CAUSES OF DEATH IN THE COMMUNITY

Results of Verbal Autopsy in Rachuonyo North, Homa Bay County, Kenya – 2017

An activity of the Homa Bay County Civil Registration and Vital Statistics Improvement Project in collaboration with the County Government of Homa Bay, Kenya

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BACKGROUND

Verbal autopsy (VA) is the process of interviewing the caregiver of a deceased person to capture signs and symptoms experienced by the deceased prior to death, resulting in a probable cause of death. The process has emerged as the leading method targeted to enhance mortality surveillance efforts among the more than 2/3rds of the world's population for which low quality or no mortality data are available. Despite recent advances in tools to streamline and automate the VA data collection and analysis processes, successful implementation within a community-based (i.e., non-research) setting and in the context of a country's legal registration and vital statistics (CRVS) system has not been achieved. The Homa Bay County CRVS Improvement Project, conducted by the Kenya Ministry of Health (MOH) and Department of Civil Registration (CRD), with support by the US CDC and the Bloomberg Data for Health Initiative, has been working to demonstrate community-based VA implementation linked to a national CRVS system.

The demonstration comprises three phases: 1) proof of concept testing, 2) implementation testing, and 3) national roll-out. The first phase, proof of concept testing, was conducted among a group of community health units in select areas of Homa Bay County between November 2015 and January 2016. The second phase, implementation testing, was conducted with all community health units to provide full coverage for Rachuonyo North Sub-county, starting in November, 2016. This report provides an overview of the implementation testing methods, findings for 2017 community deaths, and a summary of lessons learned and recommendations.

METHODS

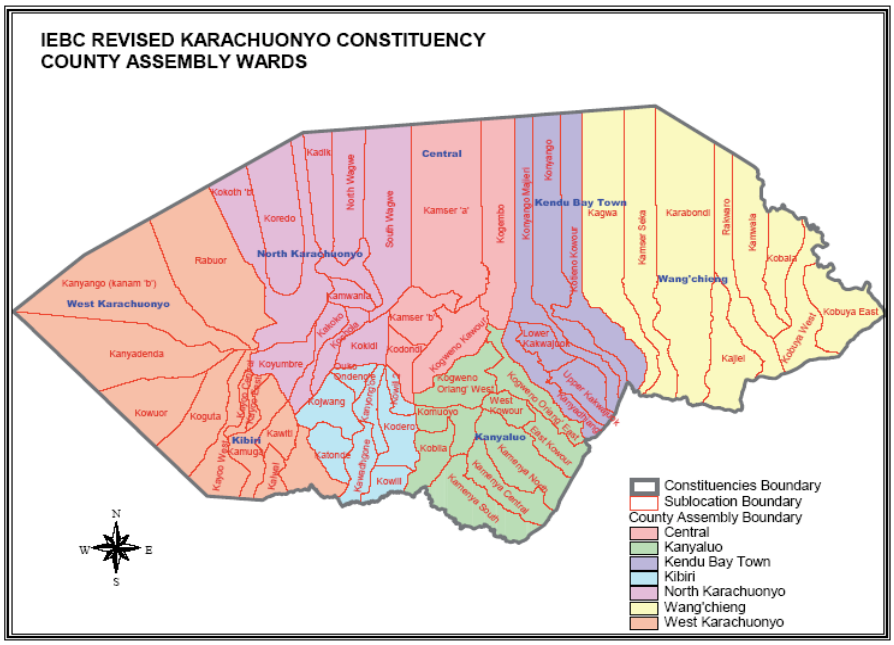
Location / Site

Homa Bay County is one of the 47 County governments in the Republic of Kenya. It is located in the Southern part of Nyanza, along the southern shores of Lake Victoria- Africa's largest Fresh water lake. The County headquarters –Homa Bay town. It borders five other Counties; - Migori, Kisii, Nyamira, Kericho and Kisumu. The county covers an area of 4,267.1 km^2 inclusive of the water surface, which on its own covers an area of 1,227 km^2, with an estimated population of 963,794 in 2009 and 1,131,950 in the year 2019 The County has semi-arid climatic conditions with daily temperatures ranging between 26°C during the coldest months (April and November) and 34°C during the hottest months (January to March). Wet months, as defined by the Homa Bay Ministry of Health, are March, April, May, June, November, and December, whereas dry months are January, February, July, August, September, and October.

Administratively, Homa Bay County is divided into eight sub-counties.

Rachuonyo North is one of the eight constituencies (Sub Counties) in Homa Bay County with seven wards, 435 sq km, and a total population of 178,686 persons. Rachuonyo North has a

fully immunized child (FIC) coverage of 45.1%, iron-folic acid supplementation (IFAS) coverage of 43.7%, fourth antenatal care (ANC) coverage of 25.5% with 36.3% of women of reproductive age (WRA) receiving family planning (FP) commodities. Amongst the WRA attending ANC services, 2.1% of them test positive for syphilis. The sub county has an estimated HIV prevalence of 21% with mother-to-child transmission (MTCT) rates of 2%. The prevention of mother-to-child transmission (PMTCT) uptake in the health facilities among HIV positive women stands at 96.7%.



Map of Rachuonyo North Sub County

Data Collection

Death Reporting and Notification

Implementation testing followed a multi-step process (see Appendix A). Community Health Volunteers (CHVs) supervised by Community Health Extension Workers (CHEWs) working under the Community Health Units (CHUs) of the Rachuonyo North MOH are assigned to visit a number of households, about 100 to 120, and to record deaths that occurred recently. For implementation testing, CHEWs, supervised by Public health officers reporting to Sub County Community services Focal Person, trained their respective CHVs to complete a locator form (see Appendix B) for all deaths that had taken place in their assigned households starting from January 1, 2017. The form specifies key attributes of the deceased that enables tracing of the compound for VA interviews. These include village, compound head, date of birth and death, place of death and sex. The form also allows collection of Burial permit serial number, that enables linkage of deaths to civil registration systems. Locator forms were completed during the CHV's routine household visit and shared with the CHEWs. The CHEWs then entered the data into electronic version of the locator form and sent to KEMRI servers for easier tracking of deaths. The CHEW then took the filled hard copy locator form together with filled VA consent form to the office of the sub county focal person and/or Health Records Information Officer

(HRIO), from where the forms were taken to KEMRI filing room for archiving. The sub-county civil registration authorities were also notified of reported deaths.

In total, 60 CHUs with 550 CHVs, and 33 CHEWs participated in the implementation testing in 2017.

Verbal Autopsy Interview

VA interviews were targeted for all deaths in 2017 that took place in the community and were not overseen by a clinician. For such deaths, the CHEW assigned to the community health unit of the household worked with the household CHV to schedule a VA interview. At the specified time, the CHEW and CHV visited the compound of the deceased and conducted the VA interview using the WHO 2016 VA instrument translated in the local language (Dholuo).

The WHO 2016 VA instrument is designed for routine use (i.e., in the context of a national CRVS system); it includes questionnaires for three age groups (under four weeks, four weeks to 11 years, and 12 years and above) and a cause-of-death list for VA prepared according to ICD-10. The questionnaires contain both common sections and specific sections appropriate to the age and sex of the deceased; sections include: personal information, information on the respondent and background about interview, cause of death, background and context of the death, and an open narrative field. The English standard version of the WHO 2016 VA instrument is available on the WHO website at: http://www.who.int/healthinfo/statistics/verbalautopsystandards/en/. An Excel mapping for ODK (Open Data Kit) programming and an instrument guide are included on the website. The Dholuo translated mapping is available upon request.

Implementation testing provided an opportunity to use the new WHO 2016 VA instrument. Accordingly, the interviewers were trained on an updated version of the instrument, which was adopted for subsequent data collection. The updated version included corrected skip patterns, clarifications of instructions and hints for interviewers, and added constraints and logic checks to improve quality of data entry; no substantive changes to the content of the instrument.

To record interview data, CHEWs used an ODK data collection platform programmed on an Android-based smartphone (Model: TECNO N6S). The smartphone was purchased new for this project (cost ~USD 75). General programmer and interviewer instructions for using the ODK platform are available upon request.

Data Management and Analysis

At the end of the interview, the interviewer uploaded the data to ODK Aggregate, a ready to deploy server hosted by Google App Engine. A python program, scheduled to run daily, transfers data from ODK Aggregate to a central internal server in KEMRI, where validation checks were applied and records were sorted into those with and without errors. Those witherrors were sent back to CHEWs for correction. Cause of death analysis was carried out using automated VA analysis software (Inter-VA 5) on the clean dataset.

Interpreting Verbal Autopsy version 5 (InterVA-5) uses probabilistic modeling to arrive at likely cause(s) of death for each VA case, the workings of the model being based on a combination of expert medical opinion and relevant available data. The InterVA-5 'high' malaria and 'high' HIV/AIDS settings were used in line with InterVA recommendations. The InterVA-5 model was applied to each case, yielding up to three possible causes of death or an indeterminate result. In a minority of cases, for example, where symptoms were vague, contradictory or mutually inconsistent, it was impossible for InterVA-5 to determine a cause of death, and these deaths were attributed as entirely indeterminate. For the remaining cases, one to three likely causes and their likelihoods were assigned by InterVA-5, and if the sum of their likelihoods was less than one, the residual component was then assigned as being indeterminate. This was an important process for capturing uncertainty in cause of death outcome(s) from the model at the individual level, thus avoiding over-interpretation of specific causes.

Further analysis was carried out using Stata/MP version 15.0.

The KEMRI/CDC Field Research Station VA team provided technical assistance for training, information technology, data management, and data analysis.

RESULTS

NOTE: VA results are not considered as equivalent to medically certified causes of death and are not generally used at an individual level; thus VA data are interpretable at a population level for statistical purposes. With a sufficient sample, cause of death results from VA may be summarized into cause-specific mortality fractions (CSMF)—overall, by age, and by sex. The results can then be shared through various levels of the Ministry of Health and Civil Registration Department.

Summary of Data

Verbal autopsy interviews for 2017 deaths were conducted between January 15th, 2017 and April 25th, 2019. A total of 402 deaths were reported by CHWs (see Table 1).

Table 1. Reported deaths by place of death as reported in the locator forms

Place of Death	Frequency	Percent
Health facility	70	17.4
Home	306	76.1
On route to hospital or facility	16	4.0
Other	10	2.5
Total	**402**	**100**

Figure 1 shows the distribution of VA cases conducted by sex and age categories. There were more males in all age categories compared to females and this was consistent with the pattern from 2016. ADD EXPLANATION FOR WHY FIG 1 ONLY HAS N=314.

