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# CRVS Fellowship report:

## Generating complete and accurate mortality statistics in Myanmar – a study on mortality information of signed and left patients in three hospitals

July 2020

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Melbourne School of Population and Global Health
Building 379
207 Bouverie Street
Carlton
VIC 3053, Australia

+61 3 9035 6560
CRVS-info@unimelb.edu.au
www.mspgh.unimelb.edu.au/dataforhealth

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# Contents

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## Acronyms and abbreviations

| | |
|---|---|
| CCBDR | Coordination Committee of Birth and Death Registration |
| COD | cause of death |
| CSO | Central Statistical Organization |
| CRVS | civil registration and vital statistics |
| D4H | Bloomberg Philanthropies Data for Health Initiative |
| DHIS2 | District Health Information Software |
| HIS | Health Information System |
| HMIS | Health Management Information System |
| MOHS | Ministry of Health and Sports |
| TMO | Township Medical Offices |
| VA | verbal autopsy |

# Executive summary

Myanmar's civil registration and vital statistics (CRVS) system is incomplete, with efforts to improve the overall quality of mortality statistics largely focused on improving notification of death and ascertainment of cause of death (COD).[1,2] A considerable issue regarding mortality data in Myanmar is the under-reporting of "signed and left" deaths; that is, terminally ill patients who are discharged from hospitals and go home to die.[3] This study aimed to investigate the extent of signed and left cases between January to June 2019 amongst residents of two townships in Myanmar, Pyinmana and Tatkon, who had been patients at three hospitals (Pyinmana, Tatkon and Naypyitaw).

Patients were retrospectively identified from the three hospitals using medical records charts and District Health Information Software (DHIS2) data, and subsequently matched with community death registrations and verbal autopsy (VA) data. Data were obtained on total hospital deaths across the three hospitals (including non-residents of Pyinmana and Tatkon), hospital deaths of Pyinmana and Tatkon (residents only, across the three hospitals), signed and left deaths of Pyinmana and Tatkon residents, and community deaths[4] in Pyinmana and Tatkon.

The total number of signed and left deaths was found to be 219 for residents of Pyinmana and Tatkon across the three hospitals, exceeding the 141 resident hospital deaths by 78. Signed and left cases comprised 23.5 per cent of total study deaths. Signed and left cases comprised 20 per cent of registered community deaths in the townships, and seven per cent of registered community deaths with a VA. Signed and left cases comprised 11.1 per cent of all deaths (hospital, community, and signed and left) of residents from the two townships, 13.2 per cent of all resident deaths in Pyinmana, and 9.1 per cent in Tatkon. The signed and left cases that could be matched to community deaths (i.e. discharged patients who died in community settings) comprised 4.1 per cent of total estimated deaths in the Pyinmana township and 3.4 per cent of total estimated deaths in the Tetkone township. Signed and left cases matched to community deaths survived an average of 2.6 days following discharge.

A misclassification matrix was used to compare diagnoses from DHIS2 medical discharge charts against VA diagnoses among identified signed and left cases, with matching International Classification of Diseases and Related Health Problems –10th edition (ICD-10 codes) for 20 out of 74 cases (27 per cent). The ranking of top CODs from both sources showed some similarities.

This study indicated that a significant proportion of signed and left cases – and therefore community deaths – may be systematically underreported, adversely affecting completeness of death registration. This is a novel study to investigate signed and left cases and will inform plans to implement policy to improve mortality statistics in Myanmar.Fellowship report: Analysis of causes of death in Myanmar using verbal autopsies

1 GBD 2017. Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *The Lancet* 2018; 382:1789-858.

2 Myanmar Ministry of Health and Sports, Myanmar Central Statistical Organization, Bloomberg Philanthropies Data for Health Initiative. Myanmar Ministry of Health and Central Statistical Organization: Bloomberg Data for Health Initiative Civil Registration and Vital Statistics Work Plan. Unpublished; 2016.

3 Zaw, M.T. Fellowship profile: Generating complete mortality statistics from hospital data in Myanmar. CRVS Fellowship reports and profiles. Melbourne, Australia: Bloomberg Philanthropies Data for Health Initiative, Civil Registration and Vital Statistics Improvement, University of Melbourne; 2020.

