sup>9</sup>

<sup>1</sup>Department of Surgery (Cardio Thoracic and Vascular Surgery Unit), Dhulikhel Hospital, Kathmandu University Hospital, Dhulikhel, Kavre, Nepal <sup>2</sup>Fellow, CVD Translational Research Program, Kathmandu University School of Medical Sciences, Dhulikhel, Kavre, Nepal. <sup>3</sup>Department of General Practice and Emergency Medicine, Kathmandu University School of Medical Sciences, Dhulikhel, Kavrepalanchok, Nepal. <sup>4</sup>Department of Community Programs, Dhulikhel Hospital-Kathmandu University Hospital, Kavrepalanchowk, Nepal. <sup>5</sup>Department of Public Health, Kathmandu University School of Medical Sciences, Kavrepalanchowk, Nepal. <sup>6</sup>Department of Chronic Disease Epidemiology, Yale School of Public Health, New Haven, USA. <sup>7</sup>Institute for Implementation Science and Health, Kathmandu, Nepal. <sup>8</sup>Department of Nursing and Midwifery, Kathmandu University School of Medical Sciences, Dhulikhel, Kavre, Nepal. <sup>9</sup>School of Public Health and Community Medicine, B.P. Koirala Institute of Health Sciences, Dharan, Nepal.

## Corresponding Author

Robin Man Karmacharya  
Department of Surgery (Cardio Thoracic and Vascular Surgery Unit),  
Dhulikhel Hospital, Kathmandu University Hospital,  
Dhulikhel, Kavre, Nepal.  
E-mail: reachrobin773@hotmail.com

## Citation

Karmacharya RM, Shrestha AP, Shrestha A, Bajracharya S, Maharjan R, Shrestha S, et al. National Needs Assessment of Health Information System to Address Cardiovascular Diseases in Nepal: A Mixed Method Study. *Kathmandu Univ Med J.* 2021; Cardiovascular Diseases (CVDs) Special Issue 75(3):51-7.

## ABSTRACT

### Background

Health information system is an integral component of a country's capacity to integrate, process, report, and use information in improving health services.

### Objective

This study aims to assess the infrastructure and capacity of the national Health information system to address cardiovascular diseases in Nepal.

### Method

We adopted the United States Agency for International Development manual "The Health System Assessment Approach: A How-To Manual", Version 2.0. Three topical areas: input, process and output, were identified. Stepwise approach for Health information system assessment was done. A desk review and key informant interview was performed. Audio recordings were transcribed in Nepali language and intercoder reliability was checked.

### Result

The upgraded District Health Information Software 2.3 provides a comprehensive online data management solution. Sustainable funding to upgrade the system exists. Annual report provides performance of all the components of the health care delivery system. Data were reviewed quarterly. However, no dedicated section for cardiovascular diseases in the Health information system is present. Private health facilities are poorly represented. Strategic planning, management, and evaluation of the Health information system are lacking. Inadequacy of timeliness, completeness, and periodicity of the reporting still exist.

### Conclusion

A separate section of cardiovascular diseases in the Health information system is required. Better reporting of private sectors and its inclusion in databases is of utmost importance. Adaptation in the recently introduced federal structure is key for development of Health information system in the country.

## KEY WORDS

CVDs, Health information management system, needs assessment, indicators, Nepal

## INTRODUCTION

Globally, the lead causes of illness and deaths has shifted from infectious diseases to noncommunicable diseases (NCDs).<sup>1,2</sup> Worldwide, the most common cause of death changed from diarrhoea and common infectious diseases in 1990 to cardiovascular diseases in 2017.<sup>3</sup> This changing pattern has been attributed to the effects of an ongoing epidemiologic transition affecting Nepal as well. Approximately 59% of DALYs were attributed to NCDs in 2017.<sup>1,4</sup> NCDs have increased from 50% in 2008 of all deaths to 66% in 2017. About 30% of all deaths are attributed to Cardiovascular disease in 2017, which has increased from 2008 estimates of 25%.<sup>5,6</sup> Despite the burden of NCD, and particularly CVD, Nepal currently lacks a comprehensive, integrated health system to address the growing burden of CVDs, including reliable and timely data that can be used by policy makers, health care providers, researchers and the public. Health information system (HIS) is an integral component of understanding a country's capacity to integrate data collection, processing, reporting and use of information necessary for improving health services through better management at all levels of health services.<sup>7</sup> The CVD monitoring indicators and data has not been integrated into Nepal's national health information system. Hence, this study aims to assess the infrastructure and capacity of the national health information system to address CVDs in Nepal.