Figure 1. Age categories of completed VAs (N=314)

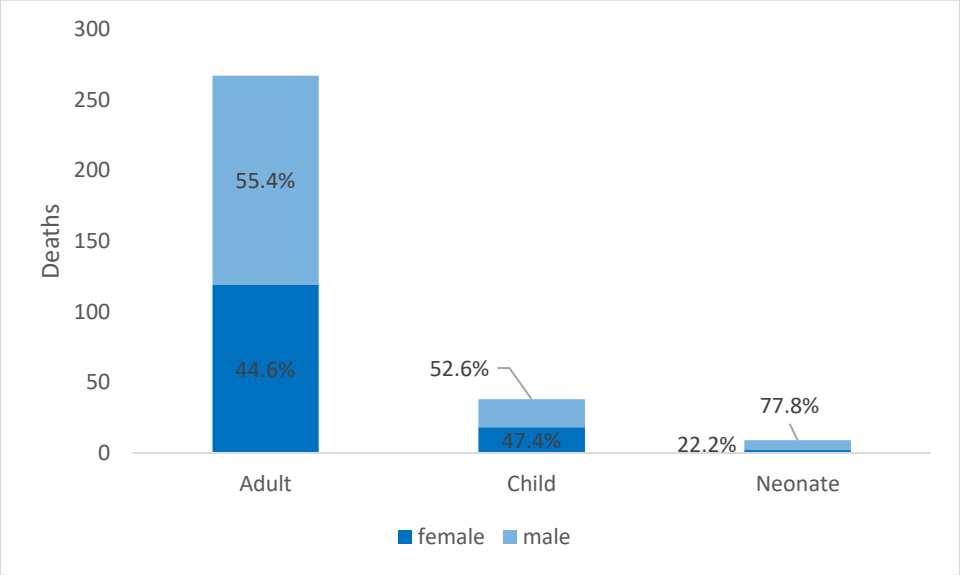
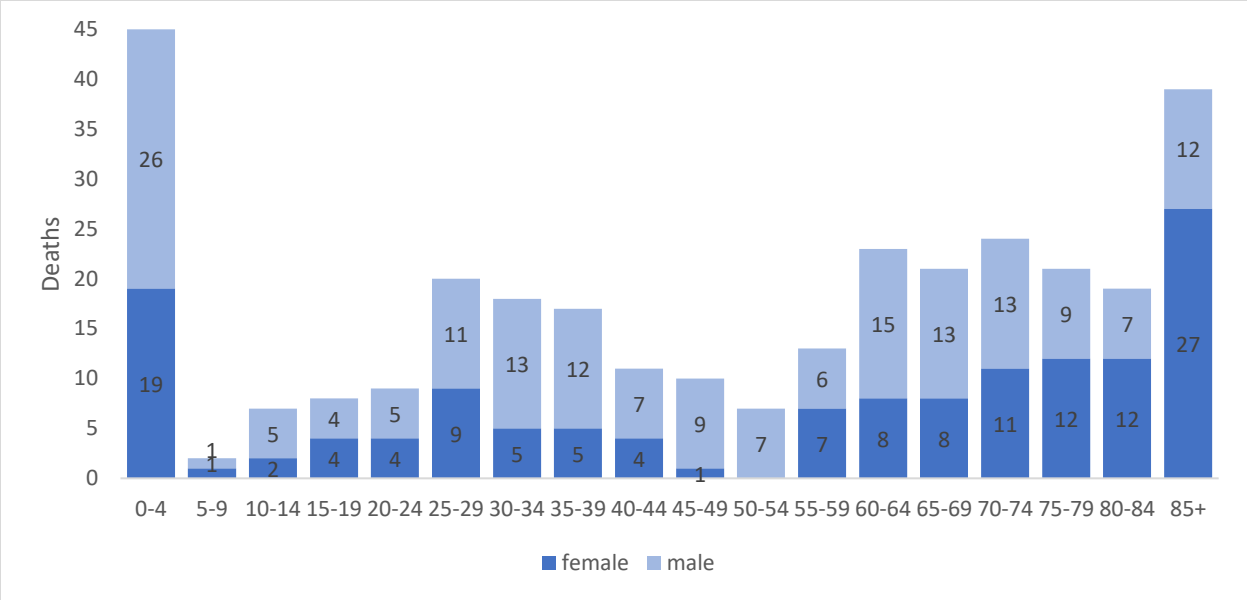


Figure 2 shows completed VAs distributed across five-years age categories.

Figure 2. Five-year age categories and sex of completed VAs (N=314)



The mean number of days between the death and the interview was 162, with a minimum of 9 and a maximum of 582; 28 (8.9%) of the interviews were conducted more than one year after the death occurred. (Justification???) For the 18 eligible deaths for which a VA was not completed, one was a refusal. Interviews took an average of 36 minutes to complete, with a minimum of 10 minutes and a maximum of 148 minutes. Of the 314 VAs completed and …… [DESCRIBE] , a total of 149 (47.5%) of deaths took place in the wet season. A total of 50 (15.9%) of respondents reported that a death certificate was issued. Relationships of the respondent to the deceased were reported as follows: 91 (29.0%) parent, 34 (10.8%) child, 166 (52.9%) other family member, 1 (0.3%) public official and 22 (7.0%) another relationship. Summary indicators are shown in Tables 2 and 3 below.

Table 2. VA interviews completed and analyzed by ward

Wards	No. of VAs completed	Average duration of interview (min)	Deaths in wet season* n (%)	Death certificate issued n (%) (Id10462=yes)
Central	32	49	14 (43.8)	6 (18.8)
Kanyaluo	71	33	40 (56.3)	9 (12.7)
Kendu Town	60	47	30 (50.0)	8 (13.3)
Kibiri	8	53	4 (50.0)	4 (50.0)
N. Karachuonyo	65	27	30 (46.2)	11 (16.9)
Wangchieng	55	37	20 (36.4)	10 (18.2)
W. Karachuonyo	23	31	11 (47.8)	2 (8.7)
Total / Overall Average	**314**	**36**	**149 (47.5)**	**50 (15.9)**

Table 3. Relationship of respondent to deceased

Relationship	n (%)
Parent	91 (29.0)
Child	34 (10.8)
Other family member	166 (52.9)
Health worker	1 (0.3)
Another relationship	22 (7.0)
Total	314 (100)

InterVA was able to process all of the 314 completed VA interviews and determine a probable cause of death for 299 (95.2%) deaths. The distribution of VAs completed and processed by geographic area is shown in Table 4.

Table 4. VAs completed and processed by ward

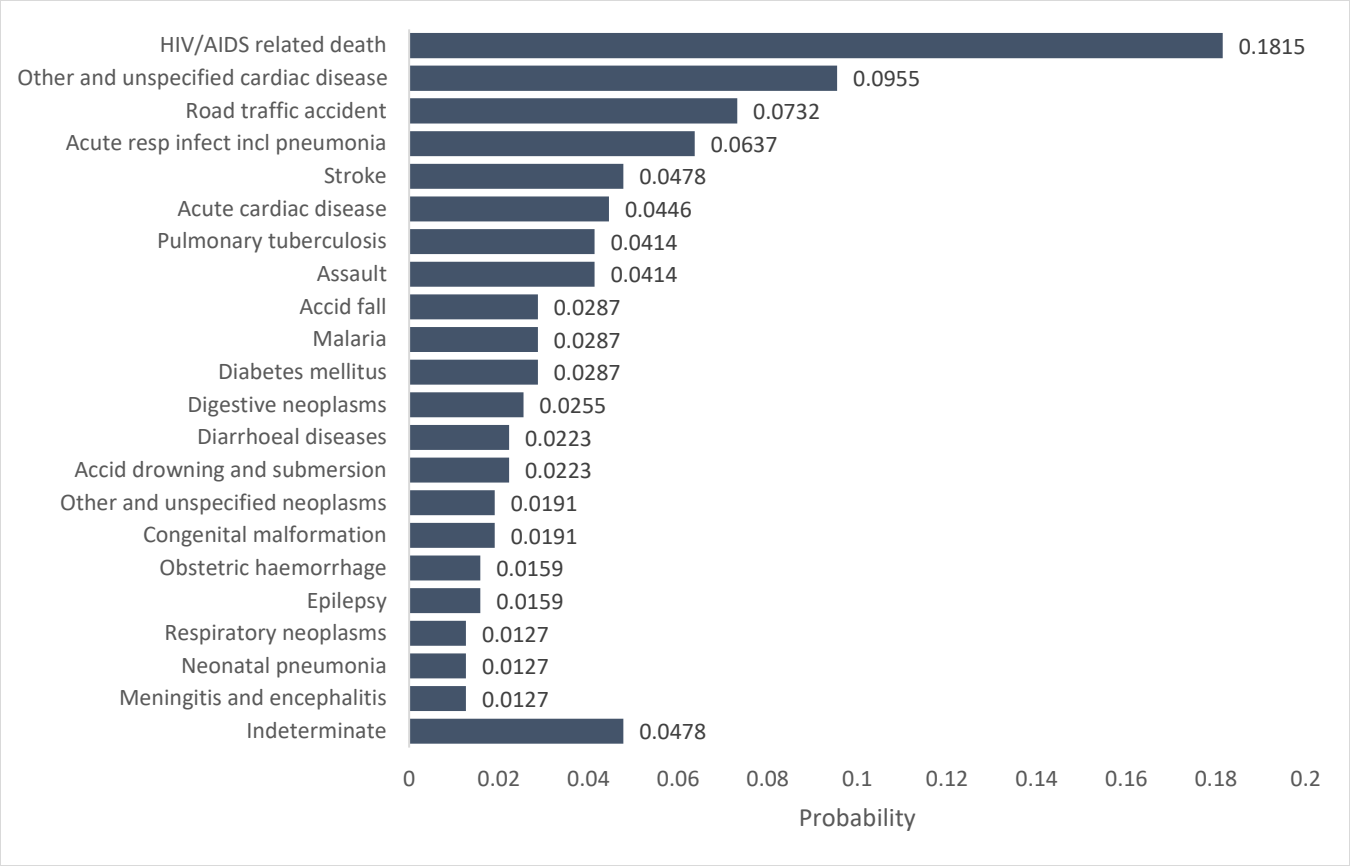
Ward	InterVA status		Total
	Processed and COD determined	Processed and COD Indeterminate	
Central	32	0	32
Kanyaluo	67	4	71
Kendu Town	56	4	60
Kibiri	8	0	8
N. Karachuonyo	63	2	65
Wangchieng	52	3	55
W. Karachuonyo	21	2	23
Total	**299**	**15**	**314**

Causes of Death according to Verbal Autopsy

Leading Causes of Death by Sex, Age, and Location

The leading causes of death, by sex, age, and location are shown in Figures 3-9 below. Figure 3 shows that HIV/AIDS related death was the leading cause of death and accounted for 18.2% of the deaths. Other and unspecified cardiac diseases, road traffic accidents and acute respiratory infection, including pneumonia, were the next in line ranging between 9.6% to 6.4% of the deaths. The rest with less than 5% were stroke, acute cardiac disease, pulmonary tuberculosis and assault.