4 Deaths that occur outside of a health facility

# CRVS Fellowship report: Generating complete and accurate mortality statistics in Myanmar – a study on mortality information of signed and left patients in three hospitals

From September to October 2019, Dr May Thu Zaw from the Ministry of Health and Sports in Myanmar undertook a Civil Registration and Vital Statistics (CRVS) Fellowship through the Bloomberg Philanthropies Data for Health Initiative at the University of Melbourne, assessing the completeness of mortality data generated from hospitals. This Fellowship report provides an overview of the CRVS system in Myanmar, and details May's investigation of signed and left cases in three hospitals in Myanmar.

## Background

A complete and accurate civil registration and vital statistics (CRVS) system is the gold standard of routine mortality information.[5] In Myanmar, a country with a population of over 50 million, true levels of mortality are uncertain, with half of all deaths in the country estimated to go unregistered.[6] This is a particularly salient issue given that Myanmar, like other Southeast Asian countries, is progressing through an epidemiological transition with an increased burden of non-communicable diseases.[7]

Myanmar's CRVS system was established in the late 19th century and rolled out nationally in 1984.[8] Since then, it has been operating as a decentralised and largely paper-based system.[9] In April 2016, the Coordination Committee of Birth and Death Registration (CCBDR), comprising 13 concerned ministries, was re-formed with the aim of providing strategic guidance to strengthen the CRVS system.[9]

Currently, the Ministry of Health and Sports (MOHS) and the Central Statistical Organization (CSO) take joint responsibility for birth and death registration.[10] The MOHS performs birth and death notification and registration, cause of death (COD) certification, and issues birth and death certificates.[10] The CSO conducts ICD coding of COD, data entry, data compilation, data quality review and produces vital statistics reports.[11] The Health Information System (HMIS) under the MOHS also records health-related information, including birth and death data, in both community and hospital settings.[10] The HMIS uses the District Health Information Software (DHIS2) data platform to obtain accurate and real time health data.[10]

Since 2016, the MOHS and CSO together with the Bloomberg Philanthropies Data for Health (D4H) Initiative have been jointly implementing interventions to strengthen the death registration system in Myanmar. Supported by D4H, verbal autopsy (VA) methods (**Box 1**) have been introduced in 42 townships across Myanmar to capture the community causes of death collected by Basic Health Staff (BHS).

5 Cobos Muñoz, D., Sant Fruchtman, C., Renggli, S., deSavigny, D. CRVS innovations: Assessing the performance of CRVS systems. CRVS technical outcome series. Melbourne, Australia: Bloomberg Philanthropies Data for Health Initiative, Civil Registration and Vital Statistics Improvement, University of Melbourne; 2019.

6 GBD, 2018, Global, regional, and national age-sex-specific mortality and life expectancy, 1950–2017: a systematic analysis for the Global Burden of Disease Study 2017, *Lancet*, 392: 1684–735.

7 Dans, A., et al. The rise of chronic non-communicable diseases in southeast Asia: time for action. *The Lancet* 2011; 377(9766):680-689.

8 Myint N. Recent levels and trends of fertility and mortality in Myanmar. Asia-Pacific Population Journal 1991;6(2):3-71

9 Myanmar Ministry of Health and Sports, Myanmar Central Statistical Organization, Bloomberg Philanthropies Data for Health Initiative. Myanmar Ministry of Health and Central Statistical Organization: Bloomberg Data for Health Initiative Civil Registration and Vital Statistics Work Plan. Unpublished; 2016.

10 The Republic of the Union of Myanmar. Myanmar Ministry of Health and Sports (MOHS). 2020. Available from https://www.mohs.gov.mm/

11 The Republic of the Union of Myanmar. Myanmar Central Statistical Organisation (CSO). 2020. Available from: https://csostat.gov.mm

**Box 1: What is VA?**

Verbal autopsy (VA) is a method for collecting information about an individual's signs and symptoms before their death from their family or next of kin, and interpreting these to diagnose the likely or most probable COD.[12]

The VA process consists of three steps:

1. Setting up an interview by a trained VA staff member at home (or another appropriate place)
2. Conducting a structured interview to collect information on signs and symptoms of illnesses and events that the deceased had before death
3. Interpreting the interview data to diagnose the most probable COD.[13]

Automated methods of collecting and analysing VA data have also been developed, and have been shown to be as reliable as physicians in diagnosing COD from VA interviews.[14] Moreover, as automated VA can be less costly and time-consuming than paper-based VA, it is a highly useful method in resource-poor settings where physicians may not be readily available.[14]

Further, in order to improve death registration completeness and the accuracy of COD data, medical certification of COD (MCCOD) trainings have been provided to physicians (**Box 2**).