## METHODS

We adopted the United States Agency for International Development (USAID) manual "The Health System Assessment Approach: A How-To Manual", Version 2.0 that facilitates a collaborative assessment process and provides a source of data to assist countries in assessing health system in six building blocks: leadership and governance, health service delivery, human resources for health, health information system, medical products and health financing.<sup>7</sup>

**Assessment team:** We formed a national level task force to coordinate and steer the overall need assessment process. The taskforce was chaired by the head of Nepal Health Research Council and the dean of Kathmandu University School of Medical Sciences. The members of the task force were representatives from Policy, Planning and Monitoring Division, Ministry of Health and Population (MoHP); Health Coordination Division, MOHP; Non-communicable Disease and Mental Health section, Epidemiology and Disease control section, Department of Health Services; Nepal Heart foundation; Nepal Health Research Council; patient representatives and co-investigators of the Translational Research Capacity Building Initiative in Low Middle-Income Countries (TREIN), Nepal. The current assessment was led by the HIS sub-committee.

**HIS assessment protocol development:** We developed the

assessment protocol based on HIS chapter of the USAID manual version 2.0. We adapted the protocol to address the HIS issues pertaining to CVD in Nepal. After receiving feedback from multiple stakeholders and experts, HIS building block sub-committee finalized the protocol and data collection tool.

**HIS topical areas and indicators:** We grouped the assessment indicators for HIS into three topical areas based on the Health Metrics Network (HMN) framework. (1) Input indicators: availability of physical and financial resources, qualified personnel and infrastructure, training and mechanism to review the utility for planning management and evaluation; (2) Process indicators: availability and accessibility of data resources, data management and analysis, timeliness of the updates to the national database of facilities, and reporting; (3) Output indicators: quality and completeness of the information, and the dissemination and use of the information.

**Stakeholder engagement:** We engaged relevant stakeholders including patients followed a stepwise approach for HIS assessment and conducted meetings with different stakeholders.<sup>8</sup> We collected and incorporated the feedback from the stakeholders after development of protocol and after data analysis.

**Data collection:** We collected the data in two phases. Firstly, we conducted a desk review of the following documents to review the status of CVD HIS in Nepal:

-Department of Health Services (DoHS), Annual Report 2016/17 AD<sup>9</sup>

-Health Management Information System Guidelines 2018 AD<sup>10</sup>

-HMIS Recording and Recording Forms 2013 AD<sup>11</sup>

-Nepal Health Facility Survey 2015 AD<sup>12</sup>

-National Health Strategy 2006 AD<sup>13</sup>

-Multisectoral Action Plan on the Prevention and Control of NCD in Nepal 2014-2020 AD<sup>14</sup>

-National Monitoring and Evaluation Guidelines 2013 AD<sup>15</sup>

Second, we conducted key informant interviews with seven key informants (two HIS representatives, Medical products representative, two Policy makers, Health service provider representative and financing representative) using a pretested semi-structured interview guide to explore current practice on HIS situation for CVD and its strengths, weaknesses, opportunities and threats (SWOT). The reason for multiple KII is to have indepth data from different stake holders related to HIS. The questionnaire once prepared were preliminary tested with two health service provider representative and as per the suggestion they were modified. All interviews were conducted in Nepali language. Suggestions for modification in further interviews were also obtained. Each interview lasted for a maximum 2 hours and was audio-recorded. The interviews

were moderated by SB, SS and APS with experience of 2 to 5 years in conducting qualitative research. The study was approved by the Nepal Health Research Council (Approval number: 176/2018). We obtained informed consent from the participants before the interview.

**Data management and analysis:** We organized the information from the desk review alongside HIS indicators according to the respective topical areas. The audio recordings from the key informant interviews were transcribed verbatim and coded by two independent researchers. These were divided into smaller, “digestible” and analyzable codes. The intercoder agreement was calculated as 95.17% implying good data reliability. The codes results were triangulated and categorized to perform

thematic analysis into four major themes: strengths, weakness, opportunities and threats.<sup>7</sup>

## RESULTS

The input indicators are presented in Table 1. About 0.36% of the total health budget went to HIS in the year 2018/19. HIS training is organized annually to train new health personnel. There is no national HIS strategic plan and functioning interagency body. Nepal Health Service exists to mandate reporting of health indicators by the public sector. For private sector it is not mandatory. Annual and quarterly review meetings are held to review HIS indicators for planning, management, and evaluation process.