Figure 3. Leading causes of death among completed verbal autopsies (probability?) (N=314)


HIV/AIDS related death
Other and unspecified cardiac disease
Road traffic accident
Acute resp infect incl pneumonia
Stroke
Acute cardiac disease
Pulmonary tuberculosis
Assault
Accid fall
Malaria
Diabetes mellitus
Digestive neoplasms
Diarrhoeal diseases
Accid drowning and submersion
Other and unspecified neoplasms
Congenital malformation
Obstetric haemorrhage
Epilepsy
Respiratory neoplasms
Neonatal pneumonia
Meningitis and encephalitis
Indeterminate
0.1815
0.0955
0.0732
0.0637
0.0478
0.0446
0.0414
0.0414
0.0287
0.0287
0.0287
0.0255
0.0223
0.0223
0.0191
0.0191
0.0159
0.0159
0.0127
0.0127
0.0127
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0
0.02
0.04
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0.08
0.1
0.12
0.14
0.16
0.18
0.2
Probability

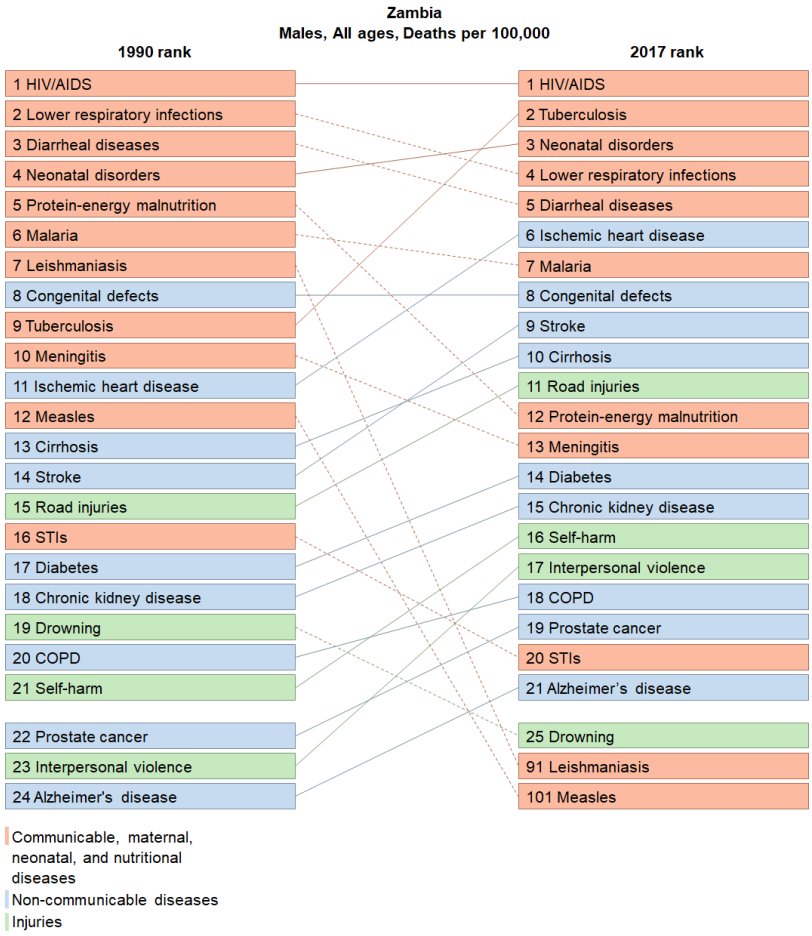


Figure 4. Leading causes of death by sex

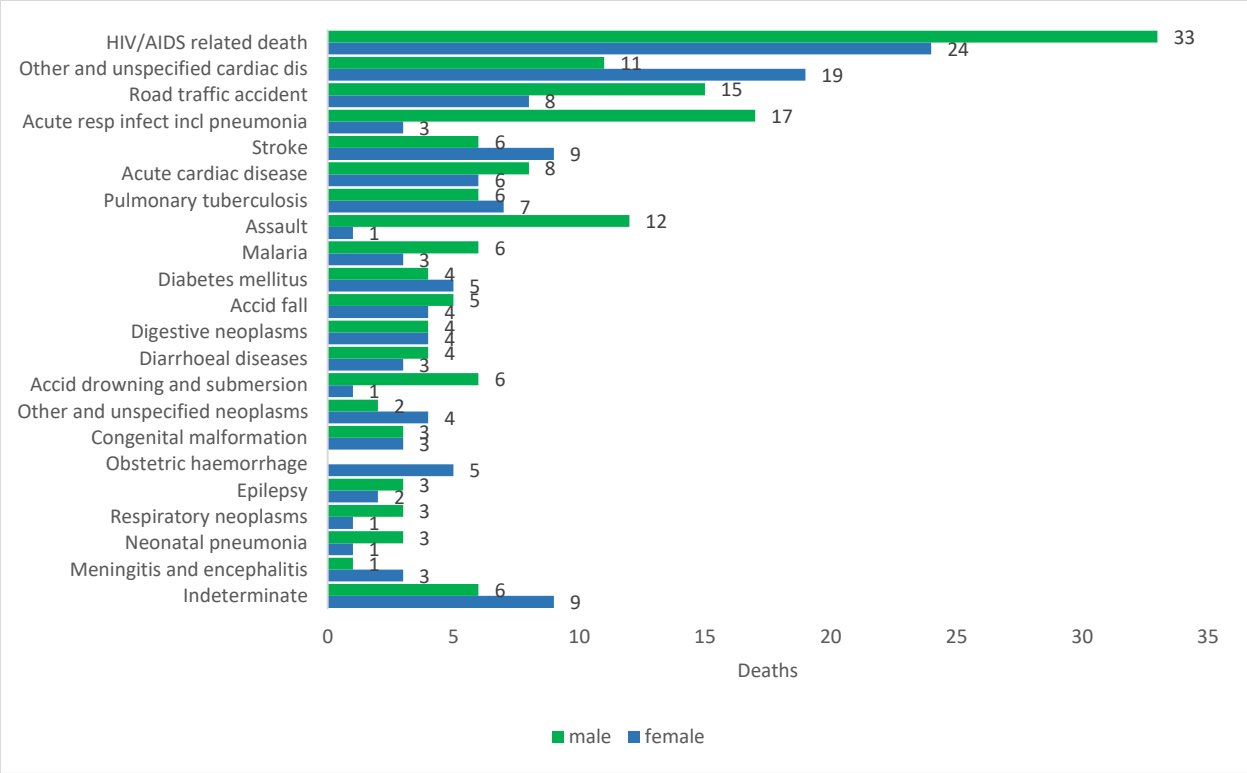


Figure 5. Leading causes of death in females (probability – edit) (N=139)

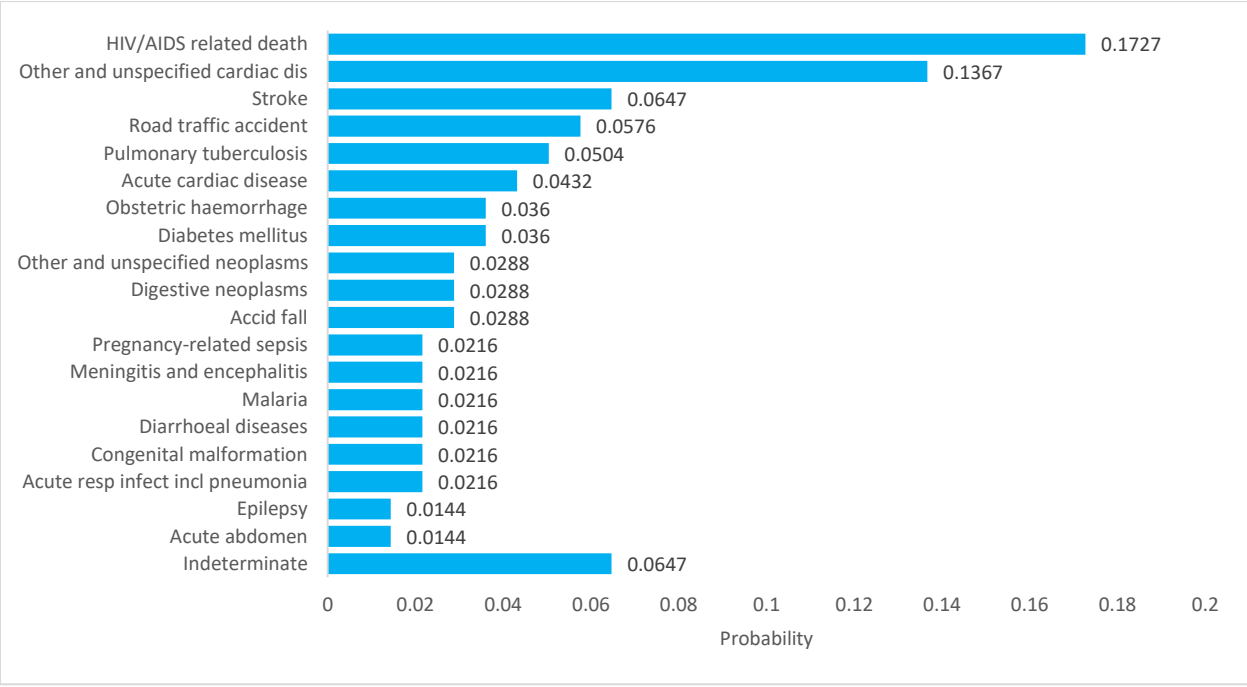


Figure 6. Leading causes of death in males (N=175)