**Box 2: What is MCCOD?**

When a patient dies in a hospital or health facility, a medical certificate of cause of death (COD) should be completed.[15] The medical death certificate is usually completed by a physician who attended to the patient or a physician who is familiar enough with the patient's medical history to confidently ascertain the COD. To certify a death, the physician must first identify the disease or injury leading directly to death, and then trace back the sequence of events to determine the underlying COD.[16]

The COD is then statistically coded, and this COD information from individual decedents aggregated into mortality statistics. The quality of such statistics is critically dependent on the accurate completion of the medical record, which is in turn dependent on the ability of physicians to correctly assign the COD.[17]

12 de Savigny et al. Integrating community-based verbal autopsy into civil registration and vital statistics (CRVS): system-level considerations. Global Health Action 2017; 10:1272882.

13 University of Melbourne. Challenges associated with automated VA training and rollout. CRVS best-practice and advocacy. Melbourne, Australia: Bloomberg Philanthropies Data for Health Initiative, Civil Registration and Vital Statistics Improvement, The University of Melbourne; 2018

14 Ibid.

15 The University of Melbourne. Strategies for improving the quality of cause of death data in hospitals, CRVS best-practice and advocacy. Melbourne, Australia: Bloomberg Philanthropies Data for Health Initiative, Civil Registration and Vital Statistics Improvement, University of Melbourne; 2017

16 Lomas HD, Berman JD. Diagnosing for administrative purposes: some ethical problems. Social Science and Medicine 1983; 17:241-244

17 University of Melbourne. Handbook for doctors on cause of death certification. CRVS technical guides. Melbourne, Australia: Bloomberg Philanthropies Data for Health Initiative, Civil Registration and Vital Statistics Improvement, the University of Melbourne and Ghana Health Service; 2017

# Study rationale

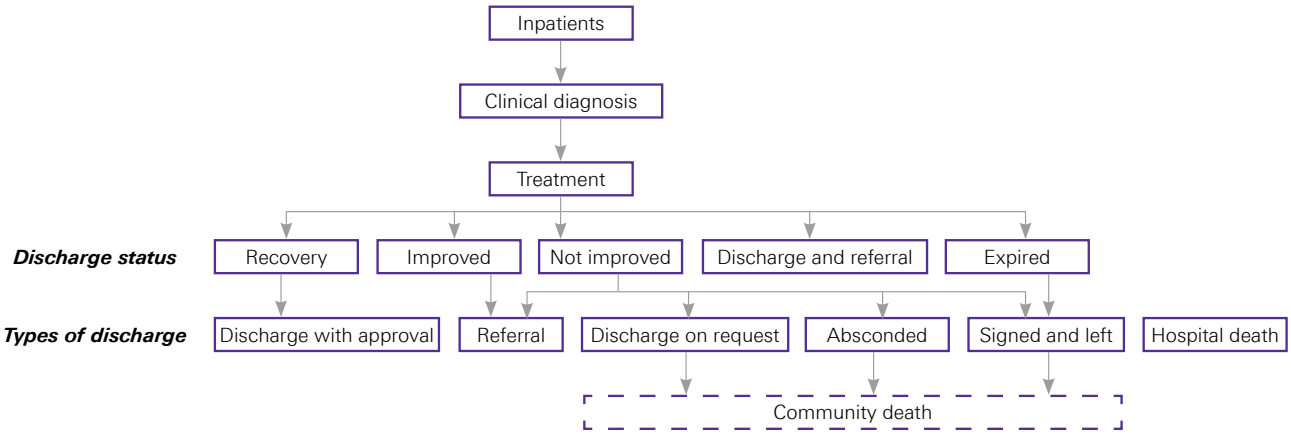
In order to improve the country's mortality statistics, Myanmar is striving to strengthen both death notification and ascertainment of COD using VA for community deaths, which accounts for over 80 per cent of all deaths in the country.[18] However, numbers of hospital deaths in Myanmar, where CODs are medically certified by physicians, remain uncertain. An accurate assessment of hospital deaths is therefore important for understanding the proportions of all deaths in the country that occur in hospitals and in community settings, and to assist in measuring the completeness of both hospital and community death reporting.[19] Of the 1151 hospitals in Myanmar, most are unable to register all deaths due to cultural constraints, limited facilities and human resources, and a lack of awareness of the importance of COD information and mortality data.[20]

