INTERACTIVE DASHBOARD DESIGN

Power Bi

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Interactive Dashboard Design – Power Bi

1. Introduction

The Acquired Immune Deficiency Syndrome (AIDS) was first discovered in Sub-Saharan Africa in the 80s and it's been spreading ever since. It is a disease that is very much characterized with the destruction of the human immune system, which subsequently result in other diseases with Tuberculosis being the most common. The virus resulting in the destruction is called the Human Immunodeficiency Virus (HIV) which is mostly contacted through sexual intercourse. [(1)]

There are still some challenges despite all the interventions by donor agencies and NGOs & progress being made.
Sub-Saharan Africa houses 12% of the world population, but unfortunately contribute 71% of the HIV global burden. (Ayesha B.M. Kharsany and Quarraisha A. Karim, 2016) [(2)]
The recent trends have shown a decline by more than 33% but the carriers of this infection remain high despite that. In fact, it has been shown that individuals uninfected by HIV where there is a high ART (Antiretroviral Therapy) Coverage were 38% less likely to contact the infection than those living in places where ART coverage was low. [(2)]

A globally-recognized NGO called Rescue International (RI) has reached out to request for an analysis of the progress report on the rates of infection spread and deaths from infected population in 10 West African countries (Benin, Burkina Faso, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Senegal, Sierra Leone & Togo) between 2006-2015 based on the support received from RI and other donor agencies to curb the plague of HIV/AIDS. This would inform RI on possible strategies to explore in future support (whether to re-strategize or continue with the current support modalities).

The objectives of this research are:

i. To determine the trend of infection in the 10 West African countries between 2006 - 2015
ii. To determine the trend of deaths from infected populace in the 10 West African countries between 2006 – 2015
iii. To determine, for the next 10 years (2016-2026) the countries to focus on in order of priority based on progress in the past 10 years (2006 – 2015)

Data for research was obtained from the WHO DataBank with Microsoft Power BI used for analysis.

2. Background Research

A considerable amount of the daily data creation—between 1 and 2 trillion trillion quintillion bytes—is being permanently acquired. However, there are still problems and difficulties in finding effective and practical ways to find the necessary and significant information that is concealed inside these enormous amounts of data.

Data visualization in developing Interactive dashboards have proven to be effective in helping to identify patterns in data sets irrespective of how big and diverse they may be. Technology through some world class computing has helped in visualizing patterns not just in a static mode but in an interactive mode. However, despite their effectiveness and strength, data visualisation technologies still fall short of fully addressing and utilising the potential of interactive data analysis. (Alexander Waldmann, 2014).

Alexander Waldmann (2014) in his work “Development of a visualization system for the interactive exploration of linked data” proposed the use of “component-based visualization” for interactive data exploration.
He argued that component-based visualization originates properties like “composability” and “information hiding” from the software component transferring them to the domain of data visualization. With this one build graphs of the components, thereby developing a complex set of visualizations. [3]
He stated that there are benefits of this method as the component’s dataset in itself can be used as a key element in defining the semantics of an arc between two components; for instance, where two visualizations are linked to develop same GPS coordinate arising from different data readings, thereby permitting being able to compare other data such as blood pressure, pulse rate and co. In addition, he stated that users are allowed to modify the processing and visualization of data by a component. With this there is freedom of creativity to build, extend and outline new visualizations and their

configuration. He further explained that the prototype called DAVID (dynamic analysis and visualization of integrated data) is one tool that can be used to explore linked data.

However, irrespective of the software being employed in building a data visualization dashboard, there are certain general principles that guide the best use, putting out the best display and aid ease of insight delivery.

Stephen R. Midway (2020) believes that one of the foremost principles in developing a dashboard should be to prioritize the information to be shared, envisioning it and designing it before making a visual. Although the least technical but very important. So before thinking about the graphs, geometries etc., focus should be on the crux of the information intended to be conveyed.
He believes using the right software comes next as long as a good knowledge of the software is in place. This is followed by the use of an effective geometry with the data shown; the use of the right colours while being conscious of colours that could affect colour blind audience; Including uncertainty which is an inherent part of understanding the visual without misleading the audience. (4)

Mayra Magalhaes Gomes (2020) also described a number of principles which are critical to building an excellent data visualization dashboard – Define a clear purpose, know the audience and Use visual features to show the data very succinctly, keeping it organized and coherent thereby enabling users to easily process information, Making data visualization inclusive with colour being primarily used to characterize and distinguish information.
She referred to a study carried out by Salesforce in 2019, which analysed how people respond to varying colour combinations used in graphs. For instance, people who strongly prefer subtle colour variations, as it known to be more appealing to view, it was found that the subtle colours make analysis and insights more difficult to obtain from the charts. If this happens, the sole purpose of the analysis and visualization is therefore defeated. Hence, charts with more contrast and less similar colours are usually preferred to make the average person find easy to read, more so people with impaired vision.(5)

The Sisense team in one of their recent articles, Dashboard Design Best Practices – 4 key Principles, mentioned 2 principles that stand out amongst others – “The 5 Second Rule” and “Logical Layout: The Inverted Pyramid”. (6)
The 5 second rule refers to the fact that your dashboard should provide the relevant information in 5 seconds. Just at a glance, your dashboard should be able to answer most of the questions.
The “Logical Layout: The Inverted Pyramid” meaning the most important insights should be on the top part of the dashboard and the relevance of the charts should be arranged in descending order down the dashboard. (6)

3. Exploration of Data Set

Downloaded data sets required from the World Bank Databank bearing in mind the three key objectives. [7]
Downloaded an initial data set which showed the incident/number of deaths of HIV patients in the ten selected countries which contained only one major variable – the number of deaths alongside the countries. Since this dataset does not contain other components such as number of HIV infection per country per annum for the duration and countries population in each during the period as well, I had to download these other 2 to make it three data sets, for a better analysis to provide a favourable solution to our objectives.