**Table 1. Input Indicators of HIS**

Indicators	Findings
1: Availability of financial and/or physical resources to support HIS related items within MOHP	In the fiscal year (FY) 2018/19, USD \$1,810,320 was allocated for HIS, which is 0.36% of the total health budget. Additionally, each of the seven provinces received USD \$1,337,670. About 91% of the allocated HIS budget is used in 2018/19. <sup>16,17</sup>
2: Availability of sufficient number of qualified personnel and infrastructure to compile and analyze information	At federal level, the HIS team consists of the Chief who governs HIS, 2 statistical officers who conduct training and manage data, 2 computer operators who enter and correct data and 1 public health officer who analyze and evaluate health implications. At provincial level, the HIS team consists of 1 statistical officer and 2 computer operators.
3: Evidence of training activities related to HIS data collection and analysis	HIS recording and reporting training were conducted twice a year in the FY 2017/18 in all 77 districts. About 200 newly recruited health workers were trained in the FY 2018/19. Training for trainees (TOT) was conducted at central and provincial level and the trainers subsequently trained personnel at municipality level. <sup>9,18</sup> There is evidence that the HIS data collection and analysis training is a regular activity of HIS section as stated by a representative: “.. this year we provided master training to Provincial Health directorate staff and Provincial Ministry staff...we gave sample data of different programs for practice. In provinces, municipal staff were invited for training, from districts and municipal hospitals... and from the central level, government and private hospitals’ data managers were invited for HMIS-DHIS-2 training... This year (2019), we trained massively to municipality staff, and next year we plan refresher training....” -Representative from Management Division, DOHS
4: National HIS strategic plan	Currently no National HIS strategic plan exists as of 21/05/2019. MOHP is drafting the health Information road-map and planning to digitize health information. <sup>19</sup>
5: Functioning interagency to guide the implementation of the national strategy	No functioning interagency body exists to guide the implementation of national strategy as of 21/05/2019.
6: Presence of international donors providing specific assistance	World Bank supported US\$ 22 million (including Procurement and Health Financing) in 2016/17. GIZ supported \$3,200,000 (including Human Resource for Health, Health Financing and Leadership) in 2017/18. <sup>9,16,17</sup> The donors’ support goes to the central government health information system.
7: Existence of policies, laws, and regulations mandating public and private health facilities/providers to report indicators	Nepal Health Service Act (4th amendment 2013) mandates health workers from public facilities to report HIS indicators. For private sector it is not mandatory.
8: Presence of mechanisms to review the utility of current HIS indicators for planning, management, and evaluation process, and existence of process by which to adapt and modify accordingly	Data review meetings are held at district and facility level quarterly. Additionally, review meetings are held for the overall assessment of HMIS at federal, provincial and local level yearly. <sup>18</sup> “In a review meeting, we discuss basis on indicator progress, trend analysis, discuss on whether there is an increasing trend or decreasing trend, then we discuss, what is the issue or problem it has. If in decreasing trend, what is the reasons, problems, constraints, we discuss on it and in future days, we plan on what to do for it, recommend solutions, we plan for it” - Representative from Management Division, DoHS “We can know details on morbidity based on information from HMIS data, thus can forecast from that data”- Representative of Logistic Division, DoHS

### The output indicator for HIS are summarized in table 3:

Output indicators discuss the timeliness and completeness of reporting of specific indicators of CVDs which states that there is no separate subheading of CVDs in HIS. However three year trend analysis of NCDs are reported

by provinces. Policy briefs are prepared through available secondary data. Additionally, feedback is provided through review meetings and workshops.