A major issue with hospital mortality data is the under-reporting of deaths due to "signed and left" cases: that is, terminally ill patients who are discharged and eventually die in the community.[3] Signed and left cases constitute a significant proportion of all deaths, and may contribute to an under-reporting of deaths[3] as they go uncaptured by hospitals, community death notification systems, and VA alike.[21] Additionally, although hospitals record patient information using DHIS2, medical certification of cause of death information for signed and left cases is not captured by the CRVS system – a gap which is caused by weak communication channels between hospitals and township medical offices (TMOs) as well as insufficiently linked HMIS and CRVS data collection systems.

In Myanmar, the types of discharges from hospital that are most likely to be recorded as community deaths are: *discharge on request, absconded*, and *signed and left* cases, as shown in **Figure 1**.

To date, there has been no study in Myanmar to measure the extent of signed and left cases and how they may impact the quality and completeness of mortality statistics.

**Figure 1: Hospital inpatients and how these relate to community deaths**



# Study aims

*General objective*

To measure the extent of signed and left deaths in Myanmar, and the impact of these deaths on death registration completeness and quality of mortality statistics.

*Specific objectives*

1. To measure signed and left cases in three hospitals based on discharge status and type of discharge
2. To measure signed and left cases as the percentage of hospital deaths and total reported township deaths
3. To match signed and left deaths to community deaths using VA data
4. To compare COD information from hospital discharge diagnoses, from signed and left cases, and from VA
5. To recommend how decision-makers, physicians, TMOs, CSOs and other CRVS stakeholders can improve the recording of signed and left cases by establishing a data transfer system between hospitals and the community.

The findings from this study will help decision-makers understand how signed and left cases are recorded by the CRVS system. This will be informative for MOHS and other government staff, physicians, BHSs, and community members in determining the completeness and accuracy of Myanmar's death data.

# Methodology

*Research design*

This is a cross sectional, descriptive and retrospective study. The data were collected from January to June 2019.

*Study sites*

This study was conducted in areas which have been implementing both MCCOD and VA interventions. VA has been implemented in the Pyinmana and Tetkon townships, and MCCOD in Naypyitaw (1,000 beds) hospital, Pyinmana (200 beds) and Tetkon (100 beds) hospitals. The study was conducted based on type of discharge, discharge status, discharge diagnosis and verbal autopsy data.

*Data sources*

1. DHIS2 (HMIS): The signed and left case records were identified from the DHIS2 data sources of three studied hospitals.
2. Patients' medical records charts from hospitals (HMIS): Signed and left cases from DHIS2 were identified through admission number together with patient's name, age, sex, father's name, date of birth, permanent address and discharge diagnosis.
3. VA data (CRVS system): Deaths registered during the first six months of 2019 with VA were collected from the CSO. An empirical completeness method developed by Dr Tim Adair and Professor Alan Lopez[22] was used to estimate deaths based on 2018 actual data. This completeness method estimates completeness of death registration using data inputs like reported crude death rate (reported deaths divided by population multiplied by 1000), under-five mortality rate, and percentage of the population aged 65 years and above.

*Sample size*

All signed and left cases from three hospitals during January to June 2019 were collected.

*Data management and analysis*

Signed and left cases from DHIS2 were identified by using patient's medical records charts from hospitals (HMIS) and matched with VA data collected from the CSO. Data were then compiled and analysed using Microsoft Excel and SPSS Statistics.