The datasets comprise basically the numerical variables in each one of them with the country name, country code and years (2006-2015) being the column headers. This is similar for each of the data set.

World Bank has the most recent data being 2015 in the data base (millennium development goals) and the chosen series for the acquired datasets. Hence, the research is limited to 2006-2015; however, with the possibility of inclusion of subsequently data from 2016 upwards anytime they are available in the World Bank Databank.

In the datasets, the major components are the years which contains the number of deaths/Infections/populations which are numerical variables and therefore the measures of the dataset as they could be arithmetically manipulated; while the country which is the link for the 3 data sets and same for all are the data attributes.

The summation of the Infected population was done before uploading to Power BI for analysis. Every other calculation and manipulation were done with DAX on Power BI.

Table 1: Number of HIV/AIDS deaths by country from 2006 – 2015

	Country Name	Country Code	Series Name	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
1	Benin	BEN	AIDS estimated deaths	4500	4600	4400	2900	2600	2600	2600	2600	2800	2900
2	Burkina Faso	BFA	AIDS estimated deaths	10000	8500	7600	6500	5400	4700	4100	4200	4100	3700
3	Guinea	GIN	AIDS estimated deaths	6500	6000	6000	5400	4800	4500	4500	4200	4500	4800
4	Guinea-Bissau	GNB	AIDS estimated deaths	1800	1900	1900	1900	2000	2000	2000	1900	2000	2000
5	Liberia	LBR	AIDS estimated deaths	5000	4600	4400	4100	3800	3400	3100	3000	2800	2800
6	Mali	MLI	AIDS estimated deaths	6500	5900	5400	5200	5000	4800	4500	5100	6100	6700
7	Niger	NER	AIDS estimated deaths	2900	2800	2800	2700	2100	2000	1900	1700	1700	1900
8	Senegal	SEN	AIDS estimated deaths	3200	3100	1900	1700	1900	2100	2200	2500	2600	2500
9	Sierra Leone	SLE	AIDS estimated deaths	2400	2600	2800	2900	2900	2900	2800	2800	3000	3000
10	Togo	TGO	AIDS estimated deaths	7100	7300	7600	7400	6900	6200	5900	5700	5800	5700

Table 2: Number of HIV-infected population by country from 2006 – 2015

Country Name	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	HIV-infected Population
Benin	63000	63000	63000	64000	66000	66900	67800	69700	70600	70200	664200
Burkina Faso	112000	110000	108000	106000	105000	104000	102000	101000	99000	97000	1044000
Guinea	89000	93000	95000	97000	100000	102000	105000	106000	109000	111000	1007000
Guinea-Bissau	30700	31900	33100	34300	35400	36500	37500	38400	38200	39100	355100
Liberia	40800	40800	39700	39600	39400	39100	37900	37700	37500	36200	388700
Mali	105000	105000	106000	106000	107000	106000	107000	107000	106000	106000	1061000
Niger	40600	39700	38600	36500	36000	34700	33500	33200	32900	31700	357400
Senegal	48400	47600	47700	47700	47700	46700	45600	44400	43200	41800	460800
Sierra Leone	66000	68000	69000	70000	71000	71000	72000	73000	74000	75000	709000
Togo	114000	114000	113000	113000	113000	112000	112000	110000	111000	110000	1122000

Table 3: Country population

Country Name	Country Code	Series name	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Benin	BEN	Population	8216893	8454790	8696915	8944713	9199254	9460829	9729254	10004594	10286839	10575962
Burkina Faso	BFA	Population	13829173	14252029	14689725	15141098	15605211	16081915	16571252	17072791	17586029	18110616
Guinea	GIN	Population	9307421	9518159	9738796	9964470	10192168	10420459	10652032	10892821	11150970	11432096
Guinea-Bissau	GNB	Population	1377582	1411545	1446936	1483920	1522603	1562996	1604981	1648259	1692433	1737207
Liberia	LBR	Population	3329211	3461911	3607863	3754129	3891357	4017446	4135662	4248337	4359508	4472229
Mali	MLI	Population	13203378	13651455	14113578	14581427	15049352	15514593	15979492	16449854	16934213	17438772
Niger	NER	Population	14143969	14685404	15250913	15843131	16464025	17114770	17795209	18504287	19240182	20001663
Senegal	SEN	Population	11382272	11687078	12004700	12335092	12678143	13033814	13401990	13782429	14174740	14578450
Sierra Leone	SLE	Population	5829240	5989641	6133599	6272735	6415636	6563238	6712586	6863975	7017153	7171909
Togo	TGO	Population	5762881	5920360	6083417	6250840	6421674	6595939	6773807	6954721	7137997	7323162

4. Investigation of Data Workflows & Proposal for Design of Dashboard

The datasets shown above were uploaded to Microsoft BI one after the other.

The first data set loaded was the "HIV Infected population" dataset. Before uploading, I had to do some transform. In the transformation page, I converted the first row to header as there was no header upon upload. I selected "Country name" column alongside other columns and unpivoted so all columns are not in rows. I changed the attribute header to "year" and the third column to "infected population." I transformed the "year" column to a Date data type.
I loaded the "Country Population" dataset and repeated as described above too. I deleted the rows showing "null" and unpivot like I did for the first dataset too. Loaded the last dataset, "Number of deaths" and did same transformation like the previous.
I duplicated the HIV Infection Population table, deleted the other columns whilst leaving just the country name column (which I did for a clearer data modelling). I removed the duplicate values, hence leaving me with just 10 countries as originally intended.
I did a new table and entered a function "Calendar table = CALENDARAUTO()" which gave me a list of date as per the tables uploaded. I changed the data type from "Date time" to "Dates". I created an extra column to call it "Year" and included the function "Year = YEAR("Calendar table"[Date]) so the calendar table has two columns - Dates and Year.
So in the modelling, I connected the Date column in the Calendar table to the Date Column on the 3 other table of datasets.
I needed a table of measures as per best practice so I can conveniently plot as needed. This I created and named "Measure Table" so all measures are all in one place. Did a DAX for my measures such as Population Estimate, Infected Population sum, Estimated Deaths sum, % Infected population, % Deaths vs Infected population.