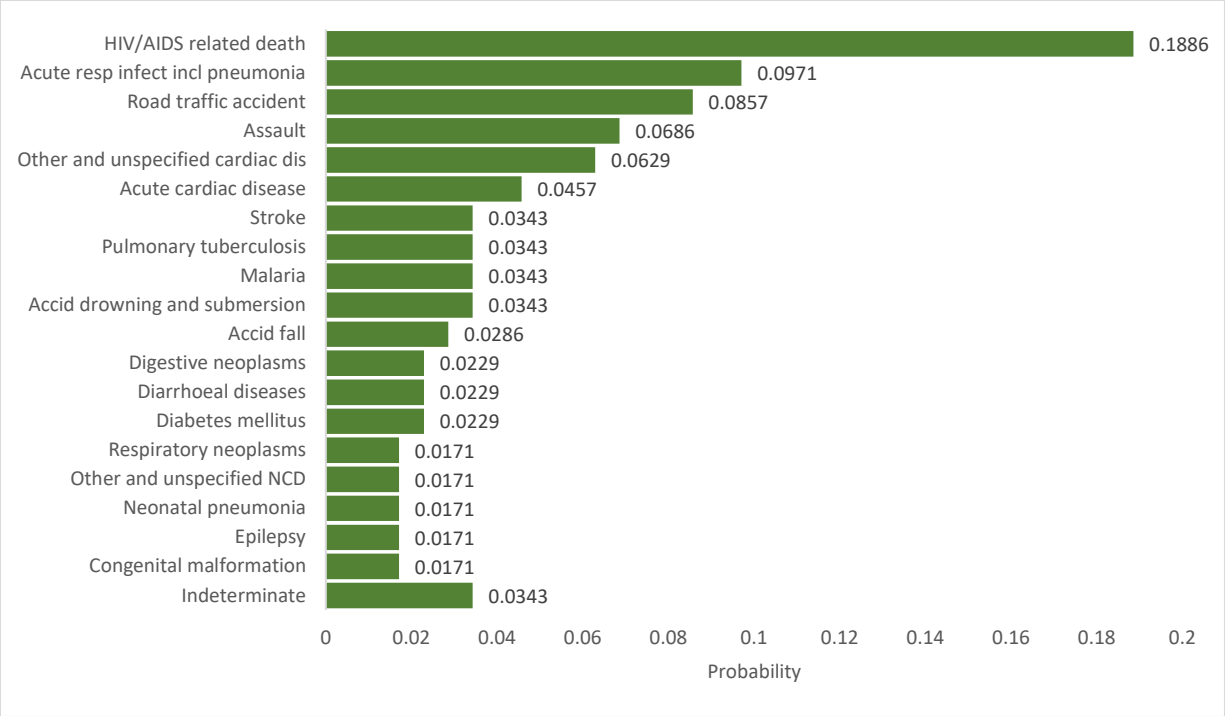
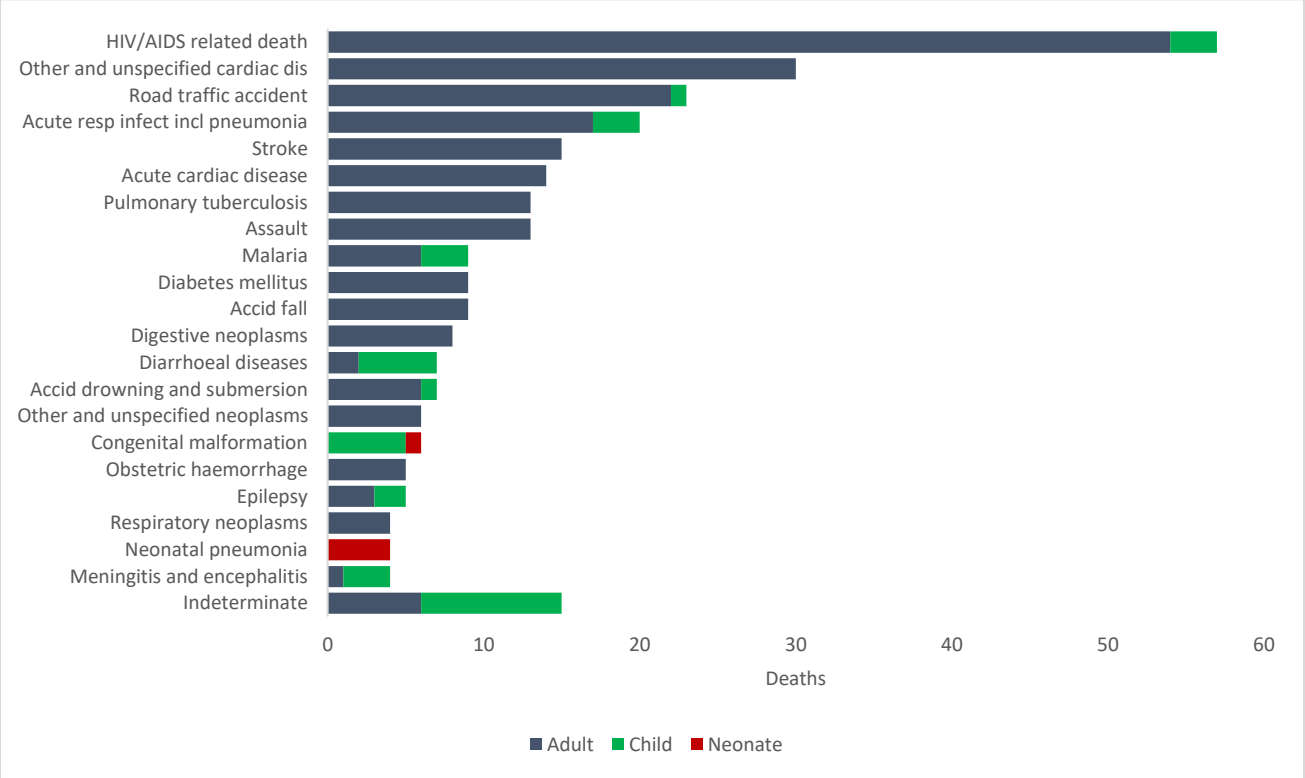


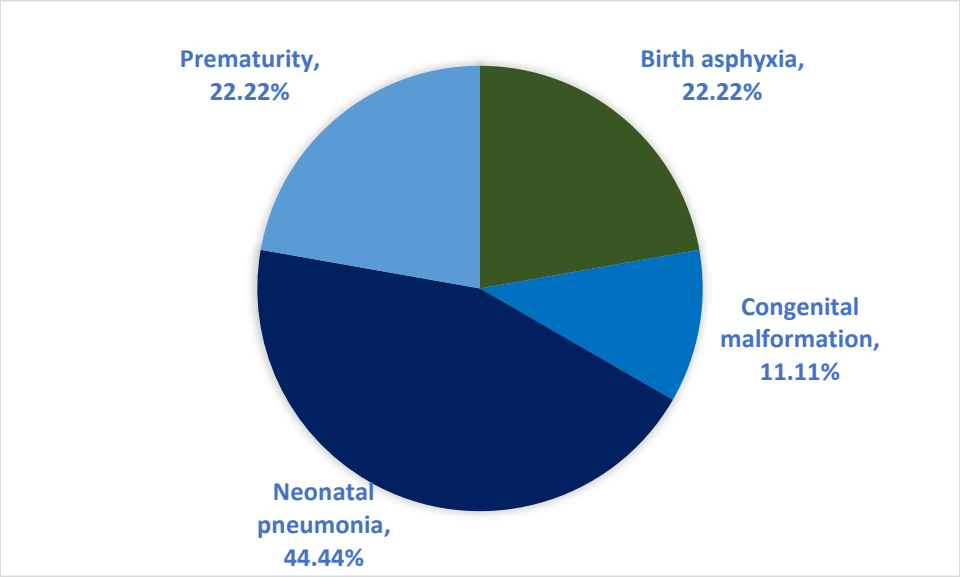
Figure 7. Leading causes of death by age group (again, this table changes back to total # deaths??)



Figures 8, 9, and 10 show the leading causes of death in neonates, children, and adults, respectively. Though there were only 9 neonatal deaths reported, 44.4% were attributed to

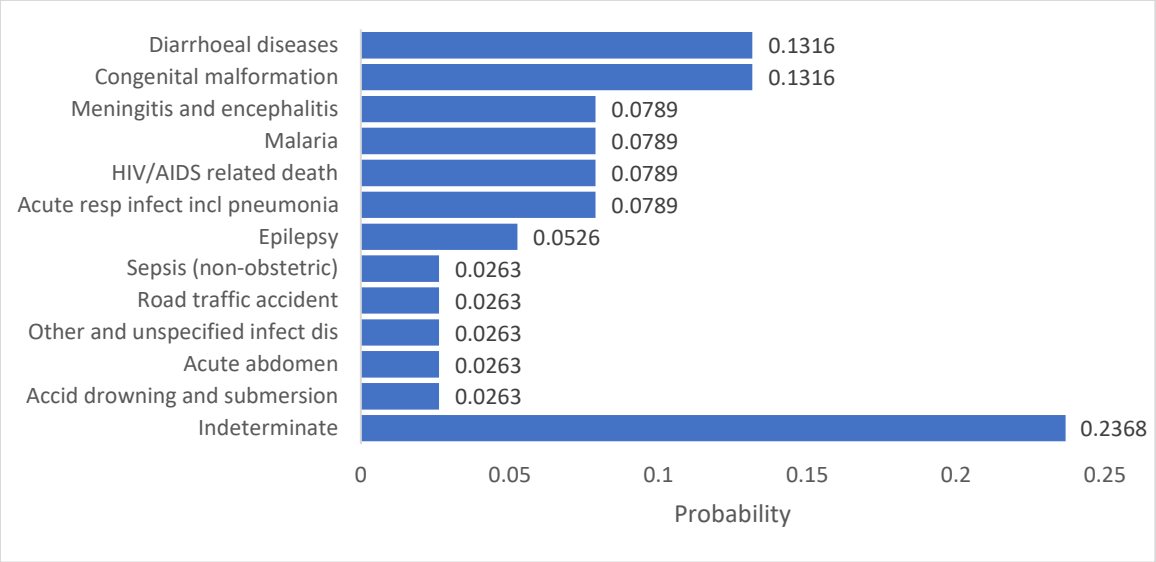
neonatal pneumonia, followed by prematurity and birth asphyxia, both at 22.2%, and congenital malformation at 11.1%, (Figure 8). No fresh or macerated still births were reported in the 2017 data.

Figure 8. Leading causes of death in neonates (N=9)



Among the 38 children for which a VA was completed, diarrheal diseases and congenital malformation were the leading causes, each accounting for 13.2% of deaths. Meningitis and encephalitis, malaria, HIV/AIDS related death, and acute respiratory infection, including pneumonia each accounted for 7.9% of deaths, followed by epilepsy, accounting for 5.3%. Sepsis, road traffic accidents, other and unspecified infectious diseases, acute abdomen and accidental drowning and submersion each accounted for 2.6% of deaths (Figure 9).
Of the three age categories; neonate, child and adult, the child age category had the highest percentage of indeterminate cases at 23.7%.

Figure 9. Leading causes of death in children (N=38)



For adults, the pattern of leading causes reflects that of the overall population, with one exception—malaria moves to the twelfth leading cause for adults, versus the tenth leading cause among the full population (Figure 10).

Figure 10. Leading causes of death in adults (N=267)

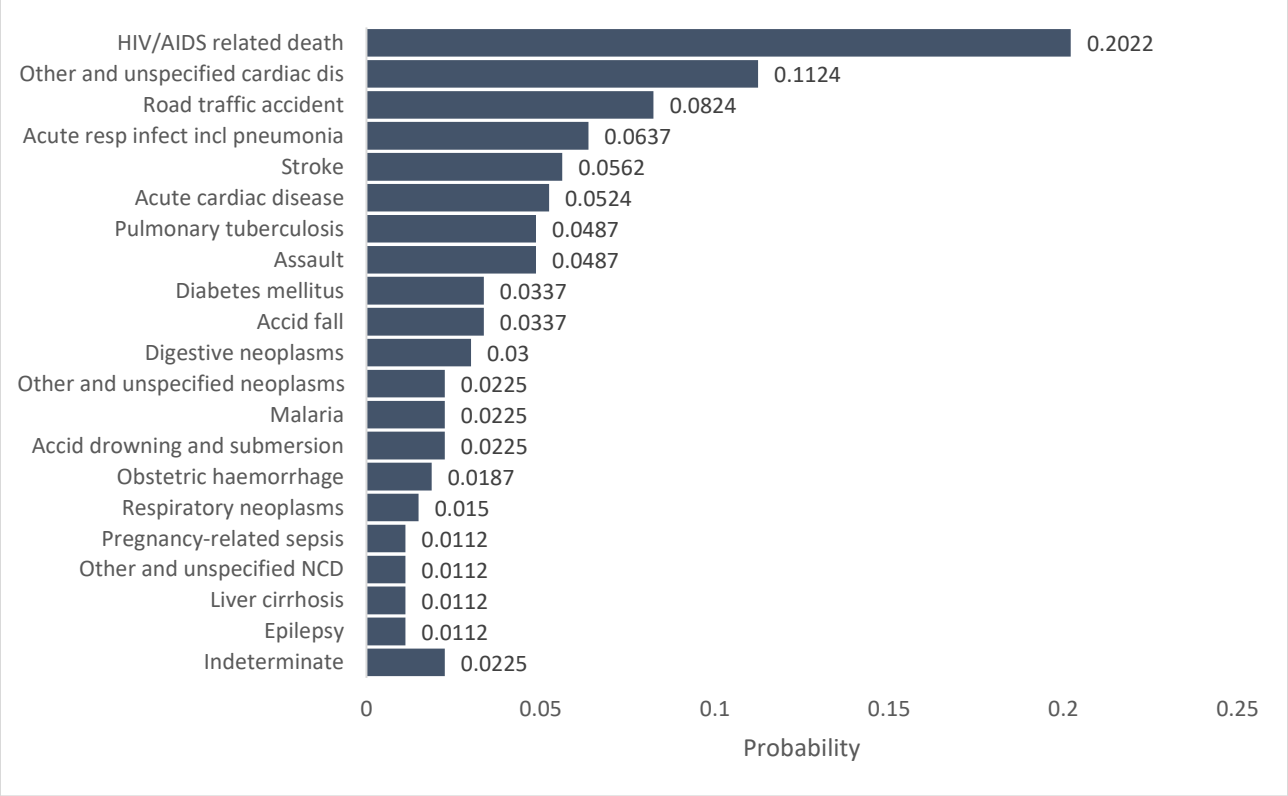


Figure 11 shows a comparison of leading 11?? causes of death across age categories. Given the paucity of reported cases of neonatal and infant death, no neonatal or infant causes are shown in this figure. Assault, road traffic accidents and HIV/AIDS related deaths account for the majority of death among the 15-49 years age group. Malaria and acute respiratory infections including pneumonia account for the majority of deaths in the 1-4 years age category, while stroke and diabetes mellitus account for the majority in the elderly, 65-84 years age categories. Acute cardiac disease and other and unspecified cardiac disease are the major causes of death in those aged 85 years and above.