*Ethical considerations*

This study used secondary data and confidentiality was strictly maintained during data collection, analysis and reporting. Data were analysed by the author of this study only.

22 Adair, T., Lopez, A.D., Estimating the completeness of death registration: An empirical method, *PLoS ONE*, 2018, 13(5): e0197047

# Results

During the first six months of 2019, the total number of signed and left cases was 780 in Naypyidaw hospital, 98 in Pyinmana hospital, and 25 in Tetkone hospital. The type of discharge for all discharges are described in **Table 1**. For each hospital, signed and left cases comprised less than five per cent of all discharges.

**Table 1: Types of discharge at the three hospitals, Jan-June 2019.**

| Type of discharge | Naypyidaw | | Pyinmana | | Tetkone | |
|---|---|---|---|---|---|---|
| | No. | Percentage (%) | No. | (Percentage (%) | No. | Percentage (%) |
| Approved/cured | 15803 | 90.2 | 4224 | 88.8 | 2084 | 89.0 |
| Signed and left | 780 | 4.5 | 98 | 2.1 | 25 | 1.1 |
| Referred | 1 | 0.0 | 208 | 4.4 | 133 | 5.7 |
| Hospital death | 653 | 3.7 | 28 | 0.6 | 14 | 0.7 |
| Discharge and Request | 8 | 0.0 | 87 | 1.8 | 41 | 1.6 |
| Absconded | 279 | 1.6 | 111 | 2.3 | 44 | 1.9 |
| **Total** | **17524** | **100** | **4756** | **100** | **2341** | **100** |

The number of signed and left cases and in-facility deaths by hospital – for residents of the townships of Pyinmana and Tetkone only – are reported in **Table 2**. The total number of signed and left cases was 219, with 141 township resident hospital deaths. Signed and left cases as a proportion of township resident hospital deaths *plus* signed and left cases (i.e. mortality where the deceased was a hospital patient before death) was 55.4 per cent in Naypyitaw, 75.9 per cent in Pyinmana and 64.1 per cent in Tetkone. Overall, signed and left cases comprised 60.8 per cent of all township resident hospital deaths *plus* signed and left cases.

**Table 2: Signed and left cases as a proportion of township-resident hospital deaths, by hospital, Jan-June 2019**

| Type of discharge | Naypyitaw | Pyinmana | Tetkone | Total |
|---|---|---|---|---|
| No. of signed and left cases | 134* | 60 | 25 | 219 |
| No. of hospital discharges | 16871 | 4728 | 2327 | 23926 |
| No. of total hospital deaths | 653 | 28 | 14 | 695 |
| No. of township resident hospital deaths | 108 | 19 | 14 | 141 |
| % of signed and left cases / (township resident hospital cases + signed and left cases) | 55.4% | 75.9% | 64.1% | 60.8% |

**Pyinmana and Tetkone deaths only*

Signed and left cases as a proportion of the total community deaths reported by VA (i.e. non-hospital deaths) was 20.4 per cent overall - 27.9 per cent in Pyinmana and 14.9 per cent in Tetkone (**Table 3**). Note that Pyinmana and Tetkone-resident signed and left cases include deaths that occurred in Naypyitaw hospital.

The total number of signed and left cases captured by VA was 74 out of the 219 cases from the studied hospitals (34 per cent). The number of signed and left cases matched to community deaths as a proportion of all reported community deaths was 8.7 per cent in Pyinmana and 5.6 per cent in Tetkone; overall the proportion matched was 7 per cent.

**Table 3: Signed and left cases matched to community deaths**

| Type of case | Pyinmana | Tetkone | Total |
|---|---|---|---|
| No. of signed and left cases | 128 | 91 | 219 |
| No. of reported community deaths (VA) | 371 | 555 | 926 |
| No. of signed and left matched to reported community deaths | 40 | 34 | 74 |
| No. of reported community deaths + (signed and left – signed and left matched to community deaths) | 459 | 612 | 1071 |
| % of signed and left / reported community deaths (including signed and left) | 27.9% | 14.9% | 20.4% |
| % of signed and left matched / signed and left cases | 31.3% | 37.4% | 33.8% |
| % of signed and left matched / reported community deaths (including signed and left) | 8.7% | 5.6% | 6.9% |

The frequency of survival times of signed and left cases matched that of community deaths (i.e. the time interval between date of discharge and date of death registered by VA), and is shown in **Table 4**. The central tendency of survival times was an average of 2.6 days, mode of 0 days, and median of 0 days. The maximum and minimum were 35 days and 0 days respectively. The standard deviation was ±5.4 days.