With the project being centred around the death rate, I did a Stacked area chart for the Number of deaths by year as seen in Figure 1. I choose this chart as it shows and makes most obvious the variations/differences between the years on the y-axis as the measure doesn't start from zero but from the point closest to the least value.

Did a second chart showing the Infected population by year still with same Stacked area chart as seen in Figure 2. The justification for this is same as that for Figure 1 – makes the differences/variations in chart most obvious & visible as well as the area below the line being more visible. With these 2 charts being my main charts, they are created with the Stacked Area Chart.

The country selection slider is included on the dashboard to allow for a quick comparison of countries beyond the overall sum shown without any selection.

A "% Death vs Infected Population" chart as seen in Figure 3 was done as a line chart which gives me the idea of the rate of deaths of infected population per year per country. This is needed to help me understand how well the countries are faring over the 10-year period, which countries are doing well with regards to declining deaths, countries not doing well as regards to little or no decline in death

rates and the countries drawing the West-African region viz-a-viz the selected countries back from good progress on curbing the deaths from HIV/AIDS.

Figure 1: Chart showing the number of deaths per year 2006-2015 for 10 West African countries

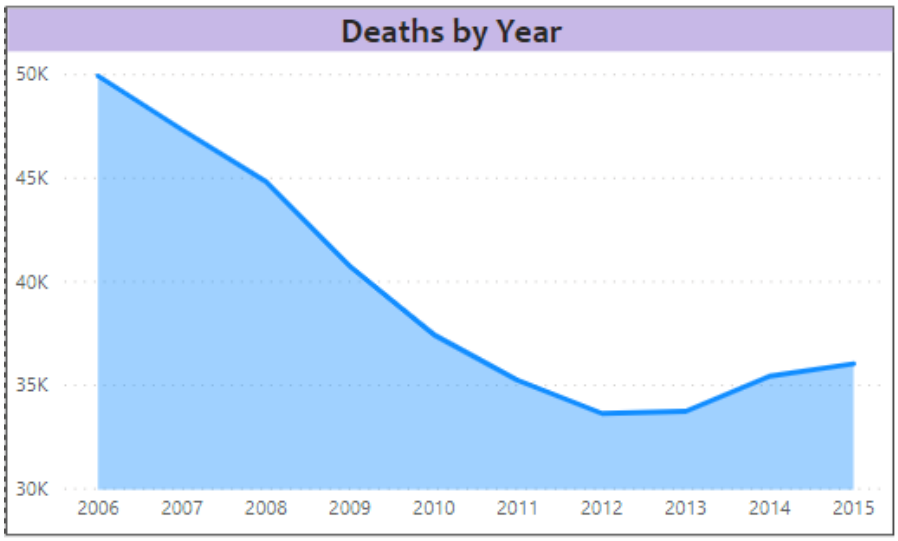
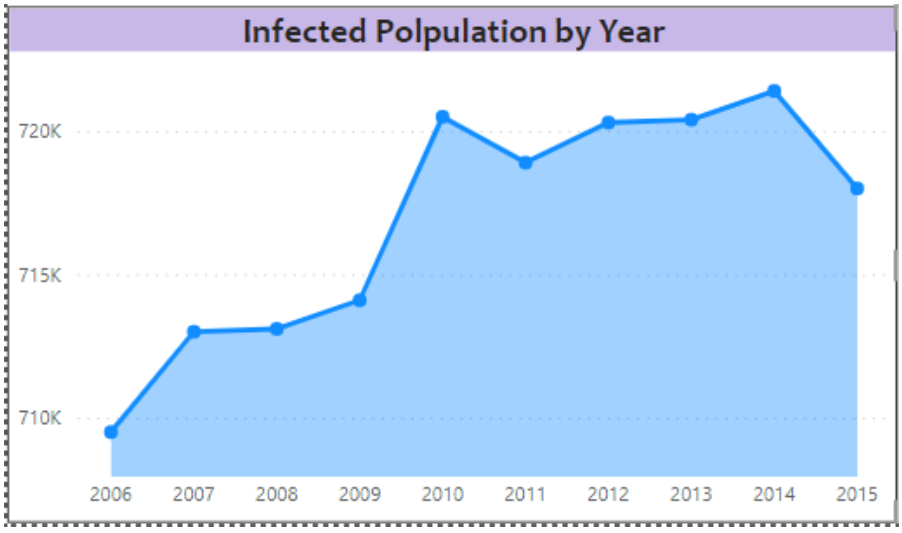


Figure 2: Chart showing the number of infected persons per year 2006-2015 for 10 West African countries



I did a forecast of this chart as it is a most important chart on the board and where we tend to draw most of our conclusions from. The forecast for the next 10 years projection of the % deaths as per infected population for the region (as per selected 10 countries), and each country if slider applied, was included. The projection reflects the scenario of deaths if all things remain equal, with regards to funding and support from Rescue International (RI) and other donor organizations remaining the same.

Another chart showing the growing country population using the “Line and Clustered Column Chart” with the “infected population” being the line y-axis as seen in Figure 4. This chart is needed to further reflect the progress made, if any, collectively as a region and by individual countries. Although not

entirely reflective of the measures as regards curbing the death rates, but reflects more on other efforts as regards curbing the HIV/AIDS menace in the region.