Figure 11. Percentages of leading causes of death by age group (N=331)

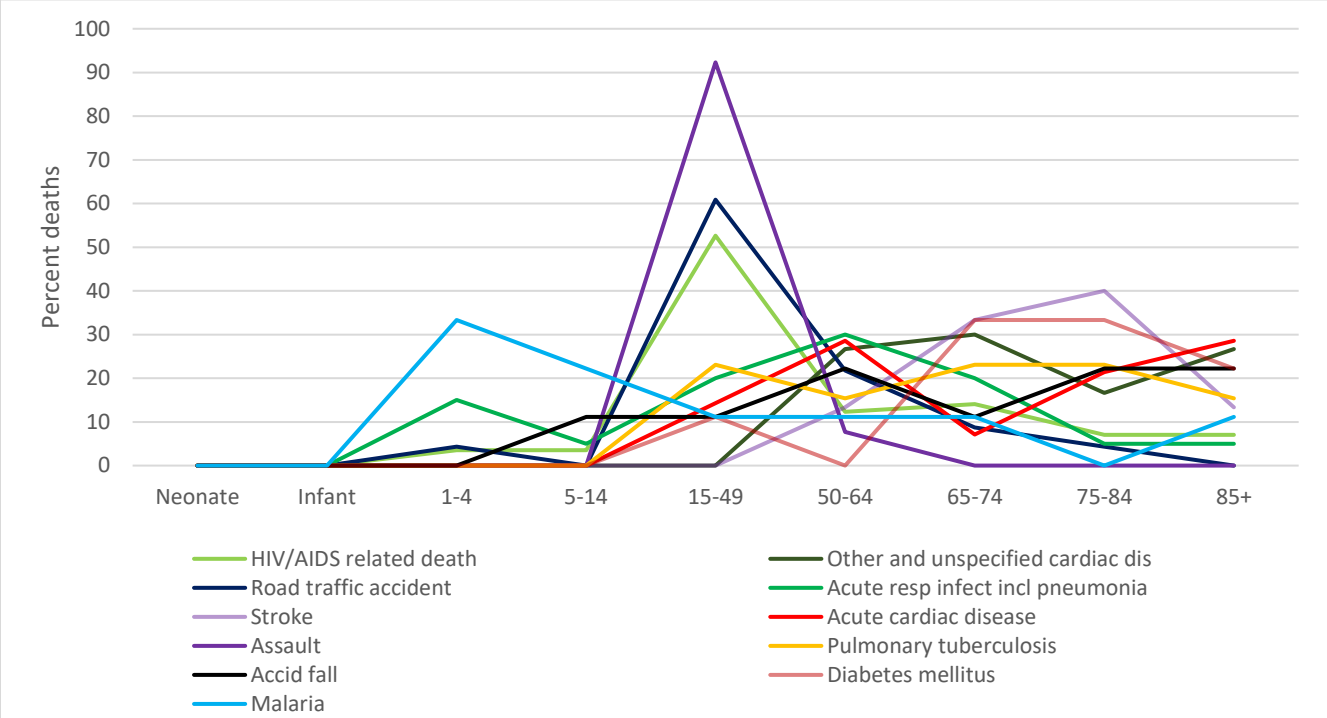
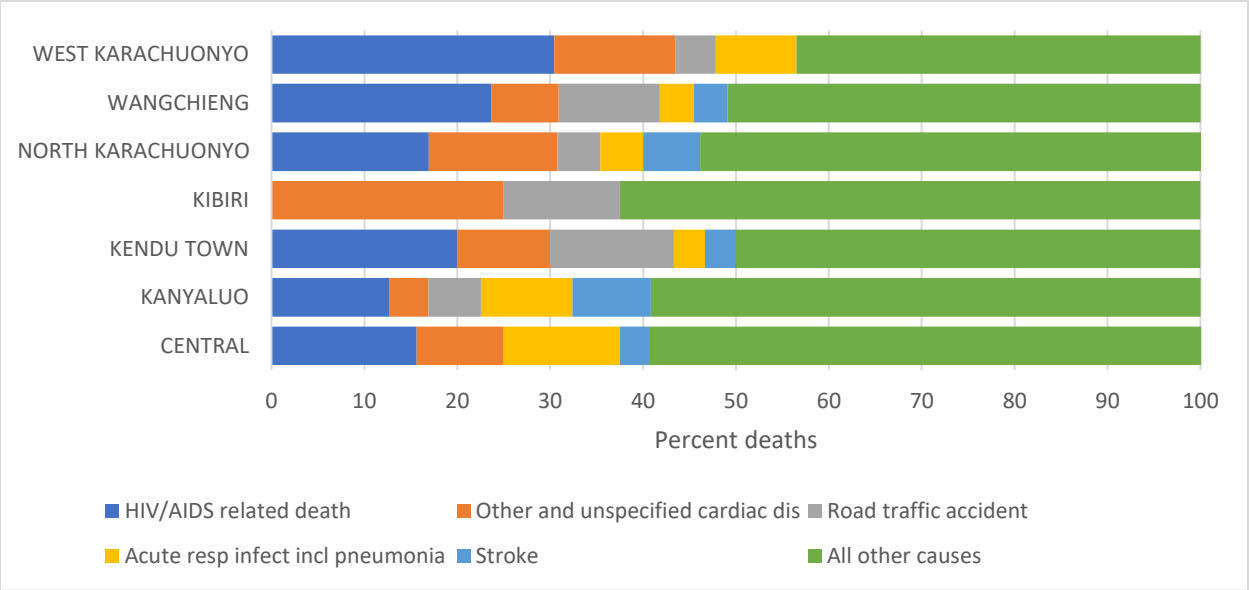


Figure 12 shows the top five causes of death, by ward. HIV/AIDS related deaths were highest in West Karachuonyo and Wangchieng', accounting for 30.4% and 23.6% of deaths respectively. HIV/AIDS related death, however, did not account for any deaths in Kibiri. Other and unspecified cardiac diseases accounted for percentages of death ranging from 25.0% in Kibiri, 13.9% in North Karachuonyo to 4.2% in Kanyaluo. Road traffic accidents accounted for no deaths in Central, but accounted for 13.3% in Kendu Town, 12.5% in Kibiri, and 4.6% in North Karachuonyo. Acute respiratory infections including pneumonia did not account for any deaths in Kibiri but did for 12.5% in Central, 8.7% in West Karachuonyo and 3.3% in Kendu town. Stroke was distributed across wards, except West Karachuonyo and Kibiri.

Figure 12. Top five causes of death and other deaths by ward



The population cause-specific mortality fraction (CSMF) is the number of deaths from a given cause divided by all deaths. The CSMF is the traditional outcome measures for VA. Table 5 shows the CSMFs for neonates, children, and adults. CSMFs can simply be multiplied by 100 to yield the percentage of deaths attributed to a given cause.

Table 5. Cause specific mortality fractions by age group.

Causes	Neonates	Children	Adults
01.02 Acute resp. infect, incl. pneumonia		0.0789	0.0637
01.03 HIV/AIDS related death		0.0789	0.2022
01.04 Diarrheal diseases		0.1316	0.0075
01.05 Malaria		0.0789	0.0225
01.07 Meningitis and encephalitis		0.0789	0.0037
01.09 Pulmonary tuberculosis			0.0487
01.10 Pertussis			
01.99 Unspecified infectious disease		0.0263	
02.02 Digestive neoplasms			0.03
02.03 Respiratory neoplasms			0.015
2.05, 02.06 Reproductive neoplasms M,F			0.0074
03.01 Severe anaemia			
03.02 Severe malnutrition			
03.03 Diabetes mellitus			0.0337
04.01 Acute cardiac disease			0.0524
04.02 Stroke			0.0562
04.03 Sickle cell with crisis			

04.99 Other and unspecified cardiac disease			0.1124
05.01 Chronic obstructive pulmonary disease			
05.02 Asthma			0.0037
06.01 Acute abdomen		0.0263	0.0075
06.02 Liver cirrhosis			0.0112
07.01 Renal failure			0.0037
08.01 Epilepsy		0.0526	0.0112
09.03 Pregnancy-induced hypertension			
09.06 Pregnancy-related sepsis			0.0112
10.01 Prematurity	0.2222		
10.03 Neonatal pneumonia	0.4444		
10.06 Congenital malformation	0.1111	0.1316	
10.99 Other and unspecified perinatal cause of death			
12.01 Road traffic accident		0.0263	0.0824
12.03 Accid fall			0.0337
12.09 Assault			0.0487
12.10 Exposure to force of nature			0.0037
Other causes	0.2222	0.2894	0.1272

Note: Numbers may not sum to 1.00 due to rounding.

Table 6 and Figure 13 show the distribution of deaths according to broad Global Burden of Disease (GBD) groups, by sex and ward, respectively. GBD Group I accounts for communicable diseases (e.g. TB, pneumonia, diarrhoea, malaria, measles), maternal and perinatal causes (e.g. maternal haemorrhage, birth trauma) and nutritional conditions (e.g. protein-energy malnutrition); Group II accounts for non-communicable diseases (e.g. cancer, diabetes, heart disease, stroke); and Group III accounts for external causes of mortality (e.g. accidents, homicide, suicide).[1]

As shown in Table 6, Group I accounts for 45.8% of deaths overall (46.1% of male deaths and 45.4% of female deaths); Group II accounts for 34.8% of deaths overall (29.0% of male deaths and 42.3% of female deaths); and Group III accounts for 19.4% of deaths overall (24.9% of male deaths and 12.3% of female deaths).