**Table 4: The frequency of survival times of signed and left cases matched to community deaths**

| Survival times (day) | Frequency | Valid percent (%) | Cumulative percent (%) |
|---|---|---|---|
| 0 | 42 | 56.8 | 56.8 |
| 2 | 11 | 14.9 | 71.6 |
| 3 | 5 | 6.8 | 78.4 |
| 4 | 1 | 1.4 | 79.7 |
| 5 | 3 | 4.1 | 83.8 |
| 6 | 6 | 8.1 | 91.9 |
| 7 | 1 | 1.4 | 93.2 |
| 9 | 1 | 1.4 | 94.6 |
| 12 | 1 | 1.4 | 95.9 |
| 17 | 1 | 1.4 | 97.3 |
| 22 | 1 | 1.4 | 98.6 |
| 35 | 1 | 1.4 | 100.0 |
| **Total** | **74** | **100.0** | **100.0** |

During the follow-up for this study, total deaths (community and hospital) were 457 in Pyinmana and 610 in Tetkone. Naypyitaw hospital deaths included 67 resident-based deaths in Pyinmana and 41 in Tetkone townships. Total study deaths (also including signed and left cases) as a proportion of estimated deaths during the first six months of 2019 was 61.5 per cent overall, 56.1 per cent in Pyinmana and 66.7 per cent in Tetkone. Signed and left cases as a proportion of estimated total deaths was 11.1 per cent overall, 13.2 per cent in Pyinmana and 9.1 per cent in Tetkone. Signed and left cases as a proportion of study deaths was 23.5 per cent in Pyinmana and 13.6 per cent in Tetkone. Signed and left cases matched to community deaths as a proportion of total study deaths was 7.3 per cent in Pyinmana and 5.1 per cent in Tetkone (**Table 5**).

**Table 5: Comparison of estimated deaths (Jan - Jun 2019)**

| Name of township | Mid-year population | 2019 2019 (Jan-June) | Community deaths | Hospital deaths | Signed and left | Signed and left matched to community deaths | Total deaths* |
|---|---|---|---|---|---|---|---|
| **Pyinmana** | 206 088 | Estimated | 936 | 35 | N/A | N/A | 971 |
| | | Study finding | 371 | 19 + 67 *(Pyinmana plus Naypyitaw hospitals)* | 128 *(23.5% as a proportion of total study deaths; 13.2% as a proportion of total estimated deaths)* | 40 *(7.3% as a proportion of total study deaths; 4.1% as a proportion of total estimated deaths)* | 545 *(56.1% as a proportion of estimated total deaths)* |
| **Tetkone** | 239 861 | Estimated | 977 | 23 | | | 1,000 |
| | | Study finding | 555 | 14 + 41 *(Tetkone plus Naypyitaw hospitals)* | 91 *(13.6% as a proportion of total study deaths; 9.1% as a proportion of total estimated deaths)* | 34 *(5.1% as a proportion of study total deaths; 3.4% as a proportion of total estimated deaths)* | 667 *(66.7% as a proportion of estimated total deaths)* |
| **Total** | 445 949 | Estimated | 1913 | 58 | | | 1971 |
| | | Study finding | 926 | 141 | 219 *(18% as a proportion of total study deaths; 11.1% as a proportion of total estimated deaths)* | 74 *(6.1% as a proportion of total study deaths; 3.8% as a proportion of total estimated deaths)* | 1212 *(61.5% as a proportion of total estimated deaths)* |

**Community deaths plus hospital deaths plus signed and left less signed and left matched*

.

A misclassification matrix for medical discharge charts of matched signed and left cases from DHIS2 and VA CODs among signed and left cases was used to identify that 20 out of 74 cases (27 per cent) had the same COD (**Annex 1**).