Figure 3: Chart showing the % of deaths of the total infected population per year 2006-2015 for 10 West African countries

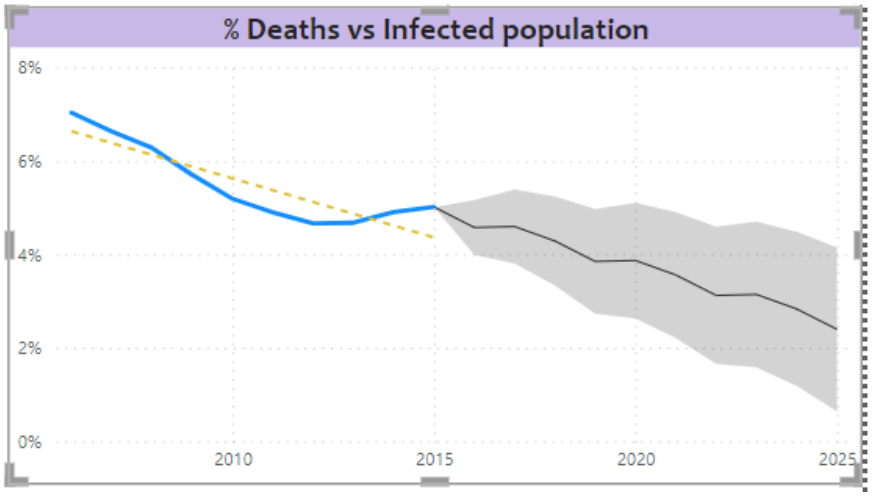
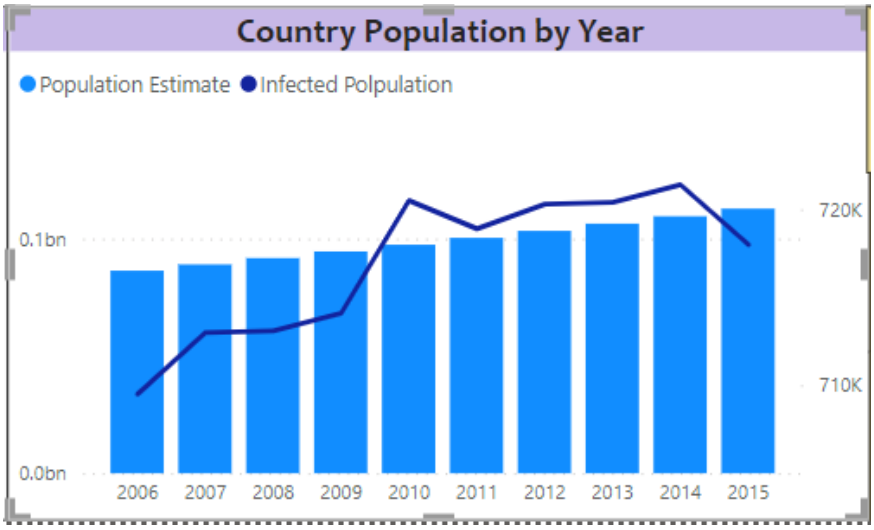


Figure 4: Chart showing the % of deaths of the total infected population per year 2006-2015 for 10 West African countries