[1] World Health Organization. ANACoD version 1.0: Analysing mortality level and cause-of-death data. Guidance document. http://www.who.int/healthinfo/anacod/en/

Table 6. Distribution of deaths according to Global Burden of Disease categories, by sex

Cause of death	Total n (%)	Sex	
		Male n (%)	Female n (%)
All defined causes	299 (100)	169 (100)	130 (100)
Group I: Communicable, maternal, perinatal, and nutritional conditions			
Infectious and parasitic diseases*	114 (38.1)	69 (40.8)	45 (34.6)
Pregnancy-, childbirth and puerperium-related disorders	9 (3.0)	0	9 (6.9)
Neonatal causes of death	14 (4.7)	9 (5.3)	5 (3.9)
Severe anaemia and severe malnutrition	0	0	0
TOTAL	**137 (45.8)**	**78 (46.1)**	**59 (45.4)**
Group II: Noncommunicable conditions			
Diabetes mellitus	9 (3.0)	4 (2.4)	5 (3.9)
Neoplasms	20 (6.7)	10 (5.9)	10 (7.7)
Diseases of the circulatory system	59 (19.7)	25 (14.8)	34 (26.2)
Respiratory disorders	1 (0.3)	0	1 (0.8)
Gastrointestinal disorders	6 (2.0)	3 (1.8)	3 (2.3)
Renal disorders	1 (0.3)	1 (0.6)	0
Mental and nervous system disorders	5 (1.7)	3 (1.8)	2 (1.5)
Other and unspecified NCD	3 (1.0)	3 (1.8)	0
TOTAL	**104 (34.8)**	**49 (29.0)**	**55 (42.3)**
Group III: Injuries			
External causes of death	58 (19.4)	42 (24.9)	16 (12.3)
TOTAL	**58 (19.4)**	**42 (24.9)**	**16 (12.3)**

*Includes acute respiratory infection, including pneumonia.

Figure 13 shows consistency in the relative burden across wards, with Group I conditions accounting for the majority of the burden, followed by Group II conditions, and then Group III conditions; one exception is in Kibiri where Group II conditions account for the highest percentage of deaths (50.0%), and Group I and Group III conditions account for equal percentages (25.0%) of death. In West Karachuonyo and Wangchieng, Group II and Group III conditions account for equal percentages of death (23.8% and 26.9% respectively). The greatest burden from Group I conditions was seen in Central, accounting for 53.1% of deaths; the greatest burden from Group II conditions was seen in Kibiri, accounting for 50.0% of deaths; and the greatest burden from Group III conditions was seen in Wangchieng, accounting for 26.9% of deaths.

Figure 13. Distribution of deaths according to Global Burden of Disease categories, by location (n=299)

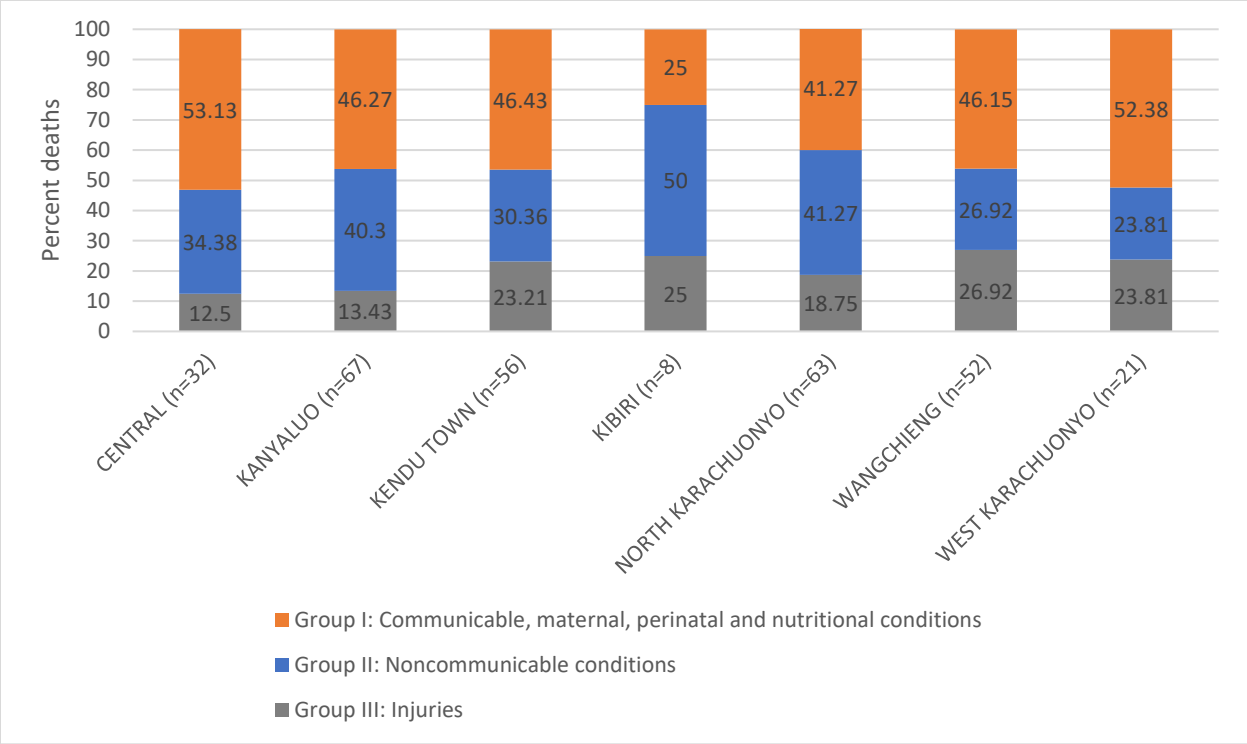


Table 7 shows how the percentage of deaths assigned to various causes in each of Groups I, II and III is expected to change across different life expectancies. This table is based on model-based percentage distributions derived from the World Health Organization's mortality database. While it is not expected that any country would fit exactly these proportions, significant departures from them suggests potential problems with the mortality data for the country.[2]

Table 7: Expected distribution of causes of death according to life expectancy by broad groups

Life Expectancy	55 years	60 years	65 years	70 years	Rachuonyo North VA
Group I causes of death	22%	16%	13%	11%	45.8%
Group II causes of death	65%	70%	74%	78%	34.8%
Group III causes of death	13%	14%	13%	11%	19.4%

[2] World Health Organization. ANACoD version 1.0: Analysing mortality level and cause-of-death data. Guidance document. http://www.who.int/healthinfo/anacod/en/

In 2015, Kenya's female life expectancy was estimated as 65.8 years,[3] while in Homa Bay County, the average life expectancy is only 47.5 years.[4] While an expected distribution of causes of death is not available for the relevant life expectancy in Homa Bay County, it is likely that the high number of Group I and relatively low number of Group II causes of death observed in the Rachuonyo North VA data may indicate some weaknesses in the mortality surveillance processes.

Select Causes of Death

Additional analysis has been conducted on select causes of death, including external causes and pregnancy, childbirth, and puerperium-related causes of death.

External Causes of Death

Figures 14-16 show external causes of death by sex, age group, and categories of external causes. As expected, external causes accounted for more male than female deaths, including for the leading external cause categories of road traffic accident, assault, accidental fall, and accidental drowning and submersion (Figure 14). External causes were highest among the 25-34 years age groups (12.1%) and lowest among 10-14 years, and 65-69 years age groups (both 1.7%) (Figure 15).

Figure 14. External causes of death by cause category and sex (n=58)

[3] World Health Organization. Global Health Observatory Data Repository. Life expectancy for women, data by country. http://apps.who.int/gho/data/view.main.WOMENLEXv

[4] Homa Bay County. Strategic Plan for Homa Bay County: 2013-2023.

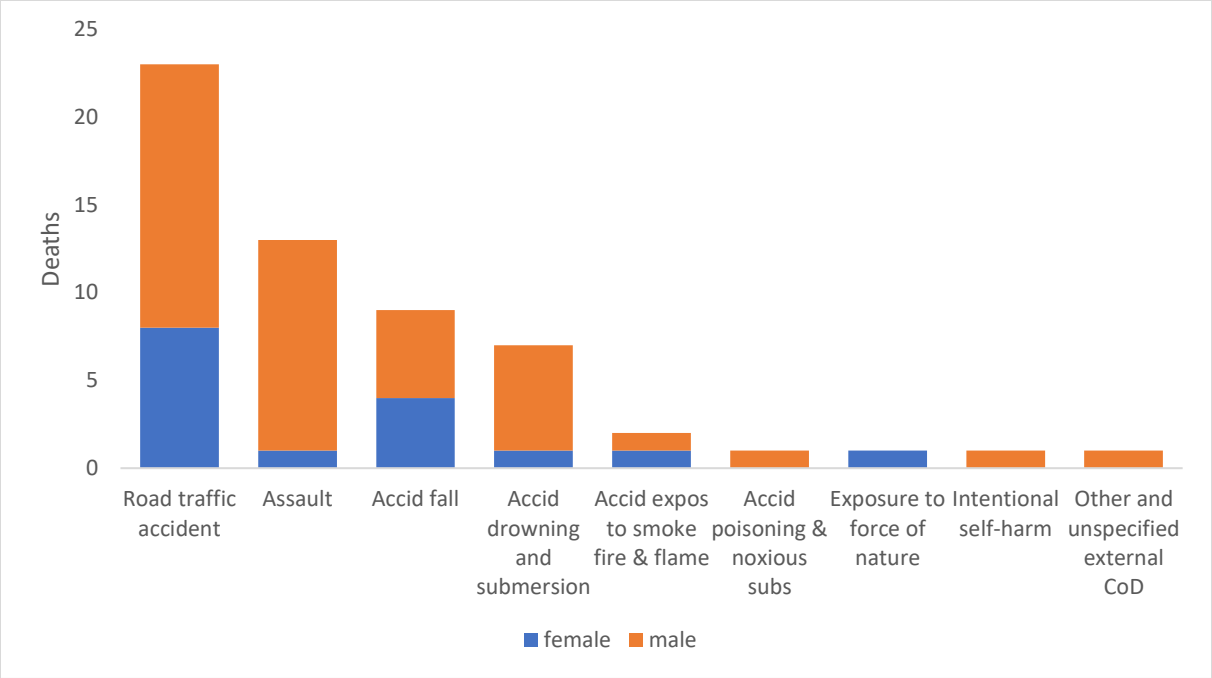
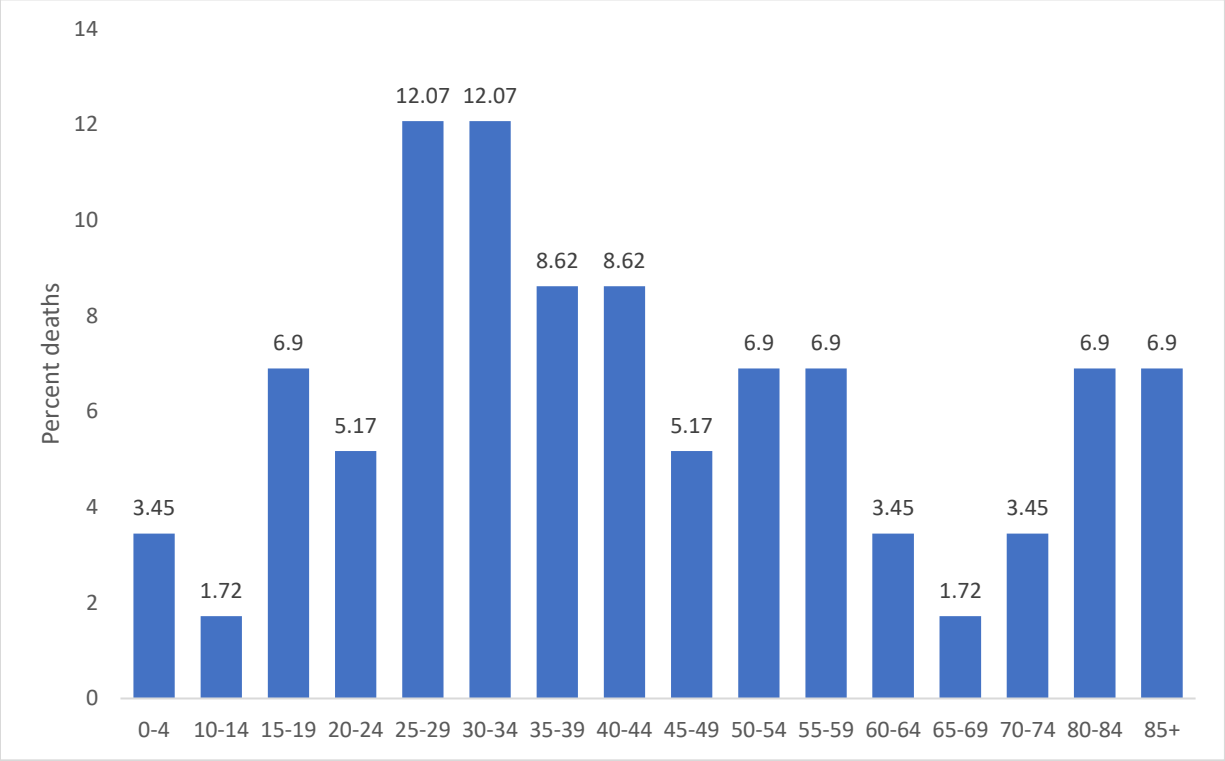
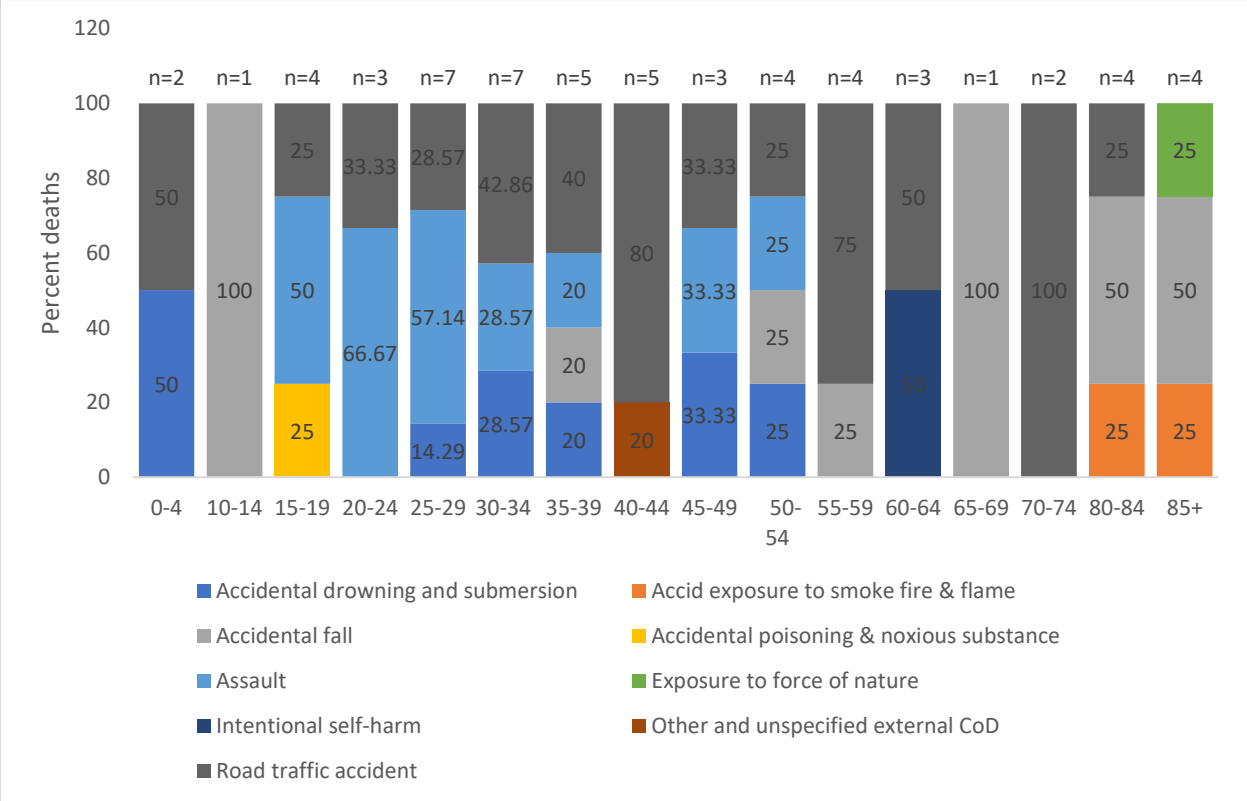