There were several causes which had a VA COD but no discharge diagnosis; particularly, other non-communicable diseases, diabetes and falls due to the immediate cause rather than underlying cause generally being entered as the discharge diagnosis. However, there were some similarities in the ranking of COD by both methods, particularly for the most common causes, shown in **Table 3**.

**Table 3: Ranking of Top 15 leading causes of death of signed and left cases from different sources of information**

| Discharge diagnosis (%) | Top 15 leading causes of death | Top 15 leading causes of death | VA% |
|---|---|---|---|
| 24.3 | Stroke | Stroke | 14.9 |
| 8.1 | Ischemic heart disease | Undetermined | 14.8 |
| 4.1 | Cirrhosis | Ischemic heart disease | 13.5 |
| 4.1 | Pneumonia | Cirrhosis | 12.1 |
| 4.1 | Hypertension | Chronic obstructive pulmonary disease | 9.5 |
| 4.1 | Mental and behavioural disorders due to use of alcohol | Diabetes | 8.1 |
| 4.1 | Acute appendicitis, unspecific | Pneumonia | 6.8 |
| 2.7 | Lung cancer | Lung cancer | 4 |
| 2.7 | Renal failure | Oesophageal cancer | 4 |
| 2.7 | Cervical cancer | Cervical cancer | 4 |
| 2.7 | Subacute abscess of buttock or limb | Other non-communicable diseases | 2.7 |
| 2.7 | Biliary cancer | Renal failure | 1.3 |
| 2.7 | Septicemic shock, unspecific | Breast cancer | 1.3 |
| 2.7 | Other disorder of electrolyte imbalance | Tuberculosis | 1.3 |
| 1.3 | Chronic obstructive pulmonary disease | Fall | 1.3 |

# Discussion

To support efforts by D4H and CRVS stakeholders in Myanmar to generate accurate and complete mortality statistics, this study assessed registration and COD data for signed and left cases. The study aimed to assess the extent of registration of signed and left cases and suggest steps to facilitate registration and identification of COD from these cases.

A key finding was that there were more signed and left cases than hospital deaths. Signed and left cases made up one-fifth (20 per cent) of reported community deaths, but signed and left cases that could be matched to registered community deaths with VA comprised only seven per cent of reported community deaths. Furthermore, signed and left cases comprised 11.1 per cent of total estimated deaths – not an insignificant proportion.

The development of systems to facilitate the registration of signed and left cases would likely improve levels of death registration completeness and the availability and accuracy of COD data. Improving follow-up, registration and COD documentation for the large proportion of signed and left cases could provide a significant boost to the quality of COD data in Myanmar. To improve completeness of death registration, a trial of a system for transferring details of signed and left cases from the hospital to BHS could be implemented. This may be most feasible, at least in the early stages of implementation, for resident-based hospital deaths. The average survival times of signed and left cases matched to community deaths was 2.6 days. Such information may be useful for health planners when considering how best to follow-up these cases. A review of medical charts to identify the underlying CODs of signed and left cases, matched with the VA CODs may be a useful validation study of the VA output for signed and left cases.

There is also a need to develop a clear definition of the "not improved" discharge status among signed and left cases based on their severity of illness. Medical recorders and health care providers would also benefit from improved understandings of DHIS2 discharge types and definitions.

Previous data have indicated that only 16 per cent of deaths in Myanmar occur in hospitals.[23] This study indicates that provision of information for signed and left cases from hospitals to TMOs to inform MCCOD completion could improve the quality of COD data for a significant proportion of community deaths.

This study was relatively small in scope, and performed as a situation analysis based on the secondary data of three selected hospitals from January to June 2019. This study was not able to intensively follow-up the missing signed and left cases due to time constraints. These findings do, however, suggest the need for further studies of national registration data to gain a better understanding of the extent of signed and left cases.



23 Hazard, R., et al. Automated verbal autopsy: from research to routine use in civil registration and vital statistics systems. *BMC Medicine* 2020; 18:60.

# Conclusion

This retrospective study of signed and left cases provides preliminary data indicating that improvements in death registration completeness and COD data may be possible with better follow-up of signed and left cases. This study identified the proportion of signed and left cases compared to community deaths and proposed areas for further investigation.

