Table [1](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7147005/table/Tab1/) describes the characteristics of the adult BiD cases aged 13 years and older and child BiD cases aged 1 month to 13 years in the UTH. The total number of cases was 1378 for adults and 209 for children during the 4-month research period from May to August 2017. There were 16 refusal cases in total. The most of reasons for refusals were respondents’ busyness to handle the funerals and emotional strain on the deceased. These refusal cases were simply excluded from the analysis since the number was small. Regarding the sex, 62.8% of adult cases and 44.9% of child cases were male. The median ages of the adults and children were 42.0 and 2.08 years old, respectively. Figures [1](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7147005/figure/Fig1/) and [​and22](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7147005/figure/Fig2/) present the age distribution according to the four age categories for the adult cases and by year for the child cases. Both figures show that there was not a normal distribution as the age of the adult cases had two peaks of distribution and the child BiD occurred more frequently in the younger ages. Most BiD cases originated from within Lusaka District.

Table 1

Characteristics of the brought-in-dead adult and child cases in the University Teaching Hospital

|  | **Adult** | **Child** |
| --- | --- | --- |
| Total Number | 1378 | 209 |
| Number of Refusals | 12 | 4 |
| Male (%) (95% CI) | 62.8 (60.2–65.4) | 44.9 (38.0–51.7) |
| Age (median year: 25–75th percentile) | 42.0 (34.0–65.0) | 0.88 (0.42–3.0) |
| Origins of the Participants | | |
| Within Lusaka | 1299 | 190 |
| Outside of Lusaka | 44 | 5 |
| Unknown Origin | 23 | 10 |

[Fig. 1](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7147005/figure/Fig1/)

Age distribution of the adult brought-in-dead cases who were aged 13 years and older. The data were collected in the University Teaching Hospital during the research period

[Fig. 2](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7147005/figure/Fig2/)

Age distribution of the child brought-in-dead cases who were aged 1 month to 13 years. The data were collected in the University Teaching Hospital during the research period

The CoD among the adult BiD cases aged 13 years and older

Table [2](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7147005/table/Tab2/) describes the top 10 CoD among the adult BiD cases according to the SmartVA and death notification form. Among 1366 BiD cases in the UTH from May to August 2017, the top 10 CoD calculated by the SmartVA were, in order, acquired immunodeficiency syndrome (AIDS), stroke, tuberculosis (TB), suicide, diabetes mellitus (DM), other cardiovascular diseases (CVDs), pneumonia, epilepsy, acute myocardial infarction, and asthma. While two main infectious diseases each occupied one of the highest ranks of the CoD, there were also several non-communicable diseases (NCDs). However, there were several discrepancies with the death notification form. Firstly, AIDS was not found in the top CoD; instead, TB and malaria ranked higher. Secondly, diarrhea/dysentery was replaced with pneumonia, and cancers and CVDs were ranked higher than stroke, epilepsy, and asthma.

Table 2

Top 10 Causes of deaths among the brought-in-dead adult cases in the University Teaching Hospital during research period by SmartVA and Death Notification Form

| **SmartVA (*N* = 1366)** | | | | **Death Notification Form (N = 1366)** | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Rank** | **Cause of Death** | **No** | **%** | **Rank** | **Cause of Death** | **No** | **%** |
|  | Undetermined | 344 | 25.2% |  | Undetermined | 526 | 38.5% |
| 1 | HIV/AIDS | 278 | 20.4% | 1 | TB | 239 | 17.5% |
| 2 | Stroke | 134 | 9.8% | 2 | Other CVDs | 148 | 10.8% |
| 3 | TB | 87 | 6.4% | 3 | Malaria | 75 | 5.5% |
| 4 | Suicide | 68 | 5.0% | 4 | Stroke | 59 | 4.3% |
| 5 | DM | 67 | 4.9% | 5 | Other Cancers | 45 | 3.3% |
| 6 | Other CVDs | 57 | 4.2% | 6 | Suicide | 33 | 2.4% |
| 7 | Pneumonia | 52 | 3.8% | 7 | Diarrhea/Dysentery | 31 | 2.3% |
| 8 | Epilepsy | 38 | 2.8% | 8 | Other NCDs | 28 | 2.0% |
| 9 | IHD/AMI | 26 | 1.9% | 9 | DM | 25 | 1.8% |
| 10 | Asthma | 25 | 1.8% | 10 | RTA | 25 | 1.8% |