**Table 2. Process Indicators of the Health information System**

Indicators	Findings
9: Availability of minimum core indicators at national and provincial level	The health programme has been divided into 13 sections with 280 indicators. The section with their important indicators are as follows: (1) Safe Motherhood, (2) Family Planning, (3) Female Community Health Volunteer, (4) Nutrition (5) Immunization, (6) Integrated Management of Childhood Illness, (7) Nutrition (8) HIV/AIDS, (9) Tuberculosis, (10) Epidemiology and Disease Control, (11) Leprosy, (12) Curative Services, (13) Health Facilities. <sup>10</sup> There are no core-indicators for NCD, including cardiovascular diseases in national HIS.
10: Availability and accessibility of data sources	The following data sources are available: (1) Census, every 10 years since 1911 AD <sup>20</sup> ; (2) Nepal Demographic Health Survey, every 5 years since 1976 <sup>12</sup> (3) STEP Surveillance (STEPS) survey, every five years since 2013 <sup>21</sup> Nepal Living Standard survey, every 5-7 years since 1995/96 <sup>22</sup> . Reports of these surveys are available as hard copies or online resources. <sup>19</sup> Out of these, census provides the denominator for CVD related indicators based on the age group. STEPS survey provides the indicators on NCD risk factors such as prevalence of overweight/obesity, high blood pressure, high blood sugar, fruits and vegetable consumption, fats consumption, salt consumption, physical inactivity, smoking and alcohol intake. Nepal Demographic Health Survey provides details health survey on selected sample of all the provinces.
11: Timeliness of updates to the national database of facilities	The national database of health facilities exists and is updated manually every year with the publication of the annual health report.
12: Percentage of districts and provinces represented in reported information	All provinces report to HMIS.
13: Percentage of private health facility data included in reported data	Forty nine percent of private health facilities data were included in the FY 2018/19 annual report. The private HIS reporting was highest in Province 7 (100%) and the lowest in Province 2 (26%). <sup>18</sup>
14: Availability of clear standards guidelines for: 1) data collection, 2) reporting procedures methods, and 3) data analysis to be performed	The following guidelines are present for data collection, reporting and analysis HMIS indicators 2013 <sup>24</sup> HMIS Recording and Reporting Forms 2013 <sup>11</sup> HMIS Data Analysis Use Book 2014 <sup>25</sup> HMIS Trainer's manual 2014 DHIS 2 Operational Guideline 2016 <sup>26</sup> HMIS guidelines 2018 <sup>10</sup> Data are routinely collected and analyzed based on these guidelines. Because the indicators for NCDs and CVDs are not included in national indicators, they are missed from the regular analysis and reporting as well. "We have fixed guidelines, 50 types of form format, 5 reporting; 45 recordings, we have guideline on how to fill it, similarly, we have indicator book and form and analysis book for the use" -Representative of Management Division, DOHS
15: Number of reports a typical health facility submits monthly, quarterly, or annually	Health institutions send the HIS report every month to their health section office of a municipality. Data on timeliness and completeness was not available.

16: Presence of procedures to verify the quality of reported data (accuracy, completeness, timeliness)

HMIS user manual 2014 provides how to check data for quality. Integrated monitoring checklist provides detail about what and how to check. Data review meetings are held at facility and district level. Reporting timeline is standard. A routine data quality assessment system with inbuilt feedback mechanism takes place with validation rules in DHIS 2.3 software.<sup>27,28</sup> The validation rules are data input validation, minimum and maximum possible numbers, outlier analysis, timeliness, completeness, etc. Data reporting from the facility is mostly manual but it is entered into DHIS2 software database at district level. It also allows checking accuracy and completeness of the data. Feedback system is inbuilt but yet to be practiced better. HMIS data are disaggregated by gender, caste/ethnicity, age, and geography. All tools are standardized.

17: Availability of a national summary report

The National summary report (Annual Report) is published every year. The latest summary report 2018/19 was available in the month of May.

18: Data derived from different health programs / sub sectors are grouped together for reporting purposes

Program specific data are collected, analyzed and presented in the annual report. The data on NCD or Cardiovascular diseases are not derived or grouped together.

19: Availability of appropriate and accurate denominators

Appropriate denominators for the facility catchment area are available. The denominators are estimated every year based on census data with adjusting for the population growth rate.

20: Availability of timely data analysis, as defined by stakeholders and users

The data analysis is guided by HMIS Data Analysis Use Book 2014.<sup>25</sup> The statistical assistant or officer at district level completes the HMIS reporting forms and calculates the health indicators. All data are aggregated at province level and at national level quarterly and an annual report is published every year.<sup>19</sup>

## HIS SWOT Analysis

### Strengths

1. The government provides significant funding and support for a sustainable HIS system. There are designated statistical assistant/ officer staffing in the public sector, and annual training basic and refresher HIS training are part of regular health programs.
2. Significant donor support exists that goes to strengthening central health information systems without creating any vertical parallel structure.
3. A strong regulatory framework exists in the form of Nepal Health Service Act that mandates all public facilities to report to the national HIS system. Multiple guidelines on indicators, recording and reporting, data quality assurance, and data analysis provide clear standards and procedures.
4. There are a standard set of indicators and corresponding, recording, and reporting formats for the priority health programs. These indicators are systematically calculated using appropriate denominators and reported from health facilities. These are aggregated at district, province and national level. The data is quarterly reviewed and an annual health report is published every year.