Building on the knowledge from this study, further research covering all signed and left cases from specific hospitals would be beneficial in order to better understand the usual survival times of these cases and if there are specific social, cultural or other barriers to death registration and VA.

In addition to improving the completeness of death registration, and to strengthen the CRVS system in Myanmar, assessments of MCCOD and VA are also important. Therefore, further studies should be undertaken using data quality and analysis software such as the University of Melbourne's ANACONDA[24] (ANAlysis of Causes of National Deaths for Action) tool for hospital deaths and VIPER[25] (Verbal Autopsy Interpretation, Performance and Evaluation Resource) for assessment of VA data on community deaths.

24 Available from the CRVS Knowledge Gateway, at: https://crvsgateway.info/anaconda
25 Available from the CRVS Knowledge Gateway, at: https://crvsgateway.info/VIPER

# Annex 1

Misclassification matrix between Discharge Diagnosis in columns and VA COD in rows

| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | I60-I69 | I20-I25 | J40-J4 | C34 | K70-7( | C15 | N17-N | C53 | C50 | J10-J2 | E14 | C16.9 | C78.2 | G81.9 | I10.X | RR00- | I38 | C22 | L02.3 | C24.1 | J93 | A15-A | R18.X | A41.9 | L98.4 | W19 | D43.2 | C23.X | UU1 | C20.X | G40.9 | E87.5 | F10.6 | J90.X | K35.9 | C78.2 | I50.0 | J93.9 | K92.0 | K85.9 | M32.9 | B90.9 | T No. |
| 1 | I60-I69 | Stroke | 7 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 |
| 2 | I20-I25 | IHD | 1 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| 3 | J40-J46 | COPD | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 7 |
| 4 | C34 | Ca lung | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| 5 | K70-76 | COL | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| 6 | C15 | Ca esophagus | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| 7 | N17-N18 | Renal Failure | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 8 | C53 | Ca Cervice | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| 9 | C50 | Ca breast | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 10 | J10-J22 | Pneumonia | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 5 |
| 11 | E14 | Diabetes | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 6 |
| 12 | C16.9 | Ca Stomach | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 13 | C78.2 | 2Ca respratoryn& digestive | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | G81.9 | Hemiplegia | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 15 | I10.X | Hyperten | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 16 | RR00-99 | undetermined | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 11 |
| 17 | I38 | Endocarditis | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18 | C22 | Ca liver | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 19 | L02.3,L03 | Subcute abscess,F,C of buttock,limb | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 20 | C24.1 | Ca billary | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 21 | J93 | spontaneous Pneumothorax | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 22 | A15-A19 | TB | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 23 | R18.X | ascities | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 24 | A41.9 | Septicemia shock, unspecific | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 25 | L98.4 | other disorder of Skin and subcutaneous tissue | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 26 | W19 | Fall | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 27 | D43.2 | Neoplasm of unknown behaviour of brain and CNS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 28 | C23.X | Malignant neoplasm of Gall bladder | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 29 | UU1 | Other Non-communicable Diseases | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| 30 | C20.X | Ca rectum | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 31 | G40.9 | Epilepsy | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 32 | E87.5 | other disorder of electrolyte imbalance | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 33 | F10.6 | mental and behavioural disorders due to use of alcohol, chronic state | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 34 | J90.X | pleural effusion | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 35 | K35.9 | Acute appendicities,unspecific | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 36 | C78.2 | secondary malignat neoplasm of respiratory and digestive system | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 37 | I50.0 | heart Failure | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 38 | J93.9 | Other spontaneous pnemothorax | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 39 | K92.0 | haematemesis | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 40 | K85.9 | Actute pancretitis | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 41 | M32.9 | SLE, unspecific | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 42 | B90.9 | sequencely of respiratory and unspecific tuberculosis | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total No. | | 18 | 6 | 1 | 2 | 3 | 1 | 2 | 2 | 1 | 3 | 0 | 1 | 0 | 1 | 3 | 0 | 1 | 1 | 2 | 2 | 0 | 1 | 1 | 2 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 2 | 3 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 74 |

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## For more information contact:

CRVS-info@unimelb.edu.au
crvsgateway.info

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