NB: *TB* tuberculosis, *DM* diabetes mellitus, *CVDs* cardiovascular diseases, *AMI* acute myocardial infarction, *IHD* ischemic heart disease, *NCDs* non-communicable diseases, *RTA* road traffic accident

If a case’s tariff score was not significantly higher for a specific health condition than for other conditions, the SmartVA labeled it as an undetermined case. In addition, in the death notification form, some descriptions, such as fever, pain, or natural death, could not be properly coded. Table [3](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7147005/table/Tab3/) shows the number of determined CoD of the BiD cases according to the SmartVA and death notification form. The proportion of BiD cases whose CoD were determined was 61% for the death notification form and 75% for the SmartVA. The results of the statistical analysis showed that the SmartVA significantly improved the determination rate of the CoD compared with the death notification form. Table [4](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7147005/table/Tab4/) presents the number of BiD cases whose CoD were not determined by the death notification form and SmartVA. The proportion of BiD cases with a determined CoD according to both methods was 686 (50.2%). Regarding these cases, Table [4](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7147005/table/Tab4/) shows that 43.3% of the CoD matched between the death notification form and SmartVA, and the concordance rate was low in term of the kappa coefficient (0.083 95% confidence interval [CI]: 0.069–0.089).

Table 3

Number of the brought-in-dead adult cases with determined causes of death by both of Death Notification Form and SmartVA in the University Teaching Hospital

|  | **No. of Cases With Determined CoDs** | **Mean** | **95% CI** | ***P*-value** |
| --- | --- | --- | --- | --- |
| Death Notification Form | 840 | 0.61 | 0.589–0.641 |  |
| SmartVA | 1021 | 0.75 | 0.724–0.771 | <  0.05 |

Table 4

The number of undetermined cases among the brought-in-dead adult cases and the concordance rate of CoDs among the cases with determined CoDs by both of Death Notification Form and SmartVA in the University Teaching Hospital

|  | | **Number** | **Percentage** |
| --- | --- | --- | --- |
| Both Undetermined | | 191 | 14.0% |
| Undetermined only by Death Notification Form | | 335 | 24.5% |
| Undetermined only by SmartVA | | 154 | 11.3% |
| Both Determined |  | 686 | 50.2% |
| Matched CoDs between both methods | | 297 | 43.3% |
| Unmatched CoDs between both methods | | 389 | 56.7% |
| Kappa coefficient | | 0.083 (95% CI: 0.069–0.086) | |

NB: *CoDs* cause of deaths

Additional file [1](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7147005/#MOESM1) shows the distribution of the CoD among the adult BiD cases according to the four age categories: 13–19 years, 20–44 years, 45–59 years, and 60 years and above. The proportion of undetermined cases was largest among people aged 13–19 years according to the death notification form (51.3%) and smallest among those aged 45–59 years according to the SmartVA (19.9%). Generally speaking, there was less malaria and more AIDS in the SmartVA group, compared with the death notification form, in the distribution of the CoD and the older the BiD cases became, the higher the number of NCDs there were in the top CoD. In addition, there were further differences between the CoD according to the SmartVA and death notification form. For example, the SmartVA identified more suicide cases among the younger population and more neurological conditions (stroke or epilepsy) and DM cases in all generations. Indeed, the concordance rates between the SmartVA and death notification form were weak among all of the age categories in terms of the kappa coefficient, whereas this coefficient was higher in the middle-aged categories (20–59 years) than in people aged 13–19 years and 60 years and above.