**Table 3. Output Indicators of the Health information System**

Indicators	Findings
21: Timeliness of reporting specified indicators of cardiovascular diseases	No separate subheading of cardiovascular diseases (CVDs) in HIS. However, province wise three-year trend analysis of hypertension and non-communicable diseases among outpatients and inpatients by province are reported. <sup>18</sup> “We don’t get reports from tertiary level hospitals managing CVD resulting in partial information particularly from hospitals where major CVD treatment takes place. We cannot provide a real burden of CVD, creating problems of completeness, coverage and timeliness issues.- Representative of Management Division, DOHS
22: Completeness of reporting	Among 125 public facilities, 92% reported and among 443 non-public health facilities, 55% reported to HMIS in fiscal year 2018/19. <sup>9,18</sup>
23: Use of data for planning, budgeting or fundraising activities in the year	In general for national health priority programs such as maternal, child health, HIV/AIDS control, the programmatic indicators are used for budgeting and setting short term and long term programmatic goals. However, the indicators for CVD are not systematically analyzed, hence are not used for decision making or fund raising activity. “CVD data are presented through morbidity, resulting in improper representation of burden. Due to improper burden, inadequate budget is forecasted for CVD, resulting in less than needed budget.” -Representative from EDCC, DoHS
24: Data or results of analyses feedback to data providers to inform them of program performance	Feedbacks are given through review meetings held at facility and municipal level along with an annual review workshop conducted yearly. <sup>18,19,25,28</sup> “In case of a problem, the central section calls and gets calls as well for feedback. There is in-built feedback system in new 2.3 version, in addition to emails and messages”- Representative of Management Division, DOHS

5. The public sector representation in the national information system is fairly good with 99% primary health care centers and 99% health posts HIS and 88% of public hospitals reporting to HIS .

6. An electronic HIS system, DHIS-2, exists that provides comprehensive data management. The Nepal government is in the process of digitizing all HIS reporting.

#### Weakness

1. There are no dedicated section, indicators, and designated recording and reporting formats for NCDs and particularly CVD in HIS.

2. Nepal does not have a HIS strategic plan that provides direction and coherence to HIS strengthening efforts. Although other health guidelines provide the clear procedures for data collection, management, analysis and dissemination, these documents lack a clear description of HIS vision, objectives and interventions

3. The interagency coordination is lacking with no formal communication channel between ministry of health and population, telecommunications, local governments, and the central statistics bureau.

4. Although the central HIS recordings and reporting exists, less than half (49%) of the private sector is represented.

5. Limited staff to support the needs of electronic HIS systems nationally challenges timeliness, completeness, and periodicity of the reporting still exist. Poor timeliness of data consolidation and dissemination limits effectiveness of data driven policy making.

#### Opportunities

1. The introduction and expansion of electronic HIS system (DHIS) can speed up data analysis and use with real-time recording, reporting and consolidation at national level.

2. The academic institutions with expertise in data management and analysis can contribute to strengthen federal and local government institutions for a robust HIS system.

#### Threats

1. Although a strong HIS system exists at national level, NCD so far does not come under national priority health programs.

2. The completeness of data and subsequently the national level interpretation is threatened by under representation of private sectors.

3. The newly formed federal structure has resulted in re-allocation and disproportionate distribution of human resources and created an unclear reporting line of health data.

4. Dependency on international collaborators for funding can threaten the sustainability of the HIS.

## DISCUSSION

Nepal invests significant input to run HIS system. Total of 0.36% of the health budget was allocated in HIS in 2018/19, of which 91% was spent. At federal, provincial and local levels, statisticians, computer operators and public health officers are designated to analyze and interpret health data. HIS training is a part of an annual regular program. International donors supported the central HIS system. Nepal Health policies act mandates all public facilities to report HIS indicators. The data processing is organized and implemented through detailed guidelines on data collection, management and analysis. There are 280 health indicators within 13 priority health programs that are regularly reported. However, CVD and NCD at large, are not covered in detail as separate headings. The reporting from the public sector is more than 95%; however, only 49% of the private sector is represented in the annual health report. The annual health report is published and disseminated. Regarding the outputs, the data use and dissemination is well structured for priority health programs, but does not include systematic and timely reporting of CVD related health indicators.

As far as the priority health programs are concerned, Nepal has done well in terms of allocating budget, resources, training and guidelines. However, NCDs including CVDs are not defined as priority health programs, even though CVD is the topmost cause of death in Nepal. Nepal government funds HIS through the Ministry of Health and Population and External Development Partners, as in Nigeria and Kenya.<sup>29,30</sup> In other countries, such as Guatemala, the government funds entry level health information system and the peripheral level health facilities should fund their activities with local resources.<sup>31</sup> A number of human resources positions are sanctioned at the federal, provincial, and local level for HIS through the Public Service Commission. The permanent position helps retain HIS staff in Nepal, as experienced in Nigeria. Contrary to this, HIS positions in Guatemala are temporary and contractual resulting in high staff turnover.<sup>29,31</sup>

Nepal Health Service Act (4<sup>th</sup> amendment 2013) mandates public health facilities to report to the national health information system. However, private sectors are not mandated to report health indicators by any acts or policy. This is of particular concern because the private sector are major service providers for getting a picture of CVD burden and its health service utilization. Reporting from the private sector has also been challenging in other settings in Africa and South America.<sup>29,31</sup>