Figure 15. External causes of death by age group (n=58)



Given the small number of deaths in the various age groups, it is difficult to draw conclusions about patterns in the categories of external causes of death across the ages. However, some expected patterns do emerge with assault accounting for more deaths among 15-34 year-olds, road traffic accidents accounting for deaths across adult age categories, except 65-69 and 85 and above year-olds, and accidental falls accounting for more deaths among the oldest age groups (Figure 16).

Figure 16. Categories of external causes of death by age group



Pregnancy, Childbirth, and Puerperium-related Causes of Death

Figures 17-18 show cause categories for pregnancy-, childbirth-, and puerperium-related causes of death by age. Only nine such cases were observed, with five attributed to obstetric haemorrhage, three to pregnancy-related sepsis and one to abortion related deaths (Figure 17). Cases were distributed across reproductive age categories, from 10 to 44 years (Figure 18).

Figure 17. Pregnancy-, childbirth and puerperium-related causes of death (N=9)

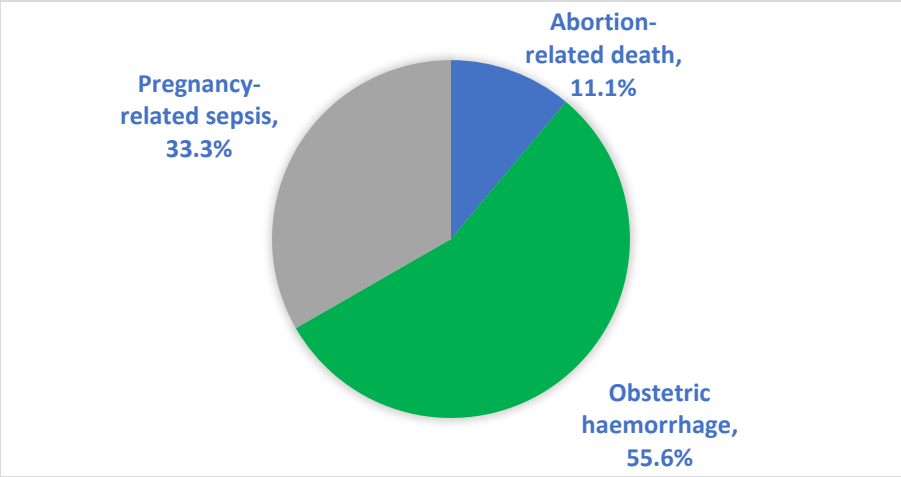
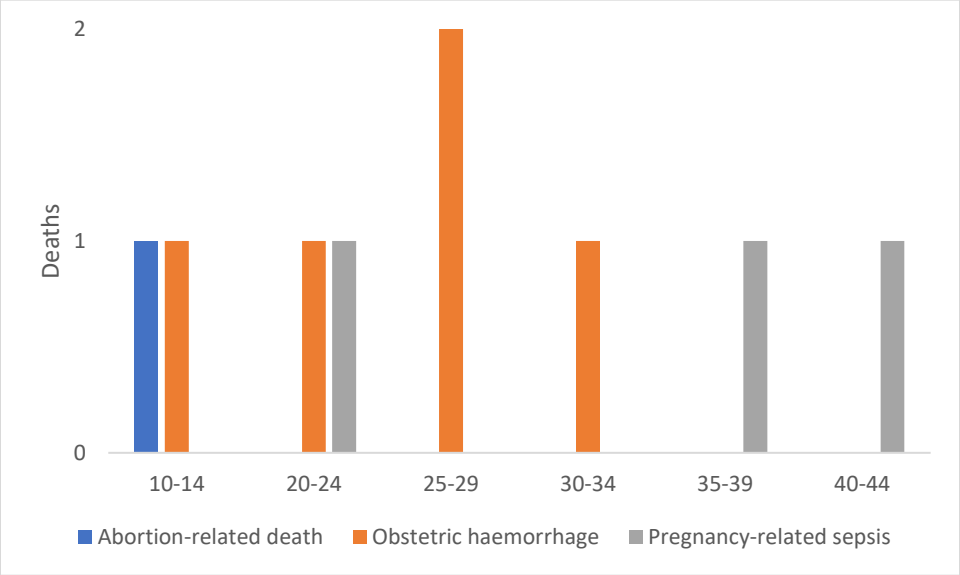


Figure 18. Pregnancy-, childbirth and puerperium-related causes of death, by age category



Health Care Experience

The VA questionnaire includes information about the health care experience of the deceased prior to death. Among the 314 VA interviews completed, 146 (46.5%) reported that the deceased traveled to a hospital or health facility in the final days before death. All (100%) of these used motorized transport, 44 (32.4%) experienced problems during admission, 29 (21.3%) experienced problems with the way the deceased was treated, and 29 (21.3%) experienced problems getting medications or diagnostic tests. Thirty seven (11.8%) respondents indicated that it takes more than 2 hours to get to the nearest hospital or health facility from the deceased's household; 62 (19.8%) indicated that there were doubts about whether medical care was needed in the final days before the death; 45 (14.3%) indicated that traditional medicine was used; 150 (47.8%) indicated that someone used a telephone or cell phone to call for help; and 141 (44.9%) indicated that the total costs of care and treatment prohibited other household payments.

DISCUSSION

Despite of the small numbers, it is notable that the known major causes of death in Rachuonyo North Sub-county are well represented among the reported deaths, e.g. HIV/AIDS related deaths among adults and malaria and acute respiratory infections, including pneumonia, among children. Furthermore, many observed patterns among the reported deaths are consistent with expected mortality patterns, including: more deaths reported among females than males in the highest age categories; more deaths reported among the youngest and oldest age categories, with the fewest deaths reported in the 5-14 year age group; expected age patterns for HIV/AIDS, malaria, and external causes deaths; and more male deaths attributed to external causes. Collectively these data provide a mortality profile for Rachuonyo North Sub-county that can be used by decision makers to prioritize and target funding and programmatic activities and to measure and evaluate progress.

In this first implementation testing of routine, community-based VA, a number of challenges and limitations were experienced and lessons learned. These experiences, along with recommendations for future steps are described below.

Challenges and Limitations

Supervision and Management

- An electronic management platform was not available for this implementation testing experience. Accordingly, supervisors and the field team relied heavily on technical assistance from the KEMRI/CDC team for routine tracking, progress, monitoring, and quality reports. Establishing an electronic management platform that is accessible to supervisors for tracking death reports and VA completion across interviewers will

facilitate local field team involvement in decision making, quality assurance, and corrective action processes. These enhancements will in turn improve responsiveness and timeliness of the system.
- Payment of field staff depended on the availability of external funds and thus contributed to an intermittent pattern of data collection.
- Involvement of supervisors and data collectors who are also involved in other competing activities by several stakeholders saw data collection and supervision interrupted for long periods of time.

Death Reporting

- The absence of an electronic death reporting system has complicated the process of matching death reports via the manually-completed locator form with civil registration records for determining or confirming death notification and registration status. As this process is of key interest for civil registration authorities, future testing should include an integrated, electronic system for reporting deaths.