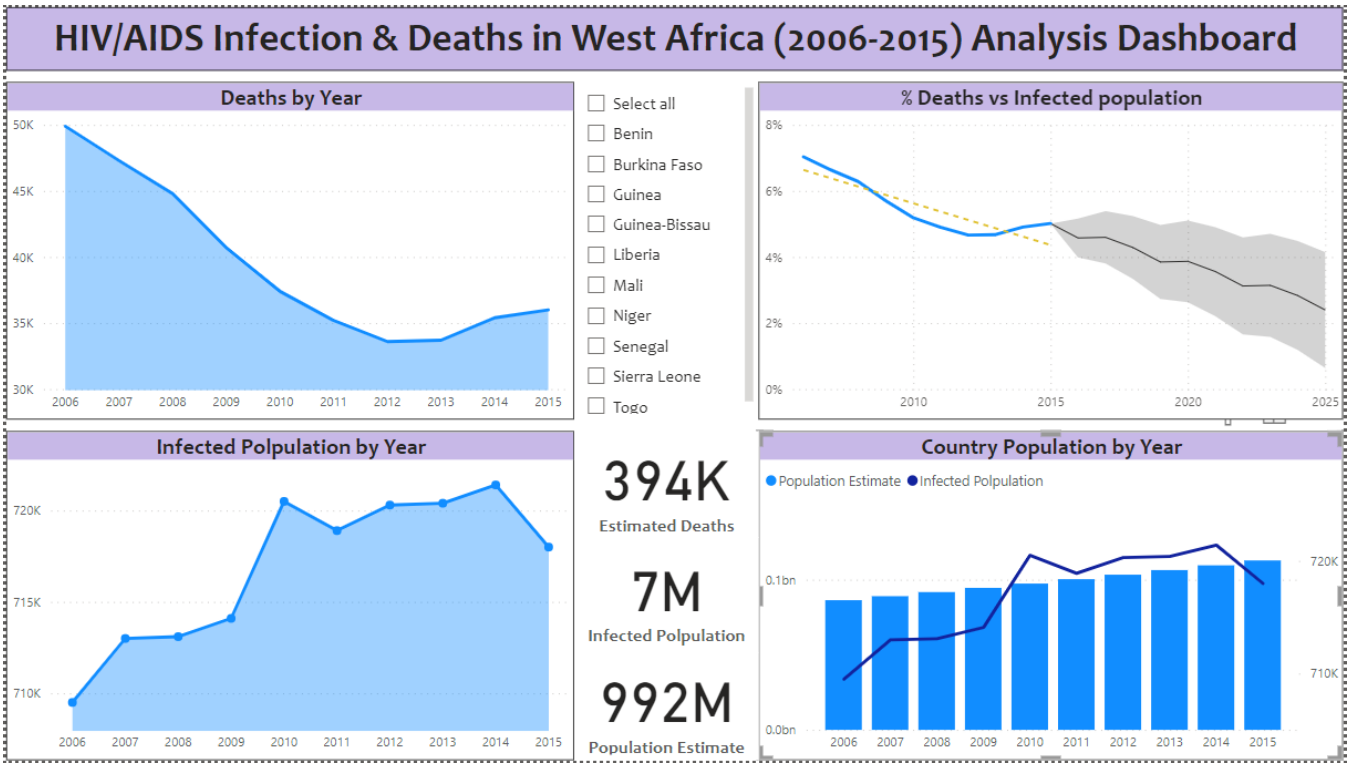


I did three cards showing the sum of estimated deaths in figures, the infected population and country population estimate.

With regards to the design and layout, I ensured that the basic colours used were four in total. The purple colour which is a bright colour was used for the headers, hence, helps the audience captures what the dashboard is all about as well as what each chart represents.
The blue colour is used for each chart to ensure uniformity in communication to reflect some form of simplicity. With the header colour and chart colour being same for all charts, making it more appealing

and simpler to relate with.
The carton colour for the cards were made to make it look different from the charts; however, the three cards all have same colour but separated with a borderline. This provides some contrast to the chart too as seen in Figure 5.
The colours generally were made to ensure there are some contrast especially with chart background being left as a white colour so each chart would pop out good enough to the audience. In all of this, I ensured that the green and red colours were avoided to ensure colour-blind persons can easily relate with the dashboard.

Figure 5: Dashboard showing the Death rates from HIV/AIDS infection from 10 West African countries



One thing I was particular about was the grid layout. I ensured the rectangles were properly placed to allow for easy flow. This makes it easier to extract insights.
However, the grid flow was briefly interrupted here by the country name list and number cards. Also had to ensure the horizontal dimension of the second chart on the top of the dashboard was longer than the others due to the forecast line that needed to be included and to accommodate both lines on the chart with some form of clarity. Despite this I ensured the rectangles still looked all similar in a way.

Another thing I was particular about was to ensure the major/more important charts are on top of the dashboard so anyone seeing this have a full grasp of what the dashboard is talking about even before going into finer details or charts below. However, another important chart is the “Infected Population by Year” chart which could not be accommodated on the top row, hence was placed at the left bottom corner of the dashboard so it is the first thing the audience sees after the charts on the upper layer.

As described by Syvantis Technologies (2021) in one of their articles, Five best practices for designing data visualizations in Power BI, the dashboard being clean and uncluttered cannot be overemphasized. I ensured spacing in each chart and as well as spacing between the main header and the first row headers to avoid confusion and a feeling of being overwhelmed.
With this in mind, I removed the y-axis and x-axis labels of the charts to further increase the sizes of the charts itself which is the focus. Since the individual chart headings already described what the chart is all about, the axis labels could as well be removed whilst a clear understanding of the charts are maintained.

5. Discussion

Figure 1 shows a stacked area chart of the deaths by year with a steady cumulative decline from 2006 up until 2012 and then a rise from 2013 up to 2015. Progress was clearly being made up until 2012 with regards to the decline. Concern should be "what contributed to the stop in decline in 2012 and rise in the number of deaths from 2013?". However, upon further filtering, only Burkina Faso and Liberia maintained a steady decline up till 2015. The deaths increased from 2013 for Benin, Guinea, Guinea Bissau, Niger and Sierra Leone; while Mali had a very steep spike from 2013 to 2015 recording the highest deaths in 2015 within the scope of this project. Benin had the sharpest drop in deaths from 4,400 to 2,900 in one year while Burkina Faso had the biggest and most impressive drop during the 10-year period from 10,000 to 3,700 deaths. From this alone we could say all other countries except Burkina Faso and Liberia contributed to the failure of project from 2013, especially the likes of Guinea Bissau and Sierra Leone whose HIV/AIDS death had been increasing consistently from the beginning of the 10-year project and Senegal whose increase started in 2009. However, that is not enough to conclude.

Figure 6: Sierra Leone's HIV/AIDS death analysis from 2006-2015 showing a steady increase from 2006

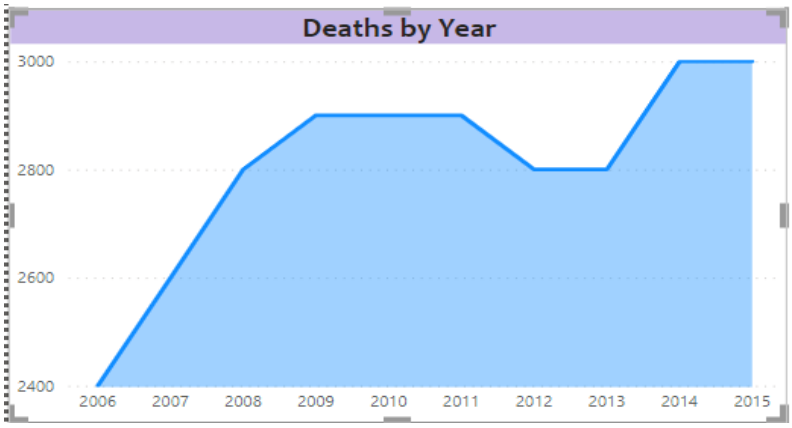


Figure 7: Guinea Bissau's HIV/AIDS death analysis from 2006-2015 showing an increase from 2006