HIS strategic plan provides direction and coherence to HIS strengthening effort, that exist in different countries such as in Afghanistan, Ghana, Bangladesh, Ethiopia.<sup>32-35</sup> Nepal does not have a national HIS strategy. However, the HIS system is guided by: HMIS guidelines 2018, 2) HMIS Recording and Reporting Forms 2013, 3) HMIS Data Analysis Use Book and 4) HMIS user manual 2014 and a HIS strategic roadmap published in 2011/12.<sup>36</sup> The minimum core indicators that need to be reported at National HIS includes 13 sections and 280 indicators.<sup>24</sup> However, there are no specific indicators for CVD information. CVD coding is recorded through hospital morbidity and mortality. As a result, the CVD indicators are not systematically tracked and discussed in national and subnational annual review meetings. These data and reports are also used for planning and policy purposes at national level. Additionally, there are no national surveys to estimate CVD burden and impact, except for CVD related risk factors that are captured in STEPS survey. This limits Nepal's ability to monitor and evaluate CVD trends.

Health facilities record and report to the national database through DHIS 2.3 software. Due to unavailability of DHIS 2.3 software in all the districts of the country paper based recording and reporting systems are still practiced which is later entered into the national database. This has resulted in unnecessary burden to the health workers in filling forms and entering into the DHIS 2.3 Software. Kenya HIS use similar software whereas Guatemala HIS is integrated into a single Health Management Information Systems

coordinating office and to the information management system itself platform.<sup>30,31</sup> Similar to Nepal, the challenges of using paper based system has been documented In Nigeria, where are frequent stock outs of forms and registries which frequently affects recording and reporting.<sup>29</sup>

To the best of our knowledge, this is one of the largest national need assessments for HIS in Nepal, conducted by a multidisciplinary team. We have used mixed methods design including extensive reviews of documents and data; in addition to key informant interviews with the national-level HIS stakeholders. We have reviewed key HIS indicators with conducting a robust multidimensional analysis of Nepal's health system in relation to HIS. However, this study has few limitations. We did not explore province-level HIS indicators and SWOT analysis. Due to the federal re-structuring of the health system, limited updated documents were accessible for desk review as they were still in process of publication.

## CONCLUSION

In conclusion, even though Nepal's health system has a HIS system guided by indicators, forms and guidelines, CVD indicators are not prioritized, nor reviewed and published as a separate chapter in annual health reports. The CVD indicators are mainly captured in OPD and In-patient ICD coding. However, about 22% of government hospitals and more than half of private sectors do not report, which provides an incomplete base of CVD trend monitoring. We recommend the following actions to effective tracking and monitoring of CVD in Nepal: NCD including CVD should be integrated into the current HIS by recording and reporting CVD related indicators, discussing them in review meetings and presenting as a separate chapter in annual health reports.

- Private sectors should be mandated to report regularly to the national HIS using the standard forms
- Private sector stakeholders should be involved as a part of HIS coordination committee
- Revise HIS guidelines to better align the needs of operator with local health system
- Develop mechanism to generate complete data for CVDs in DHIS 2.3 software for effective analysis and decision making
- Invest in innovative technology to make database system of HIS robust and informative

## Disclaimer

Research reported in this publication was supported by the National Heart, Lung, And Blood Institute of the National Institutes of Health under Award Number U24HL136789. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