The CoD among the child BiD cases aged 1 month to 13 years

Table [5](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7147005/table/Tab5/) describes the top 10 CoD among the adult BiD cases according to the SmartVA and death notification form. Among 205 BiD cases in the UTH from May to August 2017, the top 10 CoD calculated by the SmartVA were, in order, pneumonia, diarrhea/dysentery, human immunodeficiency virus (HIV)/AIDS, malaria, fires, drowning, other CVDs, meningitis, other defined CoD, and road traffic accident (RTA). Furthermore, infectious diseases, such as pneumonia, diarrhea/dysentery, and HIV/AIDS occupied the highest ranks of the CoD, followed by accidents, such as fire, drowning, and RTA. While the distribution of the CoD according to the death notification form was similar to that of the SmartVA, there were fewer HIV/AIDS cases on the death notification form and more epilepsy cases than meningitis cases. Table [6](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7147005/table/Tab6/) shows how many of the CoD of the BiD cases were determined by the SmartVA and death notification form. The proportion of the BiD cases whose CoD were determined was 46% for the death notification form and 67% for the SmartVA. The statistical analysis indicated that the SmartVA significantly improved the determination rate of the CoD compared with the death notification form. Table [7](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7147005/table/Tab7/) presents the number of BiD cases whose CoD were not determined by the death notification form and SmartVA. The proportion of BiD cases with determined CoD for both methods was 77 (37.6%). Regarding these cases, Table [7](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7147005/table/Tab7/) shows that 68.8% of the CoD were matched between the death notification form and SmartVA and the concordance rate was substantial in terms of the kappa coefficient (0.635, 95% CI: 0.548–0.740).

Table 5

Top 10 Causes of deaths among the brought-in-dead child cases in the University Teaching Hospital during research period by SmartVA and Death Notification Form

| **SmartVA (*N* = 205)** | | | | **Death Notification Form (N = 205)** | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Rank** | **Cause of Death** | **No.** | **%** | **Rank** | **Cause of Death** | **No.** | **%** |
|  | Undetermined | 68 | 33.2% |  | Undetermined | 111 | 54.1% |
| 1 | Pneumonia | 36 | 17.6% | 1 | Diarrhea/Dysentery | 18 | 8.8% |
| 2 | Diarrhea/Dysentery | 32 | 15.6% | 2 | Other Defined CoD | 14 | 6.8% |
| 3 | HIV/AIDS | 25 | 12.2% | 3 | Pneumonia | 10 | 4.9% |
| 4 | Malaria | 5 | 2.4% | 4 | Malaria | 9 | 4.4% |
| 5 | Fires | 5 | 2.4% | 5 | RTA | 7 | 3.4% |
| 6 | Drowning | 5 | 2.4% | 6 | Drowning | 7 | 3.4% |
| 7 | Other CVDs | 5 | 2.4% | 7 | Fires | 6 | 2.9% |
| 8 | Meningitis | 4 | 2.0% | 8 | Other CVDs | 6 | 2.9% |
| 9 | Other Defined CoD | 4 | 2.0% | 9 | Epilepsy | 5 | 2.4% |
| 10 | RTA | 4 | 2.0% | 10 | Other Cancers | 5 | 2.4% |

NB: *CVDs* cardiovascular diseases, *RTA* road traffic accident

Table 6

Number of the brought-in-dead child cases with determined causes of death by both of Death Notification Form and SmartVA in the University Teaching Hospital

|  | **No. of Cases With Determined CoDs** | **Mean** | **95% CI** | ***P*-value** |
| --- | --- | --- | --- | --- |
| Death Notification Form | 94 | 0.46 | 0.390–0.527 |  |
| SmartVA | 137 | 0.67 | 0.603–0.733 | <  0.05 |

Table 7

The number of undetermined cases among the brought-in-dead child cases and the concordance rate of CoDs among the cases with determined CoDs by both of Death Notification Form and SmartVA in the University Teaching Hospital

|  | **Number** | **Percentage** |
| --- | --- | --- |
| Both Undetermined | 51 | 24.9% |
| Undetermined only by Death Notification Form | 17 | 33.2% |
| Undetermined only by SmartVA | 60 | 62.4% |
| Both Determined | 77 | 37.6% |
| Matched CoDs between both methods | 53 | 68.8% |
| Unmatched CoDs between both methods | 24 | 31.2% |
| Kappa coefficient | 0.635 (95% CI: 0.548–0.740) | |

NB: *CoDs* cause of deaths