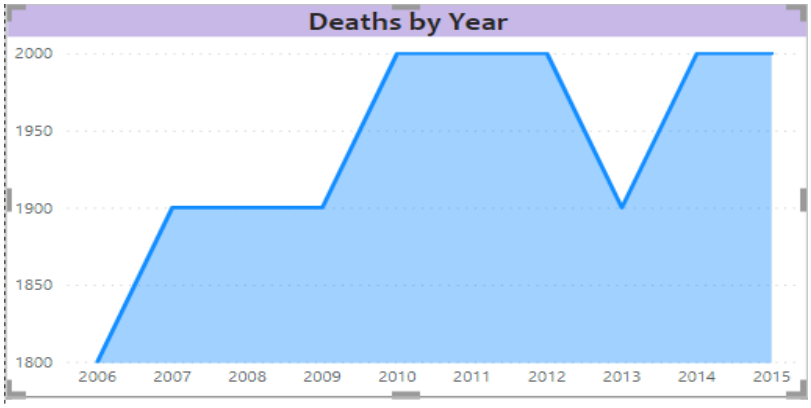
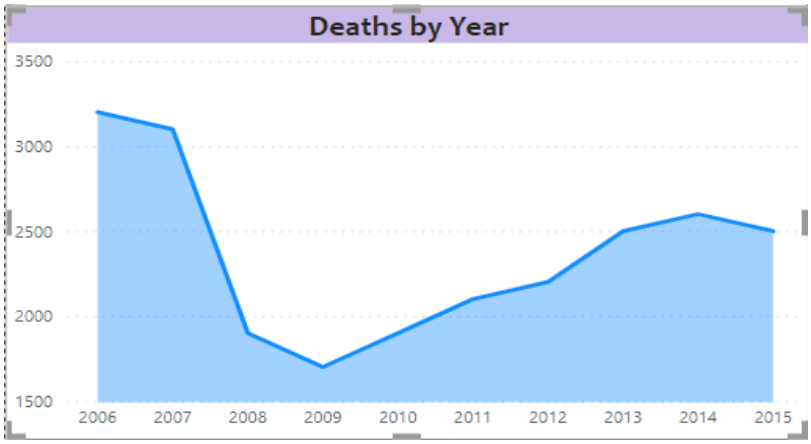


Figure 8: Senegal's HIV/AIDS death analysis from 2006-2015 showing a sudden increase from 2009



Upon further analysis, 5 countries namely Burkina Faso, Liberia, Niger, Senegal and Togo showed steady decrease in the number of infected populations during the year in review while Benin, Guinea, Guinea Bissau, Mali and Sierra Leone increased in infected population. Juxtaposing the deaths and Infected population by year says a whole different thing as compared to viewing the death charts alone.

Guinea Bissau which had an increase in deaths from 2006 as seen in Figure 7 showed a pretty steady decline as compared to the infected population by year as seen in Figure 9.
Similarly, Senegal which had a sharp drop in deaths up till 2009 and an increase from then on, had a slightly increased death rate despite the rapid drop in infected population from 2010.
No progress made in Mali as the death trend when compared to the infected population shows a flat line.
Benin showed an impressive progress as seen in Figure 10 – despite the increasing infected population, the death trend keeps dropping rapidly; however, the forecast isn't impressive due to the rise in deaths from 2013 to 2015.

Figure 9: Guinea Bissau's HIV/AIDS death trend as compared to the Infected Population

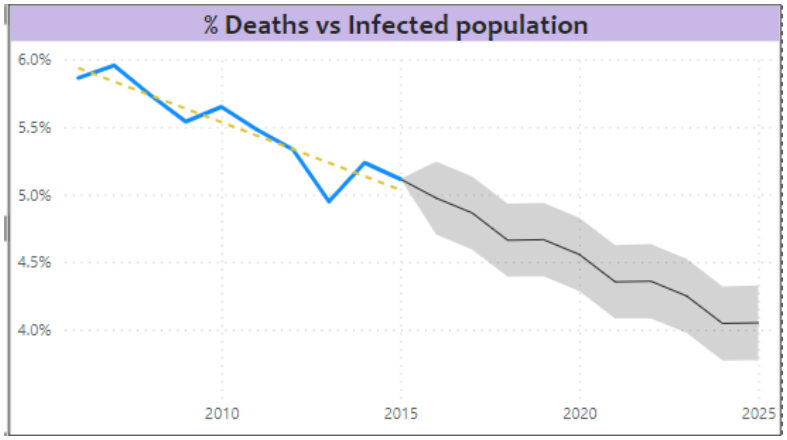
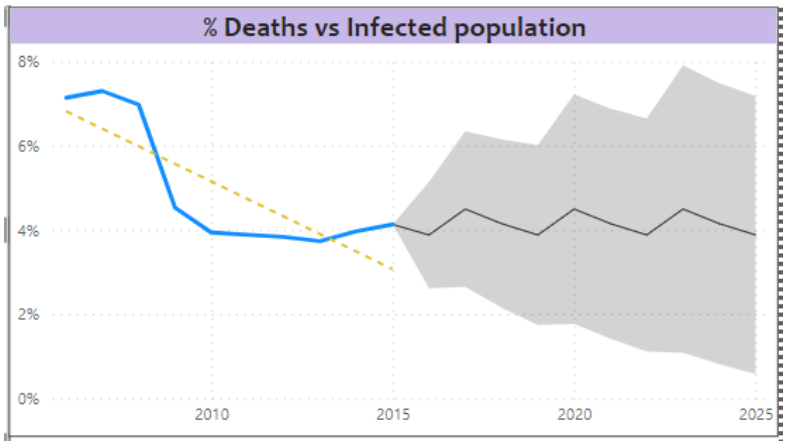


Figure 10: Benin's HIV/AIDS death trend as compared to the Infected Population



With all things being equal, countries with decreasing death forecasts include Burkina Faso, Guinea, Guinea Bissau and Liberia; while Benin, Mali, Niger, Senegal, Sierra Leone and Togo all have a flat line, which depicts that the death rate in these countries would remain as it currently is if a different strategy or approach isn't put in place in another ten years (2016 – 2005)

6. Conclusions

In conclusion, this project has reflected the poor performances of multiple countries amongst the 10 West African countries receiving funds and support from global donors including Rescue International.