## REFERENCES

- WHO. Factsheet: Non-Communicable Disease [Internet]. World Health Organization. 2018 [cited 2020 Jul 3]. Available from: <https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases>
- WHO. Global status report on noncommunicable diseases 2010 [Internet]. World Health Organization; 2010 [cited 2020 Jul 3]. Available from: <https://www.who.int/nmh/publications/ncd-report2010/en/>
- {GBD, DALYs, HALE Collaborators}. Global, regional, and national disability-adjusted life-years (DALYs) for 359 diseases and injuries and healthy life expectancy (HALE) for 195 countries and territories, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet* [Internet]. 2018; Available from: [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(18\)32335-3/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(18)32335-3/fulltext)
- Institute for Health Metrics and Evaluation (IHME). Findings from the Global Burden of Disease Study 2017 [Internet]. Institute for Health Metrics and Evaluation; 2018 [cited 2020 Nov 26]. Available from: [http://www.healthdata.org/sites/default/files/files/policy\\_report/2019/GBD\\_2017\\_Booklet\\_Issuu\\_2.pdf](http://www.healthdata.org/sites/default/files/files/policy_report/2019/GBD_2017_Booklet_Issuu_2.pdf)
- World Health Organization. Noncommunicable diseases country profiles 2011 [Internet]. World Health Organization; 2011 [cited 2020 Dec 3]. Available from: <https://www.who.int/nmh/countries/2011/en/>
- World Health Organization. Noncommunicable diseases country profiles 2018 [Internet]. World Health Organization; 2018 [cited 2020 Dec 3]. Available from: <https://www.who.int/nmh/countries/en/>
- USAID, Health Systems. The Health System Assessment Approach: A How-To Manual. Health Systems 20/20; 2012.
- {Shrestha A, Karmacharya BM, Maharjan R, Dhimal M, Vaidya A, Oli N, et al. Stakeholder Engagement in Planning the Design of National Need Assessment for Cardiovascular Disease Prevention and Management in Nepal. *Glob Heart* [Internet]. 2019;14. Available from: <http://dx.doi.org/10.1016/j.jheart.2019.05.002>
- DoHS. DOHS Annual Report 2016/17 [Internet]. Ministry of Health and Population; 2017 [cited 2020 Jul 3]. Available from: [http://DoHS.gov.np/wp-content/uploads/2018/04/Annual\\_Report\\_2073-74.pdf](http://DoHS.gov.np/wp-content/uploads/2018/04/Annual_Report_2073-74.pdf)
- DoHS. Health Management Information System Guideline 2017 [Internet]. Department of Health Services; 2017 [cited 2020 Jul 3]. Available from: <https://DoHS.gov.np/wp-content/uploads/2019/03/HMIS-Guideline-2075.pdf>
- DoHS. HMIS Recording and Reporting Forms 2013 [Internet]. Department of Health Services; 2013 [cited 2020 Jul 3]. Available from: <http://nnfsp.gov.np/PortalContent.aspx?Doctype=Resources&ID=232>
- MoHP: New Era: ICF. Nepal Demographic and Health Survey [Internet]. Ministry of Health and Population; 2016 [cited 2020 Nov 26]. Available from: <https://www.MoHP.gov.np/eng/publications/nepal-demographic-health-survey>
- Ministry of Health and Population. Health Sector Information System: National Strategy [Internet]. Government of Nepal; 2006 [cited 2020 Nov 26]. Available from: [https://www.who.int/goe/policies/nepal\\_health\\_strategy\\_2063.pdf](https://www.who.int/goe/policies/nepal_health_strategy_2063.pdf)
- Multi-sectoral Action Plan for the Prevention and Control of Non Communicable Diseases (2014-2020) [Internet]. Government of Nepal; [cited 2020 Nov 26] p. 60. Available from: [https://www.who.int/docs/default-source/searo/ncd-surveillance/pages-from-nep-ncd-action-plan-2014-2020-me.pdf?sfvrsn=9eaf4d33\\_2](https://www.who.int/docs/default-source/searo/ncd-surveillance/pages-from-nep-ncd-action-plan-2014-2020-me.pdf?sfvrsn=9eaf4d33_2)
- National Planning Commission. National Monitoring and Evaluation Guidelines [Internet]. National Planning Commission; 2013 [cited 2020 Nov 26] p. 164. Available from: [https://www.npc.gov.np/images/category/ME\\_GuidelineEng.pdf](https://www.npc.gov.np/images/category/ME_GuidelineEng.pdf)
- FMoHP, NHSSP. Budget Analysis of Ministry of Health and Population FY 2018/19 [Internet]. Government of Nepal; 2018 [cited 2020 Jul 3]. Available from: [https://www.nhssp.org.np/Resources/PPFM/Budget\\_Analysis\\_of\\_Nepal\\_Federal\\_MoHP\\_FY2018\\_19\\_Sep2018.pdf](https://www.nhssp.org.np/Resources/PPFM/Budget_Analysis_of_Nepal_Federal_MoHP_FY2018_19_Sep2018.pdf)
- MoHP. Nepal National Health Accounts 2012/13 – 2015/16 [Internet]. Ministry of Health and Population; 2018 [cited 2020 Jul 3]. Available from: [https://www.who.int/docs/default-source/nepal-documents/nepal-nha-2012-13-to-2015-16-ministry-of-health-and-population-june-2018.pdf?sfvrsn=64645c52\\_2](https://www.who.int/docs/default-source/nepal-documents/nepal-nha-2012-13-to-2015-16-ministry-of-health-and-population-june-2018.pdf?sfvrsn=64645c52_2)
- DoHS. DoHS Annual Report 2017/18 [Internet]. Ministry of Health and Population; 2017 [cited 2020 Jul 3]. Available from: <https://DoHS.gov.np/annual-report-2074-75/>
- Nepal: HIS Indicators [Internet]. MEASURE Evaluation. 2019 [cited 2020 Jul]. Available from: <https://www.measureevaluation.org/his-strengthening-resource-center/country-profiles/nepal>
- CBS. National Population and Housing Census 2011 [Internet]. Central Bureau of Statistics ; 2012 [cited 2020 Jul 3]. Available from: <https://unstats.un.org/unsd/demographic/sources/census/wphc/Nepal/Nepal-Census-2011-Vol1.pdf>
- Dhimal M, Bista B, Bhattarai S, Dixit LP, Hyder MDKA, Agrawal N, et al. Report of Noncommunicable Disease Risk Factors: STEPS Survey Nepal 2019 [Internet]. Nepal Health Research Council; 2019 [cited 2020 Jul 3]. Available from: [https://www.who.int/docs/default-source/nepal-documents/ncds/ncd-steps-survey-2019-compressed.pdf?sfvrsn=807bc4c6\\_2](https://www.who.int/docs/default-source/nepal-documents/ncds/ncd-steps-survey-2019-compressed.pdf?sfvrsn=807bc4c6_2)
- Living Standards Survey 1995-1996, First Round [Internet]. The World Bank Microdata Library. 2020 [cited 2020 Jul]. Available from: <https://microdata.worldbank.org/index.php/catalog/2301/study-description>
- Department of Health Services. DOHS Annual Report 2018/19 [Internet]. Department of Health Services; 2020 [cited 2020 Dec 15]. Available from: <http://DoHS.gov.np/DoHS-annual-report-fy-2076-77/>
- DoHS. HMIS indicators 2013 [Internet]. Department of Health and Population; 2013 [cited 2020 Jul 3]. Available from: <https://DoHS.gov.np/wp-content/uploads/2019/03/IHIMS-Indicators-booklet.pdf>
- DoHS. HMIS Data Analysis Use Book 2014 [Internet]. Department of Health Services; 2014. Available from: [https://DoHS.gov.np/wp-content/uploads/2019/03/HMIS\\_Data\\_Analysis\\_Use\\_Book.pdf](https://DoHS.gov.np/wp-content/uploads/2019/03/HMIS_Data_Analysis_Use_Book.pdf)
- DoHS. DHIS 2 Operational Guideline 2016. Department of Health Services; 2016.
- Ministry of Health and Population. Routine Data Quality Assessment [Internet]. Ministry of Health and Population; 2018 [cited 2020 Jul 3]. Available from: <https://rdqa.MoHP.gov.np/manual>
- NHSSP. Framework for Improved Management of Health Information in the Context of Federal Governance Structures in Nepal [Internet]. Nepal Health Sector Support Programme III; 2017 [cited 2020 Jul 3]. Available from: [https://www.nhssp.org.np/Resources/EA/Framework\\_for\\_Improved\\_Health\\_MIS\\_June2017.pdf](https://www.nhssp.org.np/Resources/EA/Framework_for_Improved_Health_MIS_June2017.pdf)
- Kombe G, Fleisher L, Kariisa E, Arur A, Parsa S, Ligia P, et al. Nigeria Health System Assessment 2008 [Internet]. USAID, Federal Ministry of Nigeria; 2009 Apr [cited 2020 Jan 8]. Available from: [file:///C:/Users/Dell/Downloads/NigeriaHSAFINALApril2009\\_MCDV2.pdf](file:///C:/Users/Dell/Downloads/NigeriaHSAFINALApril2009_MCDV2.pdf)
- Mulaki A, Muchiri S. Kenya Health System Assessment. Palladium; 2019.
- Gomberg DN, Banks PO, McBirney AR. Guatemala: preliminary zircon ages from central cordillera. *Science*. 1968 Oct 4;162(3849):121–2.
- Afghanistan: HIS Indicators [Internet]. MEASURE Evaluation. 2019 [cited 2020 Jul]. Available from: <https://www.measureevaluation.org/his-strengthening-resource-center/country-profiles/afghanistan>
- Ghana: HIS Indicators [Internet]. MEASURE Evaluation. 2019 [cited 2020 Jul]. Available from: <https://www.measureevaluation.org/his-strengthening-resource-center/country-profiles/ghana>
- Bangladesh: HIS Indicators [Internet]. MEASURE Evaluation. 2019 [cited 2020 Jul]. Available from: <https://www.measureevaluation.org/his-strengthening-resource-center/country-profiles/bangladesh>
- Ethiopia: HIS Indicators [Internet]. MEASURE Evaluation. 2019 [cited 2020 Jul]. Available from: <https://www.measureevaluation.org/his-strengthening-resource-center/country-profiles/ethiopia>
- Boerma T, Chikersal J, Hansen P, Low-Beer D. Strengthening of the monitoring and review component of the national health strategy. World Health Organization; 2011.