Data Collection

- This implementation testing effort served to also field test the latest version of the WHO 2016 VA standard instrument. Accordingly, issues associated with incorrect or confusing skip patterns were detected throughout implementation. While updates and corrections have been made to the data collection instrument, results may have been impacted by the incorrect structures used early in implementation.

Data Management, Analysis, Interpretation, and Quality

- There are some inherent limitations in the VA process that are important to consider when interpreting the data in this report. Causes of death with more specific symptom profiles (e.g., road traffic accidents) can be more accurately determined by VA than causes with vague or general symptom profiles (e.g., malaria).
- Given that death is a relatively rare event, particularly when disaggregated by sex, age, or cause, small numbers pose a standard limitation for interpreting VA data.

Lessons Learned & Recommendations

Supervision and Management

- An electronic platform should be established to support death reporting and notification, and to help track VA interview progress. This system should be accessible by key project staff, including supervisors and health records information officers to efficiently manage field staff and provide timely reports.
- Death reporting processes and corresponding training should be updated to ensure screening for and reporting of stillbirths. It would be useful to link such screening to other pregnancy surveillance efforts.

- With support to facilitating and strengthening of supportive supervision at field levels of management leads to addressing gaps in completeness and timely death notification, data processing and timely planned VA interviews
- There is a need for County Government to mobilize resources to be allocated for VA implementation, monitoring and evaluation

Death Reporting

- As referenced above, the locator form and death reporting process should be updated to satisfy official death notification processes. Coordination with Civil Registration authorities should be strengthened to improve coverage of death notification and registration.

Data Collection

- The VA questionnaires conducted on the ODK electronic data collection platform proved to be feasible and generally acceptable to interviewers. However, as this implementation testing served as a means for field testing a revised version of the standard WHO instrument, a robust and flexible system for version control is needed, especially if the VA system is to be scaled to additional areas.
- Coordinating payment through standard CHU payment structures will support a more routine, timely, and efficient process of data collection.

Data Management, Analysis, Interpretation, and Quality

- Timely processing of the data, quality checks, and feedback mechanisms require a competent team of fully-dedicated data management staff.
- Analytical output is feasible with an effective data collection structure, timely data processing, and quality assurance and feedback mechanism.
- Technical knowledge and capacity to manage such a system of integrated levels of operation, from community health strategy, CRVS department and MOH is crucial for a successful analysis output for all those levels of play in the system.
- Constant training and retraining of players in every stage is crucial to ensure standardized understanding of concepts behind the system, as is elicited with timely data checks and on-going analysis of data in the life course of data collection.
- Constant data checks made it possible to feedback on skip pattern flaws and ambiguities realized in certain questions of the VA. With constant feedback to the WHO technical teams, this informed the crucial revisions needed to make the WHO 2016 tool better.

Other

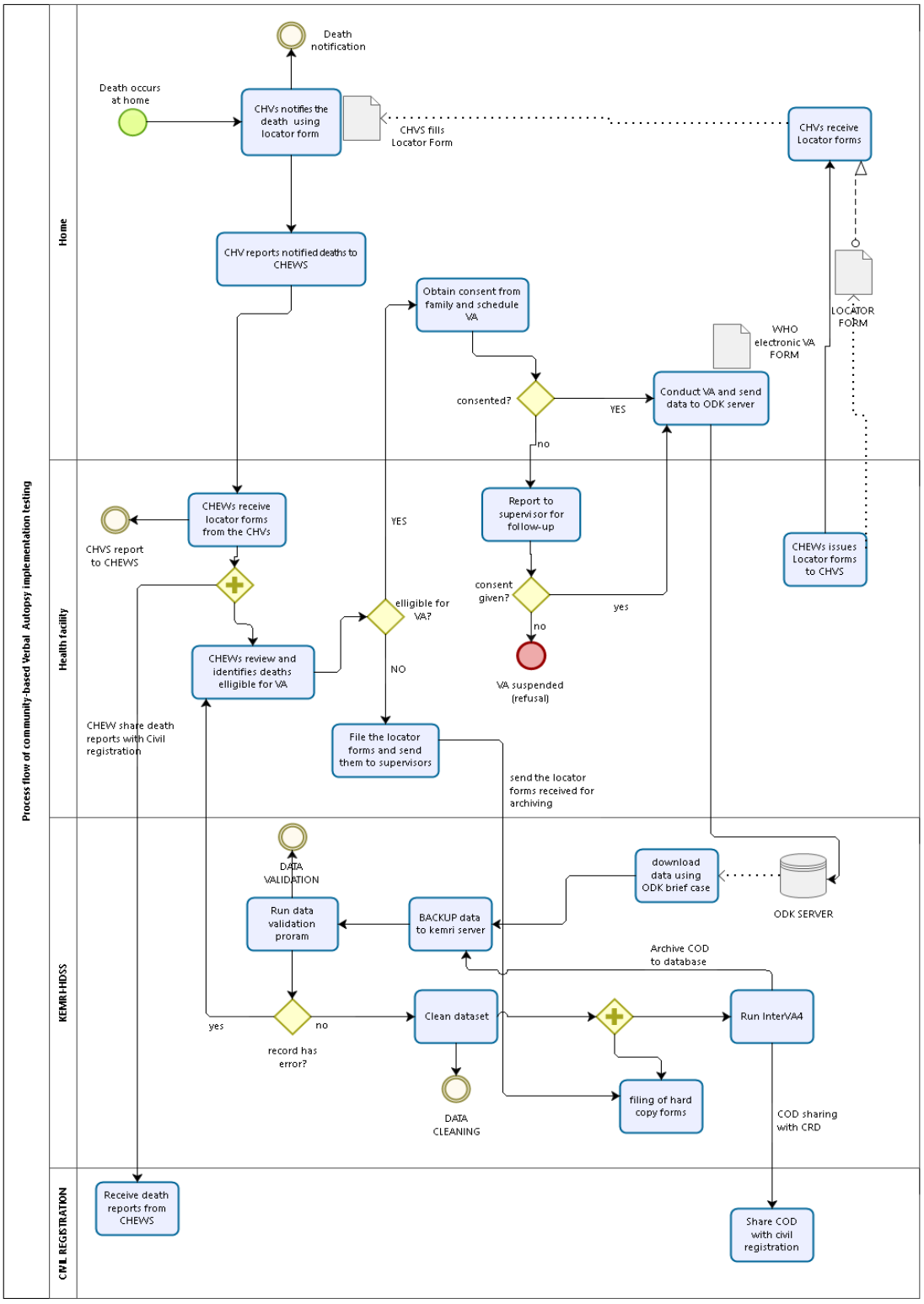
- The WHO technical team link with implementers of this project proved to be an effective feedback mechanism on how well the WHO 2016 VA tool was working in a community setting and implemented by cross cutting departments in the county government.
- The implementation of the project was also able to tease out knowledge and skill gaps in the implementing staff. These gaps were able to be addressed in a coordinated

manner with support from the project, within the existing structures of the various departments involved.

Conclusion

This first community-based implementation of routine VA across a sub-county in Kenya proved to be acceptable and feasible, as demonstrated by a low refusal rate among respondents, a high VA completion rate among eligible, reported deaths, and a high percentage of VAs being successfully analyzed by the automated software. However, it should be noted that such routine implementation of community-based VA is nascent, and guidance and standards are still emerging. Accordingly, future implementation and scale up should be based on flexible platforms that are readily able to adapt to evolving tools, resources, and support structures. For example, InterVA-5, the automated cause of death assignment software used for VA analysis in this report, was selected based on its established use and acceptable performance in the KEMRI and CDC Health and Demographic Surveillance Site in Western Kenya. However, additional automated cause assignment methods are now available for use with the same questionnaire used in this implementation testing, and a user-friendly platform for streamlining the data analysis process using multiple cause assignment methods is being developed. Accordingly, it should be expected that such new elements will be regularly added to VA implementations for the foreseeable future, and a national and subnational management structure should be established accordingly to build flexibility and adaptability into the integration of VA in Kenya's CRVS and mortality surveillance processes.

Appendix A: Process flow for community-based verbal autopsy in Rachuonyo North



Appendix B: Locator form for reporting deaths

1957227306

HOMA-BAY COMMUNITY VERBAL AUTOPSY: LOCATOR FORM

File number ☐☐☐☐☐☐ ○ FORM D1 ○ FORM D2 Serial Number: ☐☐☐☐☐☐

The Community Health Worker should complete a locator form for <u>each</u> death occuring in assigned households. Record responses in the column on the right. Submit completed forms to your Supervisor at next meeting.

1. Date of report: ☐☐ / ☐☐ / 2 0 ☐☐
   (Tarik ma indike form)
2. Name of Community Unit:
   (Nying Community Unit Mari)
3. Community Health Volunteer name:
   (Nyingi mar tich)
4. Name of Village:
   (Gweng ma dala nitie)
5. Contact number of homestead/compound:
   (Namba mar simu mar dala/landi)

Names of Head of Compound/homestead *(Nyinge wuon dala/landi)*

6. Christian/First name:
   (Nying mokuongo mar wuon dala/landi)
7. Middle name:
   (Nyingi madiere/Juok mar wuon dala/landi)
8. Last Family name:
   (Nying mogik mar wuon dala/landi)
9. Clan name:
   (Nying anyuola/dhot/nonro mar wuon dala/landi)

Please fill in the following information about deceased:
(Yie ichiw ler kuom wachegi ewi ng'at/nyathi mothoni)

10. Christian/First name of the deceased:
    (Nying mokuongo mar ng'at/nyathi mosenindo)
11. Juok/Middle name of the deceased:
    (Nying madiere mar ng'at/nyathi mosenindo)
12. Last name of the deceased:
    (Nying mogik mar ng'at/nyathi mosenindo)
13. Sex of the deceased: ○ Male(dichwo/wuowi) ○ Female(miyo/nyako)
    (Ngat/nyathi mosenindo ne en wuowi/dichwo koso nyako/miyo)
14. Date of birth of deceased ☐☐ / ☐☐ / ☐☐☐☐
    (Tarik mar nyuol mar ng'at/nyathi mosenindo)
15. Date of arrival in the compound of deceased: ☐☐ / ☐☐ / ☐☐☐☐
    (Tarik mar donjo e dala)
16. Date of death: ☐☐ / ☐☐ / ☐☐☐☐
    (Tarik mar tho)
17. Where did the deceased die: ○ Health Facility(kar thieth) ○ Home/In transit(dala/e wuoth) ○ Others(mamoko)
    (Kama ne ng'at/nyathi otho e)

If deceased was less than 18 years old at the time of death, record the parents/caregiver's names. otherwise, leave blank:(ka nyathi motho ne hike tin ma ok no chopo higni 18 to yie ichiw nyinge janyuol/Jarit)

18. Christian/First name of the parent/caregiver:
    (Nying mokuongo mar janyuol kata jarit nyathi)
19. Middle name of the parent/caregiver:
    (Nying madiere/juok mar janyuol kata jarit nyathi)
20. Last/family name of the parent/caregiver:
    (Nying mogik mar janyuol kata jarit nyathi)
21. Clan name of the father/caregiver:
    (Nying anyuola/dhot/nonro wuon kata jarit nyathi)

Verified: ☐ Locator form Version 2.0 **Page 1 of 1**