It is important to note that there would need to be a review of strategies, approach and processes towards the plan to curb the deaths of persons with HIV/AIDS. Persons with HIV/AIDS can actually live as long as they want if the right inputs (sufficient & timely supply of medications, right counselling, infrastructural support, etc.) are in place.

Countries that should be given high focus in the next 10 years in order of priority based on the current trend and forecast include:

i. **Sierra Leone** – due to the consistent rise in death from 2006 up till 2014 with a steadily increasing death trend, and a flat line death forecast trend
ii. **Mali** – due to the recent spike from 2012 and a flat line death forecast trend
iii. **Senegal** – with a marginal death trend growth over the past 10 years, a sharp rise from 2009-2014 and a flat line death forecast trend
iv. **Togo** – with a steady but sluggish drop in death rate as compared to the infected population (6.7% to just 5% in 10 years) and a flat line death forecast trend
v. **Niger** – a steady but slow drop in death rate as compared to the infected population (7.2% to 5.2% in 10 years) and a flat line death forecast trend
vi. **Benin** – a fairly good drop in death rate as compared to the infected population (6.8% to 3.1% in 10 years) but a flat line death forecast trend

Countries that should be given lesser focus as compared to the above, but with current effort not diminished but rather could be improved include;

i. **Burkina Faso** – with a steady decline in HIV/AIDS deaths and infected population from inception despite a continuous increase in country population and a forecast reflecting continuous steady decline in death rate; Burkina Faso is showing good progress and with all things being equal, the progress would be better
ii. **Guinea** – with a good decline in death trends despite a sharp increase in infected population, and forecast showing a continuous steady decline; Guinea will continue to show progress. However, the deaths increase surge 2013 up till 2015 should be a source for concern and should be looked into
iii. **Guinea Bissau** – though an erratic decline in deaths versus infected population despite a steady increase in infected population, but a steady death trend has shown there is some progress being made over the past ten years in Guinea Bissau. Death forecast is also good. However, the erratic decline should be a source of concern. Focus should also be on dropping the rate of infected population, as this would have a huge effect on the death rate decline
iv. **Liberia** – with a steady decline in both death rate, infected population rate and death trend, Liberia has made a reasonably good progress. Also, a death forecast showing a continuous decline for the next 10 years shows good future progress as long as the status quo is maintained.

Based on the insights and recommendations, these selected countries would make very good progress in the next ten years (2016-2025)

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Appendices

Appendix 1: Raw data of Clean_fuel_for_cooking_data.csv

Country	Year	clean_fuel	electricity	GDP_growth
Benin	2011	4.1	36.9	0.12
Benin	2012	4.3	38.4	1.92
Benin	2013	4.3	34.69	4.24
Benin	2014	4.3	34.1	3.44
Benin	2015	4.3	29.62	-1
Benin	2016	4.3	37.1	0.53
Benin	2017	4.2	34.5	2.81
Benin	2018	4.2	39.25	3.82
Benin	2019	4	40.33	4
Benin	2020	4	41.41	1.09
Burkina Faso	2011	6.3	14.81	3.46
Burkina Faso	2012	6.7	15.12	3.31
Burkina Faso	2013	7.1	15.41	2.68
Burkina Faso	2014	7.6	19.2	1.28
Burkina Faso	2015	8.1	16.08	0.91
Burkina Faso	2016	8.7	16.64	2.91
Burkina Faso	2017	9	17.21	3.18
Burkina Faso	2018	9.5	14.4	3.59
Burkina Faso	2019	10.1	18.37	2.72
Burkina Faso	2020	10.6	18.96	-0.91
Cape Verde	2011	70.8	82.36	2.67
Cape Verde	2012	72	83.36	-0.2
Cape Verde	2013	73.2	84.34	-0.48
Cape Verde	2014	74.4	85.31	-0.66
Cape Verde	2015	75.5	86.36	-0.24
Cape Verde	2016	76.5	87.54	3.44
Cape Verde	2017	77.8	88.69	2.48
Cape Verde	2018	78.9	90.41	3.33
Cape Verde	2019	80.2	91.4	4.48
Cape Verde	2020	81	94.16	-15.71
Cote d'Ivoire	2011	18.7	55.8	-7.6
Cote d'Ivoire	2012	19.4	55.8	5.03
Cote d'Ivoire	2013	20.6	61.36	8.05
Cote d'Ivoire	2014	21.7	61.9	6.67
Cote d'Ivoire	2015	23.1	62.6	4.52
Cote d'Ivoire	2016	24.9	64.3	4.5
Cote d'Ivoire	2017	26.55	65.6	4.66
Cote d'Ivoire	2018	28.4	67.15	4.2

Cote d'Ivoire	2019	30.3	68.46	3.56
Cote d'Ivoire	2020	31.8	69.68	-0.6
Gambia	2011	2.4	48.25	-10.86
Gambia	2012	2.3	49.83	2.1
Gambia	2013	2.2	51.5	-0.2
Gambia	2014	2.1	52.93	-4.35
Gambia	2015	2	54.56	0.97
Gambia	2016	1.9	56.33	-1.06
Gambia	2017	1.9	56.2	1.76
Gambia	2018	1.8	60.3	4.12
Gambia	2019	1.8	62.1	3.16
Gambia	2020	1.7	62.27	-3.05
Ghana	2011	17.3	64.06	11.32
Ghana	2012	18.7	56.51	6.73
Ghana	2013	19.6	70.7	4.85
Ghana	2014	20.5	78.3	0.53
Ghana	2015	21.1	74.08	-0.17
Ghana	2016	21.8	79.3	1.08
Ghana	2017	21.9	79	5.75
Ghana	2018	22.2	80.4	3.9
Ghana	2019	22.4	83.5	4.23
Ghana	2020	22.2	85.87	-1.61
Guinea	2011	0.8	29.28	3.3
Guinea	2012	0.8	26.2	3.61
Guinea	2013	0.8	31.98	1.65
Guinea	2014	0.9	33.35	1.3
Guinea	2015	1	34.75	1.27
Guinea	2016	1.1	33.5	7.93
Guinea	2017	1.2	35.4	7.29
Guinea	2018	1.4	45	3.39
Guinea	2019	1.6	42.2	2.66
Guinea	2020	1.9	44.67	1.76
Guinea-Bissau	2011	1.1	13.4	5.29
Guinea-Bissau	2012	1.1	14.8	-4.28
Guinea-Bissau	2013	1.1	16.23	0.54
Guinea-Bissau	2014	1.1	17.2	-1.67
Guinea-Bissau	2015	1.1	20.05	3.4
Guinea-Bissau	2016	1.1	22.97	3.57
Guinea-Bissau	2017	1.1	26	3.27
Guinea-Bissau	2018	1.2	28.5	-1.21
Guinea-Bissau	2019	1	30.96	1.96
Guinea-Bissau	2020	1.1	33.34	-4.73
Liberia	2011	0.4	4.1	4.8

Liberia	2012	0.4	9.11	4.91
Liberia	2013	0.3	9.8	5.8
Liberia	2014	0.4	9.4	-1.87
Liberia	2015	0.4	15.16	-2.54
Liberia	2016	0.4	17.7	-4.01
Liberia	2017	0.4	24.2	-0.06
Liberia	2018	0.4	22.88	-1.29
Liberia	2019	0.4	23.1	-4.81
Liberia	2020	0.4	27.53	-5.29
Mali	2011	0.9	28.68	0.12
Mali	2012	0.8	25.6	-3.72
Mali	2013	0.9	32.29	-0.63
Mali	2014	0.9	34.11	4.02
Mali	2015	0.9	37.6	3.1
Mali	2016	0.9	38.79	2.75
Mali	2017	0.9	34.78	2.19
Mali	2018	0.9	50.9	1.64
Mali	2019	0.9	47.84	1.66
Mali	2020	0.9	50.56	-4.13
Mauritania	2011	42.6	35.17	1.15
Mauritania	2012	42.7	36.36	1.43
Mauritania	2013	43	37.54	1.12
Mauritania	2014	43.1	38.8	1.27
Mauritania	2015	43.1	39.5	2.37
Mauritania	2016	43.3	41.32	-1.59
Mauritania	2017	43.2	42.9	3.32
Mauritania	2018	43.3	44.31	1.66
Mauritania	2019	43	45.83	2.9
Mauritania	2020	42.6	47.35	-4.38
Niger	2011	1.3	14.3	-1.53
Niger	2012	1.4	14.4	6.32
Niger	2013	1.5	15.17	1.28
Niger	2014	1.6	15.77	2.56
Niger	2015	1.7	16.6	0.42
Niger	2016	1.8	17.27	1.74
Niger	2017	1.9	18.05	1.05
Niger	2018	2.1	17.6	3.2
Niger	2019	2.3	18.97	2
Niger	2020	2.4	19.25	-0.25
Nigeria	2011	2.2	55.9	2.53
Nigeria	2012	2.7	53.23	1.47
Nigeria	2013	3.4	55.6	3.85
Nigeria	2014	4.2	54.05	3.51

Nigeria	2015	5.4	52.5	-0.03
Nigeria	2016	6.85	59.3	-4.17
Nigeria	2017	8.7	54.4	-1.79
Nigeria	2018	10.7	56.5	-0.68
Nigeria	2019	12.9	55.4	-0.38
Nigeria	2020	15	55.4	-4.26
Senegal	2011	32.4	56.5	-1.43
Senegal	2012	30.8	56.5	1.15
Senegal	2013	29.3	57	-0.41
Senegal	2014	28.4	61	3.28
Senegal	2015	27.3	60.5	3.42
Senegal	2016	26.5	64.5	3.43
Senegal	2017	25.9	61.7	4.43
Senegal	2018	25.2	66	3.3
Senegal	2019	24.7	70.4	1.78
Senegal	2020	24.2	70.37	-1.38
Sierra Leone	2011	0.4	14.2	3.92
Sierra Leone	2012	0.4	16.98	12.62
Sierra Leone	2013	0.5	13.5	18.05
Sierra Leone	2014	0.5	18.67	2.27
Sierra Leone	2015	0.5	19.53	-22.31
Sierra Leone	2016	0.5	20.3	3.78
Sierra Leone	2017	0.6	23.4	1.97
Sierra Leone	2018	0.65	26.1	1.28
Sierra Leone	2019	0.7	22.7	3.06
Sierra Leone	2020	0.8	26.2	-3.98
Togo	2011	4	39.7	3.59
Togo	2012	4.5	39	3.75
Togo	2013	5.3	40.83	3.35
Togo	2014	6	45.7	3.2
Togo	2015	6.6	44.65	3.07
Togo	2016	7.3	46.77	2.93
Togo	2017	8	48	1.79
Togo	2018	8.6	50	2.44
Togo	2019	9.25	52.36	2.94
Togo	2020	10.1	54	